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Census Data and Urban Transportation Planning in the 1980s

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Introduction

This Record is a compilation of papers and supporting documentation on the Urban Transportation Planning Package (UTPP) and other products of the 1980 Census of Population and Housing. Rising costs of local surveys and declining or stagnant budgets are forcing state, regional, and local transportation planners to rely more and more on the UTPP and other census products to provide the information base for public decision making. In this Record the design, content, and applications of these essential information resources are documented.

This Record is organized into five parts:

1. An outline of the portions of the 1980 census questionnaire, procedures, and standard products relevant to transportation planners is given first. The development of transportation-related questions into a major component of the decennial census since World War II is also documented.
2. A review of the design and content of the UTPP, which is a special product of the 1980 census specifically tailored for transportation planning, is contained in Part 2.
3. An outline of several methods for using the UTPP, such as processing its outputs on microcomputers and computer graphics software, makes up Part 3. The paper by Fulton on estimating daytime populations provides both a useful tool and an excellent demonstration of one of the greatest values of the UTPP: its ability to identify the distribution and characteristics of the working population at places of work. (All other decennial census products are tied to the geography of the place of residence.)
4. Identification of a number of potential applications for the UTPP and an outline of several ways to supplement the UTPP with other data sources to create a comprehensive data base for local trip making make up Part 4.
5. An examination of the experiences of three large metropolitan planning organizations with the UTPP is given in Part 5.

Detailed technical material relevant to more than one paper is appended at the end of this Record.

The importance of compiling the diverse range of papers and supporting material into this Record was underscored by the experiences of the ad hoc committee that designed the 1980 UTPP. When the group began its work in 1977, the only readily available documentation of the 1970 version of the UTPP was TRB's Special Report 145. The need for a public record is vital, both to leave a record for future transportation planners and to disseminate needed information to the current and potential user community.

Special Report 145 was the proceedings of a TRB conference held in Albuquerque, New Mexico, on the 1970 UTPP. TRB is sponsoring a similar conference of transportation planners, other users of transportation data, Census Bureau officials, and sponsors of special census products. The goals of the National Conference on Decennial Census Data for Transportation Planning held in Orlando, Florida, December 9-12, 1984, were as follows:

1. To identify continuing and anticipated data needs for transportation planning and related fields and determine which of the critical needs are best met by the decennial census;
2. To evaluate the utility and comprehensiveness of regular and special products from the 1980 census from the user's perspective, with particular emphasis on the UTPP;
3. To hear census officials describe planning efforts that are scheduled and major decisions to be made for the 1990 census;
4. To discuss possible changes in the questionnaire content, survey design, geographic coding, products (including the UTPP), and other aspects of the 1990 census that affect transportation planning and related fields; and
5. To develop a list of recommendations on the questionnaire content, survey design, geographic coding, products, and other aspects of the 1990 census.

The findings and recommendations are to be published in TRB Special Report 206 and forwarded to appropriate federal officials.

The papers in this Record were presented at TRB's Annual Meeting in 1983 and 1984 and at a joint workshop of TRB and the Urban and Regional Information Systems Association (URISA) in 1983. Additional material was submitted to the Committee on Transportation Information Systems and Data Requirements, which is the sponsor of this Record.

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Part 1

The 1980 Census

Transportation-Related Questions on the Decennial Census

JAMES J. McDONNELL

ABSTRACT

The development in collection of transportation-related data by the Bureau of the Census for planning purposes of state and local governments is outlined. Types of data collected and changes are described in detail for the 1960, 1970, and 1980 censuses.

Over the years, the Bureau of the Census has collected various data that have been used by planners in many different applications. From an urban transportation planning perspective, the data available from the census have mainly been demographic data for areas of residence.

In the 1940s, the Bureau of the Census lent its expertise to the development of the now-classic home-interview origin-destination (OD) survey. The Census Bureau provided the method for expanding sample data to universes within small geographic levels. The Census Bureau also provided valuable information regarding sample size and the resulting variance of selected variables.

The 1950 census again provided basic demographic data as well as the occupation and industry of workers. Information was also collected on number of hours worked in the last week before the census but not on place of work or mode of travel to work.

1960 CENSUS

In 1960 the census began obtaining transportation-oriented data for the planning purposes of state and local governments. The data of importance included

1. Place of work,
2. Mode of travel to work, and
3. Automobiles available at home.

Data on place of work related to the calendar week before the date of enumeration. It related to the geographical location in which workers carried out their occupational activities. In 1960 the workplace was coded to (a) central cities of Standard Metropolitan Statistical Areas (SMSAs), (b) other cities of 50,000 or more, (c) counties, and (d) the remainder of the county in those counties with separately identified cities.

Data on the mode of travel to work were based on the principal mode used in the last week before the census. The categories identified were railroad, subway or elevated, bus or streetcar, taxicab, private automobile or carpool, walked only, worked at home, and other means. The smallest geographic area for which these data are currently available is the census tract and then only for the home end of the work trip; information is not available for the work end. Worker streams are available in a special report for SMSAs of more than 250,000 population. The geography within an SMSA is (a) city of more than 50,000, (b) central city, (c) county, and (d) balance of county. The worker stream must have at least 50 workers to be reported.

Data on automobiles available were collected in each sampled household. The data were reported as the number of dwelling units with (a) no cars available, (b) one car, (c) two cars, and (d) three or more cars. The information is available for census tracts and larger units of geography in the housing series of reports.

In 1960, due to the lack of geographic detail for the workplace, urban transportation planners did not use the place-of-work data to any appreciable extent. In addition, most urbanized areas conducted extensive OD surveys during this time period and relied on their own primary data collection efforts. Demographic data were used to check the results of the household characteristics collected in the OD survey, but little use was made of the journey-to-work, mode-of-travel, or automobile availability data.

1970 CENSUS

The development of census data for urban transportation planning purposes continued in the 1970s. Most studies continued to use their basic OD survey data that were collected in the mid-1960s, but there was a desire to update some of the basic relationships.

As part of the 1970 decennial census, the Bureau of the Census collected basic data that were similar to the data collected in the 1960 census. The key items were, again, place of work, mode of travel to work, and automobiles available at home. The main difference between the 1960 and 1970 data was found in the level of geographic coding for the workplace and the means of travel to work.

The place-of-work data were coded to census block in 1970, and if the information available to code to census block was not available, the work address was coded to the same geography as in 1960, that is, central city of SMSA, cities of more than 50,000, county, and balance of county. Nationwide about half of the work locations were coded to census blocks; the other half were coded to large geographic areas.

In 1970 states and metropolitan planning organizations (MPOs) were given the option of ordering a special package of census products not otherwise available from the Bureau of the Census. The basic geography for these packages was the locally developed traffic analysis zones that were used in the 1960 OD surveys. Coding of workplace to traffic analysis zones allowed the analysts to update relationships for the local work-trip file, which can contain as much as 40 percent of all travel in a metropolitan area. The problem in 1970 was that the workplace responses were not coded to census blocks. Local planners were required to allocate these work locations to traffic zones. This was difficult and lessened the usefulness of the journey-to-work trip tables.

The categories for mode of transportation to work were similar in 1970 to the 1960 set but were expanded to include automobile driver and automobile

passenger. This enhanced the use of census data many times by allowing a calculation of the number of cars used in the journey to work for energy and environmental quality calculations. Another difference between 1960 and 1970 data was that in 1960 the mode usually taken "last week" was requested. In 1970 the question was worded to obtain data on the "last day of work last week." The question was on the 15 percent sample in 1970.

Data on automobiles available in 1970 again included four categories: none, one, two, and three or more passenger automobiles per household.

In the mid-1970s the Bureau of the Census conducted the Annual Housing Survey (AHS) for a national sample and for 60 specific SMSAs. Attached to the AHS was a transportation supplement that included questions on the journey to work for each worker in the household over 14 years of age. Key items included in the transportation supplement were

1. Place of work,
2. Mode of travel to work,
3. Type of shared ride (carpool),
4. Number of persons sharing the ride to work,
5. Time of day worker leaves home for work,
6. Travel time to work,
7. Travel distance to work,
8. Change of mode of travel to work in last year,
9. Comparison of satisfaction with new mode of travel with that for previous mode, and
10. Automobile and truck or van availability.

The transportation supplement returned to the 1960 concept of usual place of work and usual means of transportation last week. In 1960 data on private automobile or carpool were collected without any differentiation between the two or any indication of vehicle occupancy. In 1970 data on automobile drivers were specified separately from that on automobile passengers. In the AHS, driving alone and carpooling are tabulated separately and a vehicle occupancy question was asked.

The AHS transportation supplement was essentially a pretest of the 1980 census, although certain questions were not asked in the 1980 census due to space limitations. The supplement could also be viewed as a base for the 1990 census with the inclusion of questions such as the time workers leave for work and the distance to work. The other modes surveyed in the supplement were similar to those in the 1960 and 1970 listing, with the addition of the motorcycle and the bicycle.

In addition to the transportation supplement, the main AHS survey included questions on automobile and truck or van availability. The categories for automobile availability were none, one, two, three, and four or more; for trucks or vans, the categories were none, one, and two or more.

1980 CENSUS

In the 1980 census both the type of questions asked and the level of geographic coding were superior to those used in prior years. The excellent coding of the workplace, with as much as 80 to 95 percent of all workplaces coded to block-level geography, gives the states and MPOs a nearly complete file of the traffic flows in their areas for those who traveled to work in the week preceding the census.

The 1980 census included several data items not collected in 1970, although they had been collected in the AHS transportation supplement using personal enumeration. The questions were structured so that they would be readily understood in the mail-back interview that was used in 1980. The key items collected in 1980 were

1. Place of work,
2. Mode of travel to work,
3. Type of shared ride (carpool),
4. Number of persons sharing ride to work,
5. Travel time to work,
6. Automobile availability, and
7. Truck or van availability.

The exact wording of these questions can be found in the census questionnaire appended to this Record.

The distinctions between the 1970 and 1980 censuses are found in

1. The number of workplaces coded to block-level geography,
2. The extent of the questionnaire devoted to transportation subjects, and
3. The number of travel-to-work modes (addition of motorcycle and bicycle).

In 1980 the place-of-work data were coded to census tract and block, and in those cases in which reference material was not available to code the data to tract and block, place-level geography was used as the next aggregation. For further discussion of place-of-work coding, see Allocating Incomplete Place-of-Work Responses in the 1980 Census Urban Transportation Planning Package by Philip N. Fulton in this Record.

In 1980 as in 1970, the states and MPOs had the option of purchasing a special Urban Transportation Planning Package (UTPP) from the Bureau of the Census. The basic geographic areas tabulated were locally developed traffic zones, the basic building blocks of urban planners that were established in the 1960s. The 1980 UTPP was similar in structure to the 1970 package but was more detailed and more extensive, including travel from up to 20 surrounding counties.

In the 1980 UTPP, SMSA work trips not coded to block and terminating in the portion of the SMSA covered by the reference file, the Geographic Base File and Dual Independent Map Encoding (GBF/DIME) file, were allocated to blocks based on industry, mode of travel, and travel time, so that in the 1980 UTPPs the majority of workers were coded to small-area geography.

The 1980 census included vehicle occupancy data so that the number of vehicles traveling to work could be derived. This is different from either the 1960 or 1970 approach and gives excellent information for analytical purposes. The 1980 census also included data on motorcycle and bicycle travel to work. The mode of travel reported in 1980 was the usual mode last week, similar to the 1960 approach. In contrast, in 1970 the mode reported was that used on the last day of the preceding week. The concept of "usual" mode will result in information different from that collected using the "last day" concept.

In the 1980 census most transportation-related questions were asked of 1 household in 6. However, place of work and travel time were only coded for every other sample unit, resulting in about a 1 in 12 sample. Data were collected separately on automobile availability and truck or van availability. The categories for car availability and for truck or van availability were the same: none, one, two, and three or more.

The 1990 census will differ from any previous census in content, sample size, and coding of data, especially the place-of-work coding. State and local government staffs should advise the Bureau of the Census of their needs for 1990. Mail should be directed to Director (Attention: Decennial Census Planning Staff), Bureau of the Census, Washington, D.C. 20233.

Standard Census Products Related to Transportation Planning

SUSAN LISS

ABSTRACT

The wide variety of standard products of the decennial census that are useful for transportation planning is described. These products are often the only census data known to those local transportation planners and researchers who have either no knowledge of or no access to the special tabulations of the Urban Transportation Planning Package.

To many transportation planners and researchers, census data are available only in the standard publications, tape files, and other regular products of the Bureau of the Census. Even those with ready access to the special census tabulations in the Urban Transportation Planning Package (UTPP) will turn to standard census products for many of their data needs.

The UTPP, which is described in detail later in this Record, differs from the standard census products in two major respects. First, it can be provided by user-specified geographical units. This feature is important to the majority of transportation planning agencies that use traffic analysis zones rather than census tracts and other units of standard census geography. (Zones and tracts are generally similar in size but rarely have the same boundaries.) Second, the UTPP must be purchased from the Census Bureau at a cost that greatly exceeds that of standard census products. As a consequence, standard census products are far more widely available.

A brief overview of the standard reports and tape files from the 1980 census that are available from the Bureau of the Census is given here. A summary by the Census Bureau appears in Appendix E of this Record.

PRELIMINARY CONSIDERATIONS

The user needs to answer two basic questions before searching for particular data among the many standard census products. First, were the data collected from the full census or the sample census? Second, at what level of geographic detail is the data needed?

100 Percent Versus Sample Data

Two questionnaires were used in the decennial census. Both included the 100 percent population items and the 100 percent housing items shown in the first column of Figure 1 (1). The sample population items and sample housing items appear only on the long form of the questionnaire, which covers roughly one out of every six households nationwide. The long

100-percent population items
- *Household relationship
- Sex
- Race
- Age
- Marital status
- *Spanish Hispanic origin or descent

100-percent housing items
- Number of housing units at address
- *Complete plumbing facilities
- Number of rooms in unit
- Tenure (whether the unit is owned or rented)
- *Condominium identification
- Value of home (for owner-occupied units and condominiums)
- Rent (for renter-occupied units)
- Vacant for rent, for sale, etc., and period of vacancy

Sample population items
- School enrollment
- Educational attainment
- State or foreign country of birth
- Citizenship and year of immigration
- **Current language and English proficiency
- **Ancestry
- Place of residence 5 years ago
- Activity 5 years ago
- Veteran status and period of service
- *Presence of disability or handicap
- Children ever born
- Marital history
- Employment status last week
- Hours worked last week
- Place of work
- **Travel time to work
- *Means of transportation to work
- **Persons in carpool
- Year last worked
- Industry
- Occupation
- Class of worker
- *Work in 1979 and weeks looking for work in 1979
- *Amount of income by source in 1979
- **Total income in 1979

Sample housing items
- Number of units in structure
- Stories in building and presence of elevator
- Year unit built
- *Year moved into this house
- Source of water
- Sewage disposal
- Heating equipment
- Fuels used for house heating, water heating, and cooking
- *Costs of utilities and fuels
- Complete kitchen facilities
- Number of bedrooms and bathrooms
- Telephone
- Air conditioning
- Number of automobiles
- **Number of light trucks and vans
- **Homeowner shelter costs for mortgage, real estate taxes, and hazard insurance

Derived items (illustrative examples)
- Families
- Family type, size, and income
- Poverty status
- Population density
- Persons per room ("overcrowding")
- Household size
- Institutions and other group quarters
- Gross rent
- Farm residence

*Changed relative to 1970
**New items

FIGURE 1 Data items from 1980 census *(1)*.

form is reproduced in Appendix G of this Record and includes the questions on vehicle availability, place of work, means of transportation to work, and carpool participation that are of particular interest to transportation planners (see Figure 1).

The distinction between 100 percent and sample questions is important for two reasons. First, only 100 percent questions are published at the block level, which is the smallest geographical unit of census data available. Second, sample data are not completely reliable at the census tract level, even though they are published with the appropriate disclaimers and standard errors. Although these sample data are of high quality generally, they should not be considered absolute.

Level of Geography

One of the more difficult aspects of using census data is selection of the proper level of geography. When sample data are used, reliability problems and the likelihood that some data will be suppressed because of confidentiality problems increase as the geographical unit gets smaller. A large number of small geographical units also requires more complex and expensive data manipulation. On the other hand, the selection of units that are too large or that cross important functional boundaries may distort or eliminate the pattern being investigated. For example, comparisons of urbanized and nonurbanized areas are difficult to make with county-level data because boundaries of urbanized areas rarely coincide with county lines (even remotely).

Standard census products are usually tabulated by political area or by statistical area. Political areas include

1. The United States;
2. The states;
3. Congressional districts;
4. Counties;
5. Minor Civil Divisions (MCDs), which are legal subdivisions of counties, such as townships; and
6. Incorporated places.

Statistical areas include

1. Census regions and divisions, which are aggregations of states (four regions, each containing two or three divisions);
2. Consolidated Metropolitan Statistical Areas (CMSAs), which were formally called Standard Consolidated Statistical Areas (SCSAs) and which are combinations of functionally related Metropolitan Statistical Areas (MSAs);
3. MSAs, which were formally called Standard Metropolitan Statistical Areas (SMSAs) and which consist of counties containing and related to an urbanized area;
4. Primary Metropolitan Statistical Areas (PMSAs), which is another label for an MSA that is part of a CMSA;
5. Urbanized areas, which are population centers of at least 50,000 inhabitants and their suburbs (as defined by population density rather than political boundary, unlike the MSA);
6. Urban areas, which are places with 2,500 or more inhabitants;
7. Census county divisions, which are defined for states where MCDs are not appropriate or available;
8. Census-designated places, which are unincorporated residential concentrations with strong geographic recognition as a place;
9. Census tracts, which are MSA subdivisions of approximately 4,000 residents and which are aggregates of blocks;
10. Enumeration districts, which are census data collection areas where blocks are not used;
11. Block groups, which fall between tracts and blocks; and
12. Blocks, which are typically city blocks bounded by streets and other linear features and which are the smallest units for which data are tabulated in urbanized areas and in incorporated places with at least 10,000 residents.

PRINTED REPORTS

Printed reports are the most easily obtained and least expensive source of census data unless the user needs considerable detail for a large number of areas. There are four major report series from the 1980 census:

1. Population series--designated PC reports--based on the 100 percent questions;
2. Housing series--designated HC reports--based on both the sample and 100 percent questions and providing some cross classifications of housing and population characteristics in addition to housing data;
3. PHC series, which includes data from both population and housing questions on both 100 percent and sample basis and which includes many of the transportation-related questions; and
4. Subject matter report series, which also carries the PC designation but which includes sample data as well as 100 percent items on specific subjects such as journey to work, type of residence, employment, migration, income, and so forth.

A detailed list of these reports appears in Appendix E. The reports of particular interest to transportation planners are discussed in the following.

Metropolitan Commuting Flows (PC80-2-6C)

Report PC80-2-6C tabulates workers by place of residence and place of work for all workers 16 years and older who work or live in an MSA. The report is organized by place of residence and generally identifies flows by places with a population of 25,000 or more.

Characteristics of Workers in Metropolitan Areas (PC80-2-6D)

Report PC80-2-6D includes sex, age, race, education level, income, and other characteristics of workers by place of residence and place of work for areas with a population of 50,000 or more. This report also includes means of transportation to work, vehicle occupancy, and travel time to work.

Place of Work (PC80-2-6E)

Report PC80-2-6E is an addition to the journey-to-work subject reports. It is the first census publication to be organized by place of work rather than by place of residence. It includes characteristics of workers, means of transportation to work, vehicle occupancy, and travel time. Data are presented for all workers in the place of work and for workers who live outside the area of the workplace. The level of geography generally reaches to places with a population of 25,000 or more.

Number of Inhabitants (PC80-1-A)

Report PC80-1-A is the best source of historic population counts by most levels of census geography. Population counts are given for most areas, from CMSAs and states to incorporated places and MCDs.

General Social and Economic Characteristics (PC80-1-C)

Report PC80-1-C includes the transportation-related items among its wealth of tables of state, CMSA, MSA, county, and urbanized area of residence.

TABLE 1 Overview of Planned Summary Levels for 1980 Census Summary Tape Files *(2)*

SUMMARY AREA [a, b]	STF 1 100 percent A	STF 1 100 percent B	STF 1 100 percent C	STF 2 100 percent A	STF 2 100 percent B	STF 2 100 percent C	STF 3 sample A	STF 3 sample C	STF 4 sample A	STF 4 sample B	STF 4 sample C	STF 5 sample [c]	Summary Level Codes [d]
United States			*			*		*			*	*	01
Region			*			*		*			*	*	02
Division			*			*		*			*	*	03
State	*	*	*		*	*	*	*		*	*	*	04
SCSA			*			*		*			*		05
SCSA within State			*		*	*		*		*	*		06
SMSA			*			*		*			*	*	07
SMSA within State		*	*	*	*	*		*	*	*	*		08
Urbanized Area			*			*		*			*		09
Urbanized Area within State			*		*	*		*		*	*		10
County within State	*		*		*	*	*	*		*	*		11
MCD (CCD) within County within State	*				*		*			*			12
ED or BG within Tract (BNA) within Place within MCD (CCD) within County within State	*						*						13,14 15,&16
County within SMSA within State		*		*					*				17
ED or Block within Tract (BNA) within Place within MCD (CCD) within County within SMSA within State		*											18,19,20 21,&22
Tract (BNA) within Place within County within SMSA within State		*		*					*				23&24
ED or Block within Tract (BNA) within Place within County within SMSA within State		*											25&26
Place within State	*		*		*	*	*	*		*	*	*	27
MCD (CCD) within State			*					*					28
Indian Reservation and Alaskan Native Village						*					*		29
Indian Reservation and Alaskan Native Village for County within State					*	*				*	*		30&31
Tract (BNA) within County within SMSA within State				*					*				32
Congressional Districts within State	*		*				*	*					33
Zip Code (5 digit) [c]													

[a] In addition to summary areas presented in the STFs, geographic area codes are included for areas such as ward, state economic subregion, district office code, Indian subreservation, and standard federal administrative region.

[b] Population size cutoffs for the presentation of place-level data in the STFs are as follows: STF 1A, all places; STF 1B, all places; STF 1C, 10,000 or more; STF 2A, 10,000 or more; STF 2B, 1,000 or more; STF 2C, 20,000 or more; STF 3 A, all places; STF 3C, 10,000 or more; STF 4A, 10,000 or more; STF 4B, 2,500 or more; STF 4C, 10,000 or more; STF 5, 50,000 or more.

[c] STF 3B, which was planned to provide five-digit ZIP code tabulations, has been cancelled. However, private groups are currently discussing the possibility of funding Census Bureau tabulation of these data. The geographic structure of such a file will be decided at a later date.

[d] Multiple summary level codes for a summary area indicate a series of similar summary levels that are presented in identical STF files. A specific listing of summary levels that are grouped together from the chart is as follows (a slash mark will be used to indicate "within"): 13, place/MCD(CCD)/county/state; 14 tract(BNA)/place/MCD(CCD)/county/state; 15, BG/tract(BNA)/place/MCD(CCD)/county/state; 16, ED/tract(BNA)/place/MCD(CCD)/county/state; 18, MCD(CCD)/county/SMSA/state; 19, place/MCD(CCD)/county/SMSA/state; 20, tract (BNA)/place/MCD(CCD)/county/SMSA/state; 21, block/tract(BNA)/place/MCD(CCD)/county/SMSA/state; 22, ED/tract(BNA)/place/MCD (CCD)/county/SMSA/state; 23, place/county/SMSA/state; 24, tract (BNA)/place/county/SMSA/state; 25, block/tract(BNA)/place/county/ SMSA/state; 26, ED/tract(BNA)/place/county/SMSA/state; 30, Indian reservations and Alaskan Native villages by state; 31, Indian Reservations and Alaskan Native villages by county within state.

Census Tracts (PHC80-2)

Report series PHC80-2 is probably the most widely used source of small-area census data for planners. Most of the population and housing questions, including the transportation-related questions, are tabulated by MSA, county, incorporated place, MCD, and tract of residence for each MSA. Number of workers by a limited number of places of work is given for each place of residence.

COMPUTER TAPES

Printed reports on paper or microfiche meet the needs of occasional users or of those interested in a limited number of areas and variables. However, most transportation planners in larger jurisdictions who deal with many geographical units will quickly tire of manual data entry and manipulation.

The Bureau of the Census attempts to meet the needs of the data-intensive user with Standard Tape Files (STFs) and with special tapes. Of the latter, the journey-to-work tape is of particular interest to transportation planners.

Journey-to-Work Tape

The journey-to-work tape contains tabulations of all workers aged 16 and older, including information on their place of residence and work, their socioeconomic characteristics, and the characteristics of their work trip. Characteristics of the worker and the work trip are presented for each origin-destination pair of places with a population of 25,000 or more and for the balance of the county. This geographic detail allows the user to produce data at the place or MCD level and to aggregate the tabulations to the county or MSA. For larger areas, the central city data are divided between central business district (CBD) and balance of the central city. Although tables on the tape are organized by place of residence, the user can sort the data by place of work.

STFs

STFs are the most common machine-readable form of census data used by the transportation community. The five basic STFs are listed in Table 1 (2) and described in Appendix E.

The maximum possible geographic detail available from the Census Bureau is contained in STF 1. Data are provided for individual blocks in block-numbered areas and for enumeration districts elsewhere. The data are from the 100 percent questions.

Like STF 1, STF 2 is based on the 100 percent questions on both population and housing. Tabulations in STF 2 are nearly as geographically detailed, reaching down to census tracts, MCDs, census county divisions (CCDs), and places with a population of 1,000 or more.

STFs 3, 4, and 5 tabulate responses to the sample questions to various levels of geographic detail. The various levels of geographic detail are indicated in Table 1.

The most comprehensive of the STFs, STF 4, also contains the most detailed data on the journey-to-work questions. All transportation-related questions are tabulated down to places of residence with a population of 2,500 or more.

Public-Use Microdata Samples

Transportation researchers are particularly interested in the public-use microdata (PUM) samples, which are one of the more specialized data resources on census tape. The PUM tapes include some unaggregated household records with characteristics of the unit and those in it. Data on individuals within the household are edited out, and all names, addresses, and other geographic identifiers have been removed. The minimum-population criterion is now 100,000 (compared with 250,000 in 1970). Three mutually exclusive samples are available representing 5, 1, and 1 percent of the respondents, respectively.

CONCLUSIONS

A variety of standard products from the 1980 census has been highlighted. The Bureau of the Census has attempted to meet the data needs of a wide variety of users at relatively little cost. Many transportation planners, especially in smaller jurisdictions, may satisfy most or all of their social and economic data requirements with these products.

The place-of-work subject report is a particularly exciting development from the 1980 census. Until now, the only census data organized by place of work have been found in the UTPP. (Of course, the UTPP remains the only source for workforce data at the tract or traffic analysis zone level.) Some planners and analysts hope that these tabulations by larger units of geography will eventually be published at the tract level for a new series of census tract reports. Such a series would bring one of the best features of the UTPP within reach of a much wider constituency of planners and analysts in transportation and allied fields.

REFERENCES

1. Census '80--Introduction to Products and Services. Bureau of the Census, U.S. Department of Commerce, 1980.
2. Summary Tape File Technical Documentation. Bureau of the Census, U.S. Department of Commerce, n.d.

Part 2
The Urban Transportation Planning Package

The Urban Transportation Planning Package*

JAMES J. McDONNELL

ABSTRACT

The Urban Transportation Planning Package is a series of special tabulations from the 1980 Census of Population and Housing that provides data by standard format and user-specified geography on variables of particular interest to transportation planners. The tabulations contain work-trip data and socioeconomic information by place of residence and place of work and by trip between residence and workplace for user-specified geography. This valuable information resource for transportation planning is described.

Standard products from the decennial census have two major limitations for transportation planners. First, many useful tabulations of transportation-related questions are not provided for small units of geography such as census tracts, and no data are provided for user-defined traffic analysis zones of similar size but different boundaries. Second, none of the worker characteristics are tabulated for small geographical units at the place of work or for commuters between a given pair of origins and destinations. These missing tabulations are important to transportation planners, who make substantial use of origin-destination (OD) tables and characteristics of areas that attract trips (i.e., workplaces). Although the requisite data have traditionally been obtained through local surveys, the cost of local data collection continues to rise, whereas the available funds remain constant or decline. The decennial census provides a more cost-effective source of desired data and needs only the appropriate tabulations.

The Urban Transportation Planning Package (UTPP) is a set of special tabulations of data from the decennial census. The UTPP has been designed to meet the data needs of local, regional, and other transportation planners by providing 1980 census data by place of work, by OD pair, and by user-specified geography. The UTPP tabulations are produced by the Bureau of the Census using software developed by the bureau under contract to the U.S. Department of Transportation (DOT). Purchasers of the UTPP reimburse the bureau for processing costs, which are kept to a minimum by the use of the UTPP's standard format.

SOURCE OF THE UTPP

The UTPP journey-to-work information was collected from responses to the long-form census questionnaire intended to be completed by one in every six households and returned on census day, Tuesday, April 1, 1980. However, because of budget constraints, only half of these were coded for place of work, resulting in a sampling of 1 household in 12, or about 8.3 percent of all households.

Geographic coding was made as complete and accurate as feasible, including use of improved coding guides. Also, information was requested as a substitute for valid work addresses whenever a street address could not be specified. If the street address was not known, the respondent was asked to enter the building name, shopping center, or other physical location description. Three Census Bureau offices were established to do the geographic coding of workplaces. As a result of this decentralization, personnel in these offices could more efficiently contact local agencies for help in coding addresses that could not be coded from available information.

For the UTPP only, workers whose place of work was not reported or whose workplace could not be coded to the finest geographic detail for which it was eligible were allocated to a tract or block based on the best available information. The allocation procedure is explained in detail elsewhere in this Record.

CONTENTS OF THE UTPP

The UTPP is divided into six parts that include 82 summaries and 13,391 data items. The six parts are summarized in Table 1 and are listed in detail in Appendix F.

Because geographic coding was done at the block level, the UTPP can be ordered coded either to census tracts or to a zone system defined to the bureau by the requesting agency. The UTPP also gives subtotals for such geographic units as the central business district (CBD), central city, and so forth.

Part I provides 29 tabulations of data by tract or zone of residence. Subtotals are provided for

TABLE 1 Urban Transportation Planning Package from the 1980 Census

Part	Description	Tabulations	Data Items
I	Tabulations by census tract or block group (or zone-special order) of residence	29	773
II	Tabulations by large geographic areas of residence	19	11,642
III[a]	Tabulations by census tract (or zone-special order) of work	14	517
IV[a]	Tabulations by census tract of residence to census tract of work (or zone of residence to zone of work-special order)	3	30
V[a]	Tabulations by block group of work (subtotals to census tract of work or zone of work-special order)	7	107
VI	Tabulations by county of residence to county of work (includes up to 20 external counties or New England towns with a large number of journey-to-work trips)	10	322
Total		82	13,391

[a]In the modified UTPP for areas outside SMSAs in 1980, these parts will change as follows:

III Tabulations by central city(s), place(s) 2,500 + population, county, SMSA of work,
IV Tabulations by place/county of residence to place/county of work,
V Not applicable to those areas not involved in the census GBF/DIME program.

*From Transportation Planners' Guide to Using the 1980 Census, FHWA, U.S. Department of Transportation, January 1983.

the CBD, central city, entire area, county, and Standard Metropolitan Statistical Area (SMSA).

Part II provides 19 tables of residence data for larger areas (CBD, central city, entire area, county, and SMSA) and is most useful for examining cross-classification relationships. For example, households are classified by vehicles available, income, and household size, and the number of workers are classified by household income, size of household, and means of transportation and carpooling to work.

Part III provides 14 tabulations of data similar to Part I except that they are summarized by tract or zone for place of work instead of residence. Subtotals on all tabulations are provided by CBD, central city, entire area, county, and SMSA.

Part IV provides 3 tabulations of information on journeys between residence and place of work. Residence and place of work can each be identified by either census tract or planning zone. In addition to the trip tables by means of transportation for the journey to work distributed by tract or zone, summary trip tables are provided for the CBD, central city, entire area, county, SMSA, within commutershed, and outside commutershed.

Part V provides 7 tabulations of place-of-work data at the block-group level. Subtotals are provided by census tract or by a locally defined zone system on request. The information includes the number of workers by occupation and sex and by major industry and sex, the number of private vehicles used, persons per vehicle, and persons per carpool. Such numerical information is useful in proportioning other data available only by tract or zone to the smaller geography of block groups.

Part VI provides 10 tables of journey-to-work information on travel between counties. This summarized information, when compared with 1970 census data, for example, is useful in the study of transportation and land use trends. For each county within an SMSA, data are given for up to 20 counties that account for a large number of journey-to-work trips.

DEFINITIONS

Most of the tabulations of the UTPP focus on workers and their travel. The balance is about households, vehicles, and persons. Vehicles include automobiles, trucks, and vans available to a household. Mode is synonymous with means of transportation and usually consists of the following: car--drive alone, car--carpool, truck or van--drive alone, truck or van--carpool, bus or streetcar, railroad, subway or elevated, taxicab, motorcycle, bicycle, walked only, and other means.

In some tables (I-20, III-10, IV-3, V-5, and VI-8) the number of vehicles used in travel to work has been calculated from the number of workers who drive alone and the number who travel in carpools, which ranges from two-person pools to those of seven or more persons. In this latter category, 0.1428 was the factor used to convert the number of workers to the number of vehicles used. Persons per carpool is calculated by dividing the number of workers who share driving, drive others only, or ride as a passenger only by the number of carpool vehicles used in travel to work (total vehicles minus vehicles of workers who drive alone).

Journey-to-work questions asked in the census differ in some respects from those usually asked by planners in travel surveys. The questions related to work trips and vehicle ownership as asked in 1980 and for purposes of comparison in 1970 are given in Figure 1. (Appendix A gives detailed definitions and explanations relevant to journey-to-work questions.) Several points should be kept in mind when census data about work trips are used:

1. The address where the individual worked most often was recorded in the census questionnaire. When a worker held two jobs, the second job location normally was not entered.
2. Some workers go to different work locations on a given day. If such workers reported to a central location, this location was to be entered as the workplace. If there was no central location and the worker went to various work locations, the smallest geographic area common to the starting places (for example, Westchester County, New York) was entered.
3. The questions assumed direct trips from residence to workplace and did not request information about indirect work trips.
4. The census asked about work "at any time last week." Thus, typical (usual) workday information was received rather than average workday information. The difference between an average day and a typical day is significant in transportation planning because on an average day some 10 to 20 percent of all workers may not commute from home to work for one reason or another.
5. Time-of-day travel information was not obtained in the census. An understanding of local work schedules is important in estimating peak-hour traffic volumes.
6. The difference between the 1970 and 1980 censuses in the wording of questions about mode of travel should also be noted. The 1980 census asked how the person "usually" got to work the previous week. This probably results in mode estimates that are low for transit and high for the automobile as compared with results obtained by questions customarily asked in transportation studies.
7. Similarly, questioning about "usual" carpool size probably results in overestimation of carpool size. Carpools are usually formed of a given number of passengers. However, on any given day a carpool member might not work, might be out of town, and so on, resulting in a number of passengers lower than that reported for the usual case.
8. The census asked where the respondent was employed "last week." It did not ask, as travel surveys do, whether a trip to work was made "yesterday."
9. Journey-to-work questions were asked of both full- and part-time workers indiscriminately and only the combined responses are reported by the Bureau of the Census.

In the following section the importance of these points and how they may be managed practically will be discussed.

Journey-to-Work Adjustments (1)

The Washington Metropolitan Area Council of Governments compared census journey-to-work data with those of the metropolitan planning organization. The census source in this case was the 1977 Annual Housing Survey and a supplementary journey-to-work survey conducted by the Bureau of the Census for the U.S. Department of Housing and Urban Development. The journey-to-work supplement was similar in form to the 1980 census.

The census asked where the respondent was employed "last week." It did not ask, as travel surveys usually do, whether a trip to work was made "yesterday." In Washington, D.C., it was found that a factor of 0.85 was required to adjust the census "usual-day" data to travel demands on a specific day as sought by transportation planners.

1970	1980
Did this person work at any time *last week*?	Did this person work at any time *last week*?
How many hours did he work *last week* (all jobs)?	How many hours did this person work *last week* (at all jobs)?
Where did he work *last week*? (If he worked in more than one place, print where he worked most.)	At what location did this person work *last week*? (If this person worked at more than one location, print where he or she worked most last week?
a) address (number and street name)	a) address (number and street) If street address is not known enter the building name, shopping center, or other physical location description.
b) name of city, town, village, etc.	b) name of city, town, village, borough, etc.
c) inside the limits of this city, town, village, etc.	c) Is the place of work inside the incorporated (legal) limits of that city, town, village, borough, etc.?
d) county	d) county
e) state	e) state
f) zip code	f) zip code
How did he get to work *last week*? (Chief means used on the last day worked at the address given)	How did this person usually get to work *last week*? (If this person used more than one method, give the one usually used for most of the distance.)
Driver, Private Auto	Car
Passenger, Private Auto	Truck
Bus or Streetcar	Van
Subway or Elevated	Bus or Streetcar
Railroad	Railroad
Taxicab	Subway or Elevated
Walked Only	Taxicab
Worked at Home	Motorcycle*
Other Means	Bicycle*
	Walked Only
	Worked at Home
	Other—Specify
How many passenger automobiles are owned or regularly used by members of your household?	How many automobiles are kept at home for use by members of your household?
None	None
1 Automobile	1 Automobile
2 Automobiles	2 Automobiles
3 Or More Automobiles	3 Or More Automobiles
Not Included	How many vans or trucks of one-ton capacity or less are kept at home for use by members of your household?
	None
	1 Van or Truck
	2 Vans or Trucks
	3 Or More Vans or Trucks
Not Included	When going to work *last week*, did this person usually:
	Drive alone
	Share driving
	Drive others only
	Ride as passenger only
Not Included	How many people, including this person, usually rode to work in the car, truck, or van *last week*?
Not Included	*Last week*, how long did it usually take this person to get from home to work (one way) in minutes?

FIGURE 1 Journey-to-work questions.

Public transit trips tended to be underreported in the census data because only the usual mode was requested. A Washington, D.C., survey of transit riders showed that only 89 percent of bus riders and 76 percent of rail riders used public transit four or more days per week. For both forms of transit combined, 85 percent were regular users.

Comparisons were also made of person work trips and transit work trips. For the Washington region, census data were a little more than 6 percent low for total trips and a little more than 5 percent low for transit trips.

Overall employment data were also compared. The census does not count second jobs and, except in areas where commutershed information is available, the failure to count work trips into the region from counties outside the SMSA results in underreporting the volume of travel demands. Such underreporting results even if commutershed reporting is provided, because not all areas external to an SMSA are considered. In Washington, D.C., the census reported 1.2 million jobs as compared with local agency estimates of 1.5 million jobs, a census underreporting of about 20 percent.

Commutersheds

An option available in the UTPP is inclusion of special commutershed data for contiguous SMSAs that make up a larger planning region. The commutershed of an SMSA includes all territory in which its workers reside and from which they travel to work. In a given pair of SMSAs, the SMSA from which a significant number of commuters travel is considered part of the commutershed of the receiving SMSA. In regions where significant rates of commuting occur in both directions, each SMSA is considered within the commutershed of the other. Similarly, if an SMSA sends a significant number of commuters to more than one other SMSA, it is considered part of the commutershed of each receiving area.

In coding responses to the 1980 census question on place of work, the usual procedure was to code intermetropolitan commuters only to place or county of work. However, residents of SMSAs designated as within the commutershed of an adjoining SMSA were coded to the census tract and block level if they commuted into that adjacent SMSA. This now allows the option of including these intermetropolitan commuters in tabulations by census tract of work (Part II) and in tabulations of census tract of residence by census tract of work (Part IV).

Analysis of 1970 data on commutation between contiguous SMSAs, between all areas within multi-SMSAs, and between all areas within multi-SMSA transportation planning regions led to development of criteria for commutershed designation, which are discussed in

more detail in Appendix C. Inclusion of commutershed data in the UTPP is by special request only and at additional cost.

ZONE VERSUS TRACT DATA

The UTPP can be ordered either with the census tract as the basic reporting unit or with some other aggregate unit of block geography such as a traffic zone. Requests for zone representation must be accompanied by a census-geography-to-zone conversion table. If the UTPP is requested by zone, the Bureau of the Census will supply a list of census geographic codes and maps if needed. A zone number must then be assigned to each census geographic unit and the list returned to the Census Bureau. If both tract and zone UTPPs are desired, they may be ordered. If zone and tract boundaries coincide, there will be little, if any, additional cost for obtaining both. If they do not coincide, additional costs will be incurred.

The advantage in obtaining the UTPP by traffic analysis zones is that the information will be available for zone-based transportation planning without further manipulation. It should be noted, however, that the data will not be geographically compatible with census data available from standard Census Bureau releases (reports, STFs, etc.), in which the basic reporting unit is the census tract.

A cost differential also exists: Reporting by tract will cost about $10 per 1,000 population; by zone, between $12 and $13 per 1,000. As an example, for an area with 750,000 population the cost difference will be about $1,900. However, should zone data be needed, the cost increment is small compared with the costs of converting purchased tract data to zones. If both tract and zone data are purchased, they can be used in comprehensive planning as well as for traffic analysis.

AVAILABILITY AND COST

The special UTPP is available for 277 SMSAs coded to place of work. The package must be ordered by special request to the Bureau of the Census. Requests generally will be filled in the order received from those areas for which data are available. The reporting unit requested can be the census tract or any other combination of blocks. The cost of the UTPP to any given SMSA will be supplied by the Bureau of the Census on request. Table 2 gives cost estimates for 10 SMSA population sizes based on the following bureau guidelines:

1. $10 per 1,000 population on tract basis and
2. $12 to $13 per 1,000 population on basis of traffic analysis zone (or other geographic combination of blocks).

Agencies of urbanized areas outside SMSAs or inside new 1980 SMSAs will not be able to obtain the complete UTPP for their jurisdictions but will be able to obtain a modified version of the package. The modifications are briefly noted in Table 1, and the areas affected are listed in Appendix B. This modified package, like the complete UTPP, will contain data not available from summary tape files or census publications.

The UTPP is being sold under three basic options:

1. Full UTPP tabulations on tape without format with a print program and only Part II on a computer printout,
2. Full UTPP tabulations on tape without format

TABLE 2 Estimated Cost of UTPP*

Population of SMSA	Cost of UTPP ($)	
	Tract	Zone
50,000	2,500**	3,400**
100,000	2,500**	3,400**
200,000	2,500**	3,400**
300,000	3,000	3,750
400,000	4,000	5,000
500,000	5,000	6,250
750,000	7,500	9,375
1,000,000	10,000	12,500
2,000,000	20,000	25,000
3,000,000	30,000	37,500

*Detailed estimate must be obtained from the Bureau of the Census upon request. The above is based on the most current information where:

Tract Level Cost = $10/1,000 population

Zone Level Cost = $12-$13/1,000 poulation

The above Tract and Zone Level Costs per 1,000 population are averages and generally the cost in larger areas will be less than the average and in smaller areas the cost will be greater than the average.

**Approximate minimum charge for an order.

with a print program and all six parts on a computer printout, and

3. Full UTPP tabulations on tape without format with a print program and all six parts furnished on microfiche.

Tables on microfiche may also be purchased at additional cost. All requests for price estimates should be addressed to Philip N. Fulton, Bureau of the Census, at the address given in the front of this Record.

CONCLUSION

The UTPP is a substantial data resource for transportation planning and other applications described elsewhere in this Record. This data resource is much improved over the UTPP that was designed in conjunction with the 1970 census. The 1980 UTPP benefited in quantity from the increased number of transportation-related items on the 1980 census questionnaire and in quality from the major improvements in place-of-work coding. Most significantly, the individuals responsible for the UTPP at the Census Bureau recognize that place-of-work coding errors still occur and are willing to make corrections. When purchasers of the UTPP have questioned the contents of their package, the Journey-to-Work and Migration Statistics Branch has reviewed the tabulations and corrected coding errors without additional cost when local information has indicated that there are geographic errors in the file. This responsiveness by the Census Bureau to the transportation community is exemplary of an effective relationship between users and providers of information for public decision making.

REFERENCE

1. G.V. Wickstrom. Comparisons of Census Journey-to-Work Findings with Metropolitan Planning Organization Data. Presented at 60th Annual Meeting of the Transportation Research Board, Washington, D.C., 1981.

Allocating Incomplete Place-of-Work Responses in the 1980 Census Urban Transportation Planning Package

PHILIP N. FULTON

ABSTRACT

Place-of-work data that are included in regular 1980 census data products were not allocated for incomplete responses or nonresponses because of processing limitations. However, this does not apply to special tabulations such as the Urban Transportation Planning Package (UTPP). The place-of-work allocation procedure that was developed by the Bureau of the Census for use in the 1980 UTPP project is described.

Place-of-work data collected in the 1980 census are among the few types of data that were not allocated as part of regular census processing. Allocation is the procedure whereby information is assigned in place of responses that are missing or incomplete. For most of the subject-matter items in the census, the procedure used to change these unacceptable responses was to assign an entry that was consistent with entries for other persons with similar characteristics who lived in the same general vicinity as the respondent. If, for example, a person did not report his wage and salary income, the income was assigned based on the last previous person processed who reported wage and salary income and who matched the nonrespondent's age, race, sex, occupation, and certain other characteristics. This process ensured that the distribution of wage and salary income assigned by the computer for persons of a given set of characteristics would correspond closely to the wage and salary income distribution of persons who had reported that item in the census.

Allocation based on the responses of persons with similar characteristics has applicability for place-of-work data as well. However, it is also important to know the overall distribution of reported employment across the area into which workers are to be allocated so that the final results will reflect the workplace distribution that was originally coded. Because census data processing is sequenced on the basis of data collection areas (e.g., enumeration districts) by state of residence, the overall distribution of workers by place of work cannot be ascertained until regular census processing has been completed. Because of this limitation, allocation of place-of-work data was not undertaken for standard 1980 census products. The limitation does not apply to special tabulations such as the Urban Transportation Planning Package (UTPP), which are prepared from the final basic record files.

The UTPP is a special tabulation of census data for individual Standard Metropolitan Statistical Areas (SMSAs) tailored to geographic areas that are used in transportation planning. These areas may be census geographic areas such as census tracts or block groups or they may be locally defined traffic

analysis zones. In either instance, it is of critical importance for the place-of-work data contained in the package to give as complete a picture of the commuting patterns within the SMSA as possible. The place-of-work allocation procedure that was developed by the Bureau of the Census for use in the 1980 UTPP project is described.

PLACE-OF-WORK CODING

The types of responses with which the allocation scheme must deal are predicated on the procedure that was used to clerically code the place-of-work question during the census processing and the levels of geographic codes that resulted. Therefore, before a description of the allocation procedure, it is important to lay the groundwork with a brief discussion of place-of-work coding.

Place of work refers to the geographic locations at which workers 16 years and older carried out their occupational activities during the week before the census, usually termed the "reference week." The exact address (number and street name) for the place of work was asked as well as the place (city, town, village, or borough), county, state, and ZIP code. Place-of-work information was collected from the residents of all sample households as part of the long-term census questionnaire. Because of budget reductions, only about half of these questionnaires were processed through place-of-work coding, resulting in a sampling rate of approximately 1 in 12 for the place-of-work data compared with the rate of 1 in 6 for other sample items.

The geographic level of coding for which a place of work was eligible depended on whether the worker lived within an SMSA (as defined at the time of the census) and the general location of his workplace. When a place of work could not be coded to the lowest geographic level for which it was eligible because the respondent provided insufficient information, it was coded to the next lowest level possible. For example, an eligible worker who could not be coded to block was coded to census tract; if he could not be coded to tract, the worker was coded to the place level; and so on. Table 1 shows the levels of place-of-work coding that were undertaken during census processing.

Persons who lived in nonmetropolitan areas were eligible to be coded to place or county of work regardless of whether they worked in nonmetropolitan territory or inside an SMSA. Places of 2,500 or more population (1,000 or more in Alaska and Hawaii) were recognized for coding; persons who reported working in a place whose population was below this criterion were coded to the county in which the place was located. In the nine northeastern states (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont), place-of-work responses were coded to the Minor Civil Division (MCD) as well as to place and county. Thus, those who worked in a place of less than 2,500 in one of the northeastern states were coded to the MCD in which the place was located.

Those who lived within an SMSA but worked in nonmetropolitan territory were eligible for the same geographic levels of place-of-work coding as those who lived in nonmetropolitan areas. This was also the case for those who lived in one SMSA and worked in another SMSA, unless the two SMSAs were designated as part of a commutershed (commutershed coding is discussed in the following).

The place-of-work responses of persons who lived and worked within the same SMSA were eligible to be

TABLE 1 Geographic Levels Used for Place-of-Work Coding in the 1980 Census

Area of residence	Area of work	Eligible level of place-of-work coding
Inside an SMSA that is a commutershed for one or more contiguous SMSA's	SMSA of residence; inside the tract/block coding area	Census tract or block
	SMSA of residence; outside the tract/block coding area	Place or county (MCD in the 9 Northeastern states) if place of work is not in a place
	SMSA for which SMSA of residence is a commutershed; inside the tract/block coding area	Census tract and block
	SMSA for which SMSA of residence is a commutershed; outside the tract/block coding area	Place or county (MCD in the 9 Northeastern states) if place of work is not in a place
	SMSA for which SMSA of residence is not a commutershed	Place or county (MCD in the 9 Northeastern states) if place of work is not in a place
	Outside SMSA's	Place or county (MCD in the 9 Northeastern states) if place of work is not in a place
Inside an SMSA that is not a commutershed for another SMSA	SMSA of residence; inside the tract/block coding area	Census tract and block
	SMSA of residence; outside the tract/block coding area	Place or county (MCD in the 9 Northeastern states) if place of work is not in a place
	Another SMSA or outside SMSA's	Place or county (MCD in the 9 Northeastern states) if place of work is not in a place
Outside SMSA's	Inside an SMSA or outside SMSA's	Place or county (MCD in the 9 Northeastern states) if place of work is not in a place

coded to census tract and block if their workplace location was within the tract or block coding area. The tract or block coding area of the SMSA was defined as the portion of the potential urbanized area that was covered by the bureau's computerized Geographic Base File/Dual Independent Map Encoding (GBF/DIME) file. Where the GBF/DIME file coverage within the SMSA extended beyond the boundary of the potential urbanized area, workplace addresses outside the boundary were also coded to tract and block if that territory had been included in the tract or block coding area under the contract block program. For persons living and working within an SMSA but working outside the tract or block coding area, the place-of-work response was coded to the same level as that for those who lived in nonmetropolitan territory (i.e., place or county or both). Those who lived and worked within SMSAs that had no GBF/DIME file (Bismarck, North Dakota; Elkhart, Indiana; Enid, Oklahoma; Iowa City, Iowa; Janesville-Beloit, Wisconsin; Las Cruces, New Mexico; and Rapid City, South Dakota) were also coded to the same level as residents of nonmetropolitan territory.

Special commutershed coding was undertaken for contiguous SMSAs that make up a larger commuting region. In general, the commutershed of an SMSA extends to include the territory from which its workers flow. Thus, for a given pair of SMSAs where one area sends a significant number of commuters to the other, the sending SMSA is defined as part of the commutershed of the receiving SMSA. Where there are large flows of workers in both directions, each SMSA would be recognized as within the commutershed of the other. Similarly, if an SMSA sends a significant number of commuters to more than one other SMSA, it would be part of the commutershed of each receiving area. As previously described, in the coding of place-of-work responses the usual procedure was to code intermetropolitan commuters only to the place or county level or both. However, residents of SMSAs that were designated as a commutershed of an adjoining SMSA were coded to the census tract and block level if they commuted into that adjacent SMSA.

The place-of-work coding system also contained miscellaneous codes to be used for workers whose place-of-work response was incomplete or an unusual location. For example, some workers could only be coded to the state in which they worked, whereas others reported that they worked in a foreign country or at sea during the week before the census. And, of course, there were those workers who did not report their place of work at all. Such workers were assigned a special code for place of work not reported.

In summary, during place-of-work coding, workers were coded to varying levels of geographic detail depending on the level for which they were eligible and the accuracy of their response to the place-of-work question. It is the workers who were not coded to the fullest geographic detail for which they were eligible who are candidates for allocation. This includes workers who did not report their place of work, those who were coded only to state, those who could be coded only to county within an MCD, and workers coded to a county, MCD, or place that was completely within the tract or block coding area but who could not be coded to tract or block.

PLACE-OF-WORK ALLOCATION PROCEDURE

The objective of the place-of-work allocation procedure developed for the UTPP project is to assign workers to workplace locations within the SMSA in the same proportion as the geographic distribution of workers that resulted from actual place-of-work coding. In addition, the procedure also seeks to maintain the socioeconomic profile of the labor force in a given location by restricting allocated workers to workplace locations where workers with similar characteristics were coded during census processing. The allocation scheme proceeds in stages from one geographic level to the next to keep it as simple as possible and to permit storing in the computer all the information needed at one time to make the particular stage of the allocation. In preparation for the process, all workers in the place-of-work coding sample are stripped from the basic record census file to form a worker allocation file containing the place-of-residence and place-of-work geography necessary for allocation as well as a recode for groups 1 to 19, which are the characteristics control groups into which the workers are stratified.

Characteristics Control Groups

Three basic characteristics are cross-tabulated to form the control groups into which workers are stratified during allocation: means of transportation to work, industry of work (including armed forces as a separate category), and travel time to work. Means of transportation was chosen primarily to separate public transit riders from workers using other modes, because it would be erroneous to allocate transit users into areas of work where public transportation does not go. Similarly, industry of work was selected to distinguish, in a general sense, between areas with heavy industry and those that tend to have other types of employment. It would not be desirable to allocate a steel worker to the central business district or an insurance executive to an area typified by heavy manufacturing. Finally, travel time was selected as a control for the length of the work trip. Table 2 provides a description of the characteristics control groups.

Steps in the Allocation Procedure

Step 1: From Place of Work Not Reported to State of Work

In step 1 workers whose place of work was not reported are assigned a state of work based on the states of work that were reported by other workers with similar characteristics who live in the same general vicinity. First all the workers in the SMSA are sorted by census tract of residence and within tract of residence by characteristics control group. Then within each control group, they are further sorted by state of work. Once the file has been organized in this manner, workers whose state of work was not reported are assigned states in the same proportion as those workers living in the tract in their characteristics control group who reported a state of work. After the completion of step 1, each worker in the SMSA will have a state of work either through coding or allocation.

Step 2: From State to County of Work

In step 2 workers who have only a state of work are assigned to a county of work within that state. Again the assignment is based on the counties of work that were reported by other workers with similar characteristics who live in the same vicinity as the respondent and who work in the same state. As in step 1, all workers are sorted by census tract of

TABLE 2 Characteristics Control Groups for Place-of-Work Allocation

Control group	Characteristics		
	Travel time	Means of transportation	Industry of work
1	1 to 14 minutes	Public transportation (bus or streetcar, subway or elevated train, railroad)	"Blue-collar" industry (manufacturing; transportation, communications, and other public utilities; construction; wholesale trade)
2	1 to 14 minutes	Public transportation	"White-collar" industry (retail trade; finance, insurance, and real estate; services; public administration)
3	1 to 14 minutes	Public transportation	Armed forces
4	1 to 14 minutes	Other means of transportation (car, truck, van, taxicab, bicycle, motorcycle, walked, worked at home, other means)	Blue-collar industry
5	1 to 14 minutes	Other means of transportation	White-collar industry
6	1 to 14 minutes	Other means of transportation	Armed forces
7	15 to 29 minutes	Public transportation	Blue-collar industry
8	15 to 29 minutes	Public transportation	White-collar industry
9	15 to 29 minutes	Public transportation	Armed forces
10	15 to 29 minutes	Other means of transportation	Blue-collar industry
11	15 to 29 minutes	Other means of transportation	White-collar industry
12	15 to 29 minutes	Other means of transportation	Armed forces
13	30 minutes or more	Public transportation	Blue-collar industry
14	30 minutes or more	Public transportation	White-collar industry
15	30 minutes or more	Public transportation	Armed forces
16	30 minutes or more	Other means of transportation	Blue-collar industry
17	30 minutes or more	Other means of transportation	White-collar industry
18	30 minutes or more	Other means of transportation	Armed forces
19	Any travel time	Any means of transportation	Agriculture, forestry, and fisheries; mining

residence and characteristics control group and within control group by state of work. In addition, for step 2 the workers are further sorted by county of work within each state of work. Then the workers who were coded only to the state level and have no county of work are allocated to counties in the same proportion as the other workers living in the tract in their characteristics control group. At the end of step 2, each worker in the SMSA will have a county of work.

Step 3: From County to MCD of Work

Step 3 of the allocation procedure applies only to the nine northeastern states where MCDs were recognized for place-of-work coding. This step is omitted when SMSAs or parts of multistate SMSAs that are located outside the Northeast are processed. In step 3 workers who were coded only to the county level in a northeastern state are assigned an MCD of work. However, in contrast to the previous steps in the allocation process, the assignment is based on the overall distribution of workers that were coded to an MCD within a given county.

First, the workers are sorted by county of work and within county of work by characteristics control group. Next, within each control group the workers are sorted by MCD of work. Workers who were coded only to the county level are then allocated to MCDs of work in the same proportion as those working in the county in their characteristics control group who were coded to the MCD level.

After the completion of step 3, those working outside the SMSA are excluded from subsequent steps in the allocation process unless they work in an adjacent SMSA for which their residence SMSA is a commutershed.

Step 4: From County (or MCD) to Place of Work

Step 4 applies only to workers who worked within the SMSA or within an adjacent SMSA for which their residence SMSA is a commutershed. It is an intermediate step that precedes allocation to the census tract and block levels. In step 4 workers who were coded only to the county level (or to the MCD level in the Northeast) are allocated to a place of work if the county (or MCD) is completely within the tract or block coding area. Workers coded to the county (or MCD) level in counties (or MCDs) that are not completely within the tract or block coding area are left at that level and not allocated further.

For counties (or MCDs) that are completely within the tract or block coding area, workers are again sorted into characteristics control groups and within control group by place of work. Then workers who had been coded only to the county (or MCD) level are allocated to places of work within the county (or MCD) in the same proportion as workers who were originally coded to the place level. Workers who had been coded to parts of the county (or MCD) that are not within a place are treated as working within the place called "balance of county" (or "balance of MCD").

Step 5: From Place to Census Tract of Work

In step 5 workers who were coded to the place level in places that are completely within the tract or block coding area are assigned a census tract of work. The allocation is based on the distribution of coded workers with similar characteristics across the census tracts that make up each place. First the workers are sorted by place of work and within place of work by characteristics control group. Next, within each control group, the workers are sorted by census tract of work. Then the workers who had been coded only to the place level are allocated to census tracts of work in the same proportion as those workers working in the place in their characteristics control group who were coded to the census tract level.

Step 6: From Census Tract to Block of Work

Finally, in step 6 workers who were coded to a census tract of work but not to the block level are assigned a block of work based on the distribution of coded workers with similar characteristics across the blocks in each census tract. The workers are sorted by census tract of work and within tract by characteristics control group. Within each control group, the workers are further sorted by block of work. Then the workers who had been coded only to the census tract level are allocated to blocks of work in the same proportion as those workers working in the tract in their characteristics control group who were coded to the block level.

RESULTS OF THE ALLOCATION PROCEDURE

A comprehensive analysis of the effect of the place-of-work allocation procedure is beyond the scope of this descriptive paper. However, a few examples of the results of the allocation process for the Washington, D.C., SMSA provide a general view of its impact.

Table 3 shows the overall workplace distribution of workers across the large geographic components of the metropolitan area before and after allocation. Because Washington is a commutershed for the Baltimore SMSA, Baltimore is also shown as a destination. As can be seen from Table 3, the overall distribution of workers after allocation is nearly identical to that which resulted from actual place-of-work coding.

TABLE 3 Allocation Summary for Large-Area Commuter Flows for the Washington, D.C.-Md.-Va. SMSA: 1980

Areas of Work	Number of Workers		Percent Distribution	
	After Allocation	Before Allocation	After Allocation	Before Allocation
All workers	1,559,820	1,418,700	100.0	100.0
District of Columbia	614,685	559,311	39.4	39.4
Charles County, Md.	16,913	15,767	1.1	1.1
Montgomery County, Md.	241,656	222,693	15.5	15.7
Prince George's County, Md.	193,319	177,285	12.4	12.5
Arlington County, Va.	118,276	107,373	7.6	7.6
Fairfax County, Va.	176,384	161,553	11.3	11.4
Loudoun County, Va.	17,879	16,192	1.1	1.1
Prince William County, Va.	25,194	23,198	1.6	1.6
Alexandria City, Va.	65,235	58,678	4.2	4.1
Fairfax City, Va.	21,618	19,207	1.4	1.4
Falls Church City, Va.	14,325	12,405	0.9	0.9
Manassas City, Va.	11,411	10,228	0.7	0.7
Manassas Park City, Va.	417	386	-	-
Baltimore, Md. SMSA	20,685	18,663	1.3	1.3
Elsewhere	21,823	15,761	1.4	1.1

Table 4 gives an example of the effect of place-of-work allocation on commuter flows between components of the SMSA. The data pertain to the workplace destinations for workers who reside in suburban Fairfax County, Virginia. Again, as in Table 3, the proportion of workers in each flow is virtually the same both before and after allocation.

Table 5 shows the effect of allocation on the number of workers in the census tracts that make up the Washington, D.C., CBD, as well as their characteristics. The second line of the table indicates that the proportion of the District's employment that is attributable to each CBD census tract remained the same after allocation despite the addition of substantial numbers of workers. Furthermore, the characteristics profile of workers within each tract after allocation remained almost identical to the original coded results.

SUMMARY

Place-of-work data that are included in regular 1980 census data products were not allocated for incom-

TABLE 4 Allocation Summary for Commuter Flows for Fairfax County, Virginia: 1980

Areas of Work	Number of Workers		Percent Distribution	
	After Allocation	Before Allocation	After Allocation	Before Allocation
All workers	316,497	291,385	100.0	100.0
District of Columbia	80,582	74,953	25.5	25.7
Charles County, Md.	106	82	-	-
Montgomery County, Md.	11,309	10,377	3.6	3.6
Prince George's County, Md.	6,136	5,536	1.9	1.9
Arlington County, Va.	39,426	36,399	12.5	12.5
Fairfax County, Va.	119,175	110,227	37.7	37.8
Loudoun County, Va.	2,528	2,311	0.8	0.8
Prince William County, Va.	1,904	1,760	0.6	0.6
Alexandria City, Va.	28,060	25,925	8.9	8.9
Fairfax City, Va.	12,370	11,268	3.9	3.9
Falls Church City, Va.	7,396	6,458	2.3	2.2
Manassas City, Va.	1,455	1,264	0.5	0.4
Manassas Park City, Va.	79	60	-	-
Baltimore, Md. SMSA	912	852	0.3	0.3
Elsewhere	5,509	3,913	1.6	1.3

TABLE 5 Percentage Distribution of Workers by Characteristics Control Group Before and After Allocation for Census Tracts in the Washington, D.C., CBD: 1980

Characteristics Control group	Census tracts in the central business district											
	0051.00		0052.02		0053.02		0054.02		0057.02		0058.00	
	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before
All workers	17,859	13,392	15,379	11,817	23,299	17,820	47,803	36,196	16,990	12,774	42,964	32,511
Percent of total workers working in the District of Columbia	2.9	2.9	2.5	2.6	3.8	3.9	7.8	7.9	2.8	2.8	7.0	7.1
PERCENTAGE DISTRIBUTION BY CHARACTERISTICS CONTROL GROUP												
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1-14 min./Public trans./Blue-collar	-	-	-	-	-	-	-	-	-	-	0.1	0.1
1-14 min./Public trans./White-collar	0.2	0.2	0.3	0.2	0.3	0.3	0.4	0.5	-	0.1	0.3	0.3
1-14 min./Public trans./Armed forces	-	-	-	-	-	-	-	-	-	-	-	-
1-14 min./Other means/Blue-collar	-	-	3.0	2.9	1.2	0.9	0.6	0.5	-	-	0.6	0.6
1-14 min./Other means/White-collar	2.8	3.0	4.5	4.4	3.8	4.3	4.2	4.1	3.4	3.2	2.7	2.8
1-14 min./Other means/Armed forces	-	-	-	-	-	-	-	-	0.1	0.2	-	-
15-29 min./Public trans./Blue-collar	0.4	0.4	0.3	0.4	0.4	0.5	0.3	0.3	0.3	0.5	0.5	0.5
15-29 min./Public trans./White-collar	3.3	3.3	2.7	2.6	3.1	3.3	2.4	2.6	2.3	2.5	2.7	2.9
15-29 min./Public trans./Armed forces	-	-	-	-	-	-	-	-	-	-	-	-
15-29 min./Other means/Blue-collar	2.2	2.3	6.9	6.4	3.2	2.6	2.4	2.2	0.5	0.5	4.5	4.2
15-29 min./Other means/White-collar	16.3	16.5	14.6	14.7	19.1	19.2	19.9	19.0	17.1	17.4	16.6	16.8
15-29 min./Other means/Armed forces	-	-	-	-	-	-	-	-	0.1	0.1	0.2	0.1
30+ min./Public trans./Blue-collar	1.4	1.2	1.9	2.1	2.3	2.4	1.3	1.5	0.2	0.3	2.7	2.9
30+ min./Public trans./White-collar	10.9	10.7	6.5	7.1	11.5	12.6	12.0	13.1	8.2	8.8	8.7	9.1
30+ min./Public trans./Armed forces	-	-	-	-	-	-	-	-	-	-	-	-
30+ min./Other means/Blue-collar	9.1	7.9	11.6	11.3	9.6	9.1	6.4	6.1	2.6	2.2	10.6	10.4
30+ min./Other means/White-collar	50.1	51.9	45.9	46.4	42.5	42.3	47.1	47.8	62.6	62.3	47.3	47.3
30+ min./Other means/Armed forces	0.1	0.1	-	-	-	-	-	-	0.4	0.3	0.1	0.1
Agriculture, forestry, fisheries, and mining	3.2	2.4	1.7	1.6	3.0	2.3	3.0	2.1	2.1	1.8	2.4	2.0

plete responses or nonresponse because of processing limitations. However, this limitation does not apply to special tabulations such as the UTPP.

The allocation procedure developed for use in the 1980 UTPP assigns workers to workplace locations within a given SMSA in the same proportion as the geographic distribution of workers that resulted from actual place-of-work coding. In addition, the procedure also maintains the socioeconomic profile of the labor force in a given location by restricting allocated workers to workplace locations where workers with similar characteristics were coded during census processing. By improving the quality of the employment data contained in the UTPP, place-of-work allocation should significantly increase the utility of the package for transportation planning in the next decade.

Designing the Urban Transportation Planning Package

ALAN E. PISARSKI and ROLF R. SCHMITT

ABSTRACT

The Urban Transportation Planning Package was designed by the Bureau of the Census following specifications that were developed by an ad hoc committee of users. The relationship between the Census Bureau and the ad hoc committee was informal but effective and illustrates a way to bridge the gaps that frequently exist between users and providers of information for public decision making.

Most products of the Bureau of the Census are developed through formal committees of sponsoring agencies and other interested organizations. In contrast, the Urban Transportation Planning Package (UTPP) was designed by an ad hoc committee that had no official status. The largely informal process by which the 1980 UTPP was designed is worth examining because it illustrates an effective way to bridge the gaps that frequently exist between users and providers of information for public decision making.

THE DESIGN PROCESS

The informal design process for the 1980 UTPP had its roots in a similar effort a decade earlier. The first UTPP was designed for the 1970 census by an informal group of transportation professionals and census officials. Several participants met with other members of the transportation community at a TRB-sponsored conference in Albuquerque in 1973 to assess their experiences and make recommendations for the future (1).

Inspired by the recommendations of the 1973 conference, an ad hoc committee was formed in 1977 to develop specifications for the structure and content of the 1980 UTPP. The group included officials from the Census Bureau, FHWA, and UMTA who would be most immediately responsible for programming the UTPP and securing necessary funds, as well as professionals from other federal and regional agencies and consulting firms who were experienced with the subject matter. The group was intentionally kept small to keep the discussions manageable, never exceeding a dozen participants. All members were from the Washington, D.C., area so that meetings could be frequent and without travel cost.

Although all participants were members or friends of the TRB Committee on Transportation Information Systems and Data Requirements, the ad hoc committee was not affiliated with TRB or with any other organization. Official status was unnecessary because the Census Bureau would develop cost estimates and other feasibility analyses in response to any reasonable request by an individual or group.

The ad hoc committee met between 1977 and 1979 at the Metropolitan Washington Council of Governments (COG) offices, which provided neutral ground for the Census Bureau and transportation officials. The group started with a table-by-table review of the 1970 UTPP, relying heavily on the proceedings of the Albuquerque conference (1) for initial recommendations and for documentation of the content and procedures of the 1970 UTPP. The group also had to consider the expanded number of journey-to-work questions in the 1980 census, experience with which was limited to the Annual Housing Survey. New ideas were raised and debated, and an initial set of specifications was developed. COG's George Wickstrom served as the unofficial secretary of the ad hoc committee and forwarded the initial specifications to the Census Bureau for a cost estimate. Comments were solicited on the proposed specifications from interested individuals in a number of metropolitan planning organizations (MPOs) and through articles in a newsletter of the Urban and Regional Information Systems Association (URISA). The specifications evolved in response to the comments and further debate among the members of the ad hoc committee, and the cost estimates were revised accordingly.

At this point the process became formal. The FHWA and UMTA participants on the ad hoc committee used the specifications and cost estimates to prepare and obtain approval for a contract with the Census Bureau to develop the requisite software for the UTPP. Potential purchasers of UTPP tabulations were contacted through publications and meetings of the Census Bureau, FHWA, UMTA, TRB, URISA, and other organizations.

MAJOR ISSUES

Most deliberations of the ad hoc committee were focused on the variables and categories proposed for each table. Principal concerns included the utility of each item for transportation planning, the likelihood of suppression given the Census Bureau's confidentiality regulations, and the consequences for the total size of the UTPP. For example, a second classification of means of travel to work was developed for the origin-destination table in Part IV of the UTPP because the more detailed classification used in other parts would have exploded the size of the table and resulted in many suppressed cells.

As the proposed UTPP grew, its size and complexity became major concerns. A large UTPP might not be affordable or usable by a small MPO that lacked the technical sophistication or the substantive need to deal with the variety and detail of the proposed tabulations. On the other hand, very few agencies appeared to use the same variables in their analyses. The size of the UTPP ultimately reflected the diversity of the transportation community's data needs. The ad hoc committee hoped that the ability to use standard census geography as a default would help keep costs down, and that subsequent publications, training courses, other forms of technical assistance, and meetings among users would help each MPO get the most out of its package.

The UTPP grew substantially in the design process, in part because more transportation-related questions were being asked on the census questionnaire and in part because the ad hoc committee was responding to a greater variety of transportation models and issues. For example, the inclusion of external counties in Part VI reflects a concern with the increasing number of work trips that cross metropolitan area boundaries. (Ironically, the only member of the ad hoc committee to receive a long form with the journey-to-work questions on April 1, 1980, was also the only participant who commuted between metropolitan areas.)

STRENGTHS AND WEAKNESSES

The informal process by which the UTPP was designed worked very well because the participants were enthusiastic and seasoned transportation professionals, because they were all willing to advance innovative ideas for critical review, and because they wanted to create the best possible product for the entire transportation community. This last ingredient was most essential with respect to the participants from the Census Bureau, FHWA, and UMTA, who ultimately had the resources to make the UTPP a reality.

Even with the right cast of participants, the process was certainly not perfect. More input was needed from smaller MPOs and from potential users of the UTPP who are not in the transportation field. More attention should have been given to the medium by which the UTPP was to be distributed and on the analytical resources needed to use the package. Greater attention to the relationships between standard census products and the UTPP might have also been useful.

These weaknesses are minor considering the ad hoc committee's accomplishments. A UTPP was ultimately created in 1980 that was a major improvement over the 1970 version and a major information resource was designed for a wide range of analysts and decision makers in transportation and other fields.

The ad hoc committee succeeded because it had the flexibility and timeliness of its informal status without sacrificing its credibility. Its credibility was not based on the superstar status of its members or the reflection of all interests in their affiliations. The ad hoc committee was credible because its members sought and were open to suggestions on as many points of view as possible and because its members had a solid understanding of their issues and knew how to translate ideas into an effective product.

CONCLUSION

The effectiveness of the ad hoc committee's efforts can be measured by the response of the user community. More than 200 MPOs have purchased more than $2 million in UTPP tabulations. This represents a significant step forward in the establishment of a national commuting data base with a high level of comparability among regions.

REFERENCE

1. Census Data and Urban Transportation Planning. Special Report 145. TRB, National Research Council, Washington, D.C., 1974.

Part 3
Methods for Using the UTPP

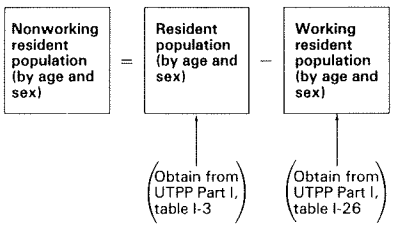


FIGURE 2 Determining the nonworking resident population for a tabulation area.

dent population age categories must be combined for comparability with those of the workers (Figure 3). Once the appropriate adjustments have been made, the procedure is simply to subtract the number of working residents from the total number of residents within each age and sex category to arrive at a breakdown of the nonworking resident workers by age and sex. These are the only characteristics of this group that are available from the UTPP.

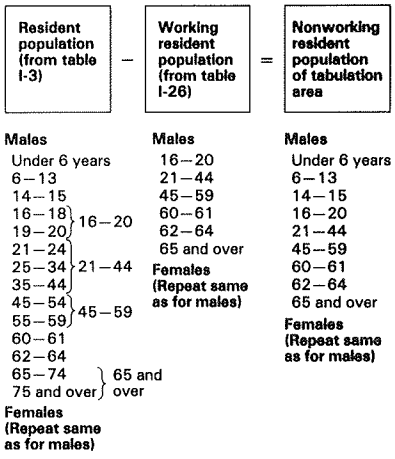


FIGURE 3 Adjusting age categories in determining the nonworking resident population by age and sex.

Occupations	Males	Females
All workers	13,903	11,930
Executive, administrative, and managerial occupations	2,996	1,741
Professional specialty occupations	2,259	1,416
Technicians and related support occupations	459	367
Sales occupations	1,391	925
Administrative support occupations, including clerical	1,400	5,036
Service occupations	1,607	1,808
Farming, forestry, and fishing occupations	23	37
Precision products, craft, and repair occupations	1,494	102
Operators, fabricators, and laborers	2,251	498
Armed Forces	23	–

FIGURE 4 Occupation and sex of the at-work population for census tract 0019 in Atlanta, Georgia, 1980.

	Resident population (from table I-3)	– Working resident population (from table I-26)	= Nonworking resident population
Males total	421	315	106
Under 6 years	24	–	24
6–13	–	–	–
14–15	7	–	7
16–20	8	8	–
21–44	247	198	49
45–59	87	69	18
60–61	20	20	–
62–64	7	7	–
65 and over	21	13	8
Females total	294	166	128
Under 6 years	26	–	26
6–13	–	–	–
14–15	–	–	–
16–20	36	24	12
21–44	120	87	33
45–59	39	27	12
60–61	18	18	–
62–64	4	4	–
65 and over	51	6	45

FIGURE 5 Nonworking resident population by age and sex for census tract 0019 in Atlanta, Georgia, 1980.

APPLICATION: ATLANTA, GEORGIA

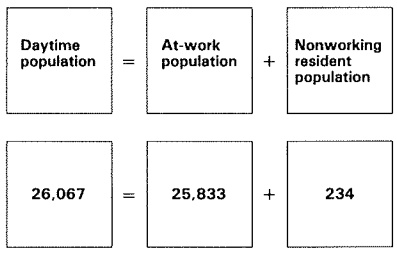
This example demonstrates the application of the procedure to a census tract within Atlanta, Georgia. The tract chosen for analysis is tract 0019, one of three tracts that make up the Atlanta central business district.

Figure 4 shows data for the at-work population that are contained in the Atlanta UTPP, Part III, Table III-1. The data provide the number of workers who work in tract 0019 by sex and occupation. The at-work population of the tract consists of 13,903 men and 11,930 women for a total of 25,833 workers.

Figure 5 shows the calculation of the number of nonworking residents of the tract, using appropriate data from the Atlanta UTPP, Part I, Tables I-3 and I-26. The nonworking resident population of tract 0019 is 234: 106 men and 128 women.

Finally, Figure 6 gives the final daytime population estimate for tract 0019. More than 26,000 persons are present in the tract on a typical day, 25,833 workers and 234 residents of the area who do not work. Figure 6 also shows the stark contrast between the daytime and resident populations of the tract. Only 715 persons reside in the tract, but that number swells to more than 26,000 on a typical day.

If tract 0019 contained any facilities such as hotels, hospitals, shopping centers, schools, or colleges, counts of those using these facilities could be obtained and added to the UTPP daytime



Total resident population = 715

Total estimated daytime population = 26,067

FIGURE 6 Estimated daytime population for census tract 0019 in 1980.

Estimating the Daytime Population with the Urban Transportation Planning Package

PHILIP N. FULTON

ABSTRACT

A procedure for estimating daytime population with data from the Urban Transportation Planning Package is described. In an illustrative application, a census tract in Atlanta, Georgia, containing 715 residents is estimated to have a daytime population of 26,067.

The Urban Transportation Planning Package (UTPP) is a special tabulation of 1980 census data for individual Standard Metropolitan Statistical Areas (SMSAs) tailored to geographic areas that are used in transportation planning. Local transportation planning organizations submit specifications to the Census Bureau for the geographic detail required for their area (e.g., traffic zones or census tracts), and the bureau then produces a standard set of tabulations for those planning areas on a cost-reimbursable basis. Specifications for the content of the UTPP were prepared and submitted to the bureau by an ad hoc committee representing the TRB Committee on Transportation Information Systems and Data Requirements.

Although the UTPP was conceived as a transportation planning tool, the place-of-work information it contains makes the package a unique product for other applications as well. For example, data from the UTPP that provide the number and characteristics of persons by place of residence and place of work can be used to make estimates of the daytime population of small areas such as census tracts or traffic zones. In this paper a brief description is presented of how to use the UTPP to produce such estimates.

BASIC CONCEPTS

Before going into the actual methodology of making daytime population estimates, it is important to understand the definitions of several underlying concepts. These are resident population, working resident population, nonworking resident population, at-work population, and daytime population.

1. Resident population: All persons living within a tabulation area (e.g., census tract) at the time of the census (as of April 1, 1980).
2. Working resident population: All persons 16 years old and older living within the tabulation area who had a job and were at work during the week before the census (commonly referred to as the reference week).
3. Nonworking resident population: All persons living within the tabulation area at the time of the census who were not at work during the week before the census. This group includes persons under 16 years of age, persons 16 and older with no job, and persons 16 and older with a job but not at work during the reference week due to illness, vacation, layoff, or some other reason.
4. At-work population: For a given tabulation area, the estimated number of workers 16 years old and older, including members of the armed forces, who carried out their occupational activities within that area during the week before the census. The at-work population is not a count of total employment because it excludes workers who usually work in the area but were not at work during the reference week.
5. Daytime population: For a given tabulation area, the estimated maximum population within the area on a typical weekday. Because the number of persons in any one location is dynamic, varying with the time of day, the estimate is of the number of persons over the course of the whole day. The daytime population is composed of three components: the at-work population, the nonworking resident population, and nonresidents who are in the area for some purpose other than work. Such persons include users of business establishments, theaters, amusement and recreation facilities, hotels, shopping centers, and transportation terminals; patients in hospitals; students in elementary and secondary schools, colleges, and universities; pedestrians; and persons in vehicles. Adjustments for this third component of the daytime population must be made independently of the UTPP.

PROCEDURE

An estimate of the daytime population of a census tract or traffic zone can be made by determining the nonworking resident population of the area and then adding that to its at-work population (Figure 1).

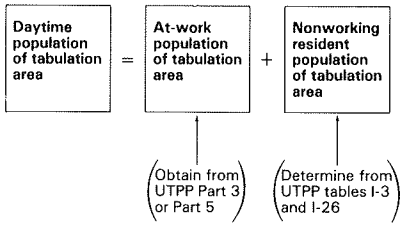


FIGURE 1 Estimating the daytime population using the UTPP.

The at-work population is readily obtainable from any of several tables in Part III or V of the UTPP, but the nonworking resident population must be derived by subtracting the working resident population found in UTPP Part I, Table I-26, from total resident population found in Part I, Table I-3 (Figure 2).

Because the UTPP age categories for the resident population are more detailed than those provided for the working resident population, some of the resi-

population total to arrive at a more accurate estimate. Surveys of pedestrians and vehicular traffic could also be conducted to further enhance the estimate if they were warranted.

CHARACTERISTICS AVAILABLE FROM THE UTPP

Because the UTPP is a special tabulation designed for transportation planning, most of the characteristics it provides are for the at-work population. As noted previously, the only characteristics available in the UTPP for nonworking residents are age and sex. However, this should not seriously limit the utility of the UTPP as a tool for analysis of the daytime population because most applications focus on the characteristics of the work force by place of work.

The characteristics of the at-work population that are available in the UTPP include the following:

- Occupation by sex,
- Industry by sex,
- Class of worker by sex,
- Means of transportation to work by earnings,
- Means of transportation to work and carpooling,
- Travel time to work by means of transportation,
- Means of transportation by race and Spanish origin,
- Carpool type and vehicle occupancy,
- Number of vehicles used to get to work,
- Persons per vehicle,
- Persons per carpool,
- Means of transportation by household income, and
- Means of transportation by number of vehicles available.

USES OF DAYTIME POPULATION ESTIMATES

Certainly the number and characteristics of persons who work in a given location are of critical importance for transportation planning. There are, however, many other uses for these data. Some of these are listed as follows:

- Transportation planning,
- Marketing,
- Environmental impact analysis,
- Disaster planning,
- Planning for service delivery,
- Labor market analysis,
- Economic development planning, and
- Equal Employment Opportunity studies.

OBTAINING DATA FROM THE UTPP

UTPPs for many SMSAs have been delivered, and packages for the majority of the remaining metropolitan areas will be produced within the next year or so. Interested data users may contact either the agency that purchased the package or the Census Bureau. A complete description of the UTPP, a list of purchasers, or information on the cost and availability of a particular UTPP may be obtained by writing to the Chief, Journey-to-Work and Migration Statistics Branch, Population Division, Bureau of the Census, Washington, D.C. 20233.

Linking the Urban Transportation Planning Package with the Urban Transportation Planning System*

MICHAEL B. CLARKE

ABSTRACT

Methods are described in detail for accessing data from the Urban Transportation Planning Package on a mainframe computer. Specific procedures are explained for using the data as part of the Urban Transportation Planning System.

The purpose of this paper is to aid the user in getting the Urban Transportation Planning Package (UTPP) into a usable format for computer-assisted urban travel modeling. The process of using the census data in a meaningful and easy manner can be difficult, and it is hoped that the reader will gain a better understanding of the mechanics of the data and their application.

This paper is organized in several sections in order to make the process more easily comprehensible and at the same time show the differences between the applications to be covered. Presented first is a general description of what the user will be confronted with when he receives the UTPP. In this section procedures the user may find helpful in using the tape, including how to access and use the UTPP print program, are detailed. The UTPP is compared with the past data-handling methods contained in UCEN70. In the next section how and why the user should reformat the UTPP data for use with the Urban Transportation Planning System (UTPS) and for use in microcomputer software packages are discussed. In the third section the creation of UTPS Z-files

*From Arthur B. Sosslau and Michael B. Clarke, Case Studies: Applying the Urban Transportation Planning Package (UTPP) in Transportation Modeling, FHWA, U.S. Department of Transportation, January 1984.

(zonal data) and J-files (trip interchange data) is covered. Building these structures is often complicated by the mere volume of UTPS documentation, and it is hoped that this section of the paper will provide a short and straightforward approach to mastering the process.

The fourth section makes up the major portion of the paper. In it, several examples are presented showing how the UTPP data can be used in modeling trip generation, trip distribution, modal choice, and traffic assignment. All examples show how to incorporate UTPS to aid in the travel demand modeling process.

UTPP TAPE, PRINT PROGRAM, AND COMPARISONS WITH UCEN70

Tape Information

The UTPP user may be rather disconcerted when he first receives the package from the Bureau of the Census. What is delivered is one or two nine-track, standard label tapes (depending on the size of the urban region); a copy of the tape request from the Bureau of the Census; and a data dictionary that describes where each piece of data can be found. The tape request in its entirety tells the user that Parts I through VI of the UTPP for their area are contained on the accompanying tape. In addition, the tape contains the UTPP print program, which enables the user to produce a listing of all or parts of the UTPP data, and a section that contains geocoding data.

In order for the user to access any parts of the UTPP, he should know that the UTPP tape has been created on a Sperry Univac computer system, and as such does not have IBM-compatible data set names. Specifically, the data set names have portions without separating periods greater than eight characters in length. This can be confirmed by mounting the tape and printing the tape labels using a local program module such as LABELSNIFF, which prints the data set name, record length, block size, and so on.

With this in mind the user can, with relative ease, circumvent the problems associated with having incompatible IBM data set names. By utilizing a printout of the tape labels of the UTPP, the user can create a program setup using the IBM utility program IEBGENER to copy all of the data sets from the original tape to another tape and specify his own specific data set names. A sample IEBGENER setup is shown in Figure 1. The user should note that the key to the whole process is to bypass label processing (BLP) on the original tape. Once IEBGENER has been run and a new tape has been created, the user is left with a new tape useful for production purposes and the original tape from the census, which can serve as a backup.

UTPP Print Program

At this point in UTPP processing the user may want to access the UTPP print program. With it, printouts of all the data contained on the tape or of selected portions can be produced. The print program is contained on the UTPP tape and is easily accessed by using a fairly standard set of Job Control Language (JCL) procedures.

The JCL needed is shown in Figure 2. Along with the JCL, two control cards are input to the program after the //LU06CNTL DD * card. The two control cards are the TABLE card and the ZONE or TRACT card.

TABLE Card

The TABLE card allows the user to print selected tables or all tables from UTPP Parts I, II, III, V, and VI. For Part IV, all tables must be printed. This card begins in card column 1. The following examples show the use and limits of the TABLE card:

1. To request all tables in UTPP Part I:
```
//LU06CNTL DD *
TABLE I
ZONE
```
2. To request individual tables within UTPP Part I:
```
//LU06CNTL DD *
TABLE I-3, I-5, I-4
ZONE
```

The second example causes the UTPP print program to print Tables I-3, I-4, and I-5. The user may request up to 12 individual tables on the same TABLE card. Table identifications do not have be in as-

```
    //COPY1 EXEC PGM=IEBGENER
1   //SYSUT1 DD LABEL=(8,BLP),VOL=SER=<Your UTPP tape>,UNIT=<Your tape device>
    // DCB=(RECFM=FB,LRECL=2529,BLKSIZE=25290),
    // DISP=(OLD,PASS)
2   //SYSUT2  DD DSN=<Your output data set name>,UNIT=<Your tape device>
    // DCB=(RECFM=FB,LRECL=2529,BLKSIZE=25290),
    // LABEL=(1,SL),DISP=(NEW,PASS),VOL=SER=<Your output tape>
    //SYSPRINT DD SYSOUT=A
    //SYSIN DD DUMMY
    //COPY2 EXEC PGM=IEBGENER
3   //SYSUT1 DD LABEL=(11,BLP),VOL=SER=<Your UTPP tape>,UNIT=<Your tape device>
    // DCB=(RECFM=FB,LRECL=15160,BLKSIZE=30320),
    // DISP=(OLD,PASS)
4   //SYSUT2 DD DSN=<Your output data set name>,UNIT=<Your tape device>
    // DCB=(RECFM=FB,LRECL=15160,BLKSIZE=30320),
    // LABEL=(2,SL),DISP(NEW,PASS),VOL=SER=<Your output tape>
```

Line Reference	Explanation
1	READS IN PART I OF THE UTPP DATA
2	WRITES OUT TO NEW TAPE UTPP PART I DATA
3	READS IN PART II OF THE UTPP DATA
4	WRITES OUT TO NEW TAPE UTPP PART II

FIGURE 1 Example of IEBGENER program to copy Parts I and II of UTPP.

```
//YOUR JOB CARD
/*SETUP TAPENUMBER
//STEP1    EXEC PGM=LU06001A,REGION=400K
//STEPLIB  DD  DSN=YOUR.LOAD.LIBRARY,DISP=SHR
//         DD  DSN=YOUR.SUB.ROUTINE.LIBRARY,DISP=SHR
//SYSOUT   DD  SYSOUT=A
//SYSUDUMP DD  SYSOUT=A
//LU06INPT DD  DSN=YOUR.INPUT.DATASET,
//             UNIT=TAPE,
//             LABEL=(FILE,TYPE,EXPDT=      ),
//             DCB=(LRECL=     ,BLKSIZE=     ,RECFM=  ),
//             DISP=(OLD,KEEP),
//             VOL=SER=TAPENUMBER
//LU06PRNT  DD SYSOUT=A,DCB=BLKSIZE=133
//LU06CNTL  DD *

TABLE I
ZONE
//
```

FIGURE 2 JCL needed to run the UTPP print program.

cending order; however, the tables will be printed in ascending order. Last, the user must run the program separately for tables coming from different parts of the UTPP.

For Part IV of the UTPP, the user would always code his TABLE card as follows:

```
//LU06CNTL DD *
TABLE IV
ZONE
```

This is because the program cannot print individual tables from Part IV.

ZONE or TRACT Cards

A ZONE or TRACT card must always be present or the program will fail. This card is placed immediately after the TABLE card and must also begin in column 1. ZONE or TRACT is used depending on how the user's data are formatted. That is, if the user's UTPP is stratified by zones, ZONE would be entered; if it is by tracts, TRACT is entered. The user should be aware of what format was ordered from the Census Bureau.

UCEN70

UCEN70 is a UTPS program that enabled users to access the 1970 census data. This program was used to reformat the data to the zonal level and to interface the data with UTPS programs. Some employment places were miscoded in the 1970 census data because the responses were coded to the home office of a company instead of to the actual job site. UCEN70 was also used to reassign employment places.

UMTA in conjunction with FHWA decided not to produce a similar program for the 1980 census data for two reasons. First, the Census Bureau now produces UTPP tapes that have data already coded to the zonal level, and, second, the Census Bureau has come up with better procedures for handling employmentplace coding and allocation, which made a UCEN80 program unnecessary. It is still necessary, however, to reformat the UTPP data so that they may be read by UTPS programs. All other capabilities of UCEN70 are available in other UTPS programs.

REFORMATTING THE UTPP

The UTPP data are contained within six distinct parts. Each part holds either interchange (matrix-type) data or zonal (trip-end type) data. Each part has its own record length and block size. All of the data are in a fixed block record format and EBCDIC (card-image) form.

The record lengths in some parts of the UTPP are in excess of the allowable length for constructing UTPS Z-files (zonal data) and J-files (interchange data). The input record length for building Z-files cannot be longer than 9,999 characters and for J-files cannot be longer than 255 characters. Also, the UTPP data are segmented; that is, multiple records (or segments) are used to contain data for one zone or tract. An example showing how the data are usually formatted in the UTPP is given in Figure 3. The number of segments and record lengths varies for each part of the package. In this example, three records, each with a record length of 15,160 characters, and three segments are used for each zone.

UTPP FORMAT:

25239

Identifiers	Data					
ZONE#	X	X	X	X	X	X
1						
1						
1						
2						
2						
2						
3						

FIGURE 3 Typical UTPP record.

UTPS cannot read the long record lengths and cannot interpret multiple segments. Therefore, the UTPP data to be input to UTPS must be reformatted onto a data set having a shorter record length and a single record for each zone or tract. This reformatting may be accomplished by running a simple FORTRAN program. An example of such a program is shown in Figure 4. It should be noted that some of the UTPP records have an s coded in numeric fields, meaning that these data have been suppressed. These fields will generate a FORTRAN error message and substitute a value of 0. The exact format information of each part of the UTPP is contained in the data dictionary.

In addition, summary records are contained in the UTPP and should be bypassed. As shown in the example

```
C  SET UP AN ARRAY TO STORE INPUT DATA FOR PROCESSING
       INTEGER*4 ADATA(3)
C  PRINT A HEADER DESCRIBING WHAT WILL BE LISTED
       WRITE(6,50)
   50 FORMAT(5X,'  ZONE',5X,'   TOTALEMP',5X,'
      RETAILEMP') WRITE(6,75)
   75 FORMAT(5X,'------',5X,'---------',5X,'---------')
C  READ ZONE NUMBER, TOTAL EMPLOYMENT, AND RETAIL
C  EMPLOYMENT FROM THE UTPP
  100 READ(1,200,END=666)ADATA
  200 FORMAT(29X,I6,4(80X),5X,I9,54X,I9/)
C  CHECK FOR SUMMARY RECORD (ZONE = 0)
       IF(ADATA(1).EQ.0)GO TO 500
C  WRITE OUTPUT TO A STORAGE UNIT WITH A SHORTER RECORD
       LENGTH WRITE(9,300)ADATA
  300 FORMAT(I6,1X,I9,1X,I9)
C  WRITE ALL OUTPUT DATA TO PRINTER
       WRITE(6,400)ADATA
  400 FORMAT(5X,I6,5X,I9,5X,I9)
  500 CONTINUE
C  CONTINUE PROCESSING UNTIL END OF INPUT DATA
       GO TO 100
  666 END FILE 9
       END
```

FIGURE 4 FORTRAN program to read UTPP and write selected data with shorter record lengths.

in Figure 4, these records can be skipped by checking that the zone number is greater than 0.

Before reformatting the UTPP data, the user must decide which data items will be needed for further processing with UTPS. Because the output record lengths are shorter than the original ones contained in the UTPP, only a subset of the UTPP data can be written on the reformatted records. After the FORTRAN program or other reformatting procedure has been run, the data are in a UTPS-readable compatible format (see Figure 5).

UTPS READABLE FORMAT:

Identifiers	Data			
ZONE#	X	X	X	X
1				
2				
3				
4				

•Has Non-Segmented Records
•Record Length is Less then 9999 for Z-File and Less than 255 for J-File

FIGURE 5 Reformatted UTPP record.

If UTPP data are to be input into a microcomputer, they must often be reformatted again into intermediate files. Once the data have been reformatted into shorter record lengths and do not contain multiple segments, they are downloaded to the microcomputer using a modem in conjunction with a communications package. Common communications software packages for such a procedure include CROSSTALK for CP/M microcomputers and the Hayes Terminal package or Visiterm for Apple computers.

The next step is to decide whether the data format needs to be changed again, which depends on the software to be used. For instance, when VisiCalc, a commercial spreadsheet package, is used, a Data Interchange Format (DIF) file must be created. Visiplot and Supercalc also require intermediate files, but many statistical packages can read the reformatted EBCDIC data as created earlier. Formatting to an intermediate file is usually done by using a PASCAL or a BASIC program. The user should refer to the documentation that accompanies the software for specific format requirements.

CREATING UTPS DATA STRUCTURES

UTPS programs can read and write three types of data formats. These are EBCDIC, Z-file, and J-file. If the UTPP data have been reformatted as described earlier and are still in EBCDIC, it would seem plausible that they could be directly applied in a modeling context. However, within UTPS it is best to have the data stored within either a Z-file or a J-file because the majority of UTPS programs can read and write only these structures. Z-files are used to hold zonal or trip-end data such as the population and number of dwelling units in a zone. J-files hold matrix data such as trip tables and zone-to-zone travel times. Within each of these data structures, a second level of storage exists; for Z-files it is called the List of Attribute Values (LAV). LAVs are vectors that store data attributed to one variable. There may be many LAVs in a Z-file. Figure 6 shows a Z-file containing three LAVs: one containing the zone number, one containing population, and one containing the number of persons owning one car.

Z-FILE

LAV Zone	LAV Population	LAV Persons Owning One Car
1	12,152	8,612
2	11,000	2,600
3	13,500	3,700
4	14,700	5,700
5	9,468	2,250
6	8,500	3,876
7	26,700	14,116
8	21,500	8,776
9	24,600	19,114
.	.	.
.	.	.
.	.	.
.	.	.

FIGURE 6 Zonal Z-file with LAVs.

The secondary level of storage for J-files is called a TABLE. One J-file may contain up to 255 tables. Each table is a matrix containing a specific set of data. For instance, the first table (J101) might contain home-based work trips, the second table (J102) might contain home-based other trips, and the third table (J103) might contain non-home-based trips.

UTPS programs UMODEL and MBUILD are used to create Z-files and J-files, respectively. Both programs take EBCDIC data as input. The following discussion describes the use of both programs.

Z-File Creation

UMODEL is often viewed as a difficult program to use because it contains several entry points at which the user can insert his own FORTRAN code. In building Z-files, UMODEL is run in the default mode, meaning that no user FORTRAN is entered. The task is therefore relatively simple. A sample UMODEL run to construct a Z-file is shown in Figure 7. In this example, one EBCDIC data set is input and one Z-file is output. The only job parameters needed are the number of zones and information concerning reports. In addition, UMODEL data identification cards are needed to supply the program with all input and output data information. The resulting output of this run will be one Z-file containing seven LAVs: ZONE, HH, INCOME, HH0, HH1, HH2, and HH3. More information about data identification cards and UMODEL can be found in the UMODEL documentation and the UMODEL User's Guide.

J-File Creation

MBUILD is the UTPS program used to construct matrix

//UMODEL1 EXEC UMODEL,CORE=256K,
Execution card calling UMODEL and specifying memory of 256k bytes.

// LIB='URD81.PROGLIB',
Specifies program library containing this version of UMODEL.

// A1='DSN=UTPP.DATA,VOL=SER=UMTA3',
Dataset name and location for input file containing reformatted UTPP EBCDIC data.

// UNITA1='3330-1',
Type of storage device: a 3330-1 disk pack.

// Z1='DSN=UMTA.UTPP.DATA,VOL=SER=UMTA2',
Z- file dataset name and its destination.

// SPACEZ1='(TRK,(10))',UNITZ1='333O-1',DISPZ1='(NEW,KEEP)'
Space allocation, device type, and disposition of the data.

//UMODEL.SYSIN DD *
Specifies that the following data (UTPS control cards) are to be read.

UMODEL RUN TO CONVERT CENSUS DATA INTO ZONAL Z FILE FORMAT
UTPS title card identifying this specific run.

&PARAM ZONES=265 &END
Number of transportation analysis zones is 265.

&SELECT REPORT=1,2 &END
Print reports 1 and 2.

& DATA
Read data identification cards.

1P 1 6 1 1 1ZONE ZONE NUMBER
This is Data Identification Card #1; data item identified is production-end* data; data is located in columns 1 through 6; store in UMODEL X array position #1; data is located on input file A1; output goes to file Z1; give data item the title "ZONE"; data is the zone number.

2P 10 17 2 1 HH HOUSEHOLDS
This is Data Identification Card #2; data item identified is production-end data; data is located in columns 10 through 17; store in X array position #2; data is located on input file A1; output goes to Z1; give data item the title "HH"; data is number of households in zone.

3P 21 28 3 1 1INCOME MEDIAN INCOME
This is Data Identification card #3; data item identified is production-end data; data is located in columns 21 through 28; store in X UMODEL array position #3; data is located on input file A1; output goes to file Z1; give data item title "INCOME"; data is median zonal income.

4P 32 39 4 1 1HH0 HH0
This is Data Identification card #4; data item identified is production-end data; data is located in columns 32 through 39; store in X UMODEL array position #4; data is located on input file A1; output goes to file Z1; give data item title "HH0"; data is zonal households not owning a car (owning 0 cars).

5P 43 50 5 1 1HH1 HH1
This is Data Identification card #5; data item identified is production-end data; data is located in columns 43 through 50; store in X UMODEL array position #5; data is located on input file A1; output goes to file Z1; give data item title "HH1"; data is zonal households owning 1 car.

6P 54 61 6 1 1HH2 HH2
This is Data Identification card #6; data item identified is production-end data; data is located in columns 54 through 61; store in X UMODEL array position #6; data is located on input file A1; output goes to file Z1; give data item title "HH2"; data is zonal households owning 2 cars.

7P 65 72 7 1 1HH3 HH3
This is Data Identification card #7; data item identified is production-end data; data is located in columns 65 through 72; store in X UMODEL array position #7; data is located on input file A1; output goes to file Z1; give data item title "HH3"; data is zonal households owning 3 or more cars.

*For a definition production-end and attraction-end variables, see UMODEL documentation.

FIGURE 7 Conversion of EBCDIC zonal data to Z-file.

files (or J-files) from EBCDIC data. MBUILD is one of the simpler UTPS programs to use and as a result the construction of J-files from the UTPP data is fairly easy. In order to build the J-file, the user should be familiar with four key words:

- -I denotes location of origin zone number on input records,
- -J denotes location of destination zone number on input records,
- -K denotes table number, and
- -XIJK denotes location of the value to be placed in the matrix cells.

A sample MBUILD setup is shown in Figure 8. In this example, J9 (the output file) contains one table. Input is the reformatted UTPP data. I tells MBUILD that the origin zone number is in columns 4 through 6; J tells MBUILD that the destination zone number is in columns 11 through 13; K tells MBUILD to put all input values into one table, XIJK tells MBUILD to put the data in columns 109 through 113 into the cells of the table.

USING THE UTPP DATA IN TRAVEL DEMAND MODELING

The UTPP contains a great deal of travel information. Much of this information can be used in travel demand modeling within UTPS. In this section methods of using parts of the UTPP in trip generation and trip distribution, calibration of travel models, mode choice, and traffic assignment are presented.

Trip Generation

Parts I and III of the UTPP contain information describing zonal characteristics such as median income, number of households, automobile ownership, and employment. These data can be used as input to a trip-generation model.

An example of a trip-generation model is the default model in NCHRP Report 187 (1). In this model, the number of person trips attracted to and produced from each zone is calculated for three trip purposes: home-based work (HBW), home-based nonwork (HBNW), and non-home-based (NHB). Trip productions are obtained for each zone based on the number of households in the zone by income category. Tables corresponding to different urbanized area population ranges give estimates of average daily person trips per household and the percentage of trips by purpose (1,pp.13 and 14).

Trip attractions are calculated based on total employment, retail employment, nonretail employment, and the total number of dwelling units. All of these data are aggregated at the zonal level. In addition, areawide control factors are used to achieve an areawide balance between productions and attractions. The equations used in estimating trip attractions are as follows:

HBW trip attractions = F_1 [1.7 (analysis area total employment)],

HBNW trip attractions = F_2 [10.0 (analysis area retail employment) + 0.5 (analysis area nonretail employment) + 1.0 (analysis area dwelling units)], and

NHB trip attractions = F_3 [2.0 (analysis area retail employment) + 2.5 (analysis area nonretail employment) + 0.5 (analysis area dwelling units)].

F_1 = areawide productions for HBW trips ÷ 1.7 (areawide total employment),

```
                                                                    Line
                                                                  Reference
//MBUILD EXEC MBUILD,CORE=192K,                                       1
//       LIB='URD81.PROGLIB',                                         2
//    INPUT='DSN=UTPP.P4TRIPS,VOL=SER=UMTA3',                         3
//       UNITINP='3330-1',                                            4
//    J9='DSN=UTPP.P4TRIPS,VOL=SER=UMTA1',                            5
//       UNITJ9='3330-1,SPACE=(TRK,(40,25),RLSE)'                     6
//MBUILD.SYSIN DD *                                                   7
 MBUILD RUN TO CONSTRUCT TRIP TABLE                                   8
 &PARAM ZONES=265,LRECL=200,NTABS=1,                                  9
    I='IN(4,6)',                                                     10
    J='IN(11,13)',                                                   11
    K='1',                                                           12
    XIJK='IN(109,113)'   &END                                        13
```

Line Reference	Explanation
1	CALL UTPS PROGRAM MBUILD
2	DEFINE LIBRARY CONTAINING UTPS PROGRAMS
3-4	DEFINE INPUT FILE CONTAINING EBCDIC RECORDS
5-6	DEFINE OUTPUT J-FILE
7	LOCATE SYSTEM INPUT (CONTROL CARDS)
8	RUN IDENTIFICATION CARD
9	PARAMETER CARD: MAXIMUM NUMBER OF ZONES FOR OUTPUT J-FILE IS 265; RECORD LENGTH OF INPUT FILE IS 200 CHARACTERS; MAXIMUM NUMBER OF OUTPUT TABLES IS 1
10	ORIGIN ZONE IS IN COLUMNS 4-6
11	DESTINATION ZONE IS IN COLUMNS 11-13
12	ONE OUTPUT TABLE
13	PERSON TRIPS TO BE STORED IN THE MATRIX ARE INTEGERS (IN) IN COLUMNS 109-113

FIGURE 8 MBUILD run to construct person trip table.

F_2 = areawide productions for HBNW trips ÷ [10.0 (areawide retail employment) + 0.5 (areawide nonretail employment) + 1.0 (areawide dwelling units)], and

F_3 = areawide productions for NHB trips ÷ [2.0 (areawide retail employment) + 2.5 (areawide nonretail employment) + 0.5 (areawide dwelling units)].

To apply this model within UTPS, UTPS program UMATRIX is run using a series of lookup tables to define which coefficients will be applied for each trip-end calculation. The UMATRIX setup assumes that two Z-files have previously been constructed from UTPP data using UMODEL. These two files contain the zonal data to be used in the calculations. Three trip purposes, HBW, HBNW, and NHB, are being estimated. All six output LAVs--home-based work productions, home-based nonwork productions, non-home-based productions, home-based work attractions, home-based nonwork attractions, and non-home-based attractions--are stored on the Z1-file. UMATRIX works in the following manner.

A new LAV, Z1CHECK, is created that is assigned a value of 1 through 13 depending on the average zonal income range as defined in the trip-generation tables described earlier (1). Next a new LAV, Z2NONEMP, is created containing all nonretail employment for each zone. New LAV Z2HH is assigned the total number of households in each zone. Following these preliminary calculations, the various trip-generation calculations by purpose are made. All productions are calculated based on income-related lookup tables. (See UMATRIX documentation for further explanation of lookup tables.) All attractions are based on the data contained in the employment LAVs.

Calibration of a Gravity Model Using the UTPP

A possible use of the UTPP data is to check a locally calibrated gravity model. Three major input data items are needed in the checking process. These are

1. The simulated HBW person trip table produced by the local gravity model, for comparison purposes;
2. The local area highway network; and
3. The UTPP Part IV data containing the home-to-work person trips.

The process used to verify the local model is detailed in the following discussion.

First, the local highway network must be input to UTPS program UROAD to produce a travel-time matrix file. Next, the user would insert intrazonal and terminal times into this file. This can be done using one of several UTPS programs. Also, UTPS program MBUILD must be run to produce a home-to-work trip table based on the UTPP Part IV data, as was described earlier.

Once the home-to-work trip table has been built, it is input to UTPS program UMATRIX to factor the trips to reconcile differences between the trip definitions of the census and those of the trip-generation model. This includes accounting for the work-to-home trip and for such factors as persons having second jobs and sickness and vacations. The user would first double the census-derived person trip table to include work-to-home trips. If the user does this, he is assuming that work-to-home trips equal home-to-work trips. Next, because the census questionnaire asked about the usual trip to work and also to account for second jobs, the user would multiply the trip table by 0.8925. This factor is a default value based on work done at various locations in the Washington metropolitan area. A sample UMATRIX setup to accomplish the foregoing is shown in Figure 9.

Once these two inputs (the census HBW trip table and the travel-time skims) have been constructed, they can be input, along with the simulated HBW person trip table produced by the locally calibrated gravity model, into UTPS program UFMTR to produce a series of trip length frequency comparison plots. An example is shown in Figure 10.

The analyst would then review these plots and determine whether the simulated trip lengths and the census trip lengths match. If the plots do not

```
1    //UMATRIX EXEC UMATRIX,CORE=320K,
     //          LIB='URD81.PROGLIB',
2    //       J1='DSN=UMTA.HTW.TRIPS,VOL=SER=UMTA3',
     //           UNITJ1='3330-1',
3    //       J9='DSN=UMTA.HBW.TRIPS,VOL=SER=UMTA3',
     //           UNITJ9='3330-1',SPACE=(TRK,(10,2),RLSE)'
     //UMATRIX.SYSIN DD *
     UMATRIX RUN TO FACTOR HOME-TO-WORK TRIPS TO HBW
4     &PARAM SIZE=265,J901='J101*2.0*0.8925                &END
     /*
```

Line Reference	Explanation
1	CALL UTPS PROGRAM UMATRIX
2	INPUT FILE CONTAINING CENSUS HOME TO WORK DATA
3	OUTPUT FILE CONTAINING CENSUS-DERIVED HOME BASED WORK TRIPS
4	DECLARES MAXIMUM ZONE NUMBER AS 265; MULTIPLIES HOME-TO-WORK TRIPS BY 2.0 AND THEN BY .8925

FIGURE 9 UMATRIX run to factor home-to-work trips to home-based work trips.

match well enough, UTPS program AGM would be used to recalibrate the gravity model as follows. Inputs to AGM include

1. Travel-time skims from UROAD,
2. Census HBW person trip table (used for comparison), and
3. Friction factors used in the local gravity model (used as a starting point).

Productions and attractions are derived from the census trip table by AGM through a row and column summing process. AGM applies the input friction factors to estimate a new trip table and then produces trip length frequency plots for both the newly estimated trip table and the input census HBW person trip table. A sample AGM setup is shown in Figure 11. The analyst would then check the plots to see how well the trip lengths in the newly estimated trip table match those in the census trip table. If the estimated trip lengths do not closely match, a revised set of friction factors would be input into a new AGM run, and the process would be iterated until the census trip lengths are matched closely.

After the trip lengths have been checked for reasonableness, the major movements in the study area should be verified. This would be done by collapsing the census trip table and the newly estimated zonal trip table into larger districts or some other level of aggregation whereby major trip movements--CBD to suburban, CBD to CBD, and so on--could be checked. This collapsing or squeezing of the trip tables is accomplished by running UTPS program USQUEX. An example is shown in Figure 12. If the trip movements are found to be reasonable, the user has completed the checking and recalibration of his gravity model. If, however, the major movements do not match the values derived from the census data, the user may then wish to introduce a set of K-factors into the gravity model to adjust for the iden-

```
1    //UFMTR EXEC UFMTR,CORE=256K,
     //          LIB='URD79.PROGLIB',
2    //       J1='DSN=UMTA.HBW.TRIPS,VOL=SER=UMTA3',
     //           UNITJ1='3330-1',
3    //       J2='DSN=UMTA.LOCAL.HBW.TRIPS,VOL=SER=UMTA3',
     //           UNITJ2='3330-1',
4    //       J3='DSN=UMTA.LOCAL.SKIMS,VOL=SER=UMTA3',
     //           UNITJ3='3330-1',
     //UFMTR.SYSIN DD*
     UFMTR RUN TO PLOT UTPP VS. LOCAL TRIP LENGTHS
5     &PARAM ZONES=265,TABLES=101,201      &END
6     &SELECT REPORT=3      &END
7     &PLOT PAIR=301,101,201,FREQ=T      &END
     /*
```

Line Reference	Explanation
1	CALLS UTPS PROGRAM UFMTR
2	INPUT CENSUS HBW TRIPS
3	INPUT LOCAL MODEL HBW TRIPS
4	INPUT TRAVEL TIME SKIMS
5	DECLARES ZONES AS 265 AND TELLS PROGRAM TO REPORT ON TABLES 101 AND 201 IN PRODUCED REPORTS
6	SELECTS TRIP END SUMMARY REPORT
7	CALLS A COMPARISON FREQUENCY PLOT OF TABLES 101 AND 201 AGAINST SKIM VALUES IN TABLE 301

FIGURE 10 UFMTR setup to produce trip length comparison plots of census and local trips.

```
1    //AGM EXEC AGM,CORE=320K,
     //         LIB='URD81.PROGLIB',
2    //       J1='DSN=UMTA.LOCAL.SKIMS,VOL=SER=UMTA3',
     //          UNITJ1='3330-1',
3    //       J2='DSN=UMTA.HBW.TRIPS,VOL=SER=UMTA3',
     //          UNITJ2='3330-1',
4    //       J9='DSN=UMTA.EST.TRIPS,VOL=SER=UMTA3',
     //          UNITJ9='3330-1',SPACE=(TRK,(10,2),RLSE)
5    //       F='DSN=UMTA.FFACTOR,VOL=SER=UMTA3',UNITF=3330-1
     //AGM.SYSIN DD *
     AGM RUN IN AC TO CALIBRATE CENSUS BASED GRAVITY MODEL
6     &PARAM TABOUT=1,AITER=3,SKIMS=101,TABLES=201,
         ZONES=265      &END
7     &OPTION AC=T      &END
8     &SELECT REPORT=5,8      &END
     /*
```

Line Reference	Explanation
1	CALLS UTPS PROGRAM AGM
2	INPUT TRAVEL TIME SKIMS
3	INPUT CENSUS TRIP TABLE
4	OUTPUT NEWLY ESTIMATED TRIPTABLE
5	INPUT FRICTION FACTORS
6	STATES THAT 1 TABLE IS OUTPUT; USE 3 ITERATIONS IN GRAVITY MODEL APPLICATIONS; SKIMS CAN BE FOUND IN TABLES 101, INPUT TRIP TABLE TO BE USED FOR COMPARISON PURPOSES AND FOR DERIVING PRODUCTIONS AND ATTRACTIONS IS TABLE 201; 265 ZONES
7	REQUESTS APPLICATION/COMPARISON OPTION
8	REQUESTS REPORTS 5 AND 8

FIGURE 11 AGM calibration run.

```
1    //USQUEX EXEC USQUEX,CORE=320K,
     //          LIB='URD81.PROGLIB',
2    //       J1='DSN=UMTA.HBW.TRIPS,VOL=SER=UMTA3',
     //          UNITJ1='3330-1',
3    //       J2='DSN=UMTA.EST.TRIPS,VOL=SER=UMTA3',
     //          UNITJ2='3330-1',
4    //        J9='DSN=UMTA.SQUEEZ.TRIPS,VOL=SER=UMTA3',
     //          UNITJ9='3330-1,SPACE=(TRK,(20,2),RLSE)'
     //USQUEX.SYSIN DD *
     RUN TO SQUEEZE ZONES TO DISTRICTS TO COMPARE MAJOR MOVEMENTS
5     &PARAM ZONES=265,DISTS=8,TABLES=101,201      &END
6     &OPTION SQUEEZE=T      &END
7     &SELECT PRINT=1,-8,REPORT=4      &END
8     &EQUIV DIST=1,Z=1,-83      &END
      &EQUIV DIST=2,Z=84,-95      &END
      &EQUIV DIST=3,Z=96,-107      &END
      &EQUIV DIST=4,Z=108,-110      &END
      &EQUIV DIST=5,Z=111,-186      &END
      &EQUIV DIST=6,Z=187,-193      &END
      &EQUIV DIST=7,Z=194,-230      &END
      &EQUIV DIST=8,Z=231,-265      &END
     /*
```

Line Reference	Explanation
1	CALL UTPS PROGRAM USQUEX
2	INPUT CENSUS HBW PERSON TRIPS
3	INPUT NEWLY ESTIMATED HBW PERSON TRIPS
4	OUTPUT ESTIMATED TRIPS AT DISTRICT LEVEL
5	ZONES EQUALS 265; 8 DISTRICTS ARE TO BE USED; INPUT TABLES ARE 101 AND 201
6	CALLS SQUEEZING OPTION
7	REQUEST MATRIX ROW REPORT FOR ALL ROWS IN OUTPUT TABLES
8	EQUIVALENCY CARDS WHICH TELL THE PROGRAM THE ZONE-DISTRICT CORRESPONDENCE

FIGURE 12 USQUEX run to squeeze zones to districts.

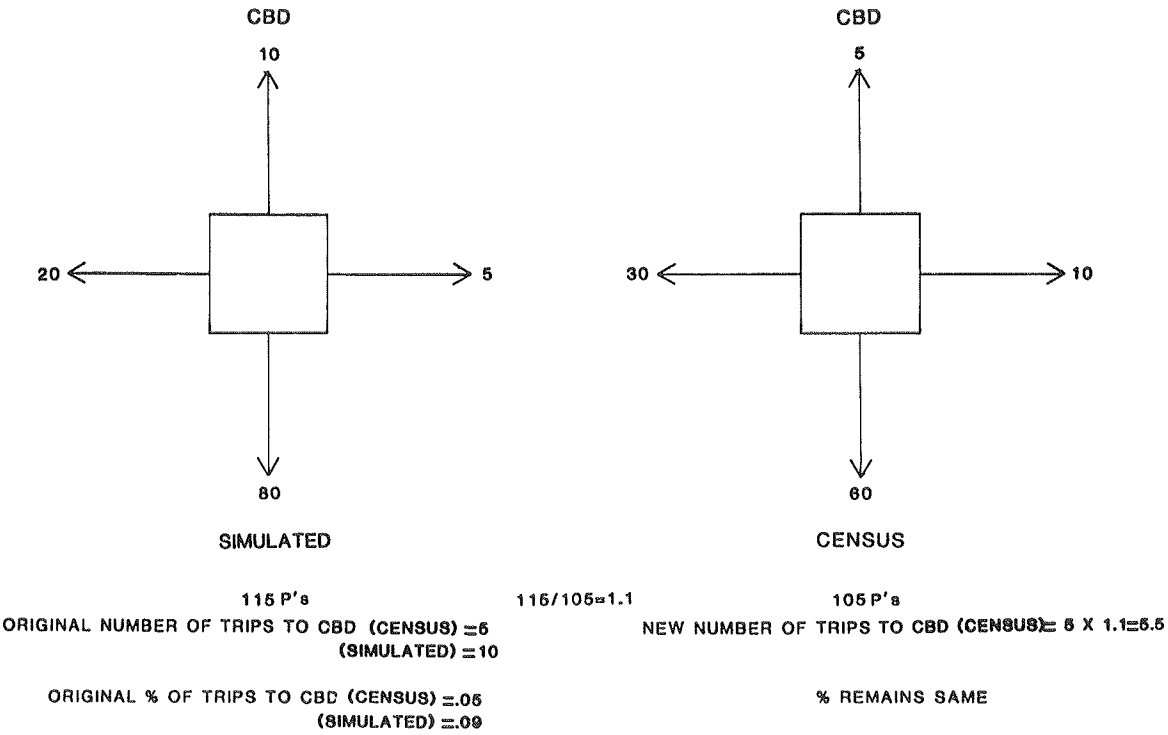


FIGURE 13 Normalization of productions.

tified errors. Once these factors have been created, the gravity model is rerun and F-factors and K-factors are adjusted until both trip lengths and major movements are found to reasonably match the census-derived data.

If the locally modeled trip lengths and the census trip lengths had matched closely, the user would still check the major movements as described earlier. In this case, however, one of the two trip tables must be adjusted so that the trips produced by each district will be the same in both tables. This may be done by running UTPS program UMATRIX to normalize the values in each row of one table so that they sum to the corresponding zonal productions in the other table. An example is shown in Figures 13 and 14, where the values in the census trip table are normalized to the productions in the local simulated trip table. Once the census trip table has been normalized, both trip tables would be collapsed into districts or some other geographic area, using UTPS program USQUEX to check the major movements. If they are found to be reasonable, the process would be complete. If they are found to be unreasonable, K-factors could be developed. If the user decided to calibrate K-factors, they would be input to AGM and the gravity model would be recalibrated.

```
1    //UMATRIX EXEC UMATRIX,CORE=320K,
     //         LIB='URD81.PROGLIB',
2    //        J1='DSN=UMTA.HBW.TRIPS,VOL=SER=UMTA3',
     //          UNITJ1='3330-1',
3    //       J2='DSN=UMTA.LOCAL.HBW.TRIPS,VOL=SER=UMTA3',
     //           UNITJ2='3330-1',
4    //       J9='DSN=UMTA.NORMAL.HBW.TRIPS,VOL=SER=UMTA3',
     //           UNITJ9='3330-1,SPACE=(TRK,(10,1)RLSE)'
     //UMATRIX.SYSIN DD *
     RUN TO NORMALIZE TO SIMULATED PRODUCTIONS
5     &PARAM SIZE=265,
        J901='J101*(ROWSUM(J201)/ROWSUM(J101))'      &END
     /*
```

Line Reference	Explanation
1	CALL UTPS PROGRAM UMATRIX
2	INPUT CENSUS PERSON TRIPS
3	INPUT LOCAL PERSON TRIPS
3	OUTPUT NORMALIZED PERSON TRIPS
4	ZONES EQUAL 265; FILL TEMPORARY MATRIX WITH ROW SUMMED VALUES IN TABLE 101; FILL TEMPORARY MATRIX WITH ROW SUMMED VALUES IN TABLE 201; FILL TEMPORARY MATRIX WITH NORMALIZING FACTORS; MULTIPLY CENSUS TRIP TABLES BY FACTOR AND OUTPUT AS NEW TRIP MATRIX

FIGURE 14 UMATRIX run to normalize trip tables.

It should be noted that a local simulated trip table is produced by applying a gravity model to simulated productions and attractions (from a trip generation model). The census-derived trip table will have a somewhat different allocation of productions and attractions. A gravity model calibrated to match the trip length frequency distribution from the census-derived trip table should not be expected to produce exactly the same distribution when applied to simulated productions and attractions. The foregoing discussion assumes, however, that the two allocations of productions and attractions are similar enough (on an aggregated level) that a gravity model calibrated to the census-derived data can be used on the simulated data. Similarly, it is assumed that if the existing locally calibrated gravity model produces a simulated trip table that matches the census-derived trip length frequency distribution and major movements reasonably well, the existing gravity model may be accepted as valid.

Mode Choice

Using UTPP data, planners can develop mode-choice models or verify existing locally developed mode-choice models. The UTPP journey-to-work data may be used to build HBW trip tables by mode by running MBUILD and then factoring the tables using UMATRIX. This procedure was described earlier. Once the tables have been built and factored, the user can determine regional mode shares and mode shares at the zonal level using UMATRIX. Through the addition of a preliminary run of USQUEX, mode shares at the district and major movement (district interchange) level may be developed. These mode shares may then be compared with mode shares estimated by a locally calibrated mode-choice model applied to spring 1979 conditions.

Another interesting section of UTPP data applicable to mode-choice analysis is the travel-time values reported by mode. The time values contained in the UTPP are the values perceived by travelers. The user can review the travel-time information in two ways: either run the print program to obtain Table 4 from Part II of the UTPP or develop trip-length frequency plots using UFMTR and build mode-specific skim matrices and trip tables through the use of MBUILD.

Mode-choice models of two types can be developed: A predistribution or trip-end model or a post-distribution interchange model. Information is present in the UTPP that describes trip-end data at both the production and the attraction ends. HBW person trip tables by mode can be developed as described previously. The user can then supply his own highway and transit networks to construct travel-time skims and supply additional trip-end data such as parking cost. As a result, the user would have all of the data needed to calibrate an interchange model. A flow chart describing this process is shown in Figure 15.

A simpler mode-choice method, one often used by smaller urban areas, is the predistribution trip-end or direct generation model. This type of model is much easier and less costly to develop because it does not require any network-based information.

Using the UTPP trip-end data along with transit availability information, the user can develop a transit trip relationship by using automobiles per dwelling unit and income. This is but one example of using the UTPP in a direct generation model. Additional cross tabulations are available in the UTPP data or could be developed. A listing of UTPP tables that contain mode-choice data is given as follows:

PART I
- I-17 Travel time by mode
- I-18 Mode and carpooling
- I-23 Means of transportation by earnings
- I-24 Means of transportation by household income
- I-25 Means of transportation by race and Spanish origin
- I-26 Means of transportation by sex by age
- I-27 Means of transportation by vehicles available
- I-28 Types of disability by age
- I-29 Means of transportation and carpooling

Part II
- II-1 Workers by race, earnings, mode, carpooling
- II-2 Workers by mode, carpooling, class
- II-3 Workers by age, earnings, mode, carpooling
- II-4 Workers by travel time and mode
- II-5 Workers by income, size of household, mode, carpooling
- II-6 Workers by income, vehicles, mode, carpooling
- II-7 Workers by sex, workers per household, vehicles, mode, carpooling

Part III
- III-4 Workers by mode and earnings
- III-5 Workers by mode and carpooling
- III-6 Workers by travel time, mode, carpooling
- III-7 Workers by mode, race, Spanish origin
- III-8 Workers by mode and sex
- III-13 Workers by workers per household, mode, income
- III-14 Workers by mode and vehicles available

PART IV
- IV-1 Workers by mode
- IV-2 Workers by mode and travel time

PART V
- V-4 Workers by mode

PART VI
- VI-4 Workers by mode and earnings
- VI-5 Workers by mode, race, Spanish origin
- VI-6 Workers by mode and sex
- VI-9 Workers by mode and vehicles available
- VI-10 Workers by mode and income

Traffic Assignment

Part IV of the UTPP contains mode-specific journey-to-work trip information. As was discussed earlier, the user can build a series of mode-specific HBW trip tables. This information can then be assigned directly to an urban area's highway and transit networks as an aid in locating park-and-ride lots, analyzing bus routing and circulation, evaluating high-occupancy-vehicle lanes, and analyzing selected links. Any analysis conducted on the results of such an application must take into account the sample size (8 percent) and the tendency of the trip table to be "lumpy" (contain many zero values). With these limitations in mind, the user should restrict his use of the data to the analysis of large area-to-area movements and of links carrying high traffic volumes, where significant amounts of travel can accumulate.

CONCLUDING NOTES

It can be readily seen that there are a variety of functions that can be handled using UTPS in conjunction with the UTPP data. In this paper an attempt has been made to clarify the procedures used to access the information, transfer it into a variety of file structures, and to show some sample applications. This paper has been extremely limited, how-

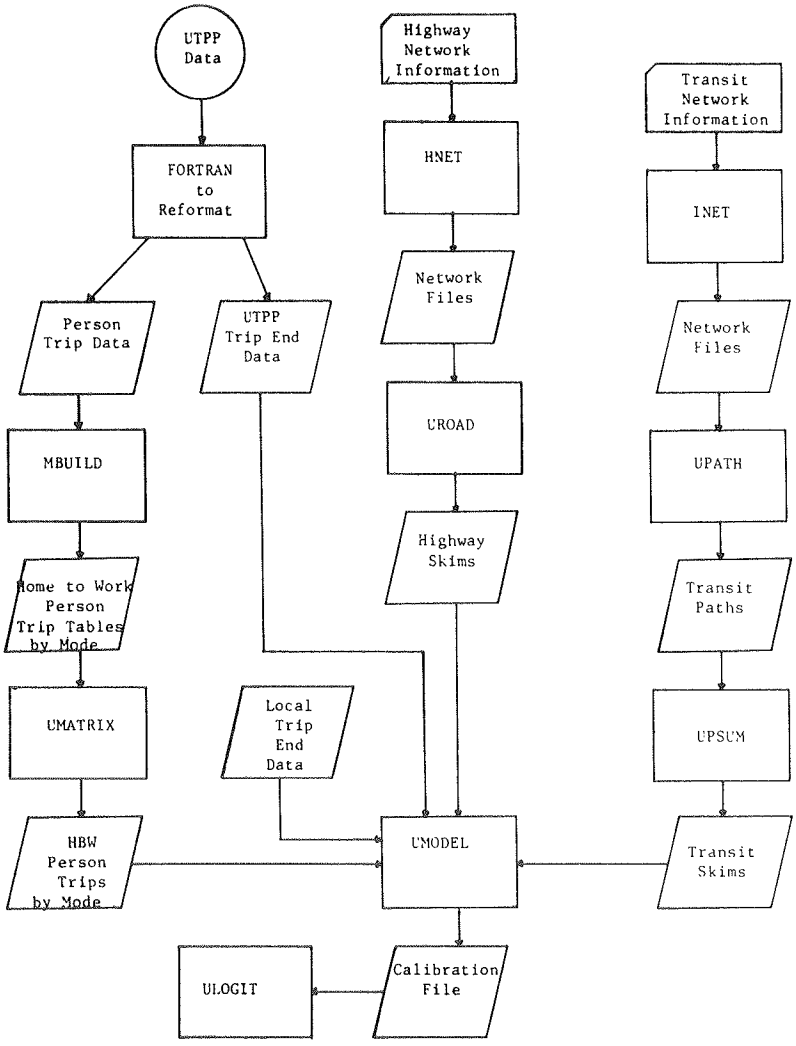


FIGURE 15 Using UTPP data in the calibration of an aggregate logit mode-choice model.

ever, in that only a few examples have been presented. The user should not take these examples as the only possible applications of the UTPP. The UTPP data can be used in any number of ways, subject to the needs and imagination of the user.

ACKNOWLEDGMENT

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Using the Urban Transportation Planning Package on a Microcomputer

MICHAEL B. CLARKE and ARTHUR B. SOSSLAU

ABSTRACT

Several technical aspects of the use of the Urban Transportation Planning Package (UTPP) on microcomputers are examined in this paper. These aspects include communications between mainframes and microcomputers, floppy disk operating systems and capacity considerations, approaches to subdividing the UTPP into files that can fit the restricted capacity, and the use of the data in commonly available software packages.

In this paper the use of data from the Urban Transportation Planning Package (UTPP) in a microcomputer environment is discussed. Most transportation planners are aware of the enormous benefits of microcomputers. These powerful, inexpensive machines provide many of the capabilities of the more expensive mainframes. Microcomputers are also generally more user friendly. With the aid of readily available software packages and UTPP data, the application of trip-generation models and other techniques can be carried out quickly and inexpensively.

This paper is divided into several sections. First, the transportation problems that are amenable to analysis with UTPP data in a microcomputer environment are highlighted. In the next two sections aspects of communications software and disk operating systems that must be considered when downloading UTPP data from the mainframe to the microcomputer are reviewed. The limited capacity of floppy disks and approaches to subdividing UTPP files in order to fit that capacity are discussed in the following two sections. Finally, illustrative uses of UTPP data with commonly available software packages are outlined.

PROBLEMS AMENABLE TO MICROCOMPUTER SOLUTION WITH UTPP

Several sources were used to determine transportation problems amenable to microcomputer solution using the UTPP:

1. Discussion at a meeting of the Subcommmittee on Urban Transportation Data and Information Systems at the 1984 Annual Meeting of TRB,
2. Contact by telephone with several planning agencies, and
3. Material prepared to assist agencies in using the UTPP, including Transportation Planners' Guide to Using the 1980 Census (1), case studies prepared as part of the Planner's Aid contract, and an UMTA brief, Linking the UTPP with UTPS and Microcomputers.

The results from the discussions at the TRB Annual Meeting and the telephone contacts are summarized as follows (some of the agencies contacted had not decided on their probable uses of the UTPP data):

1. Akron, Ohio
   Akron Metropolitan Area Transportation Study
   William E. Murphy
   Population: 515,720

No microcomputer owned or purchase planned at this time. A printed copy of the data is now being used for analysis.

Uses of the data:
- Plan bus routes using overlay technique
- No model recalibration or any kind of model verification
- No use of employment data (will use employment data from local surveys)

2. Boise, Idaho
   Ada Planning Association
   Dale Rosebrock
   Population: 134,848

No microcomputer owned or purchase planned at this time. The data are being analyzed using a printed copy.

Uses of the data:
- Update demographic reports (population, employment, number of households)
- Aid in projecting demographics for years 1990 and 2000
- Calibrate a gravity model
- Develop transit routes using overlay technique

3. Lincoln, Nebraska
   Lincoln City-Lancaster County Planning Department
   Kent R. Morgan
   Population: 173,550

No microcomputer owned or purchase planned at this time. All work is being conducted from a printed copy of the data.

Uses of the data:
- Update land use and transportation plans
- Update specifically student and employment data, checking for highway capacity needs
- Provide income data for transit modeling at the state level
- Forecast income

4. Salt Lake City and Ogden, Utah
   Wasatch Front Regional Council of Governments
   Mick Crandall
   Population: 879,945

Microcomputer owned.

Uses of the data:
- Confirm mode-choice splits
- Produce summaries, both text and graphic, of demographic variables for report purposes
- Determine trip generation using spreadsheet program

5. Sioux Falls
   South Eastern Council of Governments
   Dean B. Nielsen
   Population: 85,804

Microcomputer owned.

Uses of the data:
- Verify trip-end data and tie to their traffic-counting routines
- Produce demographic summaries for report purposes
- Verify migration patterns
- Check current travel demand models (i.e., mostly trip distribution)

6. Albuquerque, New Mexico
   Middle Rio Grande COG of New Mexico
   Dale Glass
   Population: 418,206

No use of microcomputer now; data used in mainframe procedures. However, plans are being made to download portions of the data to conduct analyses that are now being handled at the mainframe level.

Uses of the data:
- Compare census data with locally gathered data
- Validate current travel demand models
- Check demographic data and produce summaries for report purposes

7. Lansing, Michigan
   Bureau of Transportation Planning
   Michigan Department of Transportation
   Dave Geiger
   Population: 420,000

Nine metropolitan planning organizations will be receiving the data and will be doing analysis on microcomputers.

Uses of the data:
- Analyze trip generation using spreadsheet packages
- Produce graphic and text summaries of the data for report purposes
- Develop forecasting procedures (income, etc.)
- Check travel forecasting models and recalibrate
- Verify work travel patterns, automobile ownership, automobile occupancy, and so on
- Use trip tables for corridor studies

8. Washington, D.C.
   Metropolitan Washington Council of Governments
   George Wickstrom
   Population: 2,763,105

Work anticipated to be accomplished on in-house mainframe.

Uses of the data:
- Check of base-year data, including county-to-county movements by mode and trip-end data such as mode splits and vehicle availability
- Recalibrate models
- Answer requests from local agencies, basically trip distribution summaries

9. Seattle, Washington
   Puget Sound Council of Governments
   Cathy Strombom
   Population: 1,391,535

Uses of the data:
- Develop work-trip generation model
- Develop vehicle occupancy and carpool models
- Obtain percentage of transit to selected areas
- Summarize characteristics at work end of trip (percent mode choice, car occupancy)

10. Kansas City, Missouri
    Mid-American Regional Council
    Janice Hedemann
    Population: 1,097,793

Microcomputer available and will be used for some UTPP processing.

Uses of the data:
- Develop file for short-range transit planning, including data on elderly and handicapped
- Update travel models

Generally, the responses from potential census data users indicate that users can be divided into four categories that basically parallel those covered in the material developed under FHWA-UMTA sponsorship and distributed to the profession (see item 3 in the foregoing list). These categories are as follows (numbers in parentheses reflect number of responses in each area of activity):

1. Establishment of a data base
   a. Update demographics (3)
   b. Project demographics (3)
   c. Check or validate local data (3)
2. Data summary and reporting: prepare text and graphics for reports (4) (i.e., reporting current situation and trends)
3. Travel-related analysis
   a. Plan bus routes (i.e., successive overlays) (3)
   b. Check travel characteristics (trip-end data, work patterns, mode choice, etc.) (3)
   c. Use census trip tables for corridor and other trip interchange studies (3)
4. Model-related analysis
   a. Develop trip generation input or work-trip generation model (3)
   b. Validate or calibrate work-trip gravity model (6)
   c. Validate or calibrate vehicle occupancy and carpool model (1)

The expected microcomputer uses of the UTPP are quite varied. However, the microcomputer is but one tool available to planning agencies. The UTPP printouts offer a source of information to the small agencies that do not have access to either a microcomputer or a mainframe). For the larger agencies where trip-table data from Part IV are useful, the matrix capabilities of UTPS offer significant computational assistance. In this paper potential microcomputer applications of the UTPP by planning agencies of small to moderate size will be addressed. A general population range, although this is changeable, would be 50,000 to 500,000. The number of zones would be in the range of 100 to 400.

In considering the six parts of the UTPP, it appears that little use will be made of Part V, the block-group data, and this section will be eliminated from further consideration here. For further discussion it is useful to relate UTPP Parts I, II, III, IV, and VI to the four major categories of use listed earlier, as shown in Table 1.

It is also important to consider the interrelationships between the UTPP parts for the projected uses. Part II stands alone and need not be related

TABLE 1 Relationship of UTPP Parts to Anticipated Major Uses

	UTPP Part				
USE OF UTPP	I	II	III	IV	VI
Establishment of Data Base	X		X		
Data Summary & Reporting		X			
Travel Related Analysis	X	X	X	X	X
Model Related Analysis	X	X	X	X	X

physically to other data in the design of diskette storage. This is also true of Parts IV and VI. Parts I and III will often need to be related, for example, for trip-generation input and development of a trip-generation model.

TRANSFER OF UTPP DATA TO MICROCOMPUTER

One of the first technical aspects to consider after a useful microcomputer application has been decided on is the communication of the UTPP data from the mainframe to the microcomputer. There are several data formats suitable for the transfer of data. Because UTPS is run on IBM operating systems and handles EBCDIC formats, it is strongly recommended that EBCDIC be used as the data format at the mainframe level. When data are transmitted, many computers (most IBM machines) read and write the data sets in ASCII format. This makes the communication a relatively simple process, because most communications software is constructed to handle ASCII. The overall process can be best described through the aid of a flowchart (see Figure 1).

The UTPP data should be in EBCDIC format and contain no multiple segments, and the record length should be less than 200. Once the data are in this format, they can be accessed by the microcomputer-based communications program. When the data are transferred, the UTPP format is changed automatically to ASCII (in most IBM systems when data are transferred at less than 1,200 baud). After the transfer has been completed, the user has an ASCII file of the UTPP data. Some software packages can read these data directly; however, many require that an intermediate file be created in a specific format that can be read. If the user should ever desire to reverse the process, or to upload the data to the mainframe, this can be accomplished.

In addition to the communications software and an analysis package, the user would need a modem, which connects the computer to a telephone line, to execute a data transfer. A modem modulates and demodulates the computer's digital signals with the telephone line's carrier wave. That is, it converts bits of data to a form that the telephone lines can transmit, and vice versa.

TRANSFORMING UTPP DATA INTO SOFTWARE-SPECIFIC FORMATS

The discussion here is limited to three operating systems and to only a few communications and analysis software packages. At this time, three operating systems--Control Program for Microcomputers (CP/M), Apple II DOS 3.3, and Universal Communications Switching Device (UCSD) PASCAL--are used by more than 75 percent of all microcomputer operators. However, the user should be aware that these systems are completely incompatible with respect to disk input and output. Very few programs will read or write disks of more than one operating system.

CP/M

A primary communications software package operating

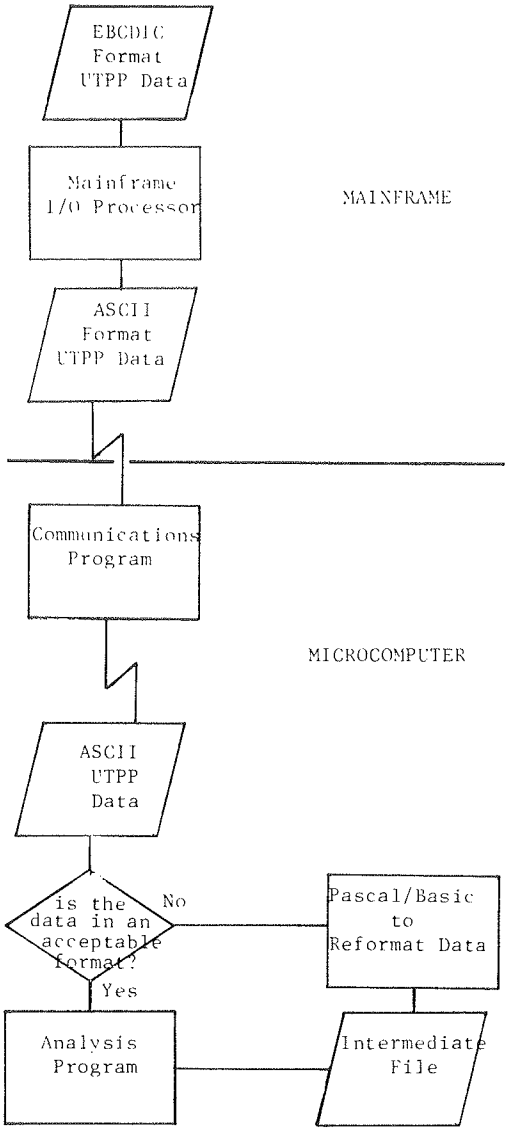

FIGURE 1 Transfer of UTPP data from a mainframe to a microcomputer-based software package.

under the CP/M system is CrossTalk. When the user installs CrossTalk, he is required to tailor the software to communicate properly with his terminal, disk drives, and modem. Once it has been properly installed, CrossTalk permits the transfer of ASCII files to and from other computers. CrossTalk has a large variety of capabilities, including using a microcomputer as a terminal. However, only the downloading capability (transfer of data from mainframe to microcomputer) will be discussed here.

When connected to a mainframe, CrossTalk allows the user to put his microcomputer in a capture mode, in which everything the mainframe writes on the terminal's display (including any echoed commands) is automatically captured and written on a microcomputer CP/M file of the user's choice. Thus to download a file, the user invokes the capture mode, lists the file at the terminal, and turns off the capture mode. The file has then been copied from the mainframe to the microcomputer.

A sample session showing how to move a data file from a mainframe operating under Computer Management System (CMS) to a CP/M-based microcomputer is shown in Figure 2.

As a warning to the user, IBM's operating systems often prefix each transmitted line with unwanted control characters. In this case, the user would have to edit his ASCII file (using a microcomputer-based editor such as WordStar) to delete these characters.

Apple II DOS 3.3 and USCD PASCAL

One of the most popular communications packages used in conjunction with the Apple II DOS 3.3 and UCSD PASCAL operating systems is the Hayes Terminal Program. This program is used in conjunction with the Hayes Micromodem II, a directly connecting smart modem. The package performs a variety of tasks, including transferring and listing files. This software is essentially equivalent to CrossTalk; a sample session is presented for DOS 3.3 in Figure 3. When data are downloaded to a UCSD PASCAL system, the only changes in the sample shown in Figure 3 that are necessary are the insertion of the UCSD PASCAL system disk in place of DOS 3.3 and change of the suffix of the file name to .TEXT instead of .TXT.

There are many marketed communications packages to serve the needs of every popular microcomputer and operating system. Some other communications packages are VisiTerm, which operates under DOS 3.3, and DataLine, which operates under UCSD PASCAL.

MICROCOMPUTER DISKETTE STORAGE

The design of UTPP subfiles that are small enough for use in the microcomputer environment where only diskette storage is available is obviously related to the amount of data that can be stored on the diskettes and the number of diskettes one wishes to produce, store, and catalogue.

Table 2 lists specifications for the range of characters that can be fit onto a diskette for various formats and microcomputers (operating systems). If an agency wished to include all data from UTPP Parts I, II, III, IV, and VI on diskettes, the information in Table 2 could be used to estimate the number of diskettes required. Calculations are provided in Table 3 for 100 and 400 zones and the popular 140K and 360K diskettes. It is obvious that for Parts I, III, and IV, too many diskettes result for ease of processing. Parts II and VI are a manageable size and, as was previously noted, can stand alone as data sources.

In the next section, the material presented previously will be used as the basis for designing UTPP subfiles.

MICROCOMPUTER UTPP SUBFILE DESIGN

The design of microcomputer diskette subfiles will

```
                              (start of session)

A>set baud pc                 Set (with software) baud rate on modem.
A>b:                          Eastablish B: as default drive.
B>crossb inform               Run CrossTalk, giving command file name.

(What appears now is mainframe's welcome message.)

.icms                         Tell mainframe what OS is wanted.

(CMS welcomes the user.  Enter account number, password, etc.)

.ezedit link.txt              Get into the editor.
.<esc>                        Ready CrossTalk to accept a command
COMMAND? ca link.txt          to save displayed data on LINK.TXT.
l                             List EBCDIC file on terminal.

(As file lists on terminal, it writes on micro's file LINK.TXT.)

.<esc>                        Ready CrossTalk to accept a command
ca -                          to shut off capture mode.

(From this point on, to the next .<esc>ca <file>.<ext>, nothing
is saved on any microcomputer file.)

.logoff                       Sign off the mainframe, if finished.

(Termination acknowledgement from mainframe.)

<esc>                         Ready CrossTalk for command
COMMAND? qu                   to tell CrossTalk the user is done.

(Termination message from CrossTalk.  CrossTalk hung up phone,
saved file B:LINK.TXT, and put user back in CP/M.)

B.type link.txt               e.g.  type file to make sure it is o.k.

                              (end of session)
```

FIGURE 2 Communications session using CrossTalk.

```
                        (start of session)

(Before turning on the Apple, the user puts the Hayes Terminal
Program Diskette in Drive 1 and the DOS System diskette in Drive
2.  When the user turns on the Apple, he or she would see dis-
played the following menu:)

1.  ORIGINATE CALL          To call up a phone number.
2.  ANSWER CALL             To answer the phone.
3.  TERMINATE CALL          To hang up the phone.
4.  CREATE FILE             To build (small) Apple files.
5.  RECEIVE FILE            To download to the Apple.
6.  SEND FILE               To upload from the Apple.
7.  LIST FILE                Totype an Applefileonthe screen.
8.  PRINTER STATUS OFF      An option to print transmitted data.
9.  CHANGE PARAMETERS       To alter communication protocol, etc.

ENTER SELECTION NUMBER: 1

ENTER PHONE NUMBER OR PH1..3
     7469211   The user types in the mainframe's phone number.
MICROMODEM II:  AWAITING CARRIER   Phone is ringing.
MICROMODEM II:  CONNECT            Computer answered.

(The screen clears and a rotating cursor appears, telling the
users that they are now online with the modem.)

<cr>                        Induce mainframe prompts.

(The user gets the mainframe's welcoming message.)

.icms                       Select the system wanted.

(CMS welcomes the user.  The user enters the account number,
password, etc.)

.ezedit UTPP Data           Call the editor.
.<esc>                      Call the Terminal Program.

(The above <esc> got the attention of the Terminal Program, which
serves up the same menu as above:)  Select Number 5.

(At this time, the user puts the (initialized DOS 3.3) diskette
on which the user wants the file to be written into Drive 2.)

ENTER FILE NAME:
utpp.txt<cr>  2             Extra <cr> to agree it's on Drive 2.

ENTER FILE TYPE: t T(TEXT I(INTEGER ...  Indicate a text file.

USE VERIFICATION OPTION(Y/N): n          Does not apply here.

(The screen clears.  Returns control back to the mainframe.)

1 utpp data                              List the file for
                                         downloading.

(The incoming data are displayed.  When finished, type:)

<esc>                                     <esc> Ends transmission.
***TRANSMISSION ABORTED***               This is a normal message.
```

FIGURE 3 Downloading of UTPP to Apple II DOS 3.3 using the Hayes Terminal package.

TABLE 2 Characteristics of Microcomputer Diskettes

Size of Diskette (Inches)	Format*	Micro/ Operating System	Number of Characters (000's)
8	SSSD	CP/M	243
	SSDD		500
	DSDD		980
5 1/4	SSSD	Apple II (DOS)	140
5 1/4	DSDD	IBM-PC (DOS)	360

*SSSD = Single side, single density
SSDD = Single side, double density
DSDD = Double side, double density

be somewhat dependent on the specific uses of data items by individual planning agencies. However, the investigation and analysis undertaken as reported in the previous sections indicate some guidelines that should be useful to those considering downloading UTPP data for microcomputer use.

It is apparent that Part V of the UTPP will have little application by the medium-sized urbanized areas. For any specialized uses, which will generally only be to subdivide downtown area zones, the printed copy should be sufficient. Of the other five parts of the UTPP, it is apparent that the form of the data and potential use mean that Parts II, IV, and VI generally are used alone and that, where possible, data from each of these parts should be confined to a single diskette (as will be described later in this section, the data required can usually all be included on a single diskette). Parts I and II contain information on a zone or tract level that will be interrelated in many applications (trip-generation input, successive-overlay analysis, work-trip generation model development, reporting and analysis of demographics, plotting of data, etc.). Therefore the design presented combines these data.

Recommendations regarding the five parts of the UTPP that will be in general use are described more fully in the following.

Parts I and III: Residence and Workplace Tabulations

It is anticipated that there will be considerable use of Part I (residence-end data) and Part III (work-end data). Uses indicated include developing a data base, checking local forecasts, examining trends, analyzing transit through the successive-overlay technique, inputting data to trip-generation models, and developing work-trip generation models. For many of these purposes, the data from the two parts should be joined into a single data source. Reference to Table 3 indicates that if all the data were downloaded, numerous diskettes would result. The purpose here is to describe what information is expected to be the most used and to design a data set that would occupy at most one or two diskettes.

In Part I of the UTPP, 29 tables are provided. Although most of the tables are useful for the purposes described, the entire stratification for each is not always required. For example, Table I-23 (number of workers by means of transportation and earnings) has for each major mode 13 income categories, which is generally not required for most analyses. This provides one means for reducing the size of the file. Other tables may not be required in many small to medium-sized areas, such as Table I-25 (number of workers by means of transportation by race and Spanish origin). Other tables are not used in most transportation planning, regardless of area size, for example, Tables I-6 and I-7 (number of workers by sex and occupation and by sex and industry at the resident end). Another space-saving strategy would be to use less than the nine characters per item provided by the Census Bureau. This has not been done for this analysis because the size of data items can best be determined locally. For most data items, it is anticipated that seven characters per item would be sufficient in the small to medium-sized areas. With the anticipated uses in mind and the foregoing considerations, Table 4 shows the data from Part I that should satisfy most needs. The total number of characters per zone resulting from the design is 429 (including zone number). For 100 zones, 42,900 characters would be downloaded to a microcomputer diskette, 171,000 for a larger area with 400 zones.

The same type of analysis was accomplished for Part III of the UTPP. Recommended data items to download from this part are summarized in Table 5. Some 189 characters per zone would be transferred (not including a zone number). For 100 zones, 18,900 characters would be downloaded, 75,644 for a larger area with 400 zones.

For a combined downloading of Parts I and II, there would be some 618 characters per zone. A diskette design would result in the following number of diskettes by size of area:

100 zones: 1 diskette, all types
200 zones: 1 diskette, all types
300 zones: 1 diskette except for 140K format (need two)
400 zones: 1 diskette except for 140K format (need two)

Another approach to the downloading would be to produce diskettes for specific purposes. For example, a diskette can be produced that contains only items required for input to a trip-generation model. Here the items would generally be limited to population, housing units, vehicles available, mean income, and employment for a small number of categories (e.g., retail, armed forces, other). Ratio values used for trip generation could also be calculated and included on the diskette (e.g., persons per housing unit and workers per household). Another diskette might contain disability-related information for analysis and reporting. A third might include detailed information on employment.

Part II: Tabulations by Large Geographic Areas of Residence

Part II provides data that interrelate travel characteristics on a large-area basis [CBD, central city, study area, county, Standard Metropolitan Sta-

TABLE 3 Approximate Number of Diskettes Required for Entire UTPP

Zones	Diskette Storage (000's)	Number of Diskettes Required UTPP Part I	II*	III	IV	VI
100	140	5	1	4	21	1**
100	360	2	1	2	8	1**
400	140	20	1	14	323	2***
400	360	8	1	6	126	1***

*For a single geography such as study area.
**Based on up to two counties in the study area.
***Based on up to three count in the study area.

TABLE 4 Recommended Data Items to Download from Part I

Table	Item	No. of Data Items
I-1	All Persons in Households	1
I-2	All Persons in Group Quarters	1
I-3	Males and Females by Age*	8
I-5	Student Enrollment (Kindergarten + Nursery, Elementary, High School, College)	4
I-9	Mean Size of Household	1
I-9	Number of Households	1
I-10	Mean Workers per Household	1
I-11	Mean Income	1
I-12	Number of Vacant Housing Units	1
I-13	Entire Table**	6
I-14	Entire Table (except all households)	4
I-16	Entire Table (except all households)	4
I-18	Entire Table***	4
I-20	Entire Table	1
I-21	Entire Table	1
I-22	Entire Table	1
I-24	Means of Transportation by Mean Income	5
I-18	Type of Disability (not by age)****	2
	TOTAL	47

*Ages would be collapsed from that provided, perhaps to: Under 19; 19-34; 35-61; 62 and above.
**Structure type would be collapsed from that provided, perhaps to: one family detached; one family attached; building for 2-9 families; building for 10 to 49 families; building for 50 or more families; mobile home trailer or other.
***Means of transportation would be collapsed to: car, truck or van drive alone; car, truck or van carpool; public transportation; bicycle, walked only, or worked at home and other means.
****Include only: persons 16 years older with a disability; with a public transportation disability.

tistical Area (SMSA), and minor civil division for nine northeastern states]. Such data provide travel models for certain characteristics, such as number of workers in households who use a car, truck, or van by vehicle occupancy, household income, and number of vehicles available (Table II-11). Other tabulations are useful in tabular or plot form or both for reporting and analyzing conditions on an area-wide basis. Examples include percentage of trips by mode by reported travel time (Table II-4), carpool arrangements by sex and vehicle occupancy (Table II-12), and number of workers in households by household income, number of workers per household, number of vehicles available, means of transportation, and carpooling (Table II6). Reference to Table 3 indicates that all data in Part II for any major geographic area (study area, SMSA, county, etc.) will fit on a single diskette. For most smaller urbanized areas the study area will be of most interest. For medium-sized areas there may also be some interest in SMSA data where the SMSA differs somewhat from the study area. For those areas with a few counties, there may be some interest in county data. In any case, the data for the major subdivisions would be handled separately, and each could be contained on a single diskette.

TABLE 5 Recommended Data Items to Download from Part III

Table	Item	No. of Data Items
III-2	Workers by Industry summarized to: Retail Trade; Industrial (i.e., agriculture, mining, construction, manufacture); Armed Forces; Other (i.e., service, wholesale trade, professional & related services)	4
III-5	Workers by Means of Transportation summarized to: Car, Truck or Van Drive Alone; Car, Truck or Van Carpool; Public Transportation; Bicycle, Walk, Work at Home, Other Means	4
III-8	Means of Transportation by Sex summarized to: Car, Truck or Van; Public Transportation; Other	6
III-10	Number of Vehicles used in Travel to Work	1
III-11	Persons/Vehicle	1
III-12	Persons/Carpool	1
III-13	Means of Transportation by Mean Income: All Workers; Car, Truck or Van; Public Transportation; Bicycle, Walk, Work at Home, Other	4
	TOTAL	21

Part IV: Journey-to-Work Information

The journey-to-work trip information in Part IV of th UTPP includes number of workers by mode, mean travel time by mode and number of vehicles used, persons per vehicle, and persons per carpool. In the investigation of uses anticipated by planning agencies, the number of workers by mode appeared to be the only area of major interest. Part IV contains 14 data items for workers by mode (the detailed mode definitions used by the Census Bureau). For areas of the size considered here, the modes of interest would be

1. Car, truck, or van--drive alone;
2. Car, truck, or van--carpool;
3. Public transportation (bus or streetcar, subway or elevated, railroad or taxicab); and
4. All other means (bicycle, walk only, work at home, motorcycle, or other means).

The number of data items for each zone-to-zone movement (four) would result in some 48 characters [this includes origin and destination (OD) number for each movement]. In an 8 percent sample (UTPP journey-to-work sample rate) one can conservatively estimate that half of the OD matrix will be empty. For a 100-zone area, this would result in 240,000 characters. One diskette would be required, except for the 140K format (two required), to store the data. For the 400-zone case, too many disks are required. In this case it is suggested that a matrix be selected for important movements (e.g., to downtown and major employment centers) or that the zone-to-zone matrix be collapsed into a district table. A combination of selected destination areas by zone and others by district is another possibility. What is desirable is that only one or two diskettes be produced for Part IV.

For the 400-zone case, if 50 major employment zones (destinations) were selected and all other zones collapsed to, say, 100 districts, the number of characters resulting would be 252,000 (assuming 30 percent of cells without data), requiring a maximum of two diskettes (depending on the type used).

Part VI: Journey to Work from County of Residence to County of Work

The information in Part VI is used for travel-related analysis, generally to assess the share that external areas contribute to the employment within the study area and the spatial distribution of such work travel. Also, Part VI provides a large amount of travel information on a county-to-county basis, which is useful when there are several internal counties. Because most smaller study areas include only one county, the entire UTPP Part VI can be downloaded to the microcomputer diskette (one diskette required; see Table 4). When there is more than one internal county (perhaps three in medium-sized areas), the number of data items transferred from Part VI should be reduced so that only a single diskette is required. The items from Part VI that will probably be most useful are as follows:

Table	Item	No. of Data Items
VI-4	Number of workers by means of transportation and earnings	25
VI-6	Number of workers by sex and means of transportation	15
VI-7	Number of workers using a car, truck, or van by carpool type	5
VI-8	Number of vehicles used in travel to work, number of persons per vehicle, and number of persons per carpool	3
VI-10	Number of workers in households by means of transportation and household income	60
Total		108

With 108 items, there would be approximately 984 characters (including county identification) for each county-to-county movement. With three internal counties and 20 external counties, there would be 118,080 characters, requiring only one diskette.

APPLYING UTPP DATA WITHIN SOFTWARE PACKAGES

This section information is provided on how the UTPP data (in ASCII) can be input and applied for transportation purposes to several microcomputer software packages. Specifically, dBase II, a data management system, and VisiCalc, a spreadsheet program, will be described. In addition, a sample trip-generation model using VisiCalc is presented. These packages are two of the most widely used in the world.

dBase II

dBase II offers excellent data entry support and strong query and programming languages and contains a fair report writer. An endless list of potential uses for UTPP owners exists. In order to enter a UTPP data file (in ASCII format), the user need only have fixed-length records ended with a carriage return and fields of fixed length. Before reading the file into dBase II the user should check to see that no extraneous records or other pieces of information exist in the ASCII input file. The actual dBase II commands needed to read in the data are simple. A sample session is provided in Figure 4.

VisiCalc

VisiCalc is probably the most widely used piece of software in the world. The reason for its popularity is its applicability to a wide variety of problems. VisiCalc is a spreadsheet program, meaning that it allows the user to enter a number, label, or formula into any cell of a large two-dimensional matrix while VisiCalc keeps current the values of the formulas.

One difficulty, however, is the ability of the user to download UTPP data into the package. Two choices are available. Either the user simply types in the data or (a much preferable process when large amounts of data are used) the UTPP data may be downloaded into an ASCII file on the microcomputer and then converted to a Data Interchange Format (DIF) file, which is read by VisiCalc.

A program (usually either in BASIC or PASCAL) is written to convert the file from ASCII into DIF. If an Apple II microcomputer is to be used and the user desires to use a Transportation Systems Center program, a program would have to be written to convert from the Apple PASCAL disk format to the DOS 3.3 disk format. A program to do that would not be easy

For the purposes of this example, assume that the input file contains the following information:

```
0001    1100    10000    25200    19990
0002    1400    20000    01544    10474
0003    0700    15000    05021    12849
0004    0150    18000    00605    05039
```

The zone number is in columns 1-5; total households in columns 6-10; average income columns 11-16; number of retail employees columns 17-22; and non-retail employees columns 23-28.

In the session below, a dBase II file called "TRPGEN" is to be created:

```
 D.db2f              (dBase II welcomes the user)

 .CREATE             (begin by creating a new data base)

Enter File name:  TRPGEN

Enter record structure as follows:

Field     Name, Type, Width, Decimal Places

 001      ZONE,n,5        (zone in columns 1-5--numeric)
 002      HH,n,5          (households in columns 6-10--numeric)
 003      INC,n,6         (average income in columns 11-16--numeric)
 004      REMP,n,6        (retail employment in columns 17-22--numeric)
 005      NREMP,n,6       (non-retail in columns 23-28--numeric)
 006      Carriage Return

        Data base is created
```

FIGURE 4 Sample dBase II session to input UTPP data.

PRODUCTION AND ATTRACTION SUMMARY 1971

	------PRODUCTIONS-------				------ATTRACTIONS-------			
ZONE	HBW	HBNW	NHB	TOTAL	HBW	HBNW	NHB	TOTAL
1	2659	10136	3822	16616	34083	164556	45437	244076
2	8879	33850	12763	55493	9064	14511	13759	37334
3	31786	121185	45693	198663	13478	41061	21024	75564
4	8275	31548	11895	51718	4257	7081	6842	18179
5	13886	52942	19962	86790	4602	22451	7072	34126
	65485	249660	94134	409279	65485	249660	94134	409279

FIGURE 5 VisiCalc trip-generation output.

to write. Instead it may be easier to purchase a software package called LinkDisk.

As an example of the power of VisiCalc, a user could download the UTPP data for use in a VisiCalc-aided trip-generation model. If the user decided to use the quick-response trip-generation model described in NCHRP Report 187 (2), he would be able to input the formulas and the period of time. It is beyond the scope of this paper to provide a step-by-step discussion of the procedure; however, a sample output of such a process as applied to a five-zone study is shown in Figure 5.

Plotting Programs

As with any software products in use today, there are a large variety of packages available that produce essentially the same product. For this discussion VisiPlot has been chosen as a sample of a software package used to produce plots. With this package the user can download the UTPP data and create a DIF file (as with its companion package, VisiCalc) and then input this to the program to produce pie charts, line graphs, and bar charts of the data. A sample of the output using the UTPP data is shown in Figure 6.

CONCLUSION

UTPP data are used for a wide variety of applications. Although it is difficult to design microcomputer diskette formats to meet all needs, general guidelines and information have been provided to assist planning agencies in this effort. Generally, UTPP Parts II, IV, and VI stand alone and need not be interrelated. Part V is specialized and will only be used by those who wish to subdivide some zones for more detailed geographic analyses. Generally, there will be no need to download these data. Parts I and III should be combined because

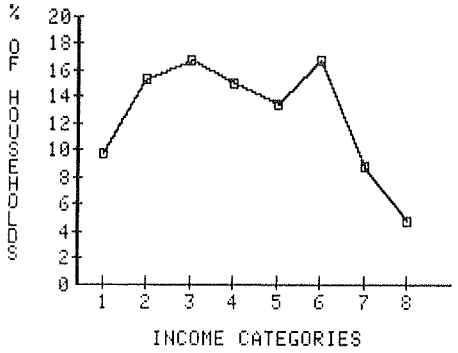

FIGURE 6 VisiPlot sample output.

they both contain zonal data used for analyses such as trip generation.

The downloading should result in as few diskettes as possible. Careful review should be made of specific uses anticipated and only those data expected to be used should be downloaded.

ACKNOWLEDGMENT

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Computer Graphics Techniques for Use with the Urban Transportation Planning Package

BOB S. EVATT, Jr.

ABSTRACT

The Urban Transportation Planning Package (UTPP) is a special tabulation of 1980 census questionnaires that provides detailed information on commuter flows and related data within the urbanized portion of Standard Metropolitan Statistical Areas (SMSAs). Four computer graphics techniques are described that assist transportation planners in analyzing and utilizing the UTPP data: automated choroplethic mapping; FLOWMAP, a geographic flow-mapping system; FLOGRAF, a program to display network traffic flows; and TRANES, a data retrieval and display system for transit route planning. A description of each technique is provided along with suggested applications using UTPP data. Sample graphics displays from the techniques are included.

The data-intensive nature of urban transportation planning places special demands on local planning agencies for data gathering and upkeep. To assist in this process the Bureau of the Census provides a special tabulation of 1980 census data called the Urban Transportation Planning Package (UTPP). Derived from questionnaires from the 1980 census, this package contains detailed information on commuter flows and related data within the urbanized portion of Standard Metropolitan Statistical Areas (SMSAs). The package can be used to study and evaluate current travel conditions and to apply and calibrate planning models used to simulate current and future conditions.

Like any large data set, the UTPP is too voluminous to be easily analyzed in its raw tubular form, even with the aid of electronic computers. Summary statistics and graphical techniques are among the methods used to render the data more readily comprehensible. Computer-assisted graphics techniques, in particular, are useful to facilitate quick yet detailed analyses of the UTPP data.

Four computer graphics techniques are described that assist transportation planners in analyzing and utilizing the UTPP data. These techniques can be used to manipulate and display the raw data or they can be used in conjunction with transportation models that accept the UTPP data as input. The first technique, automated choroplethic mapping, is a method to produce shaded-area maps that display socioeconomic and travel-related characteristics by census tract or traffic zone. The second, FLOWMAP, is a data display program that plots urban commuter flow patterns on a computer graphics plotter or graphics terminal. The third, FLOWGRAF, is an interactive graphics package that is designed to aid the analysis of urban travel on congested highway networks. The fourth, TRANES, is a data retrieval and display system for transit route planning and evaluation.

Although not designed specifically for the UTPP, these four techniques are well suited to the task of UTPP analysis. Choroplethic mapping provides an effective method for browsing and comparing the socioeconomic information contained in Parts I, II, and III of the package (see Table 1). Part IV of the UTPP, trip tables from the place of residence to the place of work, can be used as input to FLOWMAP to display the census journey-to-work data in graphic form. When these journey-to-work trips are assigned algorithmically to a computerized version of the street network, the resultant traffic patterns can be displayed using FLOWGRAF. The same data can be used with TRANES to evaluate how well alternative transit routes serve the journey-to-work travel demand to one or more employment centers.

AUTOMATED CHOROPLETHIC MAPPING

Choroplethic mapping is a process in which quantita-

TABLE 1 Component Parts of the 1980 UTPP *(1)*

Part	Description	No. of Tabulations	No. of Data Items
I	Tabulations by census tract or block group (or zone-special order) of residence	29	773
II	Tabulations by large geographic areas of residence	19	11,642
III	Tabulations by census tract (or zone-special order) of work	14	517
IV	Tabulations by census tract of residence to census tract of work (or zone of residence to zone of work-special order)	3	30
V	Tabulations by block group of work (subtotals to census tract of work)	7	107
VI	Tabulations by county of residence to county of work (includes up to 20 external counties or New England towns with a large number of journey-to-work trips)	10	322
Total		82	13,391

tive information is displayed in a geographical context using polygonal geographic boundaries and a range-graded symbolization scheme. Typically, areal data collection units such as census tracts, counties, or states are shaded on the map according to their respective quantitative magnitudes. Choroplethic maps serve to augment tabular statistics in order to more aptly display the spatial patterning of the information.

In recent years a number of computer programs have become available that allow a user to quickly and easily generate high-quality choroplethic maps on computer output devices. (Figures 1 and 2 are examples of computer-generated choroplethic maps.) These programs accept as input statistical data, such as census data, and geographical data describing the boundaries of the areas to be mapped. With a variety of program commands or parameters, the user controls various aspects of map design and symbolism, such as shading categorization and title placement.

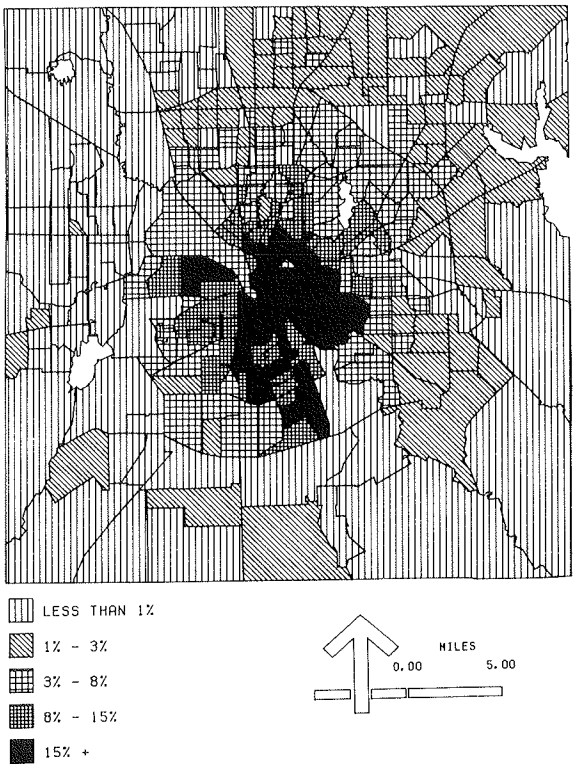

FIGURE 1 Percentage of workers riding public transit to work.

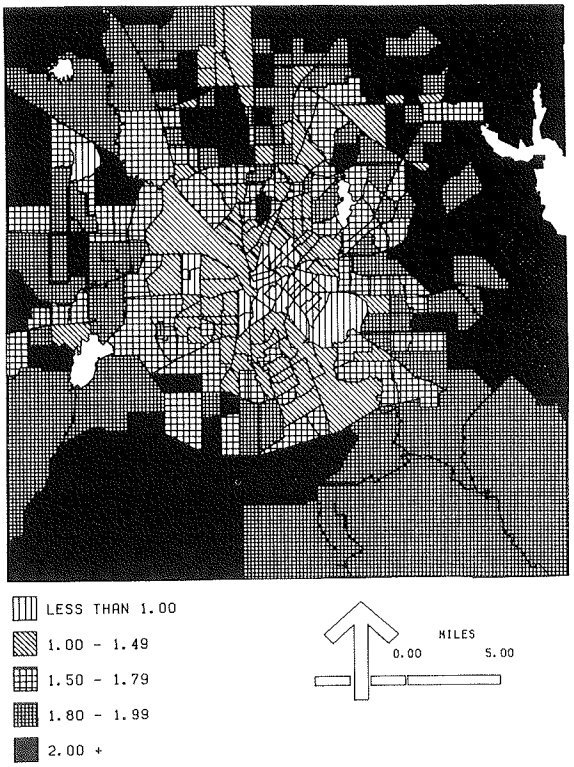

FIGURE 2 Average number of vehicles available per household.

For transportation planners using UTPP data, automated choroplethic mapping can provide an excellent tool for summarizing and reporting data. Applications of this type include the following (2):

- Evaluation of characteristics at the residence end and work end for population, housing, and employment;
- Summarizing, reporting, and analyzing 1980 conditions for journey-to-work trip lengths, mode use, carpooling, and travel times;
- Evaluation of changes in journey-to-work travel such as changes in mode of travel, vehicle use, and so on, by comparing 1970 and 1980 census data.

In addition to summarizing and reporting, the choroplethic mapping technique is useful in a variety of other analytic applications. For example, shaded-area maps of census data have been used for transit planning in a technique known as successive overlays (3). In this process, selected transit-related variables such as car ownership, income, and percentages of elderly and young populations are plotted on individual transparent map sheets that can be used as successive overlays with the street network as a base. In this way, potential areas of high transit patronage can be identified for use in evaluating alternative transit routing strategies.

In general, automated choroplethic mapping is useful in displaying the geographic distribution of static phenomena in an urban area. To represent movement across space such as traffic flow, other graphics techniques are more appropriate.

FLOWMAP

Origin and destination (OD) studies are conducted regularly by transportation planners for a number of purposes. The OD trip tables produced in these studies provide insight into the geographic travel patterns of urban commuters for purposes of transportation facilities planning and investment. They are also used to calibrate trip distribution functions that model zone-to-zone travel patterns in an urban area. As important components of regional transportation planning efforts, OD studies typically consume a large portion of an agency's data-gathering resources. This cost can be at least partially offset by using the OD trip tables in Part 4 of the UTPP.

Unfortunately, the information in OD tables is not easily summarized in graphic form, which limits the planner's ability both to comprehend and to communicate the data. This is due to the difficulty of representing complex travel patterns using conventional graphics techniques. Flow maps can be used effectively for this purpose, but they are difficult and time-consuming to prepare. In these maps, commuter flows are displayed as variable-width arrows or bands, where the width of each arrow is proportional to the magnitude of the flow it represents. In order to produce a coherent display of this type, a considerable amount of data reduction and map manipulation is required.

FLOWMAP (4) is an interactive graphics program designed to overcome the inherent problems of flow-map production. It provides a variety of automated map design options so that maps can be generated on a trial-and-error basis and modified until the desired result, a comprehensible map, is obtained. FLOWMAP provides the user with the ability to examine OD data much more comprehensively than has been possible in the past, with ease and minimal cost. It also enables the production of report-quality maps or large wall-size displays for communicating results to others.

FLOWMAP displays flow primarily as arrows, but proportional circle and pie-graph maps can be drawn to illustrate internal flows (trips that originate and terminate in the same zone). Five generic types of flow maps are possible:

1. Interzone flows are displayed as variable-width arrows with the width of the arrow proportional to the volume of flow (see Figure 3),
2. Net flows show the difference between the incoming and outgoing flows for each of several pairs of zones and are represented as variable-width arrows that point in the direction of the larger flow,
3. Internal flows are displayed as graduated circles with the area of the circle proportional to the flow volume,
4. Origin pie graphs show a circle that has an area proportional to the total flow that originates in the zone and a shaded sector proportional to the internal flow (see Figure 4), and
5. Destination pie graphs are similar to origin pie graphs but show the total flow that terminates in the zone.

FLOWMAP may be run in interactive mode or in plotter mode. Interactive use requires a Tektronix 4010-compatible interactive graphics terminal. Hard-copy units are available for these devices, which inexpensively reproduce what appears on the screen. Higher-quality paper copies can be drawn from plotter mode by using a pen or electrostatic plotter. A typical use of the program would proceed as follows: (a) design the map interactively at a graphics terminal, (b) save the set of instructions to produce that particular map, and (c) execute these instructions in plotter mode to draw the final map on paper at the desired size.

FLOWMAP requires input data from two files: a flow-data file and a geographic feature file. The flow-data file is divided into three sections: a map instruction section, an OD table, and a point location section.

The map instruction section contains the number of interacting geographical areas (usually traffic

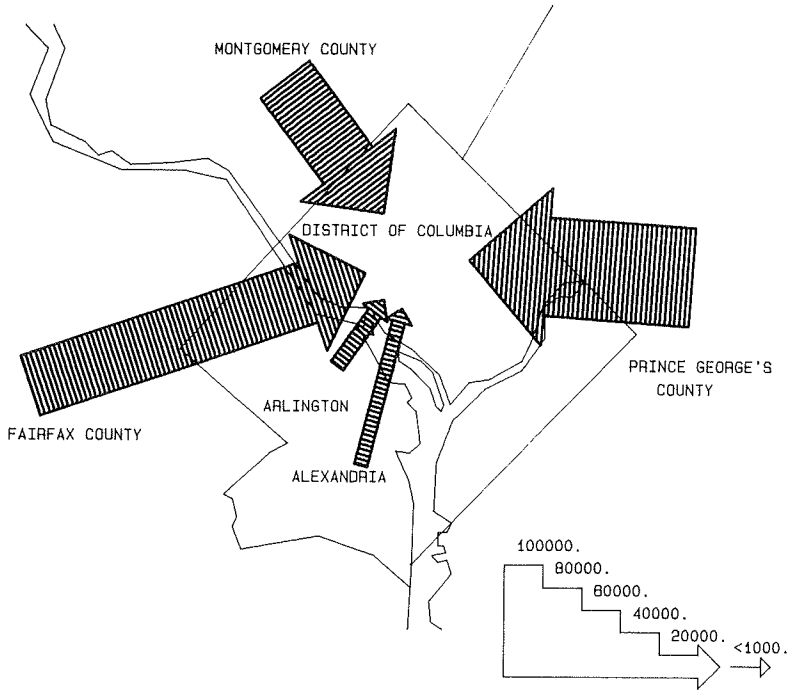

FIGURE 3 Home-to-work automobile driver trips: 1980.

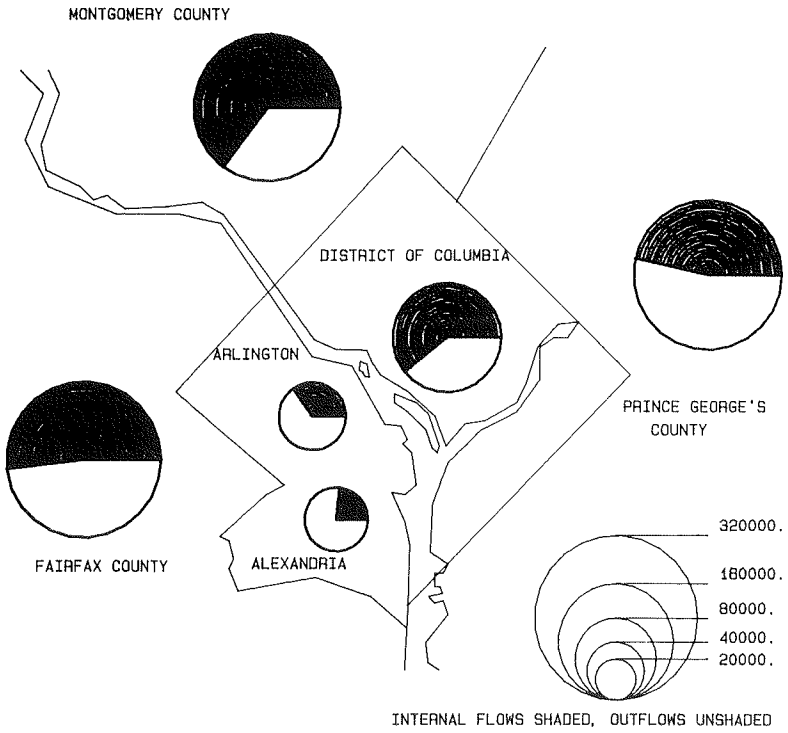

FIGURE 4 Home-to-work origin pie graphs: 1980.

zones) that are included in the OD table. The remainder of the instruction set includes a map title and optional parameters that allow the user to control various aspects of map design. With these parameters the user can designate the type of flows to be shown and choose among several map display options.

The OD table is a matrix in which the left tab represents the "from" zones and the top tab represents the "to" zones. Thus, the data value located in row 2 and column 3 is the volume of flow from zone 2 to zone 3. This matrix can be derived from Part IV of the UTPP.

The point location section consists of a set of X- and Y-coordinates that identify a reference point for each traffic zone. These locations are used to define the starting and ending points for the flow arrows. They can be located anywhere inside a zone, such as the geographic center of the zone. Also included in this section are the names or numbers of each zone and the X- and Y-coordinates for the map location of each name.

Once the input data have been prepared, the user may elect to display interzone flows, net flows, internal flows, or pie graphs. Many-to-many, many-to-one, or one-to-many flow maps may be drawn.

Many-to-many maps are the default type. All nonzero flows in the OD matrix are displayed, although small flows can be eliminated. The user may select long arrows that extend from the origin to the destination or short arrows with annotated destinations. In some cases, the short-arrow option will improve map clarity. The user can also select curved arrows, so that inbound and outbound flows are not superimposed.

Many-to-one maps display all incoming flows to one destination and one-to-many maps display all outgoing flows from a single origin. The operator decides whether a zone is active as an origin or destination for each map drawn. For example, if all zones are active origins and only one area is an active destination, a many-to-one map will be produced. It is possible to show several many-to-one or one-to-many displays on the same map.

Net flow maps display arrows that show the difference in flows between each pair of points. Internal flow maps produce no arrows but draw a circle with area proportional to the internal flow for each zone. Pie-graph maps show circles proportional to total flows beginning or ending in each zone; internal flows are represented as a shaded slice of each circle.

FLOWMAP has been found to be a useful tool for displaying flow data for two main reasons. First, it decreases total map production time through the use of interactive design. The user's time and design abilities are used more productively in the designing process. Minor problems such as overlapping text becomes trivial to correct using interactive procedures. This allows additional time to be spent on more substantive map design problems.

A more important advantage of FLOWMAP is that it allows the user to explore a data set thoroughly before creating final maps tailored to particular concerns. By alternately requesting many-to-one, one-to-many, and many-to-many maps, the user can quickly determine the best way to show the significant portions of the flow matrix. This type of flexibility is not available by using traditional cartographic techniques. It should facilitate the discovery of potentially important relationships in the data that might otherwise go unnoticed.

FLOWGRAF

FLOGRAF is an interactive color graphics program designed for displaying data that relate to the level of traffic congestion at various times of day. This is accomplished by plotting a map of the highway network on a color graphics terminal and color coding each highway link based on the amount of congestion on that link. A key is drawn along side the map indicating the level of congestion denoted by each

color. Although the map color selection is user specified, generally a hot color such as red is used to shade highly congested links, and a cool color such as blue is used to shade relatively congestion-free links. Congestion can be measured alternatively by the number of vehicles per lane kilometer, the number of vehicles per lane, the number of vehicles per kilometer, or the number of vehicles.

Schneider (5) has identified several ways in which these types of displays can be used to support the transportation planning process. First, they could be helpful in identifying and summarizing highway congestion problems by allowing the easy mapping of various indices of congestion. Second, they could help the transportation planner interpret the results of simulation models that are designed to predict the impact of various transportation policy decisions. Third, they could assist the interpretation of field data gathered in before-and-after studies associated with small-scale short-term experiments designed to test various congestion-reduction techniques in various settings. Finally, they could be similarly helpful in evaluating the impacts of congestion reduction techniques that were implemented by simulation.

An important feature of FLOWGRAF is that it allows the user to visualize traffic congestion over time, providing a temporal as well as a spatial perspective. This is significant in that it enables the user to more easily think about the complex urban traffic interactions on a holistic basis (6). For transportation modeling efforts that attempt to gauge the impact of planned congestion reduction policies, this is a valuable capability. For example, a technique that relieves congestion in one part of the network might only serve to increase congestion in another part of the network in the same or a different time frame. These relationships become more apparent when viewed in a time series of graphical displays.

The required data for FLOGRAF displays can be derived from Part IV of the UTPP, using simulation models designed to replicate or forecast the flow of vehicles on a street or urban freeway network. These models are well suited to the task of projecting the probable impacts of alternative congestion reduction strategies. Examples of these types of models are found in the Urban Transportation Planning System (UTPS) family of programs.

FLOSIM is a simple but useful simulation program that serves as a companion program to FLOGRAF. It is essentially a network assignment model that takes OD trip tables and loads them onto a computerized representation of the urban transportation network. Various indices of traffic congestion, such as volume-to-capacity ratio, can then be displayed at a color graphics terminal using FLOGRAF.

FLOSIM performs the operations necessary to simulate the flow of traffic in an urban network in three steps (6). The first program of the series, MINTREE, builds a file containing the shortest path in travel time between all pairs of nodes in the network. The second program, TRAFSIM, reads origin, destination, volume of traffic, and starting times from a data file. It accesses the appropriate minimum-path tree and simulates the flow of traffic between each OD pair. Because the clock time at each node along the minimum paths is known, the program can determine which link contains each group of trips at any particular observation time. The flows are sorted and aggregated by link in the third step of the process. This output forms the link congestion information that is displayed by FLOGRAF on the color graphics terminal.

To use FLOGRAF with simulation data, three steps must be completed:

1. The street network must be coded as a series of links and nodes so that it can be input to the computer. The X- and Y-coordinates of each node and the number of lanes and speed of each link must be recorded.

2. OD flows must be assigned to the network using FLOSIM (or a more sophisticated simulation model). This distributes the flow of traffic over the street network and calculates traffic volumes on each link in the network at prescribed observation times.

3. The FLOGRAF program is then used to produce color maps of the link traffic volumes on a color computer graphics terminal. Currently a Tektronix 4027-compatible terminal is required, although it is conceivable that a microcomputer could be used, given the appropriate communication and emulation hardware and software add-ons.

TRANSIT NETWORK EVALUATION SYSTEM: TRANES

TRANES is an interactive computer graphics program designed for transit system route planning and analysis. It uses computerized street network files and data from the 1980 census to retrieve information on the number and type of potential transit users within a specified distance of transit facilities. TRANES was originally developed for large computer systems by Johnston and others (7) and has recently been converted to the IBM personal computer by Schlesenger (8). The program has been applied to a variety of transportation and other network problems, including alternative bus and light rail route evaluation; determination of optimal location of bus, rail, and other transit stops; and medical emergency station location analysis.

TRANES has two primary applications that are of major concern to the transportation planner. First, it can be used to evaluate the accessibility of various subgroups of the population to transit facilities. Second, it can be used to measure the propensity for transit use of alternative route configurations based on the number and type of potential transit riders with access to each route.

The first application, accessibility analysis, is used to measure the effectiveness of transit in providing transportation to low-income and minority groups, who often cannot afford to own and operate automobiles. One of the main goals of public transit is to help provide access for these groups to employment, educational, shopping, recreational, and social opportunities. TRANES provides an efficient vehicle to measure transit accessibility by combining population stratifications from census data with local transit route descriptions.

The second major application provides planners with a quick and easy method to assess the potential success of alternative transit routes. By accessing appropriate census variables through the TRANES reporting capabilities, an overall index of propensity for transit use can be constructed for each route. The objective is to identify transit routes along the road network that serve areas in which the population exhibits socioeconomic and demographic characteristics similar to those of typical transit riders. In one study (3) the following variables have been found to be important in predicting transit use: the number of passenger cars per dwelling unit, average household income, the number of females aged 16 to 24, the number of persons aged 62 or over, and the number of dwelling units per acre. Other variables are available from the 1980 census that could provide additional information.

To run TRANES, a user first selects the area of the urban street network containing the transit

route or route segments to be analyzed. Two preprocessor programs are then run to produce the input files needed for TRANES. The user identifies transit stops and routes to be studied and specifies a maximum walking distance from each stop. The TRANES program can then be activated to delineate all possible paths from each stop that terminate within the specified distance. The census information related to the street links along those paths is then allocated to the appropriate transit stops. Socioeconomic profile reports can be produced either for individual stops or for entire routes. The process can be continued iteratively to evaluate alternative route designs.

A major advantage of TRANES is that it uses readily available high-quality geographic and socioeconomic data provided by the Bureau of the Census. The data are available at low cost and they are already in machine-readable form. Because of this, no extensive data collection or data entry effort is required and start-up times for TRANES projects can be kept to a minimum.

TRANES requires two types of data files as input: a street network file and a census data file. The street network file is derived from the Census Bureau's Geographic Base File and Dual Independent Map Encoding (GBF/DIME) file, commonly called the DIME file. The DIME file is a computer-readable description of all street segments in a metropolitan area with segments typically defined as street links bounded by street intersections. Other segments may be defined by nonstreet features such as lake shores or railroad tracks. Each segment is represented by a record in the file consisting of (a) the two digitized nodes that define the segment end points, (b) the name of the street or geographic feature, (c) the address ranges between nodes for both sides of the street, and (d) the left and right census geography for the segment (tract number, block number, etc.).

This information constitutes the basic link and node data that are needed for computer-assisted transportation network analysis. Each node is uniquely numbered and contains coordinate values that enable plotting the network on a plotter or computer graphics terminal. The walking distance along each link can be computed by using the straight-line distance between the two nodes.

The DIME file defines the relationship by which census socioeconomic and travel demand data can be disaggregated from polygons to street links for use by TRANES. The UTPP census data file can be accessed to assign a demographic value to every addressable street link in the DIME file. DIME records with no address range are not included because it is assumed that they represent links where there are no residences (e.g., freeway ramps). In addition to total population, other variables such as total minority population, elderly and teenage population, low-income households, and number of households with no automobiles available can be used. When TRANES is activated, it totals the values of all the street segments that lie within a given distance of user-specified transit stops. These segments are displayed graphically on the computer screen (see Figure 5) and the value totals can be printed out in report form. (In Figure 5, the lightly shaded area indicates the links that have been allocated by the path-building module.)

The user has three options regarding the disposition of the output report. The program can store the report on a diskette for later display and analysis, route the report to the printer, or display the report on the monitor. A sample report is presented in Table 2.

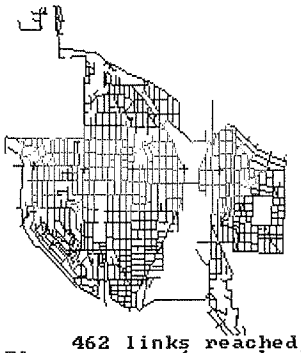

FIGURE 5 TRANES street network display.

TABLE 2 TRANES Allocation Report

	Total Population by Miles		Households by Miles		Housing Units by Miles	
Node	0-0.1	0.1-0.25	0-0.1	0.1-0.25	0-0.1	0.1-0.25
115	99	472	37	188	38	192
126	67	565	30	262	31	272
155	18	71	10	44	10	44
180	33	475	15	240	15	252
194	22	415	11	228	11	250
Total	239	1,998	103	962	105	1,010

SUMMARY AND RECOMMENDATIONS

Computer graphics provides invaluable tools for displaying, analyzing, and communicating the information contained in the 1980 UTPP. As exemplified by the four techniques presented, computer graphics enhances, complements, and expands other analytic methods used in conjunction with these data. These techniques should be considered integral parts of the transportant planner's analytical tool kit.

To facilitate the use of these techniques with UTPP, FLOWMAP, FLOGRAF, TRANES, and a choroplethic mapping program could be distributed as part of the UTPP package along with the report-writing software already included. In addition, the programs could be made more readily compatible with the UTPP data format, so that major reformatting and preprocessing of the data would not be required for their use.

A second recommendation for improvement of FLOWMAP, FLOGRAF, and TRANES is to make them compatible with a general travel demand modeling system. The programs currently operate as data retrieval and display systems and have no modeling capabilities of their own. An obvious choice would be to make the programs compatible with the UTPS system of integrated transportation models. An alternative prospect would be to include these programs in the quick-response series of programs for short-term transportation modeling (9). For transit systems planning, a functional integration with the Transit Operations Planning (TOP) (10) package could be valuable.

In lieu of these prospects, another opportunity for enhancement is to make FLOWMAP, FLOGRAF, and TRANES internally compatible with each other, creating an integrated system of transportation planning computer graphics software. This would enable a user to begin with the UTPP zone-to-zone travel demand, analyze the flows in graphic fashion, observe

where congestion on the highway network will result from this demand, and design transit systems that could potentially serve the demand. A system of this kind would be especially useful if it operated on a microcomputer, which would make it available to a large number of potential users.

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Part 4
Applying and Supplementing Census Data for Transportation Planning

The Urban Transportation Planning Package as a General-Purpose Data Resource

ROLF R. SCHMITT

ABSTRACT

The 1980 Urban Transportation Planning Package was designed primarily to serve the needs of urban transportation planners; however, its tabulations provide a valuable data resource for planners and analysts in a wide variety of public and private organizations. Several illustrative applications are outlined, and implications are suggested for regional agencies and for the 1990 census.

The special set of tabulations from the 1980 census discussed throughout this Record is called the Urban Transportation Planning Package (UTPP) for reasons of history and sponsorship. The UTPP was developed in both 1970 and 1980 under the sponsorship of the U.S. Department of Transportation to provide data for transportation planners. This emphasis on transportation does not limit the value of the UTPP to planners and analysts in a wide range of other fields.

The variety of nontransportation uses of the UTPP has been discussed in meetings of the TRB Committee on Transportation Information Systems and Data Requirements and the Transportation Special Interest Group of the Urban and Regional Information Systems Association (URISA). Much attention in these meetings has been given to the UTPP as a salable data resource to help public agencies recoup the costs of purchasing the UTPP and perhaps even contribute to the agency's operating costs. Several possible nontransportation uses of the UTPP raised in these meetings are outlined in this paper, and some implications of the uses for regional agencies and the 1990 census are discussed.

NONTRANSPORTATION USES

The UTPP is an effective general-purpose data resource for three reasons. First, it provides a number of traditional census tabulations by place of residence for user-defined geography. Second, it provides tabulations of work-force characteristics at the place of work, which are not available for small geographical units in any other census product. Third, it provides tabulations about the population on the move between places of residence and places of work.

Place-of-Residence Tabulations

Part I of the UTPP tabulates many of the same demographic, social, and economic characteristics by place of residence as are found in several standard census products. The major improvement is that the user is not tied to the census tract as the geographical unit of analysis.

Census tracts are not always the best geographical unit of analysis when plans and studies are concerned with areas of homogeneous land use or population density. Census tracts are designed to divide a metropolitan area into neighborhoods of approximately the same size and, it is hoped, containing residential areas of similar socioeconomic characteristics. Linear features such as major streets, railroads, and rivers are typically used as census-tract boundaries because these features usually divide neighborhoods. Unfortunately, high-density residential developments and nonresidential land uses are generally found on both sides of these linear features. As a consequence, census-tract boundaries usually bisect high-density residential centers, business districts, and other areas of nonresidential land use.

Most transportation planning agencies use traffic analysis zones rather than census tracts to overcome this problem. Traffic analysis zones generally bound areas of similar land use and density by using minor streets between the corridors for zone boundaries. Although these zones are defined primarily for transportation studies and plans, they can also be used for other studies for which the density of residential population is an important factor. The UTPP can then be used to obtain tabulations by the more appropriate geography.

Place-of-Work Tabulations

The tabulations of the UTPP are especially important for the planner or researcher who is concerned with daytime population or with worker characteristics at the place of work. Even if the tendency of census tracts to divide nonresidential land uses is acceptable, none of the standard census products tabulates the numbers and characteristics of workers at the place of work.

The need to tabulate workers by place of work as well as place of residence is underscored in the paper by Fulton elsewhere in this Record on the procedure for estimating daytime population. In an illustrative application of the procedure, a census tract in Atlanta with 715 residents contains an estimated daytime population of 26,067. Providers of either public or private services that serve the daytime population would be significantly misled if they used the former statistic.

The ability to estimate daytime population makes the UTPP extremely valuable for marketing and location studies for retail outlets, banks, public facilities, and other services. The UTPP is also valuable for planning programs and services that are targeted to places of work. For example, a large number of programs exist to reduce social and health problems such as alcoholism at places of employment. Planners of employer-based alcoholism countermeasure programs need to know how many employees in each local jurisdiction are at risk in order to allocate resources. This can be roughly estimated by multiplying known nationwide or statewide alcoholism rates by occupation and industry times the number of workers in the local area in the same occupation and

industry class. The UTPP provides the needed workforce tabulations at the jurisdiction level and even at the census tract level if desired.

Tabulations by Origin-Destination Pair

Some public agencies and private organizations are particularly interested in the population that is on the move between home and work. Some tabulations by the combination of home and work are available for large jurisdictions in the Census Bureau's subject reports but can be obtained for smaller areas or with substantial cross tabulations only through the UTPP.

UTPP tabulations by origin-destination (OD) pair are particularly valuable for three types of applications:

1. Marketing studies for services geared to the rush-hour commuter. Characteristics of the commuting population by areas where the commute is in progress are especially valuable to radio stations.
2. Location of emergency facilities and services on a congested network. The travel-time tabulations in the UTPP can be used to determine rush-hour accessibility to needed facilities and services.
3. Regional impacts of local policies. The most obvious example is to use the cross tabulations in Part II of the UTPP to analyze the characteristics and geographical distribution of workers who are subjected to a commuter tax in one jurisdiction of the region.

These applications can be made with UTPP tabulations directly or by combining the UTPP with a traffic assignment model.

IMPLICATIONS FOR REGIONAL AGENCIES

Councils of governments, regional planning commissions, metropolitan planning organizations, regional transportation studies, and other regional agencies have long been a major source of information on the metropolitan areas that they serve. As planning funds and program responsibilities have declined, the informal role of regional agencies as information brokers has become one of the main surviving reasons for existence in many cases. Because of its diverse range of applications, the UTPP can greatly enhance this role. The UTPP can also support the other regional planning functions that remain.

Several of the larger regional agencies have begun using the UTPP as a salable data resource to recover the costs of purchasing and processing the package. For example, the Southern California Association of Governments (SCAG) has embarked on a major effort to develop reports and maps from the UTPP and to market those products aggressively to prospective buyers. The Atlanta Regional Commission (ARC) also sells its information resources, but ARC emphasizes its geoprocessing and computerized mapping services over the sale of reprocessed census files. Regional agencies such as SCAG and ARC hope to recover some or all of their costs through the sale of UTPP tabulations and other products and in some cases provide a new revenue source for the agency.

Most agencies that have become data vendors have been concerned at some point with possible reactions by consultants and other private vendors of data. According to representatives of several regional agencies, this concern has generally subsided for two reasons. First, many clients of regional agencies are too small for a private vendor to service profitably. Second, consulting firms are frequently consumers of the regional agency's data and prefer to have the regional agency reprocess the census data so that the consultant can have inexpensive and quick access to the data without having to buy the package.

The marketing of the UTPP by regional agencies provides more than a revenue source to offset the agency's current costs. It broadens the UTPP's base of constituents by making a much wider spectrum of local planners and analysts aware that the UTPP is valuable beyond the transportation community. This constituency can share the costs of purchasing the UTPP, make more complete use of the UTPP's tabulations, and provide the political and financial base necessary to purchase and support the 1990 UTPP.

The experience of regional agencies as data vendors is limited at present. Of the few agencies that are attempting this activity now, most are in the larger metropolitan areas, and none have had the UTPP long. There is practically no equivalent activity at the state level, even though several state departments of transportation purchased the UTPP for the entire state or for the metropolitan areas within the state. The UTPP is surprisingly not a major product of most State Data Centers, which were set up between the states and the Census Bureau to disseminate census data to the public.

CONCLUSIONS

The importance of establishing a constituency for the UTPP beyond the transportation community is underscored by the planning process that has already started for the 1990 census. The $1 billion cost of the 1980 census may grow to $4 billion by 1990, and the Census Bureau is obviously interested in ways to reduce costs and share the financial burden. If a census question or product is perceived by the bureau to be of interest to a limited number or variety of users, the user community may be asked to share the item's cost or reduce the item's scope.

Clearly, the UTPP turns the journey-to-work questions of the 1980 census into a valuable information base for a diverse and large community of users. The transportation community must encourage the expansion of this constituency so that the UTPP remains a cost-effective data resource for all users in the next decade.

Uses of Census Data for Transportation Analysis*

ARTHUR B. SOSSLAU and JAMES J. McDONNELL

ABSTRACT

Census data can be applied to a wide variety of problems faced by transportation planners. A number of potential applications of census data in the evaluation of current transportation conditions are described.

Transportation planning agencies were surveyed in 1972 to determine the data items most frequently used from the 1970 census. Figure 1 (1) shows the results of that survey as published in a report prepared for FHWA (2).

The range of socioeconomic information contained in the census can readily be seen from the lists in Figure 1. This wealth of data, offered in the Urban Transportation Planning Package (UTPP) and not generally available from any other census product, affords transportation and other urban planners a unique opportunity to relate social, demographic, and economic factors to transportation patterns and trends and thereby to gain insights that are essential to the understanding of current-year conditions, to the evaluation of trends, and to the construction of models for developing future transportation strategies.

For purposes of this Record, transportation planning uses of census data are divided into two categories: model and nonmodel. The uses of census data in nonmodel studying and evaluating of current conditions are described.

TRANSPORTATION PLANNING USES

At least three major categories of uses of census data apply to nonmodel transportation planning and analysis:

1. Establishment of a data base
   a. Socioeconomic variables used in transportation planning at the residence end
   b. Employment characteristics at the employment end
   c. Journey-to-work trip information on a residence-to-workplace basis.
2. Data summary and reporting
   a. Evaluation of trends in characteristics at the residence end and work end in population, housing, and employment characteristics by comparing 1960, 1970, and 1980 census data
   b. Summary, reporting, and analysis of 1980 conditions for journey-to-work trip lengths, major trip movements (distribution), mode use, carpooling, travel times, and so forth
   c. Evaluation of changes in journey-to-work travel such as distribution of trips within the region, changes in mode of travel, vehicle use, and so forth, by comparing 1970 and 1980 census data
3. Travel-related analysis
   a. Analysis of accessibility to community services of segments of the population to assess transportation needs of special users (a PLANPAC program, SAACCESS, is a convenient tool to accomplish this)
   b. Mapping of population-related characteristics that support transit use (items such as car ownership, income, population within 0.25 mile of transit service, etc.) by applying the successive-overlay technique
   c. Utilization of journey-to-work information to indicate parking demand by destination area and area of residence for work travel
   d. Impact analysis of transportation ranging from characterization of the social and economic structure of the areas through which a new system will pass to analysis of the impacts on particular groups in the population
   e. Specialized analysis of population segments to develop targeting programs to encourage and enhance carpooling, vanpooling, transit and bicycle use, and so forth.

Among the most valuable applications of census data is the building of a data base on which current conditions of population, employment, and work trips can be evaluated. Such evaluation is the first step in determining how a region is developing, what

1. *Census Items Most Frequently Used*
   - Population & Household Data by block, tract, enumeration, district, etc.
   - Age and Sex
   - Race
   - Income
   - Auto Ownership
   - Occupation Industry & Class of Worker
   - Place of Work
   - Mode of Journey-to-Work
   - Spanish Origin
   - Number of Units at Address
   - Value
   - Contract Rent
2. *Items Frequently Used*
   - Vacancy Status
   - Employment Status
   - Hours Worked Last Week
   - Place of Residence 5 Years Ago
   - Tenure
   - Second Home
   - Disability Presence & Duration
3. *Items Occasionally Used*
   - Marital Status
   - State or Country of Birth
   - Years of School Completed
   - Number of Children Ever Born
   - Weeks Worked Last Year
   - Last Year in Which Worked
   - Country of Birth of Parents
   - Mother Tongue
   - School or College Enrollment
   - Veteran Status
   - Access to Unit
   - Kitchen Facilities
   - Rooms
   - Flush Toilet
   - Bathroom or Shower
   - Basement
   - Months Vacant
   - Heating
   - Components of Gross Rent
   - Year Structure Built
   - Number of Units in Structure/or Trailer
   - Farm Residence
   - Water Source
   - Sewerage Disposal
   - Bathrooms
   - Number of Stories/Elevator
   - Fuel
   - Bedrooms
   - Air Conditioning
4. *Items Seldom or Not Used*
   - Citizenship
   - Year of Immigration
   - Marital History
   - Vocational Training
   - Occupation-Industry 5 Years Ago
   - Commercial Establishment on Property
   - Clothes Washing Machine
   - Clothes Dryer
   - Dishwasher
   - Home Food Freezer
   - Television
   - Radio

FIGURE 1 Use of 1970 census data items *(1)*.

*From Transportation Planners' Guide to Using the 1980 Census, FHWA, U.S. Department of Transportation, Jan. 1983.

changes are occurring that may affect its transportation system, and where travel-related problems might arise. The data base is also used in most technical activities, such as evaluating changes over time and accomplishing analyses of parking demand, accessibility, and rideshare planning. These are activities that usually do not require models and other forecasting methods. The information required is available directly from census products.

Socioeconomic data used in transportation planning at the residence end include counts of population, housing units, vehicles available, income, and school enrollment. These variables are available at the census tract and or zone level or both from Part I of the UTPP. The data can also be used to examine relationships among variables, such as the number of vehicles available by household, income, and household size. This is available from Part II of the UTPP.

Employment-end information includes counts of total workers, of workers by mode of travel, of workers by sex and occupation, and of persons per vehicle and persons per carpool. This information is available from Parts III and V of the UTPP. As an example of use in transportation planning, such data can be compared with previous counts to assess shifts in nonresidential growth and changes in an area's employment makeup (e.g., shifts from industrial to service economy).

Residence-to-work trip information is available from Part IV of the UTPP at the census tract or zone level and in Part VI at the intercounty level. These data are important in developing an understanding of the geographic distribution of travel, the selection of travel modes, travel duration by mode, and the extent of and potential for ridesharing.

NONTRANSPORTATION PLANNING USES

Census data are also a valuable resource for a number of agencies other than those directly involved in transportation planning, thereby offering the possibility of cost sharing in the purchase of the package. Of special interest is worker information coded to zone or tract at the workplace, which is not available from other census sources. Potential uses by nontransportation agencies are listed in Figure 2 (3).

DESCRIPTIONS OF SELECTED USES

Several applications of census data involve analysis and presentation of the data and do not require forecasting or reliance on modeling procedures. One example is accessibility analysis for various segments of the population. Another is the use of census data to help determine park-and-ride lot locations. Some of the applications of census data for transportation planning are discussed in the following sections.

Transit Planning Through Successive Overlays

Transit agencies generally have not utilized data

DEVELOPMENT PLANNING

- Developing community profile for Overall Economic Development programs
- Analysis of labor force composition and trends
- Analysis of population/employment distribution pattern
- Retail location and marketing studies

EDUCATIONAL PLANNING

- Analysis of future school enrollments by grade
- Redistricting of schools
- Analysis of special educational needs by small areas
- Assessment of bilingual education needs

HOUSING

- Assessment of housing improvement needs
- Analyses of real estate trends and tax revenue forecasting
- Targeting of building code inspections
- Analysis of displacement and other problems occasioned by condominium conversion

HEALTH CARE

- General health care planning
- Analysis of special health program needs as related to socio-economic factors
- Analysis of public health factors
- Identification of areas not adequately served by physicians
- Identification of areas most in need of improved ambulance service

FIGURE 2 Examples of census data uses for activities other than transportation planning *(3).*

ENERGY CONSERVATION PLANNING

- Identification of target areas for energy conservation assistance in the building sector
- Analysis of local problems and opportunities for energy conservation in space heating, water heating and cooking
- Identification of key corridors for bicycle facility development

LAND-USE PLANNING

- Analysis of socio-economic, demographic, housing, employment, and transportation trends

FIRE PROTECTION AND DISASTER PLANNING

- Analysis of fire and disaster risks by subareas
- Insurance-cost analysis for residences by small areas

PUBLIC WORKS

- Evaluation of projects requiring displacement or relocation of residents
- Improved record-keeping of street inventory data using Census GBF/Dime capabilities
- Assessment of utility needs
- Estimation of right-of-way acquisition costs
- Preparation of Environmental Impact Statements

SOCIAL SERVICE PROGRAMS

- Analysis of service area boundaries and facility locations
- Analysis of client group needs and resources
- Assessment of day care center requirements
- Assessment of playground requirements
- Preparation of funding applications for programs
- Forecasts of future tax revenues

LOCAL GOVERNMENT ADMINISTRATION

- Forecasts of future demand for services
- Identification of target areas and groups to increase voter registration

OTHER

- Assessment of labor market conditions and workers by type activity

FIGURE 2 continued.

sources such as the census in planning route extensions or cutbacks and service increases or decreases. In the current economic and political climate, the need for such data-based planning has grown.

The successive-overlay technique geographically plots selected transit-related variables such as car ownership, income, percentage of elderly or young populations or both, and so on, on individual transparent map sheets that can be overlaid one on the other with a street system as the base (4). In this way potential areas of high transit patronage can be identified for use in evaluating current transit travel (this technique is also available for journey-to-work census data). Another variable of interest that was not available in previous census data is the population of handicapped persons.

In one urban area this technique was used effectively to measure the propensity for transit use in terms of the following variables:

1. Passenger cars per dwelling unit: less than one vehicle, high transit use propensity; one to two vehicles, medium propensity; and more than two vehicles, low propensity;
2. Average income: $0 to $4,000, high propensity; $4,000 to $10,000, medium propensity; more than $10,000, low propensity (these incomes were for 1970);
3. Females aged 16-24 per acre: 0.5 to 1.2, high propensity; 0.3 to 0.5, medium propensity; 0 to 0.3, low propensity;
4. Persons aged 62 or over per acre: 2.0 to 2.82, high propensity; 1.0 to 2.0, medium propensity; less than 1.0, low propensity; and
5. Dwelling units per acre: 4.0 to 6.9, high

propensity; 1.0 to 4.0, medium propensity; 0 to 1.0, low propensity.

These items were plotted individually and an overlay of all items was made as shown in Figure 3 (4). The results defined an area in which a postcard home survey of potential transit riders was then made. As a result of using the overlay technique the survey cost was reduced because a limited area in which the survey was most likely to produce significant results had been targeted.

Accessibility and Special Population Segment Analysis (5)

Many community services are keyed to special segments of the population--the elderly, the poor, ethnic and racial groups, and so forth. Other services, although keyed to the general population, may have limited interest for all but target populations, such as programs to encourage carpooling, vanpooling, and bus use.

Census data allow stratification and geographic plotting of the population by key variables such as sex, income, and car availability. Accessibility measures may also be developed linking targeted segments of the population to community services such as hospitals, schools, and employment areas. Measures of accessibility by transit and automobile can thus be developed by combining population stratifications from census data with local transportation networks.

Accessibility measurement is also used by planning agencies to assess the social impact of community services on segments of the population. Such measurements are then used to evaluate alternative proposals for transportation improvements. In fact, accessibility measurement has been used to indicate progress toward several goals--land use development objectives, social objectives, and system performance objectives.

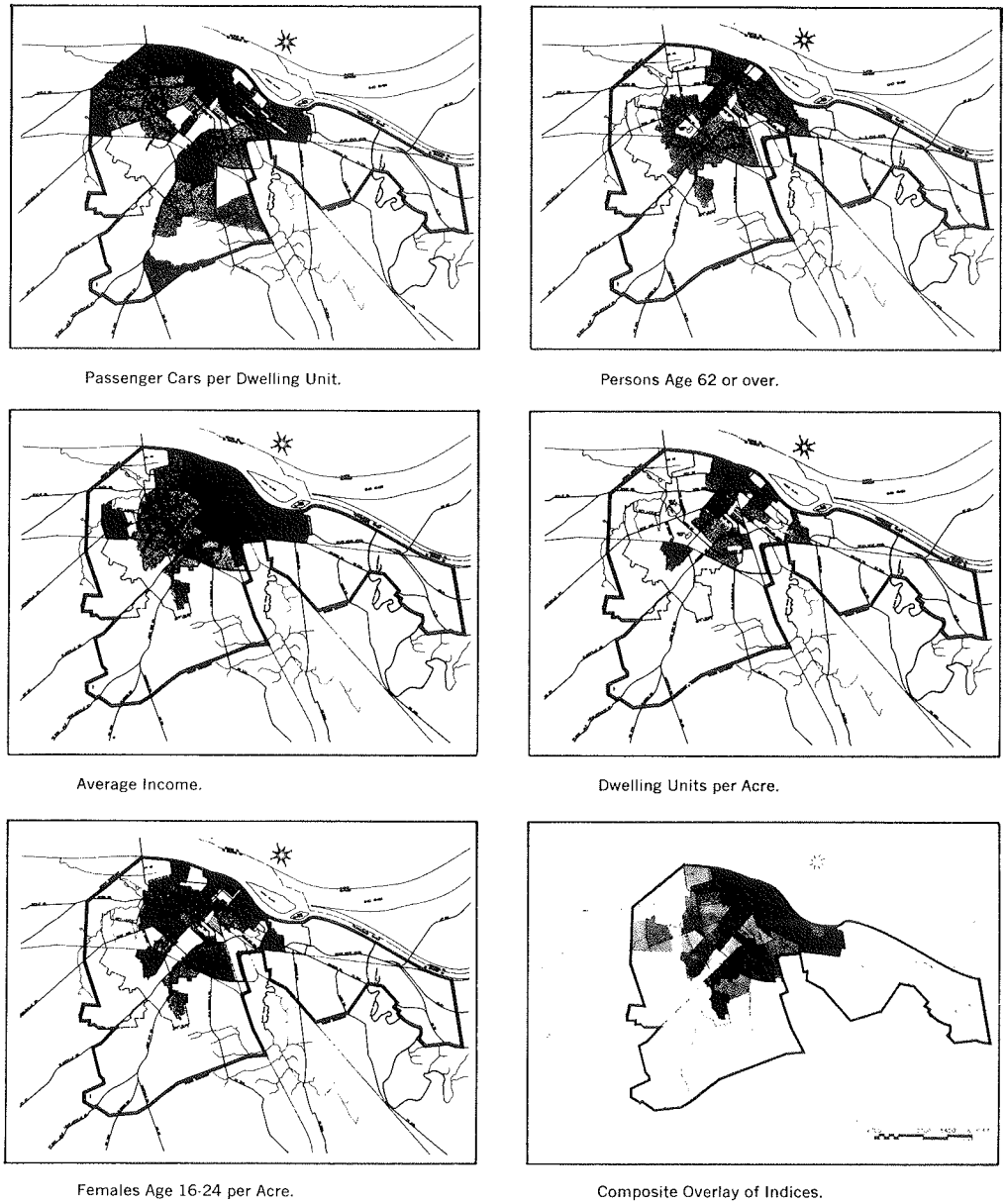


FIGURE 3 Sample plots for successive-overlay technique *(4)*.

Charts and graphs are commonly used to display accessibility measurements. Figure 4 (5) shows a graphic technique that compares accessibility of employment opportunities to population subgroups of differing geographical and income stratifications under two alternative plans. Accessibility is measured during the peak hours for the automobile mode. Similar figures could be developed from census data for other groups, other modes, and other activities and for a wide variety of combinations.

In Figure 5 (5) an isochronal map is used to display the accessibility of the low-income group to employment using the same data as those used for Figure 4. The isochronal map adds a dimension missing from Figure 4 by illustrating that although Plan B provides a higher level of accessibility overall, certain areas are more accessible under Plan A.

A third type of display of accessibility measurement is shown in Figure 6 (5). Accumulated percentages of total population are plotted across travel times to major medical facilities separately for travel by transit and by automobile. Census data can be used to further distribute these variables by sex, income, automobile availability, and so on.

Computer software is available for accessibility analysis. It produces a combination of graphic and tabular reports to display accessibility by a highway or transit system or both. The program is called Special Area Accessibility Model (SAACCESS) and is part of the PLANPAC system of programs. A standard set of reports is produced for each facility or group of facilities using SAACCESS. These include

1. A plot of cumulative percentages of the population versus travel time,
2. A histogram of percentage of the population versus travel time,
3. A tabulation of actual population with the percentage of population and the accumulated percentage of population accessible at each travel-time increment, and
4. A listing for each zone of the closest facility among a number of major community facilities and its travel time.

Locating Park-and-Ride Lots

Census data on work trips by mode can be assigned to the highway or transit network of an area or both for graphic display or they can be displayed as in the examples in Figures 4-6. These offer good visual summaries of conditions as they existed in 1980, and the successive-overlay procedure can indicate those areas that have the potential for increased

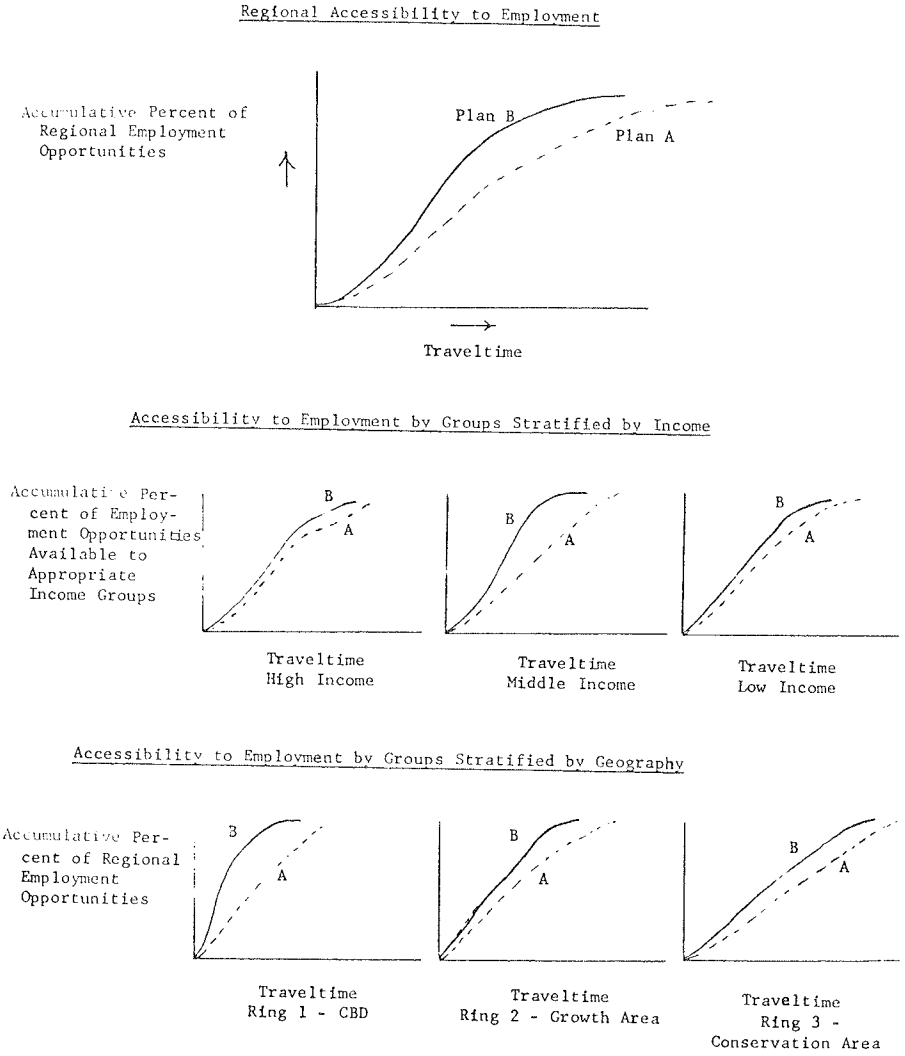


FIGURE 4 Accessibility to employment by automobile during peak hours *(5).*

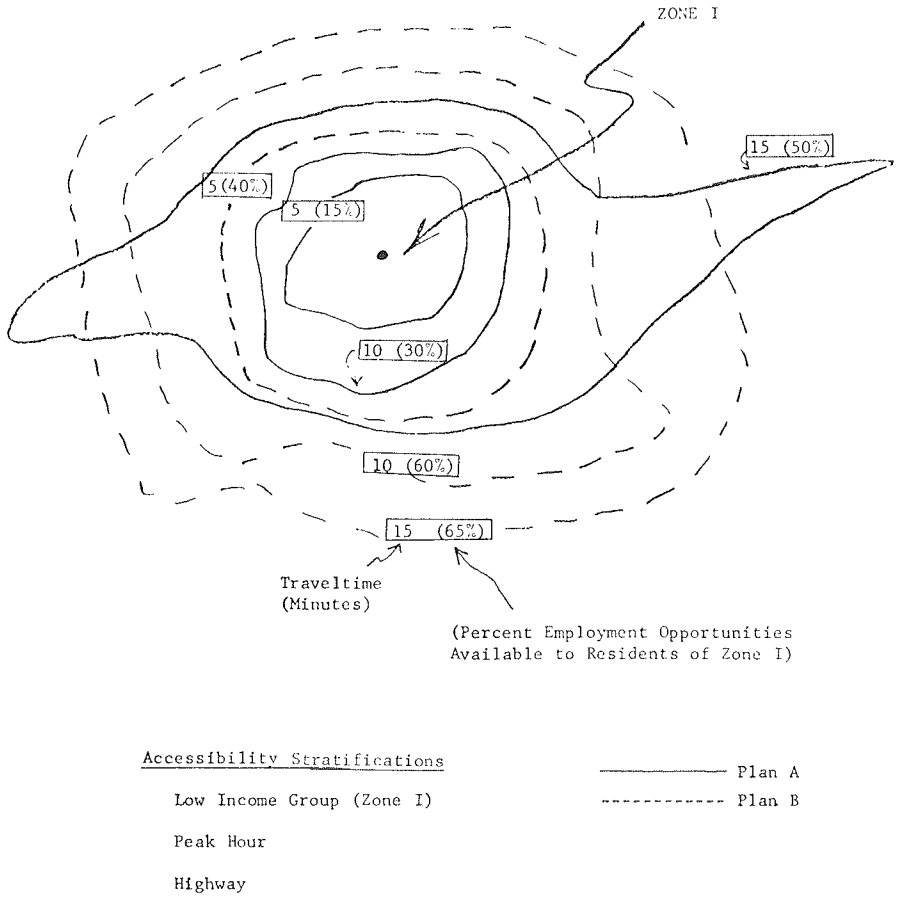


FIGURE 5 Accessibility for low-income group (Zone I) to employment opportunities via highway during peak hours *(5)*.

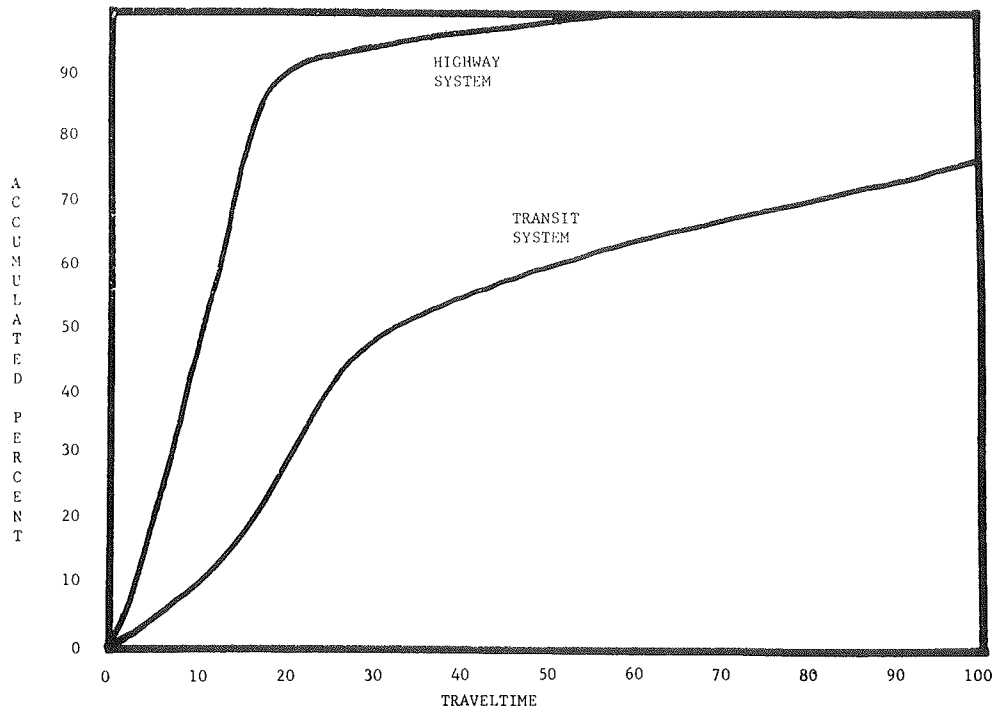


FIGURE 6 Accumulated percentage of total population versus travel time for major medical facilities *(5)*.

ridesharing or transit patronage. However, these types of analysis and display do not reveal the potential transportation savings that would result from provision of park-and-ride lots.

Selection of potential park-and-ride sites for further study can best be achieved by assigning journey-to-work vehicle trips to a transportation network and examining the link volumes that result. Destination areas with large numbers of workers are then selected and trips from all origins to the selected destinations are assigned. (The selected destinations can be combinations of downtown zones that include approximately 1 mile² each, but destinations outside the central business district (CBD) that have large concentrations of employment should also be examined as sources of park-and-ride use.)

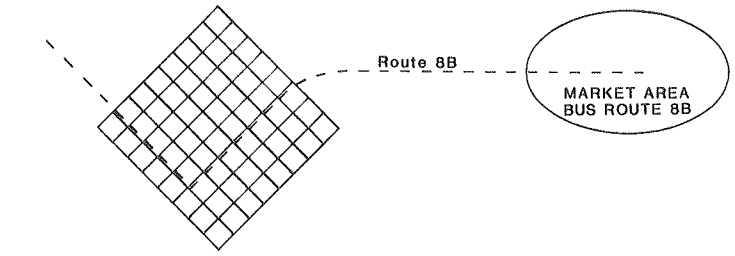
Difficulty arises because traffic assignment programs traditionally assign trips from a single origin to all destinations. To do the reverse, assigning trips from all origins to a selected destination, would prove costly. To overcome this problem, the journey-to-work trip table derived from the census can be reversed so that the workplace appears as the trip origin and the residence appears as the destination. Concentrations of these trips on individual links of the network indicate potential locations for park-and-ride lots.

The Urban Transportation Planning System (UTPS) programs of interest are UMATRIX and UROAD. UMATRIX is used to reverse the trip table. UROAD assigns trips from selected origins to all destinations.

Bus Routing and Circulation Analysis

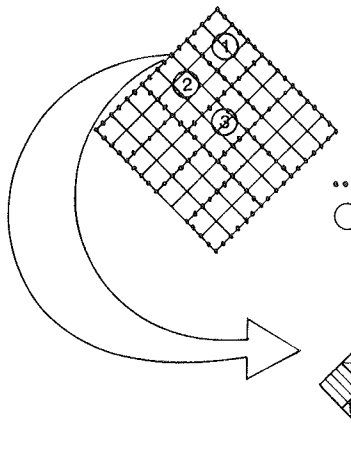
Journey-to-work trip tables contained in Part IV of the UTPP provide information useful for analysis and evaluation of bus routing and circulation.

Figure 7(a) shows an example of what might be a current CBD routing of a bus from an outlying market area. The information in Part IV of the UTPP allows identification of transit trips from the market area to each zone within the central area. CBD zones with high proportions of journey-to-work destinations from the market area are then identified. Generally they are zones with an aggregate of 70 percent of all CBD destinations from the market area. Depending on local conditions, those zones might be selected that have at least a given percentage of total destinations (15 percent in the example shown in Figure 7). Using block-group information at the



(a) EXISTING BUS ROUTING

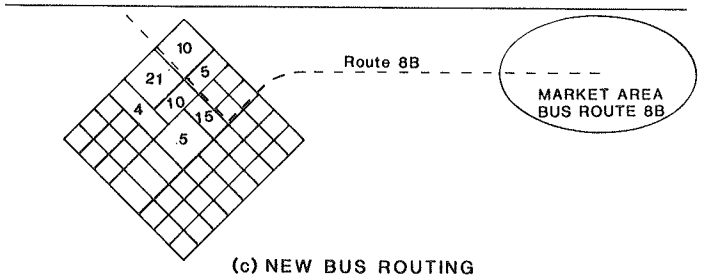
CBD Zone	% Destination from Market Area
1	15
2	35
3	20
All Others	30
	100



Block Group	% Zone Destinations (All Areas)	% Destinations from Market Area *
A	60	21
B	30	10
C	10	4
	100	35

* 35% x % Zone Destination

(b) ANALYSIS OF ZONAL DESTINATIONS



(c) NEW BUS ROUTING

FIGURE 7 Downtown bus circulation analysis.

workplace from Part V of the UTPP, zonal destinations can be further subdivided for a more detailed geographical display, as in Figure 7(b). The existing bus route can then be matched to these destinations to determine how current service might be improved, as in Figure 7(c).

Similar analysis can be done to determine optimum bus routing to a location outside a central area, such as a major industrial park or other region of high employment. Such a case is represented in Figure 8. A bus route through the CBD into an outlying area is show in Figure 8(a). Transit work-trip destinations (from Part IV of the UTPP) in the region outside the central area are plotted by zone. This is done for the origin market area for each route to be examined. The existing routing is then compared with the distribution of destinations to determine whether route changes are advisable. For this type of analysis, zones are generally appropriate areas of aggregation, although in some instances subdivision of destinations by block groups as described for Figure 7 might also be appropriate.

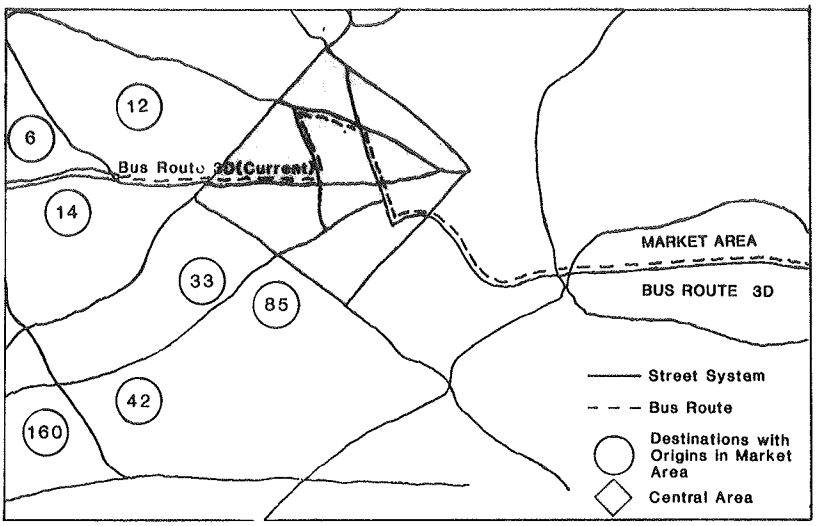
The transit system might already serve the destination concentrations thus plotted by use of transfers in the downtown, but more direct through routing is generally desirable, as shown in Figure 8(b), and is likely to attract greater patronage.

High-Occupancy-Vehicle Lane Evaluation

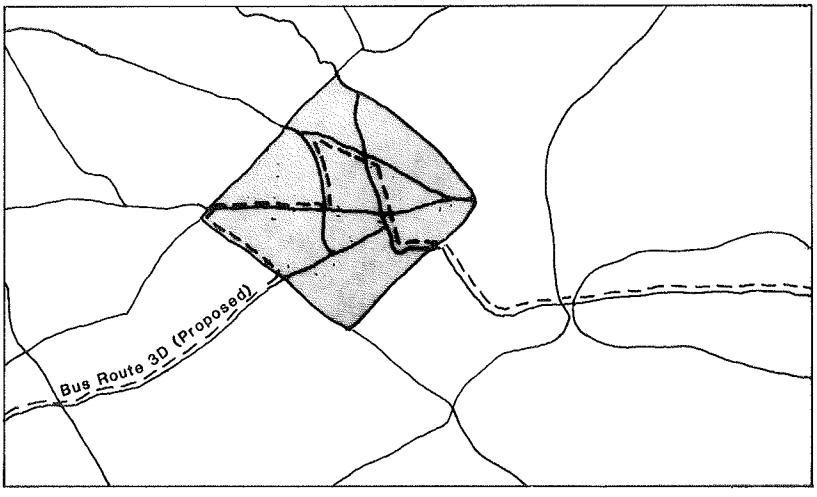
Use of high-occupancy vehicles (HOVs) is often encouraged by reserving a special highway lane that allows faster travel than is possible for other traffic. In designing an HOV lane, one problem often encountered is determining where on the facility the special lane should start. Low traffic volume on the special lane might result if it is not placed at the proper location.

Journey-to-work information from the census is most useful in making this decision. The trip table in Part IV of the UTPP can indicate those residence-to-work movements that are most likely to use the roadway being considered for an HOV lane. The trips selected for examination should be those by vehicles carrying more than one person. These vehicle trips would be accumulated along the facility through a manual assignment based on visual inspection of the best route. The accumulated volumes suggest where the HOV lane should start. Figure 9 shows how the volume might be indicated.

It should be noted that this procedure identifies existing carpools only and fails to acknowledge the potential-carpool market. The institution of an HOV lane itself is likely to encourage a shift to carpooling, and this should also be addressed before a



(a) Current Bus Route and Suburban Destinations



(b) Proposed Bus Route

FIGURE 8 Bus routing analysis.

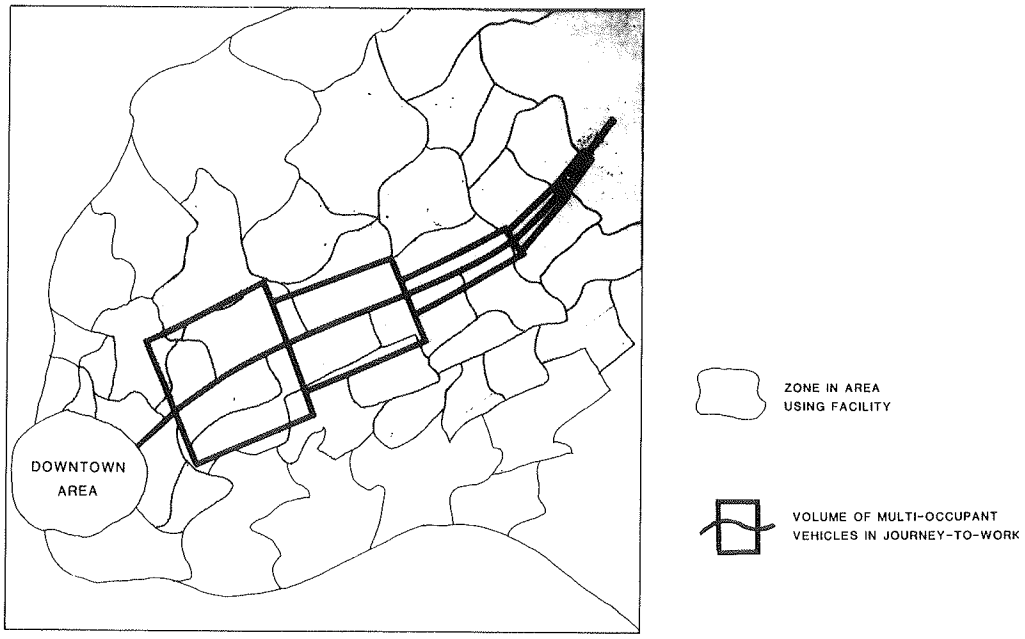


FIGURE 9 HOV-lane vehicle accumulation.

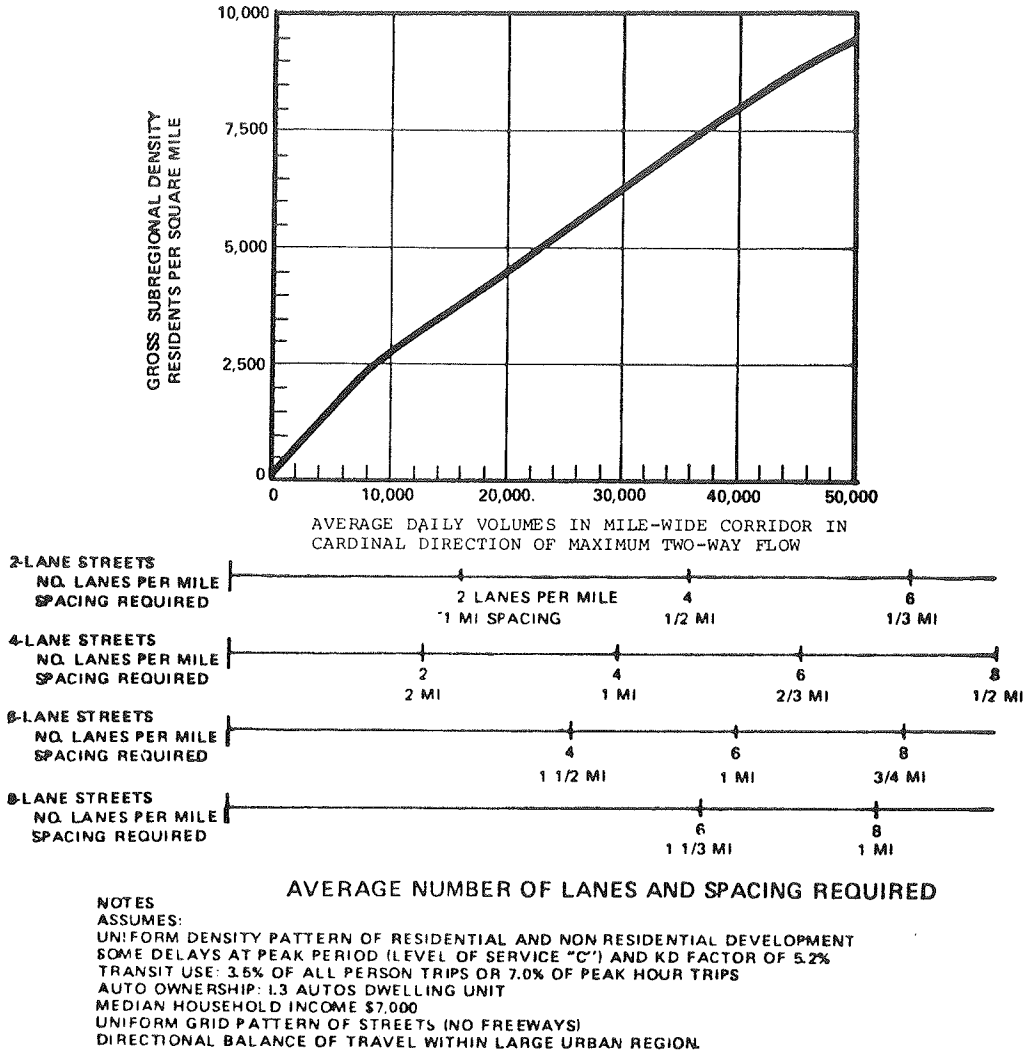


FIGURE 10 Chart for subregional density versus average volumes and lane requirements for arterials *(6)*.

final decision is reached as to where the HOV lane will start or end.

Land Use and Arterial Spacing

A technique developed by Gruen Associates has proven useful in evaluating the impact of a proposed traffic generator (shopping center, industrial park, airport, etc.) on the highway system surrounding the development (6). The procedure can also be used to estimate arterial requirements in developing suburban sections of metropolitan regions where growth potentials offer a broad range of planning opportunities.

Figure 10 (6) shows the first step, an initial approximation of average traffic volumes adjusted by factors based on

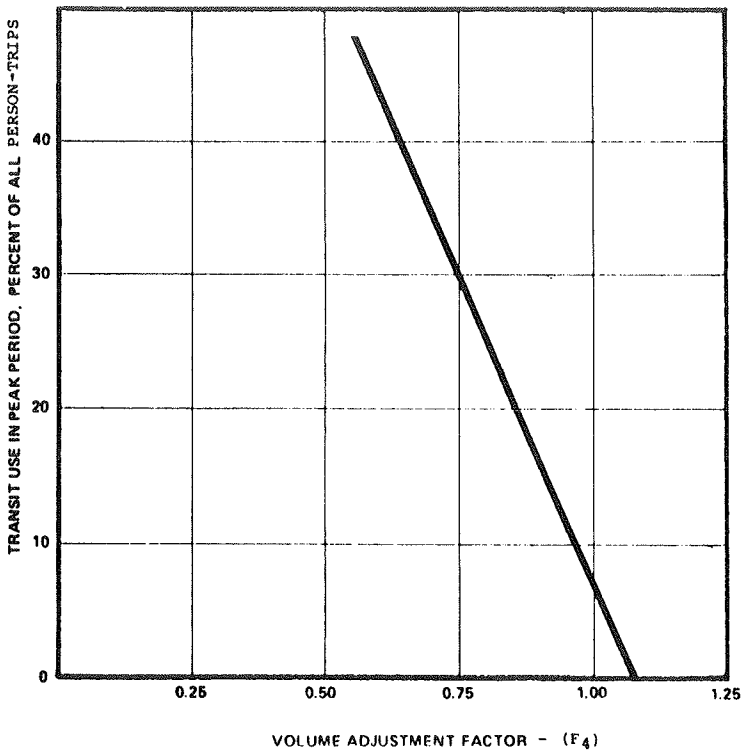
- Density and project size,
- Level of service,
- Automobile ownership,
- Transit utilization,
- Project and nonresidential or residential mix, and
- Freeway diversion.

The average number of lanes and the spacing required are derived from an estimate of gross subregional density in residents per square mile by using population data from the census divided by the area measured from a map. Many of the adjustment factors (for automobile ownership, household income, transit utilization, nonresidential or residential mix) can also be obtained from census data (e.g., UTPP Part I for residential and UTPP Part III for workplace data). The pertinent adjustment curves are shown in Figures 11-13 (6). Those interested in using this technique should refer to the FHWA report (6).

Selected-Link Analysis

In many locations traffic problems arise from the interactions of major movements through a section of highway or arterial roadway. Selected-link analysis is a useful tool for identifying these major interactions and can be performed using origin-destination data available from Part IV of the UTPP.

Although many selected-link applications are accomplished with computer programs available in PLANPAC and UTPS, evaluations of a small number of locations can also be done manually with a map and the journey-to-work trip information from the UTPP. This can be accomplished by determining from census data the origins and destinations of those trip movements that use the section of roadway being examined. The trips are then assigned to the section and accumulated in a fashion that allows evaluation of major movements.



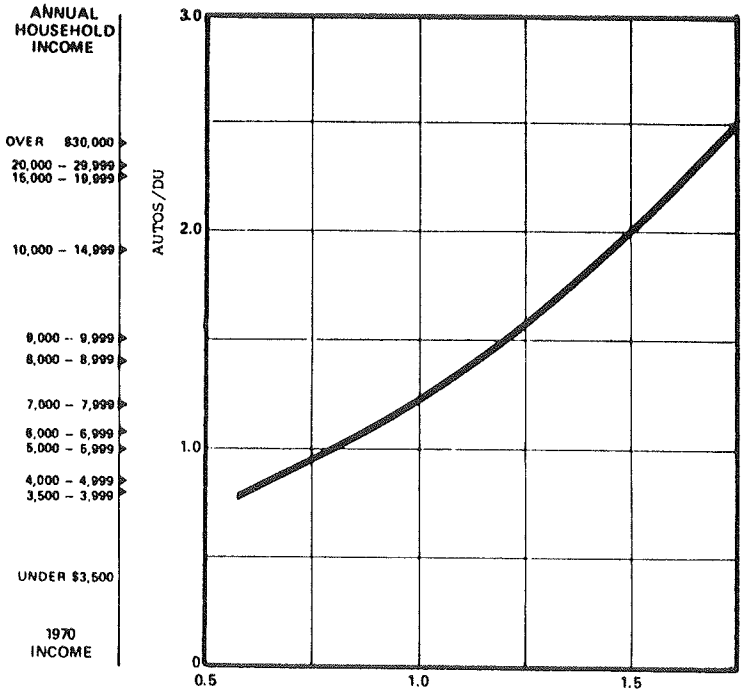
NOTES:

Assumes peak-period transit use of 7% for base condition.

Peak-period transit use of 7% is equivalent to 3.5% of all daily person-trips.

If any adjustment factor of under 0.85 is obtained from above, do not apply an adjustment factor from Figure 107 unless factors are determined to be independent.

FIGURE 11 Adjustment factors for land use: factor F_4 for transit utilization *(6)*.



NOTES:

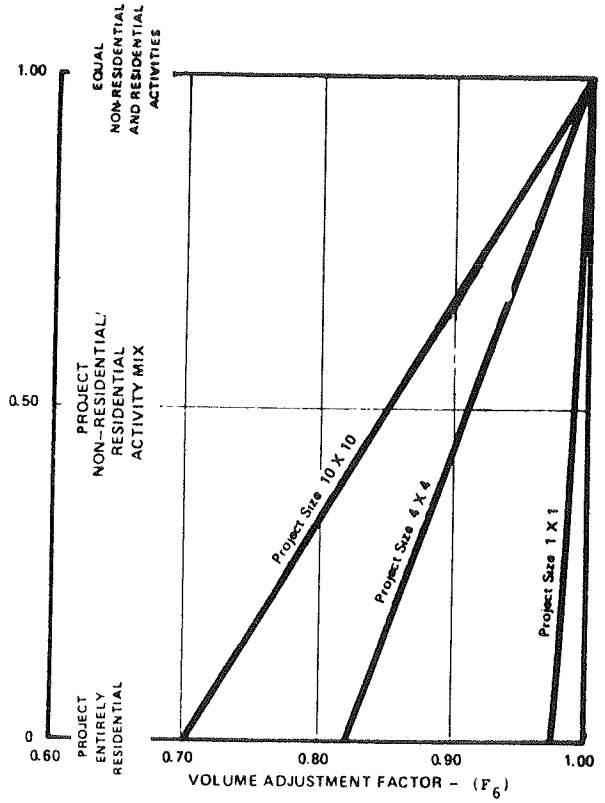
Use autos/DU as the primary parameter for volume adjustments.

Use income scale for approximation only if autos/DU data not available.

Income scale is non-linear.

See Figure 106 note concerning combined use of Figures 106 and 107.

FIGURE 12 Adjustment factors for land use: factor F_5 for automobile ownership and household income *(6)*.



NOTES:

Assumes uniform density pattern of residential development and project containing residential plus nonresidential development.

Assumes uniform grid pattern of streets (no freeways).

Assumes directional balance of travel in large urban region.

Project nonresidential/residential activity mix is defined as the number of jobs provided within project, divided by labor force within project.

For predominantly nonresidential projects (i.e., activity mix greater than 1), use of trip generation tables in Chapter 2 are recommended instead of Figure 108.

FIGURE 13 Adjustment factors for land use: factor F_6 for project nonresidential and residential activity mix *(6)*.

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Model-Related Uses of Census Data for Transportation Planning*

ARTHUR B. SOSSLAU

ABSTRACT

Census data can be used in the application, calibration, and development of urban transportation planning models. A number of such uses are discussed.

The Urban Transportation Planning Package (UTPP) contains data essential to the application, calibration, and development of planning models used to analyze and evaluate complex transportation systems in both large urbanized areas and smaller areas that have fast-growth opportunities. The availability every 10 years of fresh census data on the location and characteristics of both population and employment is of critical importance. Without this information travel demand models would become obsolete and consequently useless tools in the transportation planning process.

Model-related uses of census data, census processing, analysis software, and procedures are discussed as well as factors that can be used to convert daily work-trip totals to levels of travel during peak hours.

TRANSPORTATION PLANNING USES

Following are uses to which census data can be put in the application, calibration, and development of urban transportation planning models.

1. Application
   a. Current socioeconomic data can be used as input to determine current trip generation with existing models (i.e., population, dwelling units, income, vehicles available, employees, etc.)
   b. Census data can serve as a 1980 benchmark against which updated long- and short-range land use and socioeconomic data may be checked
   c. Information from responses to journey-to-work census questions can be used as a secondary source for checking the validity of trip-length frequency distributions, trip ends, and work-trip tables
   d. The census supplies basic information required for some regional growth models
2. Calibration and development
   a. New trip-generation models can be developed using the basic relationships for work trips and secondary relationships for other purposes (e.g., car availability as related to income and household size) derived from census data
   b. Recalibration or checking of work-trip distribution calibration factors (e.g., gravity model F- and K-factors) can be done with journey-to-work trip tables derived from the census
   c. Work-trip mode-choice models, either direct demand or logit formulation, can be developed or recalibrated based on census data
   d. Existing work-purpose-related travel models can be verified or calibrated through accumulations of journey-to-work trips by mode across corridors, cut lines, and cordons around areas such as the central business district (CBD)
   e. Factors and procedures can be developed to convert the journey-to-work census information to peak-hour work travel, which in turn can be converted to all-purpose travel and to all-purpose peak-hour travel

*From Transportation Planners' Guide to Using the 1980 Census, FHWA, U.S. Department of Transportation, Jan. 1983.

f. Land use forecasting procedures can also be developed or calibrated; data from current and previous censuses enable both the development of many types of urban activity models (e.g., empirical model) and validation of previously calibrated models

CHECKING CENSUS DATA

Before the sample-based census estimates of employment by workplace (Part III of UTPP) are used, they should be checked for reasonableness against local conditions or rules of thumb or both. For example, a labor-force participation rate can be developed by comparing census data with the reasonable rate of 0.40 to 0.45 worker per population.

A review of employment data may result in the need to apply one or more factors to census employment estimates to arrive at actual employment levels. The resulting adjusted employment can then be used as input in the trip-attraction procedure to be described in the following. Likewise, zonal data from the census to be used as input to the trip-production procedure should also be reviewed and factored, if needed, although this generally will not be necessary.

CENSUS DATA IN MODEL APPLICATIONS

In this section the focus is on a simplified application of the traditional four-step approach to using census data in model applications, as illustrated by the flow chart in Figure 1 (1). The procedure uses census data as input to available models to validate those models against 1980 ground conditions and to modify the procedure as appropriate. Available models include those borrowed from other areas and those contained in NCHRP Report 187 (1). Modification of models or model development or both thus are possible utilizing census data for work travel as well as data for certain relationships such as automobile occupancy and ownership.

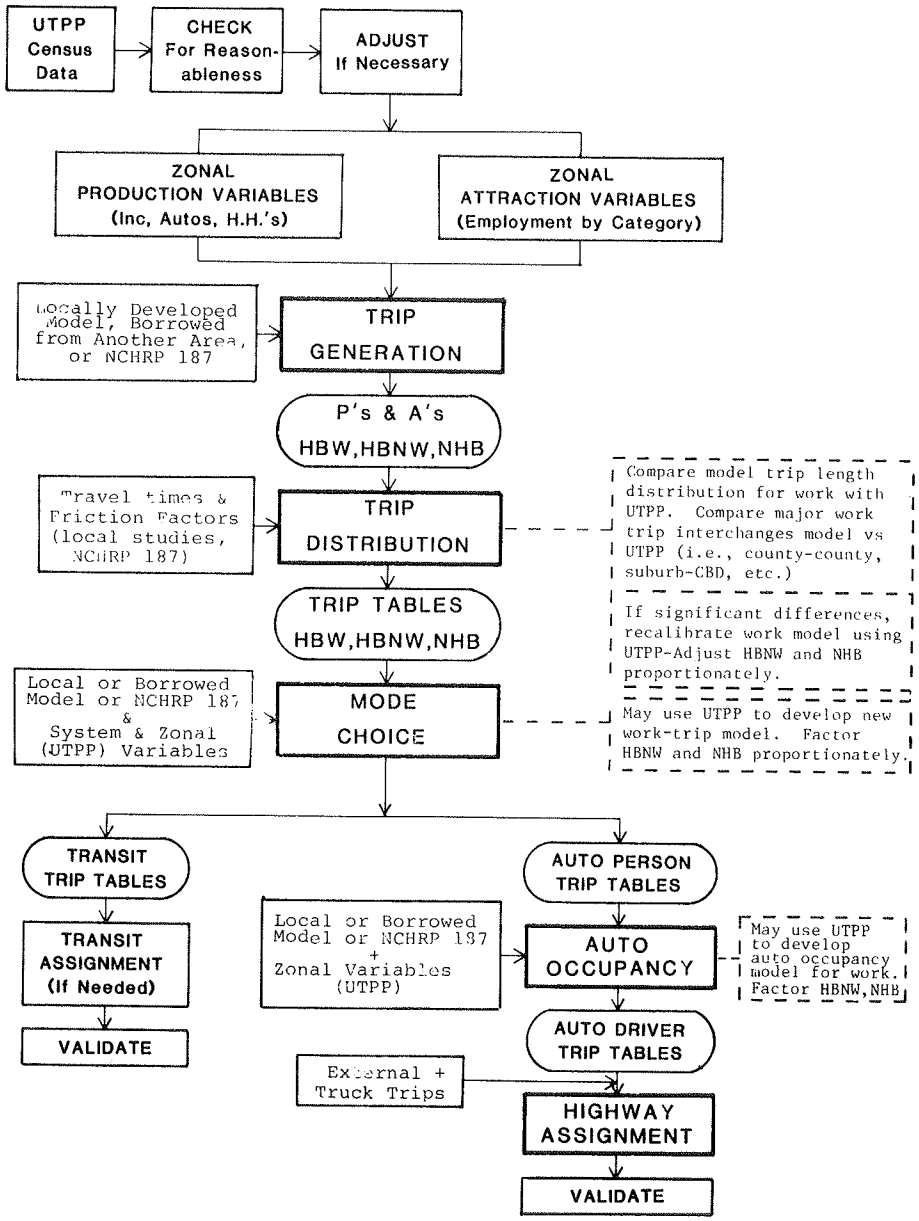

FIGURE 1 Traffic estimation procedures using 1980 census UTPP *(1)*.

Trip Generation

Most trip-generation procedures use such statistical bases as automobile ownership or income or both and the number of households or population or both. The census contains these variables and others used in procedures employed by most planning agencies. For trip-attraction estimates, employment by industry is most often used. These data are also available from the census.

In a 1973 FHWA report a procedure has been suggested for developing a trip-generation model of the cross-classification type that relates trip volumes to automobile ownership, income, and households (2). The purpose here is to update this procedure to conform with trip-generation information contained in NCHRP Report 187. Where a local model is available, it should be considered first.

The procedure is illustrated in Figure 2 (2). The relationship of the percentage of households by income and by cars available (Figure 2A) is derived from census data contained in Table II-14 of the UTPP.

Analysis of previous origin-destination data can establish person trips per dwelling unit by income level and by automobile ownership (Figure 2B). These data can be collected in a local survey or, if not available, can be obtained from NCHRP Report 187 (see Table 1, columns headed Average Daily Person Trips Per HH by No. of Autos/HH).

Figure 2C shows percentage of trips by income and trip purpose. Again, this can be gleaned from local data or from Table 1 (columns headed % Average Daily Person Trips by Purpose).

Care should be taken in using the tables in NCHRP Report 187. First, they are merely national averages for four area population groups. Second, they are based on 1970 data and require updating. Availability of 1980 census data will facilitate updating of certain items in Table 1: 1980 income levels can be used rather than the 1970 incomes shown; the information in the columns headed % HH by Autos Owned can be updated with Table II-14 of the UTPP; and using this updated distribution of percentage of households by automobiles owned from the 1980 census, column 2 of Table 1 can also be recalculated. The equation to be used is as follows:

Avg automobiles per household = (1 x %HH with 1 automobile + 2 x %HH with 2 automobiles + 3.3 x %HH with 3+ automobiles)/100.

(The average number of automobiles per household for households with three or more automobiles is estimated as 3.3.)

These changes should be made only if it appears

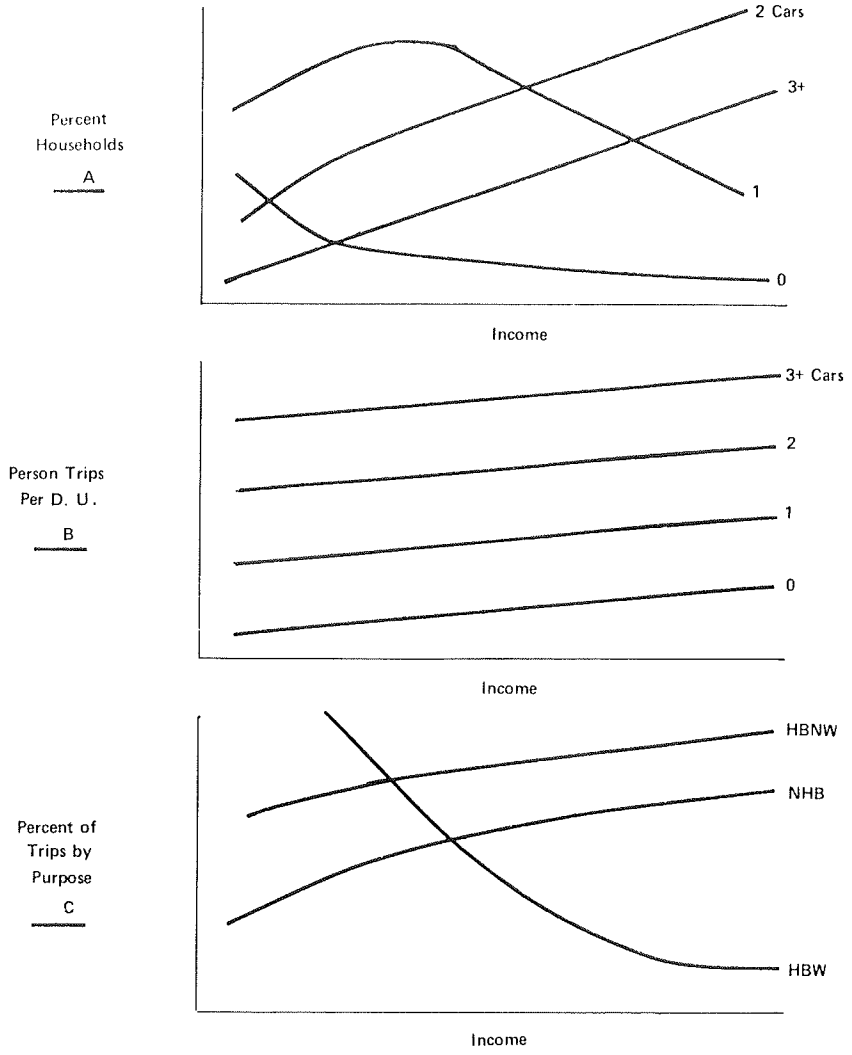

FIGURE 2 Cross-classification trip-generation analysis *(2)*.

that the distribution of percentage of households by automobiles owned for a given urban area is significantly different from that shown in Table 1.

For trip-attraction factors many planners consider other characteristics as well as employment. The default-attraction procedure of the Urban Transportation Planning System (UTPS) and the one included in NCHRP Report 187 (Table 3) both use total employment for home-based work (HBW) trip attraction and retail employment, nonretail employment, and dwelling units for both home-based nonwork (HBNW) attractions and all non-home-based (NHB)

TABLE 1 Detailed Trip-Generation Characteristics *(1)*

URBANIZED AREA POPULATION: 50,000-100,000

Income Range 1970 $ (000's)	Avg Autos Per HH[d]	Average Daily Person Trips Per HH[e]	% HH by Autos Owned[b]				Average Daily Person Trips Per HH by No. of Autos/HH[c]				% Average Daily Person Trips by Purpose[f]		
			0	1	2	3+	0	1	2	3+	HBW	HBNW	NHB
0-3	0.56	4.5	53	39	7	1	2.0	6.5	11.5	12.5	21	57	22
3-4	0.81	6.8	32	58	10	1	2.2	8.0	13.0	15.0	21	57	22
4-5	0.88	8.4	26	61	12	1	2.6	9.5	14.5	16.5	21	57	22
5-6	0.99	10.2	20	62	17	1	3.0	11.0	15.5	18.0	18	59	23
6-7	1.07	11.9	15	64	20	1	3.0	12.5	16.5	19.5	18	59	23
7-8	1.17	13.3	11	64	23	2	3.5	13.3	17.0	21.5	16	61	23
8-9	1.25	14.4	8	62	28	2	4.8	14.0	17.5	22.5	16	61	23
9-10	1.31	15.1	6	60	32	2	5.5	14.3	17.5	24.0	16	61	23
10-12.5	1.47	16.4	3	49	44	3	6.2	15.0	18.5	25.5	15	62	23
12.5-15	1.69	17.7	2	38	52	8	6.1	15.0	19.0	25.5	14	62	24
15-20	1.85	18.0	2	28	57	13	6.0	13.5	19.5	23.0	13	62	25
20-25	2.03	19.0	1	21	58	20	6.0	13.0	20.0	23.0	13	62	25
25+	2.07	19.2	1	19	59	21	6.0	12.5	20.0	23.0	13	62	25
Weighted Average	1.55	14.1	12	47	35	6	4.6	12.6	17.2	21.4	16	61	23

URBANIZED AREA POPULATION: 100,000-250,000

Income Range 1970 $ (000's)	Avg Autos Per HH[d]	Average Daily Person Trips Per HH[e]	% HH by Autos Owned[b]				Average Daily Person Trips Per HH by No. of Autos/HH[c]				% Average Daily Person Trips by Purpose[f]		
			0	1	2	3+	0	1	2	3+	HBW	HBNW	NHB
0-3	0.49	4.0	57	37	6	0	1.0	7.5	10.5	13.8	20	63	17
3-4	0.72	6.8	36	56	8	0	1.7	9.2	13.3	16.4	22	60	18
4-5	0.81	8.4	29	61	10	0	2.5	10.2	14.5	17.6	22	58	20
5-6	0.94	10.2	21	65	13	1	3.5	11.4	14.5	19.0	22	58	20
6-7	1.01	11.7	17	66	16	1	4.5	12.5	15.6	20.5	20	58	22
7-8	1.14	13.6	12	65	21	2	5.4	13.8	17.0	22.2	20	57	23
8-9	1.25	15.3	9	61	28	2	5.8	15.0	17.5	23.0	20	57	23
9-10	1.34	16.2	6	58	33	3	6.3	15.8	18.0	23.5	19	57	24
10-12.5	1.50	17.3	4	50	40	6	6.8	16.0	19.0	24.5	19	57	24
12.5-15	1.65	18.7	2	40	51	7	7.0	16.0	20.4	25.0	19	56	25
15-20	1.85	19.6	2	28	57	13	7.2	15.0	21.0	25.5	18	56	26
20-25	2.01	20.4	1	20	61	18	7.5	15.0	21.0	25.5	18	55	27
25+	2.07	20.6	1	19	59	21	7.5	15.0	21.0	25.2	18	55	27
Wt. Avg.	1.55	14.5	14	48	33	6	5.4	13.7	18.4	22.4	20	57	23

attractions. These data are available by zone in Parts I and III of the UTPP.

The results of applying the trip-generation model can then be used as input to a trip-distribution model, which in turn can be assigned to the transportation network. If ground counts are not closely matched, the trip-generation rates might require adjustment.

Regardless of the trip-generation procedure used, the independent variables are probably available from the census UTPP and the models can be applied either to the census-year data or to census data updated to the current year.

Trip Distribution

For trip distribution, zone-to-zone travel times from the local area network would be used with previously developed friction factors for the area. If locally developed friction factors are not available, they may be borrowed from another area or the values in NCHRP Report 187 may be used. For work trips, the journey-to-work information in Part IV of the UTPP can be used to develop a trip-length frequency distribution. If this distribution is significantly different from that obtained by applying the distribution model, the model should be recalibrated. Before recalibration, the census-derived frequency distribution of work-trip lengths should be smoothed out, as is usually done for calibration. For HBNW trips and NHB trips, the change in the frequency distribution of trip lengths exhibited by the census data for work trips should be applied proportionately.

Another check is to compare the distribution of work trips from the census with that from the model, both perhaps summarized to larger area levels: county to county in large urbanized areas and superdistrict to superdistrict in medium-sized and smaller areas.

The journey-to-work information in the census also includes data needed to develop updated F- and K-factors for the gravity model. For many agencies the 1980 census is the source of the most recent such travel information available for this recalibration. A UTPS gravity model program is used in calibrating or applying the gravity model. The program's input would be the journey-to-work trip table.

Mode Choice

The next step described in Figure 1 is development of a procedure to estimate mode choice. In all but large urbanized areas, simple estimation of the choice of travel mode is often appropriate. In such cases direct generation of transit trips is often also desirable.

Mode choice at the residence end is usually related to income, household size, and vehicle availability, data on all of which are contained in the census. Characteristics peculiar to local systems can be factored in by determining the availability or nonavailability of transit service in a given zone or by a computer-generated accessibility measure. The same type of analysis of mode choice at the workplace can also be accomplished with data on certain worker characteristics, such as the number of workers by income, sex, and industry from the census. It should be noted, however, that estimates of mode choice made from census data are for work trips only, although these trips are the ones of greatest concern in most areas.

Several tabulations in the UTPP will be useful in developing estimates of mode choice. Those in Part II will be of greatest value. For example, UTPP Table II-6 summarizes the number of workers by vehicles available, by income, and by mode. This may be displayed in the form shown in Figure 3A. Another useful relationship is that of transit use to income and workers per household, as shown in Figure 3B. Such relationships might be developed separately for central city residents and for those in the remainder of the urban area.

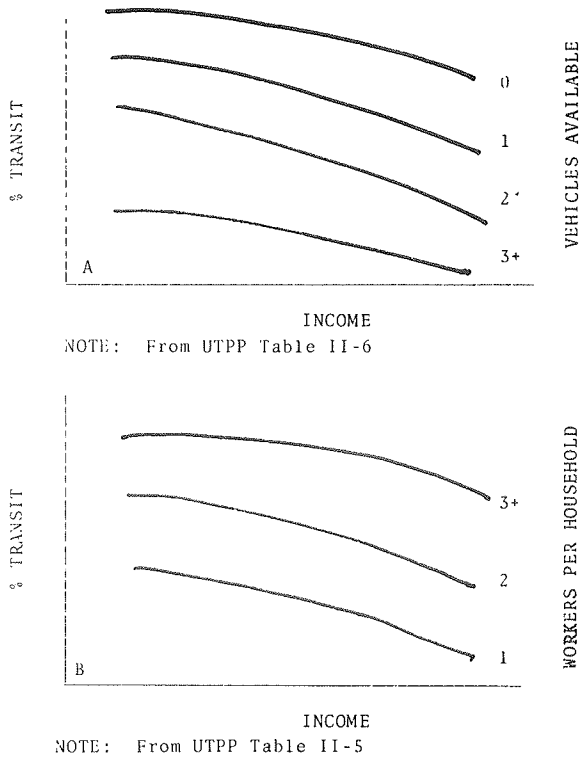

FIGURE 3 Potentially useful relationships for transit estimates: residence end.

UTPP Table III-8 is probably the most useful in developing a destination-end mode-choice relationship. One approach is to correlate the workplace (e.g., CBD, central city, remainder of area) with the sex of the worker and whether the census tract or zone of work is served by public transit. This last item will have to be added to census data from local sources. In this way a table patterned on the following one can be developed using averages derived from census data (employment density might be used as a replacement variable):

Transit Availability	Sex	Area Type	Percentage Using Transit
Y	M	CBD	X.X
		Central city	X.X
		Suburbs	X.X
	F	CBD	X.X
		Central city	X.X
		Suburbs	X.X
N	M	CBD	X.X
		Central city	X.X
		Suburbs	X.X
	F	CBD	X.X
		Central city	X.X
		Suburbs	X.X

The UTPP can also be used to calibrate aggregate mode-choice models using data of observed work trips by mode among zones in an urban area. The models are aggregate in that the dependent variables could include travel times and costs by each mode between zones in each pair and the sociodemographic characteristics of the zones such as income or automobile availability. A logit model structure can be used to calibrate these aggregate models of work-trip mode choices, and any of several UTPS programs can be used to develop the necessary data to calibrate the models. Such models usually are not required in smaller urban areas.

Data available in origin-destination format from the UTPP include total trips by mode, perceived travel time by mode, number of workers, number of vehicles, and number of persons per carpool. Additional information is needed to develop a model, including network travel times by mode, travel costs by mode, and sociodemographic variables from each end of the trip. Some of these data will be available from other sections of the UTPP, but others must be obtained from local transportation sources. The UTPS program that can most readily assemble this information into a calibration file is UMODEL, which permits melding of census data in EBCDIC format with network impedance data in UTPS matrix format and will optionally produce a calibration file in the format required by the UTPS logit model calibration program ULOGIT. Figure 4 is a simplified flow chart of this process of mode-choice model calibration showing required data sets and programs.

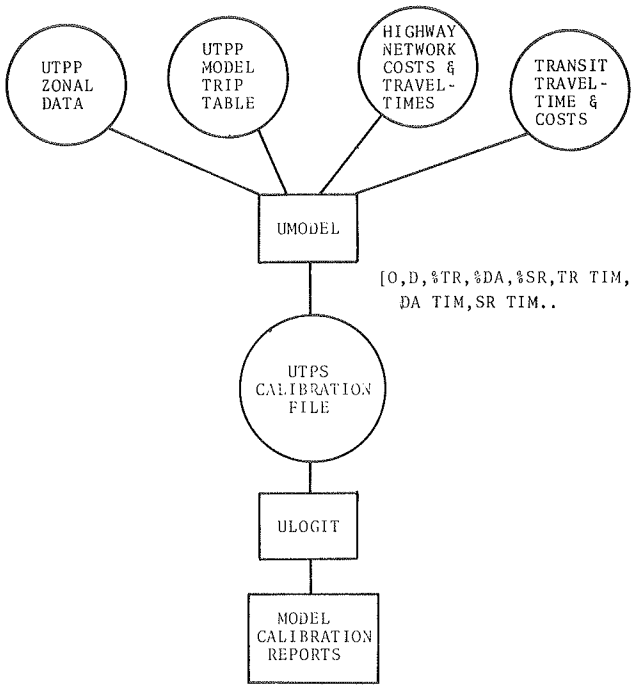

FIGURE 4 Process for calibrating work mode-choice model from UTPP and network data.

Automobile Occupancy

If a locally developed automobile occupancy procedure is available, it should be considered first. If not, alternatives are procedures borrowed from another area, factors provided in NCHRP Report 187 (see Table 3), and relationships available from the UTPP. Relationships for the residence end are contained in UTPP Tables II-9 through II-12. Table IV-3 has occupancy data on an origin-destination basis by zone or tract or both. Table V-6 provides persons per vehicle by destination. Such zone-level data can be used to develop relationships between occupancy and other characteristics not included in Part II tables, if desired.

The census material provides occupancy data only for work travel. The relationship between NHB and HBNW vehicle occupancy data can be developed by evaluating the relationship of these to work-trip occupancy data from an old local survey, from other urban areas, or from data in NCHRP Report 187 and by proportionately adjusting the work-occupancy model developed from census data.

Other Considerations

Forecasting of truck travel and external travel may also be desired. Again, local data or procedures may be available and should be considered first. NCHRP Report 187 contains a table (see Table 3 and the discussion under Trip Factors that follows) for converting internal automobile-driver trips to total vehicle trips, including truck trips and external trips.

The results of applying this procedure should be validated against known local conditions. Assignment results are normally checked against ground counts and detailed information about such checking has been reported in several publications. A good summary is provided in the system planning manual of the series Transportation Planning for Your Community (3,pp.45-48).

JOURNEY-TO-WORK DATA CONVERSIONS

Transportation agencies traditionally have forecast travel demand in terms of total daily travel using models and techniques based on total daily trips. Others use peak-hour models, recognizing that peak-hour volumes are needed for many analyses and network designs. Because the journey to work constitutes only one trip purpose, census journey-to-work counts must be converted to these counts of total daily trips or total peak-hour trips.

Less error is introduced in converting census work trips to peak-hour trips than is the case with conversions to total daily trips because work trips constitute 70 to 80 percent of all peak-hour trips. However, some research indicates that 92 percent of the variation in the results of origin-destination trips assigned to a network can be explained by daily work-trip link volumes (4). Also, considerable data are available on peak-hour factors by type of facility, area of city, and orientation of facility (5).

Trip Factors

NCHRP Report 187 contains tables for converting trips among various subgroupings, such as peak-hour, total day, and work trips, and for estimating total vehicle travel from internal-resident travel. There is a separate table for each range of urban area population (1, Chapter 6). Table 2 (1) presents this information for urban areas with populations of 250,000 to 750,000. Using Table 2, for example, total travel can be estimated from work travel by applying a factor of 5.515. If peak-hour travel is to be estimated from total work travel, a factor of 0.554 should be used, and so forth.

The factors in the table are averages for many

TABLE 2 Conversion Factors for Critical Periods of Internal Person Travel: Urbanized Area Population of 250,000 to 750,000 *(1)*

HAVE \ NEED	Total Travel	Total Work Travel	Comb. Pk.Pd. Total Travel	Pk.Hr. Total Travel	Comb. Pk.Pd. Work Travel	A.M. Pk.Pd. Work Travel	P.M. Pk.Pd. Work Travel	Pk.Hr. Work Travel
Total Travel		0.181	0.322	0.101	0.103	0.057	0.049	0.038
Total Work Travel	5.515		1.778	0.554	0.572	0.316	0.271	0.211
Comb. Pk.Pd. Total Travel	3.101	0.562		0.312	0.322	0.178	0.152	0.118
Pk.Hr. Total Travel	9.947	1.804	3.208		1.032	0.570	0.489	0.380
Comb. Pk.Pd. Work Travel	9.675	1.748	3.110	0.969		0.553	0.473	0.368
A.M. Pk.Pd. Work Travel	17.450	3.164	5.627	1.755	1.810		0.857	0.666
P.M. Pk.Pd. Work Travel	20.361	3.693	6.566	2.047	2.111	1.166		0.777
Pk.Hr. Work Travel	26.193	4.749	8.447	2.633	2.717	1.501	1.286	

"Work Travel" refers to HBW trips. "Total Travel" is (HBW + HBNW + NHB) trips. See text for definitions of travel for the various time periods.

Source: Computed from travel data contained in Reference (36), Chapter 2 and Chapter 5.

areas within the population range. They are also averages for the entire region and can be expected to vary from zone to zone. If local data are available, they should be used to develop either an area-wide factor or a factor for each zone within the area.

An example of another useful table in NCHRP Report 187 is Table 3 (1), also for urban areas with populations of 250,000 to 750,000. Its factors convert estimates of total internal automobile-driver trips (made by applying factors such as those in Table 2 to census journey-to-work data) to estimates of total vehicle trips. For example, total daily trips, including external trips, truck trips, and so on, are 1.5 times the number of internal automobile trips alone.

The factors listed in Table 3 are for conversions by hour of the day. For instance, total trips for the peak hour 7:00 to 8:00 a.m. can be calculated as 1.3 times the internal automobile-driver trips in that time period.

It is useful to examine how some trip factoring can be accomplished using available software. The discussion that follows assumes that local origin-destination data are used rather than values from NCHRP Report 187.

In the first method [Figure 5 (2)], factors for converting work-trip ends to peak-hour trip ends are developed by zone for both origins and destinations. Inputs to this factor development are base-year origin-destination output from UTPS program MBUILD. This program can separate peak-hour trips from the total daily origin-destination work-trip file using the starting time of each trip.

The trip-end factors thus developed can be applied to the census work-trip table using the UTPS program UMCON to obtain a 1980 peak-hour trip table. To judge the adequacy of this trip table, the trips should be assigned to a 1980 network and compared with 1980 peak-hour ground counts. Forecasts of work-trip ends can be made using existing or updated trip-generation models or new models developed from census data. Application of the previously developed factors results in a forecast of peak-hour trip ends, which can then be distributed and assigned to a future transportation network. This technique assumes that models have been provided that are capable of distributing and assigning peak-hour trips rather than the more traditional total daily trips. A similar approach bases trip-end conversion factors on the relationship between work trips and total daily trips.

TABLE 3 Hourly Distribution of Internal Automobile-Driver and Total Vehicle Travel: Urbanized Area Population of 250,000 to 750,000

Hour	Percent Internal Auto Drivers	Percent Total Vehicles (INT + EXT)	Ratio Of Total Vehicles To INT Auto Drivers
24-1	0.9	0.9	1.45
1-2	0.4	0.5	1.80
2-3	0.3	0.4	2.07
3-4	0.1	0.3	2.88
4-5	0.2	0.4	2.57
5-6	0.8	1.0	1.87
6-7	4.4	4.3	1.49
7-8	10.0	8.6	1.30
8-7	6.2	6.4	1.53
9-10	3.8	4.8	1.88
10-11	4.1	5.0	1.82
11-12	4.4	5.0	1.73
12-13	4.7	5.1	1.63
13-14	4.7	5.3	1.69
14-15	5.2	5.7	1.64
15-16	7.3	7.3	1.50
16-17	9.5	9.1	1.44
17-18	10.4	9.4	1.35
18-19	6.3	5.9	1.40
19-20	5.2	4.7	1.33
20-21	3.8	3.4	1.35
21-22	3.4	3.1	1.33
22-23	2.3	2.0	1.29
23-24	1.6	1.4	1.35
	100.0	100.0	1.50[a]

Source: FHWA study *(5)* and nine urbanized area studies.
[a]Represents weighted average for determining ADT total VMT from total internal auto driver travel.

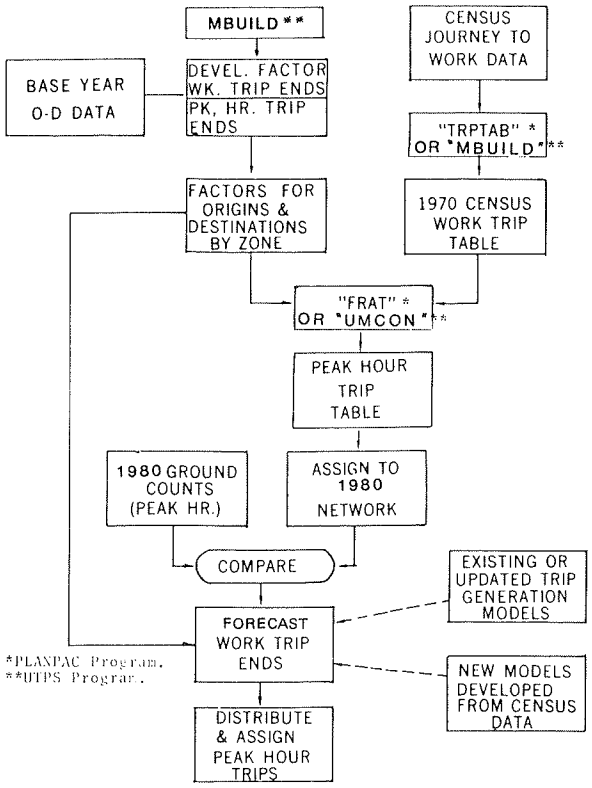

FIGURE 5 Peak-hour model: trip ends *(2)*.

In an average daily traffic (ADT) model, socioeconomic data from the census are applied to existing or updated trip-generation models to obtain 1980 trip ends by zone for all trip purposes [Figure 6 (2)]. Census journey-to-work trip ends by zone are applied to the previously developed trip ends to arrive at conversion factors. These might be developed for the entire study area or for smaller geographic units, depending on the level of aggregation of the data from which the factors were developed.

Work trip ends can be forecast by using existing or updated trip-generation procedures, discussed earlier. The factors for work to total trip ends can then be applied to obtain total future trip ends. The remainder of the forecasting process involves application of traditional estimating techniques.

The Washington, D.C., Transportation Planning Board has developed peak-hour trip relationships based on employment density and trip length (6). The board reasoned that as employment at the destination of the trip increases, the ratio of peak-hour to work trips decreases (i.e., work trips become a larger part of total peak-hour trips). However, consideration should be given to the type of land use as an indicator that may perform better than employees per acre. Similarly, the board reasoned that the longer the trips, the greater will be the percentage of total peak-hour trips that will be trips to or from work. These two relationships are shown in Figure 7 (2). Application of the concept involves combining both relationships, as shown at the bottom of the figure. A matrix of zone-to-zone work trips can also be factored using ratios based on employment at the destination and travel time (skim tree) between the zones.

Gravity Model Calibration and Development

Journey-to-work census data are useful in checking local work-trip distribution models, adjusting or recalibrating those models, or developing new ones. As obtained from the census, the data can be used to develop a trip-length frequency distribution, which can then be compared with distributions developed by applying the local model. Correspondence between the two indicates that the local model remains reliable.

Trip-Volume Factors

Surveys of peak-hour travel by type of roadway have resulted in distributions of percentages of average daily peak-hour traffic by functional class of roadway, by type of area (CBD, suburb, etc.), and by roadway orientation (radial, circumferential, etc.) (5). Using peak-hour assigned volumes, as might be developed using the procedure shown in Figure 5, factors can be applied to obtain ADT.

NCHRP Report 187 contains tables of hourly factors by facility type, area type, and trip orientation by population size group. Table 4 (1) is an example for arterials in urbanized areas with populations of 250,000 to 750,000. If the default values are used, the journey-to-work trip table derived from census data, adjusted for such definition discrepancies as average day versus usual day (1, Chap-

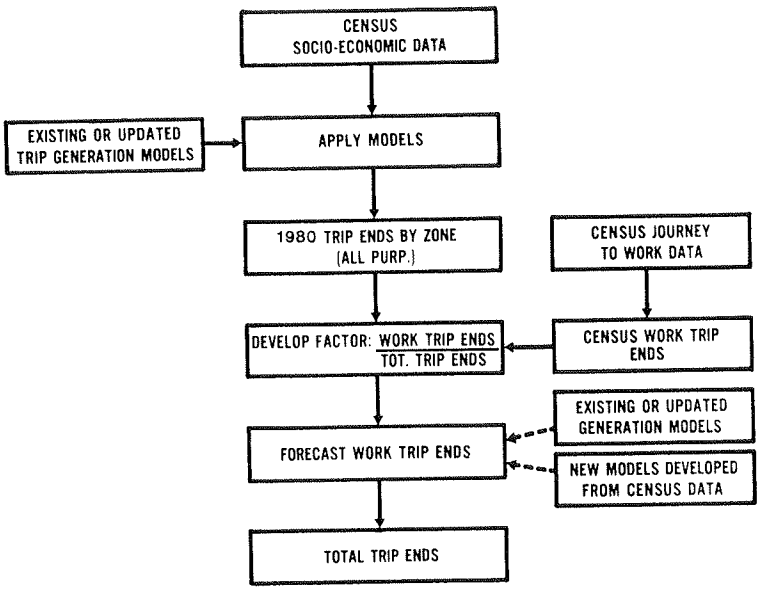

FIGURE 6 Work trip model: trip ends *(2)*.

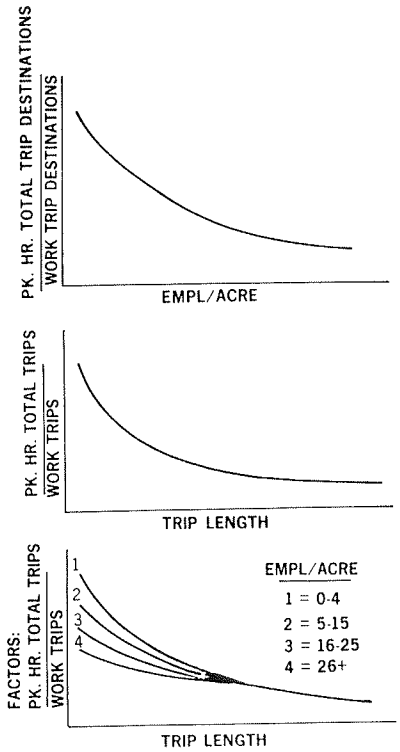

FIGURE 7 Peak factors related to employment density and trip length *(2)*.

TABLE 4 Hourly Distribution of Total Travel on Arterials: Urbanized Area Population of 250,000 to 750,000 *(1)*

HOUR	DISTRIBUTION & ORIENTATION BY SUBREGION										HOUR
	CBD		Central City				Suburb				
	All Orientations		Radial		X-Town		Radial		X-Town		
	% ADT	DIR SPLT[a]	% ADT	DIR SPLT[a]	% ADT	DIR SPLT[a]	% ADT	DIR SPLT[a]	% ADT	DIR SPLT[a]	
24-1	1.0	50	1.5	40	1.5	40	1.5	32	1.5	50	24
1-2	1.0	50	0.5	44	0.5	44	1.0	34	0.5	56	1
2-3	0.5	50	0.5	42	0.5	48	1.0	34	0.0	50	2
3-4	0.5	52	0.5	48	0.5	42	0.5	44	0.5	52	3
4-5	0.5	54	0.5	56	0.5	54	1.0	52	1.0	64	4
5-6	2.0	58	2.0	54	1.0	64	2.5	70	2.0	72	5
6-7	5.0	60	5.0	68	4.5	68	6.0	72	6.0	82	6
7-8	7.0	64	7.0	70	6.5	74	5.5	68	6.5	68	7
8-9	6.5	64	5.5	64	5.5	54	4.5	60	4.5	60	8
9-10	5.0	58	4.5	58	4.5	54	5.0	56	4.0	58	9
10-11	5.5	54	5.0	52	4.5	54	5.0	54	4.0	54	10
11-12	5.5	52	5.0	52	5.0	48	5.0	50	4.5	54	11
12-13	5.5	52	5.0	50	5.5	50	5.0	50	5.0	48	12
13-14	5.5	52	5.0	50	5.5	52	5.5	52	5.0	50	13
14-15	6.0	52	6.0	52	6.0	56	6.0	54	6.0	52	14
15-16	8.0	50	7.5	42	7.0	52	6.5	46	7.0	44	15
16-17	9.0	44	8.0	38	8.5	36	8.5	42	8.0	36	16
17-18	6.5	42	8.0	38	7.5	42	7.5	38	8.5	36	17
18-19	4.5	50	6.0	48	6.0	50	6.0	48	6.5	48	18
19-20	4.0	52	5.0	50	5.5	54	4.5	50	5.5	54	19
20-21	3.5	48	4.0	44	4.5	52	4.0	46	4.5	50	20
21-22	3.0	46	3.5	42	4.0	48	3.5	46	4.0	38	21
22-23	2.5	50	2.5	46	3.0	52	2.5	46	3.0	30	22
23-24	2.0	52	2.0	42	2.0	46	2.0	46	2.0	32	23
	100.0		100.0		100.0		100.0		100.0		

Source: Reference (36) and nine urbanized area studies.
[a] % in a.m. peak direction.

ter 3), can be converted to total peak-hour volume using the factors in Table 2. This peak-hour table is then assigned to the transportation network and factors listed in Table 3 are applied to obtain total daily travel. As noted earlier, these default values are national averages, and local data should be used if available.

Regardless of the procedure used, a good ground count program can supply the information needed to check results and calibrate or adjust them as needed.

CENSUS PROCESSING AND ANALYSIS PRODUCTS

Software programs useful for handling 1980 census data are available from the Bureau of the Census, FHWA, and UMTA. The functions to be accomplished with these programs include development of formats for tabulations, geographic plotting, statistical analysis, geographic coding, data-base management, and development of trip tables and other input for transportation models.

Format

These data items of the UTPP are supplied without format design. Three options are available in purchasing the UTPP from the Bureau of the Census:

1. Full UTPP tabulations on tape without format with a print program and only Part II on a computer printout,
2. Full UTPP tabulations on tape without format with a print program and all six parts on a computer printout, or
3. Full UTPP tabulations on tape without format with a print program and all six parts furnished on microfiche.

Census Data Accessibility with UTPS

Access to two types of census data can be made directly with UTPS: geographic trip-end data associated with traffic analysis zones (or census tracts) and trip-interchange data, both available from UTPP tabulations.

Geographic trip-end data tabulations are those associated with a zone or tract that can be related to travel, such as number of households, average household income, distribution of households by number of vehicles in the household, and so on.

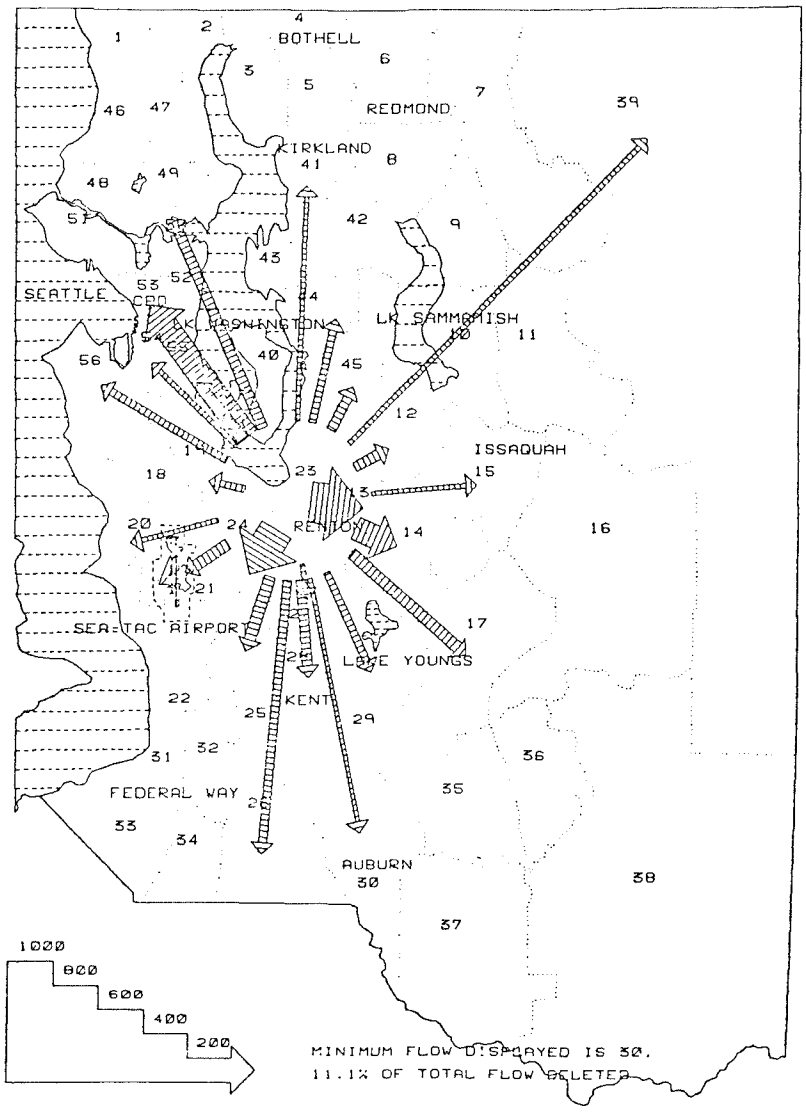

FIGURE 8 Interzonal flow of transit work trips.

Travel forecasting and analysis models within UTPS can be used with these data in a variety of studies but these data must first be converted to formats that can be read by UTPS programs. The UTPS program UMODEL can be instructed to read EBCDIC data in the format from the census UTPP tape and to convert tabulations to UTPS Z-file format.

The Z-file format is the structure used by UTPS to store zonal or geographic trip-end data. It constructs Lists of Attribute Values (LAVs) that contain the data for each zonal attribute. For example, an LAV can be constructed of zonal population, the contents of which would be the population of each zone in the study area. Once the Z-file and associated LAVs have been constructed by UMODEL from UTPP tabulations, they can be used by other UTPS programs, such as UMATRIX, to perform manipulations and transgenerations on the LAVs and to apply models using a powerful command language.

Trip-interchange data in the UTPP include origin-destination person-trip tables by mode for work trips, perceived travel time by mode, number of vehicles, average vehicle occupancy, and average carpool size for each origin-destination pair. These EBCDIC zonal interchange data files on the UTPP tape also must be converted to UTPS format to be made accessible to appropriate programs. The UTPS program most suited for this is MBUILD, designed to build UTPS J-files. This format includes origin zone, destination zone, and zonal interchange values.

Bureau of the Census Software

The Bureau of the Census has also developed software packages useful in manipulating and analyzing standard census products. These software systems are not necessarily appropriate for use with the UTPP, however.

The Data User Services Division of the Bureau of the Census provides varying degrees of support for the computer programs it distributes. For information about computer programs and support services supplied by the bureau, contact Lawrence Finnegan, Systems and Programming Branch, Data User Services Division, Bureau of the Census, Washington, D.C.

Other Software

Several other computer software programs are avail-

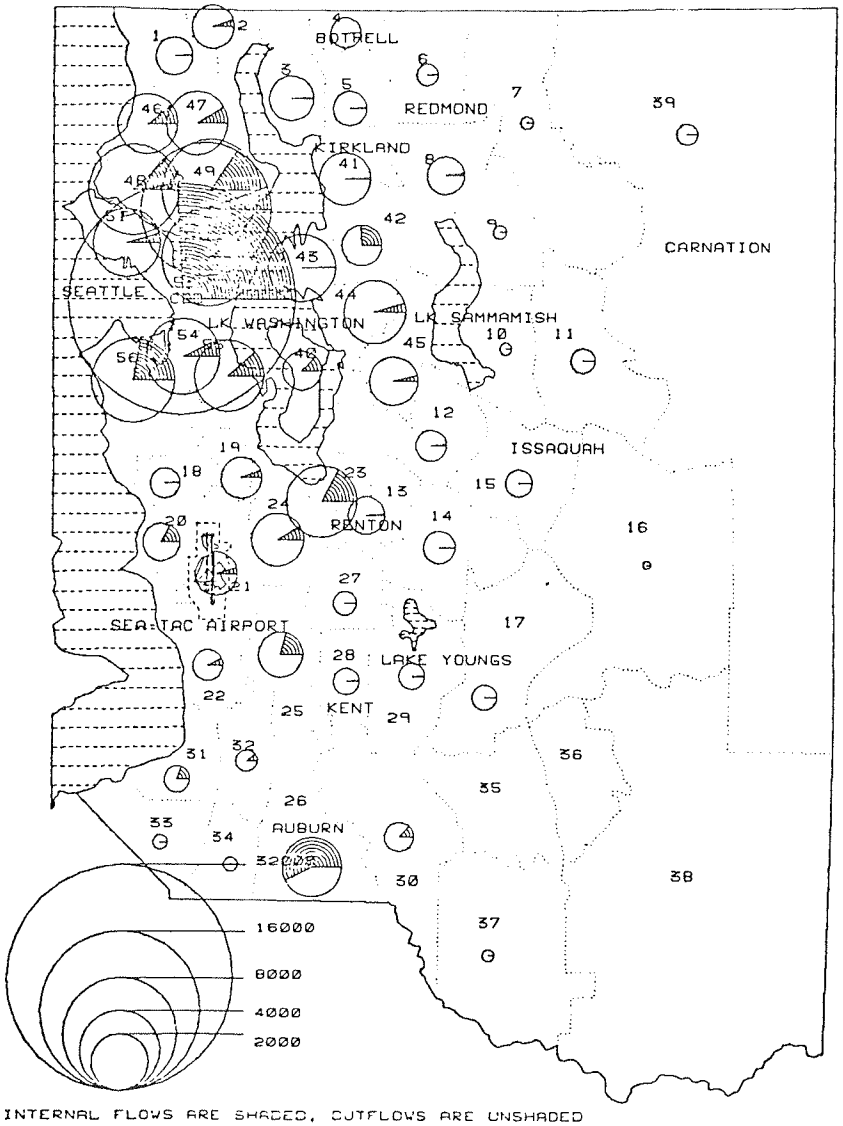

FIGURE 9 Origin pie chart of transit work trips.

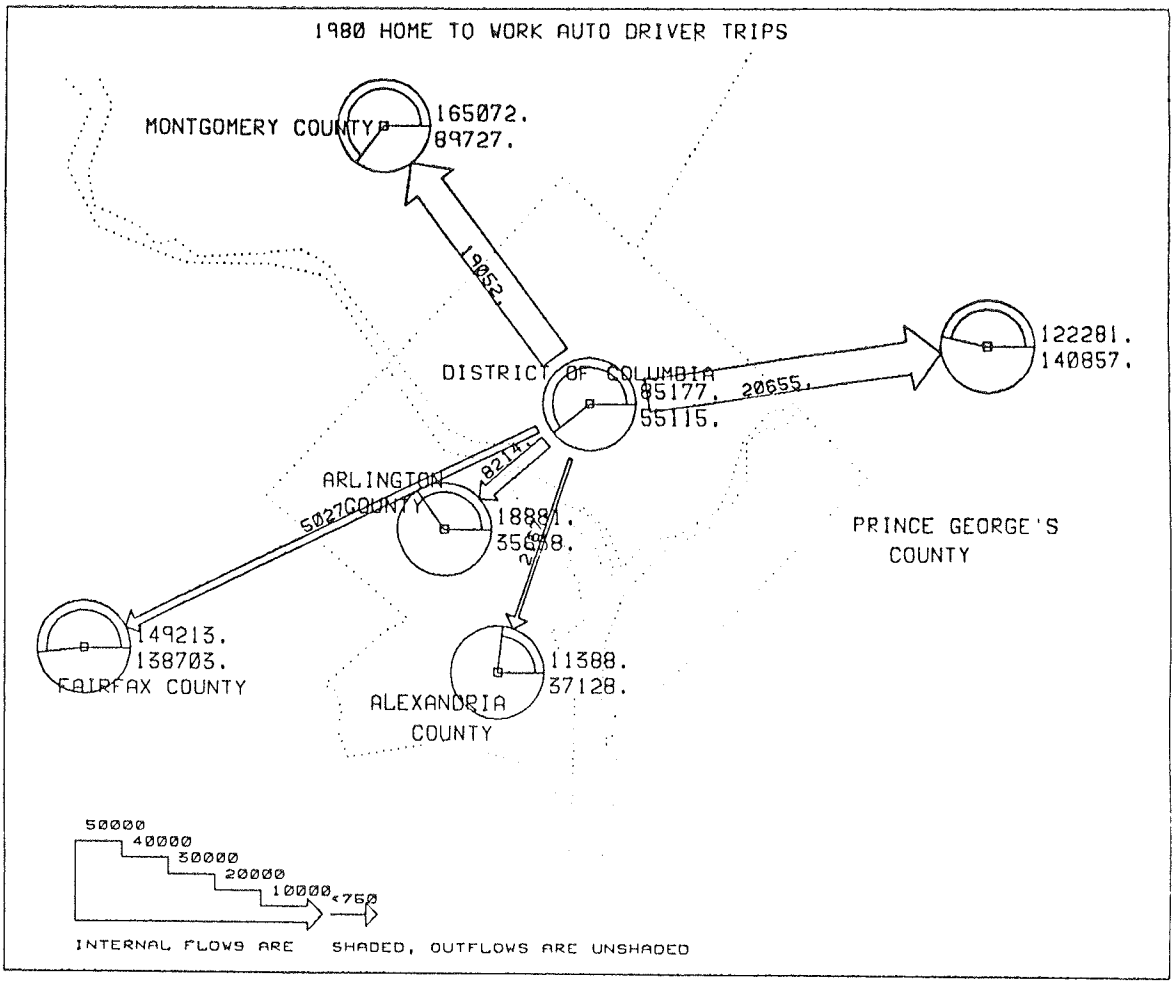

FIGURE 10 Pie charts and arrows.

able for building tables, plotting output, and performing statistical analyses. Many of these can be used to handle census data.

A program of particular interest is FLOWMAP, developed at the University of Washington, which allows the interactive designing of flow maps at a graphics terminal using origin-destination data. Options allow changes in maps to be made quickly and comprehensively. The program currently runs on the CDC CYBER 170/750 at the University of Washington and is available to outside users on General Electric's Telnet.

The program can produce six types of maps of journey-to-work flows derived from census data:

1. Interzonal flows displayed as variable-width arrows (Figure 8),
2. Net flows showing the difference between incoming and outgoing flows,
3. Interzonal flow displayed as graduated circles,
4. Origin pie charts (Figure 9),
5. Destination pie charts, and
6. Pie charts and arrow flows on the same map (Figure 10).

Further information on this system can be obtained from Jerry B. Schneider, Professor of Urban Planning and Civil Engineering, 133 More Hall (FX-10), Department of Civil Engineering, University of Washington, Seattle, Washington.

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Supplementing Census Data for Transportation Planning

GEORGE V. WICKSTROM

ABSTRACT

Based on experience at the Washington Metropolitan Area Council of Governments, census journey-to-work data supplemented with small-scale automobile use or telephone home interview surveys and with roadside interviews to obtain data on travel into and through the area can serve as a relatively low-cost basis for verifying and updating travel models and for modifying forecasts. Before-and-after studies of changes caused by the opening of major transportation facilities are valuable supplements to such a data effort. Recommendations are given with regard to supplementing census data in large urban areas.

In this paper an attempt is made to place the Urban Transportation Planning Package (UTPP) in the context of a total transportation forecasting process for an urban area. Although the package is extensive, it must be recognized that it is but one source of data and by its limited nature cannot address all of the issues surrounding transportation planning in the 1980s. The recommendations made 12 years ago for large urban areas (more than 500,000 inhabitants) are that rather than continue to collect across-the-board uniform sample home interview data (1),

1. 1970 census data together with data on transportation network characteristics be used to describe areas where differing socioeconomic and transportation service levels exist;
2. Small-scale detailed surveys be conducted in these areas in which a variety of data collection techniques would be used, including
   a. In-depth interviews in the home,
   b. On-board transit surveys,
   c. Telephone interviews,
   d. Mail-out mail-back questionnaires, and
   e. Surveys conducted at major travel generators, such as industrial parks, shopping centers, and the like;
3. The data collection be tailored to the specific requirements of the forecasting models to be used and not vice versa;
4. The home-to-work travel data obtained by the 1970 census be updated annually as opposed to conducting a large-scale survey once every 5 or 10 years; these data can largely replace the conventional home interview survey; labor force and employment data should be kept current by small area; this information can serve as the basis for applying the models and developing the home-to-work travel pattern, which can then be checked against traffic-count data;
5. Conventional truck and taxi surveys be discontinued and replaced by goods-movement and visitor (or tourist) surveys;
6. Roadside surveys be conducted in one direction on a small-sample, continuing basis and that these interviews include weekend travel; in addition, mail-back questionnaires handed or mailed to the driver can pick up socioeconomic data required for forecasting purposes; and
7. Every available opportunity be taken to collect data both before and after the implementation of new urban transportation facilities and that the models developed attempt to replicate the behavior observed.

These recommendations called for the use of 1970 census journey-to-work data supplemented with special surveys. A review of the recommendations is made in the light of experience over the last decade.

The National Capital Region Transportation Planning Board (TPB) of the Metropolitan Washington Council of Governments (COG) has planned its future program around the availability of the census package and has been involved in supplemental data collection and analysis efforts for the last few years. Experience with these supplemental efforts is now available.

1977 ANNUAL HOUSING SURVEY

Based on poor experience nationally with the 1970 UTPP, the accuracy and usefulness of the data were suspect. (It should be noted that COG/TPB did not order the 1970 package because an extensive home interview survey had been conducted in the Washington, D.C., area in 1968.) Would the 1980 data be of similar poor quality? The 1977 Annual Housing Survey (AHS) conducted by the Census Bureau contained a journey-to-work sample, and therefore there was an opportunity to find out whether the data in the 1980 package had in fact improved over those in the 1970 UTPP. In addition, census-collected work-trip data are not obtained in the same form as the conventional home interview data and would need to be adjusted so as to be compatible with the models and forecasting process used for the last decade in the region. The AHS work-trip data were derived from a sample of 15,000 households, approximately two-thirds of the number of households surveyed in the 1968 home interview survey. This is an approximately 1.5 percent sample of households compared with a 3 percent sample of 1968 households and an approximately 8 percent sample for the 1980 journey-to-work package.

The 1977 AHS work trip data were adjusted as follows:

1. Factors by mode to account for cases in which there was no fixed place of work or place of work was not reported;
2. Factors to account for absenteeism from work on the average day;
3. Factors by mode to convert the usual-day census trip data to home-based work-trip production and attraction formed (in the census the question is asked, "How do you usually travel to work?" whereas in home interview surveys it is "How did you travel to work yesterday?");
4. Factors by mode to account for occasional shifts to other modes; for example, only 85 percent of all transit riders are regular riders (based on survey data from the Washington Metropolitan Area Transit Authority for those who ride four or more days a week).

With the exception of item 4, data from the census and prior home interview data can be used to calculate adjustment factors. A full discussion of these factors may be found elsewhere (2).

COMPARISONS WITH MODEL ESTIMATES

How well do census data compare with model forecasts of work travel or vice versa? Planners were anxious to utilize the census information and compare it with their 1977 model-based forecasts. These models were built in the early 1970s using the 1968 home interview data base and had been used as the basis for transportation planning in the Washington, D.C., area ever since. More and more, politicians, citizens, and planners were questioning the continued use of these models because the data base on which they had been developed was more than a decade old. The perception was that habits had changed and that the smaller household size, two-worker households, and greatly increased car ownership had modified travel behavior. Could models constructed with 1968 data be valid in the 1980s and be used as a basis for forecasting travel in the next century?

Census journey-to-work data could only provide a partial response to these concerns. Because nonwork travel and external or through travel are not included, only work-travel forecasts could be compared. This comparison was made for total trips and trips by mode and for automobile occupancy. Where census data and model-derived data agreed, confidence could be placed in both census data and the models. Where they disagreed, judgments as to the usefulness or accuracy of the new data or the validity of the models could be made.

Total Person Work-Trip Comparison

In Table 1 total person work trips from the 1977 AHS are compared with the COG/TPB 1977 simulation. On a regional basis, total person work trips matched within 4.3 percent, transit mode-split percentage by 5.2 percent, and total transit work trips by 9.8 percent. (Total employment reported by the census was lower than that used in the simulations. Part-time workers and two-job holders are not included in census information. Preliminary comparisons of COG's 1980 employment census with 1980 census data on total employment show much closer agreement, however.) Most of the differences could be traced to lower total work-trip generation from within the District of Columbia reported by the census, which could well be caused by smaller family size (and labor force) per household. Although COG/TPB trip generation relationships do reflect lower work-trip rates for the city, an even lower rate is indicated by census data. Total person work trips from the District showed an 18.6 percent difference. If this one rate were corrected, simulation and census data would compare in all categories within 1 percent on a regional basis as follows:

Category	Rate (%)
Total person work trips	+0.6
Percent transit work trips	+0.9
Total transit work trips	+0.8

More detailed comparisons of trip generation, modal split, and trip distribution can be made with the data as well, and other corrections or adjustments to the existing simulation models can be made. Distribution by city or county of workplace is shown in Table 2. Again, extremely close correlation can be noted between the AHS data and the basic employment data used as input to the travel simulation.

Automobile Occupancy Comparison

Census data also provide the means to compare model- (or rate-) based estimates of automobile occupancy with that reported. As shown in Table 1, overall automobile occupancy simulated for 1977 compared closely with census information with the exception of travel to the core area of the Washington region. In particular, it was found that long trips to the core from outlying suburban counties had much higher car occupancies than had previously been observed or estimated. The recent emphasis on car- and vanpooling plus the existence of high-occupancy-vehicle (HOV) facilities have changed the prior relationships, even after accounting for higher core-area employment densities and parking charges. Automobile travel to the core could be overestimated if such behavioral changes are not taken into account in the planning process.

SUPPLEMENTAL TRAVEL SURVEYS

Automobile Use Study

With transit-vehicle travel data being obtained on a continuing basis by the transit authority, the con-

TABLE 1 Selected Comparisons: 1977 Simulations Versus 1977 AHS

Category	Simulation	AHS	Difference	Percentage of Difference
Total person work trips (no. of trips)				
From D.C.	447.1	376.9	+70.2	+18.6
From suburbs	1,540.2	1,529.3	+10.9	+0.1
All	1,987.3	1,906.2	+81.1	+4.3
Transit work trips (%)				
From D.C.	42.5	44.0	-1.5	-3.4
From suburbs	11.2	10.7	+0.5	+4.7
All	18.2	17.3	+0.9	+5.2
Total transit work trips (no. of trips)				
From D.C.	190.0	165.9	+24.1	+14.5
From suburbs	172.1	163.9	+8.2	+5.0
All	362.1	329.8	+32.3	+9.8
Automobile occupancy (no. of persons)				
To D.C.	1.5	1.64	-0.14	-8.5
To rest of D.C.	1.3	1.25	+0.05	+0.4
To suburbs	1.2	1.2	-	-
All	1.3	1.3	-	-

Note: Total employed workers reported by the AHS was significantly lower than that used in the 1977 simulation. Census data do not include part-time employment or second jobs.

TABLE 2 Comparison of 1977 AHS with 1977 Employment

City or County of Workplace	1977 Simulation	1977 AHS	Absolute Difference[a]
District of Columbia	41	42	-1
Arlington County	9	9	0
Alexandria City	3.5	4	-0.5
Montgomery County	16	16	0
Prince George's County	13.5	13	+0.5
Fairfax County	13	13	0
Loudoun County	1	1	0
Prince William County	3	2	+1

Source: COG employment census data (at place of work) used in traffic simulation and 1977 AHS journey-to-work data.

[a]Simulation data minus AHS data.

cept of a telephone survey of automobile users to complement these data with data on nonwork travel appeared attractive. This was especially true because home interview costs have risen to $100 per interview or more.

COG/TPB conducted a pilot study that obtained household and travel data from a sample of automobile-owning households in the Washington metropolitan area (3). Household data were obtained by phone and included information on family size, number and type of automobiles owned, number of licensed drivers, number of workers, household income, kind of dwelling unit, and other demographic variables. From this initial telephone contact, the percentage distribution of households cross-classified by the number of automobiles owned and number of persons in the household was used to obtain a quota sample for each category within each jurisdiction. These samples were mailed automobile logs. The survey data obtained were then expanded (after these variables had been adjusted for zero-car households) to the total number of households by county. The travel data obtained included the number of persons who normally use public transportation to work and a record of each automobile trip made by the household for each of two consecutive days. Trip information collected included the beginning and ending odometer reading, beginning and ending time, the number of persons in the car, the trip purpose, and the city or county of destination. More than 8,500 households were contacted, and more than 5,000 automobile logs were distributed to 2,800 households; 2,000 completed logs were received from 1,200 households.

Major conclusions from the study were that automobile ownership is a major determinant of trip production, vehicle miles of travel (VMT), and automobile occupancy. Household size, income, structure type, and the use of transit also influence automobile use but not to as great an extent. (It was found, for example, that the average miles driven per car within the region on a weekday was the same in 1980 as it was in 1968, approximately 20 miles.)

The information gathered in this type of survey can be used to obtain regional and subregional estimates of automobile ownership characteristics, average vehicle trip-generation rates, average vehicle trip lengths, and average automobile occupancies. As a result, total VMT can also be obtained and monitored. Survey-derived automobile ownership data and regional VMT were comparable with similar data obtained from other independent estimates.

This pilot study demonstrated the usefulness of the method as a relatively inexpensive way to collect relevant automobile travel information on a continuing basis. Based on the experience gained with this pilot study, the cost for an automobile use survey was estimated at approximately $20 per household or less on a continuing basis, making it feasible to conduct such smaller-scale surveys on a periodic basis to detect changes in automobile travel within an urban area.

There were two major hypotheses tested as part of the evaluation of the Automobile Use Study. The first was that a random-sample telephone-interview procedure could produce a reasonable distribution of non-car-owning and car-owning households from which a quota sample could be drawn. The second major hypothesis was that once that sample had been drawn and responses had been obtained, the expanded results would approximate the total vehicular travel by residents in the area. Both of these hypotheses have been confirmed, making such a sample survey a feasible method for updating travel data in a metropolitan area.

Telephone Interviews

The Automobile Use Survey, by design, did not attempt to obtain origin and destination addresses at less than a city or county level for the logs. It was felt that asking for an address more detailed than city or county would result in lowered response rates and fewer trips reported. In one portion of the region, COG did conduct a telephone home interview survey where detailed trip addresses were obtained directly from the respondent. This was accomplished by using a computer terminal to assist the telephone interviewer. Input statements were programmed to make the questions user friendly, automatically reference the questions to be asked, and properly sequence the question categories. For example, if the respondent said that no transit trips were made, the program would skip the transit section and branch to the next appropriate category of questions. The responses were keyed in as the questions were answered, and running totals of trips per household, and so on, were available immediately. This eliminated the need for subsequent coding of the data as well.

Based on preliminary analysis, it was concluded that this type of interactive computer-assisted telephone interviewing is entirely feasible and could reduce costs of home interviewing to acceptable levels for either periodic or small-scale continuing interviewing. Data obtained from this study are now being analyzed.

External-Travel Data

Because external and through travel can have a disproportionately larger impact than their proportion of total trips because of longer trip lengths, it is also desirable that new external-trip data be obtained to supplement census data. Although census journey-to-work data can be extended to commutersheds outside the region and external data obtained, such data are not specific to route of entry (or exit). Through trips or truck travel are not available from census data.

Alternative Methods for External Data Collection

Although external-travel data can be obtained inexpensively (on a cost-per-interview basis) through conventional roadside interviewing, traffic volumes at some locations are so high that any stoppage of traffic could cause severe delay. At other locations, such as high-speed limited-access highways, it may be judged dangerous to stop traffic for interviewing purposes.

The Maryland Department of Transportation experimented with different methods of collecting ex-

ternal-travel survey data as part of a regional update to supplement the census journey-to-work data. This survey was conducted in 1980 with the aid of the University of Maryland. Depending on the survey location, one or more of three survey methods were used. Roadside interviews were conducted at five sites, a combination of roadside interviews and return-postcard handouts was conducted at five additional stations, and a license-plate survey (with subsequent mailing of a return postcard to the address where the vehicle was registered) and a combination of roadside interviews and license-plate survey were conducted at another location. On high-speed facilities (Interstates) the license-plate technique was used, whereas on high-volume arterials (or during heavy peak-hour flows) the handout mail-back survey method was used.

It is important to classify traffic by state of origin when the license-plate technique is used so that response bias can be minimized when the survey data are factored. In addition, not all states will be surveyed. It was found that a useful technique was to record automobile occupancy both in the field and as a question on the survey form and to use this variable to check the factoring or as a basis for expanding sample data. This is especially important if any consideration is to be given to special HOV treatments, such as separate HOV lanes on these facilities. It should be noted that in all of the foregoing survey work, only inbound travel was surveyed.

Use of the New External-Travel Data

It is planned that the new external-travel data obtained be used as a basis for recalibration of the external-to-internal gravity trip distribution model (F-factors). In this regard, early data tabulations have indicated that high-speed Interstate facilities may need different F-factors than parallel arterial facilities. Because several of these facilities did not exist at the time of the last external survey in 1968, these data have the potential for improving existing forecasts. (No differential in the gravity models by type of route is currently made.) In addition, the through travel data obtained will serve as the basis for a new Fratar forecast.

Truck and Taxi Travel Data

In the 1971 paper cited previously (1), it was recommended that conventional truck and taxi surveys be discontinued and replaced by goods movement and visitor (or tourist) surveys. One-half of that recommendation has been adopted. No truck or taxi survey data have been collected since 1968 in the Washington area. Many former taxi riders, especially in the downtown area, have switched to Metrorail. Because Washington has a much smaller proportion of truck travel than most major areas, these data are not critical to transportation decision making. It is therefore unlikely that any large-scale effort to collect either truck or taxi data could be justified. Other urban areas should review their need for such data and act accordingly.

Before-and-After Studies

In addition to this basic data collection effort, supplemental before-and-after studies of the impacts of introducing new major facilities such as Metrorail and HOV lanes on Shirley Highway (I-95) and I-66 provide additional insights into travel behavior at a more detailed level. The impacts of changes in travel mode, mode of access, and automobile occupancy in affected corridors also provide new information and serve as a new data base by which models and forecasts can be compared to real-world behavior.

TRAFFIC-COUNT AND CORDON DATA

A continuing traffic-counting program to detect change and to provide the data needed to compare with that from simulations is also essential. COG/TPB experience is that such counts are invaluable, especially counts of all person trips entering the central area by mode of travel. This is done yearly through a cooperative program with the state transportation agencies and the transit authority. This program has been expanded to include travel across the Capital Beltway (I-495) on a periodic basis as well. Additional cut lines are desirable, especially in a nonradial direction.

SUMMARY AND CONCLUSIONS

Based on COG experience, census journey-to-work data supplemented with small-scale automobile use or telephone home interview surveys and with roadside interviews to obtain data on travel into and through the area can serve as a relatively low-cost basis for verifying and updating travel models and for modifying forecasts. Before-and-after studies of changes caused by the opening of major transportation facilities are valuable supplements to such a data effort. The recommendations listed at the beginning of this paper still appear valid for application to supplementing census data in large urban areas.

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The 1980 Census as a New Foundation for Urban Transportation Planning: User Activities for Supplementing and Updating

ROBERT T. DUNPHY

ABSTRACT

The special package of commuting data from the 1980 census available for 277 metropolitan areas makes it possible to obtain, at a reasonable cost, information on home-to-work trips. Each metropolitan area (or state) must decide whether to purchase the package and how to incorporate it into the local transportation planning process. A survey of the 6 states and 44 metropolitan areas who have ordered the package was conducted to provide guidance on current and planned activities. Supplemental data collected during the census period are summarized as well as plans for updating the information and the type of geographical areas used.

The 1980 Urban Transportation Planning Package (UTPP) provides an extraordinary opportunity for transportation planners to obtain commuting data collected by the Census Bureau and coded to locally defined transportation analysis zones. This information is included in a one-in-six sample of the basic census questionnaire, which has all of the authority, prestige, and quality control of the Census Bureau behind it. In addition, both the home and work locations are coded to block, which makes it possible to aggregate the data to geographic areas that are relevant to local planners (1). It is equivalent to having each metropolitan area decide to conduct a survey of commuters in 1980 and having the Census Bureau collect the data along with the standard information already collected in the census. This nationwide survey of urban commuters represents a unique data base for one component of urban travel at one time. Because the decision to purchase this package and how to incorporate it into the urban transportation planning process is a local option, this study was designed to catalogue these local decisions. The results were used in a workshop on the UTPP held at the Annual Meeting of the Urban and Regional Information Systems Association (URISA) and the Transportation Research Board in August 1983.

SURVEY OF USERS

In order to determine the types of information already collected to supplement the census data and plans for updating the information, a mail survey of users was conducted. The inventory used for the sample was the Census Bureau's list of funded contracts (those agencies that had agreed to purchase the UTPP), dated July 5, 1983. The questionnaire was sent to each of the Census Bureau's contact persons with a stamped, self-addressed envelope; this included 6 states and 44 regional agencies. The response rates were excellent for a mail survey, indicating the high level of interest in the UTPP. As shown in Table 1, responses were received by 5 out of every 6 regional agencies with fewer than 1 million persons, 2 out of every 3 regional agencies with more than 1 million persons, and 5 out of the 6 states surveyed, even with no follow-up. Responses from the regional agencies are divided about equally between those with more than 1 million, those with 0.25 to 1 million, and those with less than 0.25 million.

TABLE 1 Summary of Responses to UTPP Survey

Agency	No. Surveyed	No. Responding	Survey Rate (%)
State	6	5	
Metropolitan area			
> 1 million	19	15	79
< 1 million	25	21	84
0.5-1 million	5	3	60
0.25-0.5 million	9	9	100
< 0.25 million	11	9	82

SUPPLEMENTING THE 1980 CENSUS DATA

Sharp differences were found between the larger and smaller regions in terms of their activities to supplement the 1980 census data. As shown in the following tabulation, three out of every four large regions (more than 1 million population) had conducted supplemental data collection to adjust or extend census data, whereas only one-third of the smaller regions had done so.

	Supplemental Data Collection (no. of regions)			
Agency	Yes	No	Total	Percentage
State	2	3	5	40
Metropolitan area	18	19	37	49
> 1 million	11	4	15	73
< 1 million	7	15	22	32

Two of the five states responded that supplemental data had been collected, although individual agencies in these states have collected their own data. The difference between the larger and smaller metropolitan areas may reflect different concerns about the necessity of developing localized factors to convert census data into formats commonly used by transportation planners. It may also reflect a higher level of resources in larger agencies to collect supplemental data.

There is quite a diversity in the types of supplemental data that have been collected; as shown in Table 2, there were 10 different types. The two most common supplemental data activities, for both larger and smaller metropolitan planning organizations

TABLE 2 Types of Supplemental Data Collected by Regional Agencies

Type of Data	No. of Agencies Reporting by Size of Area	
	> 1 Million	< 1 Million
Household travel surveys	6	2
Employment inventories	6	2
Traveler surveys		
On-board transit ridership	4	1
Park and ride	2	-
Automobile use	2	-
Workplace	2	-
Counts and field inventories		
Traffic counts	2	1
Residential trip generation	-	2
Vehicle occupancy	-	1
Parking costs	-	1

(MPOs) were household travel surveys and employment inventories.

Household travel surveys, generally with small sample rates, were conducted in New York, Chicago, San Francisco, Denver, Twin Cities, Phoenix, Albany, and Shreveport. These surveys produce the factors necessary to convert work trips from those of a typical day, the census definition, to those of an average day, the transportation planner's definition. They also estimate the amount of nonwork travel, which is not included in the census data. In addition, questions of local interest can be addressed, such as mode of access to rail systems and travel by minority groups.

The second most common type of supplemental data collection was an employment inventory. Surveys of employment by place of work in 1980 were conducted in Seattle, Atlanta, Baltimore, St. Louis, Phoenix, and Washington, D.C. The popularity of such inventories substantiates the importance of the workplace data that will be available from the UTPP. For the first time, there will be data available on the characteristics of the labor force at their workplace as well as their home location, which will be consistent for different parts of an area as well as between metropolitan areas. Because of the importance of such data and because the census is subject to sampling error, many regions have elected to develop their own data base on workplace characteristics. Through the use of secondary sources, this also makes it possible to update the employment data in future years (2).

Other types of supplemental data collection mentioned can be grouped into two categories:

1. Traveler surveys and
2. Counts and field inventories.

Traveler surveys were the more common type of supplemental data collected by the larger regions, whereas smaller regions relied more heavily on counts and field inventories. Although passenger surveys are usually more expensive, they provide more information than counts.

Traveler Surveys

The most common types of surveys reported by large regions were on-board transit ridership and park-and-ride surveys. The one survey reported by a smaller agency was also a transit survey. There was one automobile use survey and one workplace survey reported by a large MPO.

Counts

Traffic counts were reported by two large regions (the only field inventory indicated among that group) and one smaller region. It is likely that many other agencies with counting programs did not report them because they are regular programs not related to the 1980 census. Three other types of counts were reported by different agencies:

1. Vehicle occupancy,
2. Residential trip generation, and
3. Parking costs.

It appears that a considerable amount of data has already been collected by regional agencies to supplement the 1980 census data. The next logical question is how it can be kept up to date.

UPDATING CENSUS DATA

In response to the question of whether they planned to update the 1980 census data, there was much more similarity between large (more than 1 million population) and small metropolitan areas:

1. Among areas of more than 1 million people, 6 out of 10 responded positively and
2. Among areas of less than 1 million people, 20 out of 21 responded positively.

At this time, however, there appears to be a great deal of uncertainty on this issue. Two respondents reported that they did not even have time to think about this issue, although they knew it would be important. The uncertainty about future direction appears to be much greater among smaller agencies. Only 6 out of the 10 smaller regions reporting that they planned to update the census data actually identified planned activities. Among the six larger regions planning to update the census data, five identified work programs. As indicated in the following tabulation, there were sharp differences in the methods of updating planned.

Update Technique	No. of Agencies by Size of Area	
	> 1 Million	< 1 Million
Model	4	2
Update input	1	4

The principal updating technique by larger agencies was the use of models, by a ratio of 4 to 1. In most cases, this means that a forecasting model will project small-area demographic and employment variables for an intercensal year, say 1984. These data will then provide inputs to traffic forecasting models, which estimate current travel patterns. Among smaller regions, four agencies planned to update the inputs directly compared with only two that anticipated the use of models. For smaller areas, it appears that the agency is able to collect data on the location of new development, which can be used to update the 1980 census population and employment totals. The difficulty of collecting such land use data in larger regions appears to be directing the regional agencies more toward the land use models rather than field data collection. They have invested data collection resources into collecting travel data to supplement the census. These observations, however, only apply to those agencies with firm plans to update the census. There remains a great deal of uncertainty among agencies on whether and how to update the census data. These

plans will become clearer after the agencies have had some experience in using the UTPP.

AREA SYSTEMS

The principal feature of the UTPP for most transportation planners is that it provides the data by locally specified transportation zones rather than the tracts more common to most census geography. The difficulty of maintaining two different area systems has recently led some agencies to consider using census tracts as their basic analysis unit. In order to determine the amount of interest in these alternative area systems, respondents were asked to indicate the level of geography they expected to use in projections:

	No. of Agencies by Size of Area		
Level of Geography	> 1 Million	< 1 Million	Total Respondents
Zone only	5	14	19
Tract only	1	-	1
Zone and tract	2	4	6
Other	1	1	2

As indicated in the preceding tabulation, the majority of agencies, both large and small, expected to use zones as their only analysis unit. About one-third as many agencies, in both larger and smaller regions, expected to use both tract and zone. Only one agency [Atlanta Regional Commission (ARC)] reported tract only. The ARC staff explained that budget constraints forced them to purchase the UTPP at the tract level, even though they would have preferred to analyze the data by zone.

A significant finding of this survey is the importance regional agencies place on obtaining and analyzing data by transportation zones. It appears that this area system serves such a unique and important function in urban transportation planning that agencies are willing to make a substantial investment to obtain it. The coding of home and work address to block by the Census Bureau was critical in obtaining this important local feature.

CONCLUSIONS

The excellent response to this survey of UTPP users confirms the intense interest in the product demonstrated by the large number of agencies who have already purchased the package. Some of the key findings of user experiences and plans are as follows:

1. Availability of census data by zone is central to the value of the package. It appears that providing the same data items by tract only would be inadequate for transportation planning.
2. Availability of labor force characteristics at the place of work appears to be a major feature of the 1980 census. Many agencies have recognized the importance of these data by conducting their own inventories of small-area employment.
3. Most MPOs in larger regions (more than 1 million) collected additional data around 1980 in order to adjust and supplement the census data. The most common data collected were employment inventories and small-scale travel surveys. Other common data efforts were traveler surveys of bus riders and drivers.
4. Most MPOs in smaller regions (less than 1 million population) did not collect data to supplement the census. Those that did were more likely to rely on different types of counts rather than travel surveys.
5. Only about half of the agency respondents reported plans to update the census data; there was little difference in the ratio for large and small regions.
6. Smaller regions are more likely to update the census data by actual measurements of changes in the land use inputs, whereas larger regions are more likely to model the changes in population and employment.

Looking ahead, there is great uncertainty in exactly how the UTPP will be incorporated into the transportation planning process of each region. These plans will become better defined as users have more experience with the data. By that time, there will also be a better understanding of how to match the UTPP files with the supplemental data. There may be some transferability of adjustment factors between regions. Once there are a sufficient number of applications of the UTPP by regional agencies, it will be possible to identify appropriate measures of updating this valuable data base. The current level of uncertainty expressed by users on how the updates should be done suggests that the profession needs to address this question and provide technical guidance to participants.

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Part 5
Experience with the UTPP

Experience with the 1980 Census Urban Transportation Planning Package in the Washington Metropolitan Area

GEORGE V. WICKSTROM

ABSTRACT

The planned uses of the Urban Transportation Planning Package by the Metropolitan Washington Council of Governments and its experiences to date are summarized. Some recommendations for the 1990 census are made.

The 1980 census journey-to-work data were obtained by the Metropolitan Washington Council of Governments (COG) from the Bureau of the Census in 1982. The data formed a major part of a multiyear regional transportation planning work program that was designed to develop a new, updated data base and to serve as a basis to verify or revise existing travel models (such as those for trip generation, distribution, and mode choice). In addition, comparisons with prior surveys could permit the development of trend data showing areas of growth and change. The relationship between census data and the validation process for a model of traffic estimation procedures is shown in Figure 1. (The roman numerals relate to COG work program tasks.)

Because census data only provide information on work travel, the Transportation Planning Board (TPB) of COG in cooperation with its member agencies

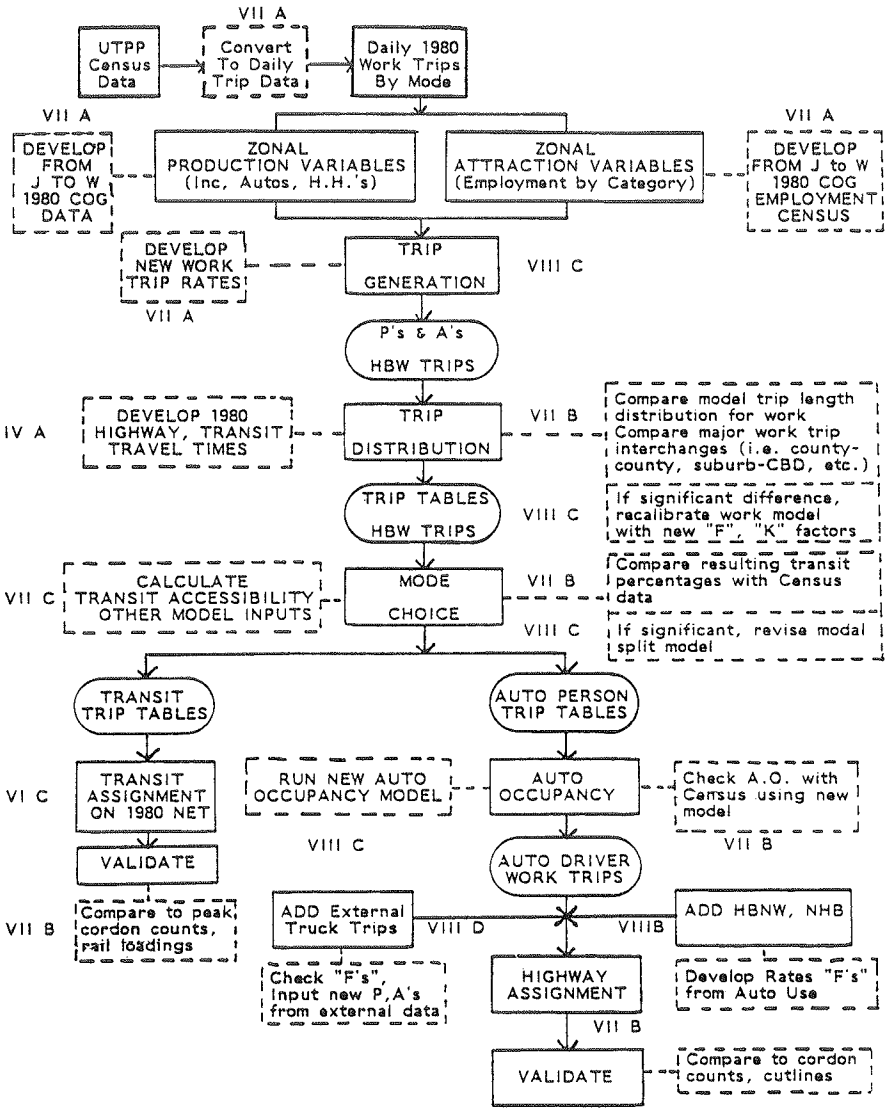

FIGURE 1 Flow chart of 1980 model validation.

undertook several small-scale supplemental surveys to add information on nonwork travel. These included analysis of an automobile use study conducted in 1980 and a roadside travel survey of traffic crossing the outer boundaries of the study area. The automobile use survey obtained information through a mail questionnaire on the use of vehicles in selected sample households.

Both surveys obtained information that could supplement work-trip relationships developed from the census. Nonwork vehicle trip generation rates and trip distribution factors were checked and revised as necessary using these survey data.

INITIAL TABULATIONS

Because TPB's basic data were all derived from the regional home interview and from external and truck-taxi surveys conducted in 1968, many participating agency representatives were anxious to obtain and use the census data base for their own analysis and planning purposes. TPB staff designed a three-part data summary that could be released at no charge to participating agencies. This data set would contain tabulated information (zone level) at the home end and the work end. In addition, county-to-county information was also provided. TPB had agreed to obtain travel data between the Baltimore and Washington regions, and this information was also included in the summaries made. Data on a detailed trip interchange basis could be made available on request as needed.

PROBLEMS

Tabulations and dissemination of the residence-zone data from Part I of the Urban Transportation Planning Package (UTPP) and of the county-to-county data from Part VI were quickly accomplished. Comparisons with TPB simulated travel data were dependent on reconciling the definitional difference between a trip made yesterday (or not made) and the census question on usual mode of travel. An analysis of rates of daily work trips indicated that census data should be adjusted by a factor of 0.85 to produce data comparable with home interview trip information.

Data by submode of travel did not seem consistent or reliable. In the census the primary mode of travel used is requested, not all modes, and the choice of the primary mode is left to the respondent. It was found desirable to combine bus and subway responses into a public transit subtotal rather than report these modes separately.

Although these problems could be overcome with minimal effort, other checks with independent sources revealed that more extensive adjustments were required before the information could be used at detailed levels of analysis.

CODING DISCREPANCIES

COG had conducted a Regional Employment Census (REC) in 1980. This REC was based on state bureau of employment security records; firms that had more than one location were called to determine the distribution of jobs by location. This file had been address coded by establishment to the block and zone level. Total REC employment was 1,665,000 jobs (this included some part-time workers and second-job holders not accounted for by the census) compared with the UTPP Part IV (zone-to-zone) total of 1,607,000. Of these, 2,000 records representing 67,000 workers were coded to other than traffic zones. Adding the 44,000 workers who commute into the Washington area as determined from UTPP Part VI brought the total to 1,651,000 jobs, 111,000 of which are not coded or allocated to zone. These trips are missing at this level of destination geography.

A comparison of the adjusted census zone-level data with the 1980 REC indicated large discrepancies in many areas, however. Some comparisons are shown in Table 1.

TABLE 1 Comparisons of 1980 Census Journey-to-Work Data at Major Employment Sites with COG 1980 REC

Area	No. of Trips	
	Census	REC
Washington, D.C., central business district	146,426	138,966
Virginia		
Springfield	23,950	20,909
Crystal City[a]	17,140	24,817
Tysons Corner[a]	12,961	27,136
Rosslyn	12,532	15,534
Merrifield[a]	11,666	17,548
Langley	10,613	6,700
Vienna	9,814	7,544
Ballston	8,742	6,900
Reston	7,423	4,836
Alexandria central business district	6,540	8,500
Bailey's Crossroads	4,649	7,152
Cameron Run	2,481	6,000
Total	128,511	153,396
Maryland		
Silver Spring[a]	27,451	17,500
Bethesda[a]	26,298	18,212
National Institutes of Health[a,b]	14,325	18,600
Andrews Air Force Base[a]	10,922	15,500
Friendship Heights	10,096	11,700
Prince George's Plaza	9,504	6,900
Wheaton	7,585	6,300
New Carrollton	7,930	8,451
Suitland	6,613	5,400
North Bethesda[a]	6,589	13,013
Largo	1,464	4,739
Total	128,777	126,311

[a]Greater than 4,000 difference.
[b]Institute of General Medical Sciences.

INTERIM CORRECTIONS

A two-part process was agreed on to reconcile the foregoing differences. First, a listing of areas where a comparison of census UTPP and REC data exceeded an absolute total job difference of 4,000 was sent to the Census Bureau for investigation and possible correction. A listing of major employers in those zones was sent to the bureau as well. As of this writing, the bureau has corrected the data from some of the sites. As shown in Table 2, the revised UTPP file is within ±10 percent of the REC for the data from three of the four corrected sites. Because these corrections took time, it was also decided to

TABLE 2 Comparison of Adjusted UTPP with Original Totals

Area	UTPP		
	Original	Adjusted	REC
Bethesda	26,298	20,016	18,212
National Institutes of Health	14,325	17,413	18,600
Andrews Air Force Base	10,922	12,096	15,500
North Bethesda	6,589	12,263	13,013
Total	58,134	61,788	65,325

go ahead and adjust the uncorrected UTPP file to match the REC totals. This was done by computing factors relating the REC and UTPP job totals at the work end by district (groups of zones). All origin districts were given a factor of 1 and a Fratar factoring process was applied. This process has the effect of readjusting the trips between districts so that the REC totals would be hit at the destination district level and so that the same number of trips would originate in each zone of origin as reported by the UTPP.

This latter file is now being used as the corrected journey-to-work data set for the Washington metropolitan area. It is adjusted at the district level to match 1980 REC employment. [It should also be noted that all downtown and central business district (CBD) zones with large numbers of employees were treated as districts in the factoring process.]

This file is an interim file and will be used until the revised census journey-to-work file is received from the bureau. That file may contain different numbers of trips by mode than the interim file, depending on whether address coding changes affected each mode equally in the recoding process.

USES OF THE CENSUS DATA

Checks of Model Output

Considerable use of the census UTPP data has already been made and more is planned. An early task was to compare the UTPP census data with the results of regional travel simulation models developed from 1968 data and run for 1980. This was done at a jurisdiction-to-jurisdiction level by mode of travel. This comparison was of considerable interest to the TPB Technical Committee because it indicated the degree to which existing travel simulation models were accurately predicting travel by mode between major geographic areas.

Conclusions from this analysis were as follows:

1. Work person trips were understated by the current model process by approximately 10 percent. This could be explained by recognizing that the common tendency to form a triangular trip to home from work (i.e., work to shop to home) was reflected in the home interview data and the model but not in census data.
2. There was a consistent bias toward understating suburban and exurban work trips and overstating closer-in origins. This indicated the need to improve the work-trip generation relationship by geographic area. A new person work-trip model has already been developed by using the UTPP data. This model shows marked improvement over the prior relationship developed with 1968 data.
3. It was noted that some model-derived county-to-county work interchanges were being systematically under- or overstated compared with the census data. Work trips to the central area were consistently understated, whereas reverse commuting was consistently overstated. This indicated a need to revise the trip distribution model. This work is under way.
4. Estimated transit use was higher than that reported by the census. This was due almost entirely to differences in two in-close jurisdictions, indicating that revisions to the mode-choice model needed to be made. This work will be undertaken by a consultant using the UTPP data.
5. A prior study using the 1977 Annual Housing Survey journey-to-work data had confirmed that carpool formation was higher from outlying areas than COG's automobile occupancy model had been forecasting. A revised automobile occupancy model was developed using the 1977 data. That revised model will be checked with the 1980 UTPP data.

Trend Analysis

Considerable use of the UTPP census data has been made in comparing 1968 (and in some cases 1970) data with the 1980 results. Major travel demand increases have been noted within and between suburban and exurban areas, with little growth in the CBD. Travel to the CBD has also increased, though by a smaller amount. This kind of information lends itself to political and public presentation and was presented to citizens and professional groups. A nationwide study of work travel trends between 1970 and 1980 was recommended and federal funding support has been approved.

Service Projects

Several service (technical assistance) projects are under way for state and local governments using the UTPP data, and several more have been approved. They are discussed in the following.

Maryland Department of Transportation

A new interregional study of the area between the Baltimore and Washington beltways is being made. Because the UTPP file covers travel movements between the two regions, a single new modeling process can provide for better peak-hour travel estimates (based on commuter patterns) than two independent processes with artificial high-volume cordon (external) stations dividing the joint study area.

This program is being carried out with the participation of the Baltimore Regional Planning Commission and is expected to produce improved traffic forecasts in this area, where current techniques are inadequate.

Montgomery County, Maryland

A study is being made of the patronage expected on the Metrorail extension expected to open late in 1983. This study uses the 1980 census data as a base along with existing mode choice and travel in the corridor to determine potential use of stations along the new line. Mode of access is also considered in the analysis by using the experience on other existing rail lines in the region.

Fairfax County, Virginia

A study of the current use of transit by Fairfax County residents and the development of a simplified mode-choice technique for use at the project and subarea planning levels are being undertaken.

Virginia Department of Highways and Transportation

A study is being made of potential patronage on two proposed new commuter rail facilities. This study looks at high-occupancy vehicle and express bus competition. Data on travel demand and carpool use were obtained from the UTPP Part VI, where outlying county commutation movements were reported.

District of Columbia

A study is being made of the current pattern of commuting into and out of (reverse flow) the Dis-

trict to determine the degree to which scarce street space can be reallocated or transit improved to serve current flow patterns. Another aspect of this study is to determine the accessibility of specific types of employment to workers in the D.C. region.

PROS AND CONS

As may be seen from the previous discussion, the 1980 census UTPP journey-to-work data have been extensively reviewed and utilized in the transportation planning process in the Washington area. There are more than 75,000 individual records representing 1,650,000 workers in 1980. It should be recognized that census data bring some inherent problems as well as provide a new data source for transportation analysts and planners.

Cons

The following problems appear inherent in these data:

1. There are certain basic definitional differences between the way the census views the journey to work and an actual trip. The difference between "usual" and "yesterday" and the triangular nature of many work trips (serving some other intermediate trip purpose) need to be dealt with.
2. Comparisons of census employment location coding with an independent data source indicates that more effort is needed to code accurately to the traffic zone or district level. Although trips to downtown and to urban areas were compatible, trips to outlying suburban centers were underrepresented in most cases.
3. Not all trips were coded to the zone level of geography. Adjusting the trips that were may not accurately represent those that were not.
4. Certain key data items useful for transportation planning were not collected. This includes information on the cost of parking, departure and arrival times for the work trip (peak hour, peak period, and nonpeak), and a listing of all modes of travel used.
5. Considerable additional staff effort was needed to produce a file considered suitable for use in recalibrating models or for use at the individual planning project level.

Pros

The following positive statements may be made:

1. The census data have been used extensively. It is unlikely that any other comprehensive data source could have been developed and used within the time and cost associated with the census data.
2. Parts I, III, and VI of the UTPP have been used most extensively so far. The county-to-county totals are extremely useful.
3. Because the Baltimore and Washington areas could be treated as a unit, there was an opportunity to obtain data in an area that was not handled adequately by two separate data collection and study processes.
4. Although not a file of individual workers, the data seem entirely capable of being used for model verification and development. The data have verified the need for revisions to current travel forecasting procedures.
5. Acceptance of the data by participants in the planning process, even in their current form, is high. As continued experience is gained with the file, other uses and improvements may be uncovered.

CHANGING PLANNING NEEDS AND USE OF 1980 CENSUS DATA

It is trite but true to say that data should respond to needs and not vice versa. A review of transportation issues over the last 30 years leads to the following conclusion: As the urban area expands, more, not less, detail is needed within the urban area. The 1970s saw the birth of subarea and corridor planning, just as the 1960s dealt comprehensively with the urban area. Planning methods used at the subregional scale differ from those at broader levels of analysis. Large-scale, comprehensive inventories of total travel movements were needed in the 1950s and 1960s because forecasts were heavily dependent on trend analysis or factoring up an existing travel pattern. As mathematical models calibrated on these existing data bases replaced actual data in the late 1960s and early 1970s, smaller trip samples could be used to develop acceptable trip data. By mid-decade, disaggregate, targeted sample data tied to behavior could substitute for uniform sample data. A major need emerged to provide updated inputs to the models as well as to verify the stability of the parameters used in the models themselves.

New planning issues have emerged at these finer levels of analysis, including traffic management of peak-hour congestion, parking, access to transit, and the provision of ridesharing and exclusive travel ways for high-occupancy vehicles. The scale of planning has shifted from designing a system of facilities to improving existing routes and services. In many areas, it has become a question of which transit routes within the urban area should be terminated, not one of expanding service.

Comparison of the 1980 journey-to-work data with those of the prior decades has established clearly that travel patterns are more diffuse than ever before. Suburban development is outpacing growth in older central areas many times over, an exurban and intrasuburban travel now dominate the urban areas. By 1990 this growth will blur urban area boundaries as regions merge together. Multinucleated areas such as the Baltimore-Washington region will create new patterns of commuting and strain the capacity of existing suburban and rural transportation facilities.

Can the planning needs of these regions be met by relying on a one-time small sample survey of commuting habits? Are the data provided useful in analyzing building tools to address these issues? The answer appears to be a qualified yes based on a review of the assets and a comparison of them with the options available.

The foremost asset of the census journey-to-work data is their comprehensiveness. The entire area is covered, even a biregional area like the Baltimore-Washington region. Data are provided on commuting from exurban areas. The data have proven useful in a variety of ways, as described previously. They provide control totals and socioeconomic and modal data and they are generally regarded as an independent, unbiased source of information at the local, state, and national levels. The initial cost of $38,000 for the 75,000 records representing 1,600,000 work trips figures out to slightly more than $0.50 per record.

RECOMMENDATIONS FOR 1990

The decennial census in the United States is a marvelous data collection device. Collecting the data is three-quarters of the battle. Relatively minor additions to content can provide the additional data needed. This is not to say that data on work travel are all that is needed. Metropolitan planning organizations (MPOs) and others will have to supplement

census data to cover nonwork travel and to keep travel patterns up to date.

A major change can be made in the coding of work addresses. One option is to allow MPOs and local governments to perform this function in the future. This will permit more rapid processing, because coding can proceed simultaneously with data collection, not sequentially as it does now with the Census Bureau doing it all. MPOs and localities can selectively process by sampling the file and code to levels of geography according to their needs.

To avoid the problem of confidentiality, all that is needed is for the Census Bureau to supply a list of addresses to the MPO, local government, or state identified only with a serial number that the Census Bureau can relate back to the interview. After local coding of these anonymous addresses, the Census Bureau can rematch them to the proper interview and provide summary data according to the rules now in effect.

Certain additional data are needed in order to make the data base more relevant to current planning issues. These include information on

1. Departure and arrival time for the work trip,
2. Parking cost, and
3. All modes of travel used.

Data are also needed, most importantly, on whether a work trip was made yesterday and what mode was used (as opposed to the usual mode).

SUMMARY

Despite its shortcomings, the census journey-to-work data are a valuable asset for transportation planning. The experience with and use of the 1980 data in one urban area have been reviewed. Although changes need to be made in 1990 to improve turnaround time and reliability, planning in the 1990s will require the kind of comprehensive information provided by this type of survey. Certain relevant additions can also greatly enhance the utility of the data base at little additional cost. User-based geography (i.e., traffic zones) is essential.

Transit agencies would also be well served by a question relevant to whether any household member used transit yesterday for a nonwork transit trip. This question would complete the picture of transit use in a region and enable the MPO and transit authority to develop relationships that would be extremely useful to forecast total transit demand. Above all, user-based geography is essential if the data are to be relevant to needs.

Analysis and Use of 1980 Urban Transportation Planning Package in the Delaware Valley Region

THABET ZAKARIA

ABSTRACT

The 1980 Urban Transportation Planning Package (UTPP) for the Delaware Valley region is analyzed with special emphasis on journey-to-work trips, employment, mode of transportation to work, car ownership, employed persons, and other socioeconomic data essential to transportation planning and travel forecasting. A review of the UTPP computer tapes and data showed some programming, sampling, and bias problems, which were resolved before the data were used as a base for trend analysis, traffic simulation, highway and transit project studies, strategic planning, and economic development. The trip information should be adjusted before it can be used for transportation planning. The errors in the 1980 UTPP data are generally small and the package shows a significant improvement over the 1970 UTPP. Most of the 1980 UTPP problems can be avoided in the future if the recommendations made in this paper and by other interested planning agencies are considered in the 1990 census.

Information on 1980 census work trips, employed persons, employment, and many other socioeconomic variables is available in the 1980 Urban Transportation Planning Package (UTPP). The UTPP is a special tabulation of census data used in transportation planning by individual Standard Metropolitan Statistical Areas (SMSAs) and tailored to a geographic area. The tabulations and data items were specified by an ad hoc committee of transportation planners representing TRB's Committee on Transportation Information Systems and Data Requirements. Funding for the development of the UTPP program was provided by the U.S. Department of Transportation.

In June 1983 the board of the Delaware Valley Regional Planning Commission (DVRPC) authorized $50,000 for the purchase of the 1980 UTPP for the Delaware Valley region, which includes portions of Pennsylvania and New Jersey. Specifically, the region includes four suburban counties in Pennsylvania (Bucks, Chester, Delaware, and Montgomery), four suburban counties in New Jersey (Burlington, Camden, Gloucester, and Mercer), and the city of Philadelphia. The Delaware Valley includes an area of 3,833 miles^2 and a population of more than 5 million. There are 352 municipalities, including such major cities as Trenton and Camden in New Jersey and Chester in Pennsylvania.

DVRPC received the UTPP data tapes on January 30, 1984, almost 4 years after Census Day in 1980. Work was initiated to process and print UTPP data for various levels of geographic units for purposes of transportation planning analysis and evaluation and for project studies. Because the contents of the UTPP are extensive, work on the processing and evaluation of data is still under way and will probably continue into 1985.

The purpose of this paper is to briefly discuss the experience of DVRPC with the UTPP data with special emphasis on the journey-to-work information and other socioeconomic information useful to transportation planning, such as population, households, employed persons, car ownership, and employment. Some specific problems found in the UTPP information are defined and some solutions are suggested. The data are evaluated and some figures are presented to illustrate the magnitude of the errors in the data selected. The use of UTPP data in several DVRPC transportation and nontransportation planning projects is described.

CONTENTS OF THE 1980 UTPP

The UTPP information was collected from the 1980 long-form census questionnaire distributed to about 17 percent (1 in 6) of all households. However, because of census budgetary constraints, only one-half (1 in 12) of this sample was processed for work-trip information at the place of work (see the paper by Fulton in this Record on allocating incomplete place-of-work responses). The UTPP consists of six parts containing 82 tabulations of data items specified as follows (1):

- Part I includes 29 tabulations of data items such as population, households, workers, automobile ownership, mode of travel, and income. This information is stratified by place of residence for all block groups and tracts in the Delaware Valley region.
- Part II contains 19 tabulations of data items related to households and workers for large geographic areas such as the Philadelphia central business district (CBD), central city, county, SMSA, and region. This information is tabulated by place of residence.
- Part III includes 14 tabulations for workers classified by place of work at the tract level. For example, it provides the number of workers by sex and industry who work in a particular census tract.
- Part IV includes 3 tabulations on workers' travel between place of residence and employment at the tract level. Essentially, it provides a work-trip matrix for all tracts in the region and for Philadelphia center city block groups.
- Part V contains 7 tabulations of the place-of-work data at the block-group level aggregated to census tracts. For example, it provides the number of workers by sex and occupation. This part is similar to Part III except for the geographic level.
- Part VI includes 10 tabulations of data items classified by county of residence to county of work, including 20 counties and cities external to the Delaware Valley but which have a significant flow of work trips to and from the region.

The data were collected using census areal units consisting of block, block group, tract, enumeration district, minor civil division (MCD)--township, borough, city, and village and county--and SMSA. In 1975 the DVRPC grid system, used for the collection of data in 1960 origin and destination surveys, was converted to the census areal system. This conversion was made to eliminate the need for a correspondence table between the two areal systems that occurred in the acquisition of the 1970 UTPP. At that time, the Census Bureau required DVRPC to provide an equivalency table of all counties, tracts, blocks, enumeration districts, and transportation zones. The preparation of such a tabulation proved to be tedious, costly, and time consuming because the region includes more than 50,000 blocks, 1,200 tracts, 5,500 modified grids, and 700 transportation zones and districts.

In 1983 DVRPC requested the Census Bureau to produce all six parts of the 1980 UTPP for the Delaware Valley region. Table 1 gives the geographic units of each part. It was believed that this aggregation of data would satisfy the majority of data requests required for transportation planning studies that would be conducted by DVRPC staff, its member governments, or transportation consultants.

TABLE 1 1980 UTPP Data Aggregation for the Delaware Valley Region

Geographic Unit	Part of UTPP					
	I	II	III	IV	V	VI
Block group of residence	X					
Block group of work					X	
Tract of residence	X					
Tract of work			X		X	
Tract of residence to tract of work				X		
Central business district		X	X			
Minor Civil Division	X		X	X	X	
Central city	X	X	X	X		
County	X		X		X	X
Urbanized area		X				
External county and city						X
SMSA and region	X	X	X		X	X

As previously noted, 20 external counties and cities to the Delaware Valley were specified for Part VI of the UTPP. Except for York County in Pennsylvania, Union County in New Jersey, and New York City, Figure 1 shows all surrounding counties and major cities that have a large number of commuters to and from the Delaware Valley region.

ANALYSIS AND EVALUATION OF 1980 UTPP DATA

A review of the 1980 UTPP data for the Delaware Valley region indicated some programming, definitional, and statistical problems. Unlike the 1970 UTPP, however, the 1980 data on work-trip destinations do not contain trips not identified by block, tract, or MCD. The Census Bureau allocated all 1980 trips not identified by street addresses to block groups and tracts. (See Allocating Incomplete Place-of-Work Responses in the 1980 Census Urban Transportation Planning Package by P.N. Fulton in this Record.) In the 1970s, DVRPC spent a considerable amount of time and money in developing a method for coding the unallocated trips (trips with no workplace addresses) to transportation zones within the region.

Programming Problems

After receiving the 1980 UTPP tapes from the Census

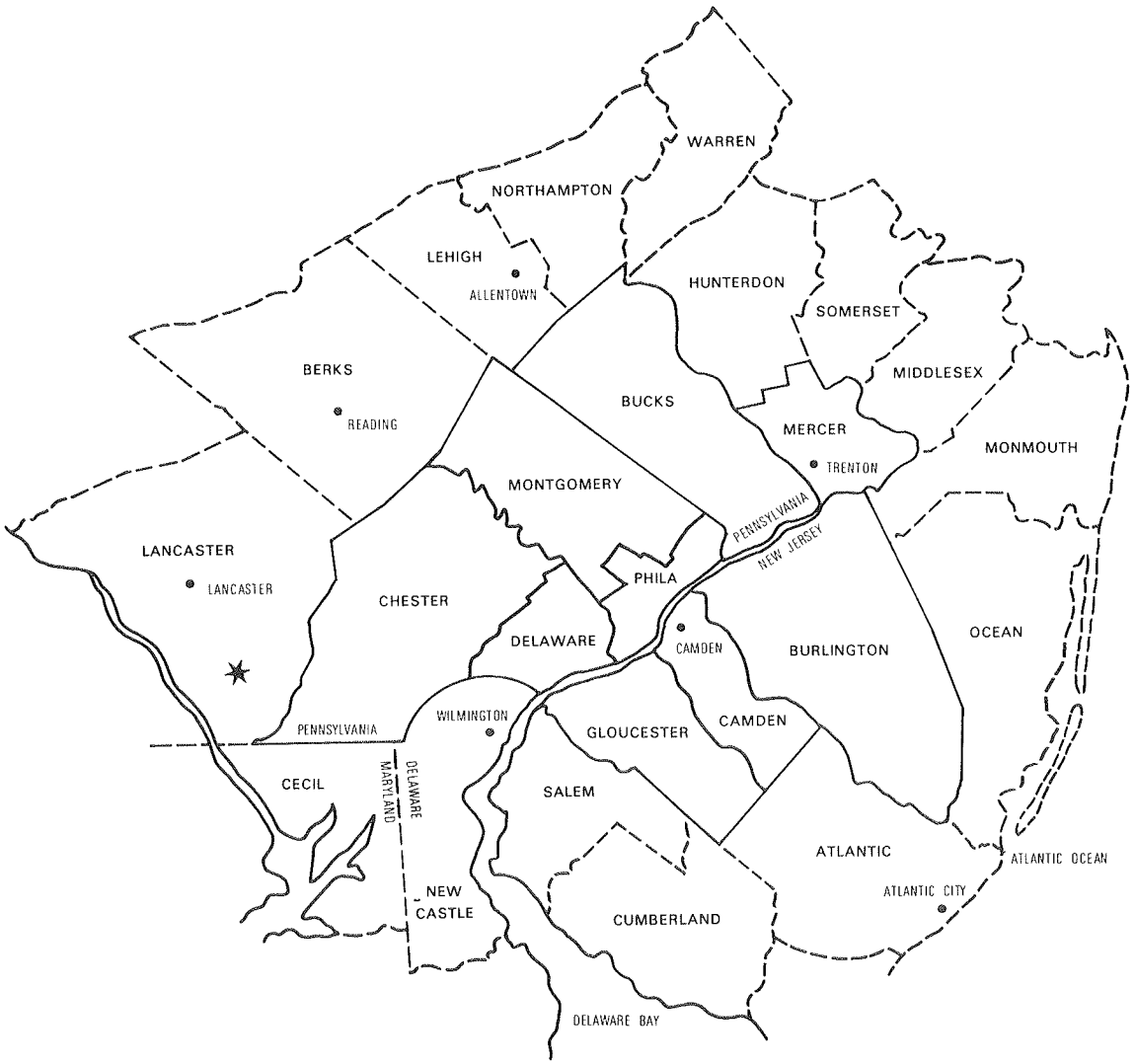

FIGURE 1 Greater Delaware Valley region.

Bureau, DVRPC examined the print program to produce data for various transportation planning studies. It was found that the format of the UTPP tapes is quite complex. It contains subtle differences from the regular census format such as the S in suppressed data fields and the presence of unallocated MCD and place-level data in tract records. The print program provided with the UTPP tapes is not operational for large regions, and DVRPC programmers were required to spend an extensive amount of time developing miniprograms to extract information from the various parts of the UTPP. The documentation of the data is good in general, although some items, such as the unallocated (000) tract- and block-level trips, are not clear.

Examination of Part V of the package indicated an error in the data. It appeared that the entry of data for Mercer County occurred twice, thereby almost doubling Mercer County employment and overestimating employment in all other DVRPC counties. Furthermore, it was found that the trips made by Salem County residents were omitted from Part VI. However, in response to a request from DVRPC, the Census Bureau corrected the errors and provided corrected versions of the UTPP tapes.

Problems of Definition and Statistics

As stated previously, the Census Bureau obtained information on workers and not on trips; the latter is usually collected in home interview surveys for transportation planning studies. The analysis of workers' trip tables (Parts IV and VI) by travel mode indicated that some walk and railroad trips were unrealistic in terms of travel time or distance. It was found, for example, that some workers walked from Philadelphia to counties a considerable distance from the city. Similarly, there were railroad trips where no such service existed. These few irrational trips are due to errors in census coding, sampling error, or incorrect information returned by respondents who did not understand the census questionnaire. Many respondents confused the access mode with the principal mode of travel.

The evaluation of employment data by industrial sector showed that some misunderstood the census question that adopted the Standard Industrial Classification (SIC) system. Some were not able to identify their industry correctly because some SIC categories are not easily defined. The public administration sector is especially complicated. An

employee of a municipal utility authority, for example, may consider himself either a member of the public administration sector or a member of the public utilities sector.

Quality of the Data

Generally, the 1980 UTPP data are good for transportation planning purposes. The data on population, household, car ownership, employed persons, and other socioeconomic characteristics obtained from Part I are quite accurate and do not require any adjustment due to sampling or nonsampling errors. The suppression of the characteristics of a small group of people (30 persons or 10 housing units) by the Census Bureau does not significantly affect the quality of tract or block-group information.

Part I data compare favorably with the 100 percent census counts. Table 2 shows the magnitude of difference between the population produced from Part I and from the 100 percent counts for a few tracts, MCDs, and counties selected at random. As can be seen, the differences are small and are acceptable for planning purposes.

TABLE 2 Comparison of 1980 UTPP Population Data and Total Census Counts

Areal Unit	1980 Population			
	Total Count	UTPP	Difference	Percent Difference
Census tract				
0069	4,960	4,960	0	0
0200	3,086	3,114	28	0.9
0840	1,995	1,995	0	0
1056	3,291	3,283	-8	-0.2
1256	9,744	9,744	0	0
Minor Civil Division				
170	12,919	12,919	0	0
160	2,836	2,836	0	0
025	35,509	35,509	0	0
County				
Philadelphia	1,688,210	1,688,144	-66	0
Montgomery	643,621	643,598	-23	0
Gloucester	199,917	199,917	0	0
Total region	5,024,681	5,024,534	-147	0

As described previously, Parts III, IV, V, and VI contain trip data at the place of work for various geographic units such as tracts, MCDs, and counties. If trip destinations by resident and nonresident workers living in commutershed areas are added together, the sum will be approximately equal to the number of jobs, or employment. A certain percentage of these work-trip destinations (employment) should be added to account for workers who were absent during the census week due to illness, vacation, or other personal reasons and for workers who had more than one job (2). Based on the Bureau of Economic Analysis (BEA) and DVRPC employment data, the UTPP employment, or number of trips to the place of work, was increased by 9.27 percent, 1.54 percent for absentees, and 7.73 percent for multiple-job workers (3).

Table 3 shows a comparison of UTPP employment before and after adjustments for selected municipalities, counties, and the total region. It also shows the percent difference between the adjusted UTPP employment estimates and those estimated by BEA or DVRPC. As shown in the table, the differences

TABLE 3 Comparison of 1980 UTPP, DVRPC, and BEA Employment Estimates

Areal Unit	1980 Total Employment			
	UTPP		BEA or DVRPC Data	Percent Difference[a]
	Unadjusted	Adjusted		
Municipality				
Abington	19,884	21,872	21,180	-3.2
Cherry Hill	36,983	40,681	37,102	-8.8
Deptford	7,254	7,979	7,821	-2.0
Upper Gwynned	8,376	9,214	9,509	3.2
County				
Bucks	170,284	186,069	186,485	0.2
Philadelphia	760,156	830,628	849,092	2.2
Burlington	124,544	136,086	133,505	-1.9
Gloucester	56,495	61,732	63,352	2.6
Total region	2,076,372	2,268,857	2,315,008	2.0

Sources: BEA: county and regional employment; DVRPC: municipal employment.
[a]UTPP adjusted versus BEA/DVRPC.

between the two sets of regional and county employment data are very small (2.0 percent). It should be noted, however, that the percent difference between the two sets of employment estimates increases as the size of a geographic unit decreases due to the sampling error.

As stated before, the 1980 UTPP employment data for the Delaware Valley region are about 9 percent lower than those estimated by BEA or DVRPC. The Washington Metropolitan Area Council of Governments compared the census journey-to-work data obtained from the Annual Housing Survey with its employment file and found that census data for Washington, D.C., are about 20 percent lower than local agency estimates of 1.5 million jobs. Total census work trips and transit work trips, however, were underestimated by only 6 and 5 percent, respectively (4).

Most parts of the UTPP include information on the worker's mode of transportation to work. A respondent was asked to choose one of 12 travel modes that he or she usually took to travel to work for most of the distance between the place of residence and work. The travel-mode proportions appear to be reasonable because they compare favorably with DVRPC highway traffic counts and transit surveys for large areas and the region. Table 4 shows that the difference between the UTPP data and actual counts for total public transportation work trips is less than 1 percent. However, such a difference becomes large for travel submodes within smaller areas. In the Philadelphia central business district (CBD), the difference between the UTPP and actual subway-elevated trips is about 33 percent. Such large differences are mainly due to incorrect responses to the questionnaire. It appears that many respondents confused the access mode to the subway station with the subway mode, which is supposed to be the principal mode of travel to work according to census definition. For example, persons who live in Delaware County and work in the Philadelphia CBD must take buses or trolleys to the 69th Street terminal where they transfer to the Market-Frankford subway-elevated line. Thus, bus or trolley rather than subway was reported as the principal means of transportation of workers in these areas. As shown in Table 4, the surface trips (bus and trolley) are overestimated as much as the subway-elevated trips are underestimated.

These problems are similar to those experienced with the 1970 UTPP (5). However, the magnitude of the 1980 errors is less. For this reason, the UTPP trip information should be adjusted before it is

TABLE 4 Comparison of 1980 UTPP and DVRPC Work-Trip Estimates for Highway and Public Transportation

Areal Unit	Mode	1980 Highway and Public Transportation Work Trips			
		UTPP		DVRPC Estimates	Percent Difference
		Unadjusted	Adjusted		
Philadelphia CBD	Public transportation				
	Railroad	41,493	45,642	40,945	11.5
	Subway-elevated	40,442	44,486	57,649	-32.8
	Surface	55,903	61,493	46,223	33.0
	Total	137,838	151,621	144,817	4.7
	Highway	80,758	88,834	87,274	1.8
DVRPC region	Public transportation	285,366	313,902	315,700	-0.6
	Highway	1,577,760	1,722,914	1,648,810	4.5

used for transportation planning. The adjusted UTPP employment data for the Delaware Valley region are quite reasonable.

USES OF THE 1980 UTPP AT DVRPC

The uses of the 1980 UTPP in the Delaware Valley region are somewhat similar to those applications outlined in the Transportation Planners' Guide to Using the 1980 Census (2). DVRPC has already utilized census data in various studies and will continue to use the UTPP in transportation planning and other planning activities. As mentioned earlier, the UTPP includes many socioeconomic data items and trip information that are invaluable to local and state governments, transit operators, and private corporations for making a variety of transportation and locational decisions. These include such decisions as the locations of shopping centers, industrial parks, banks, and service industries and the estimation of parking requirements, transit fleet sizes, and service schedules.

In order to assist state and local planners, transit operators, and others interested in interpreting and using census information, DVRPC held a one-day seminar on May 2, 1984. Representatives from FHWA and the Bureau of the Census discussed the development of the UTPP and journey-to-work data and how the data can be applied in transportation planning activities. DVRPC staff presented its plans for utilizing the information and how the data can be obtained for local use in transportation planning and locational studies. The response to the seminar was very good and the attendees were informed about the UTPP and its uses in their current and future planning studies.

There are at least six major uses of the 1980 UTPP in the Delaware Valley region. Some of these have been applied and some will continue in the future.

Establishment of Data Base for Transportation Planning

DVRPC has initiated a project to prepare a data bank for transportation planning at the block-group and tract levels. This information includes population, employment, work trips, and other socioeconomic variables required for traffic simulation and transportation analysis and planning. Such data have been extracted from Parts I, III, IV, and V of the UTPP. All data items have been edited for reasonableness and will be adjusted if necessary based on other census data and DVRPC surveys, counts, and files as described in the previous section of this paper. These data will be used in most transportation system and project planning studies.

Preparation of Data Summaries and Evaluation of Trends

DVRPC completed a report on the journey-to-work trends in the Delaware Valley region (3). This report compares the 1970 and 1980 journey-to-work information, means of transportation for commuting to work, employed persons, and employment at the county and regional levels. It also analyzes the commuting flow between the counties of the Delaware Valley region and surrounding counties and cities. The report was well received by planners and decision makers because it provides factual information about trends in development and travel patterns in the region. For example, Table 5, taken from the report, gives the 1970-1980 trend in the distribution of Montgomery County workers by place of work. Other tables show the trends in employment and mode of travel for all DVRPC counties.

Six short data bulletins were also published. Each includes one or two information items obtained

TABLE 5 Montgomery County Resident Workers: Distribution by Place of Work *(3)*

Place of Work	No. of Workers		Percent Difference
	1970	1980	
DVRPC region			
Bucks County	8,488	14,325	68.8
Chester County	5,900	10,525	78.4
Delaware County	5,897	7,773	31.8
Montgomery County	158,986	204,673	28.7
Philadelphia	54,489	55,598	2.0
Burlington County	1,632	532	-67.4
Camden	3,089	1,643	-46.8
Gloucester County	883	225	-74.5
Mercer County	1,877	354	-81.1
Total	241,241	295,648	22.6
Outside DVRPC region			
Berks County	2,499	3,070	22.8
Lancaster County	82	172	109.8
Lehigh County	633	773	22.1
New Castle County	513	282	-45.0
Northampton County	665	196	-70.5
Other	5,504	4,185	-24.0
Total	9,896	8,678	-12.3
Total workers	251,137	304,326	21.2

from Parts I or II of the UTPP. For example, a bulletin was prepared on car ownership growth between 1970 and 1980 for the counties in the Delaware Valley region. It also includes households stratified by the number of cars owned (zero, one, two, or three or more cars).

Update of DVRPC Traffic Simulation Models

A project has been initiated to update the DVRPC travel forecasting models using the 1980 UTPP. During the 1970s, the 1970 UTPP was used to check and validate the DVRPC traffic simulation models. These models will be updated again using 1980 census data. Because the DVRPC travel simulation models follow the traditional steps of trip generation, trip distribution, modal split, and travel assignment, they utilize computer programs included in the federally sponsored Urban Transportation Planning System (UTPS). Generally, the models are similar to those utilized in other large urban areas that depend on census data for system and project studies.

Figure 2 shows the activities needed to update the DVRPC traffic simulation process. This work will be completed by the end of FY 1985. A careful review and evaluation of the results of each model will be conducted and necessary adjustments will be made to achieve the most accurate calibration. The simulated traffic volumes will be compared with actual highway traffic counts and public transportation ridership to assure that acceptable accuracy of the simulated results is obtained from these models.

Use in Highway and Transit Corridor Studies

The 1980 UTPP data, especially the journey-to-work

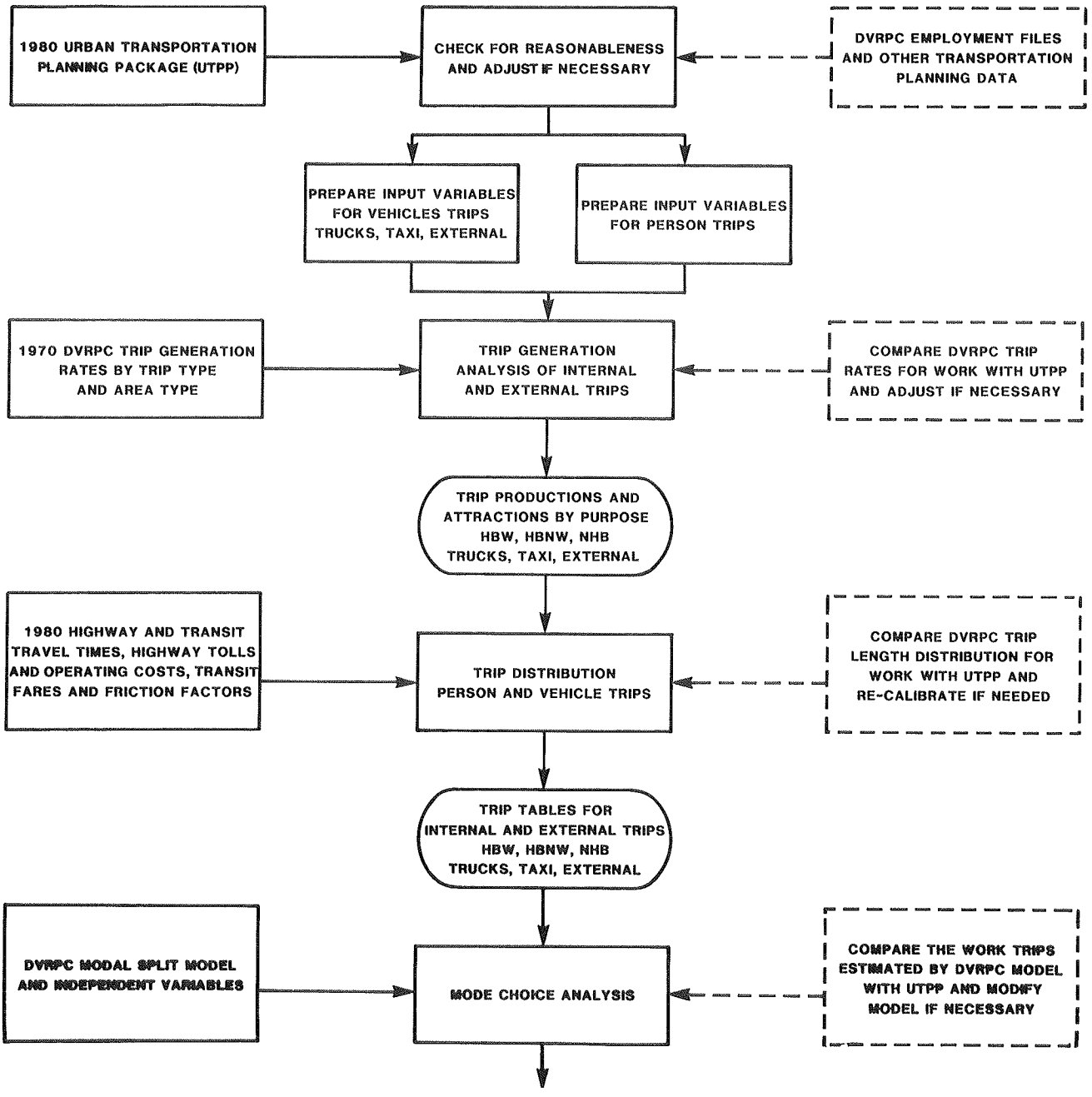

FIGURE 2 DVRPC traffic simulation update using 1980 UTPP.

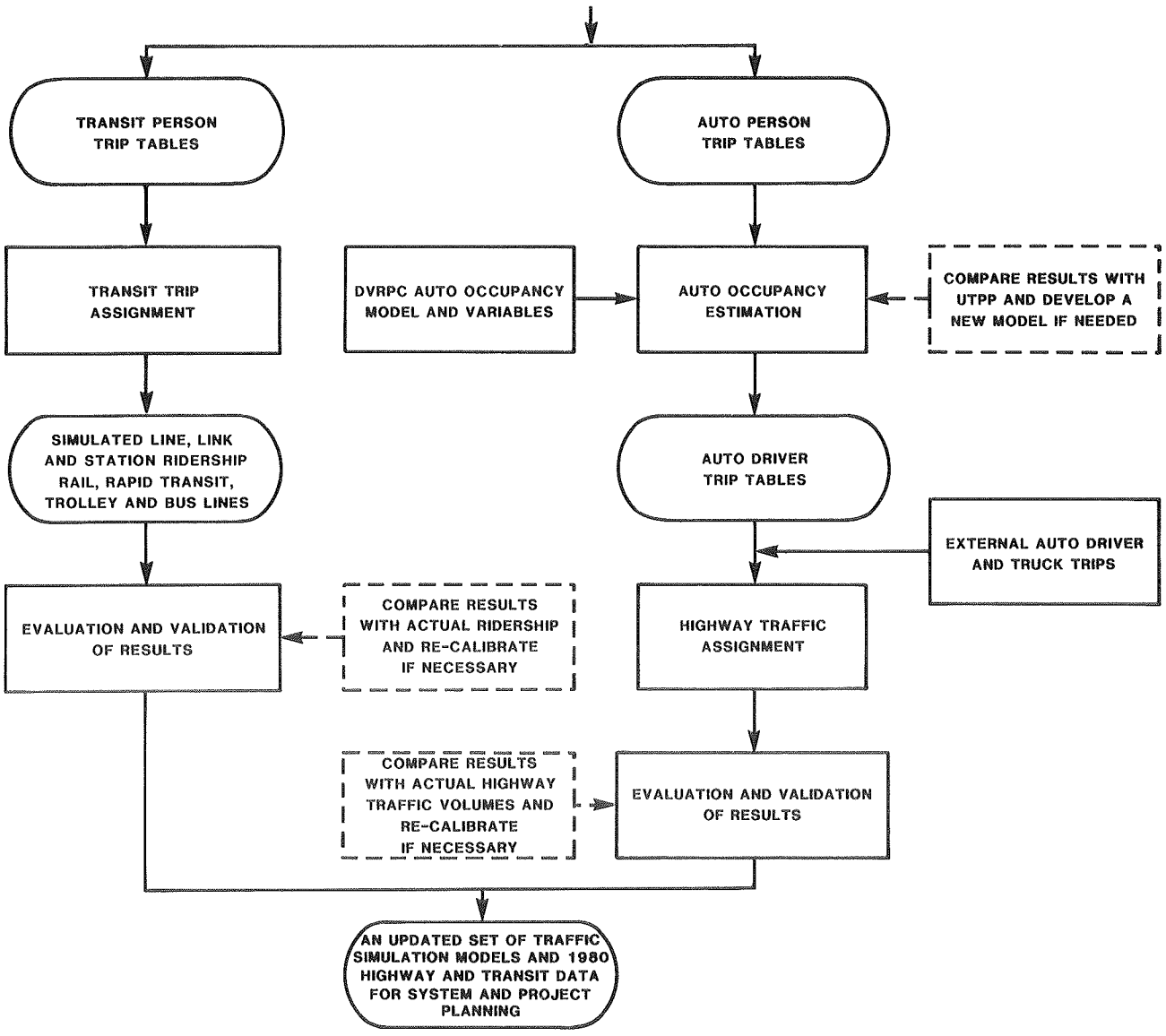

FIGURE 2 continued.

information contained in Part IV, have been used in three transit corridor studies to check the travel demand or ridership for each transit submode, including high-speed rail line, express bus and park-and-ride service, and local bus service.

The 1980 UTPP data will also be used in many future highway and transit studies because it is the only information available for transportation planning. The use of these data minimizes any large-scale data collection in the Delaware Valley and decreases the rising costs of surveys required for transportation planning.

Application in Strategic Planning and Economic Development

DVRPC has used the 1980 UTPP information on employment, particularly Part V, to evaluate the significant changes in the type and location of industries and commercial establishments. This evaluation will result in recommendations and strategies aimed at attracting new industries and high-technology firms to the Delaware Valley. Also, employment information is useful to the redevelopment of declining areas of old urban centers and provision of the required physical improvements for their rehabilitation.

Provision of 1980 UTPP Data to Public Agencies and Private Corporations

Finally, DVRPC intends to sell the 1980 UTPP information to any public or private agency involved in planning or urban studies. This may include studies for housing, finance, real estate, health facilities, social services, economic base, and economic development. It appears that some planning agencies and private companies in the Delaware Valley region are interested in obtaining the UTPP information for their various studies.

FINDINGS AND CONCLUSIONS

Generally, the 1980 UTPP for the Delaware Valley region contains quality data for transportation planning, economic base and employment location

studies, urban development analysis, and planning and evaluation of public services. However, the analysis of UTPP data indicates a few programming, statistical, and bias problems. Most of these problems were resolved before DVRPC used the UTPP as a data base for trend analysis, information purposes, traffic simulation, highway and transit project studies, strategic planning, and economic development. The errors in the 1980 data are generally smaller than those found in the 1970 UTPP.

Unlike the 1970 trips, the 1980 trip destinations were assigned or coded to block groups and tracts, and no effort by DVRPC was needed to develop or apply a procedure to allocate the uncoded trips. However, employment or trip information should be adjusted before it is used in transportation planning studies because it does not include all workers or jobs.

Most of the 1980 UTPP problems and errors can be avoided in the 1990 census by quality control edits and a careful review of the census questionnaire, sample size, and the computer programs required for processing the information. Specifically, the journey-to-work questions should be simplified to prevent any confusion on the part of respondents on such questions as mode of travel and industry classification. Many confused the access mode to subway-elevated or railroad lines with the principal mode of travel. The questionnaire should be redesigned to capture multimodal trip information from the place of residence to the place of work. It should also simplify the SIC categories to avoid any error or misunderstanding in the employment sectors.

The sample size (8.3 percent) for coding work-trip destinations should be increased 100 percent, as originally planned, to improve the quality of the trip matrix used to calibrate trip distribution models for travel forecasting and projection.

The format of the 1980 UTPP tapes is quite complex, and the print program is not operational for the Delaware Valley region. This caused extensive delays in extracting the UTPP data. Finally, DVRPC received the UTPP almost 4 years after the data had been collected; a more timely release of data is obviously important to all census data users.

ACKNOWLEDGMENT

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The author is responsible for the findings and conclusions in this paper, which may not represent the official view or policies of the funding agencies.

Uses of the Urban Transportation Planning Package from the 1980 Census in the Denver-Boulder Region

DAVID L. KURTH

ABSTRACT

The initial uses of the Urban Transportation Planning Package in the Denver-Boulder region are described. The five main purposes for which the data have been used are presented. The processes used to analyze the data, the results obtained, difficulties encountered with using the data, and solutions to those difficulties are discussed. Where possible, comparisons with results of the 1970 census or previous travel surveys are presented. Finally, some comments are made about the quality of the data and their usefulness in the Denver-Boulder region.

The Urban Transportation Planning Package (UTPP) from the 1980 census is a valuable source of detailed information for transportation planners. There are many possible uses of the data including, for example, recalibration and validation of various portions of regional transportation models, carpool planning, bus service planning, high-occupancy-vehicle (HOV) lane planning, and bicycle planning.

The initial uses of the UTPP data in the Denver metropolitan area are presented. As of June 1984, the data had been available to transportation planners in the Denver area for 8 months and had been used for five main purposes:

1. Adjustment of socioeconomic distributions used in the regional trip generation model,
2. Validation of the work-trip distribution model for the Denver urbanized area,
3. Calibration of a subarea model outside of the Denver urbanized area,
4. Special transit studies, and
5. Sales to developers and market research firms.

In addition, several of the tabulations were printed and have been used to answer basic questions about commuting in the Denver region [e.g., What percentage of the workers in the Denver central business district (CBD) live within the city of Denver?] Each of the five main purposes will be discussed in greater detail in order to present how the data have been used, the processes used to analyze the data, difficulties encountered with the data, and solutions to those difficulties. Some final comments will be made about the quality of the data and their usefulness in Denver.

The Denver Regional Council of Governments (DRCOG) made the decision to purchase the UTPP data in early 1983. The decision was based in part on the need to recalibrate the regional travel model. The UTPP data will be supplemented by a small-scale travel survey taken in the fall of 1984.

The area covered by the regional travel model for the Denver-Boulder Standard Metropolitan Statistical Area (SMSA) is shown in Figure 1. Separate travel models are now maintained for the other urbanized areas, Boulder and Longmont, in the Denver-Boulder SMSA. Because the Bureau of the Census required that UTPP data be acquired for the entire SMSA, the 589 traffic zones included in the Denver travel modeling area had to be augmented to include Boulder, Longmont, some nonurbanized parts of Adams, Arapahoe, and Boulder counties, Douglas County, and Gilpin County. A total of 794 traffic zones were defined for the entire SMSA.

The extra work required to define traffic zones outside of the Denver modeling area has already been beneficial. Three of the main uses of the data covered in this paper have required the extra data.

ADJUSTMENT OF SOCIOECONOMIC INPUTS TO TRIP GENERATION

Once preliminary checks indicated that the UTPP data were consistent and reasonable, they were used to recalibrate portions of the regional trip generation model. The DRCOG trip generation model is a household-based cross-classification model stratified by income group and household size. Population and households by income category are exogenously forecast for each traffic zone, and two submodels are used to convert these exogenously forecast data to a joint distribution of households stratified by income group and household size.

The first submodel uses the average household size of a zone to estimate the percentage of households by size in the zone (1,2). The model was originally calibrated using 1970 census data [see Figure 2 (3,Table H-1)]. In order to update the model, data from UTPP tabulation I-9, size of household, were used to develop a scatterplot of percentage of total households versus average household size. The Statistical Analysis System (SAS) was used to simplify this work. The only intermediate processing required was the aggregation of households of five, six, and seven and more persons into households of five and more persons and the conversion of absolute households by size to percentage of total households by size.

The raw results of this submodel recalibration for one-person households are shown in Figure 3. Curves were hand fit through each of scatterplots and adjusted to satisfy two criteria:

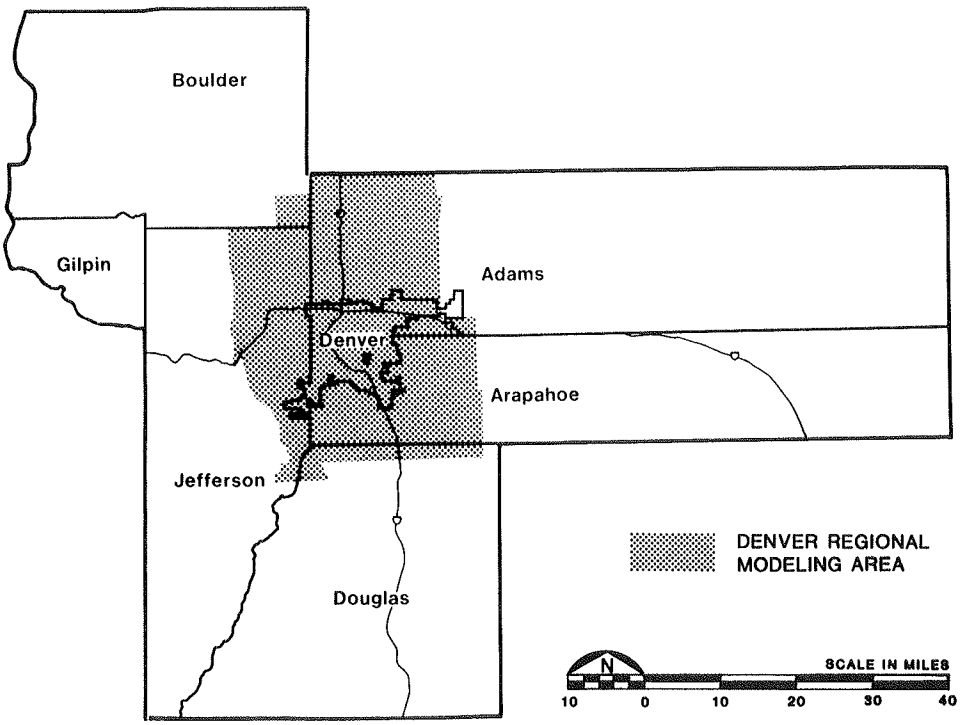

FIGURE 1 Denver-Boulder SMSA.

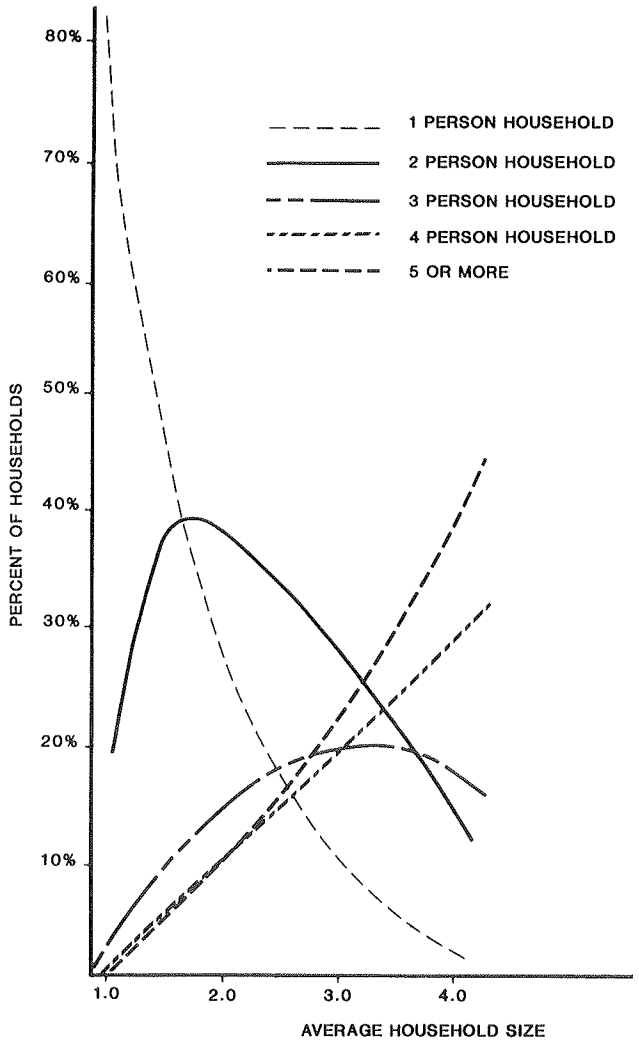

FIGURE 2 Distribution of households by average household size (*3*, Table H-1).

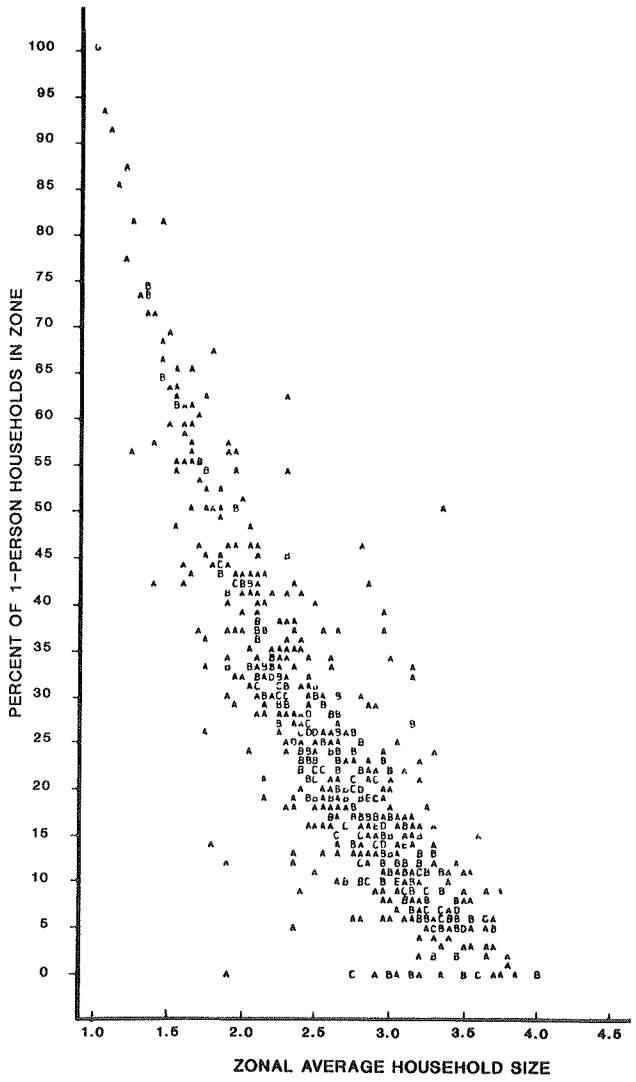

FIGURE 3 Percentage of one-person households versus average household size.

1. The sum of the percentage of households for all household sizes had to equal 100 for each average household size and
2. The average household size that results at each point has to be accurate.

The second criterion is not necessarily obvious (and, in fact, was violated in the submodel based on 1970 census data). For example, suppose that the average household size for a zone was 2.6 and that there are 100 households in the zone. From Figure 2, the following households and persons by household size might result (the average household size for households of five and more is 5.56):

Household Size	Percentage of Households	No. of Households	No. of People
1	19	19	19
2	32	32	64
3	18	18	54
4	15	15	60
5+	16	16	89
		100	286

Obviously, the resulting average household size is 2.86, not 2.6 as was originally input. The results of this submodel recalibration are shown in Figure 4. It is interesting to note the similarity in the shapes of the curves based on 1970 and 1980 data. Although the curves are not identical, their similarity implies a high degree of stability in this submodel over the past 10 years.

The only problems encountered with the UTPP data in this work were occasional illogical average household sizes. As a check of the data, the average household size of five-plus persons was computed from the reported total households, the reported average household size, and the reported one-, two-, three-, and four-persons households. This test showed that about 17 percent of the households with five-plus persons had an average household size of less than five. Although this is an illogical result, the effect on the submodel calibration was minimal because substantial smoothing of the curves was required to satisfy the second criterion listed earlier.

The second submodel is a Fratar or marginal weighting (4) procedure to adjust the regional joint distribution of households by income group and household size to match the marginal distributions of household by income group and households by household size for each zone. As with the first

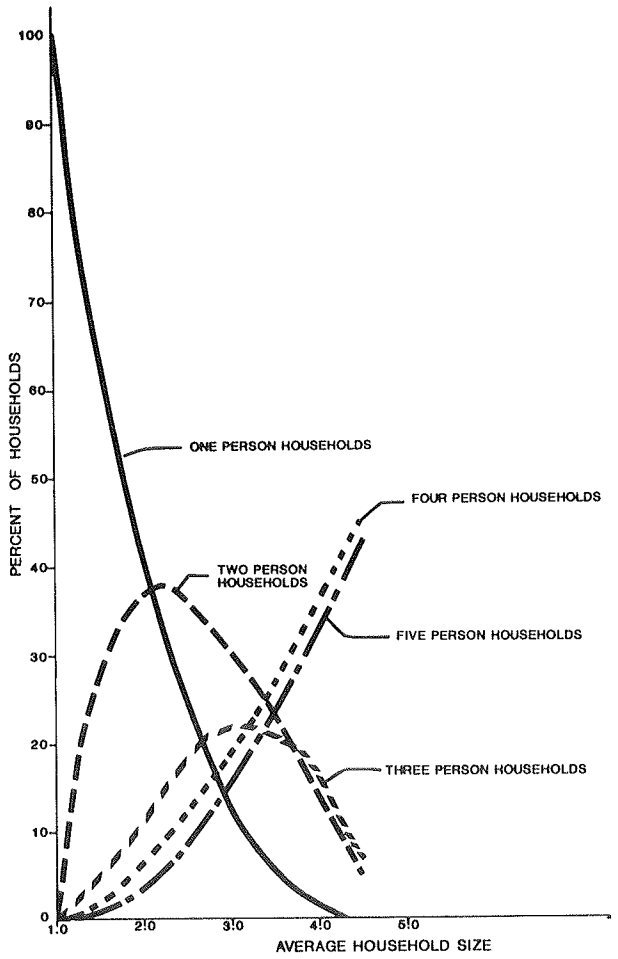

FIGURE 4 Percentage of households by average household size: 1980 UTPP data.

submodel, the input regional joint distribution was based on 1970 census data. Data from UTPP tabulation I-11, household income, were summarized for the region directly from the standard UTPP report. Some interpolation of the standard income ranges used in the UTPP was required to obtain the desired marginal distribution of percentage of households by income group.

The joint distribution from the 1980 UTPP can be compared with the original joint distribution from the 1970 census (Table 1). Through comparison of these two distributions, it is possible to see some of the socioeconomic changes that occurred in the Denver region between 1970 and 1980, especially the increase in one- and two-person households and decrease in larger households. The data appear to be reasonable and confirm the trend in decreasing household size thought to have occurred in Denver in the 1970s.

VALIDATION OF THE WORK-TRIP DISTRIBUTION MODEL

The work-trip distribution model was calibrated in 1975 based on 1971 travel survey data. Recently, some questions as to the accuracy and applicability of the work-trip distribution model have been raised by local decision makers. Some of the questions arose because of a misunderstanding of the basic travel forecasting process: Observed trip tables are required for travel forecasting. Other questions

TABLE 1 Distribution of Households by Household Size and Income Group

Income Category	Percentage of Households by Household Size					Total
	1	2	3	4	5+	
1980 Census Data						
1	9	3	1	1	1	15
2	10	8	3	2	2	25
3	6	16	9	9	6	45
4	1	5	3	3	3	15
Total	25	32	17	15	11	
1970 Census Data						
1	7	4	2	1	1	15
2	6	8	4	3	4	25
3	5	12	7	10	11	45
4	1	4	3	3	4	15
Total	19	28	16	17	20	

were raised for valid reasons, for example, The area has been through two major fuel shortages since 1971, so how do we know that 1971 travel-making characteristics still hold in 1984?

In order to test the validity of the work-trip distribution model, a trip-length frequency distribution comparison was made of the trip table from UTPP tabulation IV-1 and the regionally modeled trip table for 1980. Also direct comparison was made between the two trip tables squeezed to 38 districts. These comparisons were facilitated through the conversion of the UTPP data to the Urban Transportation Planning System (UTPS) J-tape or matrix format. In addition, work trips by bicycle, walk only, and other means were removed from the UTPP trip table during the reformatting process. This work was done to make the UTPP data compatible with and accessible to UTPS programs. A simple FORTRAN program was written to perform the conversion of the UTPP trip tables; the UTPS program MBUILD could have been used to convert the data, but the special form of the UTPP data made it easier to use a simple FORTRAN program to do this work.

Once the UTPP data had been converted to UTPS matrix format, it was necessary to factor the UTPP trip tables and the modeled work-trip tables for 1980 to a common total. The work trips, as reported in the UTPP data, were used as the control total. This was done in order to compare observed work trips.

The choice of the UTPP trip total has no effect on the results, because trip patterns, not trip generation, are being compared. However, it is interesting to note the factor by which the modeled trip tables were multipled. Each interchange in the modeled trip table was multiplied by 0.59, so that the total productions modeled were equal to the total UTPP productions. Assuming that about 15 percent of the workers in the region do not make a work trip on a given day, either because of sickness or because they work on weekends, and assuming a factor of 1.92 to convert journey-to-work data to production-attraction data normally used in transportation models, the 0.59 factor implies that the trip generation is very reasonable (5). This is because the UTPP data summarize only one-way trips made by the average worker, whereas the regional model summarizes two-way trips made on the average work day.

Figure 5 shows the trip-length frequency distribution comparison. All home-based trips made by automobile or transit are represented in the trip-length frequency distributions even though modeled

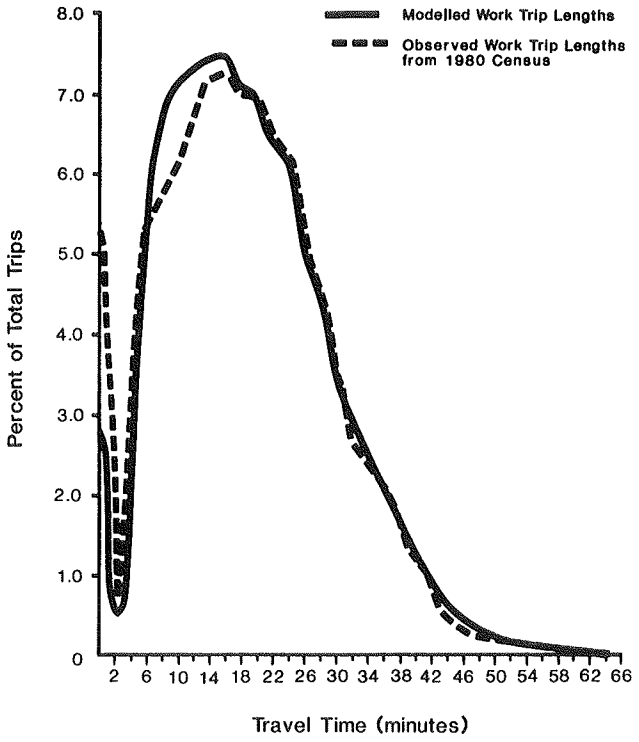

FIGURE 5 Comparison of observed and modeled work-trip lengths for 1980.

highway travel times were chosen as a measure of separation. This plot shows that the DRCOG work-trip distribution model is working quite well and needs little, if any, adjustment.

This conclusion is further supported by the direct comparison of trip interchanges after both trip tables had been aggregated to 32 districts. The high correlation coefficient, 0.93, showed that the trip tables were highly similar. However, there were some district interchanges that were significantly different when the UTPP data and the modeled work-trip tables were compared. An investigation of some of the major district interchange discrepancies showed difficulties with both the UTPP and the modeled trip tables. In the UTPP data, one zone with a large manufacturing plant showed no trip attractions. On the other hand, the UTPP data revealed that a major employer was inadvertently omitted from 1980 DRCOG employment files. These difficulties underscore the problems of comparing large urban data sets: Some differences are bound to exist due to random errors or differences in summarization processes. Although the differences noted previously could cause localized problems with traffic assignments, they do not by themselves significantly affect average trip lengths or length frequency distributions in Denver. The regional employment files have been corrected where differences with the UTPP data indicated such correction was necessary. Census Bureau officials have stated that they are willing to investigate problems reported with the UTPP data and correct any errors found. However, this action has not yet been deemed necessary by DRCOG staff.

CALIBRATION OF A SUBAREA TRAVEL MODEL

The third major use of the UTPP data in the Denver region was for calibration of a subarea model covering three communities just northwest of the Denver modeling area. These rural communities are now developing into major bedroom communities and employment centers.

A subarea focusing model was developed to analyze the effects of alternative transportation investments in these three communities. Figure 6 shows the areas covered by the primary, secondary, and tertiary study areas. Most of the primary and secondary study areas are outside the area normally included in the regional travel model for the Denver area. As a result, UTPP data from Tables I-11, household income, and III-2, sex by industry, were used to provide initial estimates of base-year socioeconomic data. The UTPP data were summarized with a simple SAS program in order to format the data into easily readable tables. Standard UTPP summary reports could have been used, but these are somewhat unwieldly and difficult to understand.

The second major use of the UTPP data in the subarea model calibration was for the home-based work-trip distribution model. Trip interchanges for the entire region were aggregated (and disaggregated where necessary) to match the zone structure used in the subarea model. The resulting trip table was factored through a Fratar process to match trip ends projected by the trip generation model. The resulting trip table was directly input into UTPS program AGM in order to calibrate the home-based work-trip distribution model. It would have been possible, and probably more appropriate, to calibrate the work-trip distribution model on the UTPP trip table that was not factored to match the modeled trip ends to ensure that the factoring process did not bias the results of the calibration.

The final use of the UTPP data in the subarea model calibration was in the calibration of nonwork-trip distribution models. A methodology developed by FHWA and presented in a course on urban transportation planning using the 1980 census was used in this calibration process. Basically, the process was as follows:

1. F-factors for the home-based work-trip distribution model were estimated using UTPP data;
2. The newly calibrated F-factors were compared to original home-based work F-factors for the Denver model, and proration factors were developed for each impedance range;
3. The proration factors were applied to F-factors for the nonwork purposes from the Denver model for each impedance range; and
4. The resulting F-factor estimates for the nonwork purposes were then adjusted to develop smooth F-factor curves.

The F-factors for the original home-based work-trip distribution model for the Denver region agreed quite closely with the new home-based work F-factors developed from the UTPP data. As a result, little adjustment was required to the nonwork F-factors. Unfortunately, the results of this calibration process were not very satisfying. The traffic volumes in the primary study area that resulted from the trip tables based on the F-factor estimates were about twice those observed. The slopes of the nonwork F-factor curves had to be increased substantially in order to decrease traffic volume to reasonable levels. The final nonwork F-factors used in the calibrated subarea model were substantially different from the initial estimates based on UTPP data.

One of the reasons that this process may not have worked is that although the communities are becoming urbanized, they still retain rural characteristics. It is quite possible that home-based work trip making is similar to that noted in the Denver urban

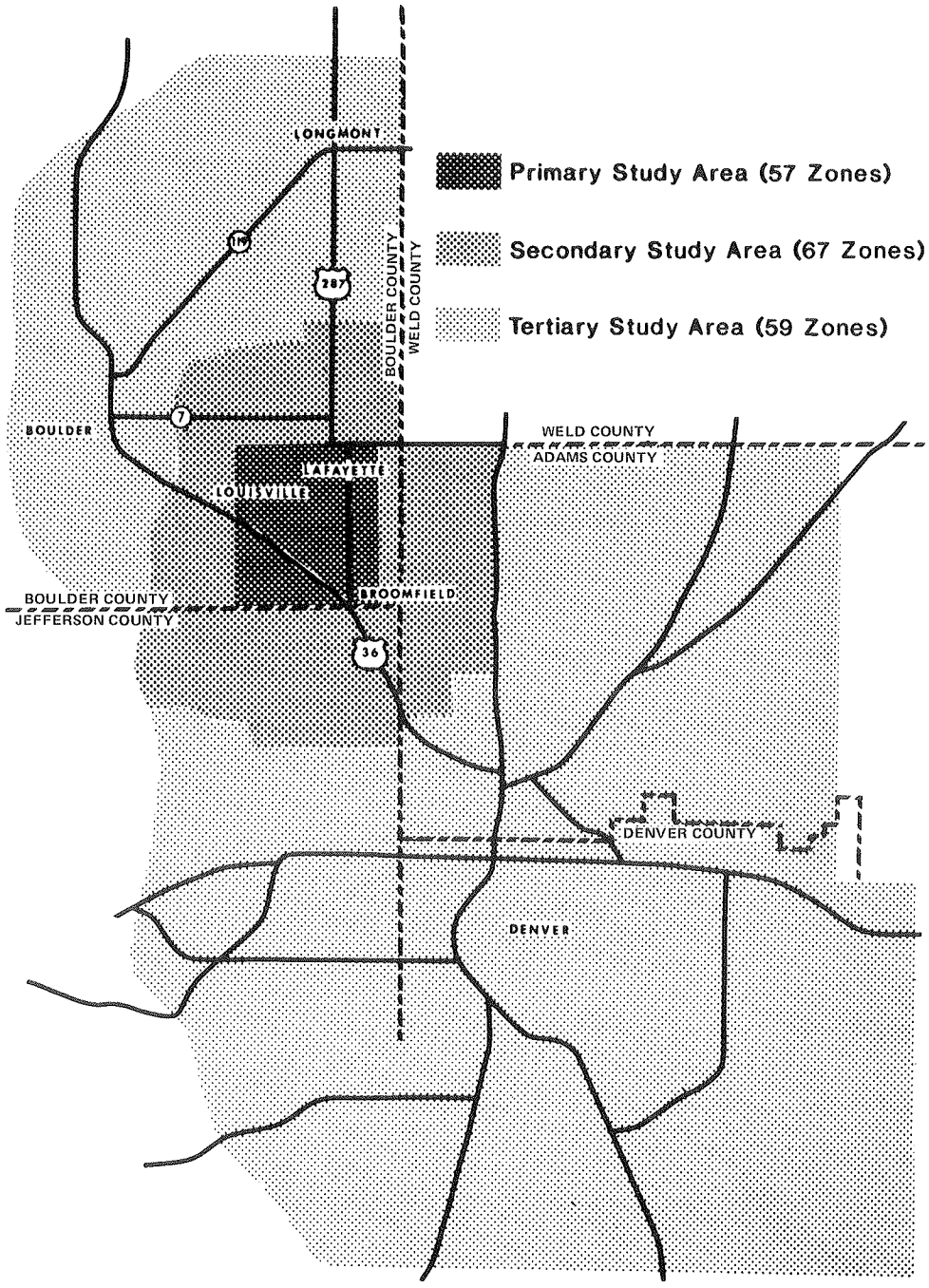

FIGURE 6 Tri-city subarea.

area (at least in terms of trip length), whereas nonwork trip making for shopping and other purposes might be much more community oriented. Another test of this process in an urban subarea is warranted to determine whether the process is valid and where it can be used.

SPECIAL TRANSIT STUDIES AND MARKETING OF DATA

One of the first uses of the UTPP data was to provide the Regional Transportation District (RTD) with data useful in determining potential markets for transit services. Because a number of major suburban employment centers have been built in the Denver region, the RTD wanted to determine whether there were any latent transit markets that were not being served. More recently, the city of Aurora, a major suburb of Denver, wanted to determine the same sort of information--that is, whether major employment centers in their city were being well served by transit.

UTPP Table IV-1 was used to provide data for both of these requests. In both cases, the trip interchange table that had been converted to UTPS matrix format was used. For the RTD, some interesting processing was done to present the data in a format easily usable for this analysis. Because two or more traffic zones were normally specified as an employment center, the regional trip interchange table was

squeezed in one direction only; that is, the columns, or destinations, of the table were aggregated to form districts that were equivalent to the employment centers. The rows of the table, or the origins, were not aggregated. The UTPS program UFMTR was used to produce a trip interchange report in column format, that is, where trip interchanges are listed with each origin zone and destination district on a single line. The resulting rectangular matrices were output to disk rather than to the printer by the program UFMTR, and the interchanges were sorted by increasing magnitude of interchange. In this way, the RTD could easily map and determine the largest potential transit markets that were not already served by transit for these employment centers.

This innovative processing was not done for the city of Aurora. Rather, the trip table was simply aggregated to districts as specified by the city of Aurora and printed in matrix form. This simplified processing was done for Aurora because the need was different: City staff wanted to be able to quickly look up trip interchanges to and from the city of Aurora.

The trip interchange data have also proved valuable to developers in the Denver region. Residential and commercial developers offer a potential source of revenue to help recover the cost of the UTPP data. Just after the RTD request had been completed, a residential developer with several homesites in the region requested data on trip lengths in Denver in order to help design a marketing campaign. The developer was quite willing to purchase special reports of the UTPP data after he understood what was available. The UTPP trip interchange data were processed in a manner similar to that used for the RTD request, except that the origins were aggregated into districts rather than destinations. The origin districts included traffic zones comprising and surrounding the developer's homesites in the region. From these data, the developer was able to target his marketing campaign to specific groups in their work locations.

FUTURE USES OF THE UTPP DATA

The principal future uses of the UTPP data will be in the recalibration of the regional home-based work-trip distribution model and the calibration of subarea travel models. An attempt will be made to calibrate a work-trip generation model for the city of Boulder from the UTPP data. Boulder is an urbanized area northwest of Denver that has some special characteristics. Specifically, the bicycle mode share percentage is seven times greater than that observed in the Denver region and the walk-to-work mode share percentage is three times greater. As a result, home-based work-trip generation rates used in normal travel models might be expected to be substantially lower than those observed in Denver. At present, it is envisioned that the UTPP data will be used to develop work-trip generation models for both Denver and Boulder. Because the trip generation rates from these models will be somewhat higher than that observed in a travel model, the differences, or possibly percentages of difference, will be applied to the regional model to calibrate a usable model for the Boulder area.

SUMMARY

UTPP data have proved useful in the Denver region. Two of the most important uses have been recalibration and validation of various portions of the regional travel model. Because of the way in which the journey-to-work questions were asked in the 1980 census, validations of the work-trip generation model and the mode-split model have been possible only at a gross level and were not reported in this paper. The UTPP has also provided a primary source of data on areas that were not surveyed at the time of the last large travel survey. The UTPP data were successfully used to calibrate portions of travel models for these newly urbanized areas.

Although some problems with the UTPP data have been discovered, they have not been insurmountable. In general, the data have been of high quality and, in fact, have helped the discovery of problems with some of DRCOG's regional data sets.

One enhancement to the UTPP that would make it more useful to transportation planners would be the provision of the trip interchange information in UTPS matrix format. This would eliminate the irritating task of converting the trip interchange information to a form usable by most readily available analysis programs. In addition, it would allow for easy customizing of reports in terms of data and zones reported.

ACKNOWLEDGMENT

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The New York Metropolitan Transportation Council's Experience with the 1980 Urban Transportation Planning Package

LAWRENCE V. HAMMEL

ABSTRACT

The experience of the New York Metropolitan Transportation Council with the 1980 Urban Transportation Planning Package is described. Problems encountered are outlined and solutions are given. Suggestions for improvement of the package are made.

Many still think of Tri-State Regional Planning Commission as the metropolitan planning organization (MPO) for the New York area rather than the New York Metropolitan Transportation Council (NYMTC). That was the case in 1980 and through part of 1982. Tri-State had made plans to acquire the Urban Transportation Planning Package (UTPP) for its 8,000-mile² region. However, Tri-State was dissolved and 10 separate MPOs evolved: 1 in New Jersey, 6 in Connecticut, and 3 in New York, of which NYMTC is the largest, covering 10 counties and 60 percent of the population of the former Tri-State region (10,881,000 out of 17,925,000). The governing board of NYMTC is composed of elected county officials and transportation agencies and operators, including the New York State Department of Transportation, the Metropolitan Transportation Authority (MTA), the Port Authority of New York and New Jersey (PANYNJ), and federal agencies. The central staff of NYMTC is administered by the state.

USES OF UTPP DATA

NYMTC purchased the six-part UTPP for three Standard Metropolitan Statistical Areas (SMSAs): New York, N.Y.; Nassau-Suffolk, and Poughkeepsie-Dutchess County. The package was purchased at the tract level because NYMTC uses square-mile geography rather than traditional traffic zones. It was elected to convert tract-level data to the square-mile base on the in-house mainframe computer. Connecticut Department of Transportation (ConnDOT) purchased a statewide package, and data files have been exchanged with them. New Jersey is purchasing the package but has not received it yet; a similar exchange with them has been proposed.

NYMTC has in general been pleased with the UTPP. The data have been in use since September 1983 with very positive results. Because NYMTC has been so radically restructured from Tri-State, its application of the package is perhaps unique. Its prime concern has been to make the data available to its members, most of whom are transit operating agencies. Most of NYMTC's members wanted hard copies of selected files, although the magnitude of the data led NYMTC to provide tape copies of the trip tables. Some of the data provided by NYMTC include the following:

1. Origin-destination (OD) tables for MTA for its Queens Subway Alternatives Study. Tract-level tables were provided of travel by Queens residents to Manhattan and a later request for data on trips from Queens to elsewhere. The MTA also wished to study characteristics of users of express bus to the Manhattan central business district (CBD), which were developed from the UTPP.
2. Tract-level OD tables and income characteristics tables were developed for Metro-North Commuter Railroad for its electrification extension project and its associated new time schedules. In addition, NYMTC is in the process of building a computerized data base for this new operating agency using the UTPP and the 1980 census Summary Tape Files. The UTPP was acquired from ConnDOT to complete this project because one of the agency's rail lines extends into Connecticut.
3. The New York City Transit Authority used information from Part II of the package to study trip generation in evaluating its January 1 fare increase.
4. Travel tables to New York's secondary CBD in downtown Brooklyn were prepared for the New York City Department of Transportation.
5. The three UTPPs, were merged to obtain a file of New York City residents and workers in the city, including those who live in the two adjacent SMSAs. This file was provided to the New York City Planning Commission, another council member, for its general planning purposes.
6. The council also processed the UTPP in support of an UMTA Section 8 technical study of work travel changes on Long Island by another council member.
7. PANYNJ, another member, obtained tables from Part VI of the package for use in support of its regional economic development activities and as an operator of bridges, tunnels, and a rail rapid transit line.
8. The travel demands of Rockland County residents were assessed and OD tables were developed for use by that county's transit coordinator.
9. The traffic department of Yonkers, the second largest city in NYMTC, received selected tabulations for analysis in serving work travel needs.
10. Copies of previously run UTPP tables have also been provided to the Long Island Rail Road; New Jersey Transit; Westchester County Department of Transportation, which is a bus operator; and two neighboring MPOs.
11. Last, the council provided the worksite locations of resident and nonresident workers in New York City to the Off-Track Betting Corporation (OTB) to assist in locating additional betting parlors.

Practically all of the council members have received processed data from the UTPP files. As is evident from the OTB request, nontransportation agencies and the private sector are approaching the council for the UTPP. The staff provides council members with processing free of charge and requests

a minimal charge from nonmembers. The council is not selling the UTPP for profit; however, neither is it making the entire package available for subsequent use by a service bureau or other profit-making company.

The central staff of the council has also begun to use the UTPP data, especially in its analysis of the change in journey-to-work travel patterns and mode choice between 1970 and 1980. The staff is in the process of inputting the data into a multimodal person-trip model. In-depth analyses are planned of worker characteristics at the worksite by transit use, carpooling, industry occupation, and number of workers as a surrogate for employment. Data from the UTPP will be employed in the council's forthcoming Trans-Hudson Corridor Study.

NYMTC has begun to release 1980 census data in the form of publications as well. Information Compendia are tabular in format with little text and are designed to disseminate information to council members and associated agencies in as rapid a manner as possible; NYMTC has been releasing one such publication each month. Staff Reports are analyses of census data that can affect policy; these are less frequent because considerable time is required to make the analyses.

The UTPP files have already been put to considerable use in the New York area. The sample size (which is approximately 8 percent in New York) has been adequate; this provides about the same number of records as the 1963-1964 Home Interview Survey.

PROBLEMS

The staff has noted problems with the three UTPP files, although these have not been major ones. The chief difficulty was in the misassignment of work trips in three large minor civil divisions (MCDs) in one county. For some undetermined reason only about 1 percent of the worksites were coded to the tract level and the remaining 99 percent were allocated based on that 1 percent. Consequently, tract-level data are unreliable in these three MCDs, although place-level data are correct.

In comparing 1970 and 1980 travel to the tract containing Wall Street in Manhattan, the UTPP measured only 45 percent of the work trips that a 1970 Worker File had found. Although the solution to this problem is not clear, it appears that some blocks may not have been included in the Master Area Reference File (MARF) and thus were thrown into a county remainder category. Tracts adjacent to Wall Street contained reasonable 1980 totals.

Areas such as the World Trade Center in Manhattan are without conventional street addresses. These were to have been given special treatment: manual coding to the tract and block group. Apparently some were inadequately handled at the block-group level, although tract totals appear correct.

Some unusual trip interchanges between counties have been observed, especially those involving railroad trips. But these are more of an annoyance than a problem.

The Display Program has been modified in order to use it on NYMTC's IBM 4341 system. The modifications are available to those interested. Part IV of the package has no geographic selection provision, so CENSPAC was used to access the data. CENSPAC worked for Parts IV, V, and VI but not for Parts I, II, and III because these are segmented files.

Finally, some of the derived values in Part V are incorrect due to a programming error in the UTPP. This has not affected NYMTC's use, because the block-group level data are below the geography level for which plans had been made.

These difficulties are really quite minor, and excellent cooperation has been received from the Census Bureau.

IMPROVEMENTS

There are two aspects for which transit operator council members would have found it useful to have data, had they been available. The first involves age statistics in Part VI, specifically those for the elderly and handicapped. The second involves collapsing the several individual transit modes into the public transportation category. This procedure severely limits the usefulness of many tables in a multimodal metropolitan area such as NYMTC's.

It has been asked whether anything could be dropped in 1990. No one wishes to lose data, but block-group data have not been especially useful. If good block-group data cannot be developed in 1990, any effort that is saved should be used to further improve tract-level data.

Appendixes

Appendix A: Definitions of Census Terms Related to Commuting

The following terms related to commuting are used in the 1980 census.

PLACE OF WORK

The data on place of work were derived from answers to question 23, which was asked only of persons who indicated in answer to question 22 that they had worked at any time during the reference week.

Place of work refers to the geographic locations at which workers carried out their occupational activities during the reference week. The exact address (number and street) of the place of work was asked as well as the place (city, town, village, borough, etc.), whether the place of work was inside or outside its incorporated (legal) limits, and the county, state, and ZIP code. If the person's employer operated in more than one location, the exact address of the location or branch where the respondent worked was requested. If the number and street name could not be given, the building name or other description of the physical location was to be entered.

Respondents who worked at more than one location were asked to report the one at which they worked the greatest number of hours during the reference week. Those who regularly worked in several locations during the reference week were requested to give the address at which they began work each day. In those cases in which daily work was not begun at a central location each day, respondents were asked to provide as much information as possible that described the area in which they worked most during the reference week (for example, various locations within a particular city).

Respondents were tabulated as working in an incorporated place if they reported working inside its legal limits or reported an incorporated place as their place of work without specifying whether they worked inside its legal boundaries. Those who reported working outside the limits of an incorporated place were tabulated as working outside the place. In contrast, respondents who reported a census-designated place (CDP)--a place with no legal boundaries--as their place of work were tabulated as working in that place regardless of their response on the incorporated-limits question. The accuracy of place-of-work data for certain CDPs may be affected by the extent to which their census names were familiar to respondents and by coding problems caused by similarities between the CDP name and the names of other geographic jurisdictions in the same vicinity.

Place-of-work data were given for minor civil divisions (townships and towns) in the nine northeastern states. Many townships and towns are locally regarded as equivalent to a place and were therefore reported as the place of work. When a respondent reported a locality or incorporated place that is part of a township or town, the coding and tabulating procedure was designed to include the response in the total for the township or town. It is believed that the accuracy of place-of-work data for minor civil divisions is greatest for the New England states. However, the data for some New England towns, for towns in New York, and for townships in New Jersey and Pennsylvania may be affected by coding problems that resulted from unfamiliarity of the respondent with the minor civil division in which the workplace was located or from the similarity between names of townships and a neighboring city or borough.

MEANS OF TRANSPORTATION TO WORK

Data on means of transportation to work were derived from answers to questions 24b, 24c, and 24d, asked only of persons who indicated in answer to question 22 that they had worked at any time during the reference week.

Means of transportation to work refers to the principal mode of travel or type of conveyance the respondent usually used to get from home to work during the reference week. Those who used different means of transportation on different days of the week were asked to specify the one they used most often. Those who used more than one means of transportation to get to work each day were asked to report the one used for the longest distance during the work trip.

The category "private vehicle" includes cars (including company cars but excluding taxicabs), trucks of 1-ton capacity or less, and vans. The category "public transportation" includes bus or streetcar, subway or elevated, railroad, and taxicab.

A question on carpooling (question 24c) was asked of all workers who reported their means of transportation to work as car, truck, or van. The category "drive alone" includes those who usually drove alone to work as well as those who were driven to work by someone who then drove back home or to a nonwork destination. The category "carpool" includes those who reported that they usually shared driving, drove others, or rode as a passenger during the reference week.

The data on means of transportation for some areas may show workers using modes of public transportation that are not available in those areas (e.g., subway or elevated in an SMSA where there actually is no subway or elevated service). This result is attributable to respondents who worked during the reference week at a location that was different from their usual place of work (such as persons away from home on business in an SMSA where subway service was available) and those who used more than one means of transportation each day but whose principal means was not available where they lived (for example, residents of nonmetropolitan areas who drove to the fringe of an SMSA and took the commuter railroad most of the distance to work).

PRIVATE VEHICLE OCCUPANCY

Data on private vehicle occupancy were derived from answers to question 24d, asked only of respondents who indicated in answer to question 22 that they had worked at any time during the reference week, and who reported in answer to question 24c that they usually shared driving, drove others, or rode as a passenger in a car, truck, or van.

Private vehicle occupancy refers to the number of

persons who usually rode to work in the vehicle during the reference week. The measure of persons per private vehicle was obtained by dividing the number of persons who reported using a car, truck, or van to get to work by the number of such vehicles that they used. The number of vehicles used was derived by counting each person who drove alone as one vehicle, each person who reported being in a two-person carpool as one-half vehicle, each person who reported being in a three-person carpool as one-third vehicle, and so on, and then summing the vehicles.

TRAVEL TIME TO WORK

Data on travel time to work were derived from answers to question 24a, asked only of respondents who indicated in answer to question 22 that they had worked at any time during the reference week. Travel time to work refers to the total number of minutes that it usually took the respondent to get from home to work during the reference week. The elapsed time includes time spent waiting for public transportation, picking up passengers in carpools, or in other activities related to getting to work.

Appendix B:
Urbanized Areas That Can Get a Modified UTPP

Alabama
- Auburn-Opelika
- Decatur
- Dothan

California
- Chico
- Redding
- Visalia
- Yiba City

Arizona-California
- Yuma

Colorado
- Grand Junction

Florida
- Fort Pierce
- Fort Walton Beach
- Naples
- Ocala

Georgia
- Athens
- Rome

Idaho
- Pocatello

Illinois
- Danville

Indiana
- Elhart-Goshen

Iowa
- Iowa City

Louisiana
- Houma

Maine
- Bangor

Maryland-Pennsylvania
- Hagerstown

Massachusetts
- Taunton

Michigan
- Benton Harbor

Mississippi
- Hattiesburg

Missouri
- Joplin

Montana
- Missoula

New Hampshire-Maine
- Portsmouth-Dover-Rochester

New Mexico
- Las Cruces
- Santa Fe

New York
- Glens Falls
- Newburgh

North Carolina
- Concord
- Goldsboro
- Hickory
- Jacksonville

North Dakota
- Bismarck-Mandan

Ohio
- Newark

Oklahoma
- Enid

Oregon
- Medford

Pennsylvania
- State College

Pennsylvania-Ohio
- Sharon

Puerto Rico
- Aguadilla
- Arecibo
- Vega Baja-Manati

Rhode Island
- Newport

South Carolina
- Anderson
- Florence
- Rock Hill

South Dakota
- Rapid City

Texas
- Victoria

Vermont
- Burlington

Virginia
- Charlottesville
- Danville

Washington
- Bellingham
- Bremerton
- Olympia

Washington-Oregon
- Longview

Maryland-West Virginia
- Cumberland

Wisconsin
- Janesville
- Sheboygan
- Wausau

Wisconsin-Illinois
- Beloit

Wyoming
- Casper
- Cheyenne

Appendix C: Place-of-Work Coding for Commutersheds

In general, the commutershed of a Standard Metropolitan Statistical Area (SMSA) extends to include the territory from which its workers flow. Thus, for a given pair of SMSAs, one of which sends a significant number of commuters to the other, the sending SMSA is defined as part of the commutershed of the receiving SMSA. When there are large flows of workers in both directions, each SMSA would be recognized as within the commutershed of the other. Similarly, if an SMSA sends a significant number of commuters to more than one other SMSA, it would be part of the commutershed of each receiving area.

When enumeration districts from an SMSA that is the commutershed of an adjacent SMSA were being coded, sample persons who work in the adjacent SMSA were coded to tract and block, if possible.

Because the purpose of commutershed coding is to provide data necessary for urban transportation planning packages and for tabulations of workers at their place of work, an SMSA was designated as part of the commutershed of another SMSA for 1980 place-of-work processing only if (a) a significant number of workers commuted from the commutershed into the receiving area or (b) the workers commuting into the receiving area represented a proportion of the labor force working in the receiving area that would be large enough to adversely affect the quality of data on the characteristics of workers at the tract of work in that SMSA if they were not coded to detailed geography.

After an extensive analysis of 1970 data on commutation between contiguous SMSAs and between all areas within multi-SMSA transportation planning study regions (identified by contacting FHWA planners in each state), the following criteria were set up for commutershed designation:

I. For a given SMSA that is not part of a multi-SMSA transportation planning study region:
   A. If the SMSA receives 10,000 or more commuters from a contiguous SMSA, the sending SMSA is designated a commutershed of the receiving area.
   B. If 20 percent or more of the workers in the SMSA commute from outside the area, any contiguous SMSA that accounts for 5 percent or more of the workers is included in the SMSA's commutershed.

II. For a given SMSA that is part of a multi-SMSA transportation planning study region that is also a Standard Consolidated Statis- tical Area (SCSA) or part of an SCSA, if the SMSA receives 3,000 or more commuters from another SMSA in the study region (contiguous or not), the sending SMSA is designated part of the commutershed of the receiving area.

III. For a given SMSA that is part of a multi-SMSA transportation planning study region that is not an SCSA or part of an SCSA, the SMSA is included in the commutershed of each other SMSA in that study region. (Such re- gions never consist of more than two SMSAs and are few in number.)

SMSAs that are not part of a multi-SMSA study region may be included in commutersheds of contiguous study regions or vice versa based on criteria I.A and I.B. Contiguous SMSAs within SCSA study regions that do not qualify for commutershed designation under criterion II may qualify under criterion I.B.

Criterion II, reflecting a cutoff point of 3,000 workers--roughly 500 intermetropolitan sample cases to code--was developed to be generally applicable to the larger study regions of New York (15 SMSAs), San Francisco (5 SMSAs), and Los Angeles (4 SMSAs). Criterion III is tailored to the smaller study regions.

The SMSA pairs that received commutershed coding in 1980 and the criteria on which they were recognized are listed as follows:

SMSA's	Commutershed of SMSA's	Criteria
New England Division		
Boston, Mass.	Brockton, Mass.	I.A.
	Lawrence-Haverhill, Mass.-N.H.	I.A.
	Lowell, Mass.-N.H.	I.A.
Bridgeport, Conn.	New Haven-West Haven, Conn.	II.
Bristol, Conn.	New Britain, Conn.	I.B.
Brockton, Mass.	Boston, Mass.	I.B.
Fall River, Mass.-R.I.	New Bedford, Mass.	III.

SMSA's	Commutershed of SMSA's	Criteria
Hartford, Conn.	New Britain, Conn.	I.A.
	Springfield-Chicopee-Holyoke, Mass.-Conn.	I.A.
Meriden, Conn.	New Britain, Conn.	I.B.
	New Haven-West Haven, Conn.	I.B.
Nashua, N.H.	Manchester, N.H.	I.B.
New Bedford, Mass.	Fall River, Mass.-R.I.	III.
New Britain, Conn.	Bristol, Conn.	I.B.
	Hartford, Conn.	I.B.
New Haven-West Haven, Conn.	Bridgeport, Conn.	II.
	Waterbury, Conn.	II.
Norwalk, Conn.	Bridgeport, Conn.	II.
Stamford, Conn.	Bridgeport, Conn.	II.
	New York, N.Y.-N.J.	II.
	Norwalk, Conn.	II.
Middle Atlantic Division		
Harrisburg, Pa.	York, Pa.	I.A.
Jersey City, N.J.	New Brunswick-Perth Amboy-Sayreville, N.J.	II.
	New York, N.Y.-N.J.	II.
	Newark, N.J.	II.
Long Branch-Asbury Park, N.J.	New Brunswick-Perth Amboy-Sayreville, N.J.	II.
Nassau-Suffolk, N.Y.	New York, N.Y.-N.J.	II.
New Brunswick-Perth Amboy-Sayreville, N.J.	Long Branch-Asbury Park, N.J.	II.
	New York, N.Y.-N.J.	II.
	Newark, N.J.	II.
New York, N.Y.-N.J.	Jersey City, N.J.	II.
	Long Branch-Asbury Park, N.J.	II.
	Nassau-Suffolk, N.Y.	II.
	New Brunswick-Perth Amboy-Sayreville, N.J.	II.
	Newark, N.J.	II.
	Norwalk, Conn.	II.
	Paterson-Clifton-Passaic, N.J.	II.
	Poughkeepsie, N.Y.	II.
	Stamford, Conn.	II.

SMSA's	Commutershed of SMSA's	Criteria
Newark, N.J.	Jersey City, N.J.	II.
	Long Branch-Asbury Park, N.J.	II.
	New Brunswick-Perth Amboy-Sayreville, N.J.	II.
	New York, N.Y.-N.J.	II.
	Paterson-Clifton-Passaic, N.J.	II.
Paterson-Clifton-Passaic, N.J.	New York, N.Y.-N.J.	II.
	Newark, N.J.	II.
Philadelphia, Pa.-N.J.	Trenton, N.J.	II.
	Wilmington, Del.-N.J.-Md.	I.A.
Trenton, N.J.	Philadelphia, Pa.-N.J.	II.
Wilmington, Del.-N.J.-Md.	Philadelphia, Pa.-N.J.	I.A.
East North Central Division		
Akron, Ohio	Canton, Ohio	I.B.
	Cleveland, Ohio	I.A.
Ann Arbor, Mich.	Detroit, Mich.	II.
Chicago, Ill.	Gary-Hammond-East Chicago, Ind.	I.A.
Cincinnati, Ohio.	Hamilton-Middleton, Ohio	II.
Cleveland, Ohio	Akron, Ohio	I.A.
	Lorain-Elyria, Ohio	II.
Dayton, Ohio	Springfield, Ohio	I.A.
Detroit, Mich.	Ann Arbor, Mich.	II.
Gary-Hammond-East Chicago, Ind.	Chicago, Ill.	I.A.
Hamilton-Middleton, Ohio	Cincinnati, Ohio	II.
Kenosha, Wis.	Racine, Wis.	III.
Lorain-Elyria, Ohio	Cleveland, Ohio	II.
Milwaukee, Wis.	Racine, Wis.	II.
Racine, Wis.	Kenosha, Wis.	III.
	Milwaukee, Wis.	II.

SMSA's	Commutershed of SMSA's	Criteria
South Atlantic Division		
Baltimore, Md.	Washington, D.C.-Md.-Va.	I.A.
Bradenton, Fla.	Sarasota, Fla.	III.
Ft. Lauderdale-Hollywood, Fla.	Miami, Fla.	I.A.
Miami, Fla.	Ft. Lauderdale-Hollywood, Fla.	I.A.
Newport News-Hampton, Va.	Norfolk-Virginia Beach-Portsmouth, Va.-N.C.	III.
Norfolk-Virginia Beach-Portsmouth, Va.-N.C.	Newport News-Hampton, Va.	III.
Sarasota, Fla.	Bradenton, Fla.	III.
Washington, D.C.-Md.-Va.	Baltimore, Md.	I.A.
East South Central Division		
Biloxi-Gulfport, Miss.	Pascagoula-Moss Point, Miss.	III.
Pascagoula-Moss Point, Miss.	Biloxi Gulfport, Miss. Mobile, Ala.	III. I.B.
West South Central Division		
Galveston-Texas City, Tex.	Houston, Tex.	II.
Houston, Tex.	Galveston-Texas City, Tex.	II.
Pacific Division		
Anaheim-Santa Ana-Garden Grove, Calif.	Los Angeles-Long Beach, Calif. Riverside-San Bernardino-Ontario, Calif.	II. II.
Los Angeles-Long Beach, Calif.	Anaheim-Santa Ana-Garden Grove, Calif. Oxnard-Simi Valley-Ventura, Calif. Riverside-San Bernardino-Ontario, Calif.	II. II. II.
Oxnard-Simi Valley-Ventura, Calif.	Los Angeles-Long Beach, Calif.	II.

SMSA's	Commutershed of SMSA's	Criteria
Riverside-San Bernardino-Ontario, Calif.	Los Angeles-Long Beach, Calif.	II.
San Francisco-Oakland, Calif.	San Jose, Calif.	II.
	Santa Rosa, Calif.	II.
	Vallejo-Fairfield-Napa, Calif.	II.
San Jose, Calif.	San Francisco-Oakland, Calif.	II.
Seattle-Everett, Wash.	Tacoma, Wash.	II.
Tacoma, Wash.	Seattle-Everett, Wash.	II.
Vallejo-Fairfield-Napa, Calif.	San Francisco-Oakland, Calif.	II.

Appendix D:
Areas Covered by the UTPP and Contact Persons

The following list includes all states, Standard Metropolitan Statistical Areas (SMSAs), and separate counties for which the UTPP has been purchased as of December 1, 1984. The contact person in the organization that purchased the package is also listed. Most entries are SMSAs. Where more than one SMSA is covered by one package, the contact person is listed under the first SMSA on the alphabetized list. The states of Connecticut and New Jersey are listed rather than their constituent SMSAs because each state bought a package that covered all urbanized and nonurbanized areas within its boundary. The individual counties on the list are jurisdictions that were not part of an SMSA as of 1980 and that had to purchase the modified package.

AREAS	CONTACT PERSON
Akron, Ohio SMSA	Mr. William E. Murphy Akron Metropolitan Area Transportation Study 613 Centran Building 159 South Main Street Akron, Ohio 44308 (216) 375-2436
Albany-Schenectady-Troy, N.Y. SMSA	Mr. Glenn Posca Capital District Transportation Committee 5 Computer Drive West Albany, New York 12205 (518) 458-2161
Albuquerque, N. Mex. SMSA	Mr. Dale Glass Middle Rio Grande Council of Governments of New Mexico 924 Park Avenue, S.W. Albuquerque, New Mexico 87102 (505) 766-7836
Alexandria, La. SMSA	Mr. John A. Spragio Traffic and Planning Division Louisiana Department of Transportation and Development P.O. Box 44245 Capitol Station Baton Rouge, Louisiana 70804 (504) 342-7817
Allentown-Bethlehem- Easton, Pa.-N.J. SMSA	Ms. Naomi Miller Joint Planning Commission Allentown-Bethlehem-Easton Airport Government Building Allentown, Pennsylvania 18103 (215) 264-4544

AREAS	CONTACT PERSON
Anaheim-Santa Ana-Garden Grove, Calif. SMSA	See Los Angeles-Long Beach, Calif. SMSA
Ann Arbor, Mich. SMSA	Mr. David Geiger Bureau of Transportation Planning Michigan Department of Transportation P.O. Box 30050 Lansing, Michigan 48909 (517) 373-9355
Anniston, Ala. SMSA	Mr. Ed Lipiner East Alabama Regional Planning and Development Commission 1001 Leighton Avenue Anniston, Alabama 36702 (205) 237-6741
Appleton-Oshkosh, Wis. SMSA	Mr. Donald V. Revello Division of Planning and Budget Wisconsin Department of Transportation P.O. Box 7913 Madison, Wisconsin 53707 (608) 266-1010
Atlanta, Ga. SMSA	Mr. Phil Boyd Atlanta Regional Commission 100 Edgewood Avenue, NE Suite 1801 Atlanta, Georgia 30335 (404) 656-7700
Austin, Tex. SMSA	Mr. Joseph P. Gieselman Austin Transportation Study P.O. Box 1748 Austin, Texas 78767 (512) 473-9370
Bakersfield, Calif. SMSA	Mr. Ronald E. Brummett Kern County Council of Governments 1106 26th Street Bakersfield, California 93301 (805) 861-2191
Baltimore, Md. SMSA	Mr. Charles Goodman Regional Planning Council 2225 North Charles Street Baltimore, Maryland 21218-5767 (301) 383-5838
Battle Creek, Mich. SMSA	See Ann Arbor, Michigan SMSA
Bay City, Mich. SMSA	See Ann Arbor, Michigan SMSA

AREAS	CONTACT PERSON
Binghamton, N.Y.-Pa. SMSA	Ms. Cynthia M. Paddick Binghamton Metropolitan Transportation Study 99 Hawley Street Binghamton, New York 13901 (607) 772-1188
Bismarck, N. Dak. SMSA	Mr. John W. Cameron Planning Division North Dakota State Highway Department 600 East Boulevard Avenue Bismarck, North Dakota 58505-0178 (701) 224-4407
Boise City, Idaho SMSA	Mr. Dale Rosebrock Ada Planning Association 650 Main Street Boise, Idaho 83702 (208) 383-4422
Boston, Mass. SMSA	Mr. Arnold Soolman Central Transportation Planning Staff 27 School Street Boston, Massachusetts 02108 (617) 451-5785
Bradenton, Fla. SMSA	Mr. Fred Kinch Florida Department of Transportation 605 Suwanee Street Tallahassee, Florida 32301-8064 (904) 488-4998
Bremerton, Wash. SMSA	See Seattle-Everett, Wash. SMSA
Brockton, Mass. SMSA	See Boston, Mass. SMSA See Fall River, Mass.-R.I. SMSA
Buffalo, N.Y. SMSA	Mr. Robert Wexler Niagara Frontier Transportation Committee P.O. Box 5008 Buffalo, New York 14205 (716) 856-2026
Canton, Ohio SMSA	Mr. Ray Fete Stark County Regional Planning Committee 512 County Office Building Canton, Ohio 44702-2298 (216) 454-5651
Charleston, W. Va. SMSA	Mr. Gregory K. Lipscomb Regional Intergovernmental Council 1223 Leone Lane Dunbar, West Virginia 20564 (304) 768-8191

AREAS	CONTACT PERSON
Charlotte-Gastonia, N.C. SMSA	Mr. Steve Patterson Charlotte-Mecklenburg Planning Commission 301 South McDowell Street Charlotte, North Carolina 28204 (704) 336-2205
Chattanooga, Tenn.-Ga. SMSA	Mr. Robert P. Shepard Chattanooga-Hamilton County Regional Planning Commission Chattanooga, Tennessee 37402 (615) 757-5216
Chicago, Ill. SMSA	Mr. Joseph F. Ligas Chicago Area Transportation Study 300 West Adams Street Chicago, Illinois 60606 (312) 793-3456
Chico, Calif. SMSA	Mr. Fred Cavanah Butte County Association of Governments 7 County Center Drive Oroville, California 95965 (916) 534-4681
Cincinnati, Ohio-Ky.-Ind. SMSA	Mr. Richard F. Bailey Ohio-Kentucky-Indiana Regional Council of Governments 426 East Fourth Street Cincinnati, Ohio 45202 (513) 621-7060
Cleveland, Ohio SMSA	Mr. Joseph Cole Northeast Ohio Areawide Coordinating Agency 1501 Euclid Avenue Cleveland, Ohio 44115 (216) 241-2414
Colorado Springs, Colo. SMSA	Mr. Brad H. Johnson Pikes Peak Area Council of Governments 27 East Vermijo Colorado Springs, Colorado 80903 (303) 471-7080
Columbus, Ohio SMSA	Mr. Jerry Brinton Mid-Ohio Regional Planning Commission 514 South High Street Columbus, Ohio 43215 (614) 228-2663

AREAS	CONTACT PERSON
Connecticut (UTPP covering the entire State)	Mr. Joseph Spragg State of Connecticut Department of Transportation 24 Wolcott Hill Road P.O. Drawer A Wethersfield, Connecticut 06109 (203) 566-3264
Cumberland, Md.-W.Va. SMSA	Mr. Roy Cool Allegany County Planning and Zoning Commission County Office Building 3 Pershing Street Cumberland, Maryland 21502 (301) 777-5951
Dallas-Ft. Worth, Tex. SMSA	Mr. Gordon Shunk North Central Texas Council of Governments P.O. Drawer COG Arlington, Texas 76011 (817) 461-3300
Daytona Beach, Fla. SMSA	See Bradenton, Fla. SMSA
Denver-Boulder, Colo. SMSA	Mr. Jeff May Denver Regional Council of Governments 2480 W. 26th Avenue - Suite 200B Denver, Colorado 80211 (303) 455-1000
Detroit, Mich. SMSA	See Ann Arbor, Mich. SMSA
Dubuque, Iowa SMSA	Mr. Larry Nagle Dubuque Metropolitan Area Transportation Study P.O. Box 1140 Dubuque, Iowa 52001 (319) 556-4166
Elkhart, Ind. SMSA	Ms. Wendy G. Beaton Michiana Area Council of Governments 1120 County-City Building South Bend, Indiana 46601 (219) 287-1829
Elmira, N.Y. SMSA	Ms. Debra Varnado Executive Transportation Committee Chemung County Human Resources Center 425-447 Pennsylvania Avenue Elmira, N.Y. 14904 (607) 737-5508

AREAS	CONTACT PERSON
Eugene-Springfield, Oreg. SMSA	Mr. James R. Carlson Research and Information Services Lane Council of Governments North Plaza Level PSB 125 East Eighth Avenue Eugene, Oregon 97401 (503) 687-4283
Fall River, Mass.-R.I. SMSA	Mr. Walter Kondo Bureau of Transportation Planning and Development Massachusetts Department of Public Works 10 Park Plaza Boston, Massachusetts 02116-3973 (617) 727-5120
Fargo-Moorhead, N.Dak.-Minn. SMSA	See Bismarck, N. Dak. SMSA
Fayetteville-Springdale, Ark. SMSA	Mr. Steve R. Mitchell Arkansas State Highway and Transportation Department P.O. Box 2261 Little Rock, Arkansas 72203 (501) 569-2000
Fitchburg-Leominster, Mass. SMSA	See Fall River, Mass.-R.I. SMSA
Flint, Mich. SMSA	See Ann Arbor, Mich. SMSA
Ft. Lauderdale-Hollywood, Fla. SMSA	See Bradenton, Fla. SMSA
Ft. Myers-Cape Coral, Fla. SMSA	See Bradenton, Fla. SMSA
Ft. Smith, Ark.-Okla. SMSA	See Fayetteville-Springdale, Ark. SMSA
Fresno, Calif. SMSA	Mr. Bob Stone Council of Fresno County Governments 2014 Tulare -- Suite 520 Fresno, California 93721 (209) 233-4148
Gainesville, Fla. SMSA	See Bradenton, Fla. SMSA
Galveston-Texas City, Tex. SMSA	See Houston, Tex. SMSA
Gary-Hammond-East Chicago, Ind. SMSA	Mr. Thomas L. Carmichael Northwestern Indiana Regional Planning Commission 8149 Kennedy Avenue Highland, Indiana 46322 (219) 923-1060

AREAS	CONTACT PERSON
Grand Forks, N.Dak. SMSA	See Bismarck, N.Dak. SMSA
Grand Junction, Colo. Urbanized Area (Mesa County)	Mr. Charles F. Trainor City-County Development Department Grand Junction-Mesa County 559 White Avenue, Room 60 Grand Junction, Colorado 81501 (303) 244-1628
Grand Rapids, Mich. SMSA	See Ann Arbor, Mich. SMSA
Green Bay, Wis. SMSA	See Appleton-Oshkosh, Wis. SMSA
Hamilton-Middletown, Ohio SMSA	See Cincinnati, Ohio-Ky.-Ind. SMSA
Honolulu, Hawaii SMSA	Mr. George Shigano State of Hawaii Department of Transportation 869 Punchbowl Street Honlulu, Hawaii 96813 (808) 548-6526
Houma, Louisiana Urbanized Area (Lafourche Parish Terreboune Parish)	See Alexandria, La. SMSA
Houston, Tex. SMSA	Mr. Alan C. Clark Houston-Galveston Area Council 3701 West Alabama Houston, Texas 77027 (713) 627-3200
Huntsville, Ala. SMSA	Mr. Sam Granato Planning Department City of Huntsville P.O. Box 308 Huntsville, Alabama 35804 (205) 532-7353
Indianapolis, Ind. SMSA	Mr. Wayne C. Depew Department of Metropolitan Development Division of Planning 2021 City-County Building Indianapolis, Indiana 46204 (317) 236-5151
Jackson, Mich. SMSA	See Ann Arbor, Mich. SMSA
Jackson, Tenn. Urbanized Area (Madison County)	Mr. John Davis City of Jackson Jackson Municipal Regional Planning Commission 105 North Church Jackson, Tennessee 38301 (901) 424-3440

AREAS	CONTACT PERSON
Jacksonville, Fla. SMSA	See Bradenton, Fla. SMSA
Kalamazoo-Portage, Mich. SMSA	See Ann Arbor, Mich. SMSA
Kansas City, Mo.-Kans. SMSA	Mr. Ken Howell Transportation Division Mid-America Regional Council 20 West Ninth--Suite 200 Kansas City, Missouri 64105 (816) 474-4240
Knoxville, Tenn. SMSA	Mr. Richard A. Margiotta Knoxville/Knox County Metropolitan Planning Commission City/County Building 400 Main Avenue-Suite 403 Knoxville, Tennessee 37902-2476 (615) 521-2500
La Crosse, Wis. SMSA	See Appleton-Oshkosh, Wis. SMSA
Lafayette, La. SMSA	See Alexandria, La. SMSA
Lake Charles, La. SMSA	See Alexandria, La. SMSA
Lakeland-Winter Haven, Fla. SMSA	See Bradenton, Fla. SMSA
Lansing, Mich. SMSA	See Ann Arbor, Mich. SMSA
Lawrence, Kans. SMSA	Mr. Glenn Anschutz Kansas Department of Transportation State Office Building Topeka, Kansas 66612 (913) 296-3841
Lawrence-Haverhill, Mass.-N.H. SMSA	See Boston, Mass. SMSA See Fall River, Mass.-R.I. SMSA
Lexington-Fayette, Ky. SMSA	Mr. Michael P. Hailperin Lexington-Fayette Urban County Government 200 E. Maine Street Lexington, Kentucky 40507 (606) 252-8808
Lincoln, Nebr. SMSA	Mr. Kent R. Morgan Lincoln City-Lancaster County Planning Department 555 South 10th Street Lincoln, Nebraska 68508-3992 (402) 471-7491
Little Rock-North Little Rock, Ark. SMSA	See Fayetteville-Springdale, Ark. SMSA
Lorain-Elyria, Ohio SMSA	See Cleveland, Ohio SMSA

AREAS	CONTACT PERSON
Los Angeles-Long Beach, Calif. SMSA	Mr. Murray Goldman Southern California Association of Governments 600 South Commonwealth Avenue Suite 1000 Los Angeles, California 90005 (213) 385-1000
Louisville, Ky.-Ind. SMSA	Mr. James Thorne Kentuckiana Regional Planning and Development Agency 914 East Broadway Louisville, Kentucky 40204 (502) 589-4406
Lowell, Mass.-N.H. SMSA	See Boston, Mass. SMSA See Fall River, Mass.-R.I. SMSA
Lynchburg, Va. SMSA	Mr. Jerry Sears Virginia Department of Highways and Transportation 1221 East Broad Street Richmond, Virginia 23219 (804) 786-1040
Madison, Wis. SMSA	See Appleton-Oshkosh, Wis. SMSA
Mansfield, Ohio SMSA	Mr. Ronald L. Laughery Richland County Regional Planning Commission 35 North Park Street Mansfield, Ohio 44902 (419) 522-9454
Melbourne-Titusville-Cocoa, Fla. SMSA	See Bradenton, Fla. SMSA
Memphis, Tenn.-Ark.-Miss. SMSA	Mr. Clark W. Odor Memphis and Shelby County Office of Planning and Development 125 North Main Street Memphis, Tennessee 38103 (901) 528-2768
Miami, Fla. SMSA	See Bradenton, Fla. SMSA
Minneapolis-St. Paul, Minn.-Wis. SMSA	Mr. Michael Munson Metropolitan Council of the Twin Cities Area 300 Metro Square Building St. Paul, Minnesota 55101 (612) 291-6359
Modesto, Calif. SMSA	Mr. Doyle D. Dodd SAAG 814 14th Street Modesto, California 95354-1082 (209) 571-6200

AREAS	CONTACT PERSON
Monroe, La. SMSA	See Alexandria, La. SMSA
Muncie, Ind. SMSA	Mr. J.C. Wright Delaware-Muncie Metropolitan Plan Commission Delaware County Building-Room 206 Muncie, Indiana 47305 (317) 747-7740
Muskegon-Norton Shores-Muskegon Heights, Mich. SMSA	See Ann Arbor, Mich. SMSA
Nashville-Davidson, Tenn. SMSA	Mr. Joseph R. Haas Metropolitan Government of Nashville and Davidson County 730 Second Avenue South Nashville, Tennessee 37201 (615) 259-6234
Nassau-Suffolk, N.Y. SMSA	See New York, N.Y.-N.J. SMSA
New Bedford, Mass. SMSA	See Fall River, Mass.-R.I. SMSA
New Jersey, (UTPP covering the entire State)	Mr. John E. Obermeier Division of Comprehensive Transportation Planning New Jersey Department of Transportation 1035 Parkway Avenue Trenton, New Jersey 08625 (609) 292-3294
New Orleans, La. SMSA	Mr. Walter R. Brooks Regional Planning Commission Masonic Temple Building--Suite 900 333 St. Charles Avenue New Orleans, Louisiana 70130-3120 (504) 568-6611
New York, N.Y.-N.J. SMSA	Mr. Lawrence Hammel New York Metropolitan Transportation Council One World Trade Center 82nd Floor New York, New York 10048 (212) 938-3300
Newark, Ohio SMSA	See Columbus, Ohio SMSA
Newport News-Hampton, Va. SMSA	See Lynchburg, Va. SMSA
Norfolk-Virginia Beach-Portsmouth Va.-N.C. SMSA	See Lynchburg, Va. SMSA

AREAS	CONTACT PERSON
Omaha, Nebr.-Iowa SMSA	Mr. John Zipay Metropolitan Area Planning Agency 7000 West Center Road Suite 200 Omaha, Nebraska 68106 (402) 444-6866
Orlando, Fla. SMSA	See Bradenton, Fla. SMSA
Owensboro, Ky. SMSA	Ms. Laura E. Phillips Green River Area Development District P.O. Box 628 Owensboro, Kentucky 42302 (502) 926-4433
Oxnard-Simi Valley-Ventura, Calif. SMSA	See Los Angeles-Long Beach, Calif. SMSA
Panama City, Fla. SMSA	See Bradenton, Fla. SMSA
Pensacola, Fla. SMSA	See Bradenton, Fla. SMSA
Peoria, Ill. SMSA	Mr. Robert Dennison Tri-County Regional Planning Commission P.O. Box 2200 Peoria, Illinois 61611 (309) 694-4391
Petersburg-Colonial Heights-Hopewell, Va. SMSA	See Lynchburg, Va. SMSA
Philadelphia, Pa.-N.J. SMSA	Mr. Thabet Zakaria Delaware Valley Regional Planning Commission 21 South 5th Street Philadelphia, Pennsylvania 19106 (215) 592-1800
Phoenix, Ariz. SMSA	Mr. Terry Max Johnson Transportation Planning Office Maricopa Association of Governments 1739 West Jackson Street Phoenix, Arizona 85007 (602) 255-8526
Pine Bluff, Ark. SMSA	See Fayetteville-Springdale, Ark. SMSA
Pittsfield, Mass. SMSA	See Fall River, Mass.-R.I. SMSA
Portland, Oreg.-Wash. SMSA	Mr. T. Keith Lawton Metropolitan Service District 527 S.W. Hall Street Portland, Oregon 97201 (503) 221-1646

AREAS	CONTACT PERSON
Portsmouth-Dover-Rochester, N.H.-Maine SMSA	Mr. Michael Casino Strafford Regional Planning Commission County Courthouse County Farm Road Dover, New Hampshire 03820 (603) 742-2523
Poughkeepsie, N.Y. SMSA	See New York, N.Y.-N.J. SMSA
Pueblo, Colo. SMSA	Mr. Eric L. Bracke Urban Transportation Planning Division Pueblo Area Council of Governments 350 South Elizabeth Street Pueblo, Colorado 81003 (303) 545-5840
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Rhode Island (UTPP covering the entire State)	Mr. Roland Frappier Rhode Island Department of Administration Statewide Planning Program 265 Melrose Street Providence, Rhode Island 02907 (401) 277-2656
Richmond, Va. SMSA	See Lynchburg, Va. SMSA
Riverside-San Bernardino-Ontario, Calif. SMSA	See Los Angeles-Long Beach, Calif. SMSA
Roanoke, Va. SMSA	See Lynchburg, Va. SMSA
Rochester, N.Y. SMSA	Mr. Nathan L. Jaschik Central Staff Director Genessee Transportation Council 65 West Broad Street Rochester, New York 14614 (716) 232-6240
Saginaw, Mich. SMSA	See Ann Arbor, Mich. SMSA
St. Louis, Mo.-Ill. SMSA	Mr. Mark Selvidge East-West Gateway Coordinating Council 100 South Tucker Boulevard St. Louis, Missouri 63102 (314) 421-4220
Salem, Oreg. SMSA	Mr. Richard Schmid Mid Willamette Valley Council of Governments 400 Senator Building 220 High Street, N.E. Salem, Oregon 97301 (503) 588-6177

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San Jose, Calif. SMSA	See San Francisco-Oakland, Calif. SMSA
Santa Barbara-Santa Maria-Lompoc, Calif. SMSA	Ms. Susan Stegall Santa Barbara County-Cities Area Planning Council 922 Laguna Street Santa Barbara, California 93101 (805) 963-7194
Santa Rosa, Calif. SMSA	See San Francisco-Oakland, Calif. SMSA
Sarasota, Fla. SMSA	See Bradenton, Fla. SMSA
Savannah, Ga. SMSA	Mr. Alfred E. Quinn Chatham County-Savannah Metropolitan Planning Commission P.O. Box 1027 Savannah, Georgia 31402 (912) 236-9523
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Shreveport, La. SMSA	Mr. Craig A. Bennight Shreve Area Council of Governments 627 Spring Street Shreveport, Louisiana 71101 (318) 226-6488
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South Bend, Ind. SMSA	See Elkhart, Ind. SMSA
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Springfield-Chicopee-Holyoke, Mass.-Conn. SMSA	See Fall River, Mass.-R.I. SMSA
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Tallahassee, Fla. SMSA	See Bradenton, Fla. SMSA
Tampa-St. Petersburg, Fla. SMSA	See Bradenton, Fla. SMSA
Texarkana, Tex.-Texarkana, Ark. SMSA	See Fayetteville-Springdale, Ark. SMSA
Toledo, Ohio-Mich. SMSA	Mr. James R. Cramer Toledo Metropolitan Area Council of Governments 123 Michigan Street Toledo, Ohio 43624-1996 (419) 241-9155

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Trenton, N.J. SMSA	See Philadelphia, Pa.-N.J. SMSA
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Washington, D.C.-Md.-Va. SMSA	Mr. George V. Wickstrom Metropolitan Washington Council of Governments 1875 Eye Street, N.W. Suite 200 Washington, D.C. 20006 (202) 223-6800
West Palm Beach-Boca Raton, Fla. SMSA	See Bradenton, Fla. SMSA
Wichita, Kans. SMSA	See Lawrence, Kans. SMSA
Wilmington, Del.-Md.-N.J. SMSA	Mr. Peter L. Johnston Wilmington Metropolitan Area Coordinating Council Suite 101 Stockton Building University Office Plaza Newark, Delaware 19702 (302) 737-6205
Worcester, Mass. SMSA	See Fall River, Mass.-R.I. SMSA

Appendix E:

1980 Census of Population and Housing

Revised February 1982 (Updated May 1983)

Tentative Publication and Computer Tape Program

The results of the 1980 census are being released as soon as they are tabulated and assembled. In this data dissemination program three major media are being utilized: printed reports, computer tapes and microfiche.

The publications of the 1980 census are released under three subject titles, *1980 Census of Population and Housing, 1980 Census of Population,* and *1980 Census of Housing.* The description of the publication program below is organized in sections, by census title, followed by the reports under each title. It should be noted that a number of population census reports contain some housing data and a number of housing census reports contain some population data.

Following the description of the publication program are sections on computer tapes, maps, and microfiche, and a section listing the subject items included in the 1980 census.

The data product descriptions include listings of geographic areas for which data are summarized in that product. Note that the term "place" refers to incorporated places and census designated (or unincorporated) places, as well as towns and townships in 11 States (the 6 New England States, the 3 Middle Atlantic States, Michigan, and Wisconsin).

Order forms for these materials are available, subject to availability of the data product, from Data User Services Division, Customer Services, Bureau of the Census, Washington, D.C. 20233; Census Bureau Regional Offices; U.S. Department of Commerce District Offices; and State Data Centers. Inquiries concerning any phase of the data dissemination program may be addressed to Data User Services Division, Customer Services, Bureau of the Census, Washington, D.C. 20233. After issuance, census reports are on file in many libraries and are available for examination at any Department of Commerce District Office or Census Bureau Regional Office.

PUBLICATIONS

1980 Census of Population and Housing

Preliminary Reports

Series PHC80-P **Preliminary Population and Housing Unit Counts**

Issued: 10/80–2/81

These reports present preliminary population and housing unit counts as compiled in the census district offices. Counts are shown for the following areas or their equivalents: States, counties, county subdivisions, incorporated places, standard metropolitan statistical areas (SMSA's) as designated prior to the census, and congressional districts as delineated for the 96th Congress. There is one report for each State, the District of Columbia, Puerto Rico, Guam, Virgin Islands of the United States, and American Samoa, and a U.S. Summary report showing counts for the United States, regions, divisions, and States.

Advance Reports

Series PHC80-V **Final Population and Housing Unit Counts**

Issued: 2/81–10/82

These reports present population and housing unit counts prior to their publication in the final reports. These counts supersede the preliminary counts issued in the PHC80-P reports. Also shown are provisional figures on numbers of persons by race and Spanish origin. The data are presented for the following areas: States, counties, county subdivisions, incorporated places, and congressional districts as delineated for the 96th Congress. There is one report for each State, the District of Columbia, Puerto Rico, Guam, Virgin Islands of the United States, and American Samoa, and a U.S. Summary report showing counts for the United States, regions, divisions, States, and congressional districts.

Final Reports

Series PHC80-1 **BLOCK STATISTICS**

Issued: 10/81–10/82

These reports, which are issued on microfiche rather than in print form, present population and housing unit totals and statistics on selected characteristics which are based on complete-count tabulations. Data are shown for blocks in urbanized areas and selected adjacent areas, for blocks in places of 10,000 or more inhabitants, and for blocks in areas which contracted with the Census Bureau to provide block statistics. The set of reports consists of 374 sets of microfiche and includes a report for each SMSA, showing blocked areas within the SMSA; and a report for each State and for Puerto Rico, showing blocked areas outside SMSA's. In addition to microfiche, printed detailed maps showing the blocks covered by the particular report are available as well as a printed U.S. Summary, which is an index to the set.

Series PHC80-2 **CENSUS TRACTS**

To be issued: Spring–Fall 1983

Statistics for most of the population and housing subjects included in the 1980 census are presented for census tracts in SMSA's and in other tracted areas. Both complete-count data and sample data are included. Most statistics are presented by race and Spanish origin for areas with at least a specified number of persons in the relevant population group. There is one report for each SMSA, as well as one for each of the States and Puerto Rico which have tracted areas outside SMSA's. In addition, maps showing the boundaries and identification numbers of census tracts in the SMSA are available as well as a U.S. Summary, which is an index to the set and also provides a historical listing of the total number of tracts by area.

The tables containing complete-count data were prepared considerably in advance of the rest of the report and may be purchased from the Data User Services Division at the cost of reproduction.

Series PHC80-3 **SUMMARY CHARACTERISTICS FOR GOVERNMENTAL UNITS AND STANDARD METROPOLITAN STATISTICAL AREAS**

Issued: 9/82–10/82

Statistics are presented on total population and on complete-count and sample population characteristics such as age, race, education, disability, ability to speak English, labor force, and income, and on total housing units and housing characteristics such as value, age of structure, and rent. These statistics are shown for the following areas or their equivalents: States, SMSA's, counties, county subdivisions (those which are functioning general-purpose local governments), and incorporated places. There is one report for each State, the District of Columbia, and Puerto Rico. This series does not include a U.S. Summary. The publication for Puerto Rico was issued May 1983.

Series PHC80-4 **CONGRESSIONAL DISTRICTS OF THE 98th CONGRESS**

Issued: 3/83

These reports present complete-count and sample data for congressional districts of the 98th Congress. The reports reflect redistricting for the 1982 elections. One report will be issued for each of the 50 States and the District of Columbia.

The tables containing complete-count data are prepared considerably in advance of the rest of the report. Each set may be purchased from the Data User Services Division at the cost of reproduction.

Series PHC80-S1-1 **PROVISIONAL ESTIMATES OF SOCIAL, ECONOMIC, AND HOUSING CHARACTERISTICS**

Issued: 3/82

This report presents provisional estimates based on sample data collected in the 1980 census. Data on social, economic, and housing characteristics are shown for the United States as a whole, each State, the District of Columbia, and SMSA's of 1 million or more inhabitants. These data are based on a special subsample of the full census sample. The sample, which represents about 1.6 percent of the total population, was developed to provide users with initial data on characteristics of the population and housing units for the Nation and large areas.

Series PHC80-S2 **ADVANCE ESTIMATES OF SOCIAL, ECONOMIC, AND HOUSING CHARACTERISTICS**

Issued: 8/82–3/83

These reports present advance sample data from the 1980 census including such social and economic characteristics of the population as education, migration, labor force, and income as well as housing characteristics such as structural information, mortgage, and gross rent. The set consists of 51 paperbound editions and includes one report for each State and the District of Columbia. No report will be issued for the United States as a whole.

Each report presents population and housing characteristics for the State, its counties or comparable areas, and places of 25,000 or more inhabitants. Selected data are shown for four race groups (White; Black; the combined American Indian, Eskimo, and Aleut; and Asian and Pacific Islander) as well as for persons of Spanish origin.

1980 Census of Population

Final Reports

Volume 1

CHARACTERISTICS OF THE POPULATION

This volume presents final population counts and statistics on population characteristics. It consists of reports for the following 57 areas: the United States, each of the 50 States, the District of Columbia, Puerto Rico, and the Outlying Areas—Guam, the Virgin Islands of the United States, American Samoa, and the Northern Mariana Islands and the remainder of the Trust Territory of the Pacific Islands. The volume consists of four chapters for each area, chapters A, B, C, and D. Chapters A and B present data collected on a complete-count basis, and chapters C and D present estimates based on sample information, except for the Outlying Areas where all data were collected on a complete-count basis. The population totals presented in chapters A and B may differ from the counts presented earlier in the PHC80-V reports because corrections were made for errors found after the PHC80-V reports were issued. Chapters B, C, and D present statistics by race and Spanish origin for areas with at least a specified number of the relevant population group.

The U.S. Summary reports present statistics for the United States, regions, divisions, States, and selected areas below the State level. The State or equivalent area reports (which include the District of Columbia, Puerto Rico, and the Outlying Areas) present statistics for the State or equivalent area and its subdivisions.

Statistics for each of the 57 areas are issued in separate paperbound editions of chapters A, B, C, and D.

Series PC80-1-A Chapter A

NUMBER OF INHABITANTS

Issued: 9/81-7/82

Final population counts are shown for the following areas or their equivalents: States, counties, county subdivisions, incorporated places and census designated places, standard consolidated statistical areas (SCSA's), SMSA's, and urbanized areas. Selected tables contain population counts by urban and rural residence. Many tables contain population counts from previous censuses. Publications for the Outlying Areas were issued in the Fall 1982. A printed U.S. Summary was issued April 1983.

Series PC80-1-B Chapter B

GENERAL POPULATION CHARACTERISTICS

Issued: 3/82-8/82

Statistics on household relationship, age, race, Spanish origin, sex, and marital status are shown for the following areas or their equivalents: States, counties (by total and rural residence), county subdivisions, places of 1,000 or more inhabitants, SCSA's, SMSA's, urbanized areas, American Indian reservations, and Alaska Native villages. Publications for U.S. Summary, Puerto Rico and the Outlying Areas will be issued in early 1983.

Series PC80-1-C Chapter C

GENERAL SOCIAL AND ECONOMIC CHARACTERISTICS

To be issued: Spring 1983–Fall 1983

Statistics are presented on nativity, State or country of birth, citizenship and year of immigration for the foreign-born population, language spoken at home and ability to speak English, ancestry, fertility, family composition, type of group quarters, marital history, residence in 1975, journey to work, school enrollment, years of school completed, disability, veteran status, labor force status, occupation, industry, class of worker, labor force status in 1979, income in 1979, and poverty status in 1979. In addition, data on subjects shown in the PC80-1-B reports are presented in this report in more detail. Each subject is shown for some or all of the following areas or their equivalents: States, counties (by rural and rural-farm residence), places of 2,500 or more inhabitants, SCSA's, SMSA's, urbanized areas, American Indian reservations, and Alaska Native villages.

Series PC80-1-D Chapter D

DETAILED POPULATION CHARACTERISTICS

To be issued: Summer–Fall 1983

Statistics on most of the subjects covered in the PC80-1-C reports are presented in this report in considerably greater detail and cross-classified by age, race, Spanish origin, and other characteristics. Each subject is shown for the State or equivalent area, and some subjects are also shown for rural residence at the State level. Most subjects are shown for SMSA's of 250,000 or more inhabitants, and a few are shown for central cities of these SMSA's.

Series PC80-2 Volume 2

SUBJECT REPORTS

To be issued: beginning 1983

Each of the reports in this volume focuses on a particular subject and provides highly detailed distributions and cross-classifications on a national, regional, and divisional level. A few reports show statistics for States, SMSA's, large cities, American Indian reservations, or Alaska Native villages. Separate reports are tentatively planned on such subjects as racial and ethnic groups, type of residence, fertility, families, marital status, migration, education, employment, occupation, industry, journey to work, income, poverty status, and other topics.

Series PC80-S1 **SUPPLEMENTARY REPORTS**

Issued: These reports present special compilations of 1980 census statistics dealing with specific population subjects. The reports scheduled to date are:

5/81	1.	PC80-S1-1	Age, Sex, Race, and Spanish Origin of the Population by Regions, Divisions, and States: 1980
5/81	2.	PC80-S1-2	Population and Households by States and Counties: 1980
7/81	3.	PC80-S1-3	Race of the Population by States: 1980
9/81	4.	PC80-S1-4	Population and Households for Census Designated Places: 1980
10/81	5.	PC80-S1-5	Standard Metropolitan Statistical Areas and Standard Consolidated Statistical Areas: 1980
4/82	6.	PC80-S1-6	Nonpermanent Residents by State and County: 1980
8/82	7.	PC80-S1-7	Persons of Spanish Origin by State: 1980
3/83	8.	PC80-S1-8	Detailed Occupation and Years of School Completed by Age, for the Civilian Labor Force, by Sex, Race, and Spanish/Hispanic Origin: 1980
3/83	9.	PC80-S1-9	State of Residence in 1975 by State of Residence in 1980
4/83	10.	PC80-S1-10	Ancestry of the Population by State: 1980
	11.	Unassigned	Population and Housing Counts for Identified American Indian Areas and Alaska Native Villages: 1980
	12.	Unassigned	Asian and Pacific Islanders Population by State: 1980

1980 Census of Housing

Final Reports

Volume 1

CHARACTERISTICS OF HOUSING UNITS

This volume presents final housing unit counts and statistics on housing characteristics. It consists of reports for the following 57 areas: the United States, each of the 50 States, the District of Columbia, Puerto Rico, and the Outlying Areas—Guam, the Virgin Islands of the United States, American Samoa, and the Northern Mariana Islands and the remainder of the Trust Territory of the Pacific Islands. The volume consists of two chapters for each area, chapters A and B. Chapter A presents data collected on a complete-count basis, and chapter B presents estimates based on sample information, except for the Outlying Areas where all data were collected on a complete-count basis. The housing totals presented in this report may differ from the counts presented earlier in the PHC80-V reports because corrections were made for errors found after the PHC80-V reports were issued. Both chapters present statistics by race and Spanish origin for areas with at least a specified number of the relevant population group.

The U.S. Summary reports present statistics for the United States, regions, divisions, States, and selected areas below the State level. The State or equivalent area reports (which include the District of Columbia, Puerto Rico, and the Outlying Areas) present statistics for the State or equivalent area and its subdivisions.

Statistics for each of the 57 areas are issued in separate paperbound editions of chapters A and B.

Series HC80-1-A Chapter A

GENERAL HOUSING CHARACTERISTICS

Issued: 4/82–9/82

Statistics on units at address, tenure, condominium status, number of rooms, persons per room, plumbing facilities, value, contract rent, and vacancy status are shown for some or all of the following areas or their equivalents: States, counties, county subdivisions, places of 1,000 or more inhabitants, SCSA's, SMSA's, urbanized areas, American Indian reservations, and Alaska Native villages. Selected tables contain housing characteristics by urban and rural residence. Publications for U.S. Summary, Puerto Rico and the Outlying Areas will be issued in early 1983.

Series HC80-1-B Chapter B

DETAILED HOUSING CHARACTERISTICS

To be issued: Spring 1983–Fall 1983

Statistics on units in structure, year moved into unit, year structure built, heating equipment fuels, air-conditioning, source of water, sewage disposal, gross rent, and selected monthly ownership costs are shown for some or all of the following areas or their equivalents: States, counties, places of 2,500 or more inhabitants, SCSA's, SMSA's, urbanized areas, American Indian reservations, and Alaska Native villages. Selected tables show housing characteristics for rural and rural farm residence at the State and county level. Some subjects included in the HC80-1-A reports are also covered in this report in more detail.

Series HC80-2 Volume 2

METROPOLITAN HOUSING CHARACTERISTICS

To be issued: Summer–Fall 1983

This volume presents statistics on most of the 1980 housing census subjects in considerable detail and cross-classification. Most statistics are presented by race and Spanish origin for areas with at least a specified number of the relevant population group. Data are shown for States or equivalent areas, SMSA's and their central cities, and other cities of 50,000 or more inhabitants. There is one report for each SMSA, and one report for each State and Puerto Rico. The set includes a U.S. Summary report showing these statistics for the United States and regions.

Series HC80-3 Volume 3

SUBJECT REPORTS

To be issued: beginning 1983

Each of the reports in this volume focuses on a particular subject and provides highly detailed distributions and cross-classifications on a national, regional, and divisional level. Separate reports are tentatively planned on housing of the elderly, mobile homes, and American Indian households.

Series HC80-4 Volume 4

COMPONENTS OF INVENTORY CHANGE

To be issued: Summer 1983

This volume consists of two reports presenting statistics on the 1980 characteristics of housing units which existed in 1973, as well as on newly constructed units, conversions, mergers, demolitions, and other additions and losses to the housing inventory between 1973 and 1980. These reports present data derived from a sample survey conducted in the fall of 1980. Data are presented for the United States and regions in report I. Report II has two parts: Part A presents data for that group of SMSA's (not individually identified) with populations of 1 million or more at the time of the 1970 census, and part B presents data for that group of SMSA's (not individually identified) with populations of less than 1 million at the time of the 1970 census.

Series HC80-5 Volume 5

RESIDENTIAL FINANCE

To be issued: Summer 1983

This volume consists of one report presenting statistics on the financing of nonfarm homeowner and rental and vacant properties, including characteristics of the mortgage, property, and owner. The statistics are based on a sample survey conducted in the spring of 1981. Data are presented for the United States and regions. Some data are presented by inside and outside SMSA's and by central cities.

Series HC80-S1 **SUPPLEMENTARY REPORTS**

These reports present statistics from the 1980 Census of Housing on general characteristics of housing units for the 50 States and the District of Columbia, counties, and independent cities.

1980 Census of Population and Housing

Evaluation and Reference Reports

Series PHC80-E **EVALUATION AND RESEARCH REPORTS**

To be issued: beginning 1983

These reports present the results of the extensive evaluation program conducted as an integral part of the 1980 census. This program relates to such matters as completeness of enumeration and quality of the data on characteristics.

Series PHC80-R **REFERENCE REPORTS**

These reports present information on the various administrative and methodological aspects of the 1980 census. The series includes:

PHC80-R1 **Users' Guide**

First part issued: April 1982
Others issued through 1983

This report covers subject content, procedures, geography, statistical products, limitations of the data, sources of user assistance, notes on data use, a glossary of terms, and guides for locating data in reports and tape files. The guide is issued in loose-leaf form and sold in parts (R1-A, -B, etc.) as they are printed.

PHC80-R2 **History**

To be issued: 1984

This report describes in detail all phases of the 1980 census, from the earliest planning (through all stages) to the dissemination of data and evaluation of results. It contains detailed discussions of 1980 census questions and their use in previous decennial censuses.

PHC80-R3 **Alphabetical Index of Industries and Occupations**

Issued: 1980 with updates through 1983

This report was developed primarily for use in classifying responses to the questions on the kind of business (industry) and kind of work (occupation) in which the respondent is engaged. The index lists approximately 20,000 industry and 29,000 occupation titles in alphabetical order.

PHC80-R4 **Classified Index of Industries and Occupations**

Issued: 1980 with updates through 1983

This report defines the industrial and occupational classification systems adopted for the 1980 Census of Population. It presents the individual titles that constitute each of the 231 industry and 503 occupation categories in the classification systems. The individual titles are the same as those shown in the Alphabetical Index. The 1980 occupation classification reflects the new U.S. Standard Occupational Classification (SOC). As in the past, the 1980 industry classification reflects the Standard Industrial Classification (SIC).

PHC80-R5 **Geographic Identification Code Scheme**

To be issued: Early 1983

This report identifies the names and related geographic codes for each State, county, minor civil division, place, region, division, SCSA, SMSA, American Indian reservation, and Alaska Native village for which the Census Bureau tabulated data from the 1980 census.

COMPUTER TAPES

Summary Tape Files

In addition to the printed and microfiche reports, results of the 1980 census also are provided on computer tape in the form of summary tape files (STF's). These data products have been designed to provide statistics with greater subject and geographic detail than is feasible or desirable to provide in printed and microfiche reports. The STF data are made available at nominal cost. The data are subject to suppression of certain detail where necessary to protect confidentiality.

There are five STF's (listed below), and the amount of geographic and subject detail presented varies. STF's 1 and 2 contain complete-count data, and STF's 3, 4, and 5 contain sample data. Note that the term "cells" used below refers to the number of subject statistics provided for each geographic area, and the number of cells is indicative of the detail of the subject content of the file.

Each of the STF's generally consists of two or more files which provide different degrees of geographic detail and, in some cases, race/Spanish origin cross-classification. For each of the files there is a separate tape or tapes for each State, the District of Columbia, and Puerto Rico. Selected files (STF 1 and STF 3) are also produced for Guam, Virgin Islands of the United States, American Samoa, and the Northern Mariana Islands and the remainder of the Trust Territory of the Pacific Islands. These tapes are issued on a flow basis and are followed by a national summary tape for the particular file. More complete descriptions of the STF's than given in the summaries below can be found in the technical documentation for the specific file and in the 1980 Census of Population and Housing, *Users' Guide,* PHC80-R1.

Available: 9/81–9/82

This STF provides 321 cells of complete-count population and housing data. Data are summarized for the United States, regions, divisions, States, SCSA's, SMSA's, urbanized areas, congressional districts, counties, county subdivisions, places, census tracts, enumeration districts in unblocked areas, and blocks and block groups in blocked areas. The data include those shown in the PHC80-1, PHC80-3, and PC80-1-A reports.

STF 2
To be available: 2/82–Spring 1983

This STF contains 2,292 cells of detailed complete-count population and housing data, of which 962 are repeated for each race and Spanish origin group present in the tabulation area. Data are summarized for the United States, regions, divisions, States, SCSA's, SMSA's, urbanized areas, counties, county subdivisions, places of 1,000 or more inhabitants, census tracts, American Indian reservations, and Alaska Native villages. The data include those shown in the PHC80-2, PC80-1-B, and HC80-1-A reports.

STF 3
To be available: 7/82–Summer 1983

This STF contains 1,126 cells of data on various population and housing subjects collected on a sample basis. The areas covered are the same as in STF 1, excluding blocks. The data include those shown in the PHC80-3 reports.

STF 4
To be available: Spring–Fall 1983

This STF is the geographic counterpart of STF 2, but the number of cells of data is greater (approximately 8,400). STF 4 provides data covering virtually all of the population and housing subjects collected on a sample basis, as well as some of the complete-count subjects. Some of the statistics are repeated for race, Spanish origin, and ancestry groups. Data are summarized for areas similar to those shown in STF 2, except that data for places are limited to those with 2,500 or more inhabitants. The data include those shown in the PHC80-2, PC80-1-C, and HC80-1-B reports.

STF 5
To be available: Summer–Fall 1983

This STF contains over 100,000 cells of data on various population and housing subjects collected on a sample basis and provides detailed tabulations and cross-classifications for States, SMSA's, counties, cities of 50,000 or more inhabitants, and central cities. Most subjects are classified by race and Spanish origin. The data include those shown in the PC80-1-D and HC80-2 reports.

Other Computer Tape Files

P.L. 94-171 Population Counts
Issued: 2/81–3/81

In accordance with Public Law (P.L.) 94-171, the Census Bureau provides population tabulations to all States for legislative reapportionment/redistricting. The file is issued on a State-by-State basis. It contains population counts classified by race and Spanish origin. The data are tabulated for the following levels of geography as applicable: States, counties, county subdivisions, incorporated places, census tracts, blocks and block groups in blocked areas, and enumeration districts in unblocked areas. For States participating in the voluntary program to define election precincts in conjunction with the Census Bureau, the data are also tabulated for election precincts.

Master Area Reference Files 1 and 2 (MARF)
MARF 1 available: 9/81–3/82

MARF 1. This geographic reference file is an extract of STF 1 designed for those who require a master list of geographic codes and areas, along with basic census counts arranged hierarchically from the State down to the block group and enumeration district levels and is issued on a State-by-State basis. The file contains records for States, counties, county subdivisions, places, census tracts, enumeration districts in unblocked areas, and block groups in blocked areas. Each record shows the total population by five race groups, population of Spanish origin, number of housing units, number of households, number of families, and a few other items.

MARF 2
To be available: Summer–Fall 1983

MARF 2. This file is the same as MARF 1 with the latitude and longitude coordinates for a representative point (centroid) in each block group (BG) or enumeration district (ED) outside block numbered areas.

Geographic Base File/ Dual Independent Map Encoding (GBF/DIME)
Beginning in 1978 periodic updates

These files are computer representations of the Metropolitan Map Series, including address ranges and ZIP Codes, which generally cover the urbanized portions of SMSA's. GBF/DIME files are used to assign census geographic codes to addresses (geocoding). The files are available by SMSA.

Public-Use Microdata Samples
Available: 3/83

There are three mutually exclusive samples: the A sample including 5 percent of all persons and housing units, and the B and C samples each including 1 percent of all persons and housing units. States and most large SMSA's will be identifiable on one or more of the files. Microdata files allow the user to prepare customized tabulations.

Public-use microdata samples are computerized files containing most population and housing characteristics as shown on a sample of individual census records. These files contain no names or addresses, and geographic identification is sufficiently broad to protect confidentiality.

Census/EEO Special File Available: 11/82

This file provides sample census data with specified relevance to EEO and affirmative action uses. The file contains two tabulations, one with detailed occupational data and the other with years of school completed by age. The data in both tabulations are crossed by sex, Spanish origin, and race. These data are provided for all counties, for all SMSA's, and for places with a population of 50,000 or more.

MAPS

Maps necessary to define areas are generally published and included as part of the corresponding reports. Maps are published for Block Statistics (PHC80-1) and Census Tracts (PHC80-2) but must be purchased separately from the reports. Maps necessary to define enumeration districts are available on a cost-of-reproduction basis.

MICROFICHE

Some of the computer tape products are available on microfiche. The STF microfiche are issued for each State or Area and for the United States. These include:

STF 1 Microfiche—Data from STF 1 are presented in tabular form for all the STF 1 geographic levels described previously, except blocks.

STF 3 Microfiche—Data from STF 3 are presented in tabular form for all the STF 3 geographic levels.

P.L. 94-171 Counts Microfiche—The data from the P.L. 94-171 computer tape are presented in a listing format.

SUBJECT ITEMS INCLUDED IN THE 1980 CENSUS

Complete-Count Items

Population

Household relationship
Sex
Race
Age
Marital status
Spanish/Hispanic origin or descent

Housing

Number of living quarters at address
Access to unit
Complete plumbing facilities
Number of rooms
Tenure (whether unit is owned or rented)
Condominium identification
Acreage and presence of commercial establishment or medical office
Value of home (owner-occupied units and condominiums)
Contract rent (renter-occupied units)
Vacant for rent, for sale, etc., and duration of vacancy

Sample Items[1]

Population

School enrollment
Years of school completed
State or foreign country of birth
Citizenship and year of immigration
Language spoken at home and ability to speak English
Ancestry
Residence in 1975
Activity in 1975
Veteran status and period of service
Work disability and public transportation disability
Children ever born
Marital history
Labor force status
Hours worked
Place of work
Travel time to work
Means of transportation to work
Private vehicle occupancy
Year last worked
Industry
Occupation
Class of worker
Number of weeks worked in 1979
Usual hours worked per week in 1979
Unemployment in 1979
Income in 1979 by source
Poverty status in 1979

Housing

Type of unit and units in structure
Stories in building and presence of elevator
Year structure built
Year householder moved into unit
Acreage and crop sales
Source of water
Sewage disposal
Heating equipment
Fuels used for house heating, water heating, and cooking
Costs of utilities and fuels
Complete kitchen facilities
Number of bedrooms
Number of bathrooms
Telephone
Air-conditioning
Number of automobiles
Number of light trucks and vans
Homeowner shelter costs for mortgage, real estate taxes, and hazard insurance

Note: Censuses similar in subject content to that of the United States were also taken in Puerto Rico, Virgin Islands of the United States, American Samoa, Guam, Northern Mariana Islands, and the remainder of the Trust Territory of the Pacific Islands. Subjects were added or deleted as necessary to make the census content appropriate to the area. The questionnaire for Puerto Rico had complete-count items and sample items, but in the other areas all questions were complete-count items.

[1] For most areas of the country in 1980, one out of every six housing units or households received the sample form which included all complete-count questions as well as sample questions. Incorporated places and minor civil divisions estimated to contain fewer than 2,500 persons in 1980 had a three-out-of-every-six sampling rate, which is designed to provide satisfactory levels of sampling reliability in the statistics needed for participation in certain Federal programs.

Appendix F:

URBAN TRANSPORTATION PLANNING PACKAGE

1980 CENSUS

FINAL SPECIFICATIONS

Journey-to-Work and Migration
Statistics Branch
U.S. Bureau of the Census
April 18, 1983

NOTE

The Urban Transportation Planning Package is a special tabulation of census data for individual standard metropolitan statistical areas (SMSA's) tailored to geographic areas that are used in transportation planning. Local transportation planning organizations submit specifications to the Census Bureau for the geographic detail required for their SMSA (i.e., traffic zones or census tracts), and the Bureau then produces a standard set of tabulations for those planning areas on a cost reimbursable basis. These specifications were prepared by an ad hoc committee of transportation planners, representing the Transportation Research Board's Committee on Information Systems and Data Requirements. Funding for the development of the UTPP Program is provided by the U.S. Department of Transportation.

PART I - TABULATIONS BY CENSUS TRACT OR BLOCK GROUP (OR ZONE-SPECIAL ORDER) OF RESIDENCE

Subtotals By:
(a) CBD
(b) Central city
(c) Urbanized area
(d) Study area
(e) Minor civil division (9 Northeast states only)
(f) County
(g) SMSA

TABLE NO.	DESCRIPTION
I-1.	Number of persons in households by sex and age
I-2.	Number of persons in group quarters by sex and age
I-3.	Number of persons by sex and age
I-4.	Number of persons by race and Spanish origin
I-5.	Number of persons 3 years old and over enrolled in school
I-6.	Number of workers by sex and occupation
I-7.	Number of workers by sex and industry
I-8.	Number of workers by sex and class of worker
I-9.	Number of households by size of household
I-10.	Number of households by number of workers in household
I-11.	Number of households by household income
I-12.	Number of vacant year-round housing units by duration of vacancy
I-13.	Number of year-round housing units by type of structure
I-14.	Number of households by number of automobiles available
I-15.	Number of households by number of trucks or vans available
I-16.	Number of households by number of vehicles (cars, trucks, or vans) available
I-17.	Mean travel time and standard deviation by means of transportation and carpooling for workers not working at home
I-18.	Number of workers by means of transportation and carpooling
I-19.	Number of workers using a car, truck, or van, by carpool type and vehicle occupancy

I-20. Number of vehicles (cars, trucks, or vans) used in travel to work

I-21. Number of persons per vehicle

I-22. Number of persons per carpool

I-23. Number of workers by means of transportation and earnings

I-24. Number of workers in households by means of transportation and household income

I-25. Number of workers by means of transportation, and race and Spanish origin

I-26. Number of workers by means of transportation, sex, and age

I-27. Number of workers in households by means of transportation and number of vehicles (cars, trucks, or vans) available

I-28. Noninstitutional population 16 years old and over with a disability by type of disability and age

I-29. Number of workers with a public transportation disability by means of transportation and carpooling

I-1. SEX (3) BY AGE (17)

Universe: All Persons in Households

Both sexes:
- All ages
  - Under 6 years
  - 6-13 years
  - 14-15 years
  - 16-18 years
  - 19-20 years
  - 21-24 years
  - 25-34 years
  - 35-44 years
  - 45-54 years
  - 55-59 years
  - 60-61 years
  - 62-64 years
  - 65-74 years
  - 75 years and over
  - Median
  - Mean

Male:
- (Repeat Age)

Female:
- (Repeat Age)

I-2. SEX (3) BY AGE (17)

Universe: All Persons in Group Quarters

Both sexes:
- All ages
  - Under 6 years
  - 6-13 years
  - 14-15 years
  - 16-18 years
  - 19-20 years
  - 21-24 years
  - 25-34 years
  - 35-44 years
  - 45-54 years
  - 55-59 years
  - 60-61 years
  - 62-64 years
  - 65-74 years
  - 75 years and over
  - Median
  - Mean

Male:
- (Repeat Age)

Female:
- (Repeat Age)

I-3. SEX (3) BY AGE (17)

Universe: All persons

Both sexes:
- All ages
  - Under 6 years
  - 6-13 years
  - 14-15 years
  - 16-18 years
  - 19-20 years
  - 21-24 years
  - 25-34 years
  - 35-44 years
  - 45-54 years
  - 55-59 years
  - 60-61 years
  - 62-64 years
  - 65-74 years
  - 75 years and over
  - Median
  - Mean

Male:
- (Repeat Age)

Female:
- (Repeat Age)

I-4. RACE AND SPANISH ORIGIN (8)

Universe: All persons

All races
  White
  Black
  American Indian, Eskimo, and Aleut
  Asian and Pacific Islander
  Other races

  Spanish origin
  Not of Spanish origin

I-5. SCHOOL ENROLLMENT (6)

Universe: All Persons 3 Years Old and Over Enrolled in School

Total
  Nursery school
  Kindergarten
  Elementary
  High school
  College

I-6. SEX (3) BY OCCUPATION (12)

Universe: All Workers

Both sexes:
  All workers
    In civilian labor force, at work
      Executive, administrative, and managerial occupations
      Professional specialty occupations
      Technicians and related support occupations
      Sales occupations
      Administrative support occupations, including clerical
      Service occupations
      Farming, forestry, and fishing occupations
      Precision products, craft, and repair occupations
      Operators, fabricators, and laborers
    Armed forces, at work

Male:
  (Repeat Occupation)

Female:
  (Repeat Occupation)

I-7. SEX (3) BY INDUSTRY (16)

Universe: All Workers

Both sexes:
  All workers
    In civilian labor force, at work
      Agriculture, forestry, and fisheries
      Mining
      Construction
      Manufacturing
      Transportation, communications, and other public utilities
      Wholesale trade
      Retail trade
      Finance, insurance, and real estate
      Business and repair services
      Personal services
      Entertainment and recreation services
      Professional and related services
      Public administration
    Armed forces, at work

Male:
  (Repeat Industry)

Female:
  (Repeat Industry)

I-8. SEX (3) BY CLASS OF WORKER (5)

Universe: All Workers

Both sexes:
  All workers
    Private wage and salary workers
    Government workers
    Self-employed workers
    Unpaid family workers

Male:
  (Repeat Class of Worker)

Female:
  (Repeat Class of Worker)

I-9. SIZE OF HOUSEHOLD (10)

Universe: All Households

All households
  1 person
  2 persons
  3 persons
  4 persons
  5 persons
  6 persons
  7 or more persons
  Median
  Mean

I-10 NUMBER OF WORKERS IN HOUSEHOLD (9)

Universe: All Households

All households
No workers
1 worker
2 workers
3 workers
4 workers
5 or more workers
Median
Mean

I-11. HOUSEHOLD INCOME (12)

Universe: All Households

All households
Less than $5,000
$5,000 to $7,999
$8,000 to $9,999
$10,000 to $14,999
$15,000 to $19,999
$20,000 to $24,999
$25,000 to $34,999
$35,000 to $49,999
$50,000 or more
Median
Mean

I-12. DURATION OF VACANCY (7)

Universe: All Vacant Year-Round Housing Units

All vacant year-round housing units
Less than 1 month
1 up to 2 months
2 up to 6 months
6 up to 12 months
1 year up to 2 years
2 or more years

I-13. TYPE OF STRUCTURE (10)

Universe: All Year-Round Housing Units

All year-round housing units
One family house-detached
One family house-attached
Building for 2-4 families
Building for 5-9 families
Building for 10-19 families
Building for 20-49 families
Building for 50 or more families
Mobile home or trailer
Other (boat, van, tent, etc.)

I-14. NUMBER OF AUTOMOBILES AVAILABLE (5)

Universe: All Households

All households
No automobiles
1 automobile
2 automobiles
3 or more automobiles

I-15. NUMBER OF TRUCKS OR VANS AVAILABLE (5)

Universe: All Households

All households
No trucks or vans
1 truck or van
2 trucks or vans
3 or more trucks or vans

I-16. NUMBER OF VEHICLES (CARS, TRUCKS, OR VANS) AVAILABLE (5)

Universe: All Households

All households
No vehicles
1 vehicle
2 vehicles
3 or more vehicles

I-17. MEAN (AVERAGE) TRAVEL TIME AND STANDARD DEVIATION (2) BY MEANS OF TRANSPORTATION AND CARPOOLING (13)

Universe: All Workers Not Working at Home

Mean travel time (minutes):
All workers not working at home
Car: drive alone
carpool
Truck or van: drive alone
carpool
Bus or streetcar
Railroad
Subway or elevated
Taxicab
Motorcycle
Bicycle
Walked only
Other means

Standard deviation of mean travel time:
(Repeat Means of Transportation and Carpooling)

I-18. MEANS OF TRANSPORTATION AND CARPOOLING (14)

Universe: All Workers

All workers
  Car: drive alone
       carpool
  Truck or van: drive alone
                carpool
  Bus or streetcar
  Railroad
  Subway or elevated
  Taxicab
  Motorcycle
  Bicycle
  Walked only
  Worked at home
  Other means

I-19. CARPOOL TYPE (5) BY VEHICLE OCCUPANCY (8)

Universe: All Workers Using a Car, Truck, or Van

All workers using a car, truck, or van:
  Total, vehicle occupancy
    Drive alone
    In 2-person carpools
    In 3-person carpools
    In 4-person carpools
    In 5-person carpools
    In 6-person carpools
    In 7-or-more person carpools

Drive alone:
  (Repeat Vehicle Occupancy)

Share driving:
  (Repeat Vehicle Occupancy)
Drive others only:
  (Repeat Vehicle Occupancy)

Ride as passenger only:
  (Repeat Vehicle Occupancy)

I-20. NUMBER OF VEHICLES (CARS, TRUCKS, OR VANS) USED IN TRAVEL TO WORK (1)

Number of vehicles = (Total workers who drive alone) +
(Total workers in 2-person carpools x .5) +
(Total workers in 3-person carpools x .3333) +
(Total workers in 4-person carpools x .25) +
(Total workers in 5-person carpools x .2) +
(Total workers in 6-person carpools x .1666) +
(Total workers in 7-or-more person carpools x .1428)

I-21. PERSONS PER VEHICLE (1)

No. of persons per vehicle=
No. of workers using a car, truck, or van ÷ No. of vehicles used in travel to work

I-22. PERSONS PER CARPOOL (1)

No. of persons per carpool=
No. of workers who share driving, drive others only, or ride as passenger only ÷ No. of carpool vehicles used in travel to work (Total vehicles minus vehicles of workers who drive alone)

I-23. MEANS OF TRANSPORTATION (5) BY EARNINGS (15)

Universe: All Workers

All workers:
- Total, earnings
  - Without earnings
  - With earnings
    - $1 to $2,999, or loss
    - $3,000 to $4,999
    - $5,000 to $7,999
    - $8,000 to $9,999
    - $10,000 to $14,999
    - $15,000 to $19,999
    - $20,000 to $24,999
    - $25,000 to $34,999
    - $35,000 to $49,999
    - $50,000 or more
    - Median
    - Mean

Car, truck, or van:
- (Repeat Earnings)

Public transportation (bus or streetcar, subway or elevated, railroad, or taxicab):
- (Repeat Earnings)

Bicycle, walked only, or worked at home:
- (Repeat Earnings)

Other means (motorcycle or other means):
- (Repeat Earnings)

I-24. MEANS OF TRANSPORTATION (5) BY HOUSEHOLD INCOME (12)

Universe: All Workers in Households

All workers in households:
- Total, household income
  - Less than $5,000

$5,000 to $7,999
$8,000 to $9,999
$10,000 to $14,999
$15,000 to $19,999
$20,000 to $24,999
$25,000 to $34,999
$35,000 to $49,999
$50,000 or more
Median
Mean

Car, truck, or van:
(Repeat Household Income)

Public transportation (bus or streetcar, subway or elevated, railroad, or taxicab):
(Repeat Household Income)

Bicycle, walked only, or worked at home:
(Repeat Household Income)

Other means (motorcycle or other means):
(Repeat Household Income)

I-25. MEANS OF TRANSPORTATION (5) BY RACE AND SPANISH ORIGIN (8)

Universe: All Workers

All workers:
All races
White
Black
American Indian, Eskimo, and Aleut
Asian and Pacific Islander
Other races

Spanish origin
Not of Spanish origin

Car, Truck, or Van:
(Repeat Race and Spanish Origin)

Public transportation (bus or streetcar, subway or elevated, railroad, or taxicab):
(Repeat Race and Spanish Origin)

Bicycle, walked only, or worked at home:
(Repeat Race and Spanish Origin)

Other means (motorcycle or other means):
(Repeat Race and Spanish Origin)

I-26. MEANS OF TRANSPORTATION (5) BY SEX (3) BY AGE (7)

Universe: All Workers

All workers:
Both sexes:

All ages
16-20 years
21-44 years
45-59 years
60-61 years
62-64 years
65 years and over

Male:
(Repeat same as for Both sexes)

Female:
(Repeat same as for Both sexes)

Car, truck, or van:
(Repeat same as for All workers)

Public transportation (bus or streetcar, subway or elevated, railroad, or taxicab):
(Repeat same as for All workers)

Bicycle, walked only, or worked at home:
(Repeat same as for All workers)

Other means (motorcycle or other means):
(Repeat same as for All workers)

I-27. MEANS OF TRANSPORTATION (5) BY NUMBER OF VEHICLES (CARS, TRUCKS, OR VANS) AVAILABLE (5)

Universe: All Workers in Households

All workers in households:
Total, vehicles available
No vehicles
1 vehicle
2 vehicles
3 or more vehicles

Car, Truck, or Van:
(Repeat Number of Vehicles Available)

Public transportation (bus or streetcar, subway or elevated, railroad, or taxicab):
(Repeat Number of Vehicles Available)

Bicycle, walked only, or worked at home:
(Repeat Number of Vehicles Available)

Other means (motorcycle or other means) :
(Repeat Number of Vehicles Available)

I-28. TYPE OF DISABILITY (6) BY AGE (7)

Universe: Noninstitutional Population 16 Years Old and Over With a Disability (work and/or public transportation disability)

Total, type of disability
  Total, persons 16 years old and over
    16-20 years
    21-44 years
    45-59 years
    60-61 years
    62-64 years
    65 years and over

With a public transportation disability and a work disability that prevents working:
  (Repeat Age)

With a public transportation disability and a work disability that does not prevent working:
  (Repeat Age)

With a public transportation disability but no work disability:
  (Repeat Age)

With no public transportation disability but with a work disability that prevents working:
  (Repeat Age)

With no public transportation disability but with a work disability that does not prevent working:
  (Repeat Age)

I-29. MEANS OF TRANSPORTATION AND CARPOOLING (14)

Universe: All Workers With a Public Transportation Disability

All workers with a public transportation disability
  Car: drive alone
       carpool
  Truck or van: drive alone
                carpool
  Bus or streetcar
  Railroad
  Subway or elevated
  Taxicab
  Motorcycle
  Bicycle
  Walked only
  Worked at home
  Other means

PART II - TABULATIONS BY LARGE GEOGRAPHIC AREAS OF RESIDENCE

Tabulations By:
(a) CBD
(b) Central city
(c) Urbanized area
(d) Study area
(e) Minor civil division (9 Northeast states only)
(f) County
(g) SMSA

TABLE NO.	DESCRIPTION
II-1.	Number of workers by race and Spanish origin, earnings, means of transportation, and carpooling
II-2.	Number of workers by means of transportation, carpooling, and class of worker
II-3.	Number of workers by age, earnings, means of transportation, and carpooling
II-4.	Number of workers not working at home by travel time and means of transportation
II-5.	Number of workers in households by household income, size of household, means of transportation, and carpooling
II-6.	Number of workers in households by household income, number of vehicles (cars, trucks, or vans) available, means of transportation, and carpooling
II-7.	Number of workers in households by sex, number of workers in household, number of vehicles (cars, trucks, or vans) available, means of transportation, and carpooling
II-8.	Number of workers in households by race and Spanish origin, household income, and number of vehicles (cars, trucks, or vans) available
II-9.	Number of workers in households who use a car, truck, or van, by vehicle occupancy, household income, and size of household
II-10.	Number of workers in households who use a car, truck, or van by vehicle occupancy, size of household, and number of vehicles (cars, trucks, or vans) available
II-11.	Number of workers in households who use a car, truck, or van by vehicle occupancy, household income, and number of vehicles (cars, trucks, or vans) available
II-12.	Number of workers who use a car, truck, or van by sex, carpool type, and vehicle occupancy

II-13. Number of households by type of structure, household income, and size of household

II-14. Number of households by number of automobiles available, household income, and size of household

II-15. Number of households by number of trucks or vans available, household income, and size of household

II-16. Number of households by number of vehicles (cars, trucks, or vans) available, household income, and size of household

II-17. Number of households by type of structure and number of automobiles available

II-18. Number of households by type of structure and number of trucks or vans available

II-19. Number of households by type of structure and number of vehicles (cars, trucks, or vans) available

II-1. RACE AND SPANISH ORIGIN (8) BY EARNINGS (15) BY MEANS OF TRANSPORTATION AND CARPOOLING (14)

Universe: All Workers

All races:
  Total, earnings:
    All workers
      Car: drive alone
           carpool
      Truck or van: drive alone
                    carpool
      Bus or streetcar
      Railroad
      Subway or elevated
      Taxicab
      Motorcycle
      Bicycle
      Walked only
      Worked at home
      Other means

  Without earnings:
    (Repeat Means of Transportation and Carpooling)

  With earnings:
    (Repeat Means of Transportation and Carpooling)

    $1-$2,999 or loss:
      (Repeat Means of Transportation and Carpooling)

    $3,000-$4,999:
      (Repeat Means of Transportation and Carpooling)

$5,000-$7,999:
(Repeat Means of Transportation and Carpooling)

$8,000-$9,999:
(Repeat Means of Transportation and Carpooling)

$10,000-$14,999:
(Repeat Means of Transportation and Carpooling)

$15,000-$19,999:
(Repeat Means of Transportation and Carpooling)

$20,000-$24,999:
(Repeat Means of Transportation and Carpooling)

$25,000-$34,999:
(Repeat Means of Transportation and Carpooling)

$35,000-$49,999:
(Repeat Means of Transportation and Carpooling)

$50,000 or more:
(Repeat Means of Transportation and Carpooling)

Median:
(Repeat Means of Transportation and Carpooling)

Mean:
(Repeat Means of Transportation and Carpooling)

White:
(Repeat same as for All races)

Black:
(Repeat same as for All races)

American Indian, Eskimo, and Aleut:
(Repeat same as for All races)

Asian and Pacific Islander:
(Repeat same as for All races)

Other races:
(Repeat same as for All races)

Spanish origin:
(Repeat same as for All races)

Not of Spanish origin:
(Repeat same as for All races)

II-2. MEANS OF TRANSPORTATION AND CARPOOLING (14) BY CLASS OF WORKER (5)

Universe: All Workers

All workers:
  Total, class of worker
    Private wage and salary workers
    Government workers
    Self-employed workers
    Unpaid family workers

Car: drive alone:
  (Repeat Class of Worker)

Car: carpool:
  (Repeat Class of Worker)

Truck or van: drive alone:
  (Repeat Class of Worker)

Truck or van: carpool:
  (Repeat Class of Worker)

Bus or streetcar:
  (Repeat Class of Worker)

Railroad:
  (Repeat Class of Worker)

Subway or elevated:
  (Repeat Class of Worker)

Taxicab:
  (Repeat Class of Worker)

Motorcycle:
  (Repeat Class of Worker)

Bicycle:
  (Repeat Class of Worker)

Walked only:
  (Repeat Class of Worker)

Worked at home:
  (Repeat Class of Worker)

Other means:
  (Repeat Class of Worker)

II-3. AGE (7) BY EARNINGS (15) BY MEANS OF TRANSPORTATION AND CARPOOLING (14)

Universe: All Workers

All Ages:
  Total, earnings:
    All workers
      Car: drive alone
           carpool

Truck or van: drive alone
carpool
Bus or streetcar
Railroad
Subway or elevated
Taxicab
Motorcycle
Bicycle
Walked only
Worked at home
Other means

Without earnings:
(Repeat Means of Transportation and Carpooling)

With earnings:
(Repeat Means of Transportation and Carpooling)

$1-$2,999, or loss:
(Repeat Means of Transportation and Carpooling)

$3,000-$4,999:
(Repeat Means of Transportation and Carpooling)

$5,000-$7,999:
(Repeat Means of Transportation and Carpooling)

$8,000-$9,999:
(Repeat Means of Transportation and Carpooling)

$10,000-$14,999:
(Repeat Means of Transportation and Carpooling)

$15,000-$19,999:
(Repeat Means of Transportation and Carpooling)

$20,000-$24,999:
(Repeat Means of Transportation and Carpooling)

$25,000-$34,999:
(Repeat Means of Transportation and Carpooling)

$35,000-$49,999:
(Repeat Means of Transportation and Carpooling)

$50,000 or more:
(Repeat Means of Transportation and Carpooling)

Median:
(Repeat Means of Transportation and Carpooling)

Mean:
(Repeat Means of Transportation and Carpooling)

16-20 years:
(Repeat same as for All Ages)

21-44 years:
(Repeat same as for All Ages)

45-59 years:
(Repeat same as for All Ages)

60-61 years:
(Repeat same as for All Ages)

62-64 years:
(Repeat same as for All Ages)

65 years and over:
(Repeat same as for All Ages)

II-4. TRAVEL TIME (94) BY MEANS OF TRANSPORTATION (5)

Universe: All Workers Not Working at Home

Total, travel time:
All workers not working at home
Car, truck, or van
Public transportation (bus or streetcar, railroad, subway or elevated, taxicab)
Bicycle or walked only
Motorcycle or other means

1 minute:
(Repeat Means of Transportation)

2 minutes:
(Repeat Means of Transportation)

3 minutes:
(Repeat Means of Transportation)

.
.
.

90 minutes:
(Repeat Means of Transportation)

91 or more minutes:
(Repeat Means of Transportation)

Median:
(Repeat Means of Transportation)

Mean:
(Repeat Means of Transportation)

II-5. HOUSEHOLD INCOME (12) BY SIZE OF HOUSEHOLD (8) BY MEANS OF TRANSPORTATION AND CARPOOLING (14)

Universe: All Workers in Households

Total, household income:
  Total, size of household:
    All workers:
      Car: drive alone
           carpool
      Truck or van: drive alone
                    carpool
      Bus or streetcar
      Railroad
      Subway or elevated
      Taxicab
      Motorcycle
      Bicycle
      Walked only
      Worked at home
      Other means

  1 person:
    (Repeat Means of Transportation and Carpooling)

  2 persons:
    (Repeat Means of Transportation and Carpooling)

  3 persons:
    (Repeat Means of Transportation and Carpooling)

  4 persons:
    (Repeat Means of Transportation and Carpooling)

  5 persons:
    (Repeat Means of Transportation and Carpooling)

  6 persons:
    (Repeat Means of Transportation and Carpooling)

  7 or more persons:
    (Repeat Means of Transportation and Carpooling)

Less than $5,000:
(Repeat same as for Total, household income)

$5,000-$7,999:
(Repeat same as for Total, household income)

$8,000-$9,999:
(Repeat same as for Total, household income)

$10,000-$14,999:
(Repeat same as for Total, household income)

$15,000-$19,999:
(Repeat same as for Total, household income)

$20,000-$24,999:
(Repeat same as for Total, household income)

$25,000-$34,999:
(Repeat same as for Total, household income)

$35,000-$49,999:
(Repeat same as for Total, household income)

$50,000 or more:
(Repeat same as for Total, household income)

Median:
(Repeat same as for Total, household income)

Mean:
(Repeat same as for Total, household income)

II-6. HOUSEHOLD INCOME (12) BY NUMBER OF VEHICLES (CARS, TRUCKS, OR VANS) AVAILABLE (5) BY MEANS OF TRANSPORTATION AND CARPOOLING (14)

Universe: All Workers In Households

Total, household income:
Total, number of vehicles available:
All workers
Car: drive alone
carpool
Truck or van: drive alone
carpool
Bus or streetcar
Railroad
Subway or elevated
Taxicab
Motorcycle
Bicycle
Walked only
Worked at home
Other means

No vehicles:
(Repeat Means of Transportation and Carpooling)

1 vehicle:
(Repeat Means of Transportation and Carpooling)

2 vehicles:
(Repeat Means of Transportation and Carpooling)

3 vehicles:
(Repeat Means of Transportation and Carpooling)

Less than $5,000:
(Repeat same as for Total, household income)

$5,000-$7,999:
(Repeat same as for Total, household income)

$8,000-$9,999:
(Repeat same as for Total, household income)

$10,000-$14,999:
(Repeat same as for Total, household income)

$15,000-$19,999:
(Repeat same as for Total, household income)

$20,000-$24,999:
(Repeat same as for Total, household income)

$25,000-$34,999:
(Repeat same as for Total, household income)

$35,000-$49,999:
(Repeat same as for Total, household income)

$50,000 or more:
(Repeat same as for Total, household income)

Median:
(Repeat same as for Total, household income)

Mean:
(Repeat same as for Total, household income)

II-7. SEX (3) BY NUMBER OF WORKERS IN HOUSEHOLD (5) BY NUMBER OF VEHICLES (CARS, TRUCKS, OR VANS) AVAILABLE (5) BY MEANS OF TRANSPORTATION AND CARPOOLING (14)

Universe: All Workers in Households

Both sexes:
Total, workers in household:
Total, number of vehicles available:
All workers in households
Car: drive alone
carpool
Truck or van: drive alone
carpool
Bus or streetcar
Railroad
Subway or elevated
Taxicab
Motorcycle
Bicycle
Walked only
Worked at home
Other means

No vehicles:
(Repeat Means of Transportation and Carpooling)

1 vehicle:
(Repeat Means of Transportation and Carpooling)

2 vehicles:
(Repeat Means of Transportation and Carpooling)

3 or more vehicles:
(Repeat Means of Transportation and Carpooling)

1 worker:
(Repeat same as for Total, workers in household)

2 workers:
(Repeat same as for Total, workers in household)

3 workers:
(Repeat same as for Total, workers in household)

4 or more workers:
(Repeat same as for Total, workers in household)

Male:
(Repeat same as for Both sexes)

Female:
(Repeat same as for Both sexes)

II-8. RACE AND SPANISH ORIGIN (8) BY HOUSEHOLD INCOME (12)
BY NUMBER OF VEHICLES (CARS, TRUCKS, OR VANS) AVAILABLE (5)

Universe: All Workers in Households

All races:
Total, household income:
Total, number of vehicles available
No vehicles
1 vehicle
2 vehicles
3 or more vehicles

Less than $5,000:
(Repeat Number of Vehicles Available)

$5,000-$7,999:
(Repeat Number of Vehicles Available)

$8,000-$9,999:
(Repeat Number of Vehicles Available)

$10,000-$14,999:
(Repeat Number of Vehicles Available)

$15,000-$19,999:
(Repeat Number of Vehicles Available)

$20,000-$24,999:
(Repeat Number of Vehicles Available)

$25,000-$34,999:
(Repeat Number of Vehicles Available)

$35,000-$49,999:
(Repeat Number of Vehicles Available)

$50,000 or more:
(Repeat Number of Vehicles Available)

Median:
(Repeat Number of Vehicles Available)

Mean:
(Repeat Number of Vehicles Available)

White:
(Repeat same as for All races)

Black:
(Repeat same as for All races)

American Indian, Eskimo, and Aleut:
(Repeat same as for All races)

Asian and Pacific Islander:
(Repeat same as for All races)

Other races:
(Repeat same as for All races)

Spanish Origin:
(Repeat same as for All races)

Not of Spanish origin:
(Repeat same as for All races)

II-9. VEHICLE OCCUPANCY (8) BY HOUSHOLD INCOME (12) BY SIZE OF HOUSEHOLD (8)

Universe: All Workers in Households Who Use a Car, Truck, or Van

All workers in households who use a car, truck, or van:
Total, household income:
Total, size of household
1 person
2 persons
3 persons
4 persons
5 persons
6 persons
7 or more persons

Less than $5,000:
(Repeat Size of Household)

$5,000-$7,999:
(Repeat Size of Household)

$8,000-$9,999:
(Repeat Size of Household)

$10,000-$14,999:
(Repeat Size of Household)

$15,000-$19,999:
(Repeat Size of Household)

$20,000-$24,999:
(Repeat Size of Household)

$25,000-$34,999:
(Repeat Size of Household)

$35,000-$49,999:
(Repeat Size of Household)

$50,000 or more:
(Repeat Size of Household)

Median:
(Repeat Size of Household)

Mean:
(Repeat Size of Household)

Drive alone:
(Repeat same as for All workers in households who use a car, truck, or van)

In 2-person carpool:
(Repeat same as for All workers in households who use a car, truck, or van)

In 3-person carpool:
(Repeat same as for All workers in households who use a car, truck, or van)

In 4-person carpool:
(Repeat same as for All workers in households who use a car, truck, or van)

In 5-person carpool:
(Repeat same as for All workers in households who use a car, truck, or van)

In 6-person carpool:
(Repeat same as for All workers in households who use a car, truck, or van)

In 7-or-more person carpool:
(Repeat same as for All workers in households who use a car, truck, or van)

II-10. VEHICLE OCCUPANCY (8) BY SIZE OF HOUSEHOLD (8) BY NUMBER OF VEHICLES (CARS, TRUCKS, OR VANS) AVAILABLE (5)

Universe: All Workers in Households Who Use a Car, Truck, or Van

All workers in households who use a car, truck, or van:
  Total, size of household:
    Total, number of vehicles available
      No vehicles
      1 vehicle
      2 vehicles
      3 or more vehicles

    1 person:
      (Repeat Number of Vehicles Available)

    2 persons:
      (Repeat Number of Vehicles Available)

    3 persons:
      (Repeat Number of Vehicles Available)

    4 persons:
      (Repeat Number of Vehicles Available)

    5 persons:
      (Repeat Number of Vehicles Available)

    6 persons:
      (Repeat Number of Vehicles Available)

    7 or more persons:
      (Repeat Number of Vehicles Available)

Drive alone:
  (Repeat same as for All workers in households who use a car, truck, or van)

In 2-person carpool:
  (Repeat same as for All workers in households who use a car, truck, or van)

In 3-person carpool:
  (Repeat same as for All workers in households who use a car, truck, or van)

In 4-person carpool:
  (Repeat same as for All workers in households who use a car, truck, or van)

In 5-person carpool:
  (Repeat same as for All workers in households who use a car, truck, or van)

In 6-person carpool:
  (Repeat same as for All workers in households who use a car, truck, or van)

In 7-or-more person carpool:
  (Repeat same as for All workers in households who use a car, truck, or van)

II-11. VEHICLE OCCUPANCY (8) BY HOUSEHOLD INCOME (12) BY NUMBER OF VEHICLES (CARS, TRUCKS, OR VANS) AVAILABLE (5)

Universe: All Workers in Households Who Use a Car, Truck, or Van

All workers in households who use a car, truck, or van:
  Total, household income:
    Total, number of vehicles available
      No vehicles
      1 vehicle
      2 vehicles
      3 or more vehicles

  Less than $5,000:
    (Repeat Number of Vehicles Available)

  $5,000-$7,999:
    (Repeat Number of Vehicles Available)

  $8,000-$9,999:
    (Repeat Number of Vehicles Available)

  $10,000-$14,999:
    (Repeat Number of Vehicles Available)

  $15,000-$19,999:
    (Repeat Number of Vehicles Available)

  $20,000-$24,999:
    (Repeat Number of Vehicles Available)

  $25,000-$34,999:
    (Repeat Number of Vehicles Available)

  $35,000-$49,999:
    (Repeat Number of Vehicles Available)

  $50,000 or more:
    (Repeat Number of Vehicles Available)

  Median:
    (Repeat Number of Vehicles Available)

  Mean:
    (Repeat Number of Vehicles Available)

Drive alone:
    (Repeat same as for All workers in households who use a car, truck, or van)

In 2-person carpool:
    (Repeat same as for All workers in households who use a car, truck, or van)

In 3-person carpool:
    (Repeat same as for All workers in households who use a car, truck, or van)

In 4-person carpool:
    (Repeat same as for All workers in households who use a car, truck, or van)

In 5-person carpool:
    (Repeat same as for All workers in households who use a car, truck, or van)

In 6-person carpool:
    (Repeat same as for All workers in households who use a car, truck, or van)

In 7-or-more person carpool:
(Repeat same as for All workers in households who use a car, truck, or van)

II-12. SEX (3) BY CARPOOL TYPE (5) BY VEHICLE OCCUPANCY (8)

Universe: All Workers Who Use a Car, Truck, or Van

Both sexes:
Total, carpool type:
All workers who use a car, truck, or van
Drive alone
In 2-person carpool
In 3-person carpool
In 4-person carpool
In 5-person carpool
In 6-person carpool
In 7-or-more person carpool

Drive alone:
(Repeat Vehicle Occupancy)

Share driving:
(Repeat Vehicle Occupancy)

Drive others only:
(Repeat Vehicle Occupancy)

Ride as passenger only:
(Repeat Vehicle Occupancy)

Male:
(Repeat same as for Both sexes)

Female:
(Repeat same as for Both sexes)

II-13. TYPE OF STRUCTURE (10) BY HOUSEHOLD INCOME (12)
BY SIZE OF HOUSEHOLD (8)

Universe: All Households

All households:
Total, household income:
Total, size of household
1 person
2 persons
3 persons
4 persons
5 persons
6 persons
7 or more persons

Less than $5,000:
(Repeat Size of Household)

$5,000-$7,999:
(Repeat Size of Household)

$8,000-$9,999:
(Repeat Size of Household)

$10,000-$14,999:
(Repeat Size of Household)

$15,000-$19,999:
(Repeat Size of Household)

$20,000-$24,999:
(Repeat Size of Household)

$25,000-$34,999:
(Repeat Size of Household)

$35,000-$49,999:
(Repeat Size of Household)

$50,000 or more:
(Repeat Size of Household)

Median:
(Repeat Size of Household)

Mean:
(Repeat Size of Household)

1 family house-detached:
(Repeat same as for All households)

1 family house-attached:
(Repeat same as for All households)

Building for 2-4 families:
(Repeat same as for All households)

Building for 5-9 families:
(Repeat same as for All households)

Building for 10-19 families:
(Repeat same as for All households)

Building for 20-49 families:
(Repeat same as for All households)

Building for 50 or more families:
(Repeat same as for All households)

Mobile home or trailer:
(Repeat same as for All households)

Other (boat, van, tent, etc.):
(Repeat same as for All households)

II-14. NUMBER OF AUTOMOBILES AVAILABLE (5) BY HOUSEHOLD INCOME (12) BY SIZE OF HOUSEHOLD (8)

Universe: All Households

Total, number of automobiles available:
  Total household income:
    Total, size of household
      1 person
      2 persons
      3 persons
      4 persons
      5 persons
      6 persons
      7 or more persons

    Less than $5,000:
      (Repeat Size of Household)

    $5,000-$7,999:
      (Repeat Size of Household)

    $8,000-$9,999:
      (Repeat Size of Household)

    $10,000-$14,999:
      (Repeat Size of Household)

    $15,000-$19,999:
      (Repeat Size of Household)

    $20,000-$24,999:
      (Repeat Size of Household)

    $25,000-$34,999:
      (Repeat Size of Household)

    $35,000-$49,999:
      (Repeat Size of Household)

    $50,000 or more:
      (Repeat Size of Household)

    Median:
      (Repeat Size of Household)

    Mean:
      (Repeat Size of Household)

No automobiles:
  (Repeat same as for Total, number of automobiles available)

1 automobile:
  (Repeat same as for Total, number of automobiles available)

2 automobiles:
  (Repeat same as for Total, number of automobiles available)

3 or more automobiles:
(Repeat same as for Total, number of automobiles available)

II-15. NUMBER OF TRUCKS OR VANS AVAILABLE (5) BY HOUSEHOLD INCOME (12) BY SIZE OF HOUSEHOLD (8)

Universe: All Households

Total, number of trucks or vans available:
Total, household income:
Total, size of household
1 person
2 persons
3 persons
4 persons
5 persons
6 persons
7 or more persons

Less than $5,000:
(Repeat Size of Household)

$5,000-$7,999:
(Repeat Size of Household)

$8,000-$9,999:
(Repeat Size of Household)

$10,000-$14,999:
(Repeat Size of Household)

$15,000-$19,999:
(Repeat Size of Household)

$20,000-$24,999:
(Repeat Size of Household)

$25,000-$34,999:
(Repeat Size of Household)

$35,000-$49,999:
(Repeat Size of Household)

$50,000 or more:
(Repeat Size of Household)

Median:
(Repeat Size of Household)

Mean:
(Repeat Size of Household)

No trucks or vans:
(Repeat same as for Total, number of trucks or vans available)

1 truck or van:
(Repeat same as for Total, number of trucks or vans available)

2 trucks or vans:
(Repeat same as for Total, number of trucks or vans available)

3 or more trucks or vans:
(Repeat same as for Total, number of trucks or vans available)

II-16. NUMBER OF VEHICLES (CARS, TRUCKS, OR VANS) AVAILABLE (5) BY HOUSEHOLD INCOME (12) BY SIZE OF HOUSEHOLD (8)

Universe: All Households

Total, number of vehicles available:
Total, household income:
Total, size of household
1 person
2 persons
3 persons
4 persons
5 persons
6 persons
7 or more persons

Less than $5,000:
(Repeat Size of Household)

$5,000-$7,999:
(Repeat Size of Household)

$8,000-$9,999:
(Repeat Size of Household)

$10,000-$14,999:
(Repeat Size of Household)

$15,000-$19,999:
(Repeat Size of Household)

$20,000-$24,999:
(Repeat Size of Household)

$25,000-$34,999:
(Repeat Size of Household)

$35,000-$49,999:
(Repeat Size of Household)

$50,000 or more:
(Repeat Size of Household)

Median:
(Repeat Size of Household)

Mean:
(Repeat Size of Household)

No vehicles:
(Repeat same as for Total, number of vehicles available)

1 vehicle:
(Repeat same as for Total, number of vehicles available)

2 vehicles:
(Repeat same as for Total, number of vehicles available)

3 or more vehicles:
(Repeat same as for Total, number of vehicles available)

II-17. TYPE OF STRUCTURE (10) BY NUMBER OF AUTOMOBILES AVAILABLE (5)

Universe: All Households

All households:
Total, number of automobiles available
No automobiles
1 automobile
2 automobiles
3 or more automobiles

1 family house-detached:
(Repeat Number of Automobiles Available)

1 family house-attached:
(Repeat Number of Automobiles Available)

Building for 2-4 families:
(Repeat Number of Automobiles Available)

Building for 5-9 families:
(Repeat Number of Automobiles Available)

Building for 10-19 families:
(Repeat Number of Automobiles Available)

Building for 20-49 families:
(Repeat Number of Automobiles Available)

Building for 50 or more families:
(Repeat Number of Automobiles Available)

Mobile home or trailer:
(Repeat Number of Automobiles Available)

Other (boat, van, tent, etc.):
(Repeat Number of Automobiles Available)

II-18. TYPE OF STRUCTURE (10) BY NUMBER OF TRUCKS OR VANS AVAILABLE (5)

Universe: All Households

All households:
Total, number of trucks or vans available
No trucks or vans

1 truck or van
2 trucks or vans
3 or more trucks or vans

1 family house-detached:
(Repeat Number of Trucks or Vans Available)

1 family house-attached:
(Repeat Number of Trucks or Vans Available)

Building for 2-4 families:
(Repeat Number of Trucks or Vans Available)

Building for 5-9 families:
(Repeat Number of Trucks or Vans Available)

Building for 10-19 families:
(Repeat Number of Trucks or Vans Available)

Building for 20-49 families:
(Repeat Number of Trucks or Vans Available)

Building for 50 or more families:
(Repeat Number of Trucks or Vans Available)

Mobile home or trailer:
(Repeat Number of Trucks or Vans Available)

Other (boat, van, tent, etc.):
(Repeat Number of Trucks or Vans Available)

II-19. TYPE OF STRUCTURE (10) BY NUMBER OF VEHICLES (CARS, TRUCKS, OR VANS) AVAILABLE (5)

Universe: All Households

All households:
Total, number of vehicles available
No vehicles
1 vehicle
2 vehicles
3 or more vehicles

1 family house-detached:
(Repeat Number of Vehicles Available)

1 family house-attached:
(Repeat Number of Vehicles Available)

Building for 2-4 families:
(Repeat Number of Vehicles Available)

Building for 5-9 families:
(Repeat Number of Vehicles Available)

Building for 10-19 families:
(Repeat Number of Vehicles Available)

Building for 20-49 families:
(Repeat Number of Vehicles Available)

Building for 50 or more families:
(Repeat Number of Vehicles Available)

Mobile home or trailer:
(Repeat Number of Vehicles Available)

Other (boat, van, tent, etc.):
(Repeat Number of Vehicles Available)

PART III - TABULATIONS BY CENSUS TRACT (OR ZONE-SPECIAL ORDER) OF WORK

Subtotals By:
(a) CBD
(b) Central city
(c) Study Area
(d) Minor civil division (9 Northeast states only)
(e) County
(f) SMSA

TABLE NO.	DESCRIPTION
III-1.	Number of workers by sex and occupation
III-2.	Number of workers by sex and industry
III-3.	Number of workers by sex and class of worker
III-4.	Number of workers by means of transportation and earnings
III-5.	Number of workers by means of transportation and carpooling
III-6.	Mean (average) travel time and standard deviation by means of transportation and carpooling for workers not working at home
III-7.	Number of workers by means of transportation, and race and Spanish origin
III-8.	Number of workers by sex and means of transportation
III-9.	Number of workers using a car, truck, or van by carpool type and vehicle occupancy
III-10.	Number of vehicles (cars, trucks, or vans) used in travel to work
III-11.	Number of persons per vehicle
III-12.	Number of persons per carpool
III-13.	Number of workers in households by number of workers in household, means of transportation, and household income
III-14.	Number of workers in households by means of transportation and number of vehicles (cars, trucks, or vans) available

III-1. SEX (3) BY OCCUPATION (12)

Universe: All Workers

Both sexes:
- All workers
  - In civilian labor force, at work
    - Executive, administrative, and managerial occupations
    - Professional specialty occupations
    - Technicians and related support occupations
    - Sales occupations
    - Administrative support occupations, including clerical
    - Service occupations
    - Farming, forestry, and fishing occupations
    - Precision products, craft, and repair occupations
    - Operators, fabricators, and laborers
  - Armed forces, at work

Male:
- (Repeat Occupation)

Female:
- (Repeat Occupation)

III-2. SEX (3) BY INDUSTRY (16)

Universe: All Workers

Both sexes:
- All workers
  - In civilian labor force, at work
    - Agriculture, forestry, and fisheries
    - Mining
    - Construction
    - Manufacturing
    - Transportation, communications, and other public utilities
    - Wholesale trade
    - Retail trade
    - Finance, insurance, and real estate
    - Business and repair services
    - Personal services
    - Entertainment and recreation services
    - Professional and related services
    - Public administration
  - Armed forces, at work

Male:
- (Repeat Industry)

Female:
- (Repeat Industry)

III-3. SEX (3) BY CLASS OF WORKER (5)

Universe: All Workers

Both sexes:
  All workers
    Private wage and salary workers
    Government workers
    Self-employed workers
    Unpaid family workers

Male:
  (Repeat Class of Worker)

Female:
  (Repeat Class of Worker)

III-4. MEANS OF TRANSPORTATION (5) BY EARNINGS (15)

Universe: All Workers

All workers:
  Total, earnings
    Without earnings
    With earnings
      $1 to $2,999, or loss
      $3,000 to $4,999
      $5,000 to $7,999
      $8,000 to $9,999
      $10,000 to $14,999
      $15,000 to $19,999
      $20,000 to $24,999
      $25,000 to $34,999
      $35,000 to $49,999
      $50,000 or more
      Median
      Mean

Car, truck, or van:
  (Repeat Earnings)

Public transportation (bus or streetcar, subway or elevated, railroad, or taxicab):
  (Repeat Earnings)

Bicycle, walked only, or worked at home:
  (Repeat Earnings)

Other means (motorcycle or other means):
  (Repeat Earnings)

III-5. MEANS OF TRANSPORTATION AND CARPOOLING (14)

Universe: All Workers

All workers
  Car: drive alone
       carpool
  Truck or van: drive alone
                carpool

Bus or streetcar
Railroad
Subway or elevated
Taxicab
Motorcycle
Bicycle
Walked only
Worked at home
Other means

III-6. MEAN (AVERAGE) TRAVEL TIME AND STANDARD DEVIATION (2) BY MEANS OF TRANSPORTATION AND CARPOOLING (13)

Universe: All Workers Not Working at Home

Mean travel time (minutes):
All workers not working at home
Car: drive alone
carpool
Truck or van: drive alone
carpool
Bus or streetcar
Railroad
Subway or elevated
Taxicab
Motorcycle
Bicycle
Walked only
Other means

Standard deviation of mean travel time:
(Repeat Means of Transportation and Carpooling)

III-7. MEANS OF TRANSPORTATION (5) BY RACE AND SPANISH ORIGIN (8)

Universe: All Workers

All workers:
All races
White
Black
American Indian, Eskimo, and Aleut
Asian and Pacific Islander
Other races
Spanish origin
Not of Spanish origin

Car, truck, or van
(Repeat Race and Spanish Origin)

Public transportation (bus or streetcar, subway or elevated, railroad, or taxicab)
(Repeat Race and Spanish Origin)

Bicycle, walked only, or worked at home
(Repeat Race and Spanish Origin)

Other means (motorcycle or other means)
(Repeat Race and Spanish Origin)

III-8. SEX (3) BY MEANS OF TRANSPORTATION (5)

Universe: All Workers

Both sexes:
All workers
Car, truck, or van
Public transportation (bus or streetcar, subway or elevated, railroad, or taxicab)
Bicycle, walked only, or worked at home
Other means (motorcycle or other means)

Male:
(Repeat Means of Transportation)

Female:
(Repeat Means of Transportation)

III-9. CARPOOL TYPE (5) BY VEHICLE OCCUPANCY (8)

Universe: All Workers Using a Car, Truck, or Van

All workers using a car, truck, or van:
Total, vehicle occupancy
Drive alone
In 2-person carpools
In 3-person carpools
In 4-person carpools
In 5-person carpools
In 6-person carpools
In 7-or-more person carpools

Drive alone:
(Repeat Vehicle Occupancy)

Share driving:
(Repeat Vehicle Occupancy)

Drive others only:
(Repeat Vehicle Occupancy)

Ride as passenger only:
(Repeat Vehicle Occupancy)

III-10. NUMBER OF VEHICLES (CARS, TRUCKS, OR VANS) USED IN TRAVEL TO WORK (1)

Number of vehicles = (Total workers who drive alone) +
(Total workers in 2-person carpools x .5) +
(Total workers in 3-person carpools x .3333) +
(Total workers in 4-person carpools x .25) +
(Total workers in 5-person carpools x .2) +

(Total workers in 6-person carpools x .1666) +
(Total workers in 7-or-more person carpools x .1428)

III-11. PERSONS PER VEHICLE (1)

No. of workers using a car, truck, or van ÷
No. of vehicles used in travel to work

III-12. PERSONS PER CARPOOL (1)

No. of workers who share driving, drive others only, or ride as passenger only ÷
No. of carpool vehicles used in travel to work (Total vehicles minus vehicles of workers who drive alone)

III-13. NUMBER OF WORKERS IN HOUSEHOLD (3) BY MEANS OF TRANSPORTATION (5) BY HOUSEHOLD INCOME (12)

Universe: All Workers in Households

Total, workers in households:
All workers in households:
Total, household income
Less than $5,000
$5,000 to $7,999
$8,000 to $9,999
$10,000 to $14,999
$15,000 to $19,999
$20,000 to $24,999
$25,000 to $34,999
$35,000 to $49,999
$50,000 or more
Median
Mean

Car, truck, or van:
(Repeat Household Income)

Public transportation (bus or streetcar, subway or elevated, railroad, or taxicab):
(Repeat Household Income)

Bicycle, walked only, or worked at home:
(Repeat Household Income)

Other means (motorcycle or other means):
(Repeat Household Income)

1 worker:
(Repeat same as for Total, workers in household)

2 or more workers:
(Repeat same as for Total, workers in household)

III-14. MEANS OF TRANSPORTATION (5) BY NUMBER OF VEHICLES (CARS, TRUCKS, OR VANS) AVAILABLE (5)

Universe: All Workers in Households

All workers in households:
  Total, number of vehicles available
    No vehicles
    1 vehicle
    2 vehicle
    3 or more vehicles

Car, truck, or van:
  (Repeat Number of Vehicles Available)

Public transportation (bus or streetcar, subway or elevated, railroad, or taxicab):
  (Repeat Number of Vehicles Available)

Bicycle, walked only, or worked at home:
  (Repeat Number of Vehicles Available)

Other means (motorcycle or other means):
  (Repeat Number of Vehicles Available)

PART IV - TABULATIONS BY CENSUS TRACT OF RESIDENCE TO CENSUS TRACT OF WORK (OR ZONE OF RESIDENCE TO ZONE OF WORK-SPECIAL ORDER)

Subtotals By:
- (a) CBD
- (b) Central city
- (c) Urbanized area (residence only)
- (d) Study area
- (e) Minor civil division (9 Northeast states only)
- (f) County
- (g) SMSA

TABLE NO.	DESCRIPTION
IV-1.	Number of workers by means of transportation
IV-2.	Mean (average) travel time by means of transportation for workers not working at home
IV-3.	Number of vehicles (cars, trucks, or vans) used in travel to work, number of persons per vehicle, and number of persons per carpool

IV-1. MEANS OF TRANSPORTATION (14)

Universe: All Workers

All workers
- Car, truck, or van:
  - Drive alone
  - Carpool:
    - 2-person carpool
    - 3-person carpool
    - 4-or-more person carpool
- Bus or streetcar
- Railroad
- Subway or elevated
- Taxicab
- Motorcycle
- Bicycle
- Walked only
- Worked at home
- Other means

IV-2. MEAN (AVERAGE) TRAVEL TIME BY MEANS OF TRANSPORTATION (13)

Universe: All Workers Not Working at Home

Mean travel time (minutes):
- All workers not working at home
  - Car, truck, or van:

Drive alone
Carpool:
2-person carpool
3-person carpool
4-or-more person carpool
Bus or streetcar
Railroad
Subway or elevated
Taxicab
Motorcycle
Bicycle
Walked only
Other means

IV-3. NUMBER OF VEHICLES (CARS, TRUCKS, OR VANS) USED IN TRAVEL TO WORK (1), PERSONS PER VEHICLE (1), AND PERSONS PER CARPOOL (1)

Number of vehicles = (Total workers who drive alone) +
(Total workers in 2-person carpools x .5) +
(Total workers in 3-person carpools x .3333) +
(Total workers in 4-person carpools x .25) +
(Total workers in 5-person carpools x .2) +
(Total workers in 6-person carpools x .1666) +
(Total workers in 7-or-more person carpools x .1428)

Persons per vehicle =

No. of workers using a car, truck, or van ÷
No. of vehicles used in travel to work

Persons per carpool =

No. of workers who share driving, drive others only, or ride as passenger only ÷
No. of carpool vehicles used in travel to work (Total vehicles minus vehicles of workers who drive alone)

PART V - TABULATIONS BY BLOCK GROUP OF WORK (SUB-TOTALS TO CENSUS TRACT OF WORK)

TABLE NO.	DESCRIPTION
V-1.	Number of workers by sex and occupation
V-2.	Number of workers by sex and industry
V-3.	Number of workers by sex and class of worker
V-4.	Number of workers by means of transportation
V-5.	Number of vehicles (cars, trucks, or vans) used in travel to work
V-6.	Number of persons per vehicle
V-7.	Number of persons per carpool

V-1. SEX (3) BY OCCUPATION (12)

Universe: All Workers

Both sexes:
- All workers
  - In civilian labor force, at work
    - Executive, administrative, and managerial occupations
    - Professional specialty occupations
    - Technicians and related support occupations
    - Sales occupations
    - Administrative support occupations, including clerical
    - Service occupations
    - Farming, forestry, and fishing occupations
    - Precision products, craft, and repair occupations
    - Operators, fabricators, and laborers
  - Armed forces, at work

Male:
- (Repeat Occupation)

Female:
- (Repeat Occupation)

V-2. SEX (3) BY INDUSTRY (16)

Universe: All Workers

Both sexes:
- All workers
  - In civilian labor force, at work
    - Agriculture, forestry, and fisheries

Mining
Construction
Manufacturing
Transportation, communications, and other public utilities
Wholesale trade
Retail trade
Finance, insurance, and real estate
Business and repair services
Personal services
Entertainment and recreation services
Professional and related services
Public administration
Armed forces, at work

Male:
(Repeat Industry)

Female:
(Repeat Industry)

V-3. SEX (3) BY CLASS OF WORKER (5)

Universe: All Workers

Both sexes:
All workers
Private wage and salary workers
Government workers
Self-employed workers
Unpaid family workers

Male:
(Repeat Class of Worker)

Female:
(Repeat Class of Worker)

V-4. MEANS OF TRANSPORTATION (5)

Universe: All Workers

All workers
Car, truck, or van
Public transportation (bus or streetcar, subway or elevated, railroad, or taxicab)
Bicycle, walked only, or worked at home
Other means (motorcycle or other means)

V-5. NUMBER OF VEHICLES (CARS, TRUCKS, OR VANS) USED IN TRAVEL TO WORK (1)

Number of vehicles = (Total workers who drive alone) +
(Total workers in 2-person carpools x .5) +
(Total workers in 3-person carpools x .3333) +
(Total workers in 4-person carpools x .25) +

(Total workers in 5-person carpools x .2) +
(Total workers in 6-person carpools x .1666) +
(Total workers in 7-or-more person carpools x .1428)

V-6. PERSONS PER VEHICLE (1)

No. of workers using a car, truck, or van ÷
No. of vehicles used in travel to work

V-7. PERSONS PER CARPOOL (1)

No. of workers who share driving, drive others only, or ride as passenger only ÷
No. of carpool vehicles used in travel to work (Total vehicles minus vehicles of workers who drive alone)

PART VI - TABULATIONS BY COUNTY OF RESIDENCE TO COUNTY OF WORK (INCLUDES 20 EXTERNAL COUNTIES OR NEW ENGLAND TOWNS WITH A LARGE NUMBER OF JOURNEY-TO-WORK TRIPS)

TABLE NO.	DESCRIPTION
VI-1.	Number of workers by sex and occupation
VI-2.	Number of workers by sex and industry
VI-3.	Number of workers by sex and class of worker
VI-4.	Number of workers by means of transportation and earnings
VI-5.	Number of workers by means of transportation, and race and Spanish origin
VI-6.	Number of workers by sex and means of transportation
VI-7.	Number of workers using a car, truck, or van, by carpool type
VI-8.	Number of vehicles (cars, trucks, or vans) used in travel to work, number of persons per vehicle, and number of persons per carpool
VI-9.	Number of workers in households by means of transportation and number of vehicles (cars, trucks, or vans) available
VI-10.	Number of workers in households by means of transportation and household income

VI-1. SEX (3) BY OCCUPATION (12)

Universe: All Workers

Both sexes:
- All workers
  - In civilian labor force, at work
    - Executive, administrative, and managerial occupations
    - Professional specialty occupations
    - Technicians and related support occupations
    - Sales occupations
    - Administrative support occupations, including clerical
    - Service occupations
    - Farming, forestry, and fishing occupations
    - Precision products, craft, and repair occupations
    - Operators, fabricators, and laborers
  - Armed forces, at work

Male:
- (Repeat Occupation)

Female:
(Repeat Occupation)

VI-2. SEX (3) BY INDUSTRY (16)

Universe: All Workers

Both sexes:
All workers
In civilian labor force, at work
Agriculture, forestry, and fisheries
Mining
Construction
Manufacturing
Transportation, communications, and other public utilities
Wholesale trade
Retail trade
Finance, insurance, and real estate
Business and repair services
Personal services
Entertainment and recreation services
Professional and related services
Public administration
Armed forces, at work

Male:
(Repeat Industry)

Female:
(Repeat Industry)

VI-3. SEX (3) BY CLASS OF WORKER (5)

Universe: All Workers

Both sexes:
All workers
Private wage and salary workers
Government workers
Self-employed workers
Unpaid family workers

Male:
(Repeat Class of Worker)

Female:
(Repeat Class of Worker)

VI-4. MEANS OF TRANSPORTATION (5) BY EARNINGS (15)

Universe: All Workers

All workers:
Total, earnings
Without earnings

With earnings
$1 to $2,999, or loss
$3,000 to $4,999
$5,000 to $7,999
$8,000 to $9,999
$10,000 to $14,999
$15,000 to $19,999
$20,000 to $24,999
$25,000 to $34,999
$35,000 to $49,999
$50,000 or more
Median
Mean

Car, truck, or van:
(Repeat Earnings)

Public transportation (bus or streetcar, subway or elevated, railroad, or taxicab):
(Repeat Earnings)

Bicycle, walked only, or worked at home:
(Repeat Earnings)

Other means (motorcycle or other means):
(Repeat Earnings)

VI-5. MEANS OF TRANSPORTATION (5) BY RACE AND SPANISH ORIGIN (8)

Universe: All Workers

All workers:
All races
White
Black
American Indian, Eskimo, and Aleut
Asian and Pacific Islander
Other races

Spanish origin
Not of Spanish origin

Car, truck, or van:
(Repeat Race and Spanish Origin)

Public transportation (bus or streetcar, subway or elevated, railroad, or taxicab):
(Repeat Race and Spanish Origin)

Bicycle, walked only, or worked at home:
(Repeat Race and Spanish Origin)

Other means (motorcycle or other means):
(Repeat Race and Spanish Origin)

VI-6. SEX (3) BY MEANS OF TRANSPORTATION (5)

Universe: All Workers

Both sexes:
  All workers
    Car, truck, or van
    Public transportation (bus or streetcar, subway or elevated, railroad, or taxicab)
    Bicycle, walked only, or worked at home
    Other means (motorcycle or other means)

Male:
  (Repeat Means of Transportation)

Female:
  (Repeat Means of Transportation)

VI-7. CARPOOL TYPE (5)

Universe: All Workers Using a Car, Truck, or Van

All workers using a car, truck, or van
  Drive alone
  Share driving
  Drive others only
  Ride as passenger only

VI-8. NUMBER OF VEHICLES (CARS, TRUCKS, OR VANS) USED IN TRAVEL TO WORK (1), PERSONS PER VEHICLE (1), AND PERSONS PER CARPOOL (1)

Number of vehicles = (Total workers who drive alone) +
(Total workers in 2-person carpools x .5) +
(Total workers in 3-person carpools x .3333) +
(Total workers in 4-person carpools x .25) +
(Total workers in 5-person carpools x .2) +
(Total workers in 6-person carpools x .1666) +
(Total workers in 7-or-more person carpools x .1428)

Persons per vehicle =

No. of workers using a car, truck, or van ÷
No. of vehicles used in travel to work

Persons per carpool =

No. of workers who share driving, drive others only, or ride as passenger only ÷
No. of carpool vehicles used in travel to work (Total vehicles minus vehicles of workers who drive alone)

VI-9. MEANS OF TRANSPORTATION (5) BY NUMBER OF VEHICLES (CARS, TRUCKS, OR VANS) AVAILABLE (5)

Universe: All Workers in Households

All workers in households:
  Total, number of vehicles available
    No vehicles
    1 vehicle
    2 vehicles
    3 or more vehicles

Car, truck, or van:
  (Repeat Number of Vehicles Available)

Public transportation (bus or streetcar, subway or elevated, railroad, or taxicab):
  (Repeat Number of Vehicles Available)

Bicycle, walked only, or worked at home:
  (Repeat Number of Vehicles Available)

Other means (motorcycle or other means):
  (Repeat Number of Vehicles Available)

VI-10. MEANS OF TRANSPORTATION (5) BY HOUSEHOLD INCOME (12)

Universe: All Workers in Households

All workers in households:
  Total, household income
    Less than $5,000
    $5,000 to $7,999
    $8,000 to $9,999
    $10,000 to $14,999
    $15,000 to $19,999
    $20,000 to $24,999
    $25,000 to $34,999
    $35,000 to $49,999
    $50,000 or more
    Median
    Mean

Car, truck, or van:
  (Repeat Household Income)

Public transportation (bus or streetcar, subway or elevated, railroad, or taxicab):
  (Repeat Household Income)

Bicycle, walked only, or worked at home:
  (Repeat Household Income)

Other means (motorcycle or other means):
  (Repeat Household Income)

Appendix G:

Please fill out this official Census Form and mail it back on Census Day, Tuesday, April 1, 1980

1980 Census of the United States

If the address shown below has the wrong apartment identification, please write the correct apartment number or location here:					
DO	A1	A2	A4	A5 L	A6

Your answers are confidential

By law (title 13, U.S. Code), census employees are subject to fine and/or imprisonment for any disclosure of your answers. Only after 72 years does your information become available to other government agencies or the public. The same law requires that you answer the questions to the best of your knowledge.

Para personas de habla hispana

(For Spanish-speaking persons):
SI USTED DESEA UN CUESTIONARIO DEL CENSO EN ESPAÑOL llame a la oficina del censo. El número de teléfono se encuentra en el encasillado de la dirección.

O, si prefiere, marque esta casilla ☐ y devuelva el cuestionario por correo en el sobre que se le incluye.

A message from the Director, Bureau of the Census . . .

We must, from time to time, take stock of ourselves as a people if our Nation is to meet successfully the many national and local challenges we face. This is the purpose of the 1980 census.

The essential need for a population census was recognized almost 200 years ago when our Constitution was written. As provided by article I, the first census was conducted in 1790 and one has been taken every 10 years since then.

The law under which the census is taken protects the confidentiality of your answers. For the next 72 years — or until April 1, 2052 — only sworn census workers have access to the individual records, and no one else may see them.

Your answers, when combined with the answers from other people, will provide the statistical figures needed by public and private groups, schools, business and industry, and Federal, State, and local governments across the country. These figures will help all sectors of American society understand how our population and housing are changing. In this way, we can deal more effectively with today's problems and work toward a better future for all of us.

The census is a vitally important national activity. Please do your part by filling out this census form accurately and completely. If you mail it back promptly in the enclosed postage-paid envelope, it will save the expense and inconvenience of a census taker having to visit you.

Thank you for your cooperation.

U.S. Department of Commerce
Bureau of the Census
Form D-2

Form Approved
O.M.B. No. 41-S78006

Please continue →

How to fill out your Census Form

See the filled-out example in the yellow instruction guide. This guide will help with any problems you may have.

If you need more help, call the Census Office. The telephone number of the local office is shown at the bottom of the address box on the front cover.

Use a black pencil to answer the questions. Black pencil is better to use than ballpoint or other pens.

Fill circles "O" completely, like this ●

When you write in an answer, print or write clearly.

Make sure that answers are provided for everyone here.

See page 4 of the guide if a roomer or someone else in the household does not want to give you all the information for the form.

Answer the questions on pages 1 through 5, and then starting with pages 6 and 7, fill a pair of pages for each person in the household.

Check your answers. Then write your name, the date, and telephone number on page 20.

Mail back this form on Tuesday, April 1, or as soon afterward as you can. Use the enclosed envelope, no stamp is needed.

Please start by answering Question 1 below.

Question 1

List in Question 1

- Family members living here, including babies still in the hospital
- Relatives living here
- Lodgers or boarders living here
- Other persons living here
- College students who stay here while attending college, even if their parents live elsewhere
- Persons who usually live here but are temporarily away (including children in boarding school below the college level)
- Persons with a home elsewhere but who stay here most of the week while working

Do Not List in Question 1

- Any person away from here in the Armed Forces
- Any college student who stays somewhere else while attending college
- Any person who usually stays somewhere else most of the week while working there
- Any person away from here in an institution such as a home for the aged or mental hospital
- Any person staying or visiting here who has a usual home elsewhere

1. What is the name of each person who was living here on Tuesday, April 1, 1980, or who was staying or visiting here and had no other home?

Note

If everyone here is staying only temporarily and has a usual home elsewhere, please mark this box ☐.

Then please
- answer the questions on pages 2 through 5 only, and
- enter the address of your usual home on page 20.

Please continue →

Page 2 → ALSO ANSWER

Here are the QUESTIONS ↓	These are the columns for ANSWERS → Please fill one column for each person listed in Question 1.	PERSON in column 1	PERSON in column 2
		Last name First name — Middle initial	Last name First name — Middle initial
2. How is this person related to the person in column 1? *Fill one circle.* *If "Other relative" of person in column 1, give exact relationship, such as mother-in-law, niece, grandson, etc.*		*START in this column with the household member (or one of the members) in whose name the home is owned or rented. If there is no such person, start in this column with any adult household member.*	If relative of person in column 1: ○ Husband/wife ○ Son/daughter ○ Brother/sister ○ Father/mother ○ Other relative → If not related to person in column 1: ○ Roomer, boarder ○ Partner, roommate ○ Paid employee ○ Other nonrelative →
3. Sex *Fill one circle.*		○ Male ○ Female	○ Male ○ Female
4. Is this person — *Fill one circle.*		○ White ○ Black or Negro ○ Japanese ○ Chinese ○ Filipino ○ Korean ○ Vietnamese ○ Indian (Amer.) *Print tribe* → ○ Asian Indian ○ Hawaiian ○ Guamanian ○ Samoan ○ Eskimo ○ Aleut ○ Other — *Specify* →	○ White ○ Black or Negro ○ Japanese ○ Chinese ○ Filipino ○ Korean ○ Vietnamese ○ Indian (Amer.) *Print tribe* → ○ Asian Indian ○ Hawaiian ○ Guamanian ○ Samoan ○ Eskimo ○ Aleut ○ Other — *Specify* →
5. Age, and month and year of birth *a. Print age at last birthday.* *b. Print month and fill one circle.* *c. Print year in the spaces, and fill one circle below each number.*		a. Age at last birthday b. Month of birth ○ Jan.—Mar. ○ Apr.—June ○ July—Sept. ○ Oct.—Dec. c. Year of birth: 1 (1 ● 8 ○ 9 ○); Ø ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○	a. Age at last birthday b. Month of birth ○ Jan.—Mar. ○ Apr.—June ○ July—Sept. ○ Oct.—Dec. c. Year of birth: 1 (1 ● 8 ○ 9 ○); Ø ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○
6. Marital status *Fill one circle.*		○ Now married ○ Widowed ○ Divorced ○ Separated ○ Never married	○ Now married ○ Widowed ○ Divorced ○ Separated ○ Never married
7. Is this person of Spanish/Hispanic origin or descent? *Fill one circle.*		○ No (not Spanish/Hispanic) ○ Yes, Mexican, Mexican-Amer., Chicano ○ Yes, Puerto Rican ○ Yes, Cuban ○ Yes, other Spanish/Hispanic	○ No (not Spanish/Hispanic) ○ Yes, Mexican, Mexican-Amer., Chicano ○ Yes, Puerto Rican ○ Yes, Cuban ○ Yes, other Spanish/Hispanic
8. Since February 1, 1980, has this person attended regular school or college at any time? *Fill one circle. Count nursery school, kindergarten, elementary school, and schooling which leads to a high school diploma or college degree.*		○ No, has not attended since February 1 ○ Yes, public school, public college ○ Yes, private, church-related ○ Yes, private, not church-related	○ No, has not attended since February 1 ○ Yes, public school, public college ○ Yes, private, church-related ○ Yes, private, not church-related
9. What is the highest grade (or year) of regular school this person has ever attended? *Fill one circle.* *If now attending school, mark grade person is in. If high school was finished by equivalency test (GED), mark "12."*		**Highest grade attended:** ○ Nursery school ○ Kindergarten Elementary through high school *(grade or year)* 1 2 3 4 5 6 7 8 9 10 11 12 ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ College *(academic year)* 1 2 3 4 5 6 7 8 or more ○ ○ ○ ○ ○ ○ ○ ○ ○ Never attended school — *Skip question 10*	**Highest grade attended:** ○ Nursery school ○ Kindergarten Elementary through high school *(grade or year)* 1 2 3 4 5 6 7 8 9 10 11 12 ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ College *(academic year)* 1 2 3 4 5 6 7 8 or more ○ ○ ○ ○ ○ ○ ○ ○ ○ Never attended school — *Skip question 10*
10. Did this person finish the highest grade (or year) attended? *Fill one circle.*		○ Now attending this grade *(or year)* ○ Finished this grade *(or year)* ○ Did not finish this grade *(or year)*	○ Now attending this grade *(or year)* ○ Finished this grade *(or year)* ○ Did not finish this grade *(or year)*
		CENSUS USE ONLY A. ○ I ○ N ○ ○	*CENSUS USE ONLY* A. ○ I ○ N ○ ○

THE HOUSING QUESTIONS ON PAGE 3 → *ALSO ANSWER THE HOUSING QUESTIONS ON PAGE 3*

PERSON in column 3	PERSON in column 4	PERSON in column 5	PERSON in column 6
Last name First name / Middle initial	Last name First name / Middle initial	Last name First name / Middle initial	Last name First name / Middle initial
If relative of person in column 1: ○ Husband/wife ○ Father/mother ○ Son/daughter ○ Other relative ○ Brother/sister	If relative of person in column 1: ○ Husband/wife ○ Father/mother ○ Son/daughter ○ Other relative ○ Brother/sister	If relative of person in column 1: ○ Husband/wife ○ Father/mother ○ Son/daughter ○ Other relative ○ Brother/sister	If relative of person in column 1: ○ Husband/wife ○ Father/mother ○ Son/daughter ○ Other relative ○ Brother/sister
If not related to person in column 1: ○ Roomer, boarder ○ Other nonrelative ○ Partner, roommate ○ Paid employee	If not related to person in column 1: ○ Roomer, boarder ○ Other nonrelative ○ Partner, roommate ○ Paid employee	If not related to person in column 1: ○ Roomer, boarder ○ Other nonrelative ○ Partner, roommate ○ Paid employee	If not related to person in column 1: ○ Roomer, boarder ○ Other nonrelative ○ Partner, roommate ○ Paid employee
○ Male ○ Female	○ Male ○ Female	○ Male ○ Female	○ Male ○ Female
○ White ○ Asian Indian ○ Black or Negro ○ Hawaiian ○ Japanese ○ Guamanian ○ Chinese ○ Samoan ○ Filipino ○ Eskimo ○ Korean ○ Aleut ○ Vietnamese ○ Other — *Specify* ○ Indian (Amer.) *Print tribe* →	○ White ○ Asian Indian ○ Black or Negro ○ Hawaiian ○ Japanese ○ Guamanian ○ Chinese ○ Samoan ○ Filipino ○ Eskimo ○ Korean ○ Aleut ○ Vietnamese ○ Other — *Specify* ○ Indian (Amer.) *Print tribe* →	○ White ○ Asian Indian ○ Black or Negro ○ Hawaiian ○ Japanese ○ Guamanian ○ Chinese ○ Samoan ○ Filipino ○ Eskimo ○ Korean ○ Aleut ○ Vietnamese ○ Other — *Specify* ○ Indian (Amer.) *Print tribe* →	○ White ○ Asian Indian ○ Black or Negro ○ Hawaiian ○ Japanese ○ Guamanian ○ Chinese ○ Samoan ○ Filipino ○ Eskimo ○ Korean ○ Aleut ○ Vietnamese ○ Other — *Specify* ○ Indian (Amer.) *Print tribe* →
a. Age at last birthday **b. Month of birth** ○ Jan.—Mar. ○ Apr.—June ○ July—Sept. ○ Oct.—Dec. **c. Year of birth** 1 1 ● | 8 ○ 9 ○ | 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ | 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○	**a. Age at last birthday** **b. Month of birth** ○ Jan.—Mar. ○ Apr.—June ○ July—Sept. ○ Oct.—Dec. **c. Year of birth** 1 1 ● | 8 ○ 9 ○ | 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ | 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○	**a. Age at last birthday** **b. Month of birth** ○ Jan.—Mar. ○ Apr.—June ○ July—Sept. ○ Oct.—Dec. **c. Year of birth** 1 1 ● | 8 ○ 9 ○ | 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ | 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○	**a. Age at last birthday** **b. Month of birth** ○ Jan.—Mar. ○ Apr.—June ○ July—Sept. ○ Oct.—Dec. **c. Year of birth** 1 1 ● | 8 ○ 9 ○ | 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ | 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○
○ Now married ○ Separated ○ Widowed ○ Never married ○ Divorced	○ Now married ○ Separated ○ Widowed ○ Never married ○ Divorced	○ Now married ○ Separated ○ Widowed ○ Never married ○ Divorced	○ Now married ○ Separated ○ Widowed ○ Never married ○ Divorced
○ No (not Spanish/Hispanic) ○ Yes, Mexican, Mexican-Amer., Chicano ○ Yes, Puerto Rican ○ Yes, Cuban ○ Yes, other Spanish/Hispanic	○ No (not Spanish/Hispanic) ○ Yes, Mexican, Mexican-Amer., Chicano ○ Yes, Puerto Rican ○ Yes, Cuban ○ Yes, other Spanish/Hispanic	○ No (not Spanish/Hispanic) ○ Yes, Mexican, Mexican-Amer., Chicano ○ Yes, Puerto Rican ○ Yes, Cuban ○ Yes, other Spanish/Hispanic	○ No (not Spanish/Hispanic) ○ Yes, Mexican, Mexican-Amer., Chicano ○ Yes, Puerto Rican ○ Yes, Cuban ○ Yes, other Spanish/Hispanic
○ No, has not attended since February 1 ○ Yes, public school, public college ○ Yes, private, church-related ○ Yes, private, not church-related	○ No, has not attended since February 1 ○ Yes, public school, public college ○ Yes, private, church-related ○ Yes, private, not church-related	○ No, has not attended since February 1 ○ Yes, public school, public college ○ Yes, private, church-related ○ Yes, private, not church-related	○ No, has not attended since February 1 ○ Yes, public school, public college ○ Yes, private, church-related ○ Yes, private, not church-related
Highest grade attended: ○ Nursery school ○ Kindergarten Elementary through high school *(grade or year)* 1 2 3 4 5 6 7 8 9 10 11 12 ○○○○○○ ○○ ○○○ ○ College *(academic year)* 1 2 3 4 5 6 7 8 or more ○○○○○○○○ ○ Never attended school — *Skip question 10*	**Highest grade attended:** ○ Nursery school ○ Kindergarten Elementary through high school *(grade or year)* 1 2 3 4 5 6 7 8 9 10 11 12 ○○○○○○ ○○ ○○○ ○ College *(academic year)* 1 2 3 4 5 6 7 8 or more ○○○○○○○○ ○ Never attended school — *Skip question 10*	**Highest grade attended:** ○ Nursery school ○ Kindergarten Elementary through high school *(grade or year)* 1 2 3 4 5 6 7 8 9 10 11 12 ○○○○○○ ○○ ○○○ ○ College *(academic year)* 1 2 3 4 5 6 7 8 or more ○○○○○○○○ ○ Never attended school - *Skip question 10*	**Highest grade attended:** ○ Nursery school ○ Kindergarten Elementary through high school *(grade or year)* 1 2 3 4 5 6 7 8 9 10 11 12 ○○○○○○ ○○ ○○○ ○ College *(academic year)* 1 2 3 4 5 6 7 8 or more ○○○○○○○○ ○ Never attended school - *Skip question 10*
○ Now attending this grade *(or year)* ○ Finished this grade *(or year)* ○ Did not finish this grade *(or year)*	○ Now attending this grade *(or year)* ○ Finished this grade *(or year)* ○ Did not finish this grade *(or year)*	○ Now attending this grade *(or year)* ○ Finished this grade *(or year)* ○ Did not finish this grade *(or year)*	○ Now attending this grade *(or year)* ○ Finished this grade *(or year)* ○ Did not finish this grade *(or year)*
CENSUS USE ONLY **A.** ○ I ○ N ○○	*CENSUS USE ONLY* **A.** ○ I ○ N ○○	*CENSUS USE ONLY* **A.** ○ I ○ N ○○	*CENSUS USE ONLY* **A.** ○ I ○ N ○○

NOW PLEASE ANSWER QUESTIONS H1—H12 FOR YOUR HOUSEHOLD

If you listed more than 7 persons in Question 1, please see note on page 20.

PERSON in column 7

Last name

First name — Middle initial

If relative of person in column 1:
- Husband/wife
- Father/mother
- Son/daughter
- Other relative
- Brother/sister

If not related to person in column 1:
- Roomer, boarder
- Other nonrelative
- Partner, roommate
- Paid employee

Male ■ Female

- White
- Black or Negro
- Japanese
- Chinese
- Filipino
- Korean
- Vietnamese
- Indian (Amer.) *Print tribe* →
- Asian Indian
- Hawaiian
- Guamanian
- Samoan
- Eskimo
- Aleut
- Other — *Specify*

a. Age at last birthday

c. Year of birth: 1 9 [8 9] [0 1 2 3 4 5 6 7 8 9] [0 1 2 3 4 5 6 7 8 9]

b. Month of birth
- Jan.—Mar.
- Apr.—June
- July—Sept.
- Oct.—Dec.

- Now married
- Separated
- Widowed
- Never married
- Divorced

- No (not Spanish/Hispanic)
- Yes, Mexican, Mexican-Amer., Chicano
- Yes, Puerto Rican
- Yes, Cuban
- Yes, other Spanish/Hispanic

- No, has not attended since February 1
- Yes, public school, public college
- Yes, private, church-related
- Yes, private, not church-related

Highest grade attended:

Nursery school — Kindergarten

Elementary through high school *(grade or year)*: 1 2 3 4 5 6 7 8 9 10 11 12

College *(academic year)*: 1 2 3 4 5 6 7 8 or more

Never attended school – *Skip question 10*

- Now attending this grade *(or year)*
- Finished this grade *(or year)*
- Did not finish this grade *(or year)*

CENSUS USE ONLY — A. ○ I ○ N ○○

H1. Did you leave anyone out of Question 1 because you were not sure if the person should be listed — *for example, a new baby still in the hospital, a lodger who also has another home, or a person who stays here once in a while and has no other home?*
- Yes — *On page 20 give name(s) and reason left out.*
- No

H2. Did you list anyone in Question 1 who is away from home now — *for example, on a vacation or in a hospital?*
- Yes — *On page 20 give name(s) and reason person is away.*
- No

H3. Is anyone visiting here who is not already listed?
- Yes — *On page 20 give name of each visitor for whom there is no one at the home address to report the person to a census taker.*
- No

H4. How many living quarters, occupied and vacant, are at this address?
- One ■
- 2 apartments or living quarters
- 3 apartments or living quarters
- 4 apartments or living quarters
- 5 apartments or living quarters
- 6 apartments or living quarters
- 7 apartments or living quarters
- 8 apartments or living quarters
- 9 apartments or living quarters
- 10 or more apartments or living quarters
- This is a mobile home or trailer

H5. Do you enter your living quarters —
- Directly from the outside or through a common or public hall?
- Through someone else's living quarters?

H6. Do you have complete plumbing facilities in your living quarters, that is, hot and cold piped water, a flush toilet, and a bathtub or shower?
- Yes, for this household only
- Yes, but also used by another household
- No, have some but not all plumbing facilities
- No plumbing facilities in living quarters

H7. How many rooms do you have in your living quarters? *Do not count bathrooms, porches, balconies, foyers, halls, or half-rooms.*
- 1 room ■
- 2 rooms
- 3 rooms
- 4 rooms
- 5 rooms
- 6 rooms
- 7 rooms
- 8 rooms
- 9 or more rooms

H8. Are your living quarters —
- Owned or being bought by you or by someone else in this household?
- Rented for cash rent?
- Occupied without payment of cash rent?

H9. Is this apartment (house) part of a condominium?
- No
- Yes, a condominium

H10. *If this is a one-family house* –

a. Is the house on a property of 10 or more acres?
- Yes ■
- No

b. Is any part of the property used as a commercial establishment or medical office?
- Yes
- No

H11. *If you live in a one-family house or a condominium unit which you own or are buying* –

What is the value of this property, that is, how much do you think this property (house and lot or condominium unit) would sell for if it were for sale?

Do not answer this question if this is –
- A mobile home or trailer ■
- A house on 10 or more acres
- A house with a commercial establishment or medical office on the property

- Less than $10,000
- $10,000 to $14,999
- $15,000 to $17,499
- $17,500 to $19,999
- $20,000 to $22,499
- $22,500 to $24,999 ■
- $25,000 to $27,499
- $27,500 to $29,999
- $30,000 to $34,999
- $35,000 to $39,999
- $40,000 to $44,999
- $45,000 to $49,999
- $50,000 to $54,999
- $55,000 to $59,999
- $60,000 to $64,999
- $65,000 to $69,999
- $70,000 to $74,999
- $75,000 to $79,999
- $80,000 to $89,999
- $90,000 to $99,999
- $100,000 to $124,999
- $125,000 to $149,999
- $150,000 to $199,999
- $200,000 or more

H12. *If you pay rent for your living quarters* –

What is the monthly rent?

If rent is not paid by the month, see the instruction guide on how to figure a monthly rent.

- Less than $50
- $50 to $59
- $60 to $69
- $70 to $79
- $80 to $89
- $90 to $99 ■
- $100 to $109
- $110 to $119
- $120 to $129
- $130 to $139
- $140 to $149
- $150 to $159
- $160 to $169
- $170 to $179
- $180 to $189
- $190 to $199
- $200 to $224
- $225 to $249
- $250 to $274
- $275 to $299
- $300 to $349
- $350 to $399
- $400 to $499
- $500 or more

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A4. Block number

A6. Serial number

B. Type of unit or quarters
- Occupied
  - First form
  - Continuation
- Vacant
  - Regular
  - Usual home elsewhere
- Group quarters
  - First form
  - Continuation

For vacant units

C1. Is this unit for —
- Year round use
- Seasonal/Mig. — *Skip C2, C3, and D.*

C2. Vacancy status
- For rent ■
- For sale only
- Rented or sold, not occupied
- Held for occasional use
- Other vacant

C3. Is this unit boarded up?
- Yes
- No

D. Months vacant
- Less than 1 month
- 1 up to 2 months
- 2 up to 6 months
- 6 up to 12 months
- 1 year up to 2 years
- 2 or more years

E. Indicators ■
1. ○○ Mail return
2. ○○ Pop./F

○○

F. Total persons

0 0 0
1 1 1
2 2 2
3 3 3
4 4 4
5 5 5
6 6 6
7 7 7
8 8 8
9 9 9

Page 4 *ALSO ANSWER THESE QUESTIONS*

H13. Which best describes this building?
Include all apartments, flats, etc., even if vacant.

- ○ A mobile home or trailer
- ○ A one-family house detached from any other house
- ○ A one-family house attached to one or more houses
- ○ A building for 2 families
- ○ A building for 3 or 4 families
- ○ A building for 5 to 9 families
- ○ A building for 10 to 19 families
- ○ A building for 20 to 49 families
- ○ A building for 50 or more families
- ○ A boat, tent, van, etc.

H14a. How many stories (floors) are in this building?
Count an attic or basement as a story if it has any finished rooms for living purposes.

- ○ 1 to 3 — *Skip to H15*
- ○ 4 to 6
- ○ 7 to 12
- ○ 13 or more stories

b. Is there a passenger elevator in this building?

- ○ Yes
- ○ No

H15a. Is this building —

- ○ On a city or suburban lot, or on a place of less than 1 acre? — *Skip to H16*
- ○ On a place of 1 to 9 acres?
- ○ On a place of 10 or more acres?

b. Last year, 1979, did sales of crops, livestock, and other farm products from this place amount to —

- ○ Less than $50 (or None)
- ○ $50 to $249
- ○ $250 to $599
- ○ $600 to $999
- ○ $1,000 to $2,499
- ○ $2,500 or more

H16. Do you get water from —

- ○ A public system *(city water department, etc.)* or private company?
- ○ An individual drilled well?
- ○ An individual dug well?
- ○ Some other source *(a spring, creek, river, cistern, etc.)*?

H17. Is this building connected to a public sewer?

- ○ Yes, connected to public sewer
- ○ No, connected to septic tank or cesspool
- ○ No, use other means

H18. About when was this building originally built? *Mark when the building was first constructed, not when it was remodeled, added to, or converted.*

- ○ 1979 or 1980
- ○ 1975 to 1978
- ○ 1970 to 1974
- ○ 1960 to 1969
- ○ 1950 to 1959
- ○ 1940 to 1949
- ○ 1939 or earlier

H19. When did the person listed in column 1 move into this house (or apartment)?

- ○ 1979 or 1980
- ○ 1975 to 1978
- ○ 1970 to 1974
- ○ 1960 to 1969
- ○ 1950 to 1959
- ○ 1949 or earlier
- ○ Always lived here

H20. How are your living quarters heated?
Fill one circle for the kind of heat used most.

- ○ Steam or hot water system
- ○ Central warm-air furnace with ducts to the individual rooms *(Do not count electric heat pumps here)*
- ○ Electric heat pump
- ○ Other built-in electric units *(permanently installed in wall, ceiling, or baseboard)*
- ○ Floor, wall, or pipeless furnace
- ○ Room heaters with flue or vent, burning gas, oil, or kerosene
- ○ Room heaters without flue or vent, burning gas, oil, or kerosene *(not portable)*
- ○ Fireplaces, stoves, or portable room heaters of any kind
- ○ No heating equipment

H21a. Which fuel is used most for house heating?

- ○ Gas: from underground pipes serving the neighborhood
- ○ Gas: bottled, tank, or LP
- ○ Electricity
- ○ Fuel oil, kerosene, etc.
- ○ Coal or coke
- ○ Wood
- ○ Other fuel
- ○ No fuel used

b. Which fuel is used most for water heating?

- ○ Gas: from underground pipes serving the neighborhood
- ○ Gas: bottled, tank, or LP
- ○ Electricity
- ○ Fuel oil, kerosene, etc.
- ○ Coal or coke
- ○ Wood
- ○ Other fuel
- ○ No fuel used

c. Which fuel is used most for cooking?

- ○ Gas: from underground pipes serving the neighborhood
- ○ Gas: bottled, tank, or LP
- ○ Electricity
- ○ Fuel oil, kerosene, etc.
- ○ Coal or coke
- ○ Wood
- ○ Other fuel
- ○ No fuel used

H22. What are the costs of utilities and fuels for your living quarters?

a. Electricity
$ _____ .00 *Average monthly cost* OR
- ○ Included in rent or no charge
- ○ Electricity not used

b. Gas
$ _____ .00 *Average monthly cost* OR
- ○ Included in rent or no charge
- ○ Gas not used

c. Water
$ _____ .00 *Yearly cost* OR
- ○ Included in rent or no charge

d. Oil, coal, kerosene, wood, etc.
$ _____ .00 *Yearly cost* OR
- ○ Included in rent or no charge
- ○ These fuels not used

H23. Do you have complete kitchen facilities? *Complete kitchen facilities are a sink with piped water, a range or cookstove, and a refrigerator.*

- ○ Yes
- ○ No

H24. How many bedrooms do you have?
Count rooms used mainly for sleeping even if used also for other purposes.

- ○ No bedroom
- ○ 1 bedroom
- ○ 2 bedrooms
- ○ 3 bedrooms
- ○ 4 bedrooms
- ○ 5 or more bedrooms

H25. How many bathrooms do you have?
A complete bathroom is a room with flush toilet, bathtub or shower, and wash basin with piped water.

A half bathroom has at least a flush toilet or bathtub or shower, but does not have all the facilities for a complete bathroom.

- ○ No bathroom, or only a half bathroom
- ○ 1 complete bathroom
- ○ 1 complete bathroom, plus half bath(s)
- ○ 2 or more complete bathrooms

H26. Do you have a telephone in your living quarters?

- ○ Yes
- ○ No

H27. Do you have air conditioning?

- ○ Yes, a central air-conditioning system
- ○ Yes, 1 individual room unit
- ○ Yes, 2 or more individual room units
- ○ No

H28. How many automobiles are kept at home for use by members of your household?

- ○ None
- ○ 1 automobile
- ○ 2 automobiles
- ○ 3 or more automobiles

H29. How many vans or trucks of one-ton capacity or less are kept at home for use by members of your household?

- ○ None
- ○ 1 van or truck
- ○ 2 vans or trucks
- ○ 3 or more vans or trucks

CENSUS USE

H22a.

H22b.

H22c.

H22d.

FOR YOUR HOUSEHOLD **Page 5**

Please answer H30–H32 if you live in a one-family house which you own or are buying, unless this is --

- **A mobile home or trailer** . . . . . .
- **A house on 10 or more acres** . . . . . .
- **A condominium unit** . . . . . .
- **A house with a commercial establishment or medical office on the property** . . . . .

If any of these, or if you rent your unit or this is a multi-family structure, skip H30 to H32 and turn to page 6.

H30. What were the real estate taxes on this property last year?

$ _____ .00 OR ○ None

H31. What is the annual premium for fire and hazard insurance on this property?

$ _____ .00 OR ○ None

H32a. Do you have a mortgage, deed of trust, contract to purchase, or similar debt on this property?

- ○ Yes, mortgage, deed of trust, or similar debt
- ○ Yes, contract to purchase
- ○ No — *Skip to page 6*

b. Do you have a second or junior mortgage on this property?

○ Yes ○ No

c. How much is your total regular monthly payment to the lender?
Also include payments on a contract to purchase and to lenders holding second or junior mortgages on this property.

$ _____ .00 OR ○ No regular payment required — *Skip to page 6*

d. Does your regular monthly payment (amount entered in H32c) include payments for real estate taxes on this property?

- ○ Yes, taxes included in payment
- ○ No, taxes paid separately or taxes not required

e. Does your regular monthly payment (amount entered in H32c) include payments for fire and hazard insurance on this property?

- ○ Yes, insurance included in payment
- ○ No, insurance paid separately or no insurance

Please turn to page 6

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	1	2	3	4	5	6	7
S.S. Yes ○ No ○							
2.							
4.							
GQ.							
H30.							
H31.							
H32c.							

Page 6 *ANSWER THESE QUESTIONS FOR*

Name of Person 1 on page 2:
Last name | First name | Middle initial

11. In what State or foreign country was this person born?
Print the State where this person's mother was living when this person was born. Do not give the location of the hospital unless the mother's home and the hospital were in the same State.

Name of State or foreign country; or Puerto Rico, Guam, etc.

12. *If this person was born in a foreign country –*
a. Is this person a naturalized citizen of the United States?
- ○ Yes, a naturalized citizen
- ○ No, not a citizen
- ○ Born abroad of American parents

b. When did this person come to the United States to stay?
- ○ 1975 to 1980
- ○ 1965 to 1969
- ○ 1950 to 1959
- ○ 1970 to 1974
- ○ 1960 to 1964
- ○ Before 1950

13a. Does this person speak a language other than English at home?
- ○ Yes
- ○ No, only speaks English – *Skip to 14*

b. What is this language?
(For example – Chinese, Italian, Spanish, etc.)

c. How well does this person speak English?
- ○ Very well
- ○ Well
- ○ Not well
- ○ Not at all

14. What is this person's ancestry? *If uncertain about how to report ancestry, see instruction guide.*
(For example: Afro-Amer., English, French, German, Honduran, Hungarian, Irish, Italian, Jamaican, Korean, Lebanese, Mexican, Nigerian, Polish, Ukrainian, Venezuelan, etc.)

15a. Did this person live in this house five years ago (April 1, 1975)?
If in college or Armed Forces in April 1975, report place of residence there.
- ○ Born April 1975 or later – *Turn to next page for next person*
- ○ Yes, this house – *Skip to 16*
- ○ No, different house

b. Where did this person live five years ago (April 1, 1975)?
(1) State, foreign country, Puerto Rico, Guam, etc.:
(2) County:
(3) City, town, village, etc.:
(4) Inside the incorporated (legal) limits of that city, town, village, etc.?
- ○ Yes
- ○ No, in unincorporated area

16. When was this person born?
- ○ Born before April 1965 – *Please go on with questions 17-33*
- ○ Born April 1965 or later – *Turn to next page for next person*

17. In April 1975 *(five years ago)* **was this person –**
a. On active duty in the Armed Forces? ○ Yes ○ No
b. Attending college? ○ Yes ○ No
c. Working at a job or business?
- ○ Yes, full time ○ No
- ○ Yes, part time

18a. Is this person a veteran of active-duty military service in the Armed Forces of the United States?
If service was in National Guard or Reserves only, see instruction guide.
- ○ Yes
- ○ No – *Skip to 19*

b. Was active-duty military service during –
Fill a circle for each period in which this person served.
- ○ May 1975 or later
- ○ Vietnam era *(August 1964–April 1975)*
- ○ February 1955–July 1964
- ○ Korean conflict *(June 1950–January 1955)*
- ○ World War II *(September 1940–July 1947)*
- ○ World War I *(April 1917–November 1918)*
- ○ Any other time

19. Does this person have a physical, mental, or other health condition which has lasted for 6 or more months and which . . .

	Yes	No
a. Limits the kind or amount of work this person can do at a job?	○	○
b. Prevents this person from working at a job?	○	○
c. Limits or prevents this person from using public transportation?	○	○

20. *If this person is a female –*
How many babies has she ever had, not counting stillbirths?
Do not count her stepchildren or children she has adopted.

None ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 ○ 11 ○ 12 or more ○

21. *If this person has ever been married –*
a. Has this person been married more than once?
- ○ Once
- ○ More than once

b. Month and year of marriage? *(Month) (Year)*
Month and year of first marriage? *(Month) (Year)*

c. *If married more than once –* **Did the first marriage end because of the death of the husband (or wife)?**
- ○ Yes
- ○ No

22a. Did this person work at any time last week?
- ○ Yes – *Fill this circle if this person worked full time or part time. (Count part-time work such as delivering papers, or helping without pay in a family business or farm. Also count active duty in the Armed Forces.)*
- ○ No – *Fill this circle if this person did not work, or did only own housework, school work, or volunteer work.*

Skip to 25

b. How many hours did this person work last week (at all jobs)?
Subtract any time off; add overtime or extra hours worked.
Hours

23. At what location did this person work last week?
If this person worked at more than one location, print where he or she worked most last week.
If one location cannot be specified, see instruction guide.

a. Address *(Number and street)*
If street address is not known, enter the building name, shopping center, or other physical location description.

b. Name of city, town, village, borough, etc.

c. Is the place of work inside the incorporated (legal) limits of that city, town, village, borough, etc.?
- ○ Yes
- ○ No, in unincorporated area

d. County

e. State **f. ZIP Code**

24a. Last week, how long did it usually take this person to get from home to work (one way)?
Minutes

b. How did this person usually get to work last week?
If this person used more than one method, give the one usually used for most of the distance.
- ○ Car
- ○ Truck
- ○ Van
- ○ Bus or streetcar
- ○ Railroad
- ○ Subway or elevated
- ○ Taxicab
- ○ Motorcycle
- ○ Bicycle
- ○ Walked only
- ○ Worked at home
- ○ Other – *Specify*

If car, truck, or van in 24b, go to 24c. Otherwise, skip to 28.

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Per. No.	11.	13b.	14.	15b.	23. ○ VL	24a.
1	⊘ ⊘ ⊘ / 1 1 1	⊘ ⊘ ⊘ / 1 1 1	⊘ ⊘ ⊘ / 1 1 1	⊘ ⊘ ⊘ / 1 1 1	⊘ ⊘ ⊘ / 1 1 1	⊘ ⊘ / 1 1
2	2 2 2	2 2 2	2 2 2	2 2 2	2 2 2	2 2
3	3 3 3	3 3 3	3 3 3	3 3 3	3 3 3	3 3
4	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4
5	5 5 5	5 5 5	5 5 5	5 5 5	5 5 5	5 5
6	6 6 6	6 6 6	6 6 6	6 6 6	6 6 6	6 6
7	7 7 7	7 7 7	7 7 7	7 7 7	7 7 7	7 7
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	9 9 9	9 9 9	9 9 9	9 9 9	9 9 9	9 9

PERSON 1 ON PAGE 2

c. When going to work last week, did this person usually —

- ○ Drive alone — *Skip to 28*
- ○ Drive others only
- ○ Share driving
- ○ Ride as passenger only

d. How many people, including this person, usually rode to work in the car, truck, or van last week?

- ○ 2
- ○ 3
- ■
- 4
- 5
- 6
- 7 or more

After answering 24d, skip to 28.

25. Was this person temporarily absent or on layoff from a job or business last week?

- Yes, on layoff
- Yes, on vacation, temporary illness, labor dispute, etc.
- No

26a. Has this person been looking for work during the last 4 weeks?

- Yes
- No — *Skip to 27*

b. Could this person have taken a job last week?

- No, already has a job ■
- No, temporarily ill
- No, other reasons *(In school, etc.)*
- Yes, could have taken a job ■

27. When did this person last work, even for a few days?

- 1980
- 1979
- 1978
- 1975 to 1977
- 1970 to 1974
- 1969 or earlier
- Never worked

Skip to 31d

28–30. Current or most recent job activity

Describe clearly this person's chief job activity or business last week.
If this person had more than one job, describe the one at which this person worked the most hours.
If this person had no job or business last week, give information for last job or business since 1975.

28. Industry

a. For whom did this person work? *If now on active duty in the Armed Forces, print "AF" and skip to question 31.*

(Name of company, business, organization, or other employer)

b. What kind of business or industry was this?
Describe the activity at location where employed.

(For example: Hospital, newspaper publishing, mail order house, auto engine manufacturing, breakfast cereal manufacturing)

c. Is this mainly — *(Fill one circle)*

- Manufacturing ■
- Wholesale trade
- Retail trade
- Other — *(agriculture, construction, service, government, etc.)*

29. Occupation

a. What kind of work was this person doing?

(For example: Registered nurse, personnel manager, supervisor of order department, gasoline engine assembler, grinder operator)

b. What were this person's most important activities or duties?

(For example: Patient care, directing hiring policies, supervising order clerks, assembling engines, operating grinding mill)

30. Was this person — *(Fill one circle)*

- Employee of private company, business, or individual, for wages, salary, or commissions ■
- Federal government employee
- State government employee
- Local government employee *(city, county, etc.)*
- Self-employed in own business, professional practice, or farm —
  - Own business not incorporated
  - Own business incorporated
- Working without pay in family business or farm

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21b. I II III IV

22b.

28. A B C D E F G H J K L M AF NW

29. N P Q R S T U V W X Y Z

31a. Last year (1979), did this person work, even for a few days, at a paid job or in a business or farm?

- ○ Yes ■
- ○ No — *Skip to 31d*

b. How many weeks did this person work in 1979?
Count paid vacation, paid sick leave, and military service.

_____ Weeks

c. During the weeks worked in 1979, how many hours did this person usually work each week?

_____ Hours

d. Of the weeks not worked in 1979 (if any), how many weeks was this person looking for work or on layoff from a job?

_____ Weeks

32. Income in 1979 —

Fill circles and print dollar amounts.
If net income was a loss, write "Loss" above the dollar amount.
If exact amount is not known, give best estimate. For income received jointly by household members, see instruction guide.

During 1979 did this person receive any income from the following sources?

If "Yes" to any of the sources below — **How much did this person receive for the entire year?**

a. Wages, salary, commissions, bonuses, or tips from all jobs . . . *Report amount before deductions for taxes, bonds, dues, or other items.*

- Yes → $ _____ .00 *(Annual amount – Dollars)*
- No

b. Own nonfarm business, partnership, or professional practice . . . *Report net income after business expenses.*

- ■
- Yes → $ _____ .00 *(Annual amount – Dollars)*
- No

c. Own farm. . .
Report net income after operating expenses. Include earnings as a tenant farmer or sharecropper.

- Yes → $ _____ .00 *(Annual amount – Dollars)*
- No

d. Interest, dividends, royalties, or net rental income . . .
Report even small amounts credited to an account.

- Yes → $ _____ .00 *(Annual amount – Dollars)*
- No

e. Social Security or Railroad Retirement . . .

- ■
- Yes → $ _____ .00 *(Annual amount – Dollars)*
- No

f. Supplemental Security (SSI), Aid to Families with Dependent Children (AFDC), or other public assistance or public welfare payments . . .

- Yes → $ _____ .00 *(Annual amount – Dollars)*
- No

g. Unemployment compensation, veterans' payments, pensions, alimony or child support, or any other sources of income received regularly . . .
Exclude lump-sum payments such as money from an inheritance or the sale of a home.

- ■
- Yes → $ _____ .00 *(Annual amount – Dollars)*
- No

33. What was this person's total income in 1979?

Add entries in questions 32a through g; subtract any losses.

$ _____ .00 *(Annual amount – Dollars)*

If total amount was a loss, write "Loss" above amount.

OR ○ None

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31b. 31c. 31d.

32a. 32b. 32c. 32d. 32e. 32f. 32g. 33.