TRANSPORTATION RESEARCH BOARD 1974

CENSUS DATA AND URBAN TRANSPORTATION PLANNING

proceedings of a conference held in Albuquerque, New Mexico, August 21-23, 1973

subject areas
55 traffic measurements
81 urban transportation administration

SPECIAL REPORT 145
TRANSPORTATION RESEARCH BOARD
National Research Council
Washington, D.C., 1974

NOTICE

The conference that is the subject of this report was approved by the Governing Board of the National Research Council acting in behalf of the National Academy of Sciences. Such approval reflects the Governing Board's judgment that the conference is of national importance and appropriate with respect to both the purposes and resources of the National Research Council.

The members of the committee selected to organize the conference and to supervise the preparation of this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project.

Responsibility for the selection of the participants in the conference and for any summaries or recommendations in this report rests with that committee. The views expressed in individual papers and attributed to the authors of those papers are those of the authors and do not necessarily reflect the view of the committee, the Transportation Research Board, the National Academy of Sciences, or the sponsors of the project.

Each report issuing from such a conference of the National Research Council is reviewed by an independent group of qualified individuals according to procedures established and monitored by the Report Review Committee of the National Academy of Sciences. Distribution of the report is approved by the President of the Academy upon satisfactory completion of the review process.

The National Research Council is the principal operating agency of the National Academy of Sciences and the National Academy of Engineering, serving government and other organizations. The Transportation Research Board evolved from the 54-year-old Highway Research Board. The TRB incorporates all former HRB activities but also performs additional functions under a broader scope involving all modes of transportation and the interactions of transportation with society.

Transportation Research Board Special Report 145
International Standard Book Number 0-309-02276-2
Library of Congress Catalog Card Number 74-7863
Printed 1974. Price $3.20

Transportation Research Board publications may be ordered directly from the Board. They are also obtainable on a regular basis through organizational or individual supporting membership in the Board; members or library subscribers are eligible for substantial discounts. For further information write to the Transportation Research Board, National Academy of Sciences, 2101 Constitution Avenue N.W., Washington, D.C. 20418.

CONTENTS

CONFERENCE SUMMARY

In 1970, the Highway Research Board (now Transportation Research Board) sponsored a conference on the use of the data from the 1970 census in the transportation planning process. Those data were subsequently tabulated and have been used by several planning agencies. At its meeting in January 1973, the Board's Committee on Transportation Information and Data requirements felt that, before plans advanced for the 1980 census, there would be value in reviewing the process for tabulating the data, hearing reports on experiences in using these data, evaluating how useful or adequate the data are for transportation planning, and recommending improvements for consideration by the Bureau of the Census and the U.S. Department of Transportation in future programs.

The conference was attended by approximately 70 professionals working in census and transportation planning activities. Three sessions were devoted to discussions of the Urban Transportation Planning Package (UTPP), which contains tabulations of the 1970-census socioeconomic and journey-to-work data; reports of user experiences; and suggestions for future direction. Two sessions were devoted to workshops for developing recommendations regarding the type of data collected and the use of those data by planning agencies.

URBAN TRANSPORTATION PLANNING PACKAGE

Manka described procedures used to code responses to the place-of-work question, which, in the 1970 census, required specific street addresses. (The 1960 census, the first to include a place-of-work question, required only city or county identification.) Data for approximately 40 million persons in 250,000 enumeration districts were coded. The Federal Highway Administration provided specifications for the tabulation of the data. The format of the 43 tables as well as the questions asked in the various census samples is given in the appendix to this report. Manka also discussed the ratio-estimation procedures used in weighting the sample data, and the appendix to his paper includes details of those procedures.

Fleet offered the following suggestions for incorporating census data into the urban transportation planning process: (a) as a basis for socioeconomic data to generate trips with existing models in the development of new trip generation models or the refinement of old ones and (b) in the comparison of updated land use and socioeconomic data. He points out that some of the limitations of the UTPP data include the degree of coding of the place of work to block level; differences in definition between census journey-to-work data and origin-destination trip data; timing of census data in relation to the continuing transportation planning needs; and geographic area coverage sampling, and method of expansion of census data. Some of the early tests and applications, which the FHWA has sponsored and are reported in this report, indicate that the census already is proving to be a valuable data source and that additional applications will further demonstrate the utility of census data.

USER EXPERIENCES

In 1972 the Federal Highway Administration initiated several projects to test the usefulness of census data in transportation planning. Reports were given at the conference on projects in Rhode Island, New Mexico, Delaware, and New York. Although not given at the conference, a report from California is included to give additional information on experiences with the use of census data.

Sosslau reported that, in the Rhode Island project, census data were to be compared with data from origin and destination surveys conducted by the state in 1961 and 1971. Conducted by the COMSIS Corporation in cooperation with the Rhode Island Department of Transportation, the project is expected to indicate (a) the accuracy achieved by using census data to update base-year data in developing average daily traffic by link via traffic assignment; (b) how the 3 methods tested for obtaining network loads compare to the average daily traffic resulting from a new origin-destination survey; and (c) what problem areas are uncovered in using census data to develop network loads, and what solutions are found for guidance to other users.

The Albuquerque, New Mexico, study was conducted by the Middle Rio Grande Council of Governments in cooperation with the New Mexico State Highway Department. The UTPP data were coded to 450 zones and included socioeconomic and travel data for approximately 315,000 persons. Davenport and Howell reported that the study found that the UTPP data augments local data but cannot at this time be used as the sole basis for transportation planning. Improvements required are complete trip and zone-to-work tables, external-to-internal work trips, and a peak-traffic model.

Carter reported on the Wilmington, Delaware, study that is to produce a multimodal transportation plan for that SMSA. The first phase determined whether UTPP data could be used to satisfy trip generation equations and to develop modal-split models. The conclusion is that the package worked for the Wilmington region, but 6 man-months were required to make it do so. Major shortcomings are (a) non-residential trip data are not provided; (b) the sample population and dwelling unit data are subject to expansion errors; (c) precise counts are given only if there are 2 or fewer automobiles; (d) zip coding for employment is inadequate; and (e) the trip table is virtually useless because of problems in matching the attraction to the related production.

The Tri-State Regional Planning Commission has planning responsibility for portions of 3 states—Connecticut, New York, and New Jersey—and for 11 SMSAs. Boswell reported that the first problem the staff encountered in using the UTPP data was the lack of inter-SMSA coding of trips. To obtain something more flexible, the commission and the census bureau developed a worker file, which is a series of tapes containing for each worker in the region a record of 20 data items about the worker and his or her household and coded to the finest geography possible. This file is a rich source of data and the only source of detailed regionwide travel data available until the 1890 census.

By July 1973, the California Department of Transportation had received UTPP data for only 3 of its 17 SMSAs and had made only preliminary analysis of their usefulness. Brown reports that the problems encountered related to (a) time lag caused largely by the restriction of a 5-digit code for analysis zones and resulting in the creation of 2

sets of geographic correspondence tables that precluded computer coding and (b) zip codes, two-thirds of which were erroneously listed in that they conflicted with the county code or did not exist at all. Recommendations are that (a) trip tables be stratified by factors such as income, structure type, and automobile availability as well as by travel mode; (b) employment be stratified by a 2-digit SIC code; (c) median as well as mean income be given; and (d) a grand total of subtotals in Parts I, II, and III be given.

FUTURE DIRECTION

In the future, Carroll suggested that we need (a) better coding machinery including programs to edit coding guides, techniques to go from written addresses to block faces or tracts by machine, and better areal measures and coordinate coding; (b) improved data mapping programs; (c) a national coordinate coding framework, possibly based on the block and the aggregation of blocks into various sized units; (d) a means of using census bureau skills to update automobile ownership and trip-making data and to sample public opinion on critical issues, possibly in the Current Population Survey; (e) more nonresidential land use data; (f) more information on goods movement and intercity travel; and (g) a working committee to further use of census data and to advise the census bureau on planning needs.

Turner reported that in planning for the 1980 census, the census bureau expects to consider (a) stronger resources for coding work addresses and expanded resources for coding incomplete responses and those not covered by coding guides; (b) computer or manual method of coding workplace addresses; and (c) centralized or decentralized coding operation. He emphasized the importance to the census bureau of receiving as soon as possible evaluation reports from agencies that have used the 1970-census data and traffic zone equivalencies from local transportation planning groups.

Ben reported the results of a telephone survey conducted on the use of the UTPP—112 urbanized areas had ordered the package at the time of the conference. With regard to the 1980 census, he suggested that (a) the journey-to-work question be rephrased to elicit a greater response; (b) geographic coverage of journey-to-work coding be expanded to SMSAs and to multi-SMSAs in large regions; (c) coding resources be significantly enhanced; and (d) data processing be quicker.

RECOMMENDATION WORKSHOPS

The workshop sessions included discussions of experiences and requirements of census data users and a review of a questionnaire that was distributed to conference participants. Questions pertained to both short-range and long-range data uses. Short-range questions were as follows:

1. How might we determine the best way to resolve the differences (and the impact of those differences) between census definitions and origin-destination survey definitions, particularly area boundary, worker, work trip, and mode categories?
2. Which of these is the greatest stumbling block to more effective use of the UTPP?
3. Are we getting sufficient information on the quality of UTPP data, particularly geocoding quality, in advance of purchase? If not, what is needed? How can that be accomplished?
4. Do special recoding arrangements make sense? What about procedures, costs, and timing?
5. Is speeding up the delivery process important? How might that be accomplished?
6. How can the experience of users best be shared and communicated? User groups? Conferences? Newsletters? What should be prime topics?
7. What experience in special tabulation requests beyond the UTPP is significant? How can that process be improved?
8. Has the UTPP reduced costs of building a data base, or has it represented an

increment to overall program costs? What has it replaced? What can it replace?

Long-range questions were as follows:

1. How can we accomplish better state and urban input and dialog on the content and structure of the data tabulations?
2. Would a household unit-record file (similar to an origin-destination file), perhaps based on the 1 in 100 census file, be of value? Is it feasible? What are the disclosure and technical requirements?
3. Can the Continuing Population Survey be applied to transportation data needs? What would be the most valuable product? What other census surveys can be applied?
4. What additional items would be most beneficial in the journey-to-work portion of the population survey? Nonwork trips? Trip start and end times? Expanded mode categories? Changes in definitions?
5. How crucial is comparability among 1960, 1970, and 1980 censuses? Are expanded data more valuable?
6. What kind of continuing planning process is required between now and 1980 to ensure a better product? How can the census bureau be involved in that process?
7. Has the importance of geocoding been overemphasized? How can local expertise and source materials be used to improve the quality of future products? What other improvements are necessary?
8. How important are costs? Are more effective funding structures possible?

The recommendations that were developed by the workshops and presented in this report deal with different aspects of the preparation and use of the census Urban Transportation Planning Package. Altogether they emphasize the overwhelming consensus of the conference: Far greater federal-local communication and joint planning are required if present and future programs are to be useful.

RECOMMENDATIONS

Near-Term Recommendations

1. COMMUNICATION

The experience of earlier users of the 1970 journey-to-work data can be invaluable to other users or agencies considering the purchase of the data. The timely communication of experience as well as who the users are is essential. The following actions will facilitate this communication.

The Data User Services Office of the Bureau of the Census assisted by the U.S. Department of Transportation should (a) regularly issue a journey-to-work newsletter devoted to user experiences with and evaluations of the data, data processing methodology, and data utilization; (b) prepare and maintain a directory of user agencies including the name and telephone number of the key person at each user agency; (c) collect and distribute to users all other information relevant to the use of the data including technical reports and notices of meetings or conferences in related areas; and (d) organize regular meetings at which discussions among users can take place.

The Transportation Research Board should devote a special session at its annual meetings for review and evaluation of the use of the journey-to-work data.

The TRB Committee on Transportation Information Systems and Data Requirements should plan a future conference on the use of census data for urban transportation planning.

2. NATIONAL AND STATEWIDE ANALYSIS

The census journey-to-work data are comparable from region to region and state to state. This comparability and compatability open the way for comparative analysis not possible with the unique data sets of the ad hoc transportation planning agencies. Comparative research and analysis should be undertaken at the national level. Further, state transportation departments that are in the

stage of defining their data needs and processes should undertake to review and investigate these data at the statewide level.

3. USEFULNESS OF UTPP

Transportation planning agencies have collected extensive data on which their transportation planning process is based. A major question for each of these agencies is how to maintain the utility and the timeliness of these data without periodically having to collect an entirely new data base at great expense.

Transportation planning agencies that undertook origin-destination surveys during the 1969-1971 period should obtain the Urban Transportation Planning Package (UTPP) and (a) carry out a definitive study of the comparability among the data items contained in the UTPP and those collected as part of the origin-destination survey and (b) once the level of comparability has been determined, evaluate the usefulness of the UTPP in updating the base-year origin-destination data file.

4. RECODE OPTION

The proportion of work destinations of the journey-to-work trips that have been coded to block varies from region to region because of differences in Address Coding Guide (ACG) coverage, reporting, and possibly unique characteristics of each region.

If an agency has determined that the percentage of workers coded to the detail necessary is too low to permit meaningful analysis or use, it should be given the opportunity to request a listing of work trips that were coded at the work-trip end to Universal Area Code (UAC), zip code, or not in SMSA. Using its own staff (sworn in as unpaid census bureau employees), the local agency should identify these to the appropriate transportation zones. This information should then be incorporated in a new tabulation of the UTPP and made available to the agency. The requesting agency should bear any additional cost that the census bureau incurs in this process.

5. UTPP PURCHASE CONDITIONS

Potential shortcomings in the degree of completeness and precision of geographic coding and definitional differences in the census journey-to-work data may require the would-be user to invest a significant amount of time and manpower in analyzing and adjusting the data before direct use can be made of them.

Therefore, the decision to purchase the UTPP should be made (a) on an individual-region basis, (b) only after careful review of all available prepurchase information on the expected quality of the data for that region, and (c) for use as a definite element in the work program such as for research, updating, or an alternative data source.

6. TECHNICAL SUPPORT

The resources available to users in individual areas for research and evaluation of the usefulness of the census journey-to-work data in the ongoing transportation planning process are severely limited in many regions. Moreover, for each region to individually undertake such analysis would involve needless duplication.

The Urban Planning Division of the Federal Highway Administration should (a) provide to user studies, especially in small areas, expanded technical support that includes assistance in using the journey-to-work data in meeting planning requirements and information on experiences in other areas; (b) examine the feasibility of making available to the user computer processing methodologies that include rapid graphic display of data; and (c) discourage the purchases of the journey-to-work data if such support is not feasible.

7. SPECIAL TABULATIONS

The UTPP does not provide journey-to-work data in flexible form. In addition, having these data nationwide in an economical form would be of value. The preparation of a worker file, similar to that proposed by the Tri-State Regional Planning Commission (see paper by Boswell in this report), could meet these needs.

Consideration should be given either (a) to preparing worker files for all metropolitan areas with funds provided by the U.S. Department of Transportation or (b) to preparing worker files for individual metropolitan areas with funds provided by local users. The Bureau of the Census should prepare cost estimates and technical specifications for use as guides in the preparation of worker files for both alternatives.

Long-Term Recommendations

1. GEOCODING

Problems associated with geographic coding and geographic identification are paramount. They relate to improving coding precision in 1980, better defining the coding area for a given city, developing better systems for identifying areas outside block coding areas, and increasing the emphasis on the importance of geocoding.

The Bureau of the Census should use the experience and knowledge of local personnel in coding addresses for each city. Mechanisms should be developed to permit local assistance, particularly on special-generator addresses. Census disclosure problems regarding addresses should be carefully reconsidered.

The Bureau of the Census should centralize its address-coding responsibility within the agency to overcome the coordination problem encountered in 1970 when many census units had joint jurisdiction.

The format for recording addresses of work should be evaluated to ensure the capability to record special-generator addresses effectively. Expanded use of X-Y coordinates should be considered in 1980 both in coding and presenting journey-to-work data.

Extensive analysis should focus on problems outside the block coding areas, including substitutes for the Universal Area Code, multiple SMSA in a single region, codes for work trips going into the SMSA from outside, and predefinition of coding boundaries.

2. MODIFICATION OF ITEMS OF DATA

Modification is needed to the structures of questions and the items of data.

The automobile count question should be restructured to obtain the actual number of automobiles without use of the open-ended category.

The code categories for mode of travel to work should be restructured to include change-mode trips. Motorcycle and bicycle modes should be considered for inclusion.

Review and revision are required of the definition of worker and work trip and should include consideration of part-time and multiple-job situations.

3. NEW ITEMS OF DATA

Further evaluation and continuing analyses are required to ensure that the most productive new data items are added, but the following should receive primary consideration.

The work trip must be identified by time—departure, arrival, or elapsed time of travel or all of these—for the effective analyses of peak-hour travel.

Nonwork trips should be included either as a total or by detailed mode and destination data for certain purposes such as school trips.

The type of land use at the work place should be recorded for work trips.

4. ADMINISTRATION AND PROCESSING

Processing should be streamlined in 1980 to increase census response times and reduce costs.

Consideration should be given to centralized funding of the process by the U.S. Department of Transportation.

Expanded prepurchase information on the quality of the UTPP should be available to prospective users.

An expanded battery of user-oriented supporting software should be developed with extensive tabulation, statistical, and graphical capability. Included in this battery should be the capability of responding to special requirements, e.g., the worker file established for the Tri-State Regional Planning Commission.

5. ORGANIZATION FOR 1980 PLANNING

To enhance effective communication and coordination between local and federal agencies, a working committee should be established and be composed of representatives of the U.S. Department of Transportation, the Bureau of the Census, and state and local agencies. The committee's responsibilities and functions should include (a) coordination of experience in the use of the existing package; (b) support and guidance of a newsletter and other communications; (c) guidance and review of the 1980 preplanning efforts including solicitation of input from local users; (d) guidance to the investigation of potential alternative transportation data collection methods, e.g., Continuous Population Survey and National Travel Survey; and (e) development of plans for further conferences. The census bureau should designate a transportation program liaison person who is knowledgeable regarding all census transportation-related matters.

CONFERENCE PAPERS

CONCEPTS AND PROCEDURES USED IN TABULATING 1970-CENSUS DATA FOR THE URBAN TRANSPORTATION PLANNING PACKAGE

Paul T. Manka, U.S. Bureau of the Census

Urban transportation planning is a continuing process that requires constant monitoring of urban growth. The changes produced by this growth require a periodic revision of transportation plans.

In response to the request from many urban transportation studies for 1970-census place-of-work data, the Federal Highway Administration (FHWA) submitted tabulation specifications to the Bureau of the Census for the compilation of both socioeconomic and journey-to-work data from the 15- and 20-percent-sample data (Appendix C in this paper explains the sample design) for traffic zones in standard metropolitan statistical areas (SMSA). The standardized tabulations contained in this 1970-census Urban Transportation Planning Package (UTPP) were designed to provide a common data base for transportation studies in the country and reduce processing costs for such tabulations.

This paper focuses on the concepts of the 1970 Census of Population and Housing as they relate to the UTPP, the procedures used to code the place-of-work data for the 15 percent sample, the processing steps involved in tabulating these data by traffic zone, and the limitations of these data for use in the transportation planning process.

PLACE-OF-WORK QUESTION: CONCEPTS AND CODING PROCEDURE

The place-of-work question, which is shown in Figure 1, was asked of all persons 14 years old and over in the 15 percent sample of the population. Working persons included all persons who responded to question 29a that they worked during the reference week March 22-28, 1970.

Place of work referred to the geographic location at which civilians and military personnel who were not on leave carried out their occupational or job activities. The 1960 census was the first census to include an inquiry on place of work. However, in that census, the identification of place of work was limited to county and city. For 1970, a more specific address (number and street name) was asked because the recent development of computerized

address coding guides (ACG) gave the census bureau the capability to code properly completed place-of-work responses to the census tract-block level.

Respondents and enumerators were given detailed instructions for answering the place-of-work question (Appendix A in this paper). The place-of-work coding operation involved approximately 250,000 enumeration districts (ED) containing data for approximately 40 million persons and 13.7 million housing units.

IMPLICATIONS OF PLACE-OF-WORK CODING PROCEDURES FOR TRANSPORTATION PLANNERS

As explained in Appendix A, the detailed place-of-work coding operation (i.e., place of work coded to census tract and block) was limited to those SMSA residents who reported place-of-work addresses that could be located within the ACG boundaries for their respective SMSA or within a commuter-shed SMSA. (A commuter shed is an area containing at least 2 contiguous SMSAs that in 1960 had at least 7.5 percent of the work force in 1 SMSA commuting from home to work in the adjoining SMSA.) In effect, the detailed place-of-work coding excluded those SMSA residents who

1. Did not report any place-of-work addresses,
2. Did not report their places of work in sufficient detail,
3. Reported place-of-work addresses outside the SMSA and not in a contiguous commuter-shed SMSA, or
4. Reported place-of-work addresses not contained in the place-of-work coding guide that the census coders used.

Given these exclusions, not every worker could be coded to census-block level. Figure 2 shows a typical ACG boundary in relation to the central city of an SMSA, its urbanized area, and the SMSA boundary. Since the place-of-work coding guide (which was prepared from the ACG) was the only tool that the census bureau had to assign a tract-block census code to a place-of-work address, those SMSA residents working in the SMSA outside of the ACG area were coded to zip code (ZC) and the Universal Area Code (UAC) only for place of work.

Because many urban transportation planners define their traffic zones in terms of groupings of blocks, they will have to allocate to their work-trip matrix both those workers who did not report places of work and those workers who were not coded to the block level. Because the extent of the geographic coverage of the place-of-work coding guide varied from one SMSA to another, the Users' Service Staff of the census bureau's Data User Services Office computed the percentages of work trips coded to the block level for each SMSA. This percentage was based on available census processing records and was calculated according to the following formula:

$$\frac{\text{(number of workers whose place-of-work responses were coded to tract-block level)}}{\text{(number of workers residing in the SMSA)}}$$

For commuter-shed SMSAs, the number of workers coded to block level included workers commuting from an adjoining SMSA, and that resulted in an inflation of this percentage. The actual percentage of workers coded to the tract-block level could not be known for these SMSAs until the 1970-census UTPP tabulations had begun. Therefore, this percentage is only intended to be used as a general indicator of the completeness of the census work-trip table from a transportation planner's viewpoint.

A percentage of 100 could be achieved if and only if all addresses within the SMSA were included within the place-of-work coding guide and all 15-percent-sample persons reported a complete place-of-work address. In reality, however, the percentage of SMSA residents whose place-of-work responses were coded to the block level ranged from 25 to 85 percent.

In summary, the percentage of workers coded to the tract-block level for a given SMSA provides a valuable indicator of the usability of the work trip table in the 1970-

Figure 1. Place-of-work question in the 1970 census.

QUESTIONS 29 THROUGH 41 ARE FOR ALL PERSONS BORN BEFORE APRIL 1956 INCLUDING HOUSEWIVES, STUDENTS, OR DISABLED PERSONS AS WELL AS PART-TIME OR FULL-TIME WORKERS

29a. Did this person work at any time last week?

○ Yes— *Fill this circle if this person did full- or part-time work. (Count part-time work such as a Saturday job, delivering papers, or helping without pay in a family business or farm; and 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 30*

29c. Zip Code

b. How many hours did he work last week (at all jobs)?
Subtract any time off and add overtime or extra hours worked.

○ 1 to 14 hours ○ 40 hours
○ 15 to 29 hours ○ 41 to 48 hours
○ 30 to 34 hours ○ 49 to 59 hours
○ 35 to 39 hours ○ 60 hours or more

29c. Street Code or UAC

c. Where did he work last week?
If he worked in more than one place, print where he worked most last week.
If he travels about in his work or if the place does not have a numbered address, see instruction sheet.

(1) Address *(Number and street name)* _____

(2) Name of city, town, village, etc. _____

(3) Inside the limits of this city, town, village, etc.?
○ Yes
○ No

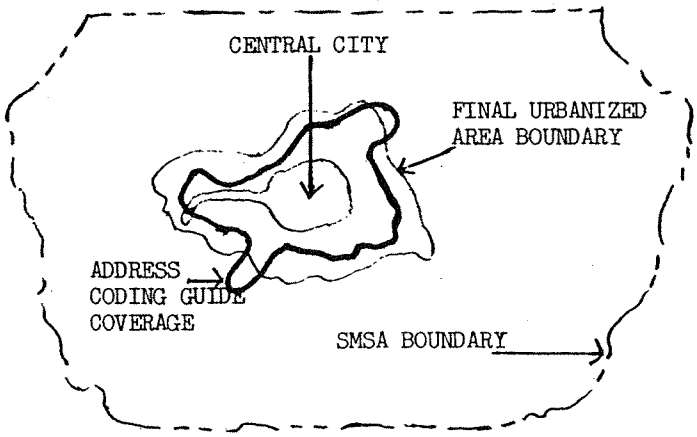
(4) County _____

(5) State _____ (6) ZIP Code _____

29c. House Number Only

Make 'no mark in this margin

Figure 2. Place-of-work coding guide coverage.



census Urban Transportation Planning Package.

PROCESSING STEPS IN THE 1970-CENSUS URBAN TRANSPORTATION PLANNING PACKAGE

Before proceeding with the UTPP tabulation for a given SMSA, the Users' Service Staff had the local transportation planners specify approximately 10 to 15 areas outside of, but adjacent to, the SMSA as place-of-work destinations and identify them in terms of the census UAC scheme. This modification allowed place-of-work data to be tabulated for only those SMSA residents' external trips that are of interest to the local transportation planners. In the final data tabulation, employment data for both those SMSA residents who did not report places of work and those SMSA residents who reported places of work outside the SMSA in an unspecified UAC are reported in pseudo traffic zone 99998.

Eight computer programs involving 3 intermediate processing steps produce the final data tables for the transportation planning package.

Computer program 1 strips only those data that will be shown in the data tables from the 1970-census sample basic record tape (BRT) for residents of an SMSA. (Figure 3 shows the flow chart of processing programs.) This program produces 2 output tape files:

1. A stripped data file that contains the shortened basic records (this shortened BRT contains either 15- or 20-percent-sample data), and
2. A geocode file that contains a list of unduplicated census geographic codes (tract-block, ED, ZC, and UAC) appearing on each sample basic record regarding both household residence and place of work.

Computer program 1a produces a set of tallies that show the number of SMSA residents and the level to which their place-of-work responses have been coded for each listed UAC. Specifically, program 1a produces a printout that shows the number of workers

1. Who reside in the SMSA,
2. Whose place-of-work responses are coded to census tract-block level,
3. Whose place-of-work responses are coded to the ZC level,
4. Whose place-of-work responses are coded to a specified UAC only,
5. Whose places of work are outside the SMSA and are not in any specified UAC, and
6. Who did not report places of work.

Program 1a tallies are first compared with the corresponding place-of-work data shown in Table P-2, "Social Characteristics of the Population," in the PHC(1) census-tract report for that SMSA. Agreement of data from program 1a with Table P-2 data ensures that the stripped data file does, in fact, contain sample data for every worker residing in that SMSA. These worker-tally printouts are then sent with the census area-traffic zone equivalency printouts to the local planners. (Examples of both printouts are given in Appendix B in this paper.)

Computer program 2 takes the geocode file and sorts its geographic codes into the following sequence: state, SMSA, county, UAC, ZC, ED, and tract-block. The output from this program is then used to produce the census area-traffic zone equivalency printout, which is sent to the local transportation planners for the assignment of traffic zones.

Each line of the census area-traffic zone equivalency printout contains the county code, a maximum of 6 geographic codes with a space allocated for the assignment of the corresponding traffic zone code, and a serial number (Fig. 4, Appendix B). This serial number is the only means by which the locally assigned traffic zone codes can be linked to each census geocode.

While the census area-traffic zone equivalency printouts were being completed,

many local transportation planners raised the following questions:

1. Since the ZC, ED, and UAC may encompass many traffic zones, should we assign them traffic zone codes on the census area-traffic zone equivalency printout?
2. Why are some of the census tract-block numbers that are listed on the census area-traffic zone equivalency printout not shown on the 1970-census Metropolitan Map Series (MMS) for the urbanized area?
3. Why are some blocks containing population counts in the HC(3) block statistics report not listed on the census area-traffic zone equivalency printout?

In response to question 1, because not all place-of-work responses could be coded to tract-block level, both the ZC and UAC listed on the census area-traffic zone equivalency printout represent place-of-work data that must be shown in some fashion in the final data tabulation. Therefore, we have suggested that local transportation planners assign pseudo traffic zone numbers to such areas so that these data may be tabulated separately. We have found that this procedure facilitates analysis and possible allocation of these data to legitimate traffic zones. Also, because in most areas only the urbanized area and its immediate vicinity have census blocks identified, this procedure results in residential information for workers living in the rural portion of the SMSA being shown on the sample BRT at the lowest possible census geographic level, i.e., the enumeration district.

In response to question 2, there are 4 possible explanations for those tract-block codes that are listed in the census area-traffic zone equivalency printout and not shown on the published 1970 MMS for an urbanized area.

1. If the tract-block code is an impossible or nonexistent census tract-block combination, the error probably resulted from the place-of-work coding operation. As stated earlier, this coding operation used the locally prepared 1970 ACG to code place-of-work responses to the tract-block level. Consequently, any tract-block errors contained in the ACG would be reflected in the data coded to tract-block level. Generally, the processing records concerning such errors, which might have been discovered subsequent to the 1970 census, have been maintained by the local planning groups who revised and edited the 1970-census ACG.
2. Some of the MMS sheets were necessarily block-numbered in their entirety. This was done prior to the definition of the potential extent of the urbanized area that coincided with the final blocked area. Subsequently when the limits of these areas were defined, many of the rural block numbers were eliminated from the revised MMS sheets. These block numbers were deleted from the place-of-residence geocodes on the sample BRT, and the identified ED was retained as the lowest geographic code. However, the place-of-work codes on the sample BRT were not revised to reflect these changes.
3. Prior to the final publication of the MMS with the HC(3) block statistics report for an urbanized area, the original maps were revised by the Geography Division of the census bureau. As part of this process, nonexistent streets were deleted. Whenever a deleted street was a block boundary, the blocks adjoining this boundary would be merged to form one block on the revised map. This new block would then assume the lowest block number of the merged blocks; e.g., when blocks 120 and 123 were merged, the new block is shown on the revised metropolitan map as block 120. In a few cases, the coding for the ACG was not revised to reflect this change. Therefore, place-of-work data coded to block 123 on the sample BRT in some cases would be shown as block 123 on the census area-traffic zone equivalency printout, but block 123 would not be shown on the revised map.
4. Although all the revisions made to MMS sheets mentioned above were made to the appropriate place-of-residence geocodes on the sample BRT, some households in certain census tracts had either a nonexistent block code or some other inconsistency in its block coding. For such cases, we instructed the local transportation planners to allocate those households that had a pseudo block code 999 to a zone within that census tract, for we knew that such households were actually contained in that tract.

After receiving written notification regarding those blocks that the local transportation planners could not locate on the revised MMS sheets, the bureau's Geography Division has been able to determine the location of many of the unmapped blocks mentioned in points 2 and 3 above by referring to census processing records.

In regard to question 3, many transportation planners mistakenly thought that the census area-traffic zone equivalency printout is a complete listing of all tract-ED or tract-block codes for their SMSA. This is not true because as mentioned earlier the data input used to produce these census area-traffic zone equivalency printouts are the basic record tapes that contain individual household and person data from the sample portion of the 1970 Census of Population and Housing. The housing unit, including all its occupants, was the sampling unit in this census. Therefore, those census blocks or EDs that either had no sample households or did not contain a coded place-of-work destination could not be included in the census area-traffic zone equivalency listing produced from the sample BRT. (Appendix C gives a detailed discussion regarding the sampling procedure and accuracy of these sample data.)

After local transportation planners have resolved all of the problems regarding geocoding discrepancies on the census area-traffic zone equivalency printout, they complete their assignments of traffic zone codes to the census area-traffic zone equivalency printouts and then return them to the census bureau. When the printouts containing these locally assigned traffic zones are received, the zones listed on each line are punched into cards with the corresponding serial number.

Computer program 3 matches the serial number of each punchcard with the census area-traffic zone equivalency file and creates a new reference file that associates a traffic zone to each census area. A printout of this reference file is then sent to the sponsor for final verification of the traffic zone assignments.

After final approval is received from the sponsor, computer program 4 uses the reference file created in the previous program and writes the appropriate traffic zone identification for both residence and place of work on each household and person record contained on the shortened BRT. The output of this program is a new stripped BRT file with traffic zone identification only on each record. Computer program 5 tallies the data on the short BRT by traffic zone; program 6 produces both a printout and a data tape file; and program 7 copies the data file as well as the FHWA display program onto a computer tape that is sent to the local transportation planners. (The display program is discussed in the 1970-Census Urban Transportation Planning Package: Summary Tape Technical Documentation, which is reprinted in the appendix to this report.)

As of the end of July 1973, data tabulations were completed for 50 SMSAs and in progress for 63 SMSAs located in 33 states. Partially because the runs of the traffic zone package had to be carried out in such a way as not to interfere with the ongoing census publication tabulations and other decennial processing operations, the average length of time to complete the 1970-census UTPP data tabulations for a given SMSA was approximately 6 months from the receipt of funds. However, approximately 3 months of this time was used by the local transportation planning groups to complete and review the census area-traffic zone equivalency printout.

Census bureau policy states that, if a secondary or subsequent request is received for the traffic zone data tabulation for a given SMSA, the latter requester will be referred to the initial sponsor. If the initial customer cannot supply a copy of the data, the bureau will then provide the copy and prorate the original cost accordingly between the parties. After a 6-month period has expired following initial delivery of the tabulations, they may be made available by the bureau to requesters at cost of reproduction.

DATA CONTAINED IN THE 1970-CENSUS URBAN TRANSPORTATION PLANNING PACKAGE

The data provided in the UTPP tabulations are divided into 4 parts. (Detailed data items are listed in the 1970-Census Urban Transportation Planning Package: Summary Tape Technical Documentation, which is reprinted in the appendix to this report.)

1. Part I has 26 tables that contain socioeconomic and demographic data. Data regarding age, race, sex, school enrollment, employment, and income are given for both persons and heads of households. In addition, data regarding household size, household income, type of structure, and number of automobiles available are given for housing units. Part I tables are produced for each traffic zone of residence in the SMSA. Many of the data given in these tables have already been released by the bureau in either published or computer tape form for census tracts and larger geographic areas. This special tabulation was designed for traffic zones, which in many cases are smaller than the smallest census geographic areas for which these data are published.

Since by law (Title 13, U.S. Code) the census bureau cannot issue any statistics that might identify or indirectly disclose the identity or characteristics of an individual, no other information except total population will be given in these tables for a given traffic zone of residence containing fewer than 33 persons (weighted estimate). Therefore, when a particular traffic zone contains fewer than 33 persons, only the total population will be given in Table 1A-2 and the remainder of the tables will have zeros in each cell. A test of this disclosure rule on actual package output indicates that only a very small number of residence zones (about 5 percent) may be affected by this confidentiality regulation (1).

2. Part II contains 12 tables that give detailed cross tabulations of some of the socioeconomic variables contained in Part I and a 3-way cross tabulation of 2 socioeconomic variables and means of transportation to work. Because the remaining parts of the package vary in length according to the number of zones, Part II data are placed first in the computer file and in the data printout. There is only one set of Part II tabulations per urbanized area in an SMSA.

3. Part III contains 4 tables that give labor force status, occupation, industry, and class of worker for persons age 16 years old and over by zone of work within the SMSA. Until 1970, the estimates provided in these tables were usually obtained from secondary sources. This is the first time that the census bureau has compiled employment characteristics by zone of work. Therefore, users of these data should exercise caution in their analyses. The weights used for the zone-of-work employment data were based on the demographic characteristics of the residential area of the workers and were not designed for weighting employment data at the work site. As a result, it is possible that these employment data may be inaccurate. The data are given for pseudo traffic zones (i.e., ZC and UAC), and local planners may have to exert considerable effort to allocate them to the appropriate zone of work. Therefore, whenever possible, these employment figures should be verified by data from other sources, such as state and local agencies.

4. Part IV contains the work-trip table that gives the number of workers making trips from a given zone of residence to a zone of work by the modes of transportation. The utility of such tables for a given SMSA is affected, of course, by the accuracy of the place-of-work responses and by the percentage of place-of-work responses that could be coded to the tract-block level. The categories "other" and "worked at home" (means of transportation categories) were combined into "other" in this table in order to meet the bureau's confidentiality requirements. Work trips were coded to pseudo zone 99998 if they were made to areas outside of the SMSA that were not specified by the local planners and if they did not have place of work reported.

ACCURACY OF THE TRAFFIC ZONE DATA

The data input used for the 1970-census UTPP is the sample records from the 1970 Census of Population and Housing. Appendix C of this paper gives for each table in the package the sample base and, hence, the weighting that applies to the items contained in each data table. Even complete-count items such as age, race, sex, etc., are tabulated from the 20-percent-sample questionnaires. As a result, only weighted estimates of the total population for these variables appear in the final data tabulations, and these may differ slightly from the corresponding complete counts.

Although the sample design of the 1970 census and the ratio estimation procedures

employed in collecting and weighting the sample data are discussed in detail in Appendix C of this paper, their key concepts are briefly reviewed here.

The statistics based on sample data are estimates made through the use of ratio-estimation procedures, applied separately for the 15 and 20 percent samples. The first step in carrying through these ratio estimates was to establish the areas within which separate ratios were to be prepared. These are referred to as sample weighting areas. A single set of weighting areas, containing a minimum population size of 2,500, was defined for use with both the 15 and 20 percent samples. These weighting areas were established by a computer operation and were defined to conform, as nearly as possible, to areas for which tabulations are produced.

In general, sample estimates for a tract may be expected to agree with complete counts whenever the tract is a weighting area. However, tracts are not weighting areas if the population is less than 2,500 persons, if the tract is a part of more than one county subdivision or place, or if the census procedure is not the same in all parts of the tract. In these situations part of a tract may be combined with other partial or complete tracts to make up a weighting area. Consequently, sample estimates for an individual tract in the combination may not agree with complete counts of population or housing units. Separate ratio-estimation processes were used for both persons and for housing units, and a unique weight was assigned to each household and every sample person, i.e., each person or household in the 20 percent sample does not necessarily have a weight of 5.

Many traffic zones are smaller than sample weighting areas, and the sampling variability for statistics compiled for such traffic zones will be greater than that for a geographic area comprising one or more complete sample weighting areas. In brief, this is due both to the nature of the smaller sample for each zone and the fact that the sample data weights were not designed for weighting subareas of the sample weighting areas. Data given in Table 1 illustrate the sample-weighting-area concept as it applies to census tracts in Sacramento, California.

In tracts 0008 through 0012, the discrepancy between the sample and the complete-count data is noticeable because each tract contained fewer than 2,500 persons and they were combined to form a single sample weighting area. However, if the sample data for these tracts are aggregated, they agree with the aggregated 100 percent data for these tracts.

From this discussion, we can conclude that the transportation planner, in order to maximize the reliability of these sample data, should try to minimize the number of zones within a given sample weighting area and to avoid combining data from several sample weighting areas into a single traffic zone.

Given the considerations stated above, the zone-of-residence data contained in Parts I and II of the traffic zone tabulation constitute an excellent primary source of data for the transportation planning process. Such data can be used to validate similar data developed from the local information system and to check and calibrate the home-to-work trip generation equation. General improvement in the accuracy of coding place-of-work responses to small geographic areas, viz., tract-block geographic levels, is needed to make the data shown in Parts III and IV of the 1970-census UTPP more useful to local transportation planners. Both the Federal Highway Administration and the Bureau of the Census seek recommendations from local planners on how to improve the utility of such place-of-work data for urban transportation planning.

REFERENCE

1. U.S. Census Bureau Urban Transportation Planning Package. Federal Highway Administration, FHWA Notice, April 18, 1972.

Figure 3. Processing stages of census data in the transportation package.

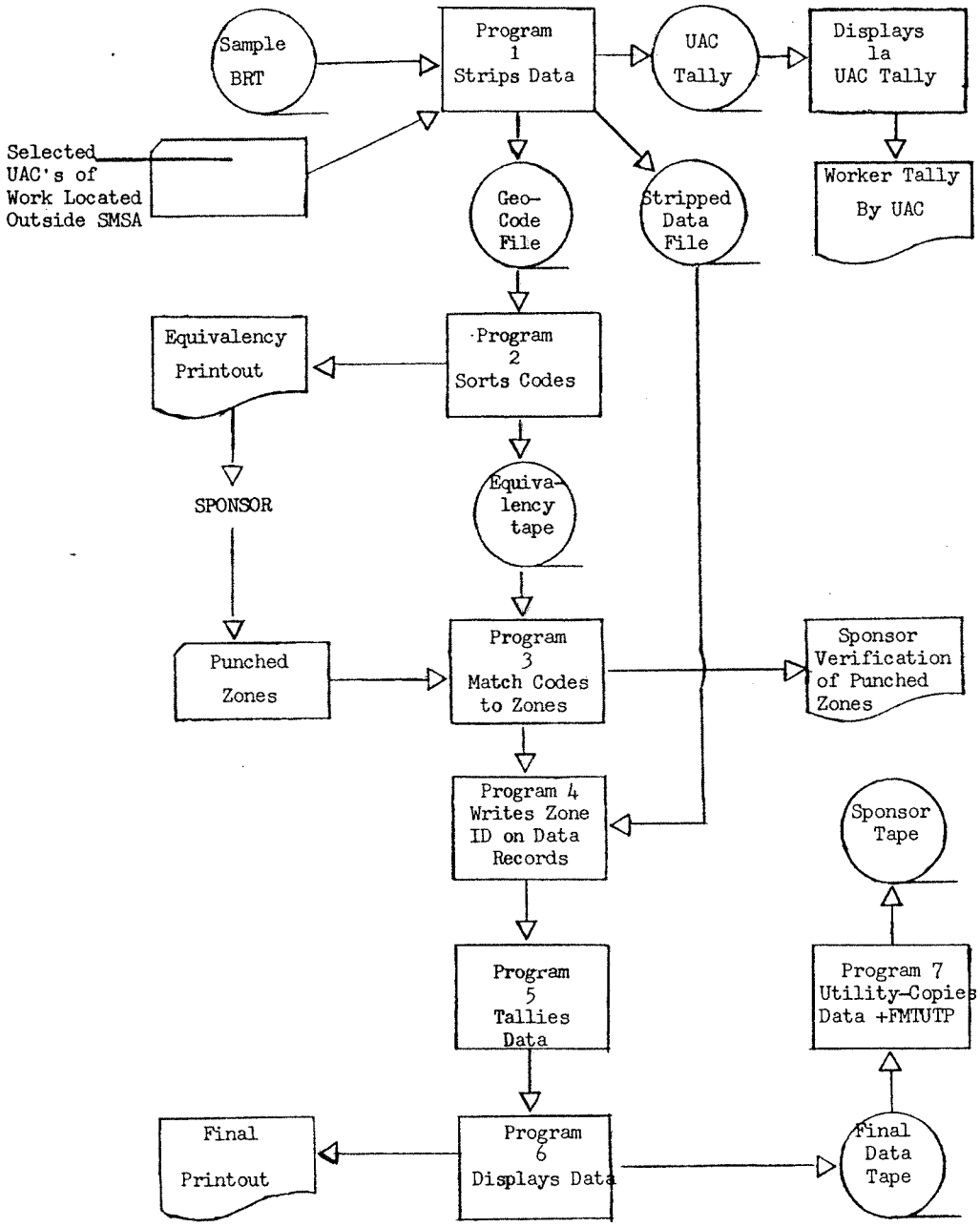


Table 1. Comparison of complete population and housing unit counts and sample weighted estimates.

	Population		Housing	
Tract	Complete (Table P-1)	Sample (Table P-2)	Complete (Table H-1)	Sample (Table H-2)
0008	377	374	321	328
0009	121	101	99	98
0010	120	78	82	68
0011	1,081	1,251	800	812
0012	2,955	2,850	2,294	2,290
Total	4,654	4,654	3,596	3,596

Source: PHC(1) 178 census tract report.

APPENDIX A: INSTRUCTIONS AND CODING PROCEDURES FOR PLACE-OF-WORK AND MEANS-OF-TRANSPORTATION INFORMATION

Respondents and enumerators were given detailed instructions for answering the place-of-work question. Some of the particular situations covered by these instructions are given below.

1. Persons who worked at more than one job are reported at the location of the job at which they worked the greatest number of hours during the reference week.
2. Salesmen, deliverymen, and others who worked in several places each week or traveled are reported as working at the address at which they began work each day or at the address of the central headquarters to which they were responsible.
3. For cases in which daily work was not begun at a central place each day, the place reported is the address at which the person worked most hours during the reference week. If the employer operated in more than one location or branch (such as a grocery store chain or public school system), the exact location or branch where the person worked is entered.
4. When the number or street name cannot be given, the name of the building or the name of the company for which the person worked is asked.
5. For persons who worked offshore or as an officer or crew member on a vessel and who did not report to a central headquarters, the words "at sea" are entered on line 1 and the remainder of question 29c is left blank.
6. If the person worked in a foreign country or a U.S. possession during the reference week, the name of the country or possession is entered on line 5 and the rest of the question is left blank.

Coding Procedures for Place of Work

The entries for question 29c were manually coded by clerks in the census bureau's Jeffersonville, Indiana, processing center. The place-of-work codes were entered by using the Film Optical Sensing Device for Input to Computer (FOSDIC) to mark circles in the first 2 or all 3 coding boxes printed next to question 29 on each person-page of the 15-percent-sample questionnaire. The code boxes and the purposes for which they were primarily used are shown in Figure 1.

All work addresses were first classified into 2 major categories according to the residence of the person reporting. Specific coding procedures were prescribed for groups within each major category. The major categories and the groups within them were as follows:

1. Persons residing in EDs not located within the limits of an SMSA were assigned to group A; and
2. Persons residing in EDs located within the limits of an SMSA were assigned to Group A if they worked outside the SMSA, to group B if they worked inside the SMSA and within that portion of the SMSA covered by the ACG, and to group C if they worked inside the SMSA but outside the area covered by the ACG.

The FOSDIC clerical coding procedure for persons in group A involved placing 00000 in the upper box and the UAC in the middle box and leaving the lower box blank (Fig. 1). The 5-digit UAC identified state, county, SMSA, central cities, other places of 20,000 or more in 1960 or at a subsequent special census, and selected minor civil divisions. For persons in group B, the zip code for workplace was entered in the upper box, the ACG street code indicating the name of the street was entered in the middle box, and the structure or house number of the workplace was entered in the lower box. For persons in group C, the ZC and the UAC were entered in the upper and middle boxes respectively and the lower box was left blank.

The place-of-work coding pattern for groups A, B, and C is given in Table 2. When

Table 2. Place-of-work coding.

Place-of-Work Coding Group	Place of Residence: Inside SMSA: Inside ACG Area	Place of Residence: Inside SMSA: Outside ACG Area	Place of Residence: Outside SMSA	Place of Work: Inside SMSA: Inside ACG Area	Place of Work: Inside SMSA: Outside ACG Area	Place of Work: Outside SMSA
A (00000/UAC)	X					X[a]
		X				X[a]
			X			X
			X		X	
			X	X		
B (ZC/street code/house no.)	X			X		
		X		X		
C (ZC/UAC)	X				X	
		X			X	

[a]If the place-of-work is located in another SMSA that is a commuter-shed SMSA, the response is coded according to either group B or group C procedures.

Figure 4. Census area-traffic zone equivalency printout.

TRAFFIC ZONES FOR SMSA STATE PAGE 1

COUNTY	UAC	ZONE	UAC	ZONE	UAC	ZONE	UAC	ZONE	UAC	ZONE	UAC	ZONE	SERIAL
028	85022	*1005											000018
031	85024	*1006											000026
043	85031	*1007											000034

COUNTY	ZIP	ZONE	ZIP	ZONE	ZIP	ZONE	ZIP	ZONE	ZIP	ZONE	ZIP	ZONE	SERIAL
043	87004	*1007	87041	*1007	87048	*1007	87104	*1007	87107	*1007	87124	*1007	000042

TRAFFIC ZONES FOR SMSA 0200 STATE 35 PAGE 13

COUNTY	TRACT	ED	ZONE	ED	ZONE	ED	ZONE	ED	ZONE	ED	ZONE	ED	ZONE	SERIAL
001	000701	0323	*8221											000232
001	000702	0322B	*8312											000240
001	0008	0337	*8441											000257
001	0037	0281	*7301											000265
001	0038	0001	*3001	0002	*3002	0003	*3003							000273
001	0039	0342	*3004	0343	*3005									000281
001	0040	0334	*5421											000299
001	004701	0300	*6402											000307
001	004702	0315	*5503											000315
001	0048	0339	*3006	0340	*3007	0341	*3008							000323

TRAFFIC ZONES FOR SMSA 0200 STATE 35 PAGE 14

COUNTY	TRACT	BLOCK	ZONE	BLOCK	ZONE	BLOCK	ZONE	BLOCK	ZONE	BLOCK	ZONE	BLOCK	ZONE	SERIAL
001	000101	101	*7443	102	*7443	103	*7443	104	*7443	105	*7443	106	*7443	000331
001	000101	108	*7443	109	*7443	111	*7443	112	*7443	113	*7445	114	*7445	000349
001	000101	115	*7445	116	*7445	117	*7445	118	*7445	119	*7445	120	*7445	000356
001	000101	121	*7445	122	*7445	123	*7445	124	*7445	125	*7445	126	*7445	000364
001	000101	127	*7445	128	*7445	129	*7445	130	*7445	131	*7445	132	*7445	000372
001	000101	201	*7445	202	*7445	203	*7445	204	*7445	205	*7445	206	*7435	000380
001	000101	207	*7435	208	*7435	209	*7435	210	*7435	211	*7435	213	*7431	000398
001	000101	214	*7431	215	*7431	216	*7431	217	*7431	218	*7431	219	*7431	000406
001	000101	220	*7431	221	*7431	222	*7431	223	*7431	224	*7431	225	*7431	000414
001	000101	226	*7431	227	*7431	228	*7431	229	*7431	230	*7431	231	*7431	000422
001	000101	301	*7432	302	*7432	303	*7432	304	*7432	305	*7432	306	*7432	000430
001	000101	307	*7432	308	*7432	309	*7432	310	*7432	311	*7432	312	*7432	000448
001	000101	313	*7434	314	*7434	315	*7434	316	*7434	317	*7434	318	*7434	000455
001	000101	319	*7434	320	*7434	321	*7442	325	*7441	327	*7441			000463
001	000102	101	*7453	114	*7454	118	*7454	119	*7454	120	*7454	121	*7454	000471
001	000102	123	*7454	124	*7454	125	*7454	127	*7454	128	*7454	129	*7454	000489
001	000102	201	*7451	203	*7451	204	*7451	205	*7451	206	*7451	207	*7451	000497
001	000102	208	*7451	209	*7451	210	*7451	214	*7451	215	*7451	216	*7451	000505
001	000102	219	*7452	301	*7452	302	*7452	303	*7452	304	*7452	305	*7452	000513
001	000102	306	*7452	307	*7452	308	*7463	309	*7463	310	*7463	311	*7463	000521
001	000102	312	*7463	313	*7463	314	*7463	315	*7463	316	*7463	317	*7463	000539
001	000102	318	*7463	319	*7463	322	*7463	323	*7463	324	*7463	325	*7463	000547
001	000102	326	*7463	327	*7463	328	*7463	330	*7464	331	*7464	401	*7464	000554
001	000102	402	*7464	403	*7464	404	*7464	405	*7464	406	*7464	407	*7464	000562
001	000102	408	*7464	409	*7464	410	*7464	411	*7464	412	*7464	413	*7464	000570
001	000102	416	*7464	417	*7464	418	*7464	419	*7464	420	*7464	421	*7461	000588
001	000102	422	*7461	423	*7461	424	*7461	425	*7461	426	*7461	427	*7461	000596

an SMSA resident reported a place-of-work address in an adjoining SMSA that was part of a commuter shed, his response was coded according to either group-B or group-C procedures. A commuter shed is an area containing at least 2 contiguous SMSAs that in 1960 had at least 7.5 percent of the work force in one SMSA commuting from homes into the adjoining SMSA. When place-of-work coding began, the commuter-shed definition was applied to any SMSA that received 7.5 percent of its work force from one or more adjoining SMSAs or had at least 7.5 percent of its employed workers commuting to adjoining SMSAs to work. In March 1971, because of time and budget strictures, this definition was narrowed to include only those SMSAs receiving workers.

The coding clerks were provided, as needed, with ACGs, telephone directories, national zip code directories, and lists for assigning UAC numbers for places of work shown as military installations, colleges or universities, or place names. If the information contained in the response to question 29c was insufficient to allow coding by reference to one or more directories or if the entries were blank, the coder referred to question 33a (For whom did he work?) to see whether an employer's name was listed there. If there was an entry, the clerk looked for this name in appropriate telephone directories to secure an address that could be coded. The clerks followed a decision logic chart. Doubtful cases or cases that could not be coded on the basis of information available to the clerks were referred to technical assistants for resolution.

Before any computer processing was begun on the data described above, the records for the worker were edited according to the following criteria:

1. The worker is in the 15 percent sample;
2. The worker's data record has an employment status recode that indicates that he is in fact a civilian or a member of the armed forces "at work";
3. The worker resided within an SMSA or selected non-SMSA counties; and
4. Clerical coding of the worker's place-of-work address is sufficient—i.e., a coded entry is in the zip code, street, and house number field.

Criteria 1 and 2 eliminated those person records that by definition did not have place-of-work data. Those worker records meeting criteria 1 and 2 but not qualifying on residence or containing sufficient address information as described above were assumed to be clerically coded to a place of work based on the UAC or ZC/UAC.

For those sample basic records meeting all of the criteria shown above, a worker's "finder" record was created. This computer file was matched to the ACG files for the appropriate SMSA on the basis of the coded ZC, street, and house number. Census geographic information obtained from this match was added to the worker's sample basic record, i.e., UAC, tract code, block number, and central business district indicator for his place-of-work response. If a match was not made, the worker codes were allocated by using the following priority:

1. Odd/even house number failure,
2. House number out of range,
3. Zip code and street match only,
4. Zip code match only, and
5. Complete mismatch.

Since the match was made as far as possible before an allocation occurred, the allocation was based on the area of match. For example, if a match for only ZC and street name was made, a line for that street from the ACG was randomly selected within that ZC, the place-of-work codes were assigned from this line (i.e., UAC, tract code, block number, and CBD), and an allocation code 3 was assigned to that record. Allocation code 5 occurred most frequently for those persons with missing digits in the zip code field. Such cases were first automatically recoded to 00000 and then distributed at random among "good" zip codes over the entire area (SMSA or commuter shed). Since there was no "not reported" category for these records, all the finder records were given legitimate place-of-work codes resulting either from a complete match or an allocation.

Coding Procedures for Means of Transportation to Work

Another important variable in the urban transportation planning process is the means of transportation to work. Question 29d was asked of all persons 14 years old and over in the 15 percent sample of the population who were reported working during the reference week:

d. How did he get to work last week? *Fill one circle for chief means used on the last day he worked at the address given in 29c.*

- ○ Driver, private auto
- ○ Passenger, private auto
- ○ Bus or streetcar
- ○ Subway or elevated
- ○ Railroad
- ○ Taxicab
- ○ Walked only
- ○ Worked at home
- ○ Other means—*Specify* _____

After completing question 29d, skip to question 33.

In completing this question, the respondents were asked to indicate the chief means of travel or types of conveyance used in traveling to and from work on the last day they worked at the addresses given in entries for item 29c (place of work). The "chief means" referred to the means of transportation covering the greatest distance if more than one means was used. "Worked at home" was entered for persons who worked on a farm where they lived or in an office or shop in their homes. If none of the means seemed appropriate, "other means" was checked and the type of transportation (such as truck, pickup truck, or bicycle) was specified.

A similar question was asked in 1960. However, the data for 1960 and 1970 are not entirely comparable because the 1960 data on means of transportation to work referred to the "last week" rather than to the "last day." Also a distinction was made in 1970 between the driver and the passenger of an automobile.

There was no manual office coding of this item. However, if the specified other means could be interpreted as one of the means listed (for instance, a company-operated station wagon used to pick up employees could be classified as a bus), the entry was changed by edit clerks in the field offices. Remaining entries for other means were tabulated as such, but the written-in entries were not coded or separately tabulated.

Nonresponses were allocated by the computer. The general procedure for allocating nonresponses was to assign an entry that was consistent with entries for other persons with similar characteristics who had reported means of transportation to work.

Number of Automobiles Available

Question H23 was asked for all of those occupied housing units covered in the 15 percent sample. This question was identical to the corresponding 1960 item.

H23. How many passenger automobiles are owned or regularly used by members of your household?
Count company cars kept at home.

- ○ None
- ○ 1 automobile
- ○ 2 automobiles
- ○ 3 automobiles or more

The automobiles reported for 1970 were passenger cars, including station wagons, that were owned or regularly used and ordinarily kept at home. Company cars were included if they were used regularly and kept at home, and rented or leased vehicles were reported if the contract was for a month or more. The cars of all members of the household were counted, including those belonging to lodgers or other nonrelatives living in the unit. The following vehicles were excluded: taxicabs, pickups or larger

trucks, dismantled or dilapidated cars in an early stage of being junked, or immobile cars used only as a source of power for some piece of machinery.

An occupied housing unit that had no response recorded for this question was allocated the response recorded for the preceding occupied housing unit. The allocation rate for this item at the U.S. level was approximately 3.7 percent.

Acknowledgment

Much of the material in this appendix was taken from Chapter 8, "Processing the Data," in 1970 Census of Population and Housing: Procedural History.

APPENDIX B: EXAMPLES OF CENSUS AREA-TRAFFIC ZONE EQUIVALENCY AND WORKER-TALLY PRINTOUTS

Census Area-Traffic Zone

A section of a census area-traffic zone equivalency printout with assigned zones for the Albuquerque, New Mexico, SMSA is shown in Figure 4. Transportation planners assigned a traffic zone code to each census area shown in this printout.

Worker Tally

The worker-tally printout (Table 3) lists the number of workers residing in the Albuquerque SMSA as distributed by the coded census geographic level for each reported place-of-work address. Data are shown for the total SMSA and separately for each UAC on the printout.

The first column lists the 5-digit UAC, the second column lists the total number of workers, the third column lists the number of workers coded to block level, the fourth column lists the number of workers coded to ZC level, the fifth column lists the number of workers coded to UAC level only, and the sixth column lists the number of workers not working in the SMSA and not reporting places of work.

The first row lists the distribution of the total number of workers residing in the SMSA, and the second row lists the distribution of workers residing in the SMSA but not working in the SMSA or any of the other listed UACs. The remaining rows list the distribution of workers for that UAC, and the last row lists the number of workers residing in the SMSA and not reporting places of work.

Since the place-of-work question was asked of only 15 percent of all households, the numbers shown on this printout have been expanded by a variable weight for each worker's household to the complete count (100 percent) level; e.g., a raw total of 15 workers would be weighted such that they might be shown as 100 workers. Therefore, the total number of workers shown for an SMSA is comparable to the numbers shown in Table P-2 in the PHC(1) Census-tract report for that SMSA.

APPENDIX C: SAMPLING AND ESTIMATION PROCEDURES

This appendix describes the 1970-census sampling and estimation procedures and their implications for the use of statistics tabulated by traffic zones. Also included is a discussion of the sampling variability of the statistics included in this report and a method of approximating their standard errors.

Sample Design

For persons living in housing units at the time of the 1970 census, the housing unit, including all its occupants, was the sampling unit. For persons living in group quarters identified in advance of the census, the sampling unit was the person. In nonmail areas, the enumerators canvassed their assigned area and listed all housing units in address registers sequentially in the order in which they first visited the units whether or not they completed the interviews. Every fifth line of the address register was designated as a sample line, and the housing units listed on those lines were included in the sample. Each enumerator was given a random line on which he or she was to start listing, and the order of canvassing was indicated in advance, although the instructions allowed some latitude in the order of visiting addresses. In mail areas, the list of housing units was prepared prior to the census day either by employing commercial mailing lists corrected through the cooperation of the Postal Service or by listing the units in a process similar to that used in nonmail areas. As in other areas, every fifth housing unit of these lists was designated to be in the sample. In group quarters, all persons were listed, and every fifth person was selected for the sample.

This 20 percent sample was subdivided into a 15 percent and a 5 percent sample by designating every fourth 20-percent-sample unit as a member of the 5 percent sample. The remaining sample units became the 15 percent sample. Two types of sample questionnaires were used, one for the 5-percent-sample and one for the 15-percent-sample unit. Some questions were included on both the 5-percent-sample and 15-percent-sample forms and, therefore, appear for a sample of 20 percent of the units in the census. Other items appeared on either the 15 percent or the 5 percent questionnaires.

An item collected on one sample rate may have been tabulated on a smaller basis. (The rate for tabulation is given in Table 7.) Only 20-percent- and 15-percent-sample statistics are included in the traffic zone tabulations.

Although the sampling procedure did not automatically ensure an exact 20 percent sample of persons or housing units in each locality, the sample design was unbiased if carried through according to instructions; generally for large areas the deviation from 20 percent was found to be quite small. Biases may have arisen when enumerators failed to follow the listings and sampling instructions exactly. Quality control procedures were used throughout the census process, however. Where there was clear evidence that the sampling procedures were not properly followed, the work was returned to the field for resampling. No attempt at sampling was made for the relatively small number of persons and housing units (in most states, less than 1 percent) added to the enumeration from the post-census Postal Service check, the various supplemental forms, and the special check of vacant units. The ratio-estimation procedure described below adjusts the sample data to reflect these classes of population and housing units.

Ratio Estimation

The statistics based on 1970-census sample data are estimates made through the use of ratio-estimation procedures, applied separately for the 15 and 20 percent samples. The first step in carrying through the ratio estimates was to establish the areas within which separate ratios were to be prepared. These are referred to as "weighting areas." A single set of weighting areas, containing a minimum population size of 2,500, was defined for use with the 15 and 20 percent samples. Weighting areas were established by the computer and were defined to conform, as nearly as possible, to areas for which tabulations are produced. In general, sample estimates for a tract may be expected to agree with complete counts whenever the tract was a weighting area. However, tracts were not weighting areas if the population was less than 2,500 persons, if the tract was a part of more than one county subdivision or place, or if the census procedure was not the same in all parts of the tract. In these situations, part of a tract may have been combined with other partial or complete tracts to make up a weighting area, and sample estimates for an individual tract in the combination may not agree with complete counts for the tract. Similarly, a traffic zone is generally a part or a combination of

parts of a weighting area so that statistics tabulated by traffic zone are somewhat less reliable than those tabulated by weighting areas. The increase in sampling variability is reflected by the standard errors presented at the end of this discussion.

Separate ratio-estimation processes were used for persons and for housing units. The ratio-estimation process for persons operated in 3 stages (Table 4). The first stage used 19 household-type groups (the first of which was empty by definition), the second stage used 2 groups (head of household and not head of household), and the third stage used 24 age-sex-race groups.

The ratio-estimation process for housing operated in 2 stages for occupied housing units and in 1 stage for vacant units (Table 5). The first stage for occupied units used 18 household-type groups (the first of which was empty by definition), and the second stage for occupied units used 4 groups (owner- and renter-occupied units by race). The single stage for vacant units used 3 groups: year-round for sale, year-round for rent, and other.

At each stage, for each of the groups, the ratio of the complete count to the weighted sample count in the group was computed and applied to the weight of each sample person or housing unit in the group. For population, this operation was performed for each of the 19 groups in the first stage, then for the 2 groups in the second stage, and finally for the 24 groups in the third stage. For occupied housing units, this was performed first for the 18 groups in the first stage and then for the 4 groups in the second stage.

As a rule, the weighted sample counts within each of the groups in the final stage should agree with the complete counts for the weighting areas. Close, although not exact, consistency can be expected for the groups in the preceding stages. There are some exceptions to this general rule, however. As indicated above, there may be differences between the complete counts and sample estimates when the tabulation area is not made up of whole weighting areas as in the case of traffic zones. As a result, sample estimates for traffic zones may not agree with complete counts when the traffic zone did not form a weighting area. Furthermore, so that the reliability would be increased, a separate ratio was not computed in a ratio-estimation group whenever certain criteria pertaining to the complete counts and the magnitude of the weight were not met. For example, for the 15- and 20-percent-population sample, the complete count of persons in a group had to exceed 85 persons and the ratio of the complete count to the unweighted sample count could not exceed 20. Where these criteria were not met, groups were combined in a specific order until the conditions were met. Where this occurred, consistency between the weighted sample and the complete counts would apply as indicated above for the combined group but not necessarily for each of the groups in the combination.

Each sample person or housing unit was assigned an integral weight to avoid the complications involved in rounding in the final tables. If, for example, the final weight for a group was 5.2, one-fifth of the persons or housing units in the group (selected at random) were assigned a weight of 6 and the remaining four-fifths a weight of 5.

The estimates realize some of the gains in sampling efficiency that would have resulted had the persons and housing units been stratified into the groups before sampling. The net effect is a reduction in both the sampling error and possible bias of most statistics below what would be obtained by weighting the results of the sample by a uniform factor (e.g., by weighting the 20 percent sample results by a uniform factor of 5). The reduction in sampling error will be trivial for some items and substantial for others. A by-product of this estimation procedure is that estimates for the urbanized area from this sample are, in general, consistent with the complete count for the groups used in the estimation procedure. However, this consistency will not be fully evident for tabulations by individual traffic zones in this report.

Sampling Variability

The estimates from sample tabulations are subject to sampling variability. The standard errors of these estimates can be approximated by using the data given in Tables 6, 7, and 8. The chances are about 2 out of 3 that the difference (due to sam-

Table 3. Worker-tally printout.

UAC[a]	Number of Workers	Workers Coded to			Workers Not in SMSA
		Blocks	ZC	UAC	
1	112,563	72,223	27,068	5,653	7,619
2	1,694	0	0	0	1,694
85001	11,451	11,433	7	11	0
85002	75,424	54,016	17,619	3,789	0
85003	16,582	6,774	9,302	506	0
85022	70	0	0	70	0
85024	89	0	0	89	0
85031	345	0	67	278	0
85034	33	0	7	26	0
85035	322	0	12	310	0
85036	47	0	0	47	0
85038	20	0	0	20	0
85040	49	0	26	23	0
85042	512	0	28	484	0
99999	5,925	0	0	0	5,925

[a]85001 = Albuquerque central business district; 85002 = remainder of Albuquerque city; 85003 = remainder of Bernalilo County (remainder of Albuquerque, New Mexico, SMSA); and 85022-85042 = county that is adjacent to the Albuquerque, New Mexico, SMSA.

Table 4. Ratio-estimation stages for persons.

Stage	Group	Description
1	1-6	Male head with own children under 18 1- to 6-or-more-person households
	7-12	Male head without own children under 18 1- to 6-or-more-person households
	13-18	Female head 1- to 6-or-more-person households
	19	Group-quarters persons
2	20	Head of household
	21	Not head of household (including persons in group quarters)
3		Male Negro
	22	Under 5 years
	23	5 to 13
	24	14 to 24
	25	25 to 44
	26	45 to 64
	27	65 and older
		Male, not Negro
	28-33	Same age groups as for male Negro
		Female Negro
	34-39	Same age groups as for male Negro
		Female, not Negro
	40-45	Same age groups as for male Negro

Table 5. Ratio-estimation stages for houses.

Housing Unit	Stage	Group	Description
Occupied	1	1-6	Male head with own children under 18 1- to 6-or-more-person households
		7-12	Male head without own children under 18 1- to 6-or-more-person households
		13-18	Female head 1- to 6-or-more-person households
	2		Owner occupied
		19	Negro
		20	Not Negro
			Renter occupied
		21	Negro
		22	Not Negro
Vacant	1	23	Year-round for sale
		24	Year-round for rent
		25	Other

Table 6. Approximate standard error of estimated number based on 20 percent sample.

Estimated Number	Type 1 Statistic[a]	Type 2 Statistic[b]
25	10	10
50	15	15
100	20	20
200	30	30
500	45	45
1,000	60	60
1,500	75	75
2,000	85	90
2,500	95	100
5,000	130	135
10,000	150	185
15,000	150	220
20,000	110	240
25,000	...	255
35,000	...	265
50,000	...	245
60,000	...	195
70,000	...	65

Note: Range of 2 chances out of 3.
[a]Counts of housing units, households, families, or other data that ordinarily appear once in a given housing unit.
[b]Counts of persons.

Table 7. Approximate standard error of estimated percentage based on 20 percent sample.

Estimated Percentage	Base of Percentage								
	200	500	1,000	2,500	7,500	10,000	20,000	25,000	70,000
2 or 98	2.0	1.3	0.9	0.6	0.3	0.3	0.2	0.2	0.1
5 or 95	3.1	2.0	1.4	0.9	0.5	0.4	0.3	0.3	0.2
10 or 90	4.2	2.7	1.9	1.2	0.7	0.6	0.4	0.4	0.2
25 or 75	6.1	3.9	2.7	1.7	1.0	0.9	0.6	0.5	0.3
50	7.1	4.5	3.2	2.0	1.2	1.0	0.7	0.6	0.4

Note: Range of 2 chances out of 3.

Table 8. Factor to be applied to standard error.

Tabulation Number[a]	Tabulation Rate (percent)	Type of Statistic[b]	Factor	Tabulation Number[a]	Tabulation Rate (percent)	Type of Statistic[b]	Factor
IA-1	20	2	1.0	ID-7	15	1	1.2
IA-2	20	2	2.6	ID-8	20	1	1.1
IA-3	15	2	1.3	ID-9	20	1	1.1
IA-4	20	2	1.0	ID-10	15	1	1.2
IA-5	20	2	1.2	IIA-1	15	1	1.0
IA-6	20	2	1.2	IIA-2	20	1	1.0
IA-7	20	2	1.2	IIA-3	20	1	0.9
IB-1	20	1	1.2	IIA-4	15	1	1.2
IB-2	20	1	1.2	IIA-5	15	1	1.0
IB-3	20	1	1.2	IIA-6	20	1	1.0
IC-1	20	1	0.7	IIB-1	15	1	1.2
IC-2	20	1	0.8	IIB-2	15	1	1.2
IC-3	15	1	1.4	IIB-3	15	1	1.2
IC-4	20	1	1.2	IIB-4	15	1	1.2
IC-5	20	1	1.2	IIB-5	15	1	1.2
IC-6	20	1	1.2	IIB-6	15	1	1.2
ID-1	20	1	0.3	III-1	15	2	1.4
ID-2	20	1	1.4	III-2	15	2	1.6
ID-3	20	1	0.9	III-3	15	2	1.7
ID-4	20	1	1.1	III-4	15	2	1.7
ID-5	20	1	1.0	IV	15	2	1.8
ID-6	20	1	1.2				

[a] See 1970-Census Urban Transportation Planning Package: Summary Tape Documentation, reprinted in the appendix to this report.
[b] See Table 6.

pling variability) between the sample estimate and the figure that would have been obtained from a complete count of the population is less than the standard error. The chances are about 19 out of 20 that the difference is less than twice the standard error and about 99 out of 100 that it is less than 2½ times the standard error. The amount by which the estimated standard error must be multiplied to obtain other odds deemed more appropriate can be found in most statistical textbooks. The sampling errors may be obtained by using the factors given in Table 8 in conjunction with data given in Table 6 for absolute numbers and in Table 7 for percentages. In addition to sampling errors, these tables reflect the effect of simple response variance, but not of bias arising in the collection, processing, and estimation steps or of the correlated error enumerators introduced. Estimates of the magnitude of some of these factors in the total error will be published at a later date.

Table 6 gives approximate standard errors of estimated numbers for most statistics based on the 20 percent sample. In the determination of the figures for this table, some aspects of the sample design, the estimation process, and the population of the area over which the data have been compiled are ignored. Table 7 gives standard errors of most percentages based on the 20 percent sample. Linear interpolation in Tables 6 and 7 will provide approximate results that are satisfactory for most purposes. Table 8 provides a factor by which the standard errors given in Tables 6 or 7 should be multiplied to adjust for the combined effect of the sample size (i.e., whether a 20 percent or 15 percent sample), the sample design, and the estimation procedure.

In Table 8, the tabulation number is the number that identifies the particular data in the Summary Tape Technical Documentation (reprinted in the appendix to this report). For example, to find the standard error on 150 housing units with 1 automobile available for a traffic zone of residence under tabulation number ID-10, interpolate in Table 6 for an approximate standard error of 25 (type 1 statistic) on a total of 150 housing units. The factor for items under tabulation number ID-10 is given in Table 8 as 1.2. Therefore, the standard error is approximately $25 \times 1.2 = 30$. To estimate the standard error for a percentage having a given characteristic, locate in Table 8 the factor applying to the tabulation number and multiply this factor by the standard error found in Table 7. The standard errors estimated from these tables are not directly applicable to differences between 2 sample estimates. To estimate the standard error of a difference, the tables are to be used somewhat differently in the 3 following situations.

1. For a difference between the sample figure and one based on a complete count (e.g., arising from comparisons between 1970 sample statistics and complete-count statistics for 1960 or 1950), the standard error is identical with the standard error of the 1970 estimate alone.
2. For a difference between 2 sample figures (that is, one from 1970 and the other from 1960 or both from the same census year), the standard error is approximately the square root of the sum of the squares of the standard errors of each estimate considered separately. This formula will represent the actual standard error accurately for the difference between estimates of the same characteristic in 2 different areas or for the difference between separate and uncorrelated characteristics in the same area. If, however, there is a high positive correlation between the 2 characteristics, the formula will overestimate the true standard error. The approximate standard error for the 1970 sample figure is derived directly from Tables 6, 7, and 8. The standard error of a 25 percent 1960 sample figure may be obtained from the relevant 1960 census report or an approximate value may be obtained by multiplying the appropriate value in Table 6 or 7 by 0.9.
3. For a difference between 2 sample estimates, one of which represents a subclass of the other, the tables can be used directly, and the difference is considered as the sample estimate.

Acknowledgment

This appendix was prepared by the Statistical Methods Division, Bureau of the Census.

APPLICATIONS AND USES OF THE CENSUS URBAN TRANSPORTATION PLANNING PACKAGE

Christopher R. Fleet, Federal Highway Administration

Urban transportation planning studies must have data. In the past emphasis was placed on obtaining detailed data on travel and socioeconomic conditions at one point in time, but today emphasis has turned toward obtaining travel and transportation-related data that are more timely and less costly and time consuming to collect and that can be incorporated into the planning process on a continuing basis.

The 1970-census Urban Transportation Planning Package (UTPP) represents a minimum common data set intended to be useful to urban transportation planning studies for continuing planning purposes. The package provides a useful supplemental base data source to aid studies in routine review of changing socioeconomic and travel conditions. It also provides a source of data that can be incorporated into the maintenance and updating of an urban transportation plan and program. This paper discusses 2 main issues: (a) how and where the UTPP can be applied in the continuing urban transportation planning process and (b) how the data can be used for transportation model development.

APPLICATION IN THE CONTINUING PLANNING PROCESS

The maintenance of both long-range and short-range transportation plans is critical for continuing urban transportation planning and for providing a timely basis for up-to-date capital improvement programs. Urban form and activity are undergoing continual change (quite often change that was not expected several years ago), and the maintenance of transportation plans must include a periodic review and evaluation to determine the effect of these unanticipated changes. If the effect is significant, then an updating of the existing future plan may be called for.

Because a wide range in the magnitude of urban change can occur, we can reasonably expect that such change, manifested in alterations of future travel demand estimates, will also require that a wide range of reviews be made of the existing long-range and short-range transportation plans.

Because land use activity and travel may also change quite rapidly, a cyclic time frame has been developed for the periodic review of existing plans. Levels of review (or reappraisal) have been characterized as routine review, major review, and complete plan reevaluation (1). This continual reappraisal activity is shown in Figure 1 by the various routes that lead to decisions about the necessary level of reappraisal effort. The cross-hatching indicates the steps in which the UTPP might be applied.

Routine review is a continual appraisal of the effects of changes in the location and magnitude of growth relative to that forecast. Its application is keyed to the existence of upcoming projects in the plan implementation stream. If a project is imminent, then early decisions must be made concerning the significance of possible differences in travel stemming from growth changes in the corridor in which the project is to be constructed. Depending on the degree of significance, the project may be processed normally, the project may need revision, or other affected projects may need to be revised. This process is shown in Figure 2.

The application of census socioeconomic data might supply valuable input to the evaluation of the effects of growth changes on travel demand in proposed project corridors. For example, the socioeconomic information contained in Parts I and III (residence zone tabulations and zone of work tabulations respectively) could provide a benchmark against which growth and development could be measured since the initial transportation study surveys were made. The first step shown in Figure 2 indicates this application.

The conversion of current socioeconomic data to trip ends (second cross-hatched box) could draw heavily on the contents of the package. Where there are growth differences, the census data could be input to trip generation relations to obtain updated trip ends. At this stage, simple trip generation rates, possibly drawn from other studies or based on the base-year origin-destination data rather than on traditional zonal regression equations would be more useful and more easily applied.

An ongoing surveillance program should also supply the data necessary for assessing the impact of growth changes on changes in travel demand. The census socioeconomic data could be used as a yardstick to evaluate the effectiveness of the surveillance program. An updating of selected census items from 1970 to the current year would probably be necessary, however.

For those studies just starting a surveillance program, the UTPP offers a good base. This is particularly true for most studies because it will have been 5 or 6 years since any substantial form of transportation and socioeconomic data were obtained in the study area. This is perhaps one of the major uses of the special package data.

If the current trip ends obtained in the routine review (second cross-hatched box, Fig. 2) indicate that trip-making is not growing as originally expected, a more extensive investigation is warranted. Here, output of the surveillance program or the census data or both in the corridor of interest are used as input to a revision of the land use forecast and will result in a more complete determination of changes in travel demand to include trip generation, trip distribution, and assignment of traffic to the future transportation system. Here, the interest lies in whether the growth changes will result in significantly different future design volumes and, if so, the geographic extent of the differences (i.e., in the corridor of interest or more widespread).

Depending on how different geographic extent and magnitude of changes in growth are from those anticipated, a more intensive assessment of the consequences may be necessary. If growth changes are significant, then either a major review or a complete plan reevaluation, including a full-scale application of the forecasting models, may be required.

There are 2 phases to a major review: (a) an evaluation of the forecasting procedures and (b) a reevaluation of the future transportation plan. In the first phase (Fig. 3) the technical adequacy of the forecasting procedures must be ascertained.

In the major review process (Fig. 3), data from the UTPP can be applied

1. As a basis for using current socioeconomic data to generate current trips with existing models;
2. In the development of new trip generation models (more discussion follows);

Figure 1. Reappraisal activity.

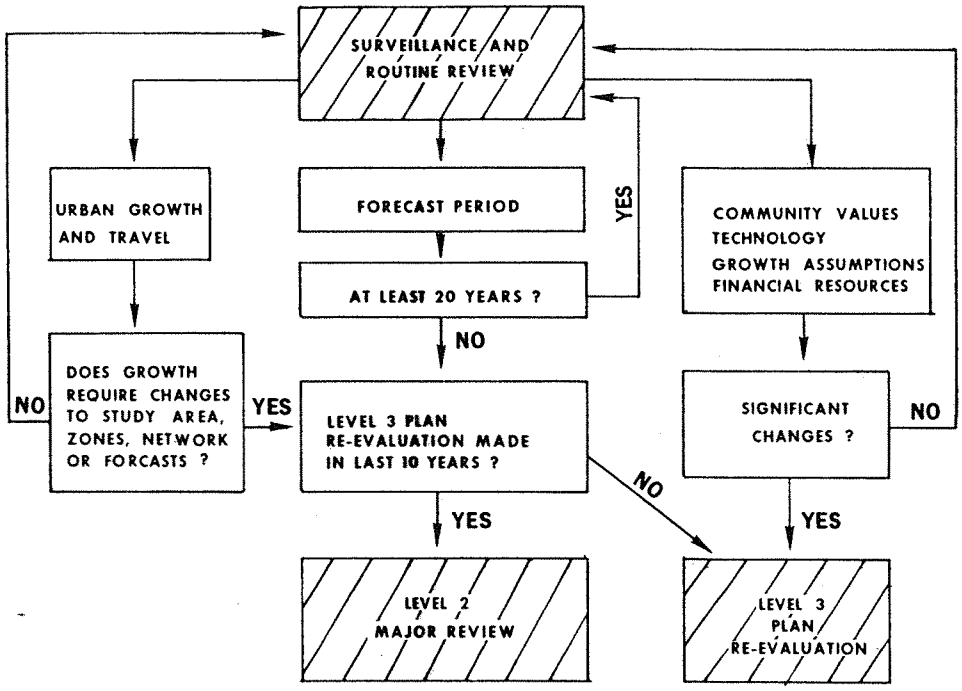
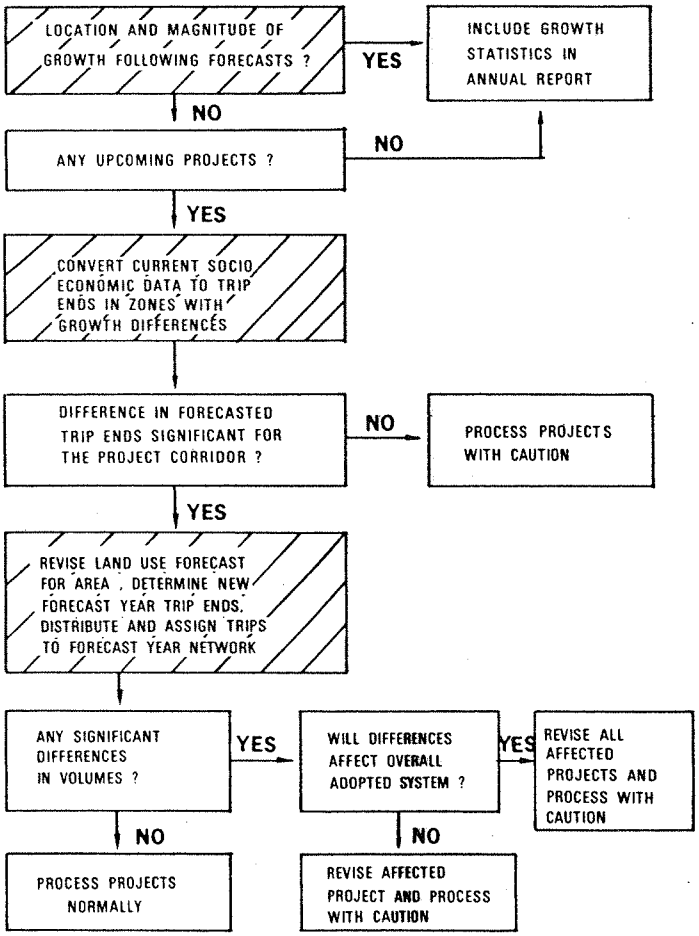


Figure 2. Routine review.



3. In the refinement of old trip generation models;
4. As a benchmark against which new updated long-range and short-range land use and socioeconomic data may be checked; and
5. As a secondary source (information from the journey-to-work question) to check trip-length frequency distribution, trip ends, and work-trip tables.

In applications 2 or 3, thought might be given to developing new trip generation relations from previous origin-destination data and census information, such as that shown in Figure 4. The foundation for the approach is the premise that there is a basic relation between household income, automobile ownership, and number of trips made by the household. Household size might also be incorporated in the relations. The independent variables are available from the UTPP, and the models can easily be applied in the current year.

Although trip generation relations can be developed without automobile ownership, this variable is a basic ingredient in the trip generation process, primarily because of the built-in sensitivity of the approach to automobile ownership saturation levels. Plots of household income-automobile ownership distributions show a characteristic shape and marked similarities in the urban areas shown in Figure 5.

Given an estimated income level by zone and the total dwellings in that zone, the relation (Fig. 5) can be applied to determine the number of households by automobile ownership category. If the number of households owning 0, 1, 2, or more automobiles is known, the total trips generated in the zone can be derived from relations similar to those shown in Figure 4. Total trips per zone by each income class can then be stratified by purpose by using a relation similar to that shown in Figure 6. Such an approach to trip generation using cross-classification analysis has considerable merit in that it is simple to use, is conceptually easy to see, and employs easily obtainable data.

The estimation of long-range and short-range land use and socioeconomic activity is difficult at best. Comparisons, therefore, between the existing conditions during the base year and the activity in 1970 available from the census (possibly updated to a current year) can provide the forecaster with a broader base of knowledge for updated forecasts. This application is shown in the bottom cross-hatched box in Figure 3. For example, analysts making new 1995 forecasts have the benefit of comparisons between original estimates for 1970 and what actually happened between the base year and 1970. Overly optimistic forecasts back in the mid-60s are evident in many studies now that socioeconomic data are available from the 1970 census.

In summary to the first point of this paper, the data in the UTPP may be used for any of several purposes in an ongoing urban transportation planning process. Many of these applications are essential to surveillance and reappraisal elements.

MODEL DEVELOPMENT

Transportation studies have traditionally forecast travel demand in terms of total average daily travel. In most studies, existing models and forecasting techniques are based on the daily trip definition. Consideration has been given to the application of peak-hour models both because peak-hour volumes are ultimately needed for design purposes and, more recently, because census journey-to-work information is available. Because the census work trip constitutes only one trip purpose, some scheme must be developed to convert the census work trips to either total daily trips or peak-hour trips.

If the decision is made to use the census journey-to-work data, less error will be introduced in converting from census work trips to peak-hour trips than to total daily trips simply because work trips constitute such a large percentage of peak-hour trips (70 to 80 percent) (2). It has, however, been demonstrated that 92 percent of the variation (i.e., $R^2 = 0.92$) in total daily trip volumes (origin-destination trips assigned to a network) can be explained through statistical analysis by daily work-trip link volumes (3). There has also been considerable research into peak-hour factors by type of facility, area of city, and orientation of facility (4).

The several suggested methods of using the census data for travel model development

Figure 3. Major review.

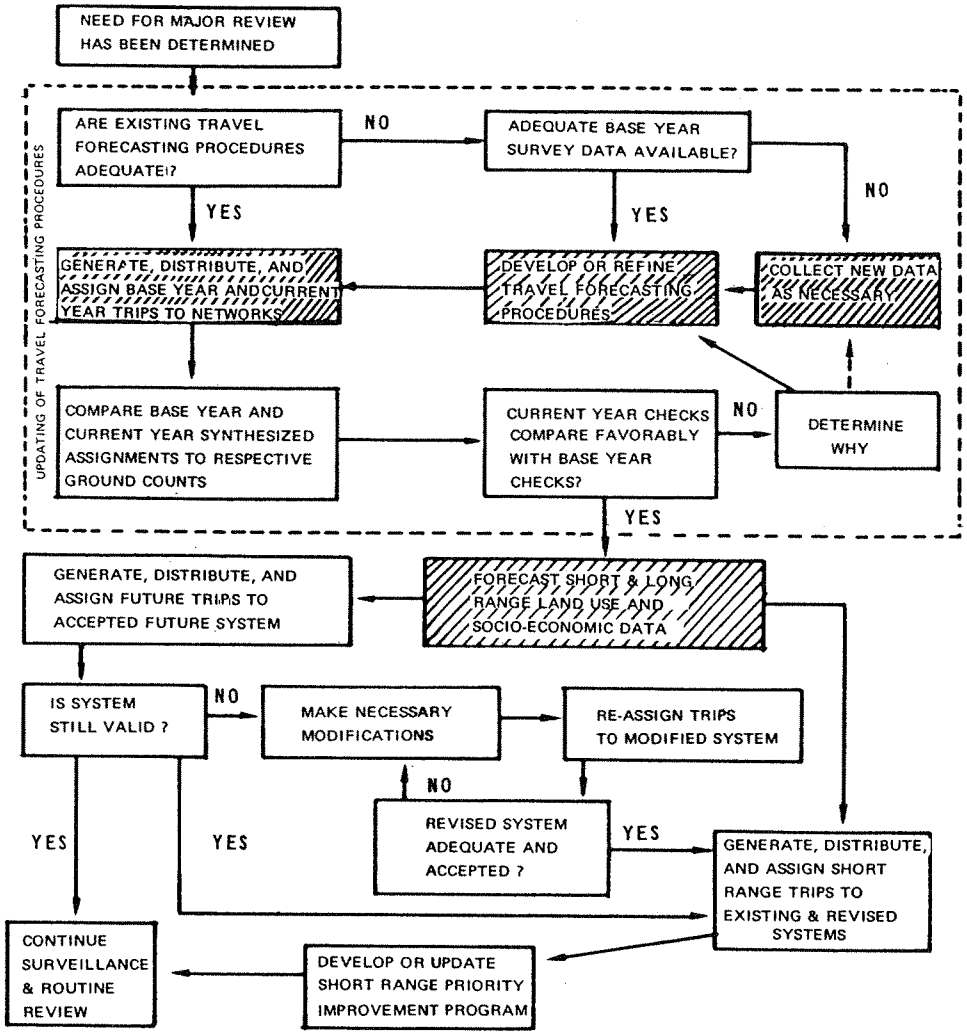


Figure 4. Income, automobile ownership, and trips.

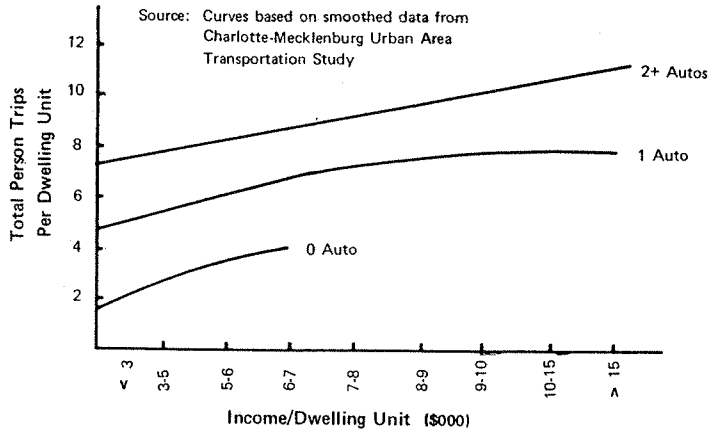


Figure 5. Income, automobile ownership, and households.

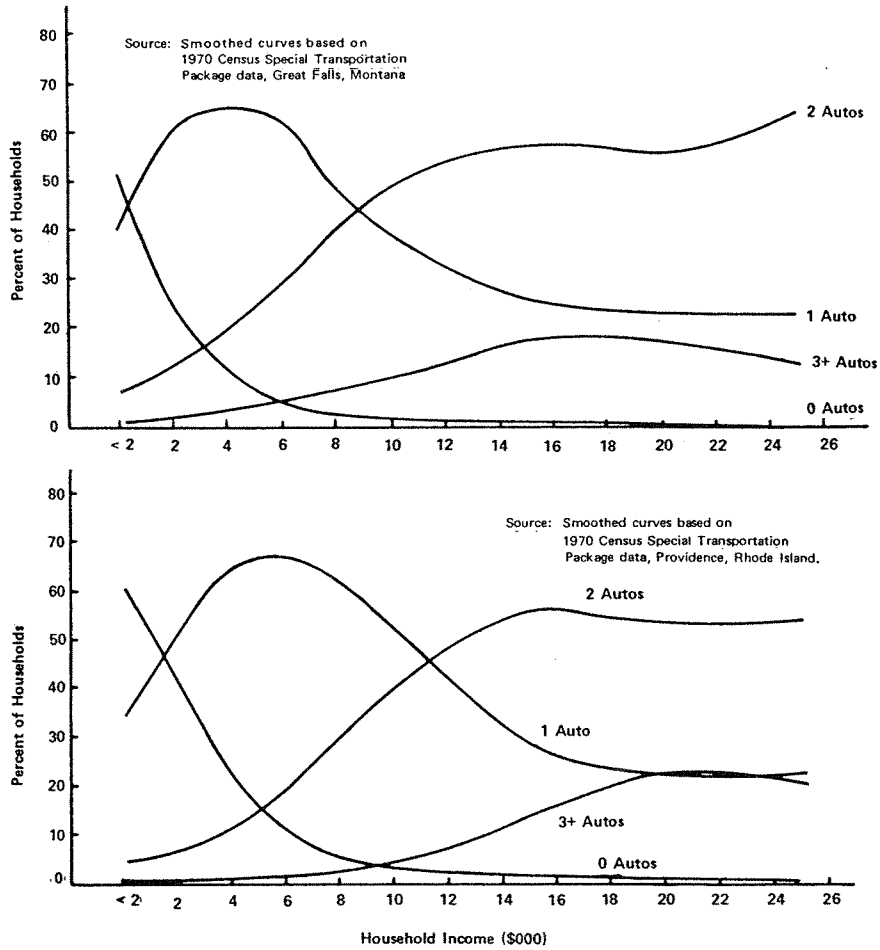
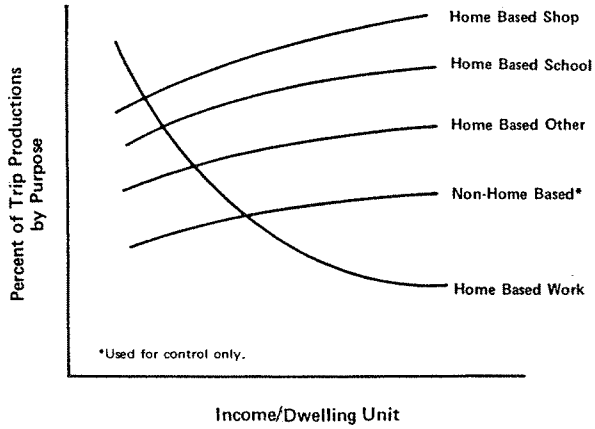


Figure 6. Income per dwelling unit and trips.



can be divided into trip-end or trip-volume models, depending on the point at which the factors are applied (before or after assignment) and further categorized by the resultant trip definition (ADT or peak hour). Other approaches to this problem are possible, and research under way at the present time will shed more light on the subject (5, 6, 7).

Trip-End Models

Four methods of using the UTPP can be classified as trip-end models. Three are oriented to the zonal definition of the study area. The fourth is based on employment density and trip length. All use trip ends in developing conversion factors. In all cases except one, the trip ends are derived from the base-year origin-destination survey data, so some consideration will have to be given to the stability of relations over time.

Zonal Peak-Hour Factors

Factors (work-trip ends and peak-hour trip ends) are developed by zone for both origins and destinations (Fig. 7). Inputs to the factor development are the base-year origin-destination data and the output from program PEAKHOUR. This program (in the FHWA-S/360 urban transportation planning battery) is designed to separate the peak-hour trips from the total daily origin-destination work-trip file by using the "trips-in-motion" concept.

The factors (in terms of trip ends) thus developed can then be applied to the census work-trip table by using the program FRAT to obtain a 1970 peak-hour trip table. To have some judgment about the adequacy of this trip table, one should assign the trips to a 1970 network and compare them with 1970 peak-hour ground counts. Based on existing or updated trip generation models, or new models developed from census data, forecasts of work-trip ends are made. Application of the previously developed factors results in forecast peak-hour trip ends, which can then be distributed and assigned to a future network. This technique assumes that some provision has been made for models capable of distributing and assigning peak-hour trips rather than the traditional daily trips.

Zonal Daily Trip-End Factors

Figure 8 shows essentially the same approach as that above, but the trip-end conversion factors are based on the relation between work and total daily trips. Existing distribution and assignment models may be used in this case.

In the second ADT model approach (Fig. 9), census socioeconomic data are applied to existing or updated trip generation models to obtain 1970 trip ends by zone for all trip purposes. Census journey-to-work trip ends by zone are applied to the previously developed trip ends to develop the factors shown in Figure 9. These factors may 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.

Forecast work-trip ends are obtained through existing or updated trip generation procedures. The work-to-total trip-end factors are then applied to obtain total future trip ends. The remainder of the forecasting process involves the application of normal estimating techniques. These approaches, of course, assume that work trips as a percentage of total trips will remain constant over time, an assumption that can be argued.

Employment Density and Trip Length

The rationale of the peak-hour relations based on employment density and trip length developed by Mann (2) is that, as employment density at the destination of the trip increases, the ratio of peak-hour trips to work trips decreases (i.e., work trips become

larger in proportion to total peak-hour trips). Similarly, as trips get longer, trips for work will constitute an increasing percentage of total peak-hour trips. These 2 relations are shown in Figure 10. Application of the concept involves a combination of both relations, shown at the bottom of the figure. A matrix of zone-to-zone work trips can be factored by using the ratios based on the employment at the destination and the travel time (skim tree) between the zones. This approach has the advantage of recognizing changes in the character of development in a zone over time; the previous approaches assume that factors are stable by zone through time.

Trip-Volume Models

There are 2 possible approaches presented here, although there may be others. The first (Fig. 11) uses some rather extensive research that was conducted on peak-hour travel (4). In this research the percentage of average daily traffic in the peak hour by functional class, area type (CBD, suburb), and orientation (radial, circumferential) was studied by using data from 7 representative cities. The development of census-based models can take advantage of this research as shown in Figure 11.

In the first approach, factors are developed for trip volumes rather than for trip ends. The program PEAKHOUR can be used to develop trip-volume factors for use converting from average daily primary work-trip volumes to peak-hour trip volumes for links in the system classified by the categories mentioned above. After the census work-trip table is assigned to a 1970 network, these factors may be applied to the resulting link volumes, giving peak-hour trip volumes by links in the system. Factors, based on the research mentioned above relating peak-hour volumes to total daily volumes, are applied to the peak-hour trip volumes from the census trip assignment. The result is total daily trip volumes on each link in the system.

Given future trip ends, based on existing or updated work-trip generation models (either developed from the census data or existing origin-destination data), future daily trip volumes can be obtained through application of the appropriate factors.

The second trip-volume approach can be classified as a peak-hour model and is being investigated under a research contract at the Georgia Institute of Technology (6). The concept of the model is shown in Figure 12 (9) and is based on peak-hour link volumes being a function of assigned work-trip link volumes. The independent variable (assigned work-trip volumes) is estimated from work-trip generation and distribution models. The distribution model can be developed by using base-year origin-destination data or possibly the census journey-to-work trip data.

Given design-year work-trip link volumes, the basic peak-hour model is applied to obtain peak-hour volumes directly by link. This model is developed from base-year assigned origin-destination data and base-year ground counts.

The above described techniques quite probably do not cover all possible approaches to using the UTPP information. They do, however, constitute a broad spectrum of probable applications and suggested strategies for developing new models.

SUMMARY COMMENTS

This paper has presented suggestions for incorporating data from the 1970 census into the continuing urban transportation planning process. In the continuing plan and program review process, census data can be applied as a basis for current socioeconomic data for generating current trips with existing models, in the development of new trip generation models, in the refinement of old trip generation models, as a benchmark against which new updated long-range and short-range land use and socioeconomic data may be compared, and as a beginning base or a benchmark to check an ongoing surveillance program.

In the second and third applications, consideration might be given to using the census variables of income and automobile ownership to develop relations at the dwelling unit level. An example was presented in this paper.

Figure 7. Peak-hour-model trip ends.

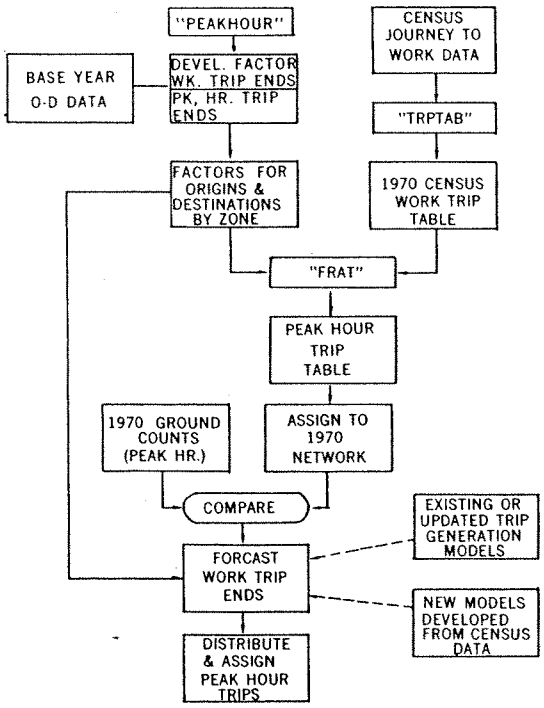


Figure 8. ADT-model trip ends.

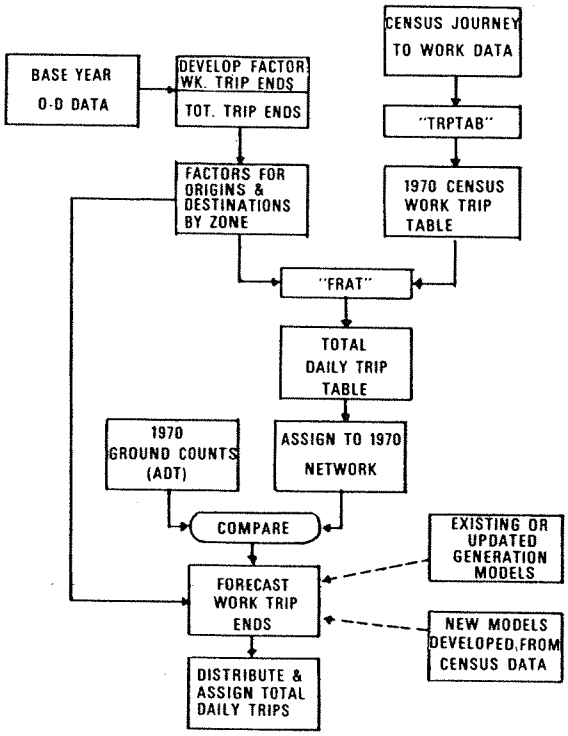


Figure 9. ADT/work-trip-model trip ends.

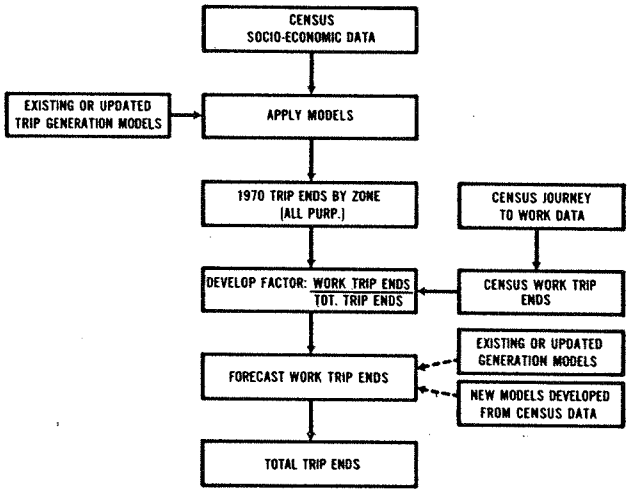


Figure 10. Peak-hour factors related to employment density and trip length.

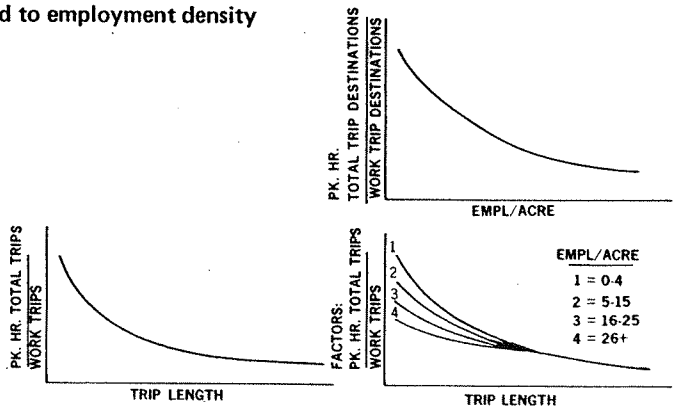


Figure 11. ADT-model trip volumes.

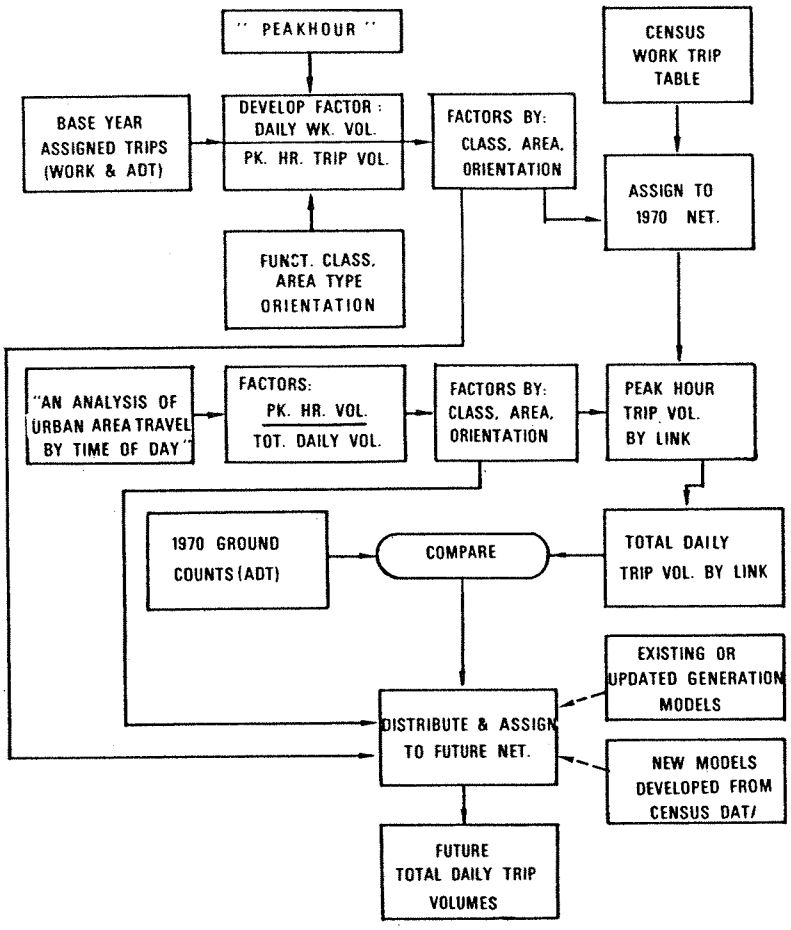
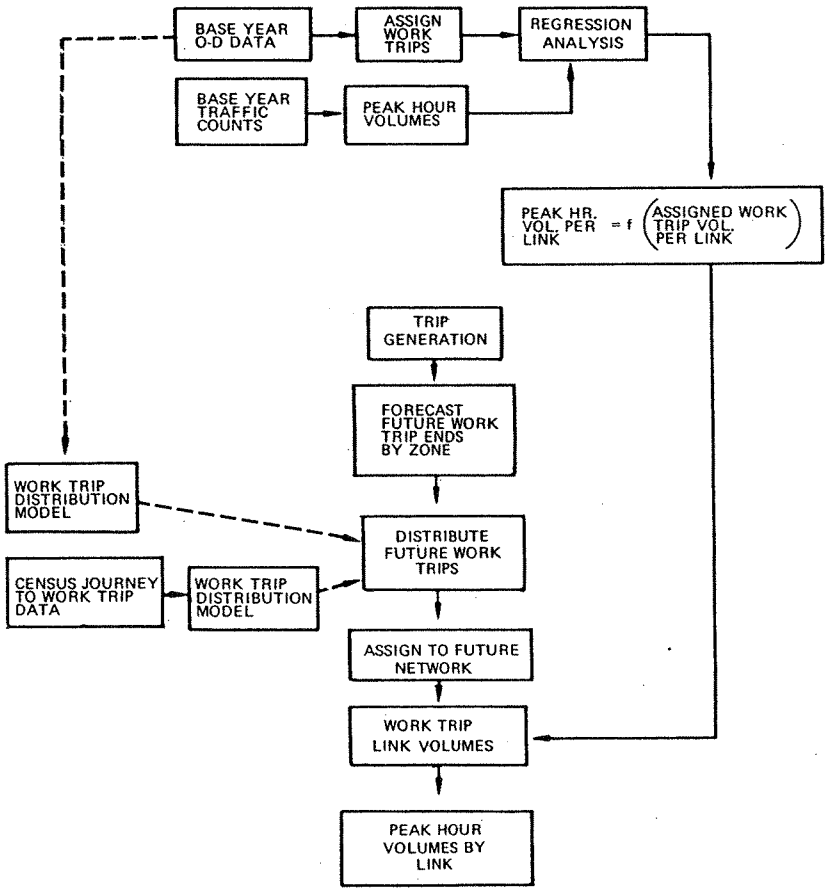


Figure 12. Peak-hour-model trip volumes.



In essence, the UTPP offers a supplemental data source that may be used for a number of purposes in the urban transportation planning process. Application of the package is not without some limitations, however, and these must be considered carefully in a practical sense, for example, the degree of coding of the place-of-work to block level, differences in definition between census journey-to-work data and the typical origin-destination trip data, timing of the census data in relation to the continuing transportation planning needs, geographic area coverage of the UTPP data, and sampling and method of expansion of the census data.

Even with the above considerations accounted for, experience to date indicates that census data can be used in urban transportation planning. As a result of some early tests and applications, the Middle Rio Grande Council of Governments (Albuquerque) concluded that UTPP data can be used in the reappraisal portion of the transportation planning process to provide a direct check on work-trip productions and attractions. Agreement was generally favorable with locally developed data in describing the socioeconomic characteristics of the area. The data were also considered to be an adequate base for trip generation analysis (5, 8).

The Delaware Department of Highways and Transportation was able to refine parts of the package and will use census data to provide independent variables for person-trip generation equations and to provide data for developing a modal-split model (8).

Although these early applications provide indications, more extensive testing and investigation are under way. These include research by Parsonson on the development of an urban peak-hour traffic model based on the 1970 census and concurrent ground counts (6) and a study sponsored by FHWA on the use of census data for updating urban transportation studies (7). The objective of the first study is the development of a peak-hour travel model for estimating 20-year design data.

As an additional guide to state highway departments and transportation studies, FHWA issued a report (9) that presents in more detail than has been included in this paper a rationale for incorporating the census data into the urban transportation planning process. It includes additional discussion on the use of the UTPP and the details that must be considered in its application.

As results of these studies and more practical application of the package become available in urban areas, the utility of the census data will be further demonstrated. The indications are that the census transportation data are an excellent data source for continuing urban transportation planning.

REFERENCES

1. Operations Plans for Continuing Urban Transportation Planning. Federal Highway Administration, IM 50-4-68, May 3, 1968.
2. Mann, W. Estimating Peak Automobile Travel. Transportation Planning Board, Metropolitan Washington Council of Governments, Washington, D.C., Technical Notes 4, Summer 1972.
3. Armbrister, C. S. Primary Work Trips as Estimators of Urban Travel Patterns. University of Texas at Austin, MSCE thesis, May 1970.
4. An Analysis of Urban Area Travel by Time of Day. Peat, Marwick, Mitchell and Co., Jan. 1972.
5. Test and Evaluation of Data From the Standard Package of Census Data for Urban Transportation Studies. Middle Rio Grande Council of Governments, April 1973.
6. Parsonson, P. S. Development of an Urban Peak-Hour Traffic Model Based on the 1970 Census and Concurrent Ground Counts. Georgia Institute of Tech., Aug. 1972.
7. The Use of Census Data for Updating Urban Transportation Studies. Comsis Corp., March 1973.
8. Urban Transportation Planning Package of Census Data—Early Tests and Application. Federal Highway Administration, FHWA Notice, April 11, 1973.
9. Sword, R. C., and Fleet, C. R. Updating an Urban Transportation Study Using the 1970 Census Data. Federal Highway Administration, Highway Planning Technical Rept. 30, Aug. 1973.

EXPERIENCES IN USING CENSUS DATA FOR TRANSPORTATION PLANNING

The Rhode Island Project

Arthur B. Sosslau, Comsis Corporation

Comprehensive urban transportation planning has been legally required since the passage of the Federal-Aid Highway Act of 1962. Comprehensive transportation planning, which is a requirement for every city having a population of more than 50,000, requires the collection and processing of a great many data. Data collection and processing is required not only to establish base-year data but to update traffic volume projections, improvement recommendations, and other information important to the community. For many years the primary source of data has been expensive and time-consuming inventories.

In recent years, an increasing amount of discussion and activity has centered on the feasibility of using the dicennial national census as a transportation planning data source. The 1970 census included questions concerning journey-to-work trips. The Bureau of the Census and the Department of Transportation have collaborated to produce the 1970-Census Urban Transportation Planning Package (UTPP) for various areas of the country. The question remains, Do the census data provide a valid source for use in updating urban transportation studies? To answer this question, the Federal Highway Administration awarded the Comsis Corporation a contract to investigate the use of these data. The project is being accomplished in conjunction with the state of Rhode Island and the Office of the Secretary of Transportation. The intent of the project is to run a series of comparisons between data obtained in the census and data obtained in origin-destination surveys conducted by the state of Rhode Island in 1961 and 1971. The project includes 3 tasks: to investigate and report on the feasibility of the project and detail the remaining tasks, to develop assignment volumes by using the 1970-census journey-to-work data, and to evaluate the methods used for developing assignment volumes. At the time this paper was presented we had completed the first task.

The products expected to result from the project include: a

report of the accuracy achieved by using census data to update the base-year data in developing average daily traffic by link via traffic assignment; a report of how the 3 methods tested for obtaining network loads compare with the average daily traffic resulting from a new origin-destination survey; and a report of the problem areas uncovered in using the census data to develop network loads, solutions to the problems, and guidelines to other users.

OBJECTIVES OF TASK 1

The objectives of task 1 were to investigate whether the methodology structured for this project was valid and feasible from the standpoint of data requirements. Specifically, the following work elements were included in task 1:

1. Design the actual processes involved in the project including techniques to be used and expected results;
2. Detail and estimate the cost of each element of work in the project, develop a critical path schedule to show the structure of the project, and provide a progress plan;
3. Investigate the feasibility of the 3 main comparison processes in task [these include a review of the previous work (1, 2, 3, 4, 5) and methods of trip generation model development].
4. Identify all data items required by the project and determine whether the required data items actually exist in an available, usable form;
5. Document the manipulations of data involved in the various processes and comparisons;
6. Indicate what software, if any, would have to be developed to complete the requirements of the project;
7. Discuss what problem areas, if any, are expected, what impact these problem areas will have, and what recommendations and actions are required for their alleviation;
8. Define what areal units can best be used as a basis for the work in the project; and
9. Make recommendations concerning any phase of task 2 that will assist in producing a better report at the end of the project.

DEVELOPING TRAFFIC ASSIGNMENT VOLUMES

Three methods were evaluated for developing traffic assignment volumes by using census data.

The first method involves using primary work automobile-driver trips as an indicator of total peak-hour automobile-driver trips and then relating the peak-hour trips to total ADT for automobile driver. (All trips discussed in this paper are automobile-driver trips unless otherwise indicated.) In this method, 1961 data are used to create primary work and peak-hour trips, a network, trees, and loaded networks. The relation developed between primary work and peak-hour trips is applied to the 1970-census journey-to-work trips to create 1970 peak-hour trips. This work is based on similar work by Parsonson (1, 2, 3) on using primary work trips as forecasters of peak-hour trips. After 1970 peak-hour volumes are developed, 1970 ADT is developed by using factors developed by Peat, Marwick, Mitchell and Company (4). These factors allow for the development of ADT by expansion factors, which vary depending on the characteristics of each link in the network.

The second method is based on the concept that primary work trips are predictors of total ADT. Armbrister (5) showed this to be a valid appraoch, and this project will further test his hypothesis. Once again, 1961 information is used. Networks loaded with primary work and average daily volumes are used to develop relations between these 2 volume types. The relations produced are used to generate 1970 ADT from the census journey-to-work trip volumes.

The third method is based on trip ends rather than trip volumes. 1961 socioeconomic

data and a trip generation procedure, such as cross classification, are used to show that total trips are related to primary work trips as a function of the socioeconomic makeup of the traffic generator and attraction areas. The results will be applied to journey-to-work productions and attractions to develop 1970 ADT productions and attractions. Finally, ADT volumes will be developed through the use of gravity model trip distributions, directional splits of gravity model trips, and the subsequent loading to the 1970 network.

EVALUATION OF CENSUS DATA AND METHODS

Task 3 will evaluate the adequacy of each method employed to generate 1970 automobile-driver link volumes (task 2) and to assess the adequacy of census journey-to-work data for transportation planning purposes. The assessment will include checks of link volumes stratified by functional class, area, and volume; volume checks across grid lines and cut lines; and vehicle-miles of travel by various areal and facility-type groupings. Seven major comparisons are currently proposed.

1. 1970 primary work automobile-driver link volumes generated from census journey-to-work data and 1970 primary work automobile-driver link volumes generated by 1961 travel models. To generate 1970 volumes, 1961 models will require the use of 1970 socioeconomic data and the 1961 trip generation, distribution, and assignment models.
2. 1970 total automobile-driver link volumes generated by 1961 travel models and 1970 ground counts factored to eliminate trucks. Again, the development of the 1970 link volumes will require the use of the 1961 trip generation, distribution, and assignment models.
3. 1970 internal automobile-driver and internal total person primary work-trip interchange volumes generated from census journey-to-work data and similar values obtained from the 1971 origin-destination survey. The 1971 trip interchange volumes will have to be factored to portray 1970 interchanges and provide a direct one-to-one comparison. These comparisons will be made on an areal basis yet to be determined and will identify any apparent differences in travel.
4. 1970 primary work automobile-driver link volumes generated from 1970 journey-to-work data and 1970 primary work automobile-driver link volumes developed from the 1971 origin-destination survey and stratified by functional classes and area types. The 1970 primary work automobile-driver trip matrix developed from the 1971 data will be assigned to the 1970 highway network before this comparison is made.
5. The generated 1970 ADT (method 1) and the 1970 ADT ground counts.
6. 1970 ADT developed from the relation between ADT and primary work trips (method 2) and automobile ground counts.
7. ADT (method 3) and automobile ground counts.

DATA REQUIREMENTS FOR PROJECT

Successful completion of this project is dependent on the acquisition and processing of various data. A study of the project requirements concerning data and the processing programs was part of task 1. The 1971 study interviewed 0.44 percent of the state's population. For the purpose of this project, the 1971 information will be modified to reflect conditions as they existed in April 1970, the time of the census. These data will be used as the basis for some of the comparisons.

1. 1961 travel models, consisting of trip distribution, generation, and assignment models, will be used in conjunction with 1970 socioeconomic data to develop 1970 link volumes for comparison with ground counts.
2. 1961 socioeconomic data, including dependent variables such as population, dwelling units, and employment used in creating the 1961 trip generation model, will be used in method 3 to develop a relation between primary work trips and total trips as a func-

tion of socioeconomic characteristics.

3. 1970-census socioeconomic data will be used in the relation developed above to create 1970 ADT volumes from primary work volumes and also with the 1961 models to create other 1970 volumes.

4. 1970-census journey-to-work information will be used to build the journey-to-work trip table and the production and attraction summaries.

5. 1970 highway network will represent the transportation network in Rhode Island at the time of the census in April 1970.

6. 1961 trip records were obtained from the origin-destination survey of 1961 and include the dwelling unit information and trip information on origins, destinations, purpose, mode, and time of travel.

7. PMM factors were created by Peat, Marwick, Mitchell and Company (4) to reflect the portion of ADT that occurs during the peak hours for various classifications of network links.

8. 1970 ground counts, which are obtained from the city of Providence and the state of Rhode Island, show actual traffic movements over selected highway links and will be the basis for several of the project comparisons.

9. 1961 productions and attractions of all trips and primary work trips reflect the total trip ends for each zone in the 1961 study area and will be analyzed by using method 3 to develop a relation between ADT and primary work-trip productions and attractions. Zonal socioeconomic characteristics will be used in the analysis.

In addition to these data sets, several other data items will be required during the study:

1. 1970 independent data sources for use in verifying census information;
2. Rhode Island codes for zones;
3. 1961 and 1970 network and zone maps from state;
4. 1961 trip generation and distribution reports for use in reviewing the validity of the models and providing input to portions of task 2;
5. 1970-71 growth factors for use in adjusting the 1971 survey results to the time of the census;
6. Write-up of the 1971 project;
7. Census-tract to traffic-zone conversion file for use in working with 1970 socioeconomic data;
8. 1970 primary work link volumes generated by the 1961 models; and
9. Total link volumes generated by the 1961 models.

PROCESSING

The project was designed to make maximum use of FHWA PLANPAC software, and the need to develop any major computer software is not expected.

One of the major elements for task 1 is to translate the conceptual design, as shown in Figure 1, to a detailed practical process in a manner such that PLANPAC can be of maximum assistance. The following describes the processing required to accomplish task 2.

Method 1

The method 1 comparison is designed as a 2-phase process (Fig. 2). First, a relation between 1961 peak-hour and primary work trips will be established according to Parsonson's methods. That relation will be applied to the 1970-census journey-to-work trip table to develop 1970 peak-hour trips. The second phase will use factors established by Peat, Marwick, Mitchell and Company to expand the 1970 peak-hour trips to ADT volumes. These ADT trips will then be compared for accuracy to the 1970 ground counts and to the generated 1970 peak-hour ground counts. The following steps are included in method 1.

Figure 1. Study design.

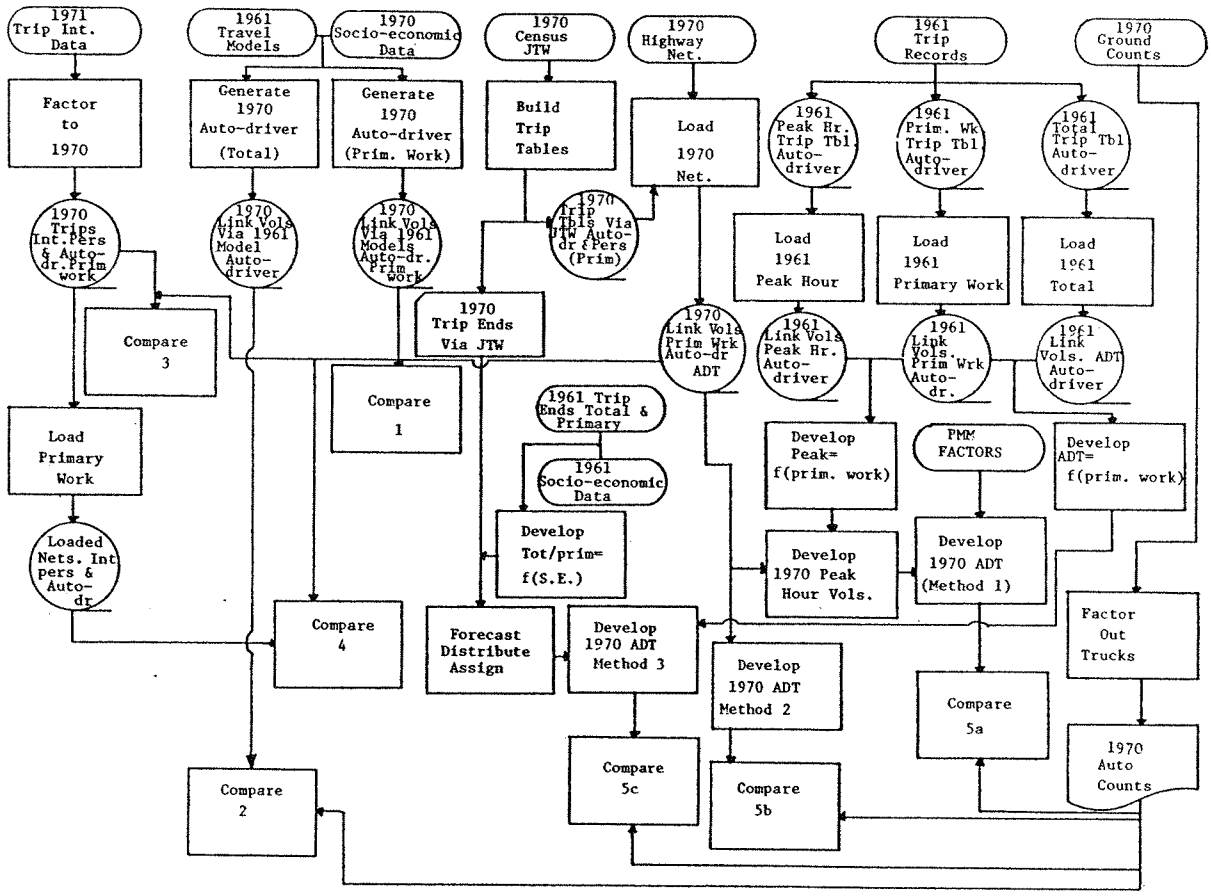
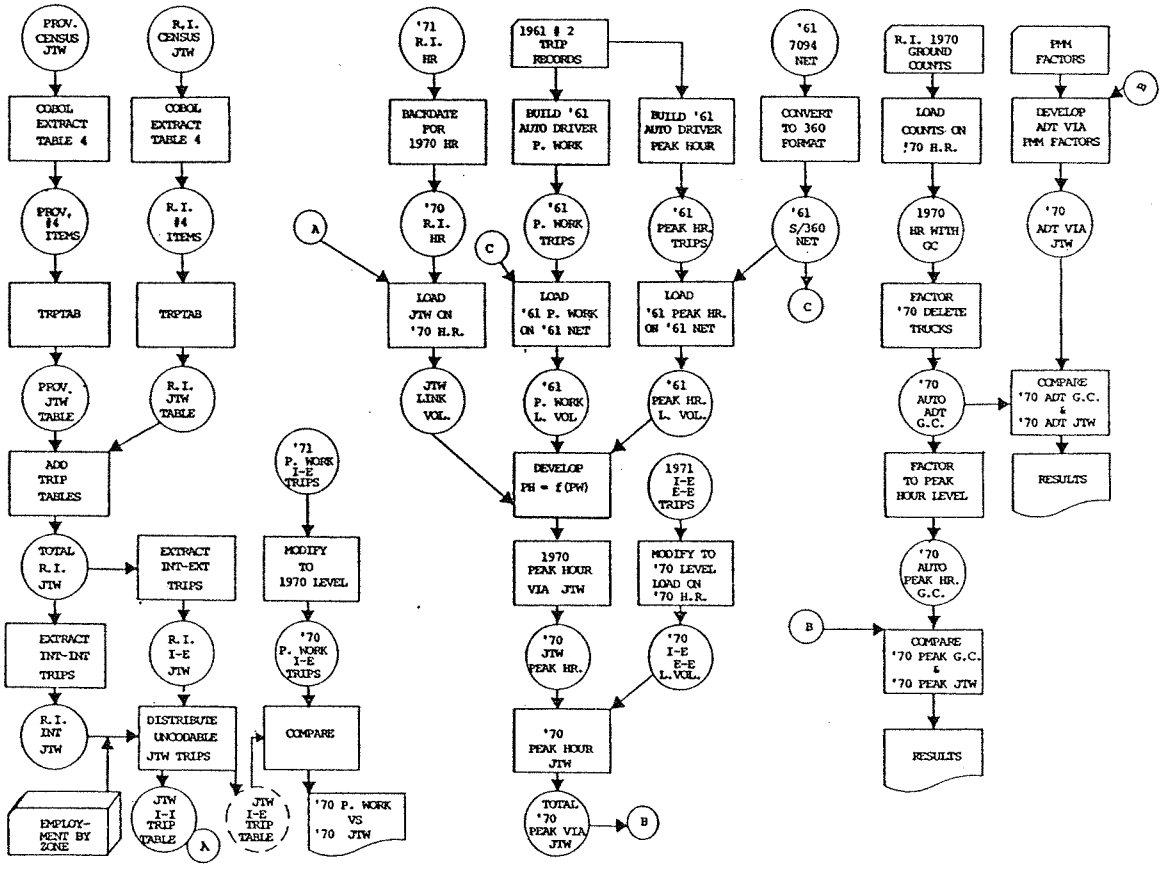


Figure 2. Method 1 process.



1. Create the 1970 journey-to-work trip table with all origins and destinations within the state boundary line:

a. Tapes of the UTPP are processed by using program FILSYS or a similar program to create a separate file of each of the census tables;

b. The fourth table is manipulated to create a journey-to-work trip table;

c. The trip tables are adjusted to allow for absentees and similar errors on the file;

d. The state trip table and the Providence trip table are added to create a total study area trip table; and

e. The study area trip table is adjusted by using zone equivalencies supplied by the state and a trip table compression program such as TRPVERT so that no zones are located outside the state.

2. Build 1970 historical record and trees:

a. Link card images of the 1971 historical record are supplied by the state;

b. The state supplies delete cards to adjust the 1971 historical record to an April 1, 1970, level;

c. The 1971 historical record is undated to create the April 1, 1970, historical record; and

d. 1970 trees are built by using program BUILDVN.

3. Create 1970 journey-to-work link volumes: The program LOADVN and the 1970 historical record, the 1970 trees, and the journey-to-work trip table are used to assign the journey-to-work trips to the 1970 historical record.

4. Build 1961 network and trees:

a. The state supplies a 1961 network in 7094 format;

b. The 7094 link card images are obtained from the 1961 network;

c. The 7094 link card images are converted to 360 link card format;

d. The 1961 historical record is built with program BUILDER; and

e. Program BUILDVN is used to build 1961 trees.

5. Build and load 1961 peak-hour and primary work trips on 1961 historical record:

a. The 1961 trip record No. 2 and No. 3 cards are used as input to program PEAKHR to build the 1961 peak-hour trip table;

b. The peak-hour trips are loaded on the 1961 historical record by using program LOADVN;

c. A trip table of 1961 primary work trips is built from the 1961 No. 2 and No. 3 cards with program TRPTAB; and

d. The primary work trips are loaded on the 1961 historical record by using program LOADVN.

6. Develop a relation of the form, peak hour = f(primary work), by comparing and analyzing the 1961 peak-hour and primary work link volumes.

7. Use the relation developed in step 6 to generate 1970 peak-hour trips from the 1970 journey-to-work trip table.

8. Develop 1970 ADT by using PMM factors:

a. The 1970 historical record is set up to carry classifications of links that can be used with the PMM factors; and

b. 1970 ADT link volumes are created by applying the PMM factors to the generated 1970 peak-hour link volumes.

9. Load ground counts and factor for trucks:

a. 1970 ground counts are obtained from the state;

b. Ground counts are inserted into 1970 historical record; and

c. Link volumes are factored to eliminate trucks.

10. Make ADT comparison of ground counts and those generated by using journey-to-work trips:

a. Ground count link volumes are compared to those generated by using journey-to-work trips; and

b. Comparison results are analyzed and interpreted.

11. Make peak-hour comparison of ground counts and journey-to-work volumes:

a. Ground counts of automobile drivers are factored to peak-hour link volumes;

b. Ground count link volumes are compared to those generated by using the journey-to-work trips; and

c. Results of comparisons are analyzed and interpreted.

Method 2

The comparison of method 2 (Fig. 3) is based on a relation between primary work trips and ADT as discussed by Armbrister (5). The steps are as follows:

1. Use program TRPTAB and input from the 1961 No. 2 and No. 3 cards to build an ADT trip table;
2. Load the 1961 historical record with 1961 ADT trips;
3. Analyze and develop a relation between 1961 ADT link volumes and 1961 primary work trips of the form, ADT = f(primary work trips);
4. Develop 1970 ADT link volumes by using the developed relation and the 1970 journey-to-work link volumes;
5. Compare 1970 link volumes and ground count link volumes; and
6. Analyze and interpret the results of the comparisons.

Method 3

Method 3 (Fig. 4) is based on zonal trip ends rather than trip tables as are methods 1 and 2. The steps are as follows:

1. Use total automobile-driver 1961 productions and attractions, 1961 primary work productions and attractions, and 1961 socioeconomic data to develop the relationship, TOTAL/PW = f(socioeconomic);
2. Obtain journey-to-work trip ends from journey-to-work trip table by using program PTSUM;
3. Develop 1970 total automobile-driver trip ends by applying the relation above to 1970 journey-to-work trip ends and 1970-census socioeconomic data;
4. Distribute the 1970 ADT productions and attractions by using the gravity model distribution technique;
5. Split the gravity-model-generated trip table by using program SPLIT and state directional factors;
6. Load the split trips on the 1970 historical record, and use program COMPARE to check the synthesized link volumes by the gravity model against the 1970 ground count link volumes; and
7. Analyze and interpret the comparison results.

CENSUS CODING

Some preliminary work has been done on summarizing the census journey-to-work information. The UTPP covers the Providence SMSA, which includes most of Rhode Island and parts of Massachusetts and Connecticut. The distribution of the 384,600 workers who lived in the SMSA is as follows:

Item	Workers
Living in SMSA	384,601
Working in Rhode Island	289,574
Working in Massachusetts and Connecticut	93,243
Working outside Rhode Island, Massachusetts, and Connecticut	1,784

Figure 3. Method 2 process.

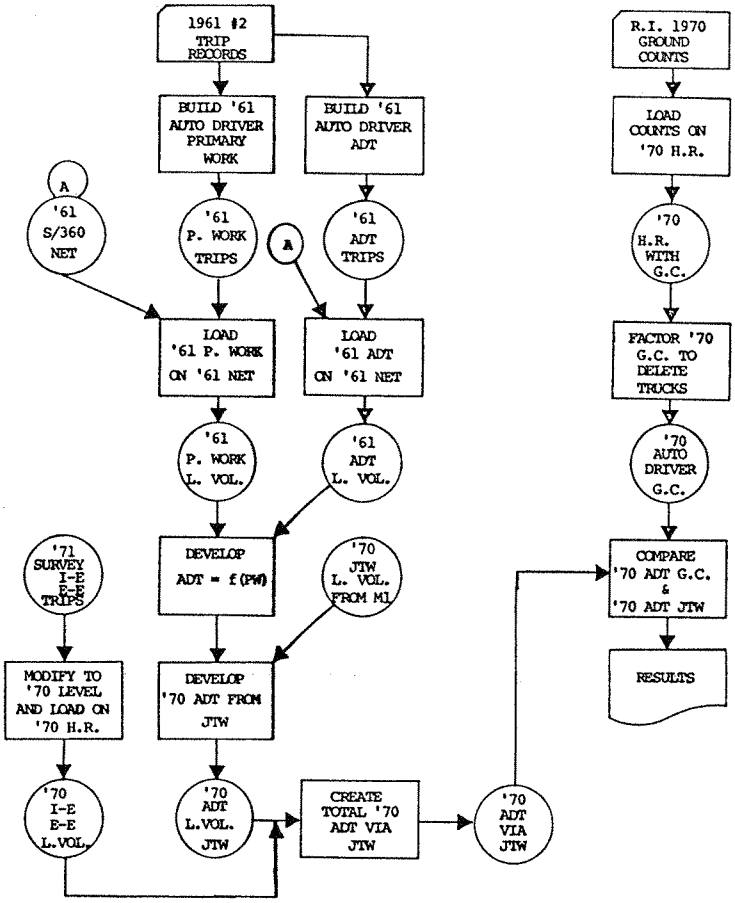
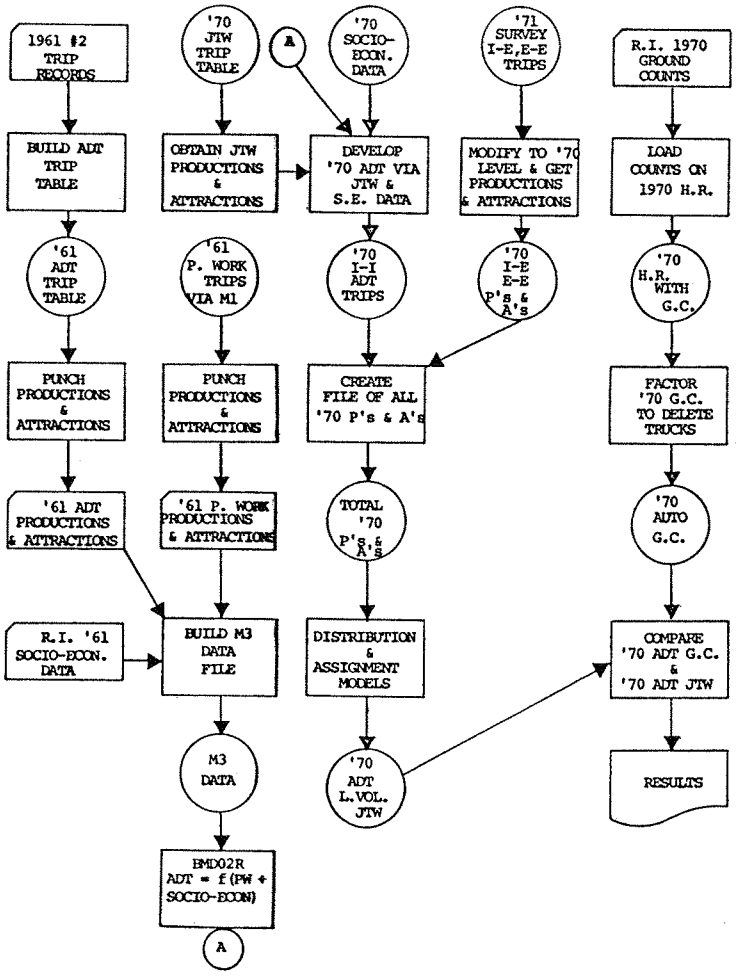


Figure 4. Method 3 process.



If the entire SMSA is considered, 52.3 percent of the workers were coded to block, 39.9 percent were coded by the Universal Area Code (UAC), 7.3 percent were not coded, and 0.5 percent worked outside the SMSA. If the urbanized area is the limit of study, 77 percent of the work places can be coded to block and 23 percent to the UAC. These percentages are of the 231,335 workers whose work places could be coded to the Providence urbanized area. If we assume that the work places that could not be coded for the urbanized area are the same proportion as urbanized area workers are to SMSA workers (about 60 percent), then we can estimate the total urbanized area residents as being 249,000. If we use this as a control, the percentage of workers coded is as follows:

Item	Providence SMSA	Urbanized Area
Block	52.3	72
UAC	39.9	21
Not coded	7.3	7
Outside SMSA	0.5	—

As mentioned previously, work places coded by the UAC and those not coded are allocated to zones. In New England, UAC covers towns or cities. In the Providence urbanized area there are 18 such areas and 3 rest-of-county areas to which work places were coded when they could not be coded to city or town. The 3 rest-of-county codes have only 5,585 coded journey-to-work trips. There are 403 traffic zones for the 1971 origin-destination survey in the urbanized area.

Some comparisons of the census data with state employment figures have been made. The average monthly employment for the entire state in 1970 was 342,750. This compares to the 289,574 workers in the Providence SMSA who worked in Rhode Island. The difference is about 15 percent, which is about what was found in other areas. Most of the difference can probably be accounted for by the fact that state employment data include multiple jobs held by a single worker and that some workers lived outside the SMSA and worked within. Comparisons of the census employment with the state data are made by town. Currently only "covered" employment is available by town (this accounts for 264,000 employees). Allocations of total employment are made for comparison with the census data.

PROBLEM AREAS

Boundaries

Different study area boundaries were used in the 1961 and 1971 Rhode Island studies. The state line was used as a boundary in the 1961 study. Portions of Connecticut and Massachusetts were included in the 1971 study. For this project, the state line will be used. In addition, the zones in the 1971 study include a set of stations placed on the state boundary. Therefore, the trips that are assigned to the Connecticut and Massachusetts segments of the study area will have to be assigned to given external Rhode Island stations. This will require that an equivalency file be established to provide for the compression of trips to the given area.

Journey-To-Work Trips That Cannot Be Coded

A portion of the census journey-to-work trips did not have sufficient response information to obtain the traffic zone of origin or destination or both. The number of trips involved is not large. Approximately 1,800 trips do not provide any usable information, and some 30,000 trips have been coded by UAC and other levels but are not now at a traffic zone stage. These trips should all be included in the journey-to-work trip table so that the information is as complete as possible. The 1,800 trips will probably

be distributed to all zones in the same proportion as known trips. The 30,000 trips will be distributed to the zones in UACs as known trips are proportional between the zones in the UAC.

Zonal Coding Differences

There is a question as to the method of development of the trip generation model for method 3 because of a change in zoning that took place in the study area between 1960 and 1971. Some question has been raised as to whether trip generation equations that were based on 546 zones could validly be applied to the same area divided into 685 zones. We do not believe this will be a problem. Another alternative is to use the cross-classification process and thus eliminate any problem caused by a differing number of traffic zones.

PMM FACTORS

In method 1, the second phase of processing calls for PMM factors to be used to expand peak-hour trips to ADT trips. These factors are based on the premise that the percentage of ADT traffic occurring on a link during a peak hour is dependent, among other factors, on the orientation of the link. The orientations are defined as CBD-radial-freeway, central city-circumferential-arterial, and so on. Also, the PMM work incorporates the influence of modal-split directional factors on peak hour-ADT traffic relation. The PMM approach, although reasonable, poses some problems. First, Rhode Island has not coded orientation into link data records. Second, the modal-split aspects of this methodology raise serious questions involving the direct use of these factors. For these reasons, it is expected that similar methodology will be used but that the link factors will be based on functional and design type classifications. These codes are available in the state and, in addition, are compatible with 1974 National Transportation Study methodology. Use of these stratifications should make the final results more directly usable in other areas.

CONCLUSION

Previous work by Parsonson and Armbrister has shown that primary work trips can be used as a basis for developing peak-hour and ADT volumes on a network. Their work was based on using origin-destination survey data to develop the relations. In this project, census data will be used as the source for developing relations, which may result in less predictive accuracy. The results should provide a clear indication of the usefulness of the census journey-to-work data for updating and forecasting purposes.

It would be well to consider, however, the relative costs of this approach to travel development versus the collection of new origin-destination data. There are 252 urban areas, each having more than 50,000 population. If sample rates of the size previously recommended by FHWA were used, approximately 1.6 million interviews would be required (an average of about 4.2 percent sample of households).

At $25 per interview, a total cost of $40 million would be realized. Most practitioners do not believe so high a sample rate as previously recommended is required. It the rate given below were used (these are generally half the FHWA previously recommended rates), urban areas could have surveys for all modes of travel producing more directly usable base data for approximately $20 million.

Population	Sample Rate	Population	Sample Rate
50 to 150	1 in 16	1,000 to 2,000	1 in 60
150 to 300	1 in 20	2,000 to 5,000	1 in 100
300 to 500	1 in 30	5,000 and more	1 in 200
500 to 1,000	1 in 40		

The costs for collecting the 1970 journey-to-work data are roughly estimated as follows:

Item	Millions of Dollars
Additional questions	5.0
Coding of census journey-to-work data	5.0
Processing to produce package	1.0
Coding guides for 80 nonmail areas	3.0
Produce information from journey-to-work data in usable format (252 areas at $5,000)	1.25

Obviously the dollars spent on the census journey-to-work data result in information useful in nonurban areas as well as in urban areas where home interview surveys are taken. However, it would appear that a critical evaluation should be made of the usefulness of the census data relative to that obtained from home interview surveys or perhaps some new collection process. We expect our work in Rhode Island to indicate the relative benefits and cost effectiveness of using census journey-to-work data versus collecting data in home interview surveys.

REFERENCES

1. Parsonson, P. S., and Roberts, R. R. Primary Work Trips as Estimators Of Urban Peak-Hour Volumes. Georgia Institute of Technology, Sept. 1969.
2. Parsonson, P. S. Current Research at Georgia Tech in the Use of Census Work Trip Data for Peak-Hour Traffic Models. Georgia Institute of Technology, 1972.
3. Parsonson, P. S. Development of an Urban Peak-Hour Traffic Model Based on the 1970 Census and Concurrent Ground Counts. Georgia Institute of Technology, Aug. 1972.
4. An Analysis of Urban Area Travel by Time of Day. Peat, Marwick, Mitchell and Co., Jan. 1972.
5. Armbrister, C. S. Primary Work Trips as Estimators of Urban Travel Patterns. MSCE thesis, University of Texas At Austin, May 1970.

The Albuquerque Project

O. A. Davenport and K. M. Howell, Middle Rio Grande Council of Governments of New Mexico

In the fall of 1972, the Federal Highway Administration initiated an evaluation of the 1970 standard package of census data for urban transportation planning studies. This evaluation study was conducted by the staff of the Middle Rio Grande Council of Governments with assistance from the Special Studies Group of the New Mexico State Highway Department. The objectives of this study were to verify the reliability of the data from the Urban Transportation Planning Package (UTPP) and to test and evaluate their practical usefulness in an actual transportation planning program. The study was conducted prior to the official release of the UTPP to other metropolitan areas in the anticipation that results of the Albuquerque study would be of general benefit to all transportation planning staffs attempting to use the census data.

The UTPP data developed for the Albuquerque SMSA consisted of socioeconomic and travel characteristics for about 450 small geographical areas called data analysis subzones. The total population for these areas in 1970 was about 315,000 persons. These people live in an oasis-like community; very little urban development exists beyond the boundaries of the Albuquerque SMSA. Low-density housing is along both sides of the Rio Grande River, and trade, business, and employment centers are dispersed; the CBD is small. A large military base and the Sandia Mountains block development to the east and south. The community is almost totally dependent on the automobile for transportation. The present street and highway system provides an excellent level of service. Extensive use is made of the 2 north-south and east-west freeways, which cross near the center of Albuquerque and provide easy access to the CBD.

A considerable amount of locally developed data was available for comparison with the census data. The Albuquerque continuing transportation planning study was initiated in 1966. Socioeconomic data for comparison are available from a number of sources including the Albuquerque public school system, the third-count summary tape of the 1970 census, New Mexico State Employment Security Commission, and the business activity module of the city of Albuquerque. Unfortunately, these data do not contain recent trip data of known accuracy. Nor was employment-by-category data available at the zone of residence.

Phase 1 of the study was a test of the validity of the UTPP data and of the techniques used in assigning them to traffic subzones. This phase was specifically an evaluation of the data contained in the zone-of-residence table. A comparison was made between selected data sets and similar information obtained from local and census sources. This comparison validated the technique used in expanding the 15- and 20-percent-sample data to the 100 percent universe. The census expansion factors were checked by using the published standard error tables for census tracts.

In addition, an evaluation was made of the practical usefulness of the UTPP format computer program that reads the magnetic tape and prints its contents in tabular form by traffic subzone.

Phase 2 incorporated the UTPP data into the transportation planning process. In this phase, the zone-of-work data and the home-to-work trip table were evaluated. Since both tables are incomplete, considerable effort was devoted to devising ways for completing them. The usefulness of these data was then determined by developing a new work-trip generation equation and comparing it with the one obtained by using the 1962 origin-destination data. A more comprehensive test was undertaken by attempting to develop a peak-period traffic model by using the completed home-to-work trip table. The results were inconclusive, but considerable insight was gained on how the UTPP and a minimum of locally developed data can be used to develop a transportation planning program. This investigation is being continued, and preliminary results look promising.

CONCLUSIONS

1. The zone-of-residence table is an excellent source of surveillance information about the socioeconomic characteristics of the traffic subzones. The data meet the accuracy standard set by the Bureau of the Census, and they are comparable to the locally developed data currently being used in the Albuquerque transportation planning process. The data contained in this table may be used as input to trip generation equations and home-to-work equations. Care should be exercised in substituting the UTPP data for local data because of possible differences in definitions and methods of data collection.

2. The home-to-work trip table by mode of transportation is incomplete and could not be used in Albuquerque because of the large number of missing trips. Some 36 percent of the trips could not be assigned to a specific work location. Instead, most were assigned to a larger areal identifier such as a zip code or the Universal Area Code (UAC). However, 6 percent could not be assigned to any area location. Techniques were developed for assigning the missing trips, and the completed trip table was

then used in the transportation planning process. A sample of UTPP data for other areas indicates that any trip table will likely not be sufficiently complete to be used without modification.

3. The zone-of-work table is also incomplete because of the large number of missing trip ends. The table must be completed before it can be used as input to trip attraction equations or a home-to-work attraction equation. Total employment by traffic zone may be obtained by the same technique used to complete the trip table. However, a different technique using local data is required to determine employment by job category. No technique was tested for completing the employment-by-job category because a large amount of locally developed data is required, and these data were not available.

4. The summary table is correct because it is based on the residence data, which were judged to be accurate and complete.

5. The information contained in the UTPP is not sufficient by itself for developing a peak traffic model that would relate work trips to peak-hour traffic. However, the UTPP data plus locally developed data and an ongoing transportation planning study should provide sufficient information for constructing such a model.

6. The FHWA format program that tabulates the data requires a computer that can process COBOL level U language. The city of Albuquerque's computer does not have this capability. In addition, there are problems associated with the reading of selected pieces of data because of the way the tape file is constructed.

7. A major deficiency in the UTPP is that it does not contain external-to-internal work trips for those trips originating outside the SMSA. For large metropolitan areas, this could mean that 20 percent or more of the total work trips will not be included in the trip table.

These conclusions indicate that the UTPP augments local data, but, at the present time, is not equivalent to a limited origin-destination survey and cannot be used as a sole basis for a transportation planning program. However, it can be improved and eventually used in this capacity. Obviously, the trip table and zone-of-work table must be completed either by improving the census data or by developing adequate techniques for expanding the tables. The external-to-internal work trips must also be provided and a peak-traffic model developed that uses a minimum of local data. If these major improvements can be developed, then the UTPP would represent a significant contribution to transportation planning.

RECOMMENDATIONS

The quality of the Urban Transportation Planning Package can be improved considerably by initiating a number of relatively minor changes.

1. School enrollment provided by the UTPP is classified by grade level only, but should be classified as private, public, or other. This would facilitate the updating of local data, for the only reliable school enrollment data may be public school data.

2. Automobile-availability data should include the total number of passenger vehicles owned, including pickup trucks. In 1971, about 33,000 pickup trucks were used in the Albuquerque area as passenger vehicles.

3. To simplify the development of algorithms for the completion of the trip table, trips that could not be coded to a specific location should be divided into 2 categories: those that cannot be coded to a work address and those that are given UACs that were not designated work areas. These 2 categories should be kept separate because they should be treated differently in the algorithm that completes the trip table by assigning those trips to work locations.

4. The UTPP equivalency table, which indicates the correspondence among zip codes, data analysis subzones, or centroids, should be subjected to an edit check.

5. Control totals should be provided for all items listed in the tables; otherwise, the totals must be obtained by combining census tract data from the Tract Book.

6. The UTPP format often uses the column heading "Totals," but what is being totaled is not always clear. A more appropriate heading should be devised that is consistent with the individual tables.

7. A user's handbook should be included with the Urban Transportation Planning Package for each SMSA. It should include pertinent information from this report plus recommendations from FHWA and the Bureau of the Census on using the data. A summary of the accuracy, data collection techniques, and data definitions would be helpful.

8. The organization of the tape file should be restructured so that selected pieces of data can be easily read off the tape by using FORTRAN IV.

9. The time of work-trip origins is a key parameter that is needed in the development of a peak-period model. This information should be obtained in the census; otherwise, it must be collected by an independent survey.

10. So that the external work trips originating outside the SMSA and terminating inside can be determined, the census should record a person's work address in all cases. At the present no specific address is asked for the workplace outside of the worker's home county.

11. A significant weakness in the UTPP data is that employment at major employment centers is often underestimated. This may result from persons' not knowing the specific addresses of their places of work and using references such as "GE Plant" or "Coronado Center." If the local agency prepared a correspondence table between major employment centers and census blocks for use in coding the sample data, the Bureau of the Census might be able to retrieve much of the lost employment information.

The really difficult problem is how to improve the collection of data so that the work trips can be assigned to a specific work subzone. It is certainly not clear from the evaluation of the UTPP where the difficulty is. A comprehensive study of the whole data collection and processing techniques may be required to identify what is required to reduce the number of unassigned trip ends to an acceptable level. This effort would certainly be worthwhile in view of the tremendous potential of the package.

Effort should also be continued on developing and evaluating techniques for assigning the missing trips. The main need is to do a quantitative check of the various alternatives so as to determine the accuracy of each technique. This would probably require that an origin-destination survey be taken at the same time the census data are collected.

To develop the necessary attraction generation equation requires that the zone-of-work table be completed. Considerable effort is still required to develop an acceptable technique and to evaluate its accuracy. It appears that a considerable amount of local data will be required to complete the table. Hence, an investigation should be initiated on how to accomplish the needed completion with a minimum of local data.

If the full potential of the UTPP concept is to be realized, effort should be continued on the development of the peak-traffic model concept. This approach looks favorable if all the information of a complete origin-destination study is available. However, it is certainly not clear how this problem can best be handled with a minimum of data.

The Wilmington Project

Maurice M. Carter, Delaware Department of Highways and Transportation

The Wilmington SMSA is located in the northern part of Delaware and includes New Castle County, Delaware; Cecil County, Maryland; and Salem County, New Jersey. The SMSA had a 1970 population of 500,000 (according to the Bureau of the Census); 386,000

of those persons lived in New Castle County, Delaware—our transportation planning study area. New Castle County represents 77 percent of the SMSAs population and 38 percent of its land area.

We are involved in an Urban Mass Transportation Administration technical study that incorporates a level 3 plan reevaluation. The joint work program uses FHWA and UMTA resources. Our goal is to produce a multimodal transportation plan for the Wilmington region.

Like most early transportation studies, the Wilmington study developed its models to predict only impacts that were highway related. Because of a reevaluation, national as well as local, we are now more interested in predicting the action of people rather than of vehicles. To accomplish that, we are developing new person-trip generation equations from the original 1964 origin-destination study, updating our 1964 base-year data to 1970, evaluating our models by comparing 1970 predictions with 1970 observations, and developing modal-split models by using 1970 socioeconomic data.

This is only the initial portion of our program, i.e., that portion that involves the 1970 census data. To say that in another way, the 1970 census data were intended to provide actual data to satisfy generation equations and to provide data for developing the modal-split model.

The Urban Transportation Planning Package (UTPP) is composed of 4 parts: (a) cross tabulations of data (Part II), data by zone of residence (Part I), data by zone of work (Part III), and work-trip data by zone of residence to zone of work (Part IV). I will give some general comments on Parts I, III, and IV and specific comments on our manipulation of those parts to conform to our needs.

The user's first contact with the package is when he is asked to complete an equivalency listing whereby he assigns his zone numbers to the census data in the blocked area and fictitious zone numbers to areas outside the blocked area and to areas designated by nongeographic entities such as zip codes.

We decided to simply "rename" the census data area for most areas outside our blocked area (the blocked area comprises 93 percent of the population and 36 percent of the land area) in New Castle County. Knowing there was a conflict of geographic boundaries, we felt it was better to keep the identity of the data and reaggregate them rather than to initially allocate them to our already existing traffic zones. I would recommend that procedure to others who intend to use the UTPP, providing data are not lost because of rules of disclosure.

The UTPP provides only residential data because the census bureau inventories people and their living characteristics according to each individual household location. In the Wilmington region 20,000 employees reside outside the SMSA. My original understanding was that we could select 20 locations outside the SMSA and obtain the number of employees coming into the SMSA from each, but, as it turns out, only residential data are provided.

Very little manipulation was necessary for Part I data because the data were by zone of residence. The only areas requiring adjustments were those located outside the blocked area. Generally these were enumeration districts, most of which were larger than our traffic zones and had to be disaggregated to varying degrees. I suggested simply renaming those areas based on data from other sources or, in homogeneous areas, on proportion of residential land area. (For those who feel that control totals must be met exactly, I will make a statistical observation. All data in the UTPP, including population and housing, are sample data. Expansion factors were applied by the Bureau of the Census to sample data according to control totals established by third count summaries. By aggregating these factored data according to a geographic shape other than a census tract, one is almost guaranteed a total having some variance with the control total.) The adjustments having been made, Part I was in working order.

Part III, data by zone of work, was the most exciting challenge. Our immediate needs from Part III were employment by type by zone. Of the data we received, 55 percent of the employment was in traffic zone and needed no manipulation, 39 percent was assigned to zip codes (ZC), and 6 percent was assigned to Universal Area Code (UAC). Remember that 20,000 additional jobs held by nonresidents were not supplied at all. Let me describe the most severe case of allocation.

1. We are given X number of jobs of a specific type in a zone.
2. To that we might add jobs that were assigned UACs. Each zone within that particular UAC area might be entitled to a portion of the UAC area's jobs.
3. If the zone happened to fall in a ZC area that contained jobs (this is true for most of the Wilmington cases), it might have some of those jobs assigned to it.
4. The zone might be entitled to a portion of the nonresidential employment that is not in the package.

Let me interject something about zip codes. First, the U. S. Postal Service has never mapped zip codes. Second, some zip codes, such as 19899 in Wilmington, are designated for boxholders at post offices; in our case, there are 2,500 possibilities of employers, some of whom are not even located in the state of Delaware. Third, the zip code that the job was coded to may represent the location of the home or central office of an employer and not the location of the job. The zip code allocation was difficult; the allocation philosophy varied for each zip code.

Fortunately, we had 2 items that assisted us greatly in making the allocation: an employment inventory for the city of Wilmington completed in 1971 and a survey of land use by acre for New Castle County outside the city of Wilmington completed in 1970. Large employers such as Chrysler, du Pont, and General Motors provided us with exact counts of employees by facility and by SIC code, and those allowed us to arrive at precise employment totals.

Nonresidential employment was a gap that had to be filled before we could consider our task complete. We went to Maryland, New Jersey, and Pennsylvania (Pennsylvania is not part of our SMSA but contributes 45 percent of the nonresidential employment) and requested a count of residents in those states who worked in Delaware. Of course, we had some of our own nonresidential or non-SMSA employees to add. The distribution of this employment group was the last to be made to our multilayered creation.

At last, we had data that satisfied the input requirements for our person trip generation equations, except for one item: automobiles. The UTPP reports the number of cases in a zone having 1, 2, and 3+ automobiles. We were concerned about the 3+ automobiles. With a little investigation, we discovered that automobile control totals for December are used by the census bureau and also by our State Planning Office to represent the year. With the aid of regression analysis, we found relations between population, income, and automobiles and have been able to create a zonal automobile table that balances with the desired region control total. So, even though the UTPP did not provide automobiles directly, the data could be obtained with the information given.

Our conclusions with regard to Part IV of the UTPP should be obvious by now. Because of the extensive reworking that was necessary in Part III, matching the productions and attractions was impossible. Our conclusion is that the trip table is virtually useless for transportation planning because, in approximately 45 percent of the cases for residential data, the attraction end of the trip is in a location other than the actual location, and matching the specific attraction to its related production is impossible. That does not mean that there is not some good information in the table. The modal relations on an areawide basis have proved to be accurate.

To summarize, I consider the following to be the major shortcomings of the package:

1. Nonresidential employment data are not provided;
2. For population and dwelling units, the data are sample data and, therefore, are subject to expansion error;
3. Automobile tables do not contain precise counts for cases having more than 2 automobiles;
4. The small area geographic accuracy for employment coding is inadequate, i.e., too much emphasis is given to coding by zip code; and
5. Given the above, part IV should be deleted from the package for economic reasons.

Some of my comments may sound pesimistic. The fact is, however, that the package works for the Wilmington region. Granted we had to tack on 6 man-months of work to make it operational, but it works. Those who are considering the purchase of the UTPP

will have to evaluate their specific cases, and the Bureau of the Census provides preliminary data that are helpful in that evaluation. We think the package is good; it just needs refining.

The Tri-State Region

Haden Boswell, Tri-State Regional Planning Commission

In order to show how the Tri-State Regional Planning Commission has used data from the 1970 census, I want first to define our region briefly and describe our role as a census processing center. I shall also describe in more detail our experience so far with the journey-to-work and the Urban Transportation Planning Package (UTPP) because I believe it is unique and will be of interest to you.

THE REGION

The Tri-State region comprises 8,456 square miles, including parts of 3 states, 27 counties and planning regions, and more than 600 communities. It contains 11 (1970) SMSAs, about 140 Universal Areas, and 4,521 census tracts.

According to the 1970 census, the population of the region was 18.7 million, a gain of 11 percent since 1960. More than 15 percent of this population is nonwhite. The population total includes 75 percent of the population of New Jersey, 67 percent of New York, and 52 percent of Connecticut. On a typical workday in 1970 there were 7.4 million journeys to work; 25 percent of those ended in the Manhattan central business district. Sixty percent of all the work trips were by automobile, an increase of 39 percent since 1960. Transit trips dropped from 48 percent in 1960 to 37 percent in 1970. There are 7.5 million registered vehicles in the region, and 85 percent of all their travel is on highways.

DATA BASE

To establish its planning data base, Tri-State in 1963 conducted field surveys in the intensively developed urbanized area of the region. A home interview survey of 1 percent of the households (57,000 interviews) gathered detailed demographic and travel data. A land use survey field-listed all blocks in the urbanized area portion (except those in New York City, which were compiled from tax assessor records). Truck, goods movement, taxi, and external (cordon crossing) surveys were also accomplished at that time.

To cope with the processing and analysis of data for a region this size, Tri-State developed the square-mile data cell, defined by X-Y coordinates. Data from the surveys, originally coded to the block, were aggregated to these square miles, which are represented visually in many forms in our planning process. The origins of these are the data map, computer produced in strips and photographically reduced. Another form in which square-mile data are represented is the "stick model," a 3-dimensional approach that also begins with the data map.

The square-mile data cell is an example of our regional approach to this large land area, an approach that is often at variance with census geography.

PROCESSING CENTER

As a census processing center, Tri-State has obtained tapes for the region of the first, second, third, fourth, and sixth counts; the public use sample; address coding guides; DAULIST 1, 2, 3, and 4; the admatch program; grids mapping system; and Medlist. We were deeply impressed with the efficient advance preparation that the census bureau provided, by means of which we were able to prepare programs in advance of the receipt of all counts except the fourth. We simply put on the tapes and ran the tables.

A total of 841 tables have been formated and printed at varying levels of geography. Copies were sent to the state and county planning offices in the region, and a copy of each table was reduced to $8\frac{1}{2} \times 11$ in. and placed in a master file containing approximately 35,000 such pages. These are copied on order for any agency, private company, or person for the cost of copying. The Metropolitan Map Series on mylar made possible the reproduction of any part of the urbanized area and was sold to accompany the tabulations. Thus, the detailed data were made available in the region far ahead of census bureau publication. Special tabulations at cost are prepared for public agencies only because Tri-State is not in competition with commercial processing centers.

For our mailing lists and for public consumption, we have prepared a group of regional profiles that contain maps and tables and show distributions, densities, growth, and changes in the region. So far, 6 have been released on population, housing units, automobile availability, work places and work travel, education, and labor force.

Users of our data include a varied group: family agencies, those interested in local redistricting, Madison Square Garden, real estate offices, Ford Motor Company, agencies for the aged, mayors' offices, the High-Impact Anti-Crime Program, Manufacturers Hanover Trust Bank, Worldwide Volkswagen, the NAACP, the Rand Corporation, the Chase Manhattan Bank, Hospital and Health Plan for Northern New Jersey, the Federal Reserve Bank, Hoboken Model Cities Program, and the U.S. Corps of Engineers.

Tri-State is actively supporting the census bureau's geographic base file efforts by encouraging the adoption of the CUE program by the various state, county, and local agencies. So far, the only DIME file in the region is in Nassau and Suffolk Counties, although New York City is developing a related program, and other counties and cities have indicated an interest.

AS A USER OF CENSUS DATA

First, of course, the census data permit us to update parts of the 1963 surveys. The third-count population and housing unit block-level totals were summarized to the square mile by using our geographic converter file. We have devised a program to convert tract level summaries to square mile, but have not yet used it.

Our 1963 land use survey was the base for estimating major categories of land use for 1970 at the square mile. Comparison of 1963 and 1970 aerial photography and 1970 census housing unit counts were the new inputs. These estimates were then used in a land development allocation system to forecast housing, jobs, and population under conditions of maximum development. Housing data were also used to obtain replacement-development ratios for 10-year periods to the planned capacity of the region, to test the correlation of Tri-State's measures of accessibility against actual development between 1963 and 1970, and to obtain data-base consistency with state and subregional planning agencies.

Many data for updating the household part of the home interview survey (at the home site) were available, especially from the fourth count. For the travel portion, county-level demographic characteristics closely related to travel demands were studied and analyzed, and Table 35 from the fourth count has been converted to a county-to-county matrix (planning region in Connecticut). A computer program, which was developed from the 1963 survey, synthesized non-work-trip interchanges among counties based on 1970 demographic data.

The second travel analysis approach involves small-area (square-mile) data, which will be obtained from the Urban Transportation Planning Package (or our version of it), and I will return to that later.

An understanding of how Tri-State has used census data can be conveyed, I believe, by reports that have been completed: Housing Losses and Demolitions; 1970 Census Housing Statistics and Analysis of Housing in the Tri-State Region; Detailed Characteristics of the 1970 Population for the Tri-State Region; 1960-1970 County Migration Patterns; Regional Net Migration Patterns; Regional Population Forecasts, 1985 and 2000; Balancing Jobs and Housing in the Tri-State Region; Occupational Employment Projections for the Tri-State Region, 1985 and 2000; Income and Gross Rent Distributions among Non-Working Household Heads; Income Distribution of Households, 1985 and 2000; Trends in Regional Income Inequality; Floor Space per Employee Change, 1963 to 1970, Including Nonresidential and Employment Densities; A Decade of Change in the Journey to Work; Changes in Auto Availability during the 1960s; Fourth-Count Census Journey to Work; Transit-Oriented Age Groups; and The Extent of Public Water and Sewer Systems in the Tri-State Region.

To make travel forecasts, we need trip ends at the square mile for our models. Tri-State's traffic assignment for highway travel is obtained through use of the direct traffic estimation method, which uses a coded highway network, trip ends, and a decay function. Transit forecasts use the Fratar method for distributing central business district trips and the intervening opportunities model for distributing all other commercial transit trips. Transit traffic assignment for both methods is obtained through the assignment portion of the intervening opportunities model. We have designed 2 models, one for highway and one for transit, to estimate the remaining 1970 nonwork travel.

URBAN TRANSPORTATION PLANNING PACKAGE

Assuming that we would be able to obtain from the UTPP work trips coded to census tract and block, we requested in 1971 a cost estimate for the UTPP. Our zones were to be square miles in the urbanized area (to be obtained by using our converter file, which contains census block/Tri-State block equivalents), and the Universal Area Codes (UAC) for the entire region. Because the census bureau was not then prepared to provide cost estimates, we had some time to think about this request, and in March of 1972 we asked that our zones be quarter square miles in the Manhattan CBD, square miles for the remainder of the urbanized area, and MCDs for the entire region. At this point our difficulties began. The census bureau responded that

1. The large number of workers in the Tri-State region prohibited the use of the UTPP,
2. The place-of-work coding guide coverage was considerably smaller than we had realized, and
3. The estimated cost would be $80,000.

Tri-State realized that it had responsibilities to other planning organizations in the region with regard to the form in which the UTPP would be requested. Therefore, Tri-State carefully reconsidered its approach to the UTPP and also discussed the matter with a "regional team" consisting of the Port Authority of New York and New Jersey, the Regional Planning Association, the New York City Planning Commission, the departments of transportation of the 3 states, and later the Nassau-Suffolk Regional Planning Commission and the Westchester County Planning Board, both of whom had indicated an intense interest in the UTPP.

Our discussions raised so many questions that we could not answer that we asked the census bureau to send representatives to New York City to meet with us. We learned a great deal from the representative who came, but also made a discovery that filled us with dismay. We learned that the UTPP was designed for an SMSA, that 16-digit coding (to tract and block) had been done in coding guide areas of all of the 11 SMSAs in the region, but that very little inter-SMSA coding had been done. For ex-

ample, none of the cross-Hudson detail coding was done for trips from New Jersey SMSAs to the New York City SMSA. All that was available was UACs. We were told that the census bureau had begun this coding but did not have sufficient funds to complete the job.

This was a blow to all of us—even more so to some of the other agencies that needed smaller work site zones than Tri-State did. Perhaps we should have realized this before, but none of us did. In the meantime, the census bureau informed us that to recode the work trips from the New Jersey SMSAs to the New York City SMSA would cost $80,000. We began to feel that $80,000 specials had been designed just for us!

Tri-State then took a long look at the UTPP and decided to ask the census bureau to provide for us a quite different product. We were spoiled with our home interview survey, which we could slice as and when we wished. We needed something more flexible than the UTPP, and so we developed what we call the Worker File. The census bureau agreed that the approach was possible and helped us work out details.

Described briefly, the Worker File is a series of tapes containing for each worker residing in the region the following record:

1. Primary or secondary earner (primary = highest earner)
2. Household relation (basic relation code)
3. Mode of travel
4. Size of household (number of persons)
5. Number of employed persons in household
6. Automobiles available to household
7. Earnings of individual
8. Household income
9. Occupation
10. Industry
11. Value of owner-occupied unit (1 family, detached, without business)
12. Other owner-occupied unit
13. Monthly gross rent
14. Number of units in structure
15. Age
16. Sex
17. Race [white, Negro, Puerto Rican (Spanish origin in Connecticutt)], other
18. Class of worker
19. Hours worked (during week)
20. Years of school completed (highest grade attended + finished grade distribution)

The record should be coded to the finest geography possible, as follows:

1. Residence—state, county, MCD, place, tract, block
2. Work site—state, county, UAC, zip, tract, block

Because the records are confidential, these tapes will, of course, stay with the census bureau and be accessed by Tri-State and others at cost. Any sort of cross stratification of the variables in summary form can be requested, but limited, of course, by the bureau's rules for suppression.

After discussions of the need for recoding the inter-SMSA trips and the costs of doing so, arrangements were made with the census bureau (at a cost of $5,000) to conduct a test of 3,500 randomly selected work trips from residents in Bergen, Morris, and Monmouth counties who worked in the New York City SMSA and were coded to a UAC. We needed to know the degree of success of coding to tract and block before we proceeded to spend the larger sum. Coding success in the New York City SMSA was, according to the bureau, more than 80 percent in New York City and lower for other areas. For this test, the regional team asked that it be allowed to code the problem cases—trips the bureau could not code to 16 digits. The bureau agreed, as long as the records were treated as confidential, which meant that team members had to be sworn in and to work on the bureau's premises.

The bureau found to its regret (and to ours) that, because of a serial numbering defect in its files, 15 percent of the records were not retrievable and could not be retrieved for any future recoding. This meant that even with perfect coding no better than 85 percent success could be achieved. The system we had set up worked very well. There were 604 problem addresses (75 percent in New York City), and the problem solving group was able to code 91.5 percent to the census tract (with 85 percent to tract and block) and 7.6 percent to UAC only. Only 5 addresses could not be coded at all.

Encouraged by the success of the test, Tri-State investigated possibilities for raising the $85,000 finally estimated to do the larger part of the recoding. The Port Authority of New York and New Jersey agreed to pay one-third of the cost; Tri-State is paying the other two-thirds. The recoding effort will require 6 to 8 months to complete; the regional team will again code the problem addresses.

To obtain some measure of the cost to access such a file, we designed a county-to-county table of several cross-stratified data items about the traveler and his household. The bureau estimated the cost to be $5,000 and warned us that a great deal of suppression would doubtless occur. To determine how much suppression, the bureau offered, at its expense, to run a test of this table on Rhode Island records, which were then being used for other forms of testing.

The table showed that all but 13 percent of the summary records was suppressed; however, that 13 percent represented 57 percent of the employed labor force. We then cut the number of data items, and the table was rerun. This time the results showed that 46 percent of the summary records was suppressed, but the remaining 54 percent represented 95 percent of the workers. Staff analysis of the test results provided what we believe to be a good set of measures for suppression that we can use in planning future requests. Copies of the analysis report are available.

The Worker File permits any agency using it to establish its own zones and specify its own data requirements. The regional team helped construct the list of data items and agreed to the scheme. At the request of the 3 state departments of transportation, all the residents of each entire state were included. The file was completed in July, and the estimated cost is $9,000. Tri-State has already ordered from the Worker File a summary tape of tract-to-tract origin and destination by mode for the entire states of New York and New Jersey and the Tri-State region portion of Connecticut. (Connecticut had already ordered a town-to-town origin and destination table from the census bureau and stated that no smaller zones were needed.) Since mode is not a confidential data item, we will receive the tapes and be able to process them. The estimated cost to prepare the tapes is $7,500.

The Worker File will, we hope, prove to be a rich source of data for many agencies in the region. It is undoubtedly the only source of detailed, regionwide travel data available to us until the 1980 census. In the use of the file, Tri-State will act in a coordinating capacity. We will assist agencies in making their requests to the census bureau for data from the file; we will coordinate requests and inform other agencies who may wish to obtain tabulations, sharing costs where possible. We will certainly share any data we obtain from the file, and the members of the regional team have indicated that they intend to do the same. Tri-State intends to order a county-to-county table with several variables cross stratified. We intend to process copies of the tract-to-tract origin and destination file by mode and send them to the states and county planning offices.

In spite of the lengthy process, the occasional cries of pain, and the feeling that we would never reach the goal, the end is at last in sight. We hope that what we learned along the way will be useful in planning for the future, and we are grateful to those in the Bureau of the Census who stayed with us until this point was reached.

The State of California

Noreen Roberts, California Department of Transportation

The California Department of Transportation uses data from the U.S. Census of Population and Housing in many areas of transportation planning. Based on that use, the following suggestions are offered for improving the format of the data for transportation planning purposes.

URBAN TRANSPORTATION PLANNING PACKAGE

The Urban Transportation Planning Package (UTPP) was designed jointly by the Bureau of the Census and the Federal Highway Administration to provide a standardized set of census data for the specific use of transportation planners and to eliminate the need for transportation studies to order individual cross tabulations of data of similar format and at a duplication of costs. In addition, the UTPP was designed to provide these data at the geographic level of traffic analysis zones or groupings of census blocks not heretofore available.

The California Department of Transportation had received data for only 3 of the 17 SMSAs in California by July 1973, and only preliminary analysis results were available. In the process of obtaining data from this package, we have encountered a variety of problems. The more significant of these are summarized below.

Time Lag

Although the census was conducted in April 1970, by August 1973 we had acquired and were analyzing data for only 3 of the 17 SMSAs in California. Part of this delay was caused within our own organization in funding and processing the actual contract. Part of the delay was understandably the time required to format and program for processing, although this lead time was probably underestimated. However, one major cause of delay was the restriction of a 5-digit code for traffic analysis zones. This restriction required the creation of 2 sets of geographic correspondence tables and precluded the use of computer coding.

Many transportation studies in California had already prepared on tape correspondence tables that equated traffic analysis zones to 1970 census tracts. However, both the zonal numbering system used in California and the census tract numbers are 6 digits. An additional correspondence table was required to equate these zone-tract numbers to a new 5-digit number. This problem was resolved in the Los Angeles area by asking the census bureau to assign sequential numbers to each census tract, zip code (ZC), and Universal Area Code (UAC) within the equivalency printouts for the four SMSAs in the region since their traffic zones are for the most part census tracts. Additional time will be required to process the data records, to reformat to allow space in the record for 7 digits of traffic zone identification, and then to recode all the records in all the data tapes to a usable traffic zone number.

In the design of future packages, we recommend a more flexible format for traffic zone coding.

Coding of Place of Work

To provide the place-of-work information during the 1970 census, respondents were asked the following question:

c. Where did he work last week?

If he worked in more than one place, print where he worked most last week.

If he travels about in his work or if the place does not have a numbered address, see instruction sheet.

(1) Address *(Number and street name)* _____

(2) Name of city, town, village, etc. _____

(3) Inside the limits of this city, town, village, etc.?

○ Yes

○ No

(4) County _____

(5) State _____ (6) ZIP Code _____

Our understanding is that the locational information provided by the respon vas coded by the census bureau as follows: Street address was matched against the ıdress coding guide. If there was a match, the appropriate census tract and block were coded. If there was no match, the ZC was taken from the questionnaire. If there was no ZC recorded by the respondent, the UAC (CBD, city, or remainder of county) was coded based on responses 2, 3, and 4.

A summary of the geographic coding for 14 of the 16 SMSAs in California showed the following distribution: 57.0 percent of all workers were located to the census tract-census block level of their places of work, 20.8 percent were located to the zip codes of places of work, 14.8 percent were located to the Universal Area Codes, 7.0 percent did not report places of work, and 0.4 percent were located in UACs we did not specify to the bureau.

Preliminary analysis indicates that approximately two-thirds of the zip codes listed are erroneous in that they either conflict with the county code or such a ZC number does not exist. For the one-third of the zip codes that seem valid, proration of data to the census tract-traffic zone level will be difficult because of problems in obtaining maps, boundary descriptions, and hence correspondence of zip code to census tract.

At this time we do not have data for all of the SMSAs and, therefore, cannot determine the number of workers assigned valid or invalid zip codes. However, employment by place of employment is a critical variable in transportation planning. Given that 21 percent of this employment is coded to zip code and another 7.4 percent cannot be located, the reliability of this variable will have to be extensively evaluated.

We strongly recommend that the zip code be dropped from any future coding for transportation planning and that implementation of the CUE program be stressed.

Journey to Work

The cross tabulation of employed persons by zone of residence, zone of work, and by mode of transportation is the only trip table provided in the package. We wonder whether it would be feasible to provide additional tables stratified by variables that are also significant for planning evaluation. For example, in addition to mode of travel, tables of zone-to-zone work trips stratified by income classes, by structure type, and by automobiles available would be useful.

Employment Classifications

As mentioned above, employment by place of employment is used extensively in planning. In the future, can employment data be made available at a 2-digit Standard

Industrial Classification of some 41 strata rather than the current Major Industrial Group stratification of 14? We realize the reliability or suppression problems or both that may be involved. Such a breakdown would be extremely useful but may not be feasible. We also request that the inconsistencies among Parts I and III—count of employed persons age 16 and over, Part IV—count of employed persons age 14 and over, and Part II—count of work trips be resolved to a single employed person total consistent among parts.

Median

It would be helpful to have median as well as mean values where appropriate.

Table Totals

Part IV totals of trips by mode are available for zone of residence. However, it would be helpful to have totals by zone of employment as well. In Parts I, II, and III, in cases of stratification, subtotals are provided for each strata, but no grand total is provided.

Urban Transportation Planning Package Format Program

The UTPP format program as received from the census bureau was not operational. In addition to the conversion problems that we had anticipated, there were problems in program logic. The program did not select individual zones. It did not select individual tables. It could not handle more than one Part II series entry; that is, it would not accept more than one urbanized area code per SMSA. The program was designed for a smaller machine so that it was rather inefficient and expensive to run on the IBM 370/165. We have redone the program to meet the specifications listed in the program documentation. Listings and copies of the program deck have been sent to FHWA and are available from our Computer Systems Department. We expect to prepare a second version of this program that will include the capability of expanding the existing records and handling a 7-digit traffic zone identification.

OTHER CENSUS DATA

Although this report deals primarily with the urban area data needs, the nonurban areas of California use census data for transportation planning. The following is a brief description of some of their problems.

Maps

Three sets of maps from the census map series are used extensively in the transportation planning process: the Metropolitan Map Series, the County Maps, and the Place Maps. These maps contain both census and jurisdictional boundary lines that are of various degrees of shading and difficult to read. Prior to 1970, the bureau indicated these maps might be available as a series of overlays on a base map. Such a series would be much easier to work with, and we suggest that the bureau reconsider this approach for the next census.

Enumeration Districts

In areas where enumeration district boundaries are used for the delineation of traffic

zones, some consideration should be given to the shape of these districts and the use to which they may be put. In some instances enumeration districts have been split into 2 or more noncontiguous segments. It would be useful for statewide planning if some of the same detail in socioeconomic variables available at the census tract level could be available at the enumeration district level.

CONCLUDING REMARKS

A report that attempts to offer suggestions and recommendations to the Bureau of the Census and the Federal Highway Administration for improving data from the census for use in transportation planning tends to focus on the problems encountered in the use of these data and fails to emphasize overall how invaluable these data are. They provide the benchmarks, both geographical and socioeconomical, on which we base much of our analysis.

We wish to thank the personnel of the Bureau of the Census for their extensive cooperation and help in resolving many of the problems we encountered in processing the equivalency printouts. They modified their procedures to permit us to obtain unique urbanized area data by individual SMSA and were particularly helpful in locating lost or strayed census blocks and tracts. We trust they will be equally patient when we start processing and analyzing the data files, for we will surely provide them with an entirely new set of questions.

HOW CAN THE CENSUS BETTER SERVE THE NEEDS OF METROPOLITAN AREAWIDE TRANSPORTATION PLANNING?

J. Douglas Carroll, Jr., Tri-State Regional Planning Commission

One of my earliest connections with the Bureau of the Census was back in the 1940s when I was the Census Tract Key Person for the Flint, Michigan, metropolitan area. That was a good title, and I worked at developing local tracts for the 1950 census and also at fashioning uses of the 1940 tract statistics. I prepared tract maps and coding books. This work appealed to the census bureau people, I believe, for they came around to look into local usage; their readiness to gather and tabulate small-area data helped our metropolitan community.

In 1953, I went to Detroit to make a traffic study. The 1950 census was completed. We had an urgent need for an accurate and thorough universe of households from which to draw a sample for the origin-destination survey. We went to Washington to urge or cajole the census bureau into providing a sample of addresses for Detroit and its environs. "After all," we argued, "the census is part of the federal establishment, and our work is being financed in part by your sister agency in the Department of Commerce, the Bureau of Public Roads." I was unaware and naive. I did not know that an address involved disclosure and that the census bureau was very concerned that its reputation for statistical and scientific precision be maintained and protected. But with an assist from the governor and congressmen, we developed a very workable compromise. The census bureau would take the survey for us and would assign a director who was acceptable to our local policy group. Together we would hire the field personnel and carry them on our local payroll, but they would be sworn in as census enumerators without pay. In this way, the census bureau could prepare samples carefully drawn and designed for day and date of interviewing. The interviewers could indicate that they were working for the Bureau of the Census. To me it was a great success, and I learned a great deal from the census people. Wherever he may be, I am particularly indebted to them for assigning John Grant to direct that work.

In the process we "proved" or audited the 1950 census for Detroit. We found a few fictitious homes, but we also found the census to have been well taken and highly accurate.

My next encounter was in 1956 or 1957. At the Highway Re-

search Board, we had been talking about adding questions to the forthcoming 1960 census. During the January 1957 meeting we visited the director of the census and pleaded our case. After numerous objections and many arguments, we allowed as how car ownership—at least—would have to be counted. After all, radios, TVs, and refrigerators were. And we urged that the mode of travel to work for employed persons be obtained, for to do so would be easy and inexpensive. Although they countered by saying, "One question = x million dollars," they agreed to think it over, and I like to believe that we played an important part in getting these 2 items on the 1960 census.

One final item is the cooperative work toward developing coding guides in the 1960s. In this period the census bureau faced for the nation what we transportation planners had been facing in one urban area after another—the problems of coding street addresses. We knew it to be a dirty, inexact business. We also had experimented with machine matching, block-face coding, and conversion to coordinates. I believe the census people underestimated the difficulty of coding work addresses. But they did understand the difficulty and the effort involved in developing address coding guides. They did succeed, in large part through the friendly efforts of Jake Silver, to develop a cooperative program to generate local block coding guides for "metro" areas. Many of us in the metropolitan planning business pitched in. It was a good effort, but less than perfect. Again, we all learned, and we still are.

And now we have the 1970 census data. The items compare quite well with the 1960 car-ownership and journey-to-work data. There are the Urban Transportation Planning Package, a definite body of wider usage, and therefore greater working familiarity on the part of the census bureau with the metropolitan consumers. We want small-area data, and we are all willing to work to get it. We need it because home interview surveys are incredibly time-consuming and expensive.

In 1973, because of the effort to code work address to blocks or block faces, we all ran into the work address coding problem. How finely can we code? How do we develop a proper effort in coding unmatched addresses? How do we define a CBD?

One thing we think we learned in our area was a way to deal in small-area geography yet avoid the troublesome problem of disclosure. Through a conference among some of the Tri-State area users, the census people, and the U.S. Department of Transportation, we settled on a new device. It is a Worker File, which Boswell discussed in his paper earlier in this report—that is, for every worker one record that includes the socioeconomic characteristics of his or her household and other related data gathered on the 15 percent sample. This file is retained only by the census bureau, but we can order tabulations in various configurations. The bureau can exercise its judgment in suppressing any potential disclosure of an individual or establishment fact. In this way, tabulations can be thought out and ordered with access to the greatest detailed file but with no disclosure dangers.

All of us in metropolitan planning use census data extensively, but have we considered how best to use the great capability of the census bureau—the geography division, the statistical staff, the field division, the users' group, or the data processing and tabulating staff? We should do so selfishly, for I can assure you that the census people will respond and will help. They have shown a great willingness to assist us in the past.

We all want to use census data to avoid updating our old surveys. This subject could take us deeply into technique. I will merely note that in my opinion the present questions on the 1970 census provide an untapped source for economical updating, so I will refrain from trying to suggest more questions until we in the field have made the most of what is currently available.

CODING

We immediately face the prospect of better coding machinery. The software programs being developed to edit coding guides, the techniques for going from written addresses to blocks or block faces or tracts by machine, and the development of better areal measures and coordinate coding being tackled by a skilled organization with a national program promise much wider user groups for geographic coding and much more

meaningful use of existing records. For example, utility meters, tax records, housing permits, and health records could be available on a more frequent and finer geographic base than ever before if the coding machinery were working. Such usage will, in turn, sharpen the coding device and improve currency and accuracy. (Realize that 100 percent coding is still a dream.)

MAPPING

Not only do we look to the census bureau to advance this capability but also we look to the bureau to develop improved data mapping programs where topological surfaces can be direct outputs from geographically detailed records. Much remains to be done here, but the technology is crying to be tested and developed. Better techniques of areal measurement go hand in hand with improved visual output. Data maps are crucial to small-area use of census coverage.

SMALL-AREA BITS

I hope we can fix on a useful, national coordinate coding framework. I believe the day of the tract is partly over and, for many items, minor civil divisions are of limited use. For transportation planning we do need more flexible geographic coding options. The block is a valuable building element, and the possibility of gathering blocks into various sized units for convenient analysis is both attractive and compelling.

USE OF CPS TO PROVIDE UPDATE

How can the field division and the sampling skills of the census bureau be used? Special surveys are one way, but these are expensive and require a lot of coordination. Another way is to use a vehicle such as the Current Population Survey (CPS). Could we piggyback some questions on this small sample to keep current on car ownership or even trip-making? Could we explore the use of this carefully designed "panel" so that a special sampling of citizen opinions could be obtained? Increasingly we are required by federal regulations, guidelines, instructional memoranda or other hortatory devices to "be responsive to all citizen groups." It would be most helpful to have a device other than elections or referenda to sample true cross sections of the public on critical issues.

This may open a whole new hard-to-measure territory—fraught with political sand traps—but the census bureau could, by using the device of data control, prevent disclosure or careless interpretations.

NONHOME DATA

Another improvement we would like to see in census data is the provision of more information on the nonhome parts of the metropolitan area. We need good proxy measures to identify the nonhome end of daily journeys. For trucks, the trip end is seldom at home; and, even for residents, nearly 4 out of 5 trips leaving homes go to some nonresidential land use. One limited goal would involve a full coding of worker locations, but problems in defining workplace make this very difficult. What can the census bureau provide as a measure of nonresidential land use? Is there a market for this other than transportation planning agencies? Could there be a committee to explore the use of the censuses of retail and wholesale trade and business and other federal records?

CENSUS OF TRANSPORTATION

With regard to the census of transportation, we would like to know more about the

flows of goods. The ICC once made a 1 percent sample of waybills, but that involved only long-haul major carriers. Is it possible to sample goods on their way from mine and field to factory to warehouse to retail outlet and to home? Remember, more than 20 percent of the cost of a delivered product is transportation.

Another item missing is intercity travel. Is it rising or falling? Is it mainly business oriented or recreational? Are airlines providing more of this service, or is it by passenger car? None of us in metropolitan areas can easily assemble the picture of interregional travel.

Could the national transportation census record vehicle usage so as to answer the question as to whether annual vehicle mileage is growing, remaining constant, or declining? (The experience gained in the old motor vehicle use surveys may prove this to be difficult or unmanageable, but there may be useful, alternative ways to answer this question.)

BITS AND PIECES

What is the value of a limited quinquennial census as opposed to a slightly enlarged CPS? We expect that income distribution, housing stock changes, car ownership, and nature of mode of travel to work change enough so that 5-year estimates are wanted to keep survey estimates of urban travel up to date.

Finally, would it be possible to record elapsed time of journey to work as an add-on item? This question was successfully used back in the 1930s on real property inventory surveys, and it is a measure that reflects somewhat on the livability of an urban area.

CONCLUSION

These are somewhat random thoughts to initiate discussion. We need to devise a list of critical data items that collectively would allow an update of a metropolitan region's travel estimates and to consider the level of geographic detail that would suffice for each measure. Experience has been that the census bureau can find ways to satisfy such demands once it is convinced of the need.

I suggest that, as an outcome of this conference, the Transportation Research Board, in cooperation with appropriate federal agencies, establish a working committee to further explicit uses of census data and to meet with and advise the census bureau on area-wide urban planning needs. Such formal machinery will eliminate some lost time, consolidate experience, and provide a useful working record for this important subject.

TRANSPORTATION PLANNING DATA IN THE 1980 CENSUS

Marshall L. Turner, Jr., U.S. Bureau of the Census

REVIEWING THE 1970 CENSUS EXPERIENCE

As in 1960, the 1970 census sought to obtain information on where the residents of a given area worked. Tabulations of this information have appeared in printed reports and, in addition, place-of-work data have been made available on our fourth-count summary tapes.

Unlike the 1960 census, the 1970-census place-of-work question was linked to the new and locally prepared address coding guide (ACG) tape files. With special congressional appropriations of almost $5 million, a massive clerical and computer operation was undertaken to code the work sites reported by respondents to the lowest possible geographic level, i.e., census tract and block.

We were looking for 2 payoffs from this new 1970 procedure: (a) a file of basic census records with detailed place-of-work codes that could be used for special tabulations; and (b) a thorough evaluation of the new techniques used to collect, code, and disseminate this information, the goal being to plan the techniques to be used for the 1980 census. Through the combined efforts of the U.S. Department of Transportation, the Bureau of the Census, and data users, we are realizing these payoffs. As part of our evaluation goal and 1980 planning, we are documenting and studying problems with the 1970 place-of-work information.

Quality of the Data

The basic strength or weakness of the data was determined by how well the respondent knew and reported his place-of-work address. Next in importance was whether the reported work address corresponded to a street-address range in the coding guides. Assuming that the respondent did know and report an address that could be coded, the clerk had to accurately mark down the corresponding geographic code (16 digit maximum). Subsequently, this code was computer matched against an ACG file to assign specific census-area codes such as census tract and block. Although we do not now have available data on the error rates associated

with each of these operations, on the average, approximately 65 percent of the work addresses within SMSAs could be coded to census tract and block. This percentage would probably be significantly higher if figures were available for only the portions of the SMSAs covered by coding guides.

Allocation of Nonresponses

Approximately 7.6 percent of the workers covered in the 15 percent sample in 1970 provided no response to the question on place of work. That compares favorably to nonresponse rates of 20 percent on questions such as income.

Some 40 SMSAs were affected by a processing error that occurred in the system of allocating workers to places of work when the information on their workplaces was incomplete. The problem concerns certain workers with incomplete zip code responses. These cases were initially recoded to 00000; the plan was to distribute them among legitimate zip code ranges for the entire area. However, because of a limitation in the memory capacity of our computer processing system, these allocation cases were not randomly distributed for 46 SMSAs and 2 specified counties. Instead, these cases were all assigned among the lower series of zip codes for the given area. The effect of this error is that some zip code ranges were used too frequently in allocating work sites, and other ranges were under used. The proportion of workers involved in the error is generally quite small. For 29 of the 48 areas, 2 percent of the workers or fewer are involved; for only 3 areas are 5 percent of the workers or more involved.

This error was found just prior to the tabulation of the data for 1970 Population Census Report PC(2)-6D, Journey to Work. Since the scope of the problem is reasonably limited and since a reallocation process was not feasible for a number of reasons, the census bureau decided to remove these cases from their allocated destinations and tabulate them in the "not reported" category for the PC(2)-6D report. This was done only for the affected areas; the areas where the allocation process had been carried through correctly were tabulated as originally planned. Thus, insofar as the PC(2)-6D report is concerned, the data for the affected areas and the data for the unaffected areas will reflect different handling of such incompletely reported cases. Furthermore, the data in the PC(2)-6D report for the affected areas and in the PC(1)-C and D reports will reflect a different handling of these incompletely reported cases. The text of the PC(2)-6D report will describe these differences.

Insofar as the special Urban Transportation Planning Package is concerned, the budgetary limitations will not permit us to retabulate the data for the affected SMSAs already completed. If, however, new requesters order these tabulations for any other affected areas, we could develop estimates of the additional costs involved in correcting this error.

A more complete and detailed description of these problems and the overall quality of the place-of-work data are presented in the PHC(E) report.

BEGINNING TO PLAN FOR 1980

In July 1973, we entered the first fiscal year of planning for the 1980 decennial census. At the writing of this paper, the congressional appropriations covering this first year of planning work had not yet been approved, although Congress has looked favorably on such planning money, and we expect affirmative action.

As in any large undertaking, there will be many competing viewpoints within the census bureau itself about the techniques to be used in the forthcoming decennial census. I mention this fact candidly because exchanges within our organization and in conferences such as this one are both healthy and helpful.

Before going into the 1970 census, the content and procedures that were used were closely scrutinized by the staff of the bureau, its professional advisory committees, other federal agency representatives, and the Office of Management and Budget. Also, as resources permitted, bureau representatives met with local governmental officials

and private organizations in a number of different cities to hear their views on the plans for the 1970 census.

Many of the suggestions had to be ruled out because they were not in the public interest, were too complex or too personal, or were more appropriate for a large sample survey than for coverage on the scale of the decennial census. However, we felt that it was best to entertain suggestions and to consider them earnestly before we made decisions on the many aspects of such a massive undertaking as the decennial census.

Having established this context, I would like to present some of the aspects of the 1980 census place-of-work data that we expect to consider during the coming months.

Coding Guides

Perhaps the most basic tool for assembling and processing the detailed place-of-work data that transportation planners want has been the address coding guide. Because most everyone is familiar with these files, I will not detail their content. Instead, I will focus on the bureau's CUE program, which involves the correction, update, and extension of the geographic base files (GBF). The goals of the CUE program include not only the correction and maintenance of the GBFs that were used in the 1970 census but also the expansion of these coding guides to cover as many as possible of the structural addresses within SMSAs, rather than just the urbanized portions of these areas. A part of this work will also include the updating and extension of the Metropolitan Map Series that corresponds to the GBFs.

One of the basic deficiencies in the 1970 census coding guides with respect to the UTPP was the lack of coverage of many work-site addresses. With the cooperation of the local groups that are working to maintain and update their files as part of the CUE program and with the special coding files that have been and will be derived from the economic censuses that are taken before 1980, we feel that we can develop a much stronger resource for coding work addresses reported in the 1980 census.

Of course, our ability to use this expanded coding resource will depend not only on its quality but also on the accuracy and completeness with which the respondent reports the address of his or her workplace.

Other Coding Resources

As in 1970, we will not depend solely on the coding guides as a means of assigning census area codes to the work-site address. City directories, listings of company names, telephone directories, and other directories will be used to code responses that are incomplete or not covered by the coding guides.

In addition, we will consider the advantages and disadvantages of having, as a possible coding resource, information obtained from transportation planners and others in a given metropolitan area who are familiar with the locations and addresses of various workplaces. The special recoding projects that are now under way for the Tri-State organization in New York have already provided us with some insights into how such local-area knowledge might be used in coding place-of-work responses that are incomplete.

Manual Versus Machine Coding

Should the 1980 census emphasize manual or computer operations with respect to the initial stages of processing? Can the tedious and repetitive operations best be performed by hundreds of clerks with green eyeshades and quill pens or by thousands of transistors, relays, and spinning tape drives?

Before the 1970 census, in fact, some of us at the bureau had visions of setting up an interactive computer-based system like that used for entering or confirming airline reservations so that the coding clerks could key in a work address or company name

and get back the necessary codes for the place of work. However, the 1960-census data indicated that no more than 5 percent of the workers living in a particular coding area (or commuter shed) actually worked in the urbanized part of another coding guide area.

With respect to coding the place-of-work addresses in 1980, using the computer poses several obstacles, such as the costs and the manner of inputting the original information supplied by the respondent, developing comprehensive dictionaries for the computer, and recycling the cases that are rejected and must be handled with manual intervention. However, such a system's potential gains in time and accuracy appear to be great, even if a significant amount of the coding remains to be done manually.

Many transportation planners have been faced with some of these same problems in coding the origin and destination addresses collected in local origin-destination surveys. Granting the significant differences in volume between these surveys and the census, the bureau would still like to hear of experiences in this area.

Decentralization Versus Centralization of Coding

Not unlike the contrasting views about manual versus machine techniques for coding place-of-work data are the contrasting opinions about centralizing versus decentralizing such coding operations. Instead of viewing this as a dichotomous set of alternatives, I would prefer to think of degrees of centralization as lying on a scale, with extreme decentralization on one end and extreme centralization on the other.

For some parts of the processing of the place-of-work data, the ideal point on the scale may be near one end; for other stages of the processing, the desirable point may be nearer the other end. For example, the physical receipt of the census questionnaires containing these place-of-work responses is best handled through our system of several hundred temporary field offices that are maintained during the decennial census period. On the other hand, the actual clerical coding of the place-of-work responses could conceivably take place in these temporary field offices or, more likely, at the regional office level in a dozen or so cities around the country.

Let us consider some of the arguments for coding place-of-work responses in a single operations office. With such centralization, closer supervision of the entire operation can be maintained. It is also easier to ensure that the same methods and procedures are applied for coding data for all parts of the country.

In terms of logistics and resources, there is less duplication of resource materials required, which in turn reduces costs. If computer-coding techniques are to be used, centralization might also be favored, for such a procedure is more economically carried out at a single machine installation.

In addition, locating the clerical coding force for operations of this type in one area allows the shifting of personnel from one operation to another as certain phases of the work are completed or as peaks and valleys occur in the workload. Thus, personnel are more economically used.

Now let us consider the advantages of decentralization. One argument is that, if a high degree of decentralization is employed in coding places of work, use could be made of the detailed knowledge that people in the local area might have. This type of payoff might not be possible unless extreme decentralization took place, such as having place-of-work responses coded in many of the several hundred district offices that will probably be used in the 1980 census.

It might also be argued that such decentralization would speed the coding of place-of-work responses, for the coding could be an ongoing operation as the questionnaires were received in these district offices from the respondents who returned them by mail.

Role of the Transportation Planner

One obvious role for the transportation planner is to report to us both the good and the bad points of the standard census tabulations on place of work and of the Urban

Transportation Planning Package data. We have already begun to study the reports provided by the Albuquerque and Wilmington planners, and we will carefully review the results of this conference.

We also propose that the local transportation planning groups work to establish their traffic zone equivalencies as soon as possible before the 1980 census. This can be done by using the Metropolitan Map Series and the extended metropolitan maps that the bureau's Geography Division is now developing as part of the CUE program. This will reduce the time required to prepare data of the type represented in the Urban Transportation Planning Package.

It probably goes without saying that it would also be advantageous for transportation planning groups in each metropolitan area to maintain close working relations with the groups that are maintaining and updating the GBFs. In many cases there is considerable overlap between these 2 types of groups; in other cases, very little contact, if any, existed before the 1970 census.

CONCLUSION

The points I have made in this paper may have an idealistic tone to them, and many may feel that we are not completely serious (or even wise) to encourage complaints and suggestions. However, having been a part of the planning for the decennial census for the past 9 years, I know that thoughtful consideration is given to all the suggestions we receive. Before the 1970 census, I reviewed hundreds of letters from users expressing their thoughts about the content and data that would result from the 1970 census. These inquiries ranged from students who wanted to know how we would count Siamese twins to pet food manufacturers who wanted us to include a question on the number of animals in the home. These humorous examples as well as the less humorous were each read, reviewed, and responded to in the context of what questions were feasible and reliable and would result in needed information.

The census bureau is most concerned with preventing the data processing and related problems that occurred in the 1970 census. As well as striving to do things right, we are also striving to do the right thing and make the output of the 1980 census more useful both to planners and to all others who can benefit from census data.

LOOKING TOWARD THE 1980 CENSUS

Constantine Ben, Federal Highway Administration

At the Federal Highway Administration, we conducted a telephone canvas of those states and urban transportation studies that ordered and received the Urban Transportation Planning Package. As of this writing, 112 urbanized areas have ordered the package (Table 1). (This does not include special orders.) Of the 112 orders, 7 were filled in 1972 (Wilmington, Delaware; Bay City, Michigan; Madison, Wisconsin; Albuquerque, New Mexico; Billings and Great Falls, Montana; and Fargo-Moorhead, Minnesota) and the remaining 44 in 1973. States that had not ordered at all were Maine, New Hampshire, Vermont, District of Columbia, Maryland, Virginia, West Virginia, Tennessee, Louisiana, Utah, Colorado, and South Dakota.

It is too early to make a definite judgment as to the effective use of the package; nevertheless, based on the responses from the field, we have made the following observations.

1. Only a few areas have made use of the files. In addition to Albuquerque and Wilmington, only Madison, Minneapolis-St. Paul, Spokane, Eugene, Portland, and Fargo-Moorhead have undertaken tape processing. The latter 3 areas reported limited use.
2. The remaining areas have used the printout. As a rule, the census bureau has supplied a copy of the printout of the package first, and the tape followed several weeks later. About a half-dozen areas only recently received their tapes and have not had time to process them. Columbia, South Carolina, has not yet used the data at all because of difficulties arising from the study area being twice as large as the package coverage.
3. The use of the printouts was limited to only Parts I and II. Although the use of Parts III and IV is planned, some areas were quite concerned about whether they will be able to make the necessary adjustments for application. Part I data are being used as a check against other local data, in model development, in various levels of reviews, in corridor studies, and in transit studies. All users were pleased with these tabulations of the socioeconomic characteristics of the population by zone of residence.
4. The question arises, Why such a limited use of the package, especially of Parts III and IV? The most prevalent answers were

Table 1. Use of Urban Transportation Planning Package.

Region	State	Number Ordered	Number Received	Use		
				Tape	Printout	None
1	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, Puerto Rico	13	2		2	
3	Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, West Virginia	13	9	1	8	
4	Alabama, Florida, Georgia, Kentucky, Mississippi, Tennessee, North Carolina, South Carolina	19	7		6	1
5	Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin	29	13	2	11	
6	Arkansas, Louisiana, New Mexico, Oklahoma, Texas	7	5	1	4	
7	Iowa, Kansas, Missouri, Nebraska	6	6		6	
8	Colorado, Montana, Utah, Wyoming, North Dakota, South Dakota	3	3	1	2	
9	Arizona, California, Hawaii, Nevada	18	3		3	
10	Alaska, Idaho, Oregon, Washington	4	3	3		
Total		112	51	8	42	1

that lack of time, staffing limitations, reorganizations, and computer problems all seriously affected the use of the package. My personal observation is that many were reluctant to tackle the adjustment problems associated with Parts III and IV.

In summary, our experiences to date are as follows:

1. The actual application of the package has been quite limited;
2. The data were unfortunately slow in coming—about 1 year behind original estimates (in August 1973 fewer than half of the ordered packages had been delivered);
3. Most users do not have time or ability to go through any adjustment process; and
4. Only about half of the urbanized areas in the country ordered the data.

These facts lead us to conclude that, in 1980 and particularly in pretests, we should be concerned with the following items:

1. There must be a rephrased journey-to-work question that will elicit a higher quality address;
2. The geographic coverage of the journey-to-work coding should be expanded to SMSAs and must cover multiareas in large urban regions;
3. The coding resources (guides, maps, business directories) must be significantly enhanced; and
4. The processing must be speeded up and possibly contracted out.

It might also be well to consider the institutional framework that will exist for future urban transportation planning. New highway legislation provides special funds to metropolitan agencies for urban transportation planning. These funds amount, in general, to about 23 cents per capita or about $11,500 per year in areas of 50,000 population and about $230,000 per year in areas of 1 million population.

If we consider that a well-balanced urban study should devote more than 20 percent of its resources for data, leaving the rest for actual plan development, then study data budgets in the 50,000 to 1 million population range would extend from $2,000 to about $40,000 per year. These amounts include provision for travel surveys, traffic counts, and surveillance activities as well as census data. Thus, we see that the small areas are going to remain in a bind to get data, while large areas can afford comprehensive data bases. The UTPP costs areas in the 50,000-population range approximately $1,400 and those in the 1-million range $8,000—a real bargain on a per capita basis. Small studies will be one-person operations, and large studies will perhaps be able to afford data specialists.

Looking toward 1980, we are optimistic. In spite of the shortcomings of the 1970 experience, we do not suggest turning back. The worst problems are behind us and, having identified the weak areas, we should proceed to develop a refined, more adequate, and more flexible approach to uses of census data in transportation planning.

PARTICIPANTS AND SPONSORING COMMITTEE

Participants

Larry Adcock, Bureau of Business Research, University of New Mexico, Albuquerque
Al Alamagro, Albuquerque Transportation Department

Robert Barraclough, Information Systems Consultant, Washington, D.C.
Constantine Ben, Federal Highway Administration, Washington, D.C.
Haden Boswell, Tri-State Regional Planning Commission, New York
Ned R. Brooke, West Palm Beach, Florida

J. Douglas Carroll, Jr., Tri-State Regional Planning Commission, New York
Maurice M. Carter, Delaware Department of Highways and Transportation, Dover
Michael V. Connolly, Albuquerque Environmental Health Department
Thomas A. Cooney, Peat, Marwick, Mitchell and Company, Albuquerque
Richard E. Corbett, Pima Association of Governments, Tucson
Gary R. Cowan, Office of Community Development, Olympia, Washington

Clyde Deets, Albuquerque Data Processing Department
Kenneth J. Dueker, Institute of Urban and Regional Research, University of Iowa, Iowa City
Fred M. Duncan, Escambia-Santa Rose Regional Planning Council, Pensacola, Florida
David J. Dunlap, Pennsylvania Department of Transportation, Harrisburg
Robert Dunphy, Metropolitan Washington Council of Governments, Washington, D.C.

Christopher R. Fleet, Federal Highway Administration, Washington, D.C.
Richard L. Forstall, Population Division, U.S. Bureau of the Census, Washington, D.C.
Alexander French, Office of Planning, Federal Highway Administration, Washington, D.C.

Charles R. Gebhardt, Ohio Department of Transportation, Columbus
David E. Geiger, Michigan Department of State Highways and Transportation, Lansing
Dale G. Glass, Middle Rio Grande Council of Governments, Albuquerque
Alan Goodman, Albuquerque Transportation Department
R. Guglielmino, Des Moines
Yehuda Gur, Oak Park, Illinois
Wayne Gyulai, New Mexico State Planning Office, Santa Fe

Vern Hagen, Albuquerque Planning Department
John R. Hamburg, Creighton, Hamburg, Inc., Bethesda, Maryland
John Harrington, Metro Plan, Little Rock
Gregory G. Henk, Colorado Department of Highways, Denver
Tymen W. Hofflander, Pikes Peak Area Council of Governments, Colorado Springs
Kenneth Howell, Middle Rio Grande Council of Governments, Albuquerque

Will Jefferies, Wasatch Front Regional Council, Utah
Keith Jones, Metro Plan, Little Rock
Dayton P. Jorgenson, Transportation Division, U.S. Bureau of the Census, Washington, D.C.

Paul Kaczorowski, Florida Department of Transportation, Tallahassee
Martin Kahel, Florida Department of Transportation, Tallahassee
Walter H. Kondo, Bureau of Transportation Planning and Development, Massachusetts Department of Public Works, Boston

E. D. Landman, Planning and Development Department, State Highway Commission of Kansas, Topeka
Roger O. Lepage, Demographic Census Staff, U.S. Bureau of the Census, Washington, D.C.

Paul Manka, Users' Service Staff, U.S. Bureau of the Census, Washington, D.C.
Alfred J. Marston, New York
Morton A. Meyer, Geography Division, U.S. Bureau of the Census, Washington, D.C.
Eugene R. Mills, Iowa State Highway Commission, Ames
Robert Mueller, MAPA, Omaha
Eugene G. Muhich, Federal Highway Administration, Denver

Ed Ordonez, Albuquerque Transportation Department

William M. Parker, North Central Texas Council of Governments, Arlington
John W. Pascoli, West Virginia Department of Highways, Charleston
Albert I. Pierce, Middle Rio Grande Council of Governments, Albuquerque
Alan E. Pisarski, U.S. Department of Transportation, Washington, D.C.
Michael Platt, New Mexico State Highway Department, Santa Fe

Noreen Roberts, California Department of Transportation, Sacramento
Sydney R. Robertson, Maryland Department of Transportation, Baltimore
Connie Rossignol, Albuquerque Department of Transportation
Ben Ruiz, Albuquerque Data Processing Department

Fidencio Sandoval, Advisory Committee, U.S. Bureau of the Census, Washington, D.C.
Jacob Silver, U.S. Bureau of the Census, Washington, D.C.
B. J. Singh, Ohio-Kentucky-Indiana Regional Planning Authority, Cincinnati

Caby C. Smith, U.S. Bureau of the Census, Washington, D.C.
Arthur B. Sosslau, Comsis Corporation, Wheaton, Maryland
Ronald M. Spessard, Ohio Department of Transportation, Columbus

Robert Tain, New York
Robert Tap, Transportation Systems Center, U.S. Department of Transportation, Cambridge, Massachusetts
Paul Taylor, Alan M. Voorhees and Associates, Inc., Los Angeles
Sandra Tichenor, Oak Ridge National Laboratories, Tennessee
Marshall L. Turner, Jr., Users' Service Staff, U.S. Bureau of the Census, Washington, D.C.
Ronald W. Tweedie, New York Department of Transportation, Albany

John H. Waggoner, Planning Survey Division, Texas Highway Department, Austin
Ken White, New Mexico State University, Las Cruces
H. Van Wittman, Alabama State Highway Department, Montgomery

Robert J. Zack, Ohio Department of Transportation, Columbus

Sponsoring Committee

COMMITTEE ON TRANSPORTATION INFORMATION SYSTEMS AND DATA REQUIREMENTS

Robert E. Barraclough, chairman, Ben Alexander, Daniel E. Benson, Geoffrey J. H. Brown, Henry W. Bruck, Jeffrey M. Bruggeman, Christian Lee Davis, Edward N. Dodson, Kenneth J. Dueker, David J. Dunlap, Alexander French, Gideon Hashimshony, George T. Lathrop, Joseph M. Manning, Edward Margolin, Alfred J. Marston, Thomas C. Muranyi, Henry A. Nejako, Jr., Peter S. Parsonson, Albin Pearson, Alan E. Pisarski, Sydney R. Robertson, George N. Sarames, Arthur B. Sosslau, George V. Wickstrom, D. L. Wieman

James A. Scott, Transportation Research Board staff

APPENDIX

QUESTIONS ASKED IN THE 1970 CENSUS OF POPULATION AND HOUSING

The pages that follow show the content of the questionnaires used in the 1970 Census of Population and Housing. This combined set of questions for the 3 samples was issued by the U. S. Bureau of the Census in an informational leaflet, which contained the following explanatory notes.

EXPLANATORY NOTES

This leaflet shows the content of the 1970 census questionnaires. The content was determined after review of the 1960 census experience, extensive consultation with many government and private users of census data, and a series of experimental censuses in which various alternatives were tested.

Three questionnaires are being used in the census and each household has an equal chance of answering a particular form.

> **80 percent** of the households answer a form containing only the questions on pages 2 and 3 of this leaflet.
>
> **15 percent** and **5 percent** of the households answer forms which also contain the specified questions on the remaining pages of this leaflet. The 15-percent form does not show the 5-percent questions, and the 5-percent form does not show the 15-percent questions. On both forms, population questions 13 to 41 are repeated for each person in the household but questions 24 to 41 do not apply to children under 14 years of age.

The same sets of questions are used throughout the country, regardless of whether the census in a particular area is conducted by mail or house-to-house canvass. An illustrative example is enclosed with each questionnaire to help the householder complete the form.

80, 15, AND 5 PERCENT (100 PERCENT) ↓

Line No.	1. WHAT IS THE NAME OF EACH PERSON who was living here on Wednesday, April 1, 1970 or who was staying or visiting here and had no other home? — Print names in this order: *Head of the household; Wife of head; Unmarried children, oldest first; Married children and their families; Other relatives of the head; Persons not related to the head*	2. HOW IS EACH PERSON RELATED TO THE HEAD OF THIS HOUSEHOLD? *Fill one circle.* *If "Other relative of head," also give exact relationship, for example, mother-in-law, brother, niece, grandson, etc.* *If "Other not related to head," also give exact relationship, for example, partner, maid, etc.*	3. SEX *Fill one circle*
1	Last name First name / Middle initial	○ Head of household ○ Wife of head ○ Son or daughter of head ○ Other relative of head—*Print exact relationship* ○ Roomer, boarder, lodger ○ Patient or inmate ○ Other not related to head—*Print exact relationship*	Male ○ Female ○
2	Last name First name / Middle initial	○ Head of household ○ Wife of head ○ Son or daughter of head ○ Other relative of head—*Print exact relationship* ○ Roomer, boarder, lodger ○ Patient or inmate ○ Other not related to head—*Print exact relationship*	Male ○ Female ○
3	Last name First name / Middle initial	○ Head of household ○ Wife of head ○ Son or daughter of head ○ Other relative of head—*Print exact relationship* ○ Roomer, boarder, lodger ○ Patient or inmate ○ Other not related to head—*Print exact relationship*	Male ○ Female ○
4	Last name First name / Middle initial	○ Head of household ○ Wife of head ○ Son or daughter of head ○ Other relative of head—*Print exact relationship* ○ Roomer, boarder, lodger ○ Patient or inmate ○ Other not related to head—*Print exact relationship*	Male ○ Female ○
5	Last name First name / Middle initial	○ Head of household ○ Wife of head ○ Son or daughter of head ○ Other relative of head—*Print exact relationship* ○ Roomer, boarder, lodger ○ Patient or inmate ○ Other not related to head—*Print exact relationship*	Male ○ Female ○
6	Last name First name / Middle initial	○ Head of household ○ Wife of head ○ Son or daughter of head ○ Other relative of head—*Print exact relationship* ○ Roomer, boarder, lodger ○ Patient or inmate ○ Other not related to head—*Print exact relationship*	Male ○ Female ○
7	Last name First name / Middle initial	○ Head of household ○ Wife of head ○ Son or daughter of head ○ Other relative of head—*Print exact relationship* ○ Roomer, boarder, lodger ○ Patient or inmate ○ Other not related to head—*Print exact relationship*	Male ○ Female ○
8	Last name First name / Middle initial	○ Head of household ○ Wife of head ○ Son or daughter of head ○ Other relative of head—*Print exact relationship* ○ Roomer, boarder, lodger ○ Patient or inmate ○ Other not related to head—*Print exact relationship*	Male ○ Female ○

4. COLOR OR RACE *Fill one circle.* *If "Indian (American)," also give tribe.* *If "Other," also give race.*	DATE OF BIRTH				8. WHAT IS EACH PERSON'S MARITAL STATUS? *Fill one circle*
	5. Month and year of birth and age last birthday *Print*	6. Month of birth *Fill one circle*	7. Year of birth *Fill one circle for first three numbers*	*Fill one circle for last number*	
○ White ○ Negro or Black ○ Indian (Amer.) *Print tribe* → ○ Japanese ○ Chinese ○ Filipino ○ Hawaiian ○ Korean ○ Other– *Print race*	Month ________ Year ________ Age ________	○ Jan.-Mar. ○ Apr.-June ○ July-Sept. ○ Oct.-Dec.	○ 186- ○ 187- ○ 188- ○ 189- ○ 190- ○ 191- ○ 192- ○ 193- ○ 194- ○ 195- ○ 196- ○ 197-	○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9	○ Now married ○ Widowed ○ Divorced ○ Separated ○ Never married
○ White ○ Negro or Black ○ Indian (Amer.) *Print tribe* → ○ Japanese ○ Chinese ○ Filipino ○ Hawaiian ○ Korean ○ Other– *Print race*	Month ________ Year ________ Age ________	○ Jan.-Mar. ○ Apr.-June ○ July-Sept. ○ Oct.-Dec.	○ 186- ○ 187- ○ 188- ○ 189- ○ 190- ○ 191- ○ 192- ○ 193- ○ 194- ○ 195- ○ 196- ○ 197-	○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9	○ Now married ○ Widowed ○ Divorced ○ Separated ○ Never married
○ White ○ Negro or Black ○ Indian (Amer.) *Print tribe* → ○ Japanese ○ Chinese ○ Filipino ○ Hawaiian ○ Korean ○ Other– *Print race*	Month ________ Year ________ Age ________	○ Jan.-Mar. ○ Apr.-June ○ July-Sept. ○ Oct.-Dec.	○ 186- ○ 187- ○ 188- ○ 189- ○ 190- ○ 191- ○ 192- ○ 193- ○ 194- ○ 195- ○ 196- ○ 197-	○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9	○ Now married ○ Widowed ○ Divorced ○ Separated ○ Never married
○ White ○ Negro or Black ○ Indian (Amer.) *Print tribe* → ○ Japanese ○ Chinese ○ Filipino ○ Hawaiian ○ Korean ○ Other– *Print race*	Month ________ Year ________ Age ________	○ Jan.-Mar. ○ Apr.-June ○ July-Sept. ○ Oct.-Dec.	○ 186- ○ 187- ○ 188- ○ 189- ○ 190- ○ 191- ○ 192- ○ 193- ○ 194- ○ 195- ○ 196- ○ 197-	○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9	○ Now married ○ Widowed ○ Divorced ○ Separated ○ Never married
○ White ○ Negro or Black ○ Indian (Amer.) *Print tribe* → ○ Japanese ○ Chinese ○ Filipino ○ Hawaiian ○ Korean ○ Other– *Print race*	Month ________ Year ________ Age ________	○ Jan.-Mar. ○ Apr.-June ○ July-Sept. ○ Oct.-Dec.	○ 186- ○ 187- ○ 188- ○ 189- ○ 190- ○ 191- ○ 192- ○ 193- ○ 194- ○ 195- ○ 196- ○ 197-	○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9	○ Now married ○ Widowed ○ Divorced ○ Separated ○ Never married
○ White ○ Negro or Black ○ Indian (Amer.) *Print tribe* → ○ Japanese ○ Chinese ○ Filipino ○ Hawaiian ○ Korean ○ Other– *Print race*	Month ________ Year ________ Age ________	○ Jan.-Mar. ○ Apr.-June ○ July-Sept. ○ Oct.-Dec.	○ 186- ○ 187- ○ 188- ○ 189- ○ 190- ○ 191- ○ 192- ○ 193- ○ 194- ○ 195- ○ 196- ○ 197-	○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9	○ Now married ○ Widowed ○ Divorced ○ Separated ○ Never married
○ White ○ Negro or Black ○ Indian (Amer.) *Print tribe* → ○ Japanese ○ Chinese ○ Filipino ○ Hawaiian ○ Korean ○ Other– *Print race*	Month ________ Year ________ Age ________	○ Jan.-Mar. ○ Apr.-June ○ July-Sept. ○ Oct.-Dec.	○ 186- ○ 187- ○ 188- ○ 189- ○ 190- ○ 191- ○ 192- ○ 193- ○ 194- ○ 195- ○ 196- ○ 197-	○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9	○ Now married ○ Widowed ○ Divorced ○ Separated ○ Never married
○ White ○ Negro or Black ○ Indian (Amer.) *Print tribe* → ○ Japanese ○ Chinese ○ Filipino ○ Hawaiian ○ Korean ○ Other– *Print race*	Month ________ Year ________ Age ________	○ Jan.-Mar. ○ Apr.-June ○ July-Sept. ○ Oct.-Dec.	○ 186- ○ 187- ○ 188- ○ 189- ○ 190- ○ 191- ○ 192- ○ 193- ○ 194- ○ 195- ○ 196- ○ 197-	○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9	○ Now married ○ Widowed ○ Divorced ○ Separated ○ Never married

9. *If you used all 8 lines* **—Are there any other persons in this household?** ○ Yes ○ No
Do not list the others; we will call to get the information.

10. Did you leave anyone out of Question 1 because you were not sure if he should be listed—for example, a new baby still in the hospital, or a lodger who also has another home? ○ Yes ○ No
On back page, give name(s) and reason left out.

11. Did you list anyone in Question 1 who is away from home now— for example, on a vacation or in a hospital? ○ Yes ○ No
On back page, give name(s) and reason person is away.

12. Did anyone stay here on Tuesday, March 31, who is not already listed? ○ Yes No
On back page, give name of each visitor for whom there is no one at his home address to report him to a census taker.

80, 15, AND 5 PERCENT ↓

A. 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

Answer these questions for your living quarters

H1. Is there a telephone on which people in your living quarters can be called?

- ○ Yes → **What is the number?** _____ *Phone number*
- ○ No

H2. Do you enter your living quarters—

- ○ Directly from the outside or through a common or public hall?
- ○ Through someone else's living quarters?

H3. Do you have complete kitchen facilities?
Complete kitchen facilities are a sink with piped water, a range or cook stove, and a refrigerator.

- ○ Yes, for this household only
- ○ Yes, but also used by another household
- ○ No complete kitchen facilities for this household

H4. 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 rooms or more

H5. Is there hot and cold piped water in this building?

- ○ Yes, hot and cold piped water in this building
- ○ No, only cold piped water in this building
- ○ No piped water in this building

H6. Do you have a flush toilet?

- ○ Yes, for this household only
- ○ Yes, but also used by another household
- ○ No flush toilet

H7. Do you have a bathtub or shower?

- ○ Yes, for this household only
- ○ Yes, but also used by another household
- ○ No bathtub or shower

H8. Is there a basement in this building?

- ○ Yes
- ○ No, built on a concrete slab
- ○ No, built in another way *(include mobile homes and trailers)*

H9. Are your living quarters—

- ○ Owned or being bought by you or by someone else in this household? *Do not include cooperatives and condominiums here.*
- ○ A cooperative or condominium which is owned or being bought by you or by someone else in this household?
- ○ Rented for cash rent?
- ○ Occupied without payment of cash rent?

H10a. Is this building a one-family house?

- ○ Yes, a one-family house
- ○ No, a building for 2 or more families or a mobile home or trailer

b. *If "Yes"*— **Is this house on a place of 10 acres or more, or is any part of this property used as a commercial establishment or medical office?**

- ○ Yes, 10 acres or more
- ○ Yes, commercial establishment or medical office
- ○ No, none of the above

H11. *If you live in a one-family house 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) would sell for if it were for sale?

- ○ Less than $5,000
- ○ $5,000 to $7,499
- ○ $7,500 to $9,999
- ○ $10,000 to $12,499
- ○ $12,500 to $14,999
- ○ $15,000 to $17,499
- ○ $17,500 to $19,999
- ○ $20,000 to $24,999
- ○ $25,000 to $34,999
- ○ $35,000 to $49,999
- ○ $50,000 or more

If this house is on a place of 10 acres or more, or if any part of this property is used as a commercial establishment or medical office, do not answer this question.

H12. *Answer this question if you pay rent for your living quarters.*

a. *If rent is paid by the month—*
What is the monthly rent?

Write amount here → $ _____.00 *(Nearest dollar)*

and

Fill one circle

- ○ Less than $30
- ○ $30 to $39
- ○ $40 to $49
- ○ $50 to $59
- ○ $60 to $69
- ○ $70 to $79
- ○ $80 to $89
- ○ $90 to $99
- ○ $100 to $119
- ○ $120 to $149
- ○ $150 to $199
- ○ $200 to $249
- ○ $250 to $299
- ○ $300 or more

b. *If rent is not paid by the month—*
What is the rent, and what period of time does it cover?

$ _____.00 per _____
(Nearest dollar) *(Week, half-month, year, etc.)*

FOR CENSUS ENUMERATOR'S USE ONLY

a4. Block number | **a5. Serial number**

Ø	○	○	○	Ø	○	○	○	Ø			
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			

B. Type of unit or quarters

Occupied
- ○ First form
- ○ Continuation

Vacant
- ○ Regular
- ○ Usual residence elsewhere

Group quarters
- ○ First form
- ○ Continuation

For a vacant unit, also fill C, D, A, H2 to H8, and H10 to H12

C. Vacancy status

Year round—
- ○ For rent
- ○ For sale only
- ○ Rented or sold, not occupied
- ○ Held for occasional use
- ○ Other vacant

- ○ Seasonal
- ○ Migratory

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 years or more

C/O ○ ○

15 AND 5 PERCENT ↓

H13. *Answer question H13 if you pay rent for your living quarters.*

In addition to the rent entered in H12, do you also pay for—

a. Electricity?

- ○ Yes, average monthly cost is → $ _____ .00 *Average monthly cost*
- ○ No, included in rent
- ○ No, electricity not used

b. Gas?

- ○ Yes, average monthly cost is → $ _____ .00 *Average monthly cost*
- ○ No, included in rent
- ○ No, gas not used

c. Water?

- ○ Yes, yearly cost is → $ _____ .00 *Yearly cost*
- ○ No, included in rent or no charge

d. Oil, coal, kerosene, wood, etc.?

- ○ Yes, yearly cost is → $ _____ .00 *Yearly cost*
- ○ No, included in rent
- ○ No, these fuels not used

H14. How are your living quarters heated?
Fill one circle for the kind of heat you use most.

- ○ Steam or hot water system
- ○ Central warm air furnace with ducts to the individual rooms, or central heat pump
- ○ 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

In some other way—*Describe* → _____

- ○ None, unit has no heating equipment

H15. About when was this building originally built? *Mark when the building was first constructed, not when it was remodeled, added to, or converted.*

- ○ 1969 or 1970
- ○ 1965 to 1968
- ○ 1960 to 1964
- ○ 1950 to 1959
- ○ 1940 to 1949
- ○ 1939 or earlier

H16. Which best describes this building?
Include all apartments, flats, etc., even if vacant.

- ○ 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 mobile home or trailer

Other—
Describe _____

H17. Is this building—

- ○ On a city or suburban lot?— *Skip to H19*
- ○ On a place of less than 10 acres?
- ○ On a place of 10 acres or more?

H18. Last year, 1969, did sales of crops, livestock, and other farm products from this place amount to—

- ○ Less than $50 (or None)
- ○ $50 to $249
- ○ $250 to $2,499
- ○ $2,500 to $4,999
- ○ $5,000 to $9,999
- ○ $10,000 or more

15 PERCENT ↓

H19. Do you get water from—

- ○ A public system *(city water department, etc.)* or private company?
- ○ An individual well?
- ○ Some other source *(a spring, creek, river, cistern, etc.)*?

H20. Is this building connected to a public sewer?

- ○ Yes, connected to public sewer
- ○ No, connected to septic tank or cesspool
- ○ No, use other means

H21. 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 complete bathrooms
- ○ 2 complete bathrooms, plus half bath(s)
- ○ 3 or more complete bathrooms

H22. Do you have air-conditioning?

- ○ Yes, 1 individual room unit
- ○ Yes, 2 or more individual room units
- ○ Yes, a central air-conditioning system
- ○ No

H23. How many passenger automobiles are owned or regularly used by members of your household?
Count company cars kept at home.

- ○ None
- ○ 1 automobile
- ○ 2 automobiles
- ○ 3 automobiles or more

5 PERCENT ↓

H24a. How many stories (floors) are in this building?

- ○ 1 to 3 stories
- ○ 4 to 6 stories
- ○ 7 to 12 stories
- ○ 13 stories or more

b. *If 4 or more stories—*
Is there a passenger elevator in this building?

○ Yes ○ No

H25a. 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

b. 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

c. **Which fuel is used most for water heating?**

Gas — From underground pipes serving the neighborhood. ○ — Bottled, tank, or LP ○
Electricity ○
Fuel oil, kerosene, etc. ○
Coal or coke ○
Wood ○
Other fuel ○
No fuel used ○

H26. 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 bedrooms or more

H27a. Do you have a clothes washing machine?

○ Yes, automatic or semi-automatic
○ Yes, wringer or separate spinner
○ No

b. **Do you have a clothes dryer?**

○ Yes, electrically heated
○ Yes, gas heated
○ No

c. **Do you have a dishwasher** *(built-in or portable)*?

○ Yes ○ No

d. **Do you have a home food freezer which is separate from your refrigerator?**

○ Yes ○ No

H28a. Do you have a television set? *Count only sets in working order.*

○ Yes, one set
○ Yes, two or more sets
○ No

b. *If "Yes"*— **Is any set equipped to receive UHF broadcasts, that is, channels 14 to 83?**

○ Yes ○ No

H29. Do you have a battery-operated radio?
Count car radios, transistors, and other battery-operated sets in working order or needing only a new battery for operation.

○ Yes, one or more ○ No

H30. Do you (or any member of your household) own a second home or other living quarters which you occupy sometime during the year?

○ Yes ○ No

Each person listed on page 2 was asked to respond to the following questions.

Name of person on line (1) of page 2

Last name First name Initial

15 AND 5 PERCENT ↓

13a. Where was this person born? *If born in hospital, give State or country where mother lived. If born outside U.S., see instruction sheet; distinguish Northern Ireland from Ireland (Eire).*

○ This State
OR
(Name of State or foreign country; or Puerto Rico, Guam, etc.)

5 PERCENT ↓

b. **Is this person's origin or descent**— *(Fill one circle)*

○ Mexican
○ Puerto Rican
○ Cuban
○ Central or South American
○ Other Spanish
○ No, none of these

15 PERCENT ↓

14. What country was his father born in?

○ United States
OR
(Name of foreign country; or Puerto Rico, Guam, etc.)

15. What country was his mother born in?

○ United States
OR
(Name of foreign country; or Puerto Rico, Guam, etc.)

5 PERCENT ↓

16. *For persons born in a foreign country*—

a. **Is this person naturalized?**

○ Yes, naturalized
○ No, alien
○ Born abroad of American parents

b. **When did he come to the United States to stay?**

○ 1965 to 70
○ 1960 to 64
○ 1955 to 59
○ 1950 to 54
○ 1945 to 49
○ 1935 to 44
○ 1925 to 34
○ 1915 to 24
○ Before 1915

15 PERCENT ↓

17. What language, other than English, was spoken in this person's home when he was a child? *Fill one circle.*

○ Spanish
○ French
○ German
○ Other— *Specify* _____
○ None, English only

18. When did this person move into this house (or apartment)?
Fill circle for date of last move.

○ 1969 or 70
○ 1968
○ 1967
○ 1965 or 66
○ 1960 to 64
○ 1950 to 59
○ 1949 or earlier
○ Always lived in this house or apartment

19a. Did he live in this house on April 1, 1965? *If in college or Armed Forces in April 1965, report place of residence there.*

○ Born April 1965 or later } *Skip to 20*
○ Yes, this house ..... }
○ No, different house

b. **Where did he live on April 1, 1965?**

(1) State, foreign country, U.S. possession, etc. _____

(2) County _____

(3) Inside the limits of a city, town, village, etc.?

○ Yes ○ No

(4) *If "Yes,"* name of city, town, village, etc. _____

20. Since February 1, 1970, has this person attended regular school or college at any time? *Count nursery school, kindergarten, and schooling which leads to an elementary school certificate, high school diploma, or college degree.*

○ No
○ Yes, public
○ Yes, parochial
○ Yes, other private

15 AND 5 PERCENT ↓

21. What is the highest grade (or year) of regular school he has ever attended?
Fill one circle. If now attending, mark grade he is in.

○ Never attended school— *Skip to 23*
○ 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 or more
○	○	○	○	○	○

22. Did he finish the highest grade (or year) he attended?

- ○ Now attending this grade (or year)
- ○ Finished this grade (or year)
- ○ Did not finish this grade (or year)

23. When was this person born?

- ○ Born before April 1956— *Please go on with questions 24 through 41.*
- ○ Born April 1956 or later— *Please omit questions 24 through 41 and go to the next page for the next person.*

5 PERCENT ↓

24. *If this person has ever been married—*

a. Has this person been married more than once?

○ Once ○ More than once

b. When did he get married? _____ *Month* *Year*

When did he get married for the first time? _____ *Month* *Year*

c. *If married more than once—* **Did the first marriage end because of the death of the husband (or wife)?**

○ Yes ○ No

15 AND 5 PERCENT ↓

25. *If this is a girl or a woman—* **How many babies has she ever had, not counting stillbirths?** *Do not count her stepchildren or children she has adopted.*

1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○

9 ○ 10 ○ 11 ○ 12 or more ○ None ○

15 PERCENT ↓

26. *If this is a man—*

a. Has he ever served in the Army, Navy, or other Armed Forces of the United States?

- ○ Yes
- ○ No

b. Was it during— *(Fill the circle for each period of service.)*

- Vietnam Conflict *(Since Aug. 1964)* ..... ○
- Korean War *(June 1950 to Jan. 1955)* ..... ○
- World War II *(Sept. 1940 to July 1947)* ..... ○
- World War I *(April 1917 to Nov. 1918)* ..... ○
- Any other time ..... ○

5 PERCENT ↓

27a. Has this person ever completed a vocational training program? *For example, in high school; as apprentice; in school of business, nursing, or trades; technical institute; or Armed Forces schools.*

○ Yes ○ No— *Skip to 28*

b. What was his main field of vocational training? *Fill one circle.*

- ○ Business, office work
- ○ Nursing, other health fields
- ○ Trades and crafts *(mechanic, electrician, beautician, etc.)*
- ○ Engineering or science technician; draftsman
- ○ Agriculture or home economics
- ○ Other field— *Specify* _____

28a. Does this person have a health or physical condition which limits the kind or amount of work he can do at a job? *If 65 years old or over, skip to question 29.*

- ○ Yes
- ○ No

b. Does his health or physical condition keep him from holding any job at all?

- ○ Yes
- ○ No

c. *If "Yes" in a or b—* **How long has he been limited in his ability to work?**

- ○ Less than 6 months
- ○ 6 to 11 months
- ○ 1 to 2 years
- ○ 3 to 4 years
- ○ 5 to 9 years
- ○ 10 years or more

QUESTIONS 29 THROUGH 41 ARE FOR ALL PERSONS BORN BEFORE APRIL 1956 INCLUDING HOUSEWIVES, STUDENTS, OR DISABLED PERSONS AS WELL AS PART-TIME OR FULL-TIME WORKERS

15 AND 5 PERCENT ↓

29a. Did this person work at any time last week?

○ Yes— *Fill this circle if this person did full- or part-time work. (Count part-time work such as a Saturday job, delivering papers, or helping without pay in a family business or farm; and 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 30*

b. How many hours did he work last week (at all jobs)? *Subtract any time off and add overtime or extra hours worked.*

- ○ 1 to 14 hours
- ○ 15 to 29 hours
- ○ 30 to 34 hours
- ○ 35 to 39 hours
- ○ 40 hours
- ○ 41 to 48 hours
- ○ 49 to 59 hours
- ○ 60 hours or more

15 PERCENT ↓

c. Where did he work last week?

If he worked in more than one place, print where he worked most last week.

If he travels about in his work or if the place does not have a numbered address, see instruction sheet.

(1) Address *(Number and street name)* _____

(2) Name of city, town, village, etc. _____

(3) Inside the limits of this city, town, village, etc.?

- ○ Yes
- ○ No

(4) County _____

(5) State _____ (6) ZIP Code _____

d. How did he get to work last week? *Fill one circle for chief means used on the last day he worked at the address given in 29c.*

- ○ Driver, private auto
- ○ Passenger, private auto
- ○ Bus or streetcar
- ○ Subway or elevated
- ○ Railroad
- ○ Taxicab
- ○ Walked only
- ○ Worked at home
- ○ Other means— *Specify* _____

After completing question 29d, skip to question 33.

15 AND 5 PERCENT ↓

30. Does this person have a job or business from which he was temporarily absent or on layoff last week?

- ○ Yes, on layoff
- ○ Yes, on vacation, temporary illness, labor dispute, etc.
- ○ No

31a. Has he been looking for work during the past 4 weeks?

○ Yes ○ No— *Skip to 32*

b. Was there any reason why he could not take a job last week?

○ Yes, already has a job
○ Yes, because of this person's temporary illness
○ Yes, for other reasons (in school, etc.)
○ No, could have taken a job

32. When did he last work at all, even for a few days?

○ In 1970 ○ 1964 to 1967 ○ 1959 or earlier
○ In 1969 ○ 1960 to 1963 ○ Never worked
○ In 1968

Skip to 36

33–35. Current or most recent job activity

Describe clearly this person's chief job activity or business last week, if any. If he had more than one job, describe the one at which he worked the most hours.

If this person had no job or business last week, give information for last job or business since 1960.

33. **Industry**

a. **For whom did he work?** *If now on active duty in the Armed Forces, print "AF" and skip to question 36.*

(Name of company, business, organization, or other employer)

b. **What kind of business or industry was this?** *Describe activity at location where employed.*

(For example: Junior high school, retail supermarket, dairy farm, TV and radio service, auto assembly plant, road construction)

c. **Is this mainly—** *(Fill one circle)*

○ Manufacturing ○ Retail trade
○ Wholesale trade ○ Other *(agriculture, construction, service, government, etc.)*

34. **Occupation**

a. **What kind of work was he doing?**

(For example: TV repairman, sewing machine operator, spray painter, civil engineer, farm operator, farm hand, junior high English teacher)

b. **What were his most important activities or duties?**

(For example: Types, keeps account books, files, sells cars, operates printing press, cleans buildings, finishes concrete)

c. **What was his job title?**

35. **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 ○

5 PERCENT ↓

36. **In April 1965, what State did this person live in?**

○ This State

OR

(Name of State or foreign country; or Puerto Rico, etc.)

15 AND 5 PERCENT ↓

37. **In April 1965, was this person—** *(Fill three circles)*

a. **Working at a job or business** *(full or part-time)*?
○ Yes ○ No

b. **In the Armed Forces?**
○ Yes ○ No

c. **Attending college?**
○ Yes ○ No

5 PERCENT ↓

38. *If "Yes" for "Working at a job or business" in question 37—* **Describe this person's chief activity or business in April 1965.**

a. **What kind of business or industry was this?**

b. **What kind of work was he doing (occupation)?**

c. **Was he—**

An employee of a private company or government agency... ○
Self-employed or an unpaid family worker ..... ○

15 AND 5 PERCENT ↓

39a. **Last year (1969), did this person work at all, even for a few days?**

○ Yes ○ No— *Skip to 41*

b. **How many weeks did he work in 1969, either full-time or part-time?** *Count paid vacation, paid sick leave, and military service.*

○ 13 weeks or less ○ 40 to 47 weeks
○ 14 to 26 weeks ○ 48 to 49 weeks
○ 27 to 39 weeks ○ 50 to 52 weeks

40. **Earnings in 1969—** *Fill parts a, b, and c for everyone who worked any time in 1969 even if he had no income. (If exact amount is not known, give best estimate.)*

a. **How much did this person earn in 1969 in wages, salary, commissions, bonuses, or tips from all jobs?** *(Before deductions for taxes, bonds, dues, or other items.)* $ _____.00 *(Dollars only)* OR ○ None

b. **How much did he earn in 1969 from his own nonfarm business, professional practice, or partnership?** *(Net after business expenses. If business lost money, write "Loss" above amount.)* $ _____.00 *(Dollars only)* OR ○ None

c. **How much did he earn in 1969 from his own farm?** *(Net after operating expenses. Include earnings as a tenant farmer or sharecropper. If farm lost money, write "Loss" above amount.)* $ _____.00 *(Dollars only)* OR ○ None

41. **Income other than earnings in 1969—** *Fill parts a, b, and c. (If exact amount is not known, give best estimate.)*

a. **How much did this person receive in 1969 from Social Security or Railroad Retirement?** $ _____.00 *(Dollars only)* OR ○ None

b. **How much did he receive in 1969 from public assistance or welfare payments?** *Include aid for dependent children, old age assistance, general assistance, aid to the blind or totally disabled. Exclude separate payments for hospital or other medical care.* $ _____.00 *(Dollars only)* OR ○ None

c. **How much did he receive in 1969 from all other sources?** *Include interest, dividends, veterans' payments, pensions, and other regular payments. (See instruction sheet.)* $ _____.00 *(Dollars only)* OR ○ None

DOCUMENTATION OF THE SUMMARY TAPE OF THE 1970-CENSUS URBAN TRANSPORTATION PLANNING PACKAGE

Reprinted below is the booklet, 1970-Census Urban Transportation Planning Package—Summary Tape Documentation, issued by the U.S. Bureau of the Census, November 1973. The booklet has 3 parts:

Contents of Summary Tape
Description of the Record Layout for the Summary Tape
Format Program

CONTENTS OF THE SUMMARY TAPE

Tabulation Number	Title
IA-1	COUNT OF PERSONS BY SEX AND AGE
IA-2	COUNT OF PERSONS BY RACE
IA-3	COUNT OF PERSONS AGE 3 AND OVER BY LEVEL OF SCHOOL ATTENDING
IA-4	COUNT OF PERSONS AGE 16 AND OVER BY SEX AND LABOR FORCE STATUS
IA-5	COUNT OF EMPLOYED PERSONS AGE 16 AND OVER BY SEX AND MAJOR OCCUPATION GROUP
IA-6	COUNT OF EMPLOYED PERSONS AGE 16 AND OVER BY SEX AND MAJOR INDUSTRY GROUP
IA-7	COUNT OF EMPLOYED PERSONS AGE 16 AND OVER BY SEX AND CLASS OF WORKER
IB-1	COUNT OF HEADS OF HOUSEHOLDS (INCLUDING PRIMARY INDIVIDUALS) BY AGE
IB-2	COUNT OF HEADS OF HOUSEHOLDS (INCLUDING PRIMARY INDIVIDUALS) BY RACE
IB-3	COUNT OF HEADS OF HOUSEHOLDS (INCLUDING PRIMARY INDIVIDUALS) BY SCHOOL YEARS COMPLETED

IC-1	COUNT OF HOUSEHOLDS BY SIZE OF HOUSEHOLD
IC-2	COUNT OF HOUSEHOLDS BY NUMBER OF UNRELATED INDIVIDUALS
IC-3	COUNT OF HOUSEHOLDS BY NUMBER OF MEMBERS ATTENDING SCHOOL
IC-4	COUNT OF HOUSEHOLDS BY NUMBER OF MEMBERS EMPLOYED
IC-5	COUNT OF HOUSEHOLDS BY HOUSEHOLD INCOME
IC-6	COUNT OF HOUSEHOLDS BY AGE OF HOUSEHOLD HEAD OR PRIMARY INDIVIDUAL AND AGE OF YOUNGEST SON OR DAUGHTER
ID-1	COUNT OF HOUSING UNITS BY TENURE (OCCUPIED) AND TYPE (VACANT)
ID-2	COUNT OF HOUSING UNITS BY NUMBER OF ROOMS IN UNIT
ID-3	COUNT OF OWNER OCCUPIED UNITS BY VALUE
ID-4	COUNT OF RENTER OCCUPIED UNITS BY MONTHLY CONTRACT RENT
ID-5	COUNT OF VACANT UNITS BY DURATION OF VACANCY
ID-6	COUNT OF HOUSING UNITS BY PRESENCE OR ABSENCE OF COMMERCIAL ESTABLISHMENT
ID-7	COUNT OF OCCUPIED UNITS BY YEAR HEAD MOVED INTO UNIT
ID-8	COUNT OF HOUSING UNITS BY TYPE OF STRUCTURE
ID-9	COUNT OF HOUSING UNITS BY YEAR BUILT
ID-10	COUNT OF OCCUPIED UNITS BY AUTOMOBILES AVAILABLE

Note: Series I tables are tabulated for each Traffic Zone of Residence in the SMSA.

IIA-1	COUNT OF HOUSEHOLDS BY SIZE OF HOUSEHOLD AND AUTOMOBILES AVAILABLE
IIA-2	COUNT OF HOUSEHOLDS BY SIZE OF HOUSEHOLD AND HOUSEHOLD INCOME
IIA-3	COUNT OF HOUSEHOLDS BY SIZE OF HOUSEHOLD AND TYPE OF STRUCTURE
IIA-4	COUNT OF HOUSEHOLDS BY AUTOMOBILES AVAILABLE AND HOUSEHOLD INCOME
IIA-5	COUNT OF HOUSEHOLDS BY TYPE OF STRUCTURE AND AUTOMOBILES AVAILABLE
IIA-6	COUNT OF HOUSEHOLDS BY TYPE OF STRUCURE AND HOUSEHOLD INCOME
IIB-1	COUNT OF WORK TRIPS BY MODE OF TRANSPORTATION, SIZE OF HOUSEHOLD AND AUTOMOBILES AVAILABLE
IIB-2	COUNT OF WORK TRIPS BY MODE OF TRANSPORTATION, SIZE OF HOUSEHOLD AND HOUSEHOLD INCOME
IIB-3	COUNT OF WORK TRIPS BY MODE OF TRANSPORTATION, SIZE OF HOUSEHOLD AND TYPE OF STRUCTURE
IIB-4	COUNT OF WORK TRIPS BY MODE OF TRANSPORTATION, AUTOMOBILES AVAILABLE AND HOUSEHOLD INCOME
IIB-5	COUNT OF WORK TRIPS BY MODE OF TRANSPORTATION, TYPE OF STRUCTURE AND AUTOMOBILES AVAILABLE
IIB-6	COUNT OF WORK TRIPS BY MODE OF TRANSPORTATION, TYPE OF STRUCTURE AND HOUSEHOLD INCOME

Note: Series II tables are tabulated for the urbanized area.

III-1	COUNT OF PERSONS AGE 16 AND OVER BY SEX AND LABOR FORCE STATUS
III-2	COUNT OF EMPLOYED PERSONS AGE 16 AND OVER BY SEX AND MAJOR OCCUPATION GROUP
III-3	COUNT OF EMPLOYED PERSONS AGE 16 AND OVER BY SEX AND MAJOR INDUSTRY GROUP
III-4	COUNT OF EMPLOYED PERSONS AGE 16 AND OVER BY SEX AND CLASS OF WORKER

Note: Series III tables are tabulated for each Traffic Zone of Work in the SMSA.

IV	COUNT OF WORKING PERSONS AGE 14 AND OVER BY TRAFFIC ZONE OF RESIDENCE AND MODE OF TRANSPORTATION

Note: Part IV is tabulated for each Traffic Zone of Residence/Work in the SMSA, with Summary for each zone of residence.

IA-1. SEX AND AGE 20%

Count of Persons

By: Sex (2) By: Age (20)

Male: Total, Male
Under 6 years
6
7-9
10-13
14
15
16-17
18
19
20
21-24
25-34
35-44
45-54
55-59
60-61
62-64
65 and over
Mean age

Female:
Repeat Age (20)

IA-2. RACE 20%

Count of Persons

By: Race (8)
Total
White
Negro
Hawaiian - Other, outside Hawaii
Japanese - Zero, " "
Chinese - Zero, " "
Filipino - Zero, outside Hawaii
Other * Zero " "

* Includes American Indian, Korean and Reported "Other race."

IA-3. LEVEL OF SCHOOL ATTENDING 15%

Count of Persons Age 3 and Over

By: Level of School Attending (7)
Total
Not attending school
Nursery school
Elementary - Kindergarten to 6 years
7 and 8 years
High school - 1 to 4 years
College - 1 or more years

IA-4. SEX AND LABOR FORCE STATUS 20%

Count of Persons Age 16 and Over

By: Sex (2) By: Labor Force Status (5)

Male: Total
In armed forced
Employed
Unemployed
Not in labor force

Female:
Repeat Labor Force Status (5)

IA-5. SEX AND MAJOR OCCUPATION GROUP 20%

Count of Employed Persons Age 16 and Over

By: Sex (2) By: Major Occupation Group (13)

Male: Total
Professional, technical and kindred workers
Managers and administrators, except farm
Farmers and farm managers
Clerical and kindred workers
Sales workers
Craftsmen and kindred workers
Operatives, except transport
Transport equipment operatives
Service workers, except private household
Private household workers
Farm laborers and foremen
Laborers, except farm

Female: (13)

IA-6. SEX AND MAJOR INDUSTRY GROUP 20%

Count of Employed Persons Age 16 and Over

By: Sex (2) By: Major Industry Group (14)

Male: Total
Agriculture, forestry and fisheries
Mining
Construction
Manufacturing
Transportation, communication and other public utilities
Wholesale trade
Retail trade
Finance, insurance and real estate
Business and repair service
Personal service
Entertainment and recreation services
Professional and related services
Public administration

Female:
Repeat major Industry Group (14)

IA-7. SEX AND CLASS OF WORKER 20%

Count of Employed Persons Age 16 and Over

By: Sex (2) By: Class of Worker (5)

Male: Total
Private wage and salary worker
Government worker
Self-employed worker
Unpaid family worker

Female: Repeat Class of Worker (5)

IB-1. Age 20%

Count of Household Heads
(Including Primary Individuals)
(excludes group quarters)

By: Age (8)
Total
14-24 years
25-34
35-44
45-54
55-64
65 and over
Mean age

IB-2. RACE 20%

Count of Household Heads
(Including Primary Individuals)
(excludes group quarters)

By: Race (8)
Total
White
Negro
Hawaiian - Other, outside Hawaii
Japanese Zero, " "
Chinese Zero, " "
Filipino Zero, outside Hawaii
Other* Zero, " "

* Includes American Indian, Korean and Reported "Other race."

IB-3. SCHOOL YEARS COMPLETED 20%

Count of Household Heads (Including Primary Individuals) (excludes group quarters)

By: School Years Completed (6)
Total
No school years completed
Elementary 1-8 years
High school 1-4 years
College 1-3 years
4 or more years

IC-1. SIZE OF HOUSEHOLD 20%

Count of Households
(excludes group quarters)

By: Size of Household (8)
Total
1 person
2
3
4
5
6
7 or more

IC-2 NUMBER OF UNRELATED INDIVIDUALS 20%

Count of Households
(excludes group quarters)

By: Number of Unrelated Individuals (4)
Total
No unrelated individuals
1
2 or more

IC-3. NUMBER OF MEMBERS ATTENDING SCHOOL 15 %

Count of Households
(excludes group quarters)

By: Number of Members Attending School (6)

Total
No members attending school
1
2
3
4 or more

IC-4. NUMBER OF MEMBERS EMPLOYED 20%

Count of Households
(excludes group quarters)

By: Number of Members Employed (7)
Total
No members employed
1
2
3
4
5 or more

IC-5. HOUSEHOLD INCOME 20%

Count of Households
(excludes group quarters)

By: Household Income (13)
Total
Under $2,000
$2,000 - $3,999
$4,000 - $5,999
$6,000 - $7,999
$8,000 - $9,999
$10,000-$11,999
$12,000-$14,999
$15,000-$19,999
$20,000-$24,999
$25,000-$49,999
$50,000 or more
Mean income

IC-6. AGE OF HOUSEHOLD HEAD OR PRIMARY INDIVIDUAL AND AGE OF YOUNGEST SON OR DAUGHTER 20%

Count of Households
(excludes group quarters)

By: Age of Household Head or Primary Individual (2)
By: Age of Youngest Son or Daughter (5)

Household Head or Primary Individual Age 14-44:
Total
No children
Youngest son or daughter age 16 and over
5-15
under 5
Household Head or Primary Individual Age 45 and over

ID-1. TENURE (OCCUPIED) AND TYPE (VACANT) 20%

Count of Housing Units
(excludes group quarters)

By: Tenure (Occupied) and Type (Vacant) (5)
Total
Occupied by owner
by renter
Vacant year round
seasonal or migratory

ID-2. NUMBER OF ROOMS IN UNIT 20%

Count of Housing Units
(excludes group quarters)

By: Number of Rooms in Unit (10)
Total
1 room
2
3
4
5
6
7
8
9 or more

ID-3. VALUE 20%

Count of Owner Occupied Units*

By: Value (13)
Total
Under $5,000
$5,000 - $7,499
$7,500 - $9,999
$10,000-$12,499
$12,500-$14,999
$15,000-$17,499
$17,500-$19,999
$20,000-$24,999
$25,000-$34,999
$35,000-$49,999
$50,000 or more
Mean value

*Restricted to one-family houses on less than 10 acres and without commercial establishment. (Value is not tabulated for mobile homes, trailers, cooperatives or condominiums.)

ID-4. MONTHLY CONTRACT RENT 20%

Count of Renter Occupied Units*

By: Monthly Contract Rent (14)
Total
Under $50
$50 - $59
$60 - $69
$70 - $79
$80 - $89
$90 - $99
$100-$119
$120-$149
$150-$199

$200-$249
$250-$299
$300 or more
Mean rent

* Restricted to: (1) one-family houses on less than 10 acres, (2) all 2-or-more unit structures and (3) all mobile homes or trailers.

ID-5. DURATION OF VACANCY 20%

Count of Vacant Units
(excludes group quarters)

By: Duration of Vacancy (7)
Total
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 years or more

ID-6. PRESENCE OR ABSENCE OF COMMERCIAL ESTABLISHMENT 20%

Count of Housing Units **

By: Presence or Absence of Commercial Establishment (3)
Total
Present
Absent

** Restricted to one-family houses on less than 10 acres (excludes mobile homes or trailers.

ID-7. YEAR HEAD MOVED INTO UNIT 15%

Count of Occupied Units
(excludes group quarters)

By: Year Head Moved into Unit (8)
Total
1969-70
1968
1967
1965-66
1960-64
1950-59
1949 or earlier

ID-8. TYPE OF STRUCTURE 20%

Count of Housing Units
(excludes group quarters)

By: Type of Structure (10)

Total
One family house - detached
One family house - attached
Building for 2 families
3-4
5-9
10-19
20-49
50 or more
Mobile home or trailer

ID-9. YEAR BUILT 20%

Count of Housing Units
(excludes group quarters)

By: Year Built (7)

Total
1969-70
1965-68
1960-64
1950-59
1940-49
1939 or earlier

ID-10. NUMBER OF AUTOMOBILES AVAILABLE 15%

Count of Occupied Units
(excludes group quarters)

By: Number of Automobiles Available (5)
Total
No automobile available
1
2
3 or more

PADDING 6 (7 character) fields

IIA-1. SIZE OF HOUSEHOLD AND AUTOMOBILES AVAILABLE 15%

Count of Households
(excludes group quarters)

By: Automobile Available (5)
By: Size of Household (8)
Total, All Households:
Repeat Autos Available (5)
1 person: Total
No automobile available
1
2
3 or more

2 persons:
Repeat Automobiles Available (5)

3 persons:
Repeat Automobiles Available (5)

4 persons:
Repeat Automobiles Available (5)

5 persons:
Repeat Automobiles Available (5)

6 persons:
Repeat Automobiles Available (5)

7 or more:
Repeat Automobiles Available (5)

IIA-2. SIZE OF HOUSEHOLD AND HOUSEHOLD INCOME 20%

Count of Households
(excludes group quarters)

By: Household Income (12)
By: Size of Household (8)
Total
Repeat Household Income (12)
1 person: Total
Under $2,000
$2,000 - $3,999
$4,000 - $5,999
$6,000 - $7,999
$8,000 - $9,999
$10,000-$11,999
$12,000-$14,999
$15,000-$19,999
$20,000-$24,999
$25,000-$49,999
$50,000 or more

2 persons:
Repeat Household Income (12)

3 persons:
Repeat Household Income (12)

4 persons:
Repeat Household Income (12)

5 persons:
Repeat Household Income (12)

6 persons:
Repeat Household Income (12)

7 or more:
Repeat Household Income (12)

IIA-3. SIZE OF HOUSEHOLD AND TYPE OF STRUCTURE 20%

Count of Households
(excludes group quarters)

By: Type of Structure (10)
By: Size of Household (8)
Total:
Repeat Type Structure (10)
1 person: Total
One family house - detached
One family house - attached
Building for 2 families
3-4
5-9
10-19
20-49
50 or more
Mobile home or trailer

2 persons:
Repeat Type of Structure (10)

3 persons:
Repeat Type of Structure (10)

4 persons:
Repeat Type of Structure (10)

5 persons:
Repeat Type of Structure (10)

6 persons:
Repeat Type of Structure (10)

7 or more:
Repeat Type of Structure (10)

IIA-4. AUTOMOBILES AVAILABLE AND HOUSEHOLD INCOME 15%

Count of Households
(excludes group quarters)

By: Household Income (12)
By: Automobiles Available (5)
Total:
Repeat Household Income (12)
No automobiles available:
Total
Under $2,000
$2,000 - $3,999
$4,000 - $5,999
$6,000 - $7,999
$8,000 - $9,999
$10,000-$11,999
$12,000-$14,999
$15,000-$19,999
$20,000-$24,999
$25,000-$49,999
$50,000 or more

1 automobile available:
Repeat Household Income (12)

2 automobiles available:
Repeat Household Income (12)

3 or more:
Repeat Household Income (12)

IIA-5. TYPE OF STRUCTURE AND AUTOMOBILES AVAILABLE 15%

Count of Households
(excludes group quarters)

By: Automobiles Available (5)
By: Type of Structure (10)
Total:
Repeat Automobiles Available (5)
1 family house - detached:
Total
No automobiles available
1
2
3 or more

1 family house - attached:
Repeat Automobiles Available (5)

Building for 2 families:
Repeat Automobiles Available (5)

Building for 3-4 families:
Repeat Automobiles Available (5)

Building for 5-9 families:
Repeat Automobiles Available (5)

Building for 10-19 families:
Repeat Automobiles Available (5)

Building for 20-49 families:
Repeat Automobiles Available (5)

Building for 50 or more families:
Repeat Automobiles Available (5)

Mobile home or trailer:
Repeat Automobiles Available (5)

IIA-6. TYPE OF STRUCTURE AND HOUSEHOLD INCOME 20%

Count of Households
(excludes group quarters)

By: Household Income (12)
By: Type of Structure (10)
Total:
Repeat Household Income (12)
1 family house - detached:
Total
Under $2,000
$2,000 - $3,999
$4,000 - $5,999
$6,000 - $7,999
$8,000 - $9,999
$10,000-$11,999
$12,000-$14,999
$15,000-$19,999
$20,000-$24,999
$25,000-$49,999
$50,000 or more

1 family house - attached:
Repeat Household Income (12)

Building for 2 families:
Repeat Household Income (12)

Building for 3-4 families:
Repeat Household Income (12)

Building for 5-9 families:
Repeat Household Income (12)

Building for 10-19 families:
Repeat Household Income (12)

Building for 20-49 families:
Repeat Household Income (12)

Building for 50 or more families:
Repeat Household Income (12)

Mobile home or trailer:
Repeat Household Income (12)

IIB-1. MODE OF TRANSPORTATION, SIZE OF HOUSEHOLD AND AUTOMOBILES AVAILABLE 15%

Count of Work Trips
(excludes group quarters)

By: Size of Household (8)
By: Mode of Transportation (9)
By: Automobiles Available (5)

Auto - driver:
Total, Household:
Repeat Automobiles Available (5)
1 person:
Total
No automobiles available
1
2
3 or more

2 persons:
Repeat Automobiles Available (5)

3 persons:
Repeat Automobiles Available (5)

4 persons:
Repeat Automobiles Available (5)

5 persons:
Repeat Automobiles Available (5)

6 persons:
Repeat Automobiles Available (5)

7 or more:
Repeat Automobiles Available (5)

Auto - passenger:
Same as Auto - driver (40)

Bus or streetcar:
Same as Auto - driver (40)

Subway or elevated:
Same as Auto - driver (40)

Railroad:
Same as Auto - driver (40)

Taxicab:
Same as Auto - driver (40)

Walked:
Same as Auto - driver (40)

Worked at home:
Same as Auto - driver (40)

Other:
Same as Auto - driver (40)

IIB-2. MODE OF TRANSPORTATION, SIZE OF HOUSEHOLD AND HOUSEHOLD INCOME 15%

Count of Work Trips
(excludes group quarters)

By: Size of Household (8)
By: Mode of Transportation (9)
By: Household Income (12)

Auto - driver:
Total, Households
Repeat Household Income (12)

1 person:
Total
Under $2,000
$2,000 - $3,999
$4,000 - $5,999
$6,000 - $7,999
$8,000 - $9,999
$10,000-$11,999
$12,000-$14,999
$15,000-$19,999
$20,000-$24,999
$25,000-$49,999
$50,000 or more

2 persons:
Repeat Household Income (12)

3 persons:
Repeat Household Income (12)

4 persons:
Repeat Household Income (12)

5 persons:
Repeat Household Income (12)

6 persons:
Repeat Household Income (12)

7 or more:
Repeat Household Income (12)

Auto - passenger:
Same as Auto - driver (96)

Bus or streetcar:
Same as Auto - driver (96)

Subway or elevated:
Same as Auto - driver (96)

Railroad:
Same as Auto - driver (96)

Taxicab:
Same as Auto - driver (96)

Walked:
Same as Auto - driver (96)

Worked at home:
Same as Auto - driver (96)

Other:
Same as Auto - driver (96)

IIB-3. MODE OF TRANSPORTATION, SIZE OF HOUSEHOLD AND TYPE OF STRUCTURE 15%

Count of Work Trips
(excludes group quarters)

By: Size of Household (8)
By: Mode of Transportation (9)
By: Type of Structure (10)

Auto - driver:
Total Households:
Repeat Type of Structure (10)

1 person:
Total
1 family house - detached
1 family house - attached
Building for 2 families
3-4
5-9
10-19
20-49
50 or more
Mobile home or trailer

2 persons:
Repeat Type of Structure (10)

3 persons:
Repeat Type of Structure (10)

4 persons:
Repeat Type of Structure (10)

5 persons:
Repeat Type of Structure (10)

6 persons:
Repeat Type of Structure (10)

7 or more:
Repeat Type of Structure (10)

Auto - passenger:
Same as Auto - driver (80)

Bus or streetcar:
Same as Auto - driver (80)

Subway or elevated:
Same as Auto - driver (80)

Railroad:
Same as Auto - driver (80)

Taxicab:
Same as Auto - driver (80)

Walked:
Same as Auto - driver (80)

Worked at home:
Same as Auto - driver (80)

Other:
Same as Auto - driver (80)

IIB-4. MODE OF TRANSPORTATION, AUTOMOBILES AVAILABLE AND HOUSEHOLD INCOME 15%

Count of Work Trips
(excludes group quarters)

By: Automobiles Available (5)
By: Mode of Transportation (9)
By: Household Income (12)

Auto - driver:
Total, All Automobiles:
Repeat Household Income (12)

No automobiles available:
Total
Under $2,000
$2,000 - $3,999
$4,000 - $5,999
$6,000 - $7,999
$8,000 - $9,999
$10,000-$11,999
$12,000-$14,999
$15,000-$19,999
$20,000-$24,999
$25,000-$49,999
$50,000 or more

1 automobile available:
Repeat Household Income (12)

2 automobiles available:
Repeat Household Income (12)

3 or more:
Repeat Household Income (12)

Auto - passenger:
Same as Auto - driver (60)

Bus or streetcar:
Same as Auto - driver (60)

Subway or elevated:
Same as Auto - driver (60)

Railroad:
Same as Auto - driver (60)

Taxicab:
Same as Auto - driver (60)

Walked:
Same as Auto - driver (60)

Worked at home:
Same as Auto - driver (60)

Other:
Same as Auto - driver (60)

IIB-5. MODE OF TRANSPORTATION, TYPE OF STRUCTURE AND AUTOMOBILES AVAILABLE 15%

Count of Work Trips
(excludes group quarters)

By: Type of Structure (10)
By: Mode of Transportation (9)
By: Automobiles Available (5)

Auto - driver:
Total, All Structures:
Repeat Automobiles Available (5)

1 family house - detached:
Total
No automobiles available
1
2
3 or more

1 family house - attached:
Repeat Automobiles Available (5)

Building for 2 families:
Repeat Automobiles Available (5)

Building for 3-4 families:
Repeat Automobiles Available (5)

Building for 5-9 families:
Repeat Automobiles Available (5)

Building for 10-19 families:
Repeat Automobiles Available (5)

Building for 20-49 families:
Repeat Automobiles Available (5)

Building for 50 or more families:
Repeat Automobiles Available (5)

Mobile home or trailer:
Repeat Automobiles Available (5)

Auto - passenger:
Same as Auto - driver (50)

Bus or streetcar:
Same as Auto - driver (50)

Subway or elevated:
Same as Auto - driver (50)

Railroad:
Same as Auto - driver (50)

Taxicab:
Same as Auto - driver (50)

Walked:
Same as Auto - driver (50)

Worked at home:
Same as Auto - driver (50)

Other:
Same as Auto - driver (50)

IIB-6. MODE OF TRANSPORTATION, TYPE OF STRUCTURE AND HOUSEHOLD INCOME 15%

Count of Work Trips
(excludes group quarters)

By: Type of Structure (10)
By: Mode of Transportation (9)
By: Household Income (12)

Auto - driver:
Total, All Structures:
Repeat Household Income (12)

1 family house - detached:
Total
Under $2,000
$2,000 - $3,999
$4,000 - $5,999
$6,000 - $7,999
$8,000 - $9,999
$10,000-$11,999
$12,000-$14,999
$15,000-$19,999
$20,000-$24,999
$25,000-$49,999
$50,000 and over

1 family house - attached:
Repeat Household Income (12)

Building for 2 families:
Repeat Household Income (12)

Building for 3-4 families:
Repeat Household Income (12)

Building for 5-9 families:
Repeat Household Income (12)

Building for 10-19 families:
Repeat Household Income (12)

Building for 20-49 families:
Repeat Household Income (12)

Building for 50 or more families:
Repeat Household Income (12)

Mobile home or trailer:
Repeat Household Income (12)

Auto - passenger:
Same as Auto - driver (120)

Bus or streetcar:
Same as Auto - driver (120)

Subway or elevated:
Same as Auto - driver (120)

Railroad:
Same as Auto - driver (120)

Taxicab:
Same as Auto - driver (120)

Walked:
Same as Auto - driver (120)

Worked at home:
Same as Auto - driver (120)

Other:
Same as Auto - driver (120)

PADDING 144 (7 character) fields

II-1. SEX AND LABOR FORCE STATUS 15%

Count of Persons Age 16 and Over

By: Sex (2) By: Labor Force Status (3)

Male:
Total
In armed forces
Employed

Female:
Repeat Labor Force Status (5)

III-2. SEX AND MAJOR OCCUPATION GROUP 15%

Count of Employed Persons Age 16 and Over

By: Sex (2) By: Major Occupation Group (13)

Male:

Total
Professional, technical and kindred workers
Managers and administrators, except farm
Farmers and farm managers
Clerical and kindred workers
Sales workers
Craftsmen and kindred workers
Operatives, except transport
Transport equipment operatives
Service workers, except private household
Private household workers
Farm laborers and foremen
Laborers, except farm

Female:

Repeat Major Occupation Group (13)

III-3. SEX AND MAJOR INDUSTRY GROUP 15%

Count of Employed Persons Age 16 and Over

By: Sex (2) By: Major Industry Group (14)

Male:

Agriculture, forestry and fisheries
Mining
Construction
Manufacturing
Transportation, communication and other public utilities
Wholesale trade
Retail trade
Finance, insurance and real estate
Business and repair service
Personal service
Entertainment and recreation services
Professional and related services
Public administration

Female:

Repeat Major Industry Group (14)

III-4. SEX AND CLASS OF WORKER 15%

Count of Employed Persons Age 16 and Over

By: Sex (2) By: Class of Worker (5)

Male:

Total
Private wage and salary worker
Government worker
Self-employed worker
Unpaid family worker

PADDING 1 (7 character) field

IV. TRAFFIC ZONE OF RESIDENCE/WORK AND MODE OF TRANSPORTATION 15%

Count of Working Persons Age 14 and Over, By Zone of Residence (1) Zone of Work (1), and by Mode of Transportation:

Each Traffic Zone of Residence by Each Traffic Zone of Work

Total
Auto - driver
Auto - passenger
Bus or streetcar
Subway or elevated
Railroad
Taxicab
Walked
Other

PADDING 1 (7 character) field

DESCRIPTION OF THE RECORD LAYOUT FOR THE SUMMARY TAPE

The traffic zone data file and a data display program (See Part III) are both contained on a IBM EBCDIC nonlabeled computer tape at 800 bpi density. The display program will appear first on the tape and will be separated from the data file by an "end of file" tape mark. The physical record length is 2016 characters and is composed of 288 7-character fields. The tables appear on this tape in the following sequence:

1. Table II Series-(Urbanized Area Summaries)-There are 16 blocks of data for each set of urbanized area summaries. The identification field which is the first field for each set of 16 blocks consists of a record type code 2 in the first digit, zeros (padding) in the second and third digits, and the 1970 urbanized area code in the last four digits.

2. Table I Series-(Traffic Zone of Residence Summaries)-There

is one block of data per traffic zone of residence. The number of data blocks is contingent upon the number of traffic zones of residence defined for a given tabulation area. The number of traffic zones of residence is given in the second data field of the first data block in the Table II Series. The identification field, which is located in the first seven characters of each traffic zone of residence data block, consists of a record type 1 code in the first digit and the traffic zone of residence code in the remaining six digits.

3. Table III Series-(Traffic Zone of Work Series)-There are four traffic zones of work data per block. The number of data blocks is contingent upon the number of traffic zones of work defined for a given tabulation area. The number of traffic zones of work is given in the third field of the first data block in Table II series. The identification field (first seven characters) for each traffic zone of work consists of record type code 3 in the first digit and the traffic zone of work code in the remaining six digits.

4. Table IV Series (Traffic Zone of Residence by Traffic Zone of Work By Mode of Transportation) - There are 24 traffic zone of residence by traffic zone of work tabulations per block. The number of zone of residence by zone of work tabulations is given in the fourth field of the first data block in the Table II series. The identification field (first seven characters) of each traffic zone of residence by traffic zone of work tabulation consists of record type code 4 in the first digit and the traffic zone of residence code in the remaining six digits. The traffic zone of work is given in the second seven character field. A summary record is given for each zone of residence. The traffic zone of work identification field for this record will be blank.

TABLE	NO. OF FIELDS	FIELD NO.	CONTENT
Series	4	1	Urbanized Area Codes
		2	No. Zones of Residence
		3	No. Zones of Work
		4	No. Zones Residence/Work
IIA1	40=5x8	5-44	No. Autos x House Size
IIA2	96=12x8	45-140	Income x Size

TABLE	NO. OF FIELDS	FIELD NO.	CONTENT
IIA3	80=10x8	141-220	Structure x Size
IIA4	60=12x5	221-280	Income x No. Autos
IIA5	50=5x10	281-330	No. Autos x Structure
IIA6	120=12x10	331-450	Income x Structure
IIB1	360=5x8x9	451-810	No. Autos x Size x Mode
IIB2	864=12x8x9	811-1674	Income x Size x Mode
IIB3	720=10x8x9	1675-2394	Structure x Size x Mode
IIB4	540=12x5x9	2395-2934	Income x No. Autos x Mode
IIB5	450=5x10x9	2935-3384	No. Autos x Structure x Mode
IIB6	1080=12x10x9	3385-4464	Income x Structure x Mode
Fill	144	4465-4608	Zeros

****

PART I

Series	1	1	Zone of Residence
IA1	40=20x2	2-41	Age x Sex
IA2	8	42-49	Race 1/
IA3	7	50-56	School
IA4	10=5x2	57-66	Labor Force x Sex
IA5	26=13x2	67-92	Occupation x Sex
IA6	28=14x2	93-120	Industry x Sex
IA7	10=5x2	121-130	Class of Worker x Sex
IB1	8	131-138	Age of Head
IB2	8	139-146	Race of Head
IB3	6	147-152	Education of Head
IC1	8	153-160	Size of Household
IC2	4	161-164	Unrelateds
IC3	6	165-170	No. in School
IC4	7	171-177	No. Employed
IC5	13	178-190	Household Income
IC6	10=5x2	191-200	Age of Youngest Child x Age Head
ID1	5	201-205	Tenure
ID2	10	206-215	Rooms
ID3	13	216-228	Value
ID4	14	229-242	Rent

TABLE	NO. OF FIELDS	FIELD NO.	CONTENT
ID5	7	243-249	Vacancy
ID6	3	250-252	Commercial
ID7	8	253-260	Year Moved
ID8	10	261-270	Structure
ID9	7	271-277	Year Built
ID10	5	278-282	No. Autos
Fill	6	283-288	Zero
Series	1	1	Zone of Work
IIIA1	6=3x2	2-7	Labor Force x Sex
IIIA2	26=13x2	8-33	Occupation x Sex
IIIA3	28=14x2	34-61	Industry x Sex
IIIA4	10=5x2	62-71	Class Worker x Sex
Fill	1	72	Zero

****

PART IV

Series	2	1	Zone of Residence
		2	Zone of Work
IV	9	3-11	Mode
Fill	1	12	Zero

1/ Total population of zone in Field 42. If the toal population for a zone of residence is less than 33, only the total population will be shown. The remaining fields for that zone will contain zeros.

FORMAT PROGRAM

General

A program "FMTUTP" has been developed to display in tabular format the urbanized area data collected and processed by the Bureau of the Census for specially defined geographic areas, namely traffic zones.

The program will print all tables for all zones or, by use of optional program control cards, will print: (1) selected tables for all zones, (2) all tables for selected zones, or (3) selected tables for selected zones. This selection process does not allow for all combinations of tables and zones. If different tables are desired for different zones, the program must be rerun for those specific combinations.

This program is written in American National Standard COBOL using the release 18 version of IBM's COBOL U complier. It has been developed and run on IBM 360 models 50 and 65 operating under OS-MFT and require approximately 60K of core storage. This program will appear first on the tape and will be separated from the data by an "end of file" tape mark.

Input-Output

Several datasets are used during each program execution:

1. SYSIN — Standard "systems inputs" file containing the program control cards.

2. DPNTAPE — Standard "systems output" file destined for the printer.

3. TAPEI — Data file provided by the Bureau of the Census.

Control Cards

The program operation is controlled by user supplied paramenters on the "ZONES" and "TABLES" cards. These are optional and allow for selected printing. If omitted, all tables for all zones are printed. For table series 1, the "ZONES" card refers to the zones of residence. For table series 2, the "ZONES" card is not applicable since these tables refer to the entire urbanized area. For the table series 4, which is a combination of zones of residence/zone of work, selection will be made on zone of residence.

The formats of the various control cards are:

1. ID — Columns 1-3 must be coded ID, and Columns 4-80 will contain any descriptive text desired. This card is optional.

2. ZONES — Columns 1-6 must be coded ZONES, Columns 7-80 may contain zone numbers separated by commas or a range of zones indicated by a hyphen between the limits. A blank will indicate the end of the scan;
   e.g., ZONES, 10,20,30, 50-100, 500-600
   This example would print tables for zones 10,20,30, zones 50 to 100 inclusive, and zones 500-600 inclusive. This card is optional.

3. TABLES — Columns 1-7 must be coded TABLES, Columns 8-80 will be coded with the table numbers to be printed separated by commas. The numbers used must match the table series numbers shown in appendix II. A blank will indicate the end of the scan.
   e.g., TABLES, 1A1, 1B2, 3A1
   This would print tables 1A1, 1B2, and 31A only. None of the series 2 or 4 tables would be printed. This card is optional.

4. GO — Columns 1-3 must be coded GO. The rest of the card is blank. This card is mandatory. If it is omitted, the program will only check the other control cards for syntax validity but will not print the tables. This card must be the last control card (i.e., it must follow the ID, ZONES, and TABLES cards if provided).

THE Transportation Research Board is an agency of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering. The Board's purpose is to stimulate research concerning the nature and performance of transportation systems, to disseminate information that the research produces, and to encourage the application of appropriate research findings. The Board's program is carried out by more than 150 committees and task forces composed of more than 1,800 administrators, engineers, social scientists, and educators who serve without compensation. The program is supported by state transportation and highway departments, the U.S. Department of Transportation, and other organizations interested in the development of transportation.

The Transportation Research Board operates within the Division of Engineering of the National Research Council. The Council was organized in 1916 at the request of President Woodrow Wilson as an agency of the National Academy of Sciences to enable the broad community of scientists and engineers to associate their efforts with those of the Academy membership. Members of the Council are appointed by the president of the Academy and are drawn from academic, industrial, and governmental organizations throughout the United States.

The National Academy of Sciences was established by a congressional act of incorporation signed by President Abraham Lincoln on March 3, 1863, to further science and its use for the general welfare by bringing together the most qualified individuals to deal with scientific and technological problems of broad significance. It is a private, honorary organization of more than 1,000 scientists elected on the basis of outstanding contributions to knowledge and is supported by private and public funds. Under the terms of its congressional charter, the Academy is called upon to act as an official—yet independent—advisor to the federal government in any matter of science and technology, although it is not a government agency and its activities are not limited to those on behalf of the government.

To share in the task of furthering science and engineering and of advising the federal government, the National Academy of Engineering was established on December 5, 1964, under the authority of the act of incorporation of the National Academy of Sciences. Its advisory activities are closely coordinated with those of the National Academy of Sciences, but it is independent and autonomous in its organization and election of members.