Using the Urban Transportation Planning Package on a Microcomputer

MICHAEL B. CLARKE and ARTHUR B. SOSSLAU

ABSTRACT

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

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

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

PROBLEMS AMENABLE TO MICROCOMPUTER SOLUTION WITH UTPP

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

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

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

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

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

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

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

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

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

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

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

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

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

Microcomputer owned.

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

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

Microcomputer owned.

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

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

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

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

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

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

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

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

Work anticipated to be accomplished on in-house mainframe.

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

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

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

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

Microcomputer available and will be used for some UTPP processing.

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

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

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

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

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

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

TABLE 1 Relationship of UTPP Parts to Anticipated Major Uses

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

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

TRANSFER OF UTPP DATA TO MICROCOMPUTER

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

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

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

TRANSFORMING UTPP DATA INTO SOFTWARE-SPECIFIC FORMATS

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

CP/M

A primary communications software package operating

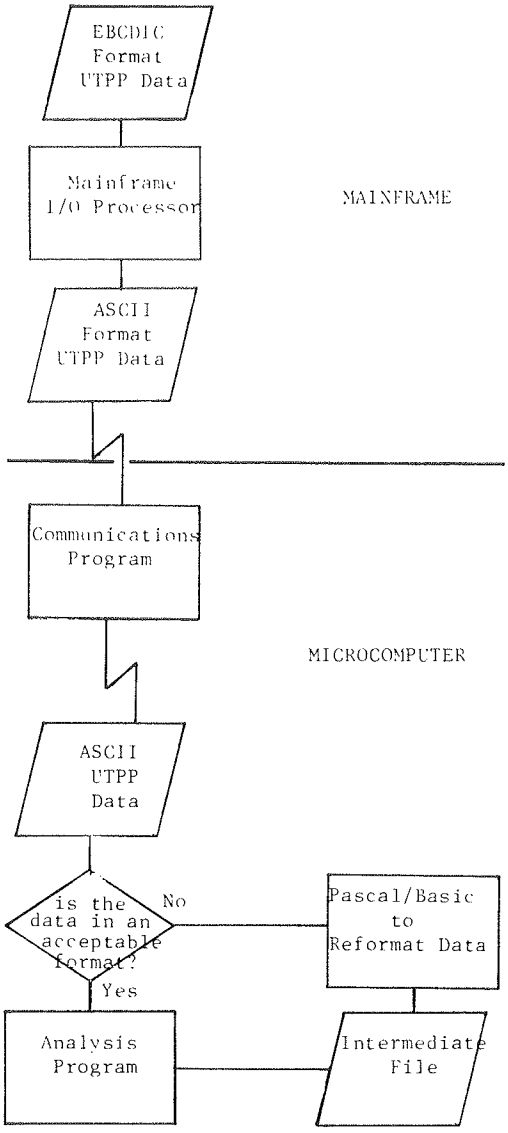

FIGURE 1 Transfer of UTPP data from a mainframe to a microcomputer-based software package.

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

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

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

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

Apple II DOS 3.3 and USCD PASCAL

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

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

MICROCOMPUTER DISKETTE STORAGE

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

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

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

MICROCOMPUTER UTPP SUBFILE DESIGN

The design of microcomputer diskette subfiles will

```
                              (start of session)

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

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

.icms                         Tell mainframe what OS is wanted.

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

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

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

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

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

.logoff                       Sign off the mainframe, if finished.

(Termination acknowledgement from mainframe.)

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

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

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

                              (end of session)
```

FIGURE 2 Communications session using CrossTalk.

```
                        (start of session)

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

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

ENTER SELECTION NUMBER: 1

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

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

<cr>                        Induce mainframe prompts.

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

.icms                       Select the system wanted.

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

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

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

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

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

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

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

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

1 utpp data                              List the file for
                                         downloading.

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

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

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

TABLE 2 Characteristics of Microcomputer Diskettes

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

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

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

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

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

Parts I and III: Residence and Workplace Tabulations

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

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

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

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

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

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

Part II: Tabulations by Large Geographic Areas of Residence

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

TABLE 3 Approximate Number of Diskettes Required for Entire UTPP

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

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

TABLE 4 Recommended Data Items to Download from Part I

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

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

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

TABLE 5 Recommended Data Items to Download from Part III

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

Part IV: Journey-to-Work Information

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

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

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

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

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

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

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

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

APPLYING UTPP DATA WITHIN SOFTWARE PACKAGES

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

dBase II

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

VisiCalc

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

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

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

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

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

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

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

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

 .CREATE             (begin by creating a new data base)

Enter File name:  TRPGEN

Enter record structure as follows:

Field     Name, Type, Width, Decimal Places

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

        Data base is created
```

FIGURE 4 Sample dBase II session to input UTPP data.

PRODUCTION AND ATTRACTION SUMMARY 1971

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

FIGURE 5 VisiCalc trip-generation output.

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

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

Plotting Programs

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

CONCLUSION

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

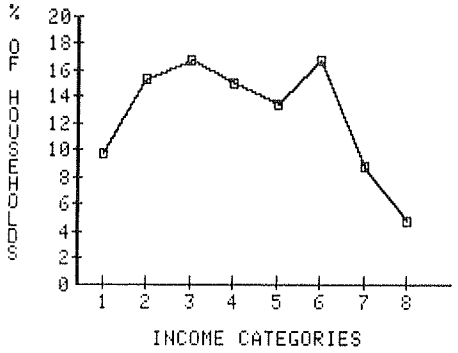

FIGURE 6 VisiPlot sample output.

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

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

ACKNOWLEDGMENT

Portions of the material in this paper were developed previously under a contract with UMTA.

REFERENCES

1. Transportation Planners' Guide to Using the 1980 Census. FHWA, U.S. Department of Transportation, 1983.
2. A.B. Sosslau, A.B. Hassam, M.M. Carter, and G.V. Wickstrom. Quick-Response Urban Travel Estimation Techniques and Transferable Parameters: User's Guide. NCHRP Report 187. TRB, National Research Council, Washington, D.C., 1978.

Computer Graphics Techniques for Use with the Urban Transportation Planning Package

BOB S. EVATT, Jr.

ABSTRACT

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

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

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

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

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

AUTOMATED CHOROPLETHIC MAPPING

Choroplethic mapping is a process in which quantita-