UTPS/SLIM

Applications Manual and Case Study

Submitted to:

Urban Mass Transportation Administration
U.S. Department of Transportation
Washington, D.C. 20596

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UTPS/SLIM APPLICATIONS MANUAL AND CASE STUDY

This document presents examples of the application of the Urban Transportation Planning System's Simplified Limited Instructional Manual (UTPS/SLIM) for urban transportation planning. UTPS/SLIM is a simplified version of the UTPS modeling program developed by the Urban Mass Transportation Administration.

INTRODUCTION

This manual will lead you, the reader, through the steps necessary to use the UTPS/SLIM system of programs and will provide examples of applications. It also provides a series of worksheets that should help the transportation planning professional unfamiliar with the UTPS packages to set up and operate the UTPS software. The manual assumes that you have read the UTPS/SLIM documentation and suggests that you have that documentation available for reference when following this case study.

The case study performs the following six basic transportation modeling functions:

- o trip generation,
- o highway network construction,
- o path skimming,
- o trip distribution,
- o mode split and peak hour trip table production, and
- o highway assignment.

These steps are the basic tasks required by a small urban area for forecasting future travel growth. To perform them, six different UTPS programs must be run, some of them more than once. Unlike the UTPS/SLIM manual, which

describes these six basic programs, this manual is structured to follow the modeling sequence listed above and illustrated by the flow chart in Exhibit 1.

Because UTPS programs only operate on IBM mini- and mainframe computers (and work alikes), a limited amount of assistance has been provided in Appendix A for those professionals who are not familiar with standard, IBM mainframe operating system Job Control Language (JCL) instructions. This appendix should provide enough information to allow the beginner to appropriately name and reference his/her datasets. If a more complete understanding of JCL is desired, a suggested reference is *System/370 Job Control Language*, by Gary Brown, published in 1977.

TEST CITY

The modeling process using UTPS/SLIM was completed for a small urban test area. Each section of this manual will show the UTPS/SLIM input used and will contain a series of comments indicating how the input parameters were used to apply UTPS/SLIM to the test city.

WORKSHEETS

This report makes use of several worksheets. A blank copy of each worksheet is included in Appendix B. You may copy these and use them to assist you in creating actual UTPS/SLIM production runs.

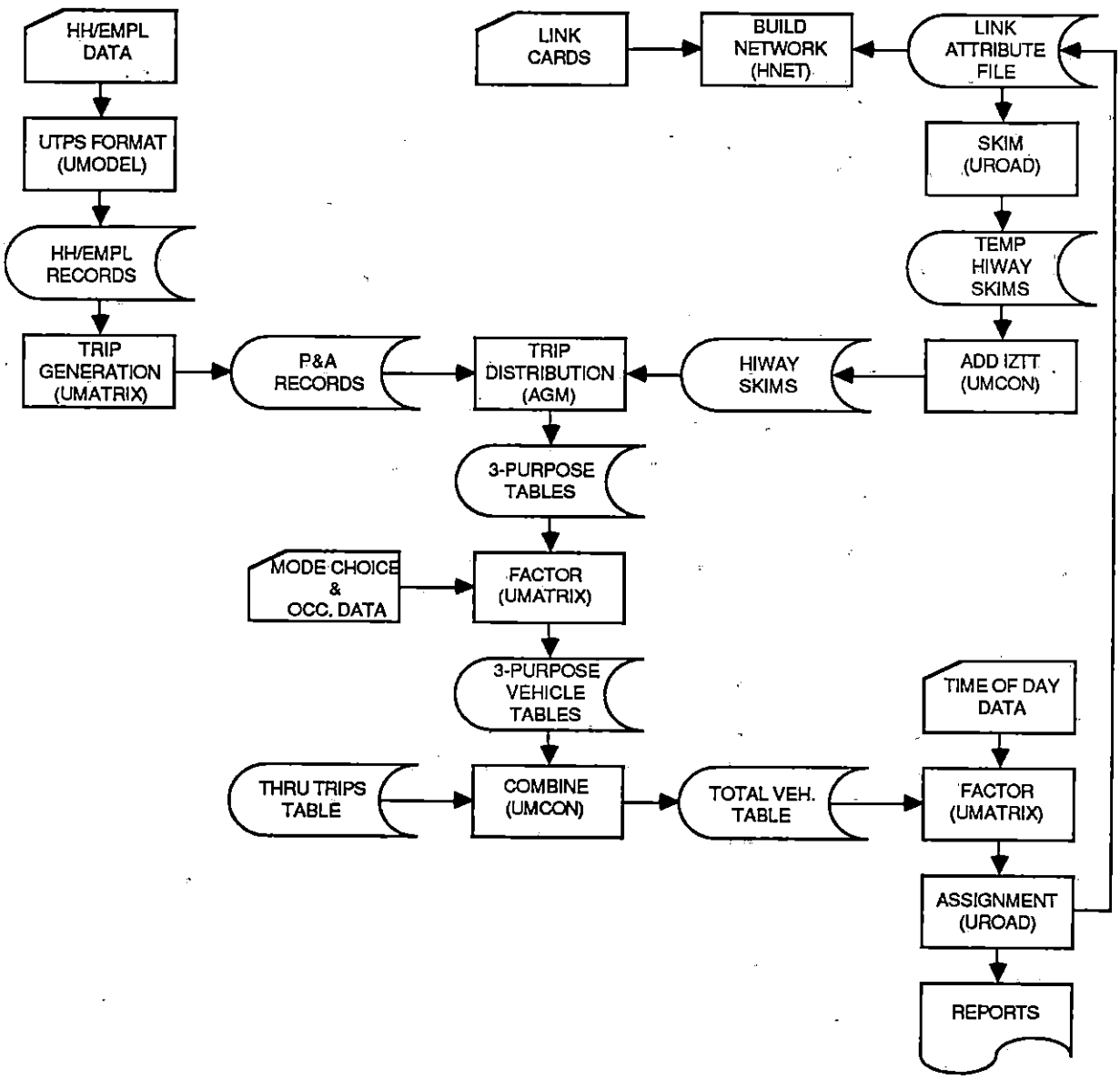

Exhibit 1. UTPS/SLIM Modeling Sequence Flow Chart.

CHAPTER 1
TRIP GENERATION

This chapter describes the steps necessary for you to establish trip generation rates (productions and attractions) for a given zone system. Specifically, this chapter covers

- converting household or population and employment data into a UTPS compatible format, and
- manipulating that data into trip production and attraction (P&A) rates for each zone.

To accomplish this, you must run two UTPS programs:

- UMODEL and
- UMATRIX.

Exhibit 2 illustrates where trip generation occurs in the modeling sequence. This manual assumes that you already have available household or population and employment data by zone, as well as factors for converting such data into productions and attractions.

UMODEL -- FORMATTING OF HOUSEHOLD AND EMPLOYMENT DATA

This section details the initial conversion of household and employment data into a dataset compatible with UTPS programs. This involves running the UMODEL program. Exhibit 3 presents the finished JCL setup to run the UMODEL program, which will be described and referenced throughout the first part of this Chapter. This manual assumes that household or population and employment information are already available on a computer tape that can be read by the IBM system. For this example, it is assumed that each record of the household and employment tape is structured in the following manner:

TRIP GENERATION

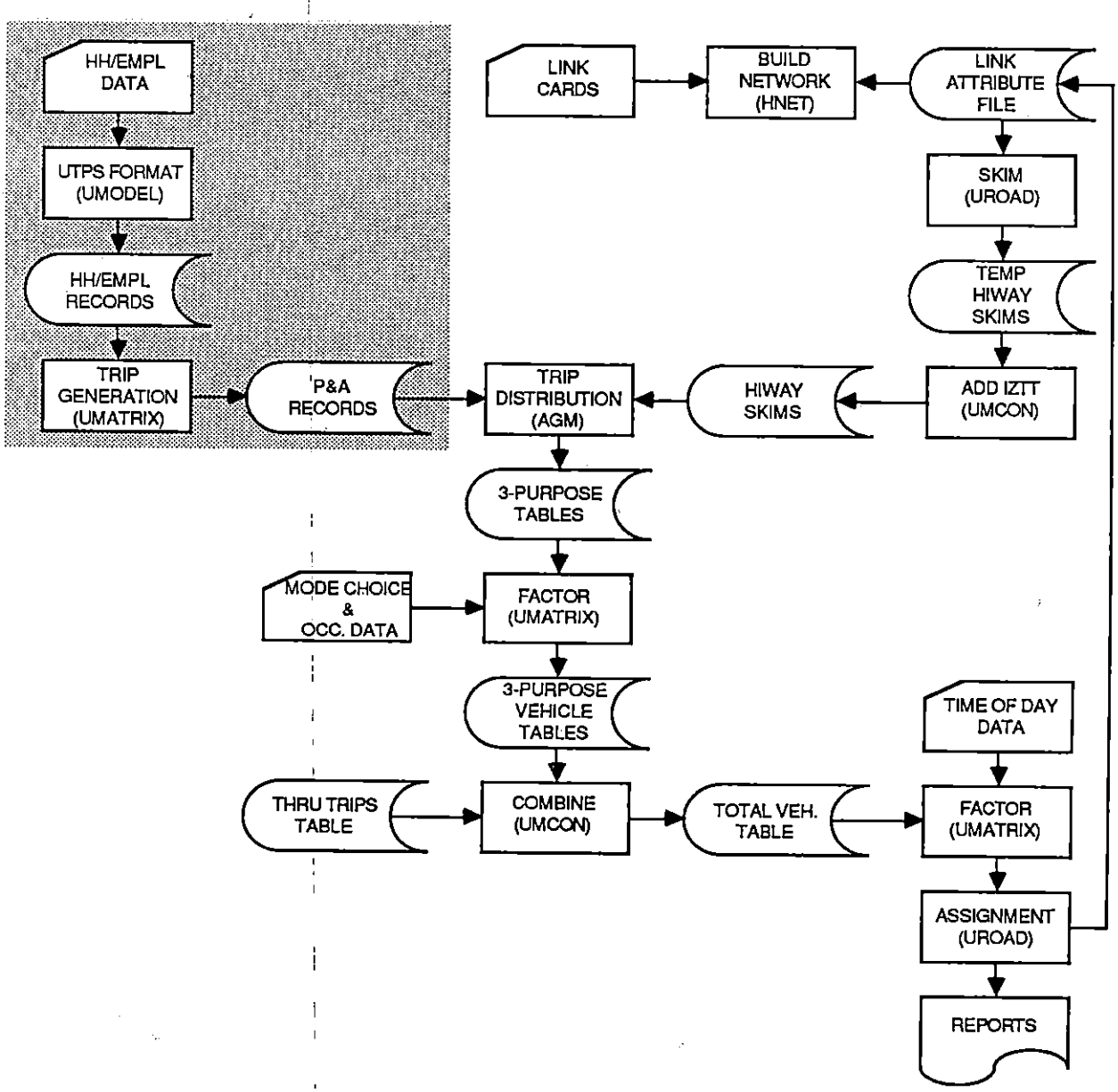

Exhibit 2. Trip Generation.

EXHIBIT 3

UMODEL RUN TO FORMAT HOUSEHOLD AND EMPLOYMENT DATA

```
//JOB CARD
//UMODEL EXEC UMODEL,CORE=300K,TIME=1
//         A8='DSN=HHEMP.DATA,VOL=SER=UMTA1',UNITA8=2314,
//         Z1='DSN=HHEMP.ZFILE,VOL=SER=UMTA1',UNITZ1=2314
//UMODEL.SYSIN DD *
     TRANSFER HH & EMPLOYMENT DATA TO Z-FILE
 &PARAM ZONES=180              &END
 &SELECT REPORT=1              &END
 &DATA
  1 P     1    6    1 1 1ZONE      ZONE NUMBER
  2 P     7   12    2 1 1HHINC1    HOUSEHOLDS - INC 1
  3 P    13   18    3 1 1HHINC2    HOUSEHOLDS - INC 2
  4 P    19   24    4 1 1HHINC3    HOUSEHOLDS - INC 3
  5 P    25   30    5 1 1POP       TOTAL POPULATION
  6 A    31   36    6 1 1EMPLOY    TOTAL EMPLOYMENT
  7 A    37   42    7 1 1RETAIL    RETAIL EMPLOYMENT
```

Line Number

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

Column Number	Item
1 through 5	Zone number
6 through 10	Number of households with income in range 1
11 through 15	Number of households with income in range 2
16 through 20	Number of households with income in range 3
21 through 30	Zonal population
31 through 40	Total zone employment
41 through 50	Zonal retail employment

Exhibit 3 shows the JCL setup which will convert this data file from the above file into a UTPS compatible file. The exhibit is described below:

Line 1: This line is called your Job Card and is specific to your computer installation. It usually contains at least a job name and your computer account number. Contact your computer operator for assistance with its format.

Line 2: This line executes the UMODEL program and establishes a central processing unit (CPU) size allocation of 300 kilobytes. This should be sufficient for any zone system used by a small urban area. The **CORE** specification can be increased (try 450K) if the program fails to run as a result of insufficient CPU space availability. The **TIME** parameter specifies the upper limit (in minutes) of CPU time for the job. This UMODEL run should take place in well under the one minute specified.

Line 3: The **A8** specification is the input dataset, where **DSN=** proceeds the name of the file containing the household and employment information. **VOL=SER=** specifies the name of the disk or tape on which the file is located, and **UNITA8=** specifies the model of the disk or tape drive specified by the **VOL=SER=** statement. (DISK or TAPE9 are good defaults for the unit specified if

you do not know the correct way to specify the device you are referencing. If you have difficulty, contact your system operator.)

Line 4: The Z1 specification provides the name for where you want the UTPS compatible data set to be output. This dataset will serve as an input into the trip generation dataset. Again, VOL=SER= and UNITZ1= simply describe the disk or tape device which contains sufficient empty space to hold the output dataset.

Line 5: Include this line as is; it indicates the beginning of the instructions needed by the UMODEL program (i.e., it defines Unit 5).

Line 6: This line is for you to enter a title describing what actions are to occur in this job. You may enter any comments you wish so long as column 1 is blank, and the comments stop before column 73 (i.e., you may use column 72).

Line 7: This line specifies the number of zones in the input dataset. Place the "&" in column 2, and replace "180" with the number of zones in your urban area.

Line 8: This line indicates which output reports should be sent to the line printer. Report number one is recommended. Again note that the "&" should go in column 2.

Line 9: The &DATA card indicates that the succeeding lines contain DATA IDENTIFICATION information. It should be included as is shown.

Lines 10 through 16: These lines tell the UMODEL program what information is on the input file, and how that information is to be arranged on the the UTPS output file. One line is needed for each item being put onto an output file. Lines 10 through 16 will cause the household and employment data described earlier to be placed onto the file named as Z1= in line 4. More than seven items (lines) can be input if more than seven values are to be place on the Z1 file. The format of these data identification cards can be found on pages three and four of the UMODEL section of the UTPS/SLIM documentation.

With all of the above data filled in, you are now ready to execute the UMODEL program. The execution command will be specific to your computer system.

TEST CITY APPLICATION

For the case study's test city, the following zonal population and employment information was available on tape:

Column Number	Item
1 through 4	Zone Number
6 through 12	Zonal Population
13 through 15	Population Trip Generation Factor
16 through 22	Zonal Employment
33 through 36	Employment Trip Generation Factor

The UMODEL input file which converted this data into a UTPS/SLIM readable Z-file is shown in Exhibit 4. The &PARAM card (line 2) shows that the test city had 169 zones. No output reports were requested so it is blank after the &SELECT key word (line 3). The &DATA card (line 4) is followed by five data locations and identification cards (lines 5-9). As an example, line 6 was the second zonal data item pulled off the test city tape. The data item was labeled a production (p in column 5) and was on columns 6-12 of the tape. The data was output to Z-file 1 (the 1 in column 24). The name of the Z-file attribute was POP, while the user identification name in columns 37-60 was TOTAL POPULATION.

EXHIBIT 4

TEST CASE PARAMETERS FOR UMODEL
POPULATION/EMPLOYMENT FILE CONVERSION TO UTPS FORMAT

```
        1         2         3         4         5         6         7
----5----0----5----0----5----0----5----0----5----0----5----0----5----0
```

```
  TRANSFER POP AND EMPLOYMENT DATA TO Z-FILE
&PARAM  ZONES=169-                  &END
&SELECT                             &END
&DATA
 1 P      1    4  1 1 1ZONE         ZONE NUMBER
 2 P      6   12  2 1 1POP          TOTAL POP
 3 P     13   15  3 1 1POPGEN       POPULATION GENERATOR
 4 A     16   22  4 1 1EMPLOY       TOTAL EMPLOYMENT
 5 A     33   36  5 1 1RETLGEN      RETAIL GENERATOR
```

Line Number
1*
2
3
4
5
6
7
8
9

*Not part of UTPS/SLIM program

UMATRIX -- TRIP GENERATION

Once the UMODEL program has run correctly, you have household and employment data in a form compatible with UTPS and are ready to perform the trip generation phase of the analysis. Trip generation for this case study will be performed for three trip purposes:

- o Home Based Work (HBW),
- o Home Based Other (HBO), and
- o Non-Home Based (NHB).

However, there is nothing sacred about these categories and you may use them or other trip purpose categories as required.

The actual estimation of productions and attractions is performed using an algebraic equation relating productions and attractions to the number of people (by income category) and the amount of retail and total office space in each zone. The UMATRIX program is used to perform this calculation.

Exhibit 5 shows the job set-up and equations that were used to perform the trip generation procedure. This exhibit is described below.

Line 1: This is your Job Card.

Line 2: This line executes the UMATRIX procedure provided with the UTPS tape. The 256K **CORE** statement should be sufficient, although for larger zone systems it can be expanded to 300 or 450K.

Line 3: The **J1** dataset is the input dataset containing household and employment information. This should be specified as the output dataset from the UMODEL run you just completed (i.e., Exhibit 3, line 4). As before, **UNITJ1** is the model of disk drive (or tape drive) the program is stored on. This JCL set-up assumes that the household and employment data has been cataloged on the computer, and therefore, the volume specification used in the UMODEL program set-up is not necessary.

Line 4: The Z9 dataset is the output dataset. You will need to specify what dataset name you wish for this new file. It will contain trip production and attraction rates for each trip purpose (e.g., for the case study it contained all six separate trip production and attraction estimates).

Line 5: This line indicates that the UMATRIX parameter information (Unit 5) will be starting with the next line of input. Input this line as is.

Line 6: This line serves as the title for the program output. Use it to specify what UMATRIX is being used to perform. Start your title in column 2.

Line 7: The &PARAM statement indicates that the following lines contain the calculations you want UMATRIX to perform. Place the "&" in column 2.

Lines 8 through 27: These lines define the computations UMATRIX will perform for each zone. Note that

- All variable names start with the two digit file identifier (J1 or Z9 in the case study example), with the remainder of the variable name being user specified. For example, J1HHINC1 is variable HHINC1 on the file J1, which you specified in line 3. The user specified variable name is used later to reference that variable for both printouts and calculations. Ten characters are allowed for each variable name.
- The right side of each equation is enclosed in single quotes.
- A comma after the closing single quote separates equations.
- Equations may use more than one line.

UMATRIX performs all equations in the order they are listed. The first equation is performed for each zone before the second equation is performed.

The indentations shown in Exhibit 5 are not specifically required by UMATRIX (however, don't use column one), but they are recommended for readability.

EXHIBIT 5

UMATRIX TRIP GENERATION RUN

```
//JOB CARD
//   EXEC UMATRIX,CORE=256K,
//   Z1='DSN=HHEMP.DATA',UNITJ1=3330,
//   Z9='DSN=TGEN90.DATA',UNITZ1=3330
//UMATRIX.SYSIN DD *
 UMATRIX/SLIM TRIP GENERATION
 &PARAM
       Z9HBWP1='1.10*Z1HHINC1',
       Z9HBWP2='1.80*Z1HHINC2',
       Z9HBWP3='2.00*Z1HHINC3',
       Z9TOTP='SUM(Z9HBWP1+Z9HBWP2+Z9HBWP3)',
       Z9HBWA='1.60*(Z1EMPLOY) + 1.70*(Z1RETAIL)',
       Z9TOTA='SUM(Z9HBWA)',
       Z9NORMAL='Z9TOTA/Z9TOTP',
       Z9HBWP='Z9HBWP1+Z9HBWP2+Z9HBWP3)*Z9NORMAL',
       Z9HBOP='1.60*(Z1HHINC1+Z1HHINC2+Z1HHINC3) + 1.40*(Z1POP)',
       Z9HBOA='2.00*(Z1EMPLOY) + 9.00*(Z1RETAIL)
          + 1.00*(Z1HHINC1+Z1HHINC2+Z1HHINC3)',
       Z9NHBP='1.00*(Z1EMPLOY) + 4.00*(Z1RETAIL)
          +  0.50*(Z1HHINC1+Z1HHINC2+Z1HHINC3)',
       Z9NHBA='Z9NHBP',
       Z9TOTNWP='SUM(Z9HBOP+Z9NHBP)',
       Z9TOTNWA='SUM(Z9HBOA+Z9NHBA)'
       Z9NORM2='Z9TOTNWA/Z9TOTNWP',
       Z9HBOP='Z9NORM2*Z9HBOP',
       Z9NHBP='Z9NORM2*Z9NHBP',
&END
&SELECT
    REPORT4='Z9HBWP','Z9HBWA',
            'Z9HBOP','Z9HBOA',
            'Z9NHBP','Z9NHBA',
    PRINT4=1,-5
&END
```

Line Number

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33

Line 28: The **&END** parameter signals the end of the calculations to be performed. It may be included on the same line as the last equation.

Line 29: The **&SELECT** card is used to indicate which reports you want generated for this UMATRIX run. Input it as shown.

Lines 30 through 32: These lines indicate that report format 4 (column format, see the UTPS/SLIM manual) will be printed for the calculated variables HBWPROD, HBOPROD, NHBPROD, HBWATTR, HBOATTR, and NHBATTR, which can be found on the **Z9** (output) file.

Line 33: **PRINT4** specifies which zones to include in the printed output (not to be confused with output to the disk file). In the case study, information for only five zones were printed (zones 1, 2, 3, 4, and 5). Enough zones should be output to ensure that the program functions correctly, but note that asking for all zones can sometimes produce extremely large volumes of printed output.

Line 34: The **&END** card signifies the end of the **&SELECT** information, and in this instance the end of the UMODEL parameter input.

The UMATRIX trip generation run is now ready to be submitted.

TEST CITY APPLICATION

After the test city information was in UTPS format it was necessary to model the trips generated by each zone. UMATRIX was used to multiply population and employment by trip generation factors. The trip generation factors were developed by planners in the test city from the *Quick Response Users Guide* (National Cooperative Highway Research Program Report 187, *Quick Response Urban Travel Evaluation Techniques and Transferable Parameters*: Transportation Research Board, 1976) and other sources. The trip purposes' travel percentages also were borrowed from other sources and were set at HBW = 20%, HBO = 50% and NHB = 30%. The UMATRIX input to generate trip purpose by zone is shown in

Exhibit 6. The &PARAM card (line 3) shows that 169 zones will be output onto the Z-file. The equation cards (lines 5-12) perform a number of operations in order to generate trips for each zone. For example, line 4 multiplies the population of each zone by a population related trip generation factor. Line 6 normalizes the population production trips with the employment attraction trips. Lines 7-9 break the population production trips into three trip purposes. Under the &SELECT card (line 13) the REPORT4 cards request the production and attraction for each of the three trip purposes to be output. The PRINT4 card (line 17) specifies that they be printed out for zones 1 to 169. The REPORT5 card requests that report 5 be printed for the Z-files 1 and 9.

EXHIBIT 6

TEST CASE TRIP GENERATION PARAMETERS

```
        1         2         3         4         5         6         7
----5----0----5----0----5----0----5----0----5----0----5----0----6----0
```

```
UMATRIX/SLIM TRIP GENERATION
CREATES A TRIP GENERATION FOR TEST CITY
&PARAM SIZE9=169,
     Z9POPPRD='EMPLGEN*Z1POP',
     Z9EMPATTR='Z1RETLGEN*Z1EMPLOY',
     Z9NEMPATTR='Z9EMPATTR*.732',
     Z9HBWPRD='Z9POPPRD*.2',
     Z9HBOPRD='Z9POPPRD*.5',
     Z9NHBPRD='Z9POPPRD*.3',
     Z9HBWATTR='Z9NEMPATTR*.2',
     Z9HBWOTTR='Z9NEMPATTR*.5',
     Z9NHBATTR='Z9NEMPATTR*.3'            &END
 &SELECT
     REPORT4='Z9HBWPRD','Z9HBWATTR',
             'Z9HBOPRD','Z9HBOATTR',
             'Z9NHBPRD','Z9NHBATTR',
    PRINT4=1,-169,
    REPORT5=1,9                           &END
```

Line Number
1*
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

*Not part of the program

CHAPTER 2
HIGHWAY NETWORK CONSTRUCTION

This chapter demonstrates the construction of a highway network for the study area. It will show how link and node information were converted into a highway network representation that could be utilized by UTPS. Exhibit 7 illustrates this portion of the modelling sequence. This process starts with the definition and description of formatted highway link cards. This information is used in the execution of the HNET program to build a road network file compatible with UTPS path skimming algorithms. Path skimming is detailed in Chapter 3.

HNET -- NETWORK CONSTRUCTION

The UTPS HNET program performs the task of setting up a working highway network file. This file is used to calculate travel paths for automobile trips. Travel time paths are used in the trip distribution process. Exhibit 8 presents the UTPS run used in this case study to execute the HNET program. This exhibit is explained below.

Line 1: This is your Job Card.

Line 2: This line executes the HNET program. The **BUILDN** parameter is simply a name and may be replaced by any user specified name that meets JCL guidelines. The rest of the line should be entered as is.

Lines 3 and 4: These two lines are necessary to provide enough space to input the information used to define the **N1** output dataset. The **N1** dataset is the main UTPS listing of link and node representations. This file would be referenced initially if changes were to be made to the link data file.

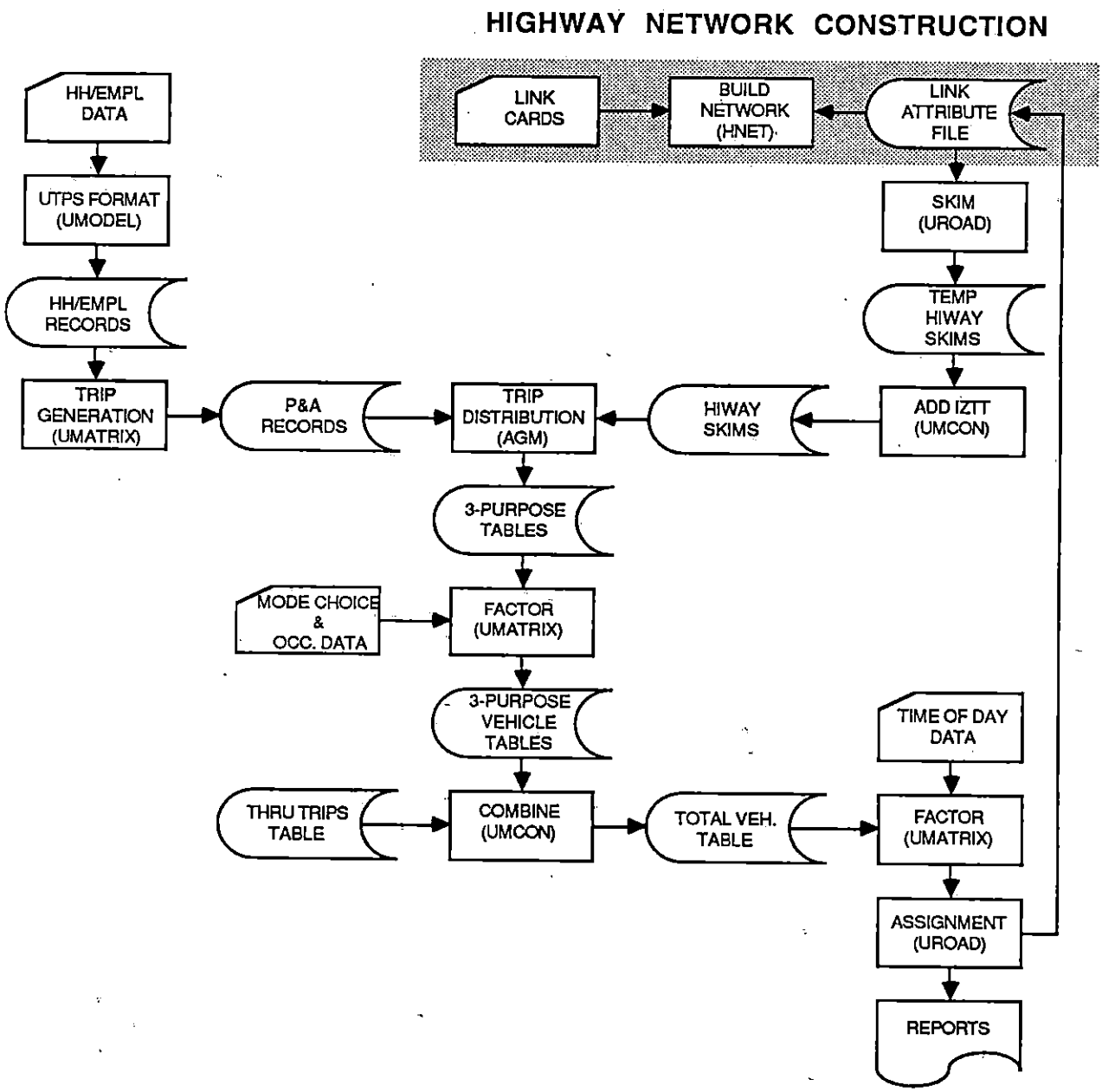

Exhibit 7. Highway Network Construction.

EXHIBIT 8

BUILDING NETWORK FILES

```
//JOB CARD
//BUILDN EXEC HNET,
//    N1='DSN-UMTA.UTOWN.NFILE,VOL=SER=UMTA1',SPACEN1='(TRK,100)',
//        DISPN1='(,KEEP)',
   // Z1='DSN=UMTA.UTOWN.LZFILE,VOL=SER=UMTA1',SPACEZ1='(TRK,100)',
        DISPZ1='(NEW,KEEP)'
//HNET.LINKS DD DSN=UMTA.UTOWN.DATA(LINK),DISP=SHR,LABEL=(,,,IN)
//HNET.SYSIN DD *
 BUILD N-FILE AND Z-FILE FROM LINK CARDS
 &PARAM  NODES=600,ZONES=180   &END
 &SELECT REPORT=16,18,
    Z1LAVS= 'DC',   'D',   'FT',   'AT',   'GL','FFS','FFT',
            'C',  'NL',   'LG',    'A',    'B'     &END
 &DATA
 3 5 1 1 1 9+  0.0 55.0
 2 4 2 2 1 9+  0.0 40.0
 5 5 2 2 1 9+  0.0 50.0
 5 5 6 6 1 9+  0.0 35.0
```

Line Number

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

The JCL commands on these two lines indicate the following: **DSN=** specifies the output dataset name; **VOL=SER=** indicates the disk were the N1 file is to be output; **SPACEN1='(TRK,100)'** indicates that the N1 dataset will need roughly 100 tracks of disk space; and **DISPN1='(,KEEP)'** indicates that the dataset should be kept (as opposed to discarded) at the completion of the job.

Lines 5 and 6: These two lines define the **Z1** output file. The **Z1** file contains the attributes of the highway network. It is this information that is used by UROAD as input data.

As in lines 3 and 4, **DSN=** specifies the dataset name to be given to the new **Z1** file. **VOL=SER=** specifies the volume of the disk where the output dataset will be written. **SPACEZ1=** indicates the amount of space needed by the **Z1** file, and **DISPZ1=** indicates that this new datset is to be kept after the program terminates.

Line 7: This line defines the location of the input link and node cards. HNET.LINKS (also known as Unit 2) indicates that the dataset to be named in the remainder of this JCL statement contains the HNET link records. DD is simply a JCL identifier; include it as is. The **DSN=** statement indicates the name of the dataset that contains the original link cards. **DISP=SHR** is a standard JCL statement which allows the use of existing datasets by more than one program at a time. **LABEL=(,,,IN)** indicates that the link card data is on a tape. This final portion of the statement is unnecessary if the input data is already on a disk file.

Line 8: This card indicates that the HNET control cards will follow immediately. This statement defines Unit 5 for those users who wish to separate their input data deck from their job control instructions.

Line 9: This is the title card for the HNET run. You may include any identifying information you desire for inclusion on the printed output. Start the information in column 2.

Line 10: For this card, **&PARAM** should be placed starting in column 2. **NODES=** specifies the largest possible node number for the highway network. You may indicate a node size larger than actually exists in the network at the moment in order to allow room for future growth. **ZONES=** specifies the number of zones in the study area. **&END** must be included following the above information.

Lines 11 through 13: The **&SELECT** card performs two tasks for the HNET program. The first is to control the reports produced using the **REPORT** control parameter. For the case study, reports 16 (a summary of the Z1 file) and 18 (a printout of the speed/capacity tables) will be printed.

The second use of the **&SELECT** card is to define which attributes will be included on the output Z1 file. The attributes included in the case study are recommended for the majority of HNET output runs. These values are explained on page 10 of the UTPS/SLIM HNET write-up, and summarized in Exhibit 9.

Also note that **&END** should follow the final attribute definition as shown in Exhibit 6.

Line 14: The **&DATA** card(s) indicates that you will be updating the speed/capacity table that comes with the UTPS tape. Due to default speed limits in excess of 55 MPH, this should be done by all UTPS/SLIM users.

Lines 15 through 18: A description of the data card input format is included in the HNET/SLIM documentation starting on page 16. A summary of the card format is included in Exhibit 10 for quick reference.

After the data cards are complete, the HNET program is ready for execution.

EXHIBIT 9

HNET LAV NAMES

DC	DIRECTION CODE
D	DISTANCE IN MILES
FT	FACILITY TYPE
AT	AREA TYPE
FFS	FREE FLOW SPEED (LOOK-UP TABLE)
FFT	FREE FLOW TIME (MINUTES, BASED ON FFS)
C	HOURLY CAPACITY (VEHICLES/HOUR)
NL	NUMBER OF LANES
GL	GEOGRAPHIC LOCATION
LG	LINK GROUP
A	ANODE
B	BNODE
OT	OBSERVED TRAVEL TIMES (CODED, MINUTES)
OS	OBSERVED SPEED (CODED IN MPH)

EXHIBIT 10

HNET DATA CARD FORMAT FOR EXHIBIT 8

Columns	Data Value	Contents
2	Zone Number	The begining zone of the range to which the change will be applied.
4	Zone Number	The ending zone of the range to which the change will be applied.
6	Facility Type	The code of the low facility type in the range to which the change is applied.
8	Facility Type	The code of the high facility type in the range to which the change is applied.
10	Number of Lanes	The lowest number of lanes a facility will have and have the change applied.
12	Number of Lanes	The highest number of lanes a facility will have and have the change applied.
13	Capacity Operator	Code which indicates the modification to take place.
14-18	Capacity/lane	Vehicles per hour
19	Speed Operator	Code which indicates the modification to take place with the speed defaults.
20-23	Speed	Miles per hour

These coding values can be repeated in columns 24 through 46, and then again from columns 47 through 69.

TEST CITY APPLICATION

For the test city, a computer file containing node numbers, distances, travel speeds, number of lanes, road facility types and area type for each segment of the test city street network was put into the proper format for HNET. The HNET inputs used to create a Z-file and an N-file are shown in Exhibit 11. The &PARAM card (line 2) indicates that the test city had 169 zones and the highest link number was less than or equal to 600. Under the &SELECT card (line 3) fourteen link attributes were written to the Z-file (lines 4-5). Some of these attributes were input from the test city data and others were to be created by HNET. The &SELECT card also specified that reports 16 and 18 be output (line 6). Under the &DATA card (line 7) a number of updates (lines 8-12) were made to the speed/capacity table used for default values. Updating the speed/capacity table was necessary because a number of speed limits were greater than 55 MPH or were not appropriate for the test city. As an example, the first update card (line 8) modified area types 3 to 5 and facility type 1 (1 to 1) having one to nine lanes, by adding 0.0 to the capacity (i.e., no change from the default value) and replacing the default speed with 55.0 MPH. If it has been necessary, HNET could have also been used to change, add, or delete links in the street network.

EXHIBIT 11

TEST CASE PARAMETERS FOR
CONSTRUCTION OF THE HIGHWAY NETWORK

```
BUILD HNET N-file & Z-FILE FOR TEST CITY
 &PARAM
    ZONES = 169,
    NODES = 600,                  &END
 &SELECT
   Z1LAVS='A','B','DC','D','FT','AT','OS','OT','C','NL',
          'LG','GL','FFS','FFT',
   REPORT=16,18                   &END
 &DATA
 3 5 1 1 1 9+   0.0 55.0
 2 4 2 2 1 9+   0.0 40.0
 5 5 2 2 1 9+   0.0 50.0
 4 4 6 6 1 9+   0.0 25.0
 5 5 6 6 1 9+   0.0 35.0
```

*Not part of the program.

Line Number

CHAPTER 3
PATH SKIMMING

This chapter describes the steps necessary for converting the link/mode highway network representation into a matrix of zone-to-zone travel time paths. Exhibit 12 shows the location of path skimming in the modeling sequence. You will use this path network several times in the remaining steps of the transportation forecasting effort. Initially, the zone-to-zone travel times (impedances) will be used by the gravity model to convert productions and attractions into specific origin/destination (O/D) pairs. Later in the process the travel paths will be used for assigning vehicle trips to particular highway segments.

The path skimming portion of UTPS/SLIM requires the following to separate model runs:

- a UROAD run to provide highway travel times from node to node; and
- an UMCON run to add into the above information intra-zonal travel time estimates

As before, these two programs will be described separately.

UROAD -- INITIAL PATH SKIMMING

For this model run, the UROAD program utilizes the HNET output from the previous chapter in order to perform the initial travel time skims of the coded highway network. Exhibit 13 presents the JCL necessary for this run. These statements are explained in more detail below.

Line 1: This is your Job Card.

Line 2: This statement executes the UROAD procedure included on tape with the UTPS programs. It specifies a core memory of 350K and a time limit of

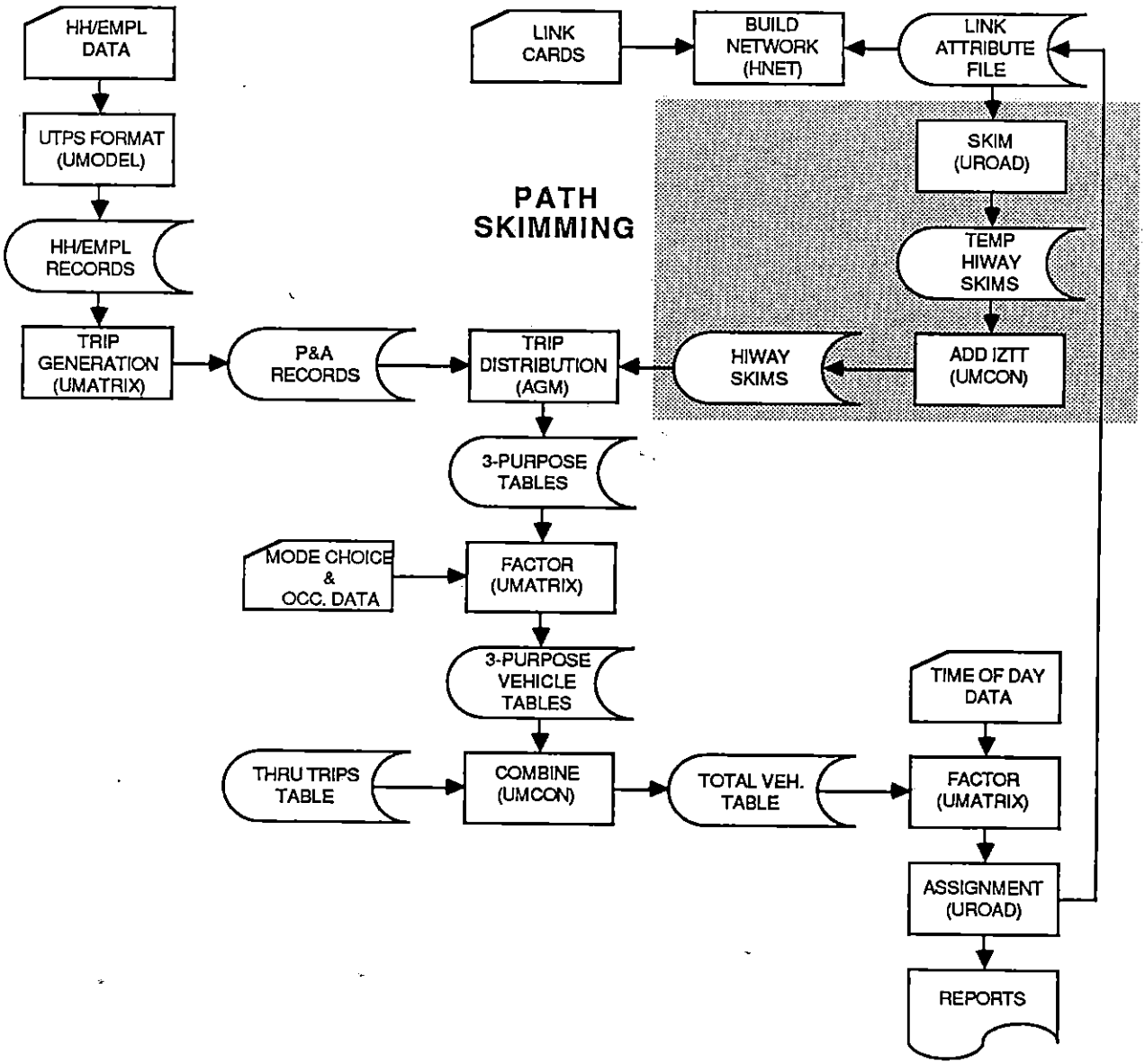

Exhibit 12. Path Skimming.

EXHIBIT 13

TRAVEL TIME PATH SKIMMING

```
//JOB CARD
//NROAD  EXEC  UROAD,CORE=350K,TIME=1,
//   Z1='DSN=UMTA.UTOWN.LZFILE,VOL=SER=UMTA1',UNITZ1=SYSDA,
//   J9='DSN=ALTO.SKIMS',UNITJ9='SYSDA,SPACE=(TRK,(10,10),RLSE)'
//UROAD.SYSIN DD *
 SKIM FOR TEST CITY TRAVEL TIMES
 &PARAM TLAV='OT'      &END
 &SELECT  TIME='HIWAY TIME'     &END
```

Line Number

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10 minutes. Both the core and time limits can be expanded for large highway networks.

Line 3: **Z1=** specifies the highway network file output from the HNET program in the previous chapter. The dataset name should be preceded by a single quote and **DSN=** as shown in Exhibit 13. Note also that the **VOL=SER=** disk specification is included inside the single quotes. **UNITZ1** specifies the model of disk specified by the **VOL=SER=** parameter.

Line 4: **J9=** specifies the output dataset for the UROAD path skims. As in line 3, the file name is enclosed in single quotes and preceeded by **DSN=**. Note that no volume specification is given. This and the **UNIT=SYSDA** specification are used together to allow the computer system to select an appropriate disk for this output file. A particular volume (disk) can be specified by coding a **VOL=SER=** parameter as in Line 3. Finally, note that a space allocation is included within the unit specification. This is necessary. The space indicated in the exhibit is appropriate for most situations but can be changed to match your needs.

Line 5: This record specifies that the input control cards will follow immediately (it specifies Unit 5). Input this card as shown.

Line 6: This is the title card for the run. Any identifying information you desire may be placed here. Start in column 2.

Line 7: The **&PARAM** statement specifies what UROAD functions will be performed for this run. **TLAV=** indicates which LAV (table on the Z1 file) you wish to use in the path skimming. The name you specify must have been included in the HNET run which set up the input **Z1** file used in this program (see lines 12 and 13, Exhibit 8). In Exhibit 13 **TLAV** is set equal to OT (observed time). The other choice for link travel times is "FFT" for using the speeds and times contained in the speed/capacity table.

Note that the &END parameter follows the TLAV specification, and the &PARAM specification starts in column 2.

Line 8: The &SELECT record controls the output of information. The TIME= parameter specifies that highway skims are to be output to the J9 file. In this example this output field is called HIWAY TIME. The & should be placed in column 2.

The UROAD program is now ready to be run.

TEST CITY APPLICATION

Using the street network created by HNET, the network's skim or travel times were created. Exhibit 14 is the UROAD input that generated the skims. The &PARAM card (line 2) requested that the attribute OT (observed time) from the input Z-file be used to calculate the skims. The &SELECT card (line 3) named the output skim table HIWAY TIME. No reports were requested.

UMCON: -- ADDING INTRAZONAL TIMES

The highway travel time paths computed above do not include intrazonal travel estimates (i.e., average travel times for moving within a zone not on the coded highway network) or terminal time (travel from one origin/destination to a node on the highway network). These times are necessary for the proper functioning of the gravity model used to distribute trips throughout the region. To insert these travel times onto the travel time paths calculated with UROAD in the section immediately above this, you must perform an UMCON run.

Exhibit 15 presents the JCL and control cards to perform the necessary UMCON functions. It is described below:

Line 1: This is your Job Card.

EXHIBIT 14

TEST CASE PARAMETERS FOR
TRAVEL TIME PATH SKIMMING

```
                                                                    Line
                                                                    Number
UROAD/SLIM SKIM GENERATION                                          1
 &PARAM  TLAV='OT'      &END                                        2
 &SELECT  TIME='HIWAY TIME'      &END                               3
```

EXHIBIT 15

ADDITION OF INTRAZONAL TRAVEL TIMES
TO THE INITIAL TRAVEL TIME SKIMS

```
//JOB CARD
//MCONT4 EXEC UMCON,CORE=160K,
//   J1='DSN=ALTO.SKIMS,VOL=SER=UMTA1',UNITJ1=2314,
//   J9='DSN=UMCON.SKIMS,VOL=SER=UMTA1,SPACE=(TRK,(10,10),RLSE)',
//         UNITJ9=2314
//UMCON.SYSIN DD *
 &PARAM CARDS=8,ZONES=5,TABLES=1001,NAME1='AUTO TIME'  &END
 &SELECT  PRINT=1,-5  &END
99999
 10011001   1   5   1   1+   4  10011001    1    5    2   2+   3
 10011001   1   5   3   3+   2  10011001    1    5    4   4+   2
 10011001   1   5   5   5+   2  10011001    1    1    1   5+   4
 10011001   2   2   1   5+   3  10011001    3    3    1   5+   2
 10011001   4   4   1   5+   2  10011001    5    5    1   5+   2
 10011001   1   1   1   1+   4  10011001    2    2    2   2+   9
 10011001   3   3   3   3+  10  10011001    4    4    4   4+  12
 10011001   5   5   5   5+  13
```

Line Number

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Line 2: This record executes the UMCON procedure supplied with the UTPS program tape. It specifies a core memory requirement of 256K, which should be sufficient for most UMCON runs. It can be expanded if necessary.

Line 3: **J1=** specifies the input dataset containing the output of the UROAD program run previously (see Exhibit 13, line 4). Note that the **VOL=SER=** parameter specifying the disk drive name is included within the single quotes as in the **DSN=** specification before the filename. **UNITJ1** specifies the model of the disk drive.

Lines 4 and 5: **J9=** specifies the output dataset. This file will be input into the gravity model for performing the trip distribution phase of the modeling effort. Since this is a new file, a **SPACE** allocation has been included with the dataset name. It is placed inside the single quotes along with the dataset name. (It could also be included in quotes along with the **UNITJ9** specification as in line 4 of Exhibit 13). The **SPACE** allocation provided in line 4 should be sufficient for UTPS/SLIM users, but it may be increased or decreased at your discretion.

Line 6: This record specifies that the UMCON control cards follow immediately (it specifies Unit 5). Include it as shown.

Line 7: This is the title for the UMCON run. You may code any identifying information you wish here, using columns 2 through 71.

Line 8: The **&PARAM** record starts in column 2 and specifies the parameters for controlling the UMCON operations. **CARDS=** specifies the number of modification cards (records) which are included in this job. **TABLES=** specifies the file and table number of the input to be processed. **NAME1=** specifies a title to be associated with the first output table being written. (If two tables were to be output, **NAME2** would apply to the second.) Naming tables is advisable for later reference and error checking. **ZONES=** specifies the number of zones on

the table being input. **&END** must be coded after the other parameters have been specified.

Line 9: **&SELECT** starts in column 2 and is used to specify the reports to be printed upon conclusion of this run. **PRINT**=1,-5 indicates that data from zones 1 through 5 should be printed. You should change the 5 to the value of your last zone in order to print out the entire travel time matrix for error checking. UMCON automatically prints Report 6, a row summary of the datafile specified as **J9**. Code **&END** following the **PRINT** specification.

Line 10: **&DATA** should be coded on this line, starting in column 2.

Line 11: Place five "9"s in this line, starting with column 1.

Lines 12 and on: These records are used to specify modifications to the file input as **J1**=. Two modifications can be performed with each card image (record). The number of card images present should be specified in line 8 with the **CARDS** parameter. The proper format for these cards is explained on page 4 of the UTPS/SLIM UMCON document. Exhibit 16 explains what line 12 represents.

No **&END** parameter is needed for the **&DATA** specification. This program is now ready to be run.

TEST CITY APPLICATION

Intrazonal travel times for the test city were developed using the *Quick Response User's Guide*. Each zone was classified as downtown, central city, or subdivision. Travel times were added to each zone depending on their classification.

Exhibit 17 shows the UMCON input used to add intrazonal and terminal travel times. The &PARAM card (line 2) indicated that test city needed fewer than 50 zonal skim modification cards, that the input table was on Z-file 1 -- table number 001, that the first (and only) output table was named HIWAY TIME,

EXHIBIT 16

DESCRIPTION OF UMCON DATA CARDS
USED IN EXHIBIT 15
(See Line 10 of Exhibit 15)

Columns	Value	Meaning
2-5	101	This change applies to the first file on the J1 dataset. (There can be more than one table on a file.)
6-9	101	The last table this change applies to is table 1 on the J1 dataset.
10-14	1	The first production file the change applies to is zone 1
15-19	5	The last zone the change applies to is zone five (i.e., it applies to zones 1 through 5)
21-24	1	The first attraction zone the change applies to is zone 1.
25-28	1	The last attraction zone the change applies to is zone 1.
29	+	The value is columns 30-36 will be added to the existing travel times.
30-36	4	Four minutes will be added.
38-41	101	This change applies to the first file on the J1 dataset.
42-45	101	The last table this change applies to is table 1 on the J1 dataset.
46-50	1	The first production file the change applies to is zone 1
51-55	5	The last zone the change applies to is zone five (i.e., it applies to zones 1 through 5)
57-60	2	The first attraction zone the change applies to is zone 2.
61-64	2	The last attraction zone the change applies to is zone 2.
65	+	The value is columns 66-72 will be added to the existing travel times.
66-72	3	Three minutes will be added.

EXHIBIT 17

TEST CASE PARAMETERS FOR
ADDITION OF INTRAZONAL TRAVEL TIMES

```
INTRAZONAL TRAVEL TIMES - ADDITION TO SKIMS
&PARAM CARDS=50,TABLES=1001,NAME1='HIWAY TIME',ZONES=169  &END
&SELECT PRINT=21,-27     &END
&DATA
99999
 10011001   71   74   71   74+     12 10011001   71   74  138  169+     8
 10011001   71   74   30   70+      6 10011001   71   74  128  137+     5
 10011001   71   74   21   29+      5 10011001   71   74   75  127+     5
 10011001  138  169  138  169+     12 10011001  138  169   30   70+     6
 10011001  138  169  128  137+      6 10011001  138  169   21   29+     5
 10011001  138  169   70  128+      5 10011001   30   70   30   70+    11
 10011001   30   70  128  137+      4 10011001   30   70   21   29+     3
 10011001   30   70   75  127+      3 10011001  128  137  128  137+    11
 10011001  128  137   21   29+      3 10011001  128  137   75  127+     3
 10011001   21   29   21   29+      7 10011001   21   29   75  127+     2
 10011001   75  127   75  127+      7 10011001
```

Line Number

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and that the city had 169 zones. The &SELECT card (line 3) specified that rows 21 through 27 of the output matrix be printed in default report 7. Under the &DATA card (line 4) additional travel times were added to various zones (lines 6-15). The nines card (line 5), as required, preceded the modification cards. Line 7, as an example, requested that 5 minutes be added to travel times from the first table on file one (tables 1001 to 1001), production zones 71 to 74, attraction zones 21 to 29. The second half of line 7 is another, separate, modification operation.

CHAPTER 4
TRIP DISTRIBUTION

This chapter describes the steps necessary, using UTPS/SLIM, to convert the productions and attractions calculated in Chapter 2 into origin/destination matrices usable for mode choice and traffic assignment. Exhibit 18 shows the location of this step in the modeling sequence. The end result of the steps performed in this chapter are purpose specific production/attraction matrices. Note that nothing is sacred about the three trip purposes used as an example in this chapter. Most urban areas use at least three trip purposes, but your specific area may have a different number, depending upon the sophistication of your population and employment data and the availablity of equations to convert them to accurate production and attraction rates.

AGM -- GRAVITY MODEL

To perform the trip distribution function, UTPS/SLIM runs the gravity model program AGM. AGM requires three primary sources of input:

- the production and attraction tables produced in Chapter 1,
- the travel time matrice that was just calculated in Chapter 3 using UROAD and UMCON, and
- friction factor tables that allow the gravity model to account for the propensity of indivduals to travel.

Exhibit 19 presents a sample setup for an AGM run. This setup is described below.

Line 1: This is your Job Card.

Line 2: This line executes the AGM procedure (PROC) included in the UTPS program tape supplied by UMTA. **CORE2=** specifies the amount of CPU storage space required for this run. 256K is usually the minimum necessary for

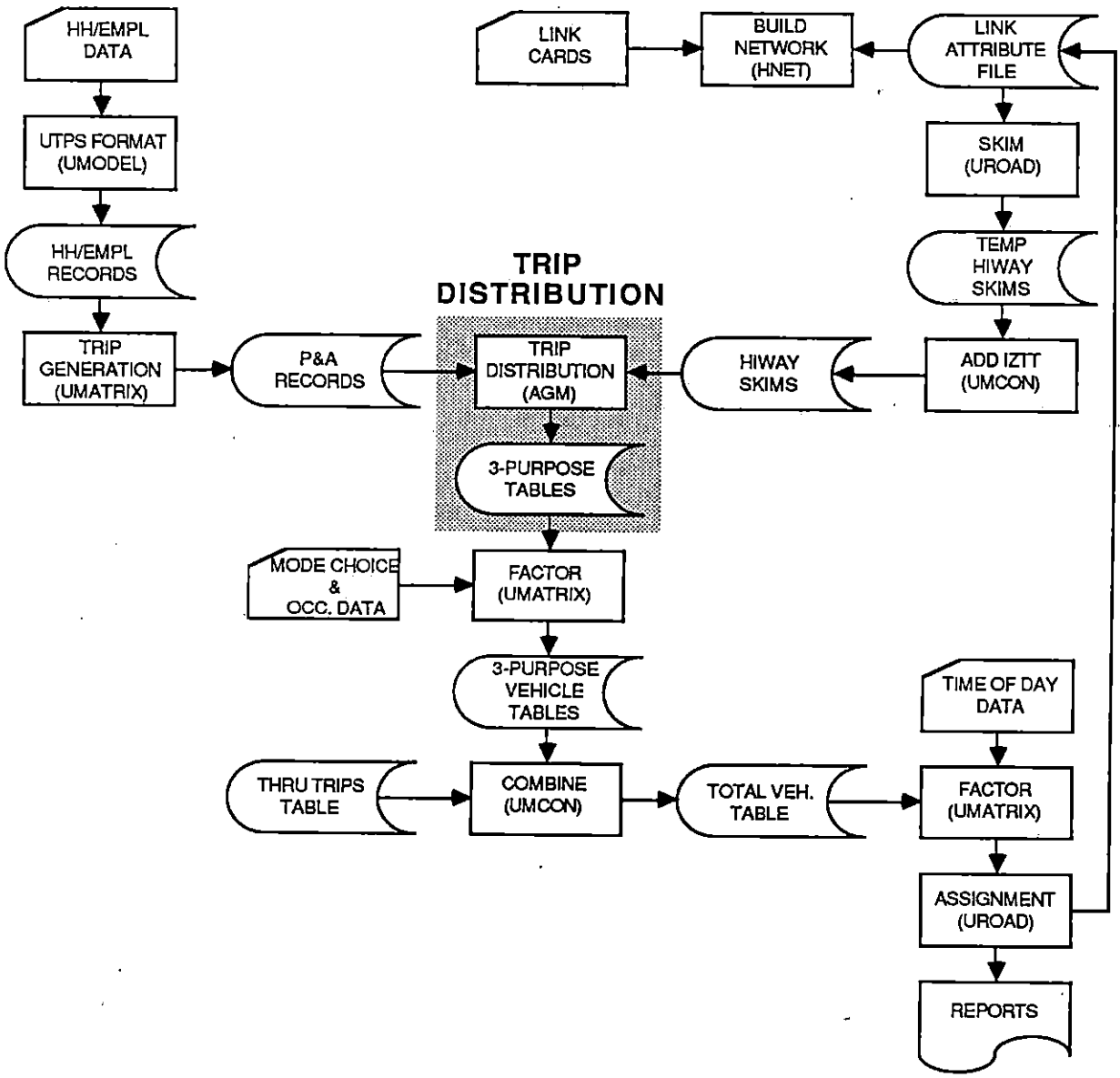

Exhibit 18. Trip Distribution.

EXHIBIT 19

TRIP DISTRIBUTION GRAVITY MODEL

```
//JOB CARD
//AGM EXEC AGM,CORE2=180K,
//   J1='DSN=UMCON.SKIMS,VOL=SER=UMTA1',UNITJ1=2314,
//   J9='DSN=AGM.OUTPUT,VOL=SER=UMTA1,SPACE=(TRK,(50,10))',
//        UNITJ9=2314,
//   Z1='DSN=TGEN90.DATA,VOL=SER=UMTA1',UNITP=2314,
//   F='DSN=FFACT.DATA,VOL=SER=UMTA1',UNITA=2314
//AGM.SYSIN DD *
 GRAVITY MODEL RUN WITH 3 ITERATIONS, 3 TRIP PURPOSES
 &PARAM AITER=3,3,3,TABOUT=3,
       ZP1='Z1HBWP',ZA1='Z1HBWA',
       ZP2='Z1HBOP',ZA2='Z1HBOA',
       ZP3='Z1NHBP',ZA3='Z1NHBA'    &END
 &OPTION A=T    &END
 &SELECT REPORT=3,5,8        &END
```

Line Number

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

most urban areas; 300 to 400K can be necessary for urban areas with large zone systems.

Line 3: The **J1** file defines the zone-to-zone travel time paths (skims) that were calculated in the UMCON program in Chapter 3 (line 4, Exhibit 15).

Lines 4 and 5: The **J9** file defines the new output dataset that will contain the origin/destination data trip table calculated by the AGM program. As with the other UTPS programs, the dataset name for both the **J1** and **J9** files should be enclosed in single quotes and be prefaced by **DSN=**. In addition, because the **J9** file is a new file, it must have its location defined (the **VOL=SER=** parameter defines the disk to be used by the dataset), and the approximate amount of space it will require (the **SPACE=** parameter).

Line 5: The **Z1** file defines the production and attraction tables computed in Chapter 1 (line 4, Exhibit 5). As with above, the **VOL=SER= and UNITP=** simply help define the location of the **Z1** dataset.

Line 6: The **F** file defines the location of the friction factor. The format of the records in this file can be found on page seven of Part 3 of the UTPS/SLIM manual.

Line 7: This statement defines the location of input control cards for the AGM run (i.e., it defines Unit 5) as following immediately. Include it as indicated unless your control cards are stored in a separate file.

Line 8: The title card for this job. This may be used to place a header on the UTPS output for identifying this run.

Lines 9 through 12: These lines define the primary tasks to be performed by the AGM program. **&PARAM** should be placed starting in column 2. **AITER=3,3,3** indicates that this model run will contain three different tables of output and will iterate a maximum number of three times for each of the three tables being produced by the gravity model. **TABOUT=** indicates the number of

tables being output by AGM. This number should equal the number of values listed in the **AITER=** statement.

ZP1= defines the zonal production table to be used in the first pass of the gravity model (i.e., it will be used to produce the first of the three requested tables). **ZA1=** provides the corresponding zonal attraction table definition. In line 10, the two tables are defined as Z1HBWP and Z1HBWA. These correspond to the tables named HBWP and HBWA in the UMATRIX run that set up the file defined as **Z1=** in line 5 (see lines 12 and 15 in Exhibit 4).

Note that **Z1** in the table name defines the name of the dataset file that the desired information resides on, and the rest of the name defines <u>which</u> table on that dataset (there is often more than one) is desired.

ZP2, ZA2, ZP3, and ZA3 define the second and third sets of tables to be used by the AGM program (i.e., the information to be used to produce output tables number 2 and 3).

Remember to include the **&END** parameter after all of the **&PARAM** parameters have been specified.

<u>Line 13</u>: The **&OPTION** statement specifies the desired parameters for this run of the gravity model. For UTPS/SLIM, the only specification that needs to be included is the **A=T** value included in the example. Include the **&END** specification as shown in the exhibit.

<u>Line 14</u>: The last line of the AGM program is for specifiying the desired reports to be output upon completion of the model run. The **&SELECT** and **REPORT** keywords are used to specify which reports are to be printed. The three reports indicated in Exhibit 19 (3, 5 and 8) are recommended. These reports will allow for a complete review of the model results before continuing with the next phase of the modeling effort.

The AGM setup is now ready for submittal to the computer.

TEST CITY APPLICATION

The test city trip distribution required three input data sets. One comprised the three trip purpose, zonal production and attraction tables created by UMATRIX (Chapter 1). The second consisted of the street network travel times created by UMCON (Chapter 3). The third included friction factors for the three trip purposes. For the test city this information was developed from the *Quick Response User's Guide.* The friction factor file was put into the format required by AGM. The AGM input to create a test city trip distribution is shown in Exhibit 20. The &PARAM card (line 2) specified that the gravity model be iterated three times (to calculate production/attraction tables) for each of the three trip purposes. Also requested was that three output tables, one for each trip purpose, be created. Lines 3-6 named the output attraction and production attributes and listed which of the three tables they were assigned to. The OPTION card (line 6) specified, as required by AGM/SLIM, that A=T be used. The &SELECT card (line 7) listed reports 3, 5, and 8 to be output.

EXHIBIT 20

```
GRAVITY MODEL FOR 3 TRIP PURPOSES (CASE STUDY)
&PARAM AITER=3,3,3,TABOUT=3,
       ZP1='Z1HBWPRD',        ZA1='Z1HBWATTR',
       ZP2='Z1HBWPRD',        ZA2='Z1HBOATTR',
       ZP3='Z1NHBPRD',        ZA3='Z1Z1NHBATTR'     &END
&OPTION A=T                                         &END
$SELECT REPORT=3,5,8,PRINT=22        &END
```

Line Number*
1
2
3
4
5
6
7

* Not apart of the job set-up.

CHAPTER 5
MODE SPLIT AND CALCULATION OF HOURLY TRIP TABLES

This chapter describes the process of converting the production and attraction pairs produced by the AGM model into vehicle trips ready for assignment to the highway network. Three model runs are normally needed to convert trip end tables produced by AGM into vehicle trip tables. Exhibit 21 shows the location of this step in the modeling sequence.

The first step in the process is to apply a mode choice model to the AGM trip table. It is assumed in UTPS/SLIM assumes that you will be applying a relatively simple mode choice model, in which vehicle trips can be determined by multiplying total trips by a known fraction. Usually, the known fraction accounts for both transit ridership and carpooling. This type of approach uses the UMATRIX program and is described and shown below. An alternative is for the city to develop and code its own modal split model using UMODEL. This capability is described in the regular UTPS documentation. The UMODEL approach is used by most large urban areas but usually requires the use of a consultant to install and calibrate the mode choice model.

The second phase of the estimation of vehicle trips is the addition of external trips to the trip matrices. This process can be performed in two ways. You can use the UMCON program to add the externals to the existing matrices, or you can create a second trip matrix exclusively for external trips and then use the UMATRIX program to add the two separate matrices together.

The last model run necessary to produce trip tables ready for assignment to the highway network is a UMATRIX run used to develop hourly (peak AM, peak PM or midday) origin/destination tables from the completed production and attraction vehicle trip tables.

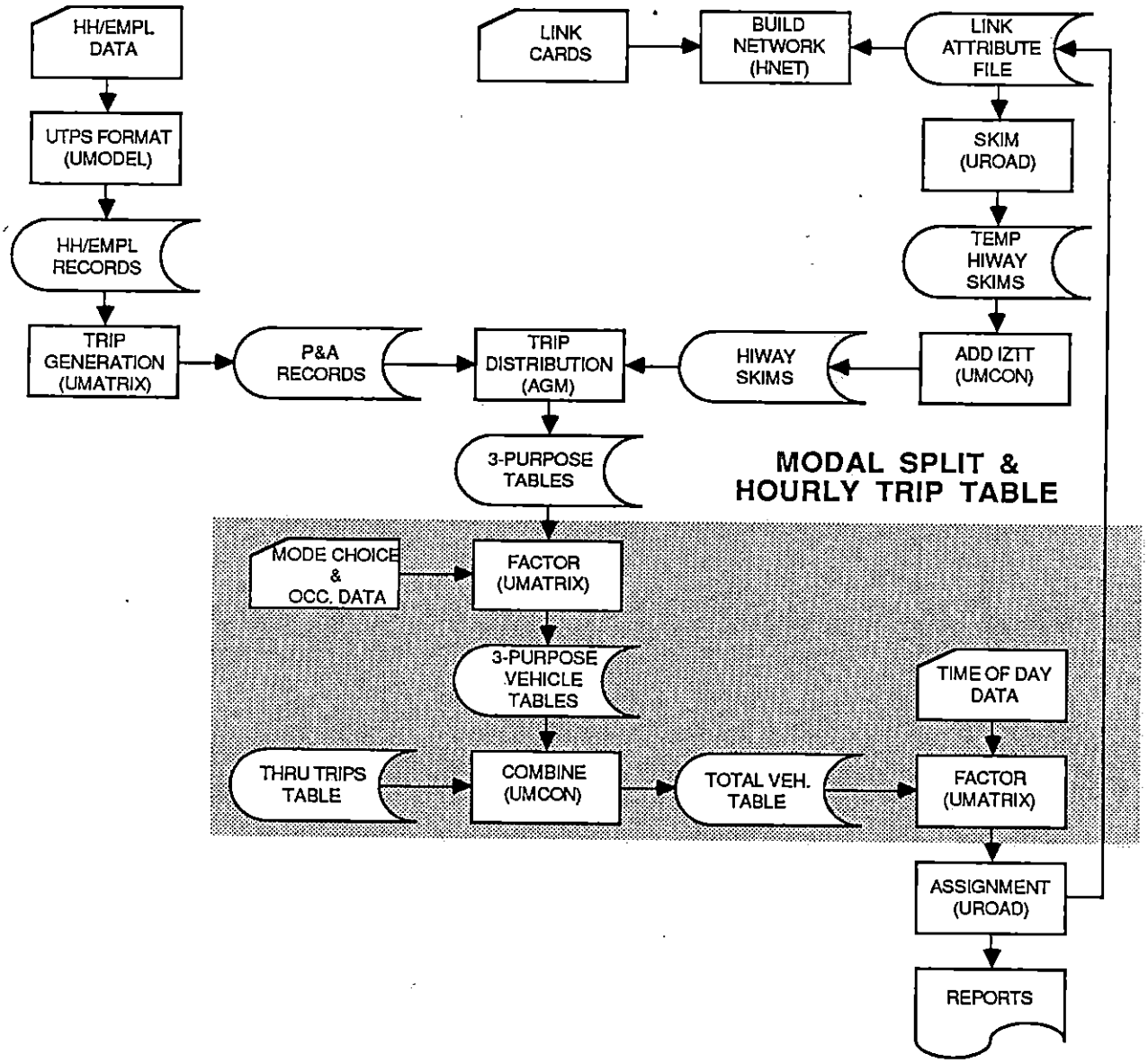

Exhibit 21. Modal Split & Hourly Trip Table.

UMATRIX -- MODE CHOICE

The mode choice model used in the UTPS/SLIM process is a simple factor approach which uses the UMATRIX model. In this approach, a known factor is applied to all trips to account for the difference between person trips and vehicle trips due to the use of transit, carpooling, and other alternative means of transportation.

An example of the UMATRIX program used for this purpose is shown in Exhibit 22. In this exhibit, a different mode split rate and a different vehicle occupancy rate for each trip purpose are used when calculating vehicle trips. The Exhibit is detailed below:

Line 1: This is your job card

Line 2: This record executes the UMATRIX procedure included on the UTPS program tape. The JCL record is unnamed in this instance so there is a blank space between the second "/" and the **UMATRIX** specification. The **CORE=** specification indicates the amount of CPU memory needed by this program run. 256K is usually sufficient, although more **CORE** may be needed for larger zone systems.

Line 3: **J1=** specifies the input production/attraction dataset. This file is produced as the output file from the AGM program (Exhibit 19, line 4). The **UNITJ1=** specifies the type of device on which the dataset is written.

Line 4: **J9=** defines the output dataset which will contain the production/attraction tables after they are factored to account for mode choice and vehicle occupancy. **UNITJ9=** specifies the type of device on which the output file will be written.

Line 5: This record indicates that the UMATRIX parameter input will be immediately following in the input stream. (It defines the location of Unit 5 input.) Include this record as it is shown.

EXHIBIT 22

CONVERSION OF PERSON TRIPS TO VEHICLE TRIPS

```
//JOB CARD                                                          1
// EXEC UMATRIX,CORE=256K,                                          2
//  J1='DSN=AGM.OUTPUT',UNITJ1=3330,                                3
//  J9='DSN=VEHI90.TRIPS',UNITJ9=3330                               4
//UMATRIX.SYSIN DD *                                                5
FACTOR HBW, HBO, & NHB TRIP TABLES FOR TRANSIT & OCCUPANCY          6
 &PARAM SIZE=180,                                                   7
   J901='J101 * 0.90 / 1.15',                                       8
   J902='J102 * 0.98 / 1.40',                                       9
   J903='J103 * 1.00 / 1.10'          &END                          10
```

Line Number

Line 6: This record is the title record for this run. Include on it information that will describe the run to you and other users.

Line 7: The &PARAM specification starts in column two, and indicates the begining of the input parameters. SIZE= indicates the number of zones in the input dataset. Note that a comma follows the SIZE specification.

Lines 8 through 10: These three lines describe the mathematical functions that will be performed to convert the input person trips into a vehicle trip table. Line 8 calculates HBW automobile trips and stores them in the first table on the output dataset. Line 9 calculates HBO vehicle trips and stores them on the second table of the output dataset. Line 10 calculates NHB vehicle trips. Note that each mathematical equation is enclosed in parentheses, and that lines 8 and 9 are followed by commas.

Lines 8 through 10 can be described as follows: HBW person trips are found on the first table of the input file (J1001); 90 percent of the trips are made via the automobile, with an auto occupancy rate of 1.15 people per vehicle. For HBO trips, 98 percent are made by automobile and 1.4 persons are in each car. For NHB trips, 100 percent are made by automobile, with an occupancy rate of 1.10 people per vehicle.

Note that an &END specification follows the last equation. This UMATRIX run is now ready for submittal.

TEST CITY APPLICATION

For the test city, transit ridership information was available from the local transit agency while vehicle occupancy by trip purpose was obtained from the *Quick Response User's Guide*. The UMATRIX input used to factor the trip table for modal split and vehicle occupancy is shown in Exhibit 23. The &PARAM card (line 3) specified that the test city had 169 zones. Lines 4-6 multiplied each of the

EXHIBIT 23

TEST CASE PARAMETERS FOR
VEHICLE TRIP TABLE CALCULATION

```
UMATRIX/SKIM VEHICLE TRIP TABLE GENERATION                          1
&PARAM  SIZE=169,                                                   2
   J9001='(J1001 * .97)/1.38',                                      3
   J9002='(J1002 * .99)/1.82',                                      4
   J9003='(J1003 * 1.00)/1.43'                                      5
&SELECT REPORT2=9001,9002,9003,   PRINT2=22,-25   &END              6
```

Line
Number

trip purposes by a modal split factor and divided them by vehicle occupancy rate. As an example, line 5 specified that J9 output-table 002 would equal the J1 input -- table 002 (home base other trips) multiplied by 99 percent (i.e., one percent of the trips were on other modes) and divided by a vehicle occupancy of 1.82 people per vehicle. The &SELECT card (line 7) requested that report 2 be output for each of the three output matrices and the information on zones 22 through 25 be printed.

ADDING EXTERNAL TRIPS

At this point in the analysis, the modeling process has produced vehicle trip production/attraction pairs for the urban area. In most instances, the trip generation process performed in Chapter 2 will not have produced estimates of external to external movements. These trips must usually be added separately.

Two methods exist for adding these trips (and, potentially, external to internal trips) to the vehicle trip table calculated above. The first method is to use the UMCON program to add trips to specified zonal interchanges. This run is similar in structure to the UMCON run used to add intrazonal travel times to the travel time matrix (see Chapter 3). The principal exception is that the dataset cards change, and the data modification cards deal with trips rather than travel time. This method is described below.

The second method for adding external trips to the vehicular trip table is to follow the steps in Chapters 1 and 4 for producing person trips with the exception that information for estimating external trips is used. This trip table is then added to the existing trip table using UMATRIX.

UTPS/SLIM assumes that the first case is the most common for small urban areas. Exhibit 24 presents an example of how such a job should be set up.

Line 1: This is your job card.

EXHIBIT 24

ADDITION OF EXTERNAL TRIPS

```
//JOB CARD
//TCON  EXEC UMCON,CORE=256K
//   J1='DSN=VEHI90.TRIPS',UNITJ1=3330,
//   J9='DSN=UMCON.VEHI90.OUTPUT',SPACE=(TRK,(15,15),RLSE),
//        UNITJ9=SYSDA
//UMCON.SYSIN DD *
 &PARAM  CARDS=14, ZONES=180, TABLES=1001,1002,1003  &END
 &SELECT    PRINT=1,-5  &END
99999
 10031003   1   1   2   2+     10 10031003   1   1   8   8+     10
 10031003   1   1   3   7+     50 10031003   2   2   1   1+     15
 10031003   2   2   3   3+     15 10031003   2   2   4   8+     65
 10031003   3   3   2   2+      5 10031003   3   3   4   4+      5
 10031003   3   3   5   8+     45 10031003   3   3   1   1+     45
 10031003   4   4   5   5+     10 10031003   4   4   3   3+     10
 10031003   4   4   6   8+     35 10031003   4   4   1   2+     35
 10031003   5   5   4   4+     10 10031003   5   5   6   6+      5
 10031003   5   5   7   8+     55 10031003   5   5   1   3+     60
 10031003   6   6   7   7+      8 10031003   6   6   5   5+      8
 10031003   6   6   8   8+     15 10031003   6   6   1   4+     15
 10031003   7   7   8   8+      4 10031003   7   7   6   6+      6
 10031003   7   7   1   5+     25 10031003   8   8   1   1+     10
 10031003   8   8   7   7+     10 10031003   8   8   2   6+     35
```

Line Number

1 2 3 4 5 6 7 8 9 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Line 2: This line executes the UMCON procedure included on the UTPS tape provided to your computer center. The JCL statement is called TUMCON, but this may be changed to any other name. The **CORE=** specification of 256K of CPU memory can be expanded if your zone system requires larger amounts of memory.

Line 3: **J1=** defines the input dataset. This dataset is the output file from the mode choice program (Exhibit 22, Line 4). **UNITJ1=** defines the type of device the file is stored on.

Line 4: **J9=** defines the output dataset which will contain the complete production/attraction trip tables output by the UMCON program. **UNITJ9=** defines the type of device the file is stored on.

Line 5: This record indicates that the UMCON parameters (Unit 5) will follow immediately in the input data stream. Input this line as is.

Line 6: The **&PARAM** specification starts in column 2 and indicates the begining of the UMCON input control parameters. **CARDS=** indicates the number of data modification records that will follow. **TABLES=** indicates the number of input and output tables that will be processed. **ZONES=** indicates the number of zones in the input files. **&END** must follow the input parameters.

Line 7: The **&DATA** parameter is placed starting in column 2.

Line 8: The 99999 card is placed starting in column 1, and indicates the begining of the data modification cards.

Lines 9 through 30: These are the input modification cards used to modify the input trip tables. The cards add trips between the external zones of the urban area into the third output table (NHB). Exhibit 25 indicates what the items in the data modification cards mean.

The UMCON run is now ready to be executed.

EXHIBIT 25

CALCULATION OF PM HOURLY TRIP TABLE

```
//JOB CARD                                                                    1
// EXEC UMATRIX,CORE=256K                                                     2
//  J1='DSN=UMCON.VEHI90.OUTPUT',UNITJ1=3330,                                 3
//  J9='DSN=OD90.TRIPS',UNITJ9=3330                                           4
//UMATRIX.SYSIN DD *                                                         5
CONVERT P & A TABLES TO O & D                                                6
 & PARAM SIZE=180                                                            7
      J901='.02 * J1001 + .02 * J1002 + .05 * J1003                          8
          + TR(.20 * J1001 + .05 * J1002 + .05 * J1003)'   &END              9
```

Line Number

TEST CITY APPLICATION

For the test city it was not necessary to factor in external trips. This was due to the fact that the initial street network and production/attraction files included external locations. Thus, external trips were factored into AGM earlier in the modeling sequence.

UROAD -- HOURLY TRIP TABLES

Trips to be assigned to a highway network are generally for a one hour time period. This is how the capacity tables in UROAD are designed. You must therefore convert the daily trip tables calculated in the above step into hourly tables to allow for their assignment to the highway network. You must perform several actions to convert daily trip tables for each purpose (the output from the above section) into a single assignable trip matrix. These steps are as follows:

- Convert the production/attraction (P&A) tables into origin-destination tables.
- Factor the daily estimates to represent the intended hour of assignment (AM peak, PM peak, midday, etc. . . .).
- Sum the trip purposes into one trip table.

For example, the PM peak period consists of mostly work trips, with limited numbers of HBO and NHB trips. In addition, the production/attraction trip tables which currently exist treat all work trips as sending trips from the production end (home) to the attraction end (work). Two P&A trips are produced for each daily work trip. The same is true for the other trip purposes. For the PM work trip, the direction of travel needs to flow primarily from work to home. Finally, not all work trips occur during any one hour period. Thus, trips need to be reduced to account for this temporal distribution.

Exhibit 25 presents a UMATRIX setup which converts the three trip purpose daily trip tables into a PM peak hour trip table. This exhibit is described below.

Line 1: This is your job card.

Line 2: This record executes the UMATRIX procedure included with the UTPS program tape supplied to your computer center. In this instance the JCL statement is unnamed (there is a blank between the second "/" and the EXEC statement). As usual, the **CORE=** specification for 256K of CPU memory should be sufficient for all but the largest zone systems.

Line 3: **J1=** specifies the input trip table dataset. This should be the output file from the UMCON run above (see Exhibit 24, line 4), or the output of the mode choice model if no external trips need to be added (Exhibit 22, line 4). As before, the dataset name is enclosed in single quotes, and the **UNITJ1=** specification describes the type of device that the file is stored on.

Line 4: **J9=** defines the output dataset that will contain the PM peak hour origin/destination trip table being produced. It is similar to line 3.

Line 5: This record indicates that the UMATRIX parameter file will be immediately following in the input stream. (It defines Unit 5). Include this line as it is shown.

Line 6: This is the title card. Use it to describe this UMATRIX run. Place the title so that it starts in column 2.

Line 7: The **&PARAM** specification indicates the following information provides the input parameters that control the UMATRIX program. **SIZE=** defines the number of zones in the urban area. Note that the **SIZE** parameter is followed by a comma.

Lines 8 and 9: These two lines describe the calculations that are necessary for producing the PM trip table from the daily P&A trip tables. **J9001=** indicates

that the output trip table is to be stored on the first table of the output file (i.e., file J9). The equation in single quotes sums the information in the following trip table matrices (i.e., it is actually adding six separate tables):

- 2 percent of the HBW P&A trip table (table 1 of file 1),
- 2 percent of the HBO P&A trip table (table 2 of file 1),
- 5 percent of the NHB P&A trip table (table 3 of file 1),
- 20 percent of the transposed HBW trip table (this causes trips to flow from their attraction end to their production end),
- 5 percent of the transposed HBO trip table, and
- 5 percent of the transposed NHB trip table.

Note that an **&END** parameter follows the equation. It signals the end of the **&PARAM** specifications. This UMATRIX run is now ready for submittal.

TEST CITY APPLICATION

The *Quick Response User's Guide* was used as a reference to determine the time of day distribution by trip purpose for the test city. Exhibit 26 shows the UMATRIX program which created a 4 PM to 5 PM origin/destination table using all trip purposes. The &PARAM card (line 3) specified that the test city had 169 zones. Lines 4 and 5 factored in the time of day distribution to each of the three trip purpose tables and also transposed the production and attraction format to an origin/destination table. As an example, the home to work matrix (file J9 -- table 001) was multiplied by one percent and also transposed and multiplied by 13 percent to create both directions of home-to-work travel between 4 PM and 5 PM. A similar process was also used on the other two trip purposes, and added together they all created an output J9 file -- table 001. The &SELECT card (line 6) requested that report 2 for file J9 -- table 001, be output. Zones 22 through 25 would be printed.

EXHIBIT 26

TEST CASE PARAMETERS FOR
CONVERTING TRIP TABLES TO PM O AND D FORMAT

```
UMATRIX/SLIM CONVERT TRIP TABLE TO O/D AND FACTOR FOR PM PEAK HOUR
&PARAM  SIZE=169,
   J9001='.01*J1001+ .03 * J1002 + .04 * J1003
        + TR(.13 * J1001 + .05 * J1002 + .04 * J1003)'  &END
&SELECT  REPORT2=9001, PRINT2=22,-25  &END
```

Line Number
1
2
4
5
6

CHAPTER 6
HIGHWAY ASSIGNMENT

This chapter describes the final step in the UTPS/SLIM process, as shown in Exhibit 27, Assignment of Traffic Volumes to the Highway Network. The UROAD model uses the trip table output from the UMATRIX run (performed in the previous chapter) and assigns it to the highway network to be used as input for the path skimming operation described in Chapter 2.

UROAD -- TRAFFIC ASSIGNMENT

UROAD has several options for assigning traffic. The two principal choices used in UTPS/SLIM are

- o stochastic assignment (assigning trips between two locations to more than one path in proportion to the travel time on those paths), and
- o all-or-nothing (assignment of all trips between two points to one path).

The stochastic assignment is usually preferred for transportation planning purposes and is described below. Exhibit 28 shows a JCL setup that you can use to operate the UROAD program in its traffic assignmant mode. It is described below:

Line 1: This is your job card

Line 2: This line executes the UROAD procedure included in the UTPS program tape supplied by UMTA. **NROAD** is simply the name of the the first JCL statement. **EXEC** and **UROAD** tells the machine to execute the UROAD program, while **CORE=** and **TIME=** indicate the CPU memory space needed by the job (250K is normally sufficient), and the CPU time needed to perform the job (anywhere from one minute to 15 minutes depending on the size of the highway network and the complexity of the highway assignment).

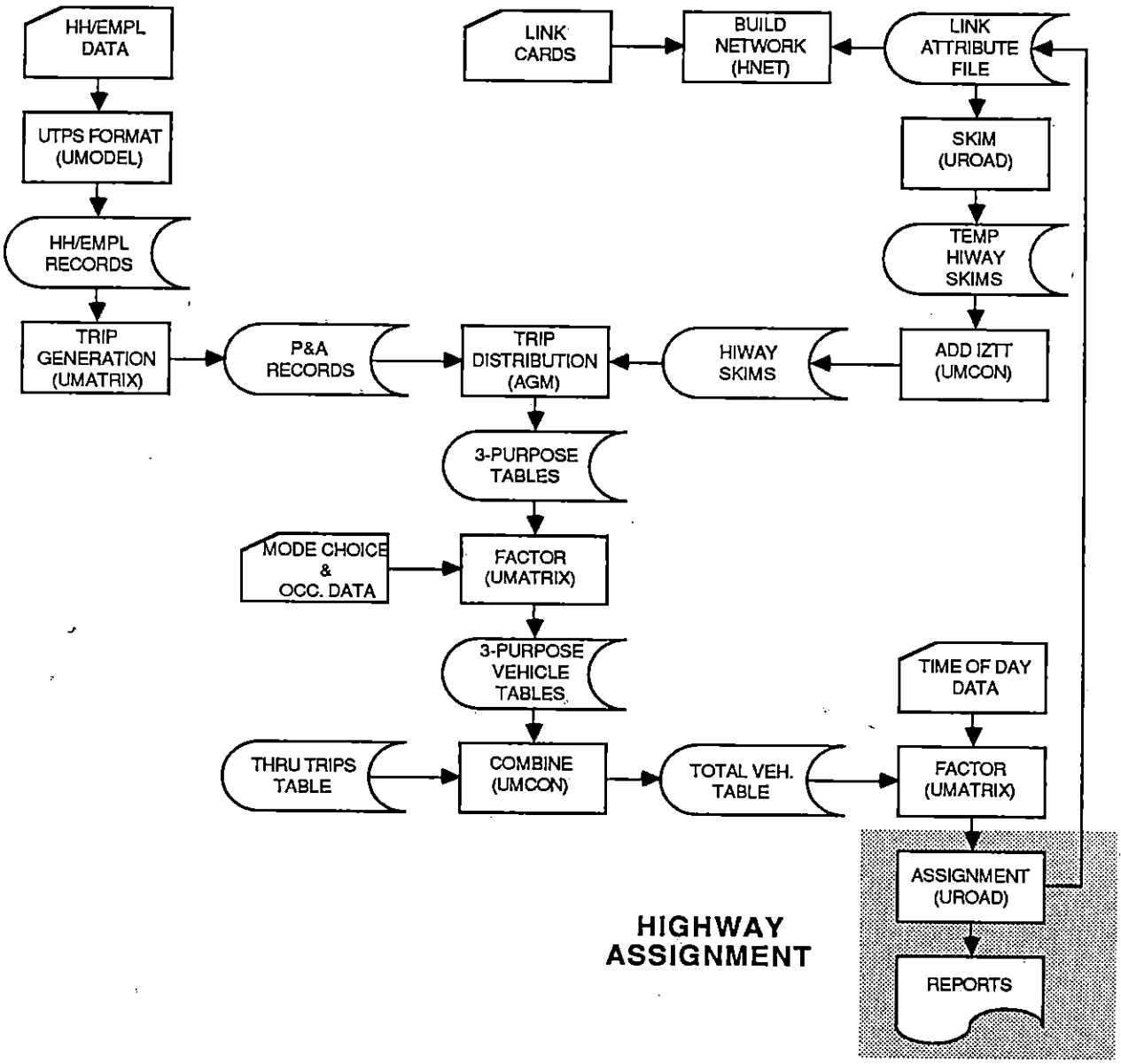

Exhibit 27. Highway Assignment.

EXHIBIT 28

STOCHASTIC TRAFFIC ASSIGNMENT USING UROAD

```
//NROAD EXEC UROAD,CORE=350K,TIME=10,
//    Z1='DSN=UMTA.UTOWN.LZFILE,VOL=SER=UMTA1',UNITZ1=SYSDA,
//    J1='DSN=0090.TRIPS,VOL=SER=UMTA1',UNITJ1=SYSDA,
//    J9='DSN=ALT1.SKIMS',UNITJ9='SYSDA,SPACE=(TRK,(10,10),RLSE)'
//UROAD.SYSIN DD *
 ASSIGN PM PEAK TRIPS ON HIGHWAY NETWORK
 &PARAM THETA=.002,TABLES=1001          &END
 &SELECT  REPORT=4,6                    &END
```

Line Number

1
2
3
4
5
6
7
8

Line 3: **Z1=** defines the highway network Z-file. This is the output from HNET in Chapter 2 (Exhibit 8, line 5). Note that this data set definition follows the usual UTPS conventions of being enclosed in single quotation marks, being preceded by **DSN=**, and being followed by the volume/serial number specification for the named dataset. The **UNITZ1** specification defines the type of disk referenced by the **VOL=SER=** specification.

Line 4: **J1=** defines the input trip table to be assigned to the highway network. This file is the output file from the UMATRIX run in the previous chapter (Exhibit 26, Line 4). **VOL=SER=** and **UNITJ1=** parameters are needed here as in the previous line.

Line 5: **J9=** defines an output dataset location if you wish to save an output skim table after the trip assignment has been performed. **UNIT9=SYSDA** indicates that no particular storage disk is requested for this new dataset. **SPACE=** indicates how much disk space the computer will need to provide for the new dataset.

Line 6: **UROAD.SYSIN** * indicates that the **UROAD** parameter input (Unit 5) will follow immediately. This line should be entered as is.

Line 7: This line is the title for the job. Use it to describe the contents of this run. Start the title in column 2.

Line 8: Place **&PARAM** on this line, starting in column 2. **THETA=.002** indicates that a stochastic assignment is desired. Use this unless you wish to perform an all or nothing assignment, and then use **THETA=0**. **TABLES=** defines which trip table is to be used in the highway assignment. The 1001 shown indicates that this assignment will be performed using the first table off of input file J1.

Note that **&END** is needed after the **TABLES** command.

Line 9: Place &SELECT on this line, starting in column 2. The keyword **REPORT=** defines what output reports you desire. Reports 4 and 6 are suggested. The **TIME=** specification defines a name for the travel time table being output onto the J9 dataset. This may be any 12 character specification you desire.

Note that like line 8, **&END** is required to complete the **&SELECT** card.

The UROAD traffic assignment run is now ready for submission to the computer.

TEST CITY APPLICATION

For the final step, information was output on the number of trips between 4 PM and 5 PM for each link in the test city street network. Exhibit 29 is the UROAD program which output this information for the final report. The &PARAM card (line 1) specified that the link assignment be a probabilistic (stochastic) multipath assignment with a THETA of 002. The THETA value was suggested by UTPS/SLIM. The input file 1 -- table 001 was to be used for the assignment. The &SELECT card (line 2) specified that reports 4 and 6 be output.

EXHIBIT 29

TEST CASE PARAMETERS FOR
STOCHASITIC PM HIGHWAY ASSIGNMENT

```
UROAD/SLIM PM LINK ASSIGNMENT
&PARAM  THETA=.002,TABLES=1001,LAVN=1      &END
&SELECT   REPORT=4,6        &END
```

Line Number
1
2
3

GLOSSARY

The following glossary is included to provide the reader with an easy reference on IBM JCL terminology, and at the same time provide a small amount of JCL usage support.

Dataset names -- All dataset names are designated by the the parameter DSN= and are followed by a name chosen by the user. Dataset names tend to consist of up to eight alphnumeric characters with one or more (up to) eight character extensions. The extensions are separated from the first eight characters and later extensions by periods. For some computer installations, the first eight digits are used to reference your computer account and the extensions are used to describe the actual dataset. Check with your computer system operator for information concerning the dataset naming conventions for your machine.

Table names -- Within UTPS some datasets can contain more than one table of information. Essentially, the datasets that contain these files are partitioned datasets. Table names are used within UTPS to reference the individual (partitioned) files. Table names within the larger dataset should not be confused with the dataset name used in JCL statements; they do not need to correlate.

VOL=SER= -- This is the parameter which specifies the volume/serial number (name) of a disk or tape drive containing a referenced dataset.

UNIT -- This is a parameter which specifies the type of device named with a VOL=SER= parameter. This is used to help the operating system differentiate between various models and sizes of disk and tape drives.

SYSDA -- The system default disk or tape drive. It is usually used to indicate to the computer that no particular volume is requested for a given dataset, and that the computer may choose any disk drive that contains the appropriate amount of space.

SPACE -- A parameter used to indicate how much disk space will be needed for a new dataset. See your system operator or the UTPS documentation for assistance with estimating space requirements for your datasets.

DISP -- A parameter which indicates the "dispensation" you desire for the referenced dataset. The DISP specification contains two parts. The first designates whether the dataset being referenced is new or old. The second indicates what should be done with the dataset during the processing of the job. Your choices for the second portion of the DISP specification are KEEP, PASS, DELETE, SHR, and CATLOG. KEEP tells the computer to keep the dataset upon completion of the job. PASS indicates that the dataset should remain on the computer until the completion of the job, and then be deleted. DELETE indicates that the dataset should be deleted. SHR indicates that the file can be used by other datasets at the same time as it is used by this job, and that the file should be kept upon completion of the program. CATLOG causes the file to be kept and its volume/serial and unit information to be stored on the computer.

APPENDIX A

APPENDIX A

This appendix presents a very brief summary of the Job Control Language (JCL) commands needed to run the UTPS programs described in this case study. This appendix is not intended as a complete course in JCL, neither will it entirely replace the need for some familiarity with your own computer system or the need for communication with the system operator of your installation.

Information not found in this document can be found in IBM operating system manuals and in various textbooks on the use of IBM JCL. One good source for learning JCL or for use as a JCL reference is *System/370 Job Control Language*, by Gary Brown, published in 1977 by Wiley-Scientific.

INTRODUCTION TO JCL

JCL statements describe to the computer what programs are to run and where the information to be processed is to be found and placed upon completion of the job. All JCL statements begin with two "/" marks in columns one and two of each record. They usually precede and often succeed non-JCL statements (records) in the file which executes a given program.

If a JCL statement is longer than one record it may be continued across more than one line of code. To continue a JCL statement, the first (or previous) record must end with a comma (,). The second (or succeeding) record(s) starts with two "/" marks and then is continued starting in column four. For the most part, JCL ignores blanks, so that blanks can be inserted wherever desired to improve readability. As a result, JCL statements can be split between two or more records to improve readability even if the statement would fit on one line.

IBM JCL was developed to provide a very flexible operating system. The result is that most IBM mainframes can read and process information from many

different types of tape and disk devices as well as read information in both ASCII and EBCDIC codes. The problem with providing this flexibility is that there are virtually no defaults in JCL; everything must be specified. Thus, to specify a dataset, you must specify in JCL the following:

- o name of the datset,
- o where the file can be found (the volume/serial number), and
- o a description of the device named by the volume/serial name.

In addition, you must specify the status of the dataset, such as if it exists already or is new, if it is a temporary file, should be kept, or should be deleted at the end of the job.

Some of the above information can be provided automatically by the computer system. If datasets are catalogued, the computer will maintain information about the location of a dataset and the type of device on which it is located. Many computer systems require that datasets be catalogued. If you catalogue your files, you may disregard the VOL=SER= and most UNIT= parameters shown in the example JCL setups included in this report.

UTPS AND JCL

When writing the UTPS software, UMTA took several steps to ease the burden of using JCL for you. One of these steps was the creation of procedure files (also called "PROCS"), which provide defaults for most of the required JCL (with the notable exception of dataset names).

In order to use these PROC files, however, it is important that you follow strict punctuation rules. Thus, when following the JCL examples provided in this manual, be careful to duplicate the punctuation. This is particularly true for commas and quotation marks. Failure to do so will most likely result in a program submittal that will not work.

It is also possible that your particular computer system may use a dataset naming a constraint or an operating system that is somehow incompatable with the UTPS PROCS. If a JCL error occurs after a program submittal, first review your setup for typographical errors, and then consult your system operator or someone familiar with the operation of PROCs to fix the indicated error.

APPENDIX B

EXHIBIT B-1

UMODEL RUN TO FORMAT HOUSEHOLD AND EMPLOYMENT DATA

```
//JOB CARD                                                                    1
//UMODEL EXEC UMODEL,CORE=300K,TIME=1                                         2
//         A8='DSN=HHEMP.DATA,VOL=SER=UMTA1',UNITA8=2314,                     3
//         Z1='DSN=HHEMP.ZFILE,VOL=SER=UMTA1',UNITZ1=2314                     4
//UMODEL.SYSIN DD *                                                           5
     TRANSFER HH & EMPLOYMENT DATA TO Z-FILE                                  6
&PARAM ZONES=180              &END                                           7
&SELECT REPORT=1              &END                                           8
&DATA                                                                        9
 1 P     1    6    1 1 1ZONE      ZONE NUMBER                                 10
 2 P     7   12    2 1 1HHINC1    HOUSEHOLDS - INC 1                          11
 3 P    13   18    3 1 1HHINC2    HOUSEHOLDS - INC 2                          12
 4 P    19   24    4 1 1HHINC3    HOUSEHOLDS - INC 3                          13
 5 P    25   30    5 1 1POP       TOTAL POPULATION                            14
 6 A    31   36    6 1 1EMPLOY    TOTAL EMPLOYMENT                            15
 7 A    37   42    7 1 1RETAIL    RETAIL EMPLOYMENT                           16
```

EXHIBIT B-2

UMATRIX TRIP GENERATION RUN

```
//JOB CARD                                                              1
//    EXEC UMATRIX,CORE=256K,                                           2
//    Z1='DSN=HHEMP.DATA',UNITJ1=3330,                                  3
//    Z9='DSN=TGEN90.DATA',UNITZ1=3330                                  4
//UMATRIX.SYSIN DD *                                                    5
 UMATRIX/SLIM TRIP GENERATION                                           6
 &PARAM                                                                 7
       Z9HBWP1='1.10*Z1HHINC1',                                         8
       Z9HBWP2='1.80*Z1HHINC2',                                         9
       Z9HBWP3='2.00*Z1HHINC3',                                         10
       Z9TOTP='SUM(Z9HBWP1+Z9HBWP2+Z9HBWP3)',                           11
       Z9HBWA='1.60*(Z1EMPLOY) + 1.70*(Z1RETAIL)',                      12
       Z9TOTA='SUM(Z9HBWA)',                                            13
       Z9NORMAL='Z9TOTA/Z9TOTP',                                        14
       Z9HBWP='Z9HBWP1+Z9HBWP2+Z9HBWP3)*Z9NORMAL',                      15
       Z9HBOP='1.60*(Z1HHINC1+Z1HHINC2+Z1HHINC3) + 1.40*(Z1POP)',       16
```

Line Number

EXHIBIT B-2 (Continued)

UMATRIX TRIP GENERATION RUN

```
        Z9HBOA='2.00*(Z1EMPLOY) + 9.00*(Z1RETAIL)                    17
           + 1.00*(Z1HHINC1+Z1HHINC2+Z1HHINC3)',                     18
        Z9NHBP='1.00*(Z1EMPLOY) + 4.00*(Z1RETAIL)                    19
           +  0.50*(Z1HHINC1+Z1HHINC2+Z1HHINC3)',                    20
        Z9NHBA='Z9NHBP',                                             21
        Z9TOTNWP='SUM(Z9HBOP+Z9NHBP)',                               22
        Z9TOTNWA='SUM(Z9HBOA+Z9NHBA)'                                23
        Z9NORM2='Z9TOTNWA/Z9TOTNWP',                                 24
        Z9HBOP='Z9NORM2*Z9HBOP',                                     25
        Z9NHBP='Z9NORM2*Z9NHBP',                                     26
&END                                                                 27
&SELECT                                                              28
    REPORT4='Z9HBWP','Z9HBWA',                                       29
            'Z9HBOP','Z9HBOA',                                       30
            'Z9NHBP','Z9NHBA',                                       31
    PRINT4=1,-5                                                      32
&END                                                                 33
```

Line Number

EXHIBIT B-3
BUILD NETWORK FILES

```
//JOB CARD                                                                    1
//BUILDN EXEC HNET,                                                           2
//    N1='DSN-UMTA.UTOWN.NFILE,VOL=SER=UMTA1',SPACEN1='(TRK,100)',            3
//        DISPN1='(,KEEP)',                                                   4
   // Z1='DSN=UMTA.UTOWN.LZFILE,VOL=SER=UMTA1',SPACEZ1='(TRK,100)',           5
        DISPZ1='(NEW,KEEP)'                                                   6
//HNET.LINKS DD DSN=UMTA.UTOWN.DATA(LINK),DISP=SHR,LABEL=(,,,IN)              7
//HNET.SYSIN DD *                                                             8
 BUILD N-FILE AND Z-FILE FROM LINK CARDS                                      9
 &PARAM  NODES=600,ZONES=180   &END                                           10
 &SELECT REPORT=16,18,                                                        11
   Z1LAVS= 'DC',   'D',   'FT',   'AT',   'GL','FFS','FFT',                   12
           'C',  'NL',   'LG',    'A',    'B'     &END                        13
 &DATA                                                                        14
 3 5 1 1 1 9+  0.0 55.0                                                       15
 2 4 2 2 1 9+  0.0 40.0                                                       16
 5 5 2 2 1 9+  0.0 50.0                                                       17
 5 5 6 6 1 9+  0.0 35.0                                                       18
```

EXHIBIT B-4

TRAVEL TIME PATH SKIMMING

```
                                                                          Line
                                                                         Number
//JOB CARD                                                                 1
//NROAD  EXEC  UROAD,CORE=350K,TIME=1,                                     2
//   Z1='DSN=UMTA.UTOWN.LZFILE,VOL=SER=UMTA1',UNITZ1=SYSDA,                3
//   J9='DSN=ALTO.SKIMS',UNITJ9='SYSDA,SPACE=(TRK,(10,10),RLSE)'           4
//UROAD.SYSIN DD *                                                         5
 SKIM FOR TEST CITY TRAVEL TIMES                                          6
 &PARAM TLAV='OT'      &END                                               7
 &SELECT  TIME='HIWAY TIME'     &END                                      8
```

EXHIBIT B-5
ADDITION OF INTRAZONAL TRAVEL TIMES
TO THE INITIAL TRAVEL TIME SKIMS

```
                                                                                                                    Line
                                                                                                                    Number
//JOB CARD                                                                                                          1
//MCONT4 EXEC UMCON,CORE=160K,                                                                                      2
//   J1='DSN=ALTO.SKIMS,VOL=SER=UMTA1',UNITJ1=2314,                                                                 3
//   J9='DSN=UMCON.SKIMS,VOL=SER=UMTA1,SPACE=(TRK,(10,10),RLSE)',                                                   4
//         UNITJ9=2314                                                                                              5
//UMCON.SYSIN DD *                                                                                                  6
 &PARAM CARDS=8,ZONES=5,TABLES=1001,NAME1='AUTO TIME'  &END                                                         7
 &SELECT  PRINT=1,-5  &END                                                                                         8
99999                                                                                                              9
 10011001   1   5   1   1+   4  10011001    1    5    2   2+   3                                                   10
 10011001   1   5   3   3+   2  10011001    1    5    4   4+   2                                                   11
 10011001   1   5   5   5+   2  10011001    1    1    1   5+   4                                                   12
 10011001   2   2   1   5+   3  10011001    3    3    1   5+   2                                                   13
```

EXHIBIT B-5 (Continued)
ADDITION OF INTRAZONAL TRAVEL TIMES
TO THE INITIAL TRAVEL TIME SKIMS

```
10011001  4  4  1  5+  2  10011001  5  5  1  5+  2                    14
10011001  1  1  1  1+  4  10011001  2  2  2  2+  9                    15
10011001  3  3  3  3+ 10  10011001  4  4  4  4+ 12                    16
10011001  5  5  5  5+ 13                                              17
```

Line Number

EXHIBIT B-6

TRIP DISTRIBUTION GRAVITY MODEL

```
//JOB CARD                                                              1
//AGM EXEC AGM,CORE2=180K,                                              2
//    J1='DSN=UMCON.SKIMS,VOL=SER=UMTA1',UNITJ1=2314,                   3
//    J9='DSN=AGM.OUTPUT,VOL=SER=UMTA1,SPACE=(TRK,(50,10))',            4
//         UNITJ9=2314,                                                 5
//    Z1='DSN=TGEN90.DATA,VOL=SER=UMTA1',UNITP=2314,                    6
//    F='DSN=FFACT.DATA,VOL=SER=UMTA1',UNITA=2314                       7
//AGM.SYSIN DD *                                                        8
 GRAVITY MODEL RUN WITH 3 ITERATIONS, 3 TRIP PURPOSES                   9
 &PARAM AITER=3,3,3,TABOUT=3,                                           10
        ZP1='Z1HBWP',ZA1='Z1HBWA',                                      11
        ZP2='Z1HBOP',ZA2='Z1HBOA',                                      12
        ZP3='Z1NHBP',ZA3='Z1NHBA'    &END                               13
 &OPTION A=T    &END                                                    14
 &SELECT REPORT=3,5,8        &END                                       15
```

EXHIBIT B-7

CONVERSION OF PERSON TRIPS TO VEHICLE TRIPS

```
//JOB CARD                                                              1
// EXEC UMATRIX,CORE=256K,                                              2
//  J1='DSN=AGM.OUTPUT',UNITJ1=3330,                                    3
//  J9='DSN=VEHI90.TRIPS',UNITJ9=3330                                   4
//UMATRIX.SYSIN DD *                                                    5
FACTOR HBW, HBO, & NHB TRIP TABLES FOR TRANSIT & OCCUPANCY              6
 &PARAM SIZE=180,                                                       7
   J901='J101 * 0.90 / 1.15',                                           8
   J902='J102 * 0.98 / 1.40',                                           9
   J903='J103 * 1.00 / 1.10'          &END                              10
```

Line Number

EXHIBIT B-8

ADDITION OF EXTERNAL TRIPS

```
//JOB CARD                                                                    1
//TCON  EXEC UMCON,CORE=256K                                                  2
//   J1='DSN=VEHI90.TRIPS',UNITJ1=3330,                                       3
//   J9='DSN=UMCON.VEHI90.OUTPUT',SPACE=(TRK,(15,15),RLSE),                   4
//       UNITJ9=SYSDA                                                         5
//UMCON.SYSIN DD *                                                           6
 &PARAM  CARDS=14, ZONES=180, TABLES=1001,1002,1003  &END                    7
 &SELECT    PRINT=1,-5  &END                                                 8
99999                                                                       9
 10031003   1   1   2  2+     10 10031003   1   1   8 8+                    10
 10031003   1   1   3  7+     50 10031003   2   2   1  1+     15            12
 10031003   2   2   3  3+     15 10031003   2   2   4  8+     65            13
 10031003   3   3   2  2+      5 10031003   3   3   4  4+      5            14
 10031003   3   3   5  8+     45 10031003   3   3   1  1+     45            15
 10031003   4   4   5  5+     10 10031003   4   4   3  3+     10            16
 10031003   4   4   6  8+     35 10031003   4   4   1  2+     35            17
```

EXHIBIT B-8 (Continued)

ADDITION OF EXTERNAL TRIPS

												Line Number
10031003	5	5	4	4+	10	10031003	5	5	6	6+	5	18
10031003	5	5	7	8+	55	10031003	5	5	1	3+	60	19
10031003	6	6	7	7+	8	10031003	6	6	5	5+	8	20
10031003	6	6	8	8+	15	10031003	6	6	1	4+	15	21
10031003	7	7	8	8+	4	10031003	7	7	6	6+	6	22
10031003	7	7	1	5+	25	10031003	8	8	1	1+	10	23
10031003	8	8	7	7+	10	10031003	8	8	2	6+	35	24

EXHIBIT B-9

CALCULATION OF PM HOURLY TRIP TABLE

```
                                                                          Line
                                                                          Number
//JOB CARD                                                                  1
// EXEC UMATRIX,CORE=256K                                                   2
//  J1='DSN=UMCON.VEHI90.OUTPUT',UNITJ1=3330,                               3
//  J9='DSN=OD90.TRIPS',UNITJ9=3330                                         4
//UMATRIX.SYSIN DD *                                                        5
CONVERT P & A TABLES TO O & D                                               6
 & PARAM SIZE=180                                                           7
        J901='.02 * J1001 + .02 * J1002 + .05 * J1003                       8
            + TR(.20 * J1001 + .05 * J1002 + .05 * J1003)'   &END           9
```

EXHIBIT B-10

STOCHASTIC TRAFFIC ASSIGNMENT USING UROAD

```
//NROAD EXEC UROAD,CORE=350K,TIME=10,                                    1
//   Z1='DSN=UMTA.UTOWN.LZFILE,VOL=SER=UMTA1',UNITZ1=SYSDA,              2
//   J1='DSN=OD90.TRIPS,VOL=SER=UMTA1',UNITJ1=SYSDA,                     3
//   J9='DSN=ALT1.SKIMS',UNITJ9='SYSDA,SPACE=(TRK,(10,10),RLSE)'         4
//UROAD.SYSIN DD *                                                       5
 ASSIGN PM PEAK TRIPS ON HIGHWAY NETWORK                                6
 &PARAM THETA=.002,TABLES=1001          &END                            7
 &SELECT  REPORT=4,6                    &END                            8
```

Line Number