TTI: 2-10-87-1110-4F

TEXAS TRANSPORTATION INSTITUTE

SUBAREA ANALYSIS USING TRANPLAN/NEDS

RESEARCH REPORT 1110-4F

COOPERATIVE RESEARCH PROGRAM

TEXAS TRANSPORTATION INSTITUTE
THE TEXAS A&M UNIVERSITY SYSTEM
COLLEGE STATION, TEXAS

STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION

in cooperation with the
U.S. Department of Transportation
Federal Highway Administration

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA/TX-87/1110-4F		

4. Title and Subtitle	5. Report Date
SUBAREA ANALYSIS USING TRANPLAN/NEDS	NOVEMBER 1988
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
Duk M. Chang and George B. Dresser	Research Report 1110-4F
9. Performing Organization Name and Address	10. Work Unit No.
Texas Transportation Institute The Texas A&M University System College Station, TX 77843	11. Contract or Grant No. 2-10-87-1110
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Texas State Department of Highways and Public Transportation Transportation Planning Division P.O. Box 505, Austin, TX 78763	FINAL - September 1986 November 1988
	14. Sponsoring Agency Code

15. Supplementary Notes

Study was conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration. Study title: Subarea Analysis Using Micro-computers.

16. Abstract

The primary objective of this study is to develop and incorporate into the Texas Travel Demand Package procedures for downloading a portion of the output from the Package to the selected microcomputer transportation planning package to perform subarea analysis. In order to get compatible results between TRANPLAN and the Texas Trip Distribution Models, it is recommended that the final (or fifth) relative values from MODEL or ATOM be used for the Friction-Factors in the TRANPLAN trip distribution. The modified R-VALUE from ATOM is recommended for the "assumed average" intra-zonal impedance of the TRANPLAN separation matrix. The results of the comparison indicated that there are slight differences in the trip tables between TRANPLAN and ATOM, but the differences are of no practical significance. It is recommended that the user-specified V/C time adjustment curve data be used in the TRANPLAN assignment. The recommended user curve data is essentially from the final formulation of the impedance adjustment function in the Texas Package. General description of subarea analysis and procedure are discussed in this report. The conversion programs between the mainframe and the microcomputer were developed and tested. The program documentation is attached in Appendix C. Menu-driven batch files were developed to execute the conversion programs. The batch files are user friendly and make full use of the interactive capability of the microcomputer.

17. Key Words	18. Distribution Statement
TRANPLAN/NEDS Texas Travel Demand Package Subarea Analysis	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	67	

Form DOT F 1700.7 (8-69)

SUBAREA ANALYSIS USING TRANPLAN/NEDS

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Subarea Analysis Using Microcomputers

Research Report Number 1110-4F

Research Study Number 2-10-87-1110

Sponsored by

Texas State Department of Highways and Public Transportation

In Cooperation with the
U.S. Department of Transportation
Federal Highway Administration

Texas Transportation Institute
The Texas A&M University System
College Station, Texas

November 1988

METRIC (SI*) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

LENGTH

Symbol	When You Know	Multiply By	To Find	Symbol
in	inches	2.54	millimetres	mm
ft	feet	0.3048	metres	m
yd	yards	0.914	metres	m
mi	miles	1.61	kilometres	km

AREA

Symbol	When You Know	Multiply By	To Find	Symbol
in^2	square inches	645.2	millimetres squared	mm^2
ft^2	square feet	0.0929	metres squared	m^2
yd^2	square yards	0.836	metres squared	m^2
mi^2	square miles	2.59	kilometres squared	km^2
ac	acres	0.395	hectares	ha

MASS (weight)

Symbol	When You Know	Multiply By	To Find	Symbol
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg

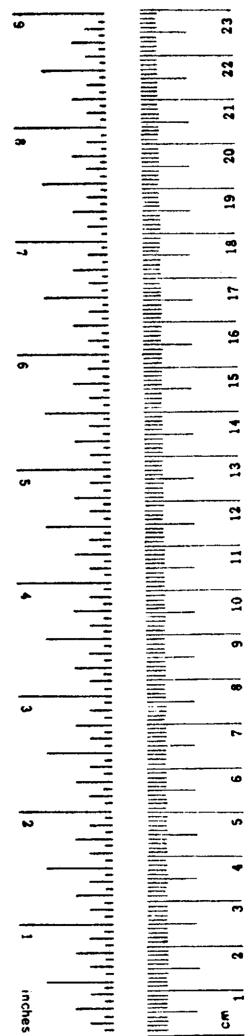
VOLUME

Symbol	When You Know	Multiply By	To Find	Symbol
fl oz	fluid ounces	29.57	millilitres	mL
gal	gallons	3.785	litres	L
ft^3	cubic feet	0.0328	metres cubed	m^3
yd^3	cubic yards	0.0765	metres cubed	m^3

NOTE: Volumes greater than 1000 L shall be shown in m^3.

TEMPERATURE (exact)

Symbol	When You Know	Multiply By	To Find	Symbol
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C



APPROXIMATE CONVERSIONS TO SI UNITS

LENGTH

Symbol	When You Know	Multiply By	To Find	Symbol
mm	millimetres	0.039	inches	in
m	metres	3.28	feet	ft
m	metres	1.09	yards	yd
km	kilometres	0.621	miles	mi

AREA

Symbol	When You Know	Multiply By	To Find	Symbol
mm^2	millimetres squared	0.0016	square inches	in^2
m^2	metres squared	10.764	square feet	ft^2
km^2	kilometres squared	0.39	square miles	mi^2
ha	hectores (10 000 m^2)	2.53	acres	ac

MASS (weight)

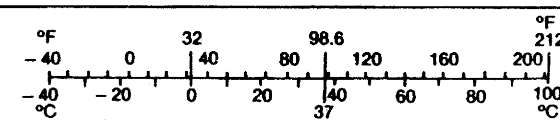
Symbol	When You Know	Multiply By	To Find	Symbol
g	grams	0.0353	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams (1 000 kg)	1.103	short tons	T

VOLUME

Symbol	When You Know	Multiply By	To Find	Symbol
mL	millilitres	0.034	fluid ounces	fl oz
L	litres	0.264	gallons	gal
m^3	metres cubed	35.315	cubic feet	ft^3
m^3	metres cubed	1.308	cubic yards	yd^3

TEMPERATURE (exact)

Symbol	When You Know	Multiply By	To Find	Symbol
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



These factors conform to the requirement of FHWA Order 5190.1A.

* SI is the symbol for the International System of Measurements

ABSTRACT

The primary objective of this study is to develop and incorporate into the Texas Travel Demand Package procedures for downloading a portion of the output from the Package to the selected microcomputer transportation planning package to perform subarea analysis. Subarea analyses need to be accomplished within the context of a validated comprehensive urban transportation study.

In order to get compatible results between TRANPLAN and the Texas Trip Distribution Models, it is recommended that the final (or fifth) relative values from MODEL or ATOM be used for the Friction-Factors in the TRANPLAN trip distribution. The modified R-VALUE from ATOM is recommended for the "assumed average" intrazonal impedance of the TRANPLAN separation matrix. The trip table evaluations demonstrate the feasibility of using the TRANPLAN gravity model interfacing with the Atomistic Model in further applications. The results of the comparison indicated that there are slight differences in the trip tables between TRANPLAN and ATOM, but the differences are of no practical significance.

It is recommended that the user-specified V/C time adjustment curve data be used in the TRANPLAN assignment. The recommended user curve data is essentially from the final formulation of the impedance adjustment function in the Texas Package.

General description of subarea analysis and procedure are discussed. The conversion programs between the mainframe and the microcomputer were developed and tested. The program documentation is attached in Appendix C. The documentation will be incorporated into the documentation manuals for the Texas Travel Demand Package. The programs for downloading from Texas Package to TRANPLAN included the following: link data, X and Y coordinate data, trip table, production and attraction data, and Friction-Factor, zonal radii data. Also, the programs for uploading from TRANPLAN to Texas Package included the following: link data and production and attraction data. Menu-driven batch files were developed to execute the conversion programs. The batch files are user friendly and make full use of the interactive capability of the microcomputer.

DISCLAIMER

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CHAPTER I. INTRODUCTION

I.1. STUDY OBJECTIVES

The primary objective of this study is to develop and incorporate into the Texas Travel Demand Package procedures for downloading a portion of the output from the Package to the selected microcomputer transportation planning package to perform subarea analysis. This objective has been accomplished by evaluating existing microcomputer software for suitability to perform subarea analysis and for compatibility with output from the Texas Travel Demand Package. The next objective is to select, test, and implement the preferred microcomputer software. The third objective of the study is to develop the user training and demonstration materials with sample problems applicable to Texas practice. The final objective is to conduct subarea analysis workshops for the Transportation Systems Planning Section (D-10P) staff and District Planning Engineers.

I.2. STUDY PROBLEMS

There is an increasing requirement to perform transportation studies for small geographic areas within a major urban area. For example, in the Houston-Galveston Regional Transportation Study, it might be desirable to study and evaluate several alternatives within a portion of Harris County (i.e., a subarea of the Houston-Galveston eight-county area). The cost of rerunning the distribution and assignment models for the entire eight-county area for each such alternative might be impractical. As a result, interest has been focused on subarea analysis whereby only a portion of the area might be studied, and the alternatives examined at a reasonable cost.

Subarea analyses need to be accomplished within the context of a validated comprehensive urban transportation study. In evaluating the impacts of proposed changes in land use on an existing or future roadway network, it is necessary to consider the impacts not only within the subarea but also the interchange of trips between the subarea and the remainder of the urban area. Similarly, when performing an analysis of travel within a corridor or interchange, the impact of all trips through the corridor or interchange must be considered. The validated urban transportation study provides this framework.

Texas Urban areas over 50,000 in population prepare and maintain comprehensive travel demand studies using the Texas Travel Demand Package. The subarea windowing capabilities incorporated into the Texas Travel Demand Package are appropriate for some applications. However, because of the complexity of the Texas Travel Demand Package, the Package is not the most appropriate tool for all subarea applications; and because of the training required, only a limited number of people are able to use the Package.

Microcomputer technology is developing very rapidly. Presently, microcomputer software packages designed for transportation network analysis and other transportation planning applications are in varying stages of development and maturity. Some are being modified to take advantage of recent improvements in operating systems. These existing microcomputer packages are sufficiently advanced to perform subarea analysis.

I.3. SUMMARY OF RESEARCH REPORTS

This 1110-4F report, "Subarea Analysis Using TRANPLAN/NEDS," is a final report of this research. The report is a summary and/or conclusion of the research as a part of a coordinated series of the preceding research reports. The following three research reports were completed:

- o 1110-1, "Detailed Evaluation of the TRANPLAN Package of Microcomputer Programs."
- o 1110-2, "Comparison of the Results from TRANPLAN with the Texas Package."
- o 1110-3, "A Comparison of Microcomputer Packages for Network-Based Highway Planning."

<u>Research Report 1110-3</u>

Objectives of the report were to evaluate existing microcomputer software for suitability to perform subarea analysis and for compatibility with the Texas Travel Demand Package. This report has been prepared not to attempt a critical evaluation and not to conduct rigorous performance evaluations. Transit route planning programs and plotting programs that use a network base were not considered for critical review.

The initial phase of the study included a detailed literature and software search. As a result, the following eleven potential transportation software packages were identified: QRS, IRAP, ASSIGN, LinkOD, TMODEL, EMME/2, MicroTRIPS, MINUTP, MOTORS, TransPro, and TRANPLAN/NEDS. The Quick Response System II (QRS II) was developed in August 1987. QRS II is an entirely new implementation of the theory and philosophy found in the original NCHRP report; however, it was not available at the time the initial phase was performed. A substantial portion of the material for this report comes from several sources: (1) the "Microcomputers in Transportation - Software and Source Book" published by UMTA in February 1987, (2) the draft report "Transportation Network Analysis Packages for Microcomputers" written by Multisystems, Inc., in January 1985, and (3) the information provided by software vendors. Package vendors were asked to provide a user's manual or comparable documentation, access to the package, and test data.

The procedures of the QRS package are not compatible with the network based analysis used by the Texas Travel Demand Package. The maximum number of zones (50) is less than that required for intended application. The gravity model in the trip distribution process utilizes zone-to-zone travel times which are input directly or are converted from airline distances. The gravity model output (e.g., P's and A's) are never converted to O's and D's; therefore, data files must be laboriously re-entered each time the model is run. The traffic assignment is non-network based; the QRS user must specify the links on which a given O-D movement is to be loaded. Although developed to be user friendly, it was found to be less user friendly than other packages (e.g., QRS uses NCI P-System which is different from IBM-DOS). Screen prompts and written documentation at times do not give sufficient guidance.

The IRAP package was designed for the analysis of micro-areas such as central business districts or shopping malls (e.g., the limitation of 50 zones is less than required); it was not designed for network analysis/

evaluation of the type performed using the mainframe package. Specific deficiencies for regional networks include the following: minimum paths are calculated only from a specified origin to all destinations, paths are limited to 30 links, and trip distribution must be done manually since it does not have a trip generation program and a trip distribution capability.

The ASSIGN package has the limitation of 75 zones. The package has the following trip distribution deficiencies: (1) it does not include the Fratar method; (2) external-external trips are distributed by the gravity model; or (3) they may be excluded and dealt with manually. Trip tables cannot be entered directly. Although trip tables can be created, the gravity model requires a user-defined exponent value rather than Friction-Factors as used in the Texas Travel Demand Package. Trip ends are assumed to be origins and destinations (not productions and attractions) and no conversion from P's and A's to O's and D's is provided. Thus, the gravity model is used to distribute O's and D's, a procedure not compatible with standard practice. The package also does not have a matrix handling capability.

The LinkOD program generates an estimated O-D table from link volumes. The process is not applicable to the standard trip generation, trip distribution, and traffic assignment processes where trip ends are calculated based upon socioeconomic-demographic variables and trip generation rates.

The TMODEL trips are loaded directly at the nodes rather than via centroid connectors as in the Texas Travel Demand Package procedure (i.e., there are no centroid connectors); therefore, a zone is defined as the area surrounding its link-like node number. Paths are always built through zone centroids. The package has no provisions for link type codes. Trips are simultaneously distributed and assigned; therefore, a gravity model is applied within the assignment module. Path building is also imbedded in the assignment module.

EMME/2 integrates the most recent advances in graphic displays. A very important graphic tool of EMME/2 is the graphic window. The window allows the user to view, change, and plot networks. Graphic windowing is accomplished several ways including using coordinates, a digitizing pad, previously designed windows, and centering on an individual node. However, EMME/2, which is the most expensive package and requires expensive hardware systems, was not evaluated.

After an initial review of each package, the following five packages were chosen for further in-depth evaluation (information was provided by each vendor in January 1987):

- o MicroTRIPS (9 program diskettes and user's manual)
- o MINUTP (5 demonstration diskettes and user's manual)
- o MOTORS (11 program diskettes and user's manual)
- o TransPro (2 demonstration diskettes and user's manual)
- o TRANPLAN/NEDS (14 program diskettes and user's manual of TRANPLAN)

The MicroTRIPS link distances and impedances are specified in hundredths of units; however, the separation matrix is output in tenths of a minute. Link impedances are also calculated in tenths of a minute. A separate run of the trip generation program and the trip distribution model is required for each trip purpose. MicroTRIPS offers a different approach for adding variability to multipath assignment. The package has no capability of selected nodes as O/D and no capability of ground count comparisons. Poor graphic capabilities are the most critical deficiency of MicroTRIPS in comparison with TRANPLAN/NEDS.

In MINUTP, complex Job Control Language (JCL) is required to run the program, and the user's manual is difficult to understand. An hourly capacity per lane and the number of lanes on each link are specified as input instead of the capacity in the direction. The MINUTP gravity model has no self-calibration procedure. Selected link options are available during all-or-nothing iterations of assignment.

The MOTORS package lacks the network building procedures as follows. Nodes must be numbered in sequence without any gaps. The separation matrix is output in tenths of a minute; link impedances are also calculated in tenths of a minute. Only four different types of link codes, link classes, and jurisdictions can be entered interactively. A-to-B and B-to-A link data must be entered separately, but links entered interactively can be designated as two-way if characteristics are the same in both directions. The user must balance trip ends within five percent prior to running a distribution model. Separate runs must be used to distribute trips for more than three different purposes. There are no user-defined F-factors (F-factors are supplied by using a "power" function or an exponential function) and no self-calibration procedure for the gravity model. Other limitations include the following: no iterative capacity-restraint assignment or multi-path options; no specification of selected nodes as O/D.

TransPro does not require nodes to be numbered sequentially; numbering gaps is permitted. However, the package does require centroid or zone nodes to be numbered below 300. The package lacks trip distribution features such as calibration of gravity model, K-factors, and Fratar procedure. The package has all-or-nothing, incremental, and iterative capacity-restraint assignment capabilities. It does not have equilibrium assignment or multipath options. Other limitations include the following: no transit analysis; no plotting capabilities; and only basic report printing capability.

TRANPLAN is the most comprehensive, fully integrated, and user-oriented package. Unlike other transportation software, TRANPLAN uses English-like syntax and uniform specifications in all programs; and it is extremely easy to learn and to apply. Recently, TRANPLAN has been interfaced with on-line, interactive graphics software (NEDS) for network editing and display. TRANPLAN provides selected link analysis with the equilibrium assignment.

In TRANPLAN, up to 15 purposes may be distributed in a run. The purposes may be stored in separate tables or merged into a single table. TRANPLAN includes a variety of select link analysis options. A trip table for a subarea analysis can be extracted from an assignment involving selected links. TRANPLAN gives the user the option of printing a complete network description after each step. The package provides a field for counts in the link data and lets the user compare assigned values to observed traffic. Finally, the TRANPLAN/NEDS packages were selected for suitability to perform subarea analysis and for compatibility with the output from the Texas Travel Demand Package comparing the different microcomputer packages which were evaluated.

Research Report 1110-1

This report represents the detailed evaluation of the TRANPLAN package including sample control files and outputs. One of the study objectives is to develop and incorporate procedures into the Texas Travel Demand Package for downloading a portion of the output from the Texas Package to the selected microcomputer transportation planning package to perform subarea analysis. The TRANPLAN package was tested and recommended for interface with the Texas Package.

TRANPLAN is a comprehensive, fully integrated, and user-oriented transportation modeling software with highway and transit programs. Unlike other software, TRANPLAN uses English-like syntax and uniform specifications in all programs. TRANPLAN is distributed on 12 (13 if plotting) diskettes, and requires about 3.5 MB of storage if all programs are transferred to a hard disk. The entire set of programs is separated into 42 modules referred to as "FUNCTIONS," each of which has specific capabilities. TRANPLAN documentation is available in hard copy. The package also includes substantial plotting capability. Recently, TRANPLAN has been interfaced with on-line, interactive graphics software for Network Editing and Display (NEDS). Detailed evaluation of TRANPLAN plotting capabilities and NEDS was included in this report. General definition of terms used in the transportation planning process is in Appendix A. Microcomputer hardware requirement for TRANPLAN/NEDS is available in Appendix B of this report.

Research Report 1110-2

This report represents the comparison of the results from TRANPLAN with the Texas Travel Demand Package (Texas Package). The TRANPLAN package was already tested and recommended for interface with the Texas Package. TRANPLAN should be compared with the Texas Package before subarea analysis is performed. A two-phase test procedure was utilized: Phase I -- assignment comparisons using the same trip table and Phase II -- trip table comparisons. The 1985 network in Bryan-College Station was selected as the data base for this test.

The results from the TRANPLAN assignments using three different assignment techniques (All-Or-Nothing and two different Incremental Assignments) were compared to the Texas Large Network Assignment Models (All-Or-Nothing, Capacity Restraint, and Incremental Assignments) results. The analysis included a selected link-by-link comparison of the posted assignment results, comparisons of screenlines and cutlines, and a comparison of major travel routes. Phase II investigated alternative trip distribution techniques (i.e., TRANPLAN, Texas Model, and Atomistic distributions) for the modeling of the trip table. The results of three trip tables were then compared on a cell-by-cell basis.

It was found that there were no differences between TRANPLAN and the Texas Package using All-Or-Nothing, and that there were no significant differences between the TRANPLAN Incremental assignment and the new capacity restraint assignment of the Texas Large Network Assignment Models. There are slight differences in trip tables between TRANPLAN and MODEL using the fifth relative values from MODEL for the Friction-Factors in TRANPLAN, but the differences are not practically significant.

CHAPTER II. RECOMMENDED OPTIONS AND PARAMETERS

II.1. MINIMUM PATH

Preliminary evaluation of the results found that some differences existed in searching a minimum path between the Texas Travel Demand Package and TRANPLAN. The problems were associated with the handling of a decimal number. The impedance (e.g., travel time) of the Texas Package is calculated by truncation in a third decimal point while the impedance of TRANPLAN is rounded to a second decimal point. Two separation matrices from the Texas Package and TRANPLAN were compared after the truncation problem of the Texas Package was altered. It was found that there is no difference between the two separation matrices.

II.2. TRIP DISTRIBUTION

Trip distribution is the process by which the trip interchange volumes between zones are estimated. Thus, the expected urban travel pattern is described. The trip distribution of TRANPLAN uses the classical gravity model formula with "Friction-Factors." The Texas Trip Distribution Models provides the analyst with the option to select either of two synthetic, mathematical, distribution techniques. The alternatives are the interactance model (MODEL) and Atomistic Model (ATOM). MODEL and ATOM perform the same task, trip distribution, but in fundamentally differing ways. Nevertheless, the inputs and outputs are similar between MODEL and ATOM.

The gravity model derives its name and basic premise from Isaac Newton's law of gravity. Newton's law states that the attractive force between any two bodies is directly related to the masses of the bodies and inversely related to the distance between them. Similarly, in the gravity model, the number of trips between two areas is directly related to activities in the area represented by trip generation and inversely related to the separation between the areas represented as a function of travel time. Therefore, areas with large amounts of activity tend to exchange more trips, and areas farther from each other tend to exchange fewer trips.

TRANPLAN Gravity Model

The gravity model function in TRANPLAN accepts the interzonal skim impedances and zonal trip end productions/attractions stratified by class of trip (purpose), travel impedance factors (Friction-Factors), zone-to-zone travel indices, and K-factors (optional), and generates a zone-to-zone trip table file from the gravity model distribution formula. The function also checks the acceptability of computed attractions, and if necessary, adjusts the calculated attractions to each zone to equal the input attractions. Friction-Factors are supplied, by trip purpose, for all integer values of impedance over the range occurring in the skim tables. The classical gravitational formula is restructured for computer users as follows:

1. The separation is generalized to allow inclusion of any travel index. In TRANPLAN, time, distance, cost or a combination of them may be used. Most users select time as separation.

2. The effect of separation for each minute time increment is represented by a table of "Friction-Factors"; this replaces the squared quantity in the denominator. The travel separation function is then more easily represented.
3. A modification in the basic gravitational formulation is made to combine all these effects with the constant of proportionality.

The gravity model formula appears as follows:

$$T_{ij} = P_i \frac{A_j F_{ij} K_{ij}}{\sum_{j=1}^{n} A_j F_{ij} K_{ij}}$$

where $F_{ij} = f(t_{ij})$

and T_{ij} = trips produced in zone i, and attracted at zone j;

P_i = total trip production at i;

A_j = total trip attraction at j;

F_{ij} = Friction-Factor for trip interchange ij;

K_{ij} = socioeconomic adjustment factor for interchange ij;

t_{ij} = travel time (or impedance) for interchange ij;

i = origin analysis area (zone) number;

j = destination analysis area (zone) number; and

n = number of the analysis area (zone).

Texas Trip Distribution Models

The Texas Trip Distribution Models is a complete collection of computer programs having the capability of performing several different types of trip distributions. The methods range from directionally expanding existing trip matrices to new totals, to performing synthetic distributions using a constrained interactance model, or the Atomistic Model.

The interactance model (MODEL) applies trip lengths directly in the distribution process, and consequently, needs no calibration. Other properties of the interactance model are similar to a gravity model without "Friction-Factors." By activating a constraint based on interchange propensity, only selected zone pairs enter into the distribution rather than all possible zone pair combinations, as with the gravity model. A sector structure may be imposed to permit a statistical analysis for, and correction of, sector interchange bias created by socioeconomic-topographical travel barriers. Movements having external terminals may be processed simultaneously with the synthetic distribution of internal trips.

The Atomistic Model (ATOM) is a spatially disaggregate gravity model. It allocates intrazonal trips rationally by using the radius data for each zone and the trip length frequency. It is self-calibrating for both intrazonal trips and interzonal trips because it applies the trip length frequency constraint directly. The only additional input required by the Atomistic Model (but not required by the MODEL procedure) is a zonal parameter, the R-VALUE, which defines the size of the centroid area to be used to represent the zone.

The MODEL and ATOM routines perform the distribution of travel interchanges and write a modeled trip matrix. Four tables of printed output result from each iteration of the model. Each of these tables reflects the success of the balancing process in applying the indirect constraints. The Trip Length Balance, Table L1, is printed in the third table. Each entry refers to a separation value. The resulting trip length frequencies output is the estimate of the disaggregate trip length frequency and not the common trip length frequency of zonal interchange. The last three entries represent the external movements. In addition, the desired and resulting percentage of trips is printed for each separation. Summary statistics are presented at the end. An example of Table L1 is shown in Figure 1. The relative values (columns 92 to 102 in Table L1) are calculated by the following steps using the mathematical formulas:

STEP 1: Initial Relative Value (F-value) at First Iteration;

$$FF_S = DT_S/I_S$$

STEP 2: The routine applies the four constraints to the unscaled F-value;

$$FF_3 \geq 1.05\ FF_4$$

$$FF_2 \geq 1.05\ FF_3$$

$$FF_1 \geq 1.05\ FF_2$$

$$FF_S \geq 0.0001$$

STEP 3: The routine applies a scaling factor to scale separation 5 to 100;

$$F_S = FF_S \times S.F$$

STEP 4: Then, Relative Value between Iterations;

$$\mathit{new}FF_S = DT_S/RT_S \times \mathit{old}F_S$$

$$\mathit{new}F_S = \mathit{new}FF_S \times S.F$$

where, DT_S = desired trips at separation S,
RT_S = resulting trips at separation S,
I_S = number of eligible interactions (zone pairs) at separation S,
$S.F$ = scale factor = $100/FF_5$,
FF_S = unscaled F-value at separation S, and
F_S = scaled F-value at separation S.

Figure 1. A Sample Output for Trip Length Balance (Table L1).

TABLE L1(5) TRIP LENGTH BALANCE (ITERATION 5)

SEPARATION	PERCENT DESIRED	PERCENT RESULTING	DESIRED	RESULTING	DIFFERENCE	PCT ERR	CHI-SQUARE	RELATIVE	CORRECTION	CORRECTED RELATIVE
1	7.0978	7.1167	7844.5	7865.3	20.9	0.266	0.1	168.4976	0.9973	168.0505
2	13.6320	13.6440	15066.0	15079.2	13.2	0.088	0.0	214.3663	0.9991	214.1780
3	15.8907	15.8879	17562.3	17559.2	-3.1	-0.017	0.0	179.2607	1.0002	179.2918
4	15.0988	15.0980	16687.1	16686.2	-0.8	-0.005	0.0	142.2361	1.0000	142.2431
5	12.8261	12.8266	14175.3	14175.8	0.5	0.004	0.0	100.0000	1.0000	99.9961
6	10.1503	10.1190	11218.0	11183.4	-34.6	-0.308	0.1	73.0437	1.0031	73.2695
7	7.6492	7.6352	8453.9	8438.3	-15.6	-0.184	0.0	51.8706	1.0018	51.9662
8	5.5619	5.5710	6147.0	6157.1	10.1	0.164	0.0	36.7581	0.9984	36.6980
9	3.9351	3.9460	4349.1	4361.1	12.1	0.277	0.0	29.2453	0.9972	29.1644
10	2.7247	2.7303	3011.3	3017.5	6.2	0.205	0.0	23.0577	0.9980	23.0105
11	1.8540	1.8498	2049.0	2044.4	-4.6	-0.225	0.0	16.9668	1.0023	17.0050
12	1.2435	1.2439	1374.3	1374.8	0.5	0.034	0.0	13.2740	0.9997	13.2695
13	0.8240	0.8258	910.7	912.7	2.0	0.219	0.0	10.0588	0.9978	10.0369
14	0.5404	0.5418	597.2	598.8	1.6	0.264	0.0	8.0868	0.9974	8.0655
15	0.3513	0.3656	388.3	404.0	15.8	4.066	0.6	6.7947	0.9609	6.5293
16	0.2266	0.2146	250.4	237.2	-13.2	-5.280	0.7	5.0841	1.0557	5.3675
17	0.1452	0.1426	160.5	157.6	-2.9	-1.802	0.1	4.0397	1.0184	4.1138
18	0.0925	0.0939	102.2	103.8	1.6	1.533	0.0	3.2859	0.9849	3.2363
19	0.0586	0.0558	64.8	61.7	-3.1	-4.782	0.1	2.3593	1.0502	2.4778
20	0.0369	0.0324	40.8	35.8	-4.9	-12.094	0.6	2.0601	1.1376	2.3436
21	0.0232	0.0206	25.6	22.8	-2.9	-11.151	0.3	1.9273	1.1255	2.1692
22	0.0145	0.0148	16.0	16.3	0.3	1.933	0.0	1.6545	0.9810	1.6231
23	0.0090	0.0083	9.9	9.2	-0.8	-7.949	0.1	1.7569	1.0864	1.9087
24	0.0056	0.0043	6.2	4.7	-1.5	-24.024	0.4	1.3578	1.3162	1.7872
25	0.0035	0.0041	3.9	4.5	0.7	17.096	0.1	1.8379	0.8540	1.5695
26	0.0021	0.0032	2.3	3.6	1.2	53.634	0.7	2.0358	0.6509	1.3251
27	0.0013	0.0018	1.4	2.0	0.5	37.687	0.2	2.2934	0.7263	1.6656
28	0.0008	0.0001	0.9	0.1	-0.7	-84.107	0.6	0.3897	1.0000	0.3897
29	0.0005	0.0001	0.6	0.1	-0.5	-86.996	0.4	0.4787	1.0000	0.4787
30	0.0003	0.0000	0.3	0.0	-0.3	-94.910	0.3	0.6407	1.0000	0.6407
31	0.0002	0.0000	0.2	0.0	-0.2	-99.977	0.2	0.9254	1.0000	0.9254
32	0.0000	0.0000	0.0	0.0	0.0	-100.000	0.0	0.0001	1.0000	0.0001
33	0.0000	0.0000	0.0	0.0	0.0	-100.000	0.0	0.0001	1.0000	0.0001
34	0.0000	0.0000	0.0	0.0	0.0	-100.000	0.0	0.0001	1.0000	0.0001
35	0.0000	0.0000	0.0	0.0	0.0	-100.000	0.0	0.0001	1.0000	0.0001

							5.8			

	DESIRED	RESULTING	PERCENT DIFFENCE
AVERAGE INTERNAL TRIP LENGTH	4.98014	4.97767	-0.04964
TOTAL INTERNAL TRAVEL	550402.	550129.	-0.04962

TOTAL INTRAZONAL TRIPS = 2646.0

Recommendation for Compatible Results

In order to get compatible results between TRANPLAN and the Texas Trip Distribution Models, it is recommended that the final (or fifth) relative values from MODEL or ATOM be used for the Friction-Factors in the TRANPLAN trip distribution.

RADIUS cards that are not required as input into TRANPLAN or MODEL are used to define the centroid area in ATOM. This card simply presents the dimension (in minutes) of each zone radius as input into ATOM. Where zones or sectors are not performing correctly during the validation process, the adjustment of the radius value can increase or decrease intrazonal trips as needed to establish proper interchange volumes. In order to obtain the close results between TRANPLAN and ATOM, it is decided that the R-VALUE should be used in the TRANPLAN trip distribution. The following formula is used to generate "assumed average" intrazonal impedances (defaults for intrazonal impedance = 1.00 minute) for the separation matrix based on the R-VALUE:

$$I_{aa} = 2R_a \times 2/3$$

where, I_{aa} = calculated intrazonal impedance in zone A and

R_a = R-VALUE in zone A

II.3. COMPARISONS BETWEEN TRANPLAN AND ATOM

The same input data base (1985 Tyler network) was used for the comparison between the results of the TRANPLAN gravity model and the Atomistic Model. The final (or fifth) relative values from ATOM were used for the Friction-Factors in the TRANPLAN trip distribution. The distribution of the Friction-Factors for the four internal trip purposes is shown in Figure 2. The modified R-VALUE is used for the "assumed average" intrazonal impedance of the TRANPLAN separation matrix.

Distribution of Zonal Interchanges

Figure 3 shows the distributions of internal zonal interchange (cell) volumes for the trip tables from the TRANPLAN gravity model and the Atomistic Model. The frequency distributions of zonal interchange volumes for the two trip tables are very similar. The effect of the Friction-Factors and the modified Radii values give distributions of TRANPLAN zonal interchange volumes which were very close to the distributions of the Atomistic Model. However, this does not mean the two matrices are the same on a cell-by-cell basis.

Comparisons on a Cell-by-Cell Basis

The trip table of the TRANPLAN gravity model was compared with the trip table of the Atomistic Model on a cell-by-cell basis. These comparisons included the percent and absolute differences. Appendix A presents the output files for the frequency distribution of the percent and absolute differences in the zone-to-zone (cell) volumes by volume groups using the Report Matrix Comparison program of TRANPLAN.

Figure 2. 1985 Tyler Friction-Factor Curves by Trip Purposes.

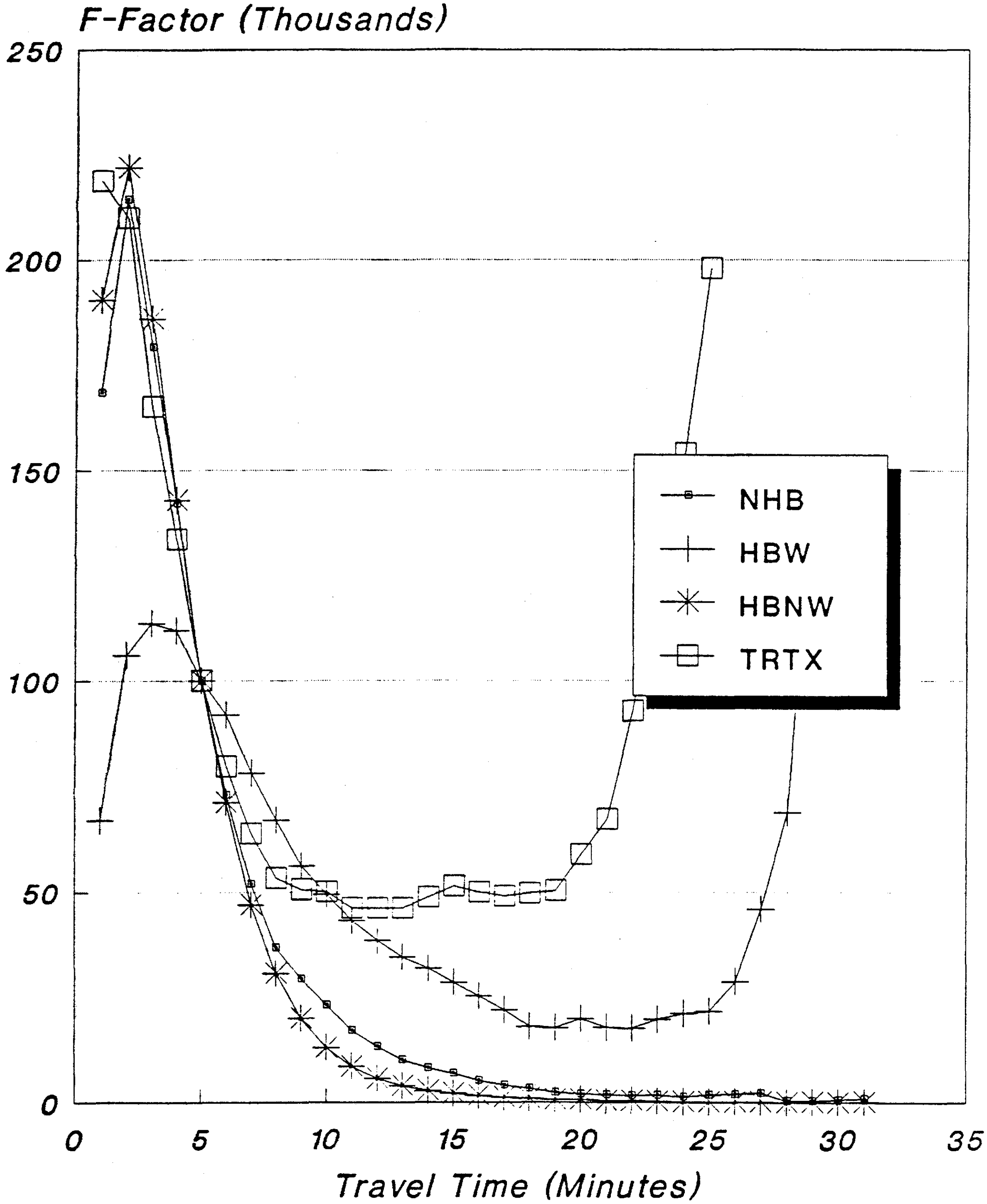


Figure 3. Distribution of Zonal Interchange Volumes for TRANPLAN and Atomistic.

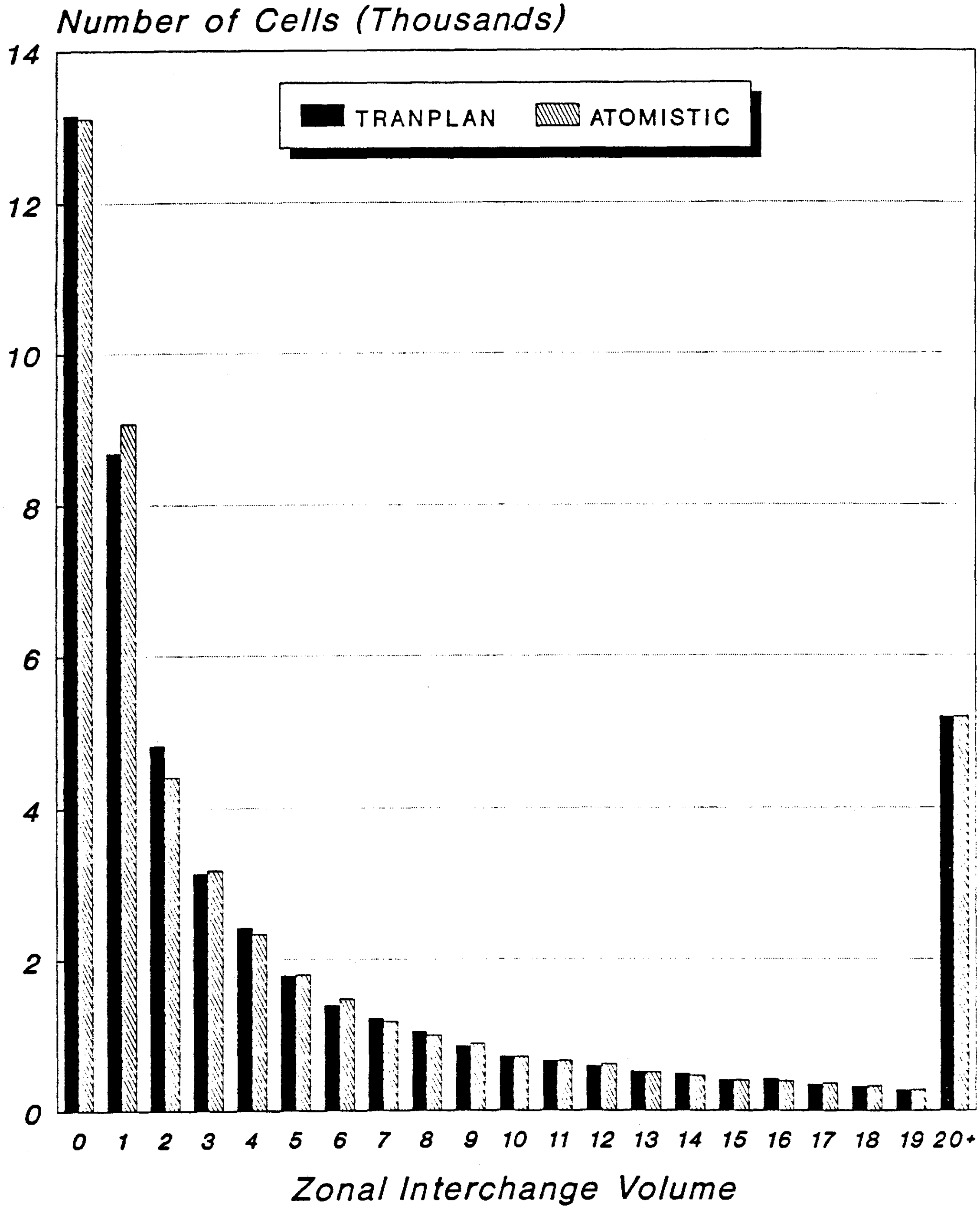


Table 1 shows a summary of the percent differences based on a cell-by-cell comparison. The table shows that 49,095 cells (77.3 percent) have five or fewer trips in TRANPLAN. A total of 81.49 percent of the cells have a difference of less than or equal to 20.0 percent when the trip table of the TRANPLAN gravity model is compared to the table of the Atomistic Model. It was concluded that there is no significant (practical) differences between the two matrices.

Table 1. Summary of Trip Matrix Percent Difference.

Volume	Percent Difference [(V1 - V2)/(V1 + V2)]x100					
Group (V1)	0%	1%-10%	11%-20%	21%-50%	51%-100%	Total
0 - 5	33785	406	3362	4794	6748	49095
6 - 10	1946	2557	549	161	1	5214
11 - 50	2567	4775	212	39	0	7593
51 - 100	576	465	24	6	0	1071
101 - 2000	237	266	19	9	0	531
Total	39111	8469	4166	5009	6749	63504
Percent	61.59	13.34	6.56	7.89	10.62	100.0
Accum. %	61.59	74.93	81.49	89.38	100.0	100.0

Table 2 indicates the absolute differences between the two trip matrices. Comparison of TRANPLAN and ATOM shows that a total of 38,538 interchanges (60.69 percent) have no differences and only 1,405 interchanges (2.21 percent) have a difference of three or more trips. It was concluded that there is no significant absolute difference when the trip tables of the TRANPLAN gravity model and the Atomistic Model were compared on a cell-by-cell basis.

Table 2. Summary of Trip Matrix Absolute Difference.

Volume	Absolute Difference [(V1 - V2)					
Group (V1)	0	1	2	3	4+	Total
0 - 5	33785	13290	1881	131	8	49095
6 - 10	1946	2441	714	103	10	5214
11 - 50	2555	3393	1126	285	234	7593
51 - 100	219	355	212	116	169	1071
101 - 2000	33	81	68	69	280	531
Total	38538	19560	4001	704	701	63504
Percent	60.69	30.80	6.30	1.11	1.10	100.0
Accum. %	60.69	91.49	97.79	98.90	100.0	100.0

Statistical Comparisons

Each of the two trip tables has approximately the same number of total internal trips (428,000 trips). The average interchange volume is obviously

6.7 trips (428,000/(252x252)) for both trip matrices because the trip matrices were generated using same input (production and attraction) data base. Four common statistical measures were used to compare the trip matrices from the TRANPLAN gravity model and the Atomistic Model on a cell-by-cell basis. These are standard deviation of the differences (SD), root-mean-square error (RMS), percent RMS error (PRMS), and sum of square difference (SUMSQ). These were employed in the evaluation of trip table differences on a cell-by-cell basis.

The standard deviation is a measure of the dispersion of data about the mean, and it gives some indication of the "goodness" of the results. The smaller the value of the standard deviation, the closer the grouping of data about the mean.

Root-mean-square (RMS) error is very similar to the standard deviation in that it is also a measure of dispersion of the data. However, it is a measure of dispersion of the differences relative to a zero difference, whereas the standard deviation is relative to the mean difference. Calculation of the standard deviation involves a bias which is the mean; as the mean difference approaches zero, the standard deviation approaches the RMS error.

Percent RMS (PRMS) error measures the relationship between RMS error and the average traffic volume. It is valuable in comparing results of different trip tables, and it is a relative measure among trip tables. Sum of square difference (SUMSQ) is the most direct measure of interchange differences between the two matrices. The following relationships were used for calculation:

$$SD = \sqrt{(\sum(V1_i - V2_i)^2 / (N-1)) - (\sum(V1_i - V2_i) / N)^2}$$

$$RMS = \sqrt{(\sum(V1_i - V2_i)^2 / (N-1))}$$

$$PRMS = 100 \times (RMS / (\sum V2_i / N))$$

$$SUMSQ = \sum(V1_i - V2_i)^2$$

where: $V1_i$ = compared traffic volume of interchange i

$V2_i$ = base traffic volume of interchange i

N = total number of interchanges of trip table

Appendix B presents the output files for the comparisons of the two trip matrices by volume groups using the Report Matrix Comparison program of TRANPLAN. Table 3 shows a summary of the trip matrix comparisons. Also, a summary of the trip matrix comparisons from Table III-5 in the Research Report 1110-2 is included in Table 3 for comparison purposes. There were no significant differences in trip tables between TRANPLAN and MODEL because the fifth relative values from MODEL were used for the Friction-Factors in TRANPLAN.

Table 3. Summary of Statistical Comparisons.

	SD	RMS	PRMS	SUMSQ
TRANPLAN vs. MODEL*	0.86	0.9	14.49	49130
TRANPLAN vs. ATOM*	8.14	8.1	137.23	4408464
MODEL vs. ATOM*	8.14	8.1	137.19	4405842
TRANPLAN vs. ATOM	2.20	2.2	32.71	308585

*Note, * indicates that the data is from Table III-5 in Research Report 1110-2.*

As indicated, there is no difference between SD and RMS because there are no differences in mean traffic volume between the trip matrices. The SD and RMS for the comparison of TRANPLAN vs. MODEL were the smallest. Also, it is 90 times smaller than the other two comparisons (TRANPLAN vs. ATOM* and MODEL vs. ATOM*) in the SUMSQ difference. The values in the comparison of TRANPLAN (using the fifth relative values from ATOM for the Friction-Factors) vs. ATOM shown in the last line are much smaller than the values on the second and third lines. Also, the SUMSQ was 15 times smaller than for the other comparisons. Finally, in comparison to values of the four statistical measures from the TRANPLAN and Atomistic trip tables, the result appears to be within acceptable limits.

Trip Length Frequency Distributions

This section provides a comparison of the "calculated" trip length frequency (TLF) distribution with the "desired" TLF distribution from the survey data. The TLF distributions were produced by the two trip matrices developed in the trip distribution procedure. A comparison of the mean trip length is also presented in this section.

The comparisons are presented graphically with plots showing the percentage of trips at each separation. Both calculated and desired TLF by the four internal trip purposes are shown in Figures 4, 5, 6, and 7. It should be noted that all separations are in units of minutes computed from link distance and link speed and are not synonymous with clock time.

As seen in Figures 4, 5, 6, and 7, the distribution of TRANPLAN appears to be skewed to the left compared to the distribution of Atomistic and the desired TLF. These modes (the most frequent points) are also higher for all four internal trip purposes. Consequently, many more trips at shorter travel times are expected in the assignment results of TRANPLAN based on the comparison of the TLF, but the differences are of no practical significance at all. It should be recalled that the TLF for both TRANPLAN and Atomistic was generated using the constraint of the desired TLF. Therefore, the results of TRANPLAN and Atomistic have almost identical distributions of TLF.

The Bureau of Public Roads suggested that the observed (or desired) TLF distribution and the TLF from the gravity model should exhibit the following two characteristics: the shape and position of both curves should be relatively close to one another when compared visually, and the difference

Figure 4. Comparisons of Trip Length Frequency Distribution (NHB) for TRANPLAN vs. Atomistic.

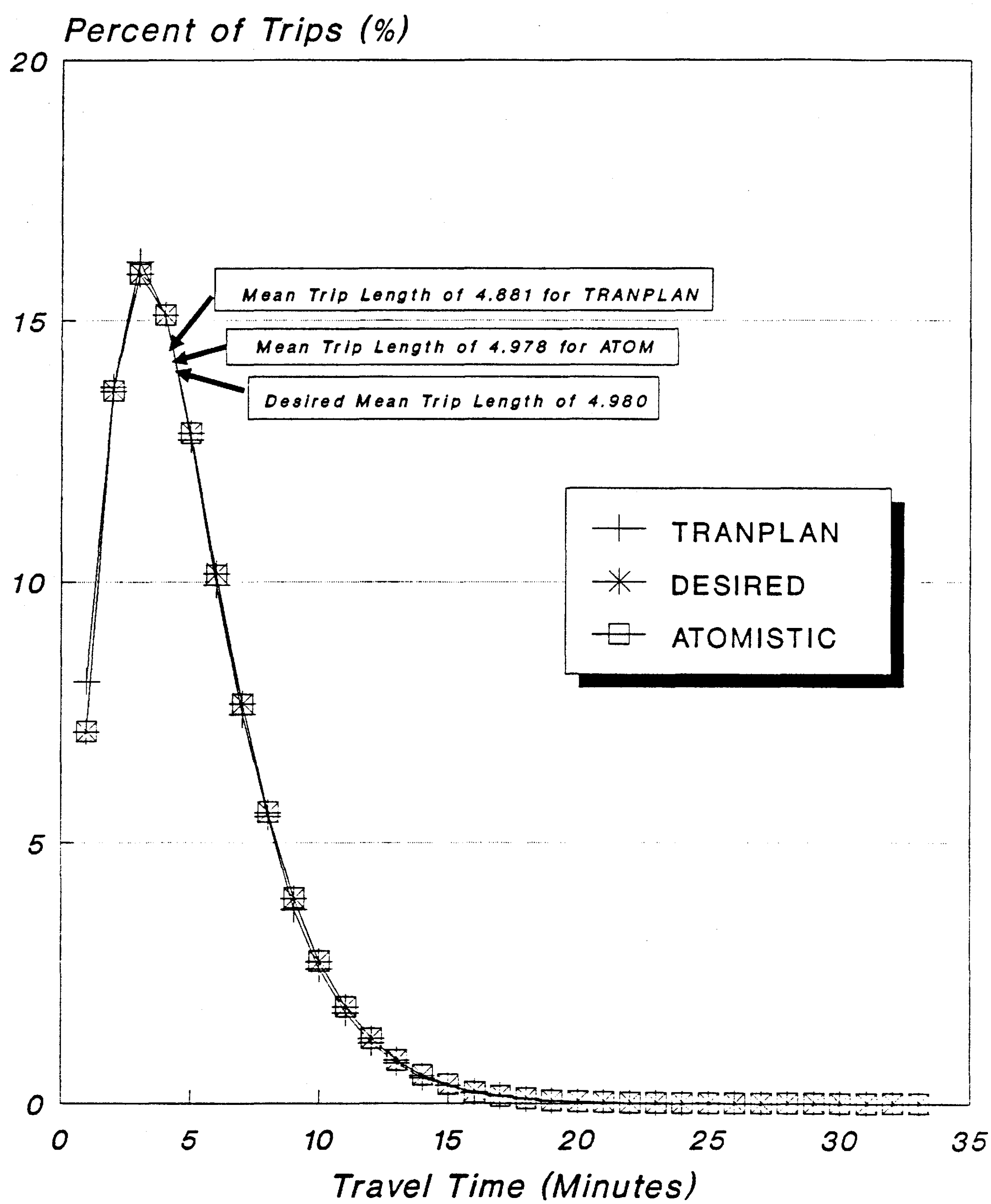


Figure 5. Comparisons of Trip Length Frequency Distribution (HBW) for TRANPLAN vs. Atomistic.

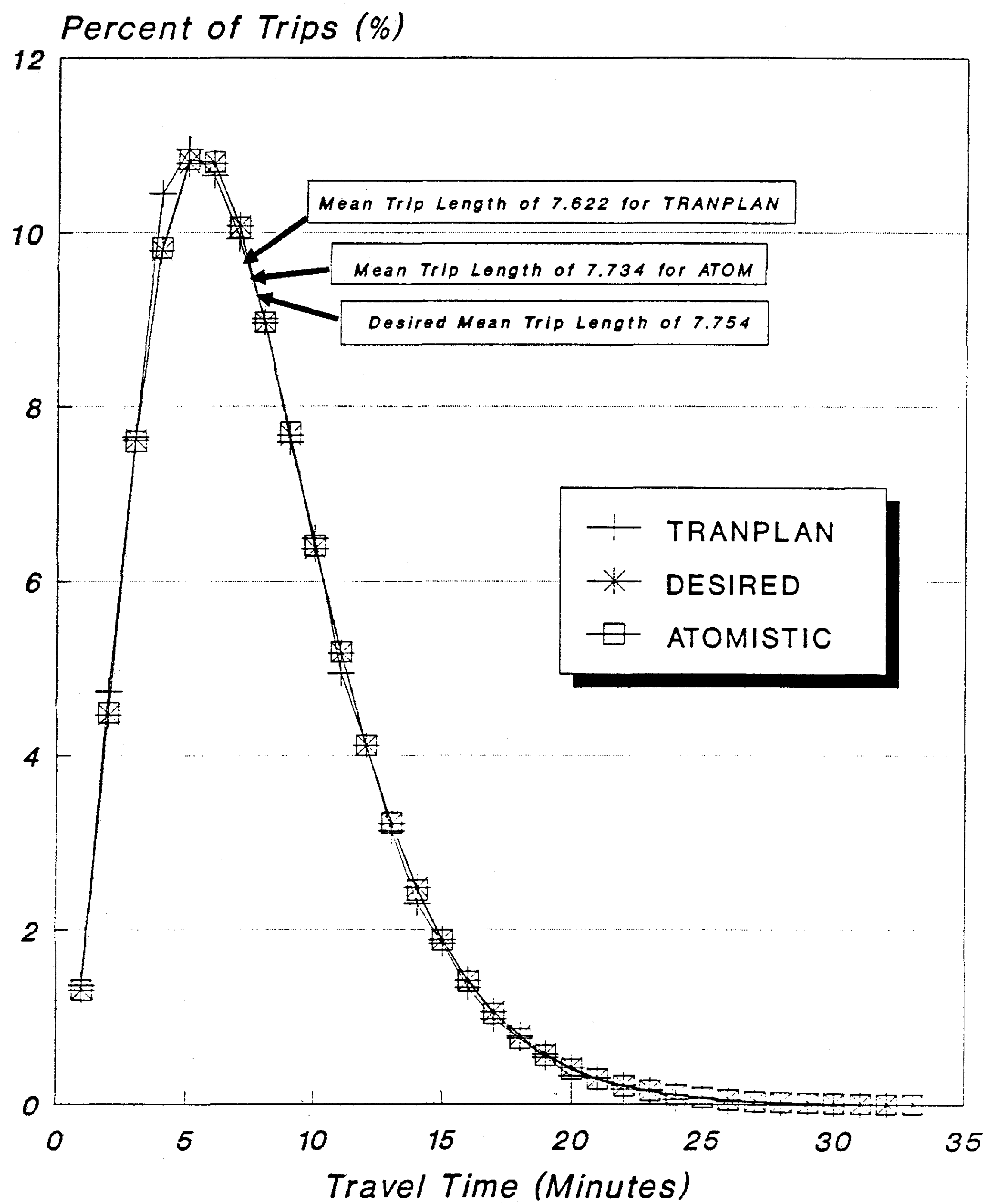


Figure 6. Comparisons of Trip Length Frequency Distribution (HBNW) for TRANPLAN vs. Atomistic.

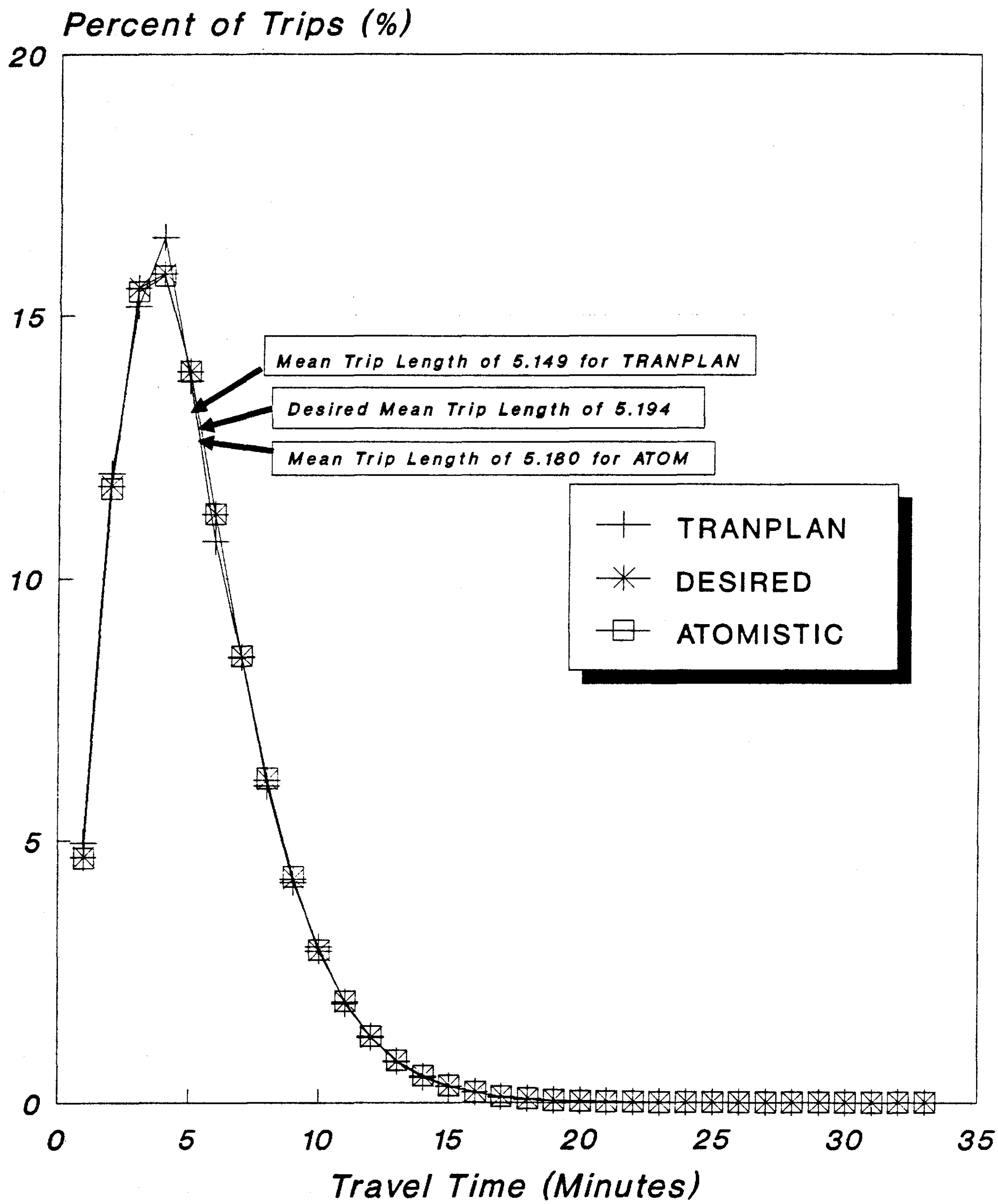
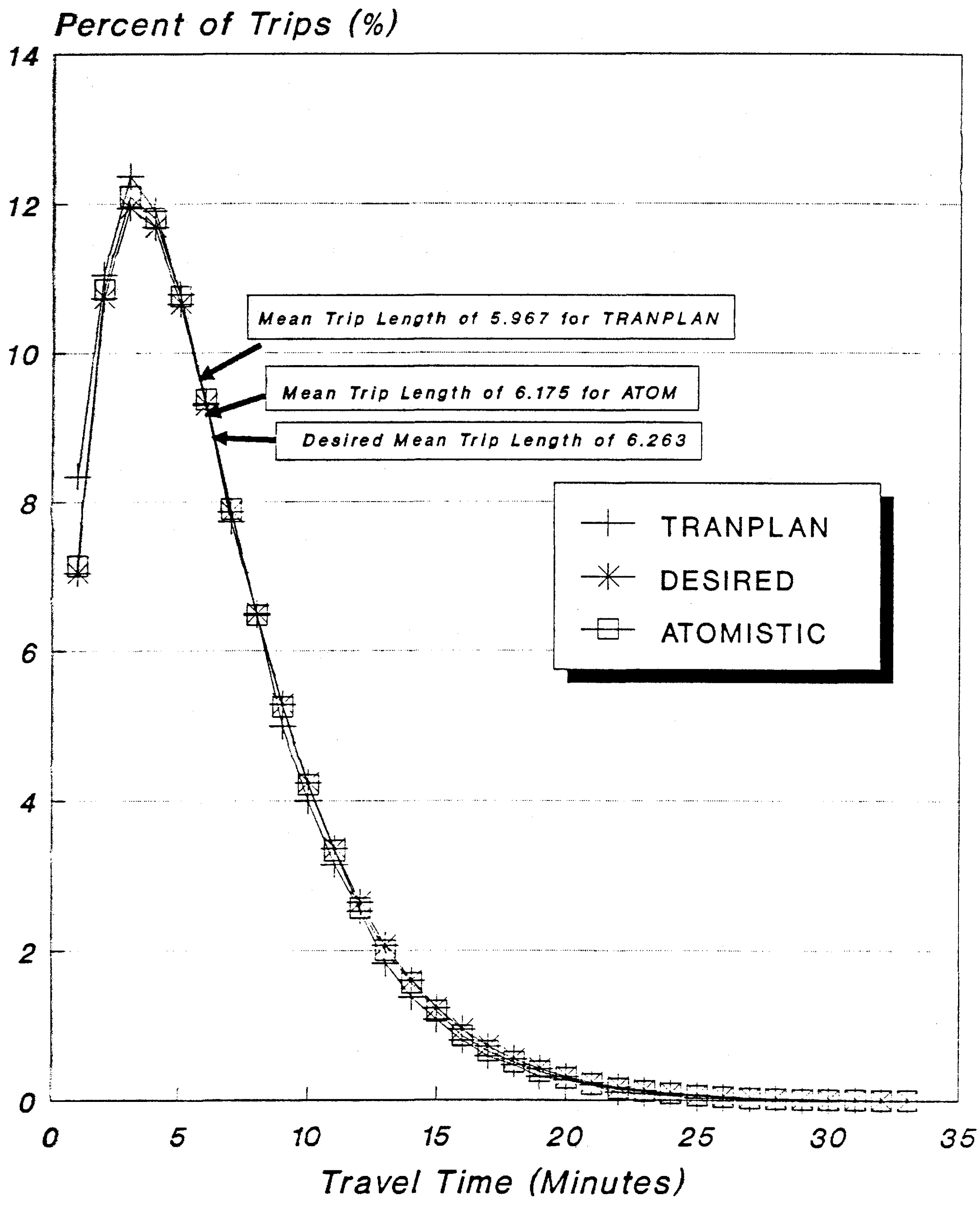


Figure 7. Comparisons of Trip Length Frequency Distribution (TRTX) for TRANPLAN vs. Atomistic.



between the average trip lengths should be within ±3 percent. Table 4 shows the mean trip length for the results of the TRANPLAN gravity model and the Atomistic Model and the desired mean trip length by the four internal trip purposes.

Table 4. Summary of Mean Trip Length Comparisons.

	NHB	HBW	HBNW	TRTX
Desired	4.980	7.754	5.180	6.263
Atomistic	4.978 (0.04)	7.734 (0.26)	5.194 (0.27)	6.175 (1.41)
TRANPLAN	4.881 (1.98)	7.622 (1.70)	5.149 (0.60)	5.967 (4.73)

Note, (0.04) indicates a percent difference from the desired mean TL.

The results of the mean trip length for the Atomistic Model indicate shorter than the desired mean trip length for the three internal trip purposes, and the results for the TRANPLAN gravity model give the shortest mean trip length for the all internal trip purposes. However, the differences are less than 3.0 percent which is defined as an acceptable limit, the only exception of the mean trip length of the TRTX purpose in TRANPLAN.

Overall, it was concluded that there is no significant difference between the TLF distributions of the TRANPLAN gravity model and of the Atomistic Model. Also, a comparison of the mean trip length indicated that there is no difference between the "calculated" TLF distribution and the "desired" TLF distribution from the survey data.

Summary of Comparisons between TRANPLAN and ATOM

The trip table evaluations demonstrate the feasibility of using the TRANPLAN gravity model interfacing with the Atomistic Model in further applications. The TRANPLAN gravity model is considering the activities within a zone to be concentrated at a single theoretical point (i.e., the zone centroid), instead of considering the activities to be spatially distributed in the Atomistic Model. In order to eliminate this difference, the modified Radii value was used for the "assumed average" intrazonal impedance of the TRANPLAN separation matrix. Also, in order to obtain the compatible results of the TRANPLAN gravity model with the Atomistic Model, the fifth relative values from ATOM were used for the Friction-Factors in the TRANPLAN trip distribution procedure.

The results of the comparison using the zonal interchange volumes and the comparison on a cell-by-cell basis indicated that the there is no significant difference between the two trip tables. The results in comparison of the trip tables using the four statistical measures appeared to be within acceptable limits. It was also concluded that there is no difference between the "calculated" trip length frequency distributions for the TRANPLAN gravity model and the Atomistic Model. Finally, there are slight differences of trip tables between TRANPLAN and ATOM, but the differences are of no practical significance.

II.4. TRAFFIC ASSIGNMENT

The formulation of the Texas Large Network Assignment Models in running Assign Self-Balancing uses directly the impedance computed from the input speed and distance rather than an estimate of the zero volume impedance based on a free flow speed. Since the input speeds in Texas studies reflect an estimated speed at a V/C ratio of roughly 0.85, the impedance remains unchanged at this ratio. The impedance should increase at ratios above 0.85; the impedance decreases at the ratios below 0.85. A bounding condition was placed on the impedance adjustment function because there is a potential for severe oscillation in both link impedances and assigned link volumes. The formulation of the impedance adjustment function is:

$$I_{(n+1)} = (0.92 + 0.15\ (V_{(n)}/C)^4) \times I_{(1)}$$

subject to the constraint that $I_{(n+1)} \leq (n+1)I_1$

where, $V_{(n)}$ = a weighted average of the volumes assigned on all preceding iterations,

C = level of service link capacity,

$I_{(1)}$ = level of service link impedance, and

$I_{(n+1)}$ = adjusted link impedance.

Level of service link capacity is the maximum number of vehicles a link can serve and still maintain a steady flow without being unstable. Level of service link travel time is the time required to traverse the link under these conditions. It is important to note that every link impedance having a specified capacity is subject to adjustment between successive iterations in this procedure.

In TRANPLAN, the network parameter, time, may be adjusted link by link according to user-specified volume/capacity time adjustment curve data or the following capacity restraint formula:

$$T_n = T_{n-1} \times [\ 1.0 + 0.15\ (V/C)^4\ ] \times 0.87$$

where, n = current restraint iteration,

T_n = travel time on loaded link,

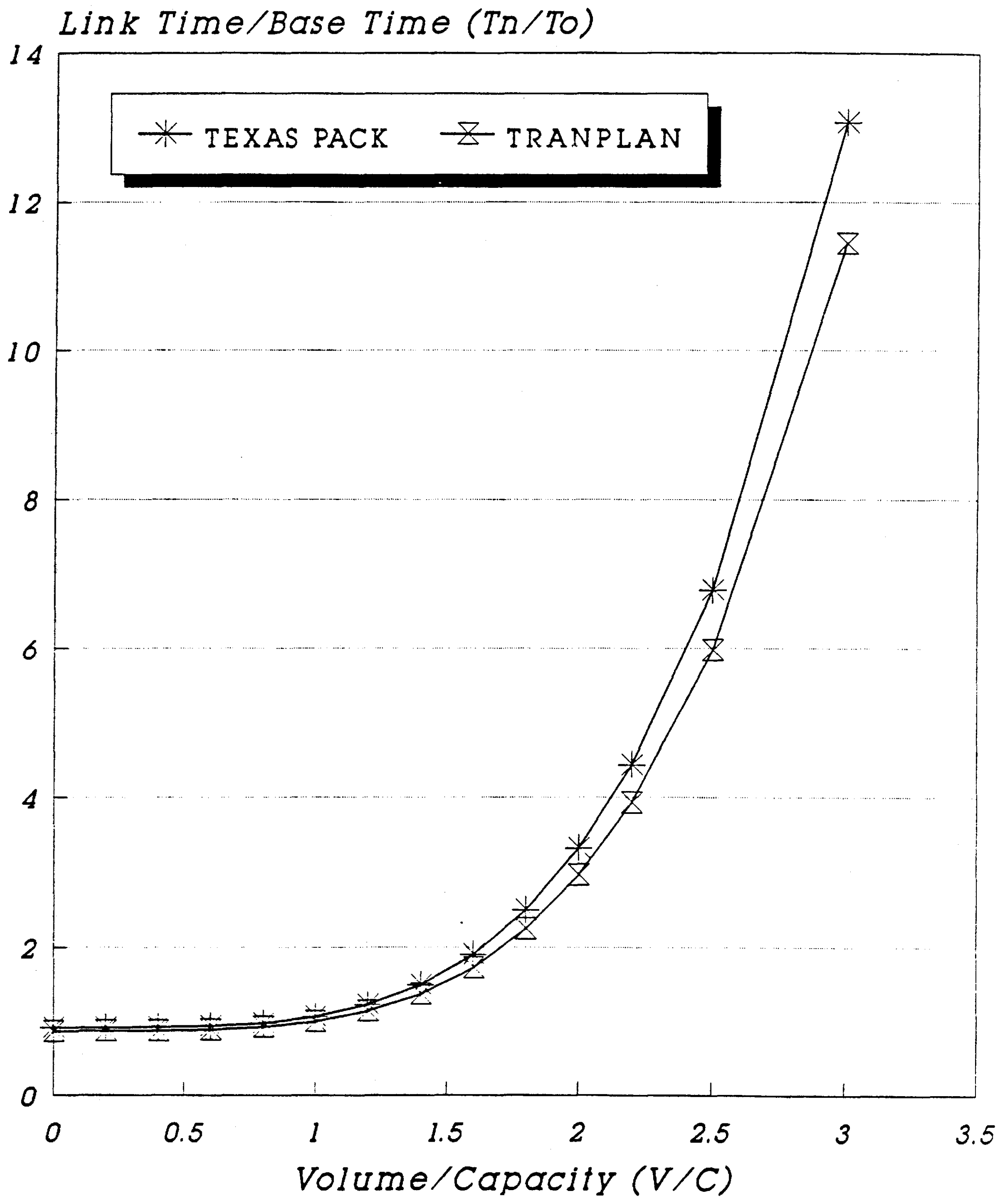
T_{n-1} = travel time of the previous iteration,

V = assigned volume, and

C = capacity specified in link data (practical capacity).

A capacity-restraint assignment is constrained not only to the travel impedance but also to each link capacity. Figure 8 illustrates the comparison of the travel impedance adjustment function between the two packages. Since the two capacity restraint formulas are different, it is recommended that the user-specified V/C time adjustment curve data be used in TRANPLAN.

Figure 8. Comparison of Impedance Function.



The recommended user curve data is essentially from the final formulation of the impedance adjustment function in the Texas Package. The bounding condition, $Max(I_{(n+1)}) \leq (n+1)I_1$, is placed on the impedance adjustment function in the Texas Package. However, this limit cannot be simulated in each iteration of TRANPLAN. Instead of the bounding condition, the minimum limit of 0.167 (for base time/adjusted time) might be used in the V/C ratio of 2.4 or higher. Finally, it is recommended that the following curve data should be specified using the data specifications in a TRANPLAN control file (see Figure 9):

```
$DATA
  ASSIGNMENT GROUP = 0-9, XYDATA = (0.0,1.087) (0.5,1.076) (1.0, .935)
                         (1.5,0.595) (2.0,0.301) (2.4,0.167) (4.0,0.167)
$END TP FUNCTION
```

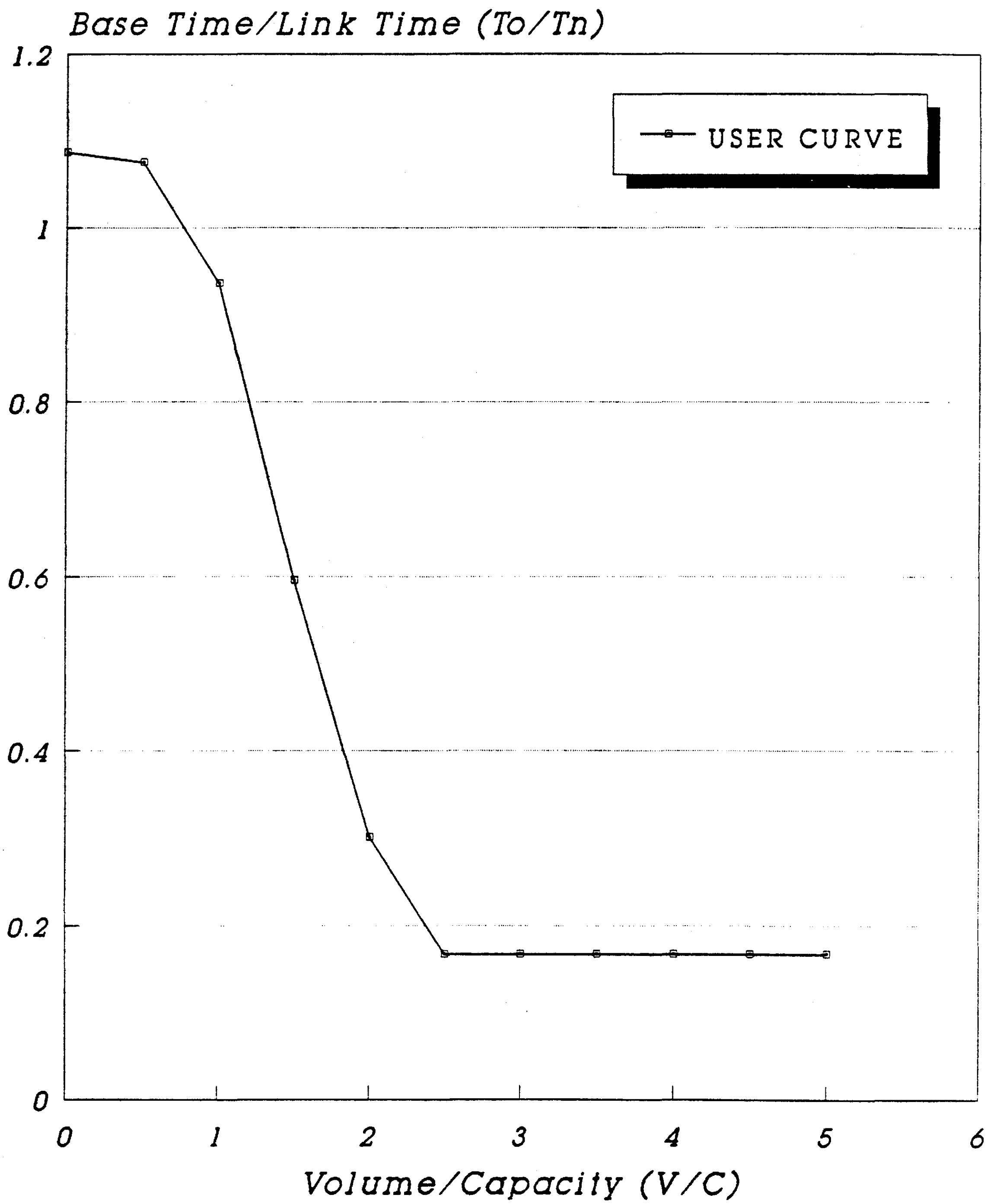
In defining the iteration weights, it was recommended that later assignments (iteration) should be weighted more heavily than earlier ones. Additionally, in an effort to dampen oscillations in the assignments to parallel facilities on consecutive iterations, successive pairs of all-or-nothing assignments should receive equal weights. As a result of these considerations, iteration weights of 15, 15, 20, 20, and 30 percent were recommended in the Texas Package.

It was found that there are significant different procedures and options in iterative capacity restraint assignment in TRANPLAN compared with the new capacity restraint assignment procedure used for the Texas Package because all selected interzonal highway trips are loaded on the minimum paths of the input highway network in Restraint Loading of TRANPLAN. However, the incremental assignment in TRANPLAN might give very similar results if the proper options and parameters are used. There are various options and parameters for the TRANPLAN incremental assignment procedures. In order to obtain the compatible results with Capacity Restraint Traffic Assignment in the Texas Package, it is recommended that the following options and parameters should be used in TRANPLAN:

1. DAMPING option should not be used. The option specifies that the network time is directly adjusted by the time difference.
2. BASE NETWORK option should be used in this assignment. This option specifies that the adjusted network for any iteration is based on an accumulated loaded volume which is applied to the original network to produce the adjusted network (unless, applied to the previous network).
3. ADJUST 100 option should be used. This option specifies that volumes loaded are hypothetically expanded to 100 percent before the V/C ratio is calculated for link impedance adjustment.
4. LOAD PERCENTAGES parameter of 15, 15, 20, 20, and 30 percents should be used in this procedure. This parameter specifies the number of iterations as well as the percent of the total volume to be applied during each iteration.

There are totally different incremental assignment procedures and options between TRANPLAN and the Texas Large Network Assignment Models. An incremental technique in Texas Package adjusts link impedances from a look-up table by level of service (LOS) to obtain the desired balance. The program runs four increments, each of 25 percent. The program produces

Figure 9. Recommended User Curve Data for TRANPLAN.



several cross classification tables and comparison tables to indicate how well the objective is being achieved.

As mentioned earlier, the research report 1110-2 entitled "Comparison of the Results from TRANPLAN with the Texas Package" represents the comparison of the results from TRANPLAN with the Texas Travel Demand Package. The results from the TRANPLAN assignments using three different assignment techniques (All-Or-Nothing and two different Incremental Assignments) and using the recommended options and parameters were compared to the Texas Large Network Assignment Models' (All-Or-Nothing, Capacity Restraint, and Incremental Assignments) results. It was found that there were no differences between TRANPLAN and the Texas Package using All-Or-Nothing, and that there were no significant differences between the TRANPLAN Incremental assignment and the new capacity restraint assignment of the Texas Large Network Assignment Models.

CHAPTER III. GENERAL DESCRIPTION OF SUBAREA ANALYSIS

III.1. INTRODUCTION OF SUBAREA ANALYSIS

Subarea analysis, as used in this research, means any analysis conducted using all or a subset of a network representing the street and highway system of an urban area over 50,000 population. Urban areas in Texas over 50,000 population prepare and maintain comprehensive travel demand studies using the Texas Travel Demand Package.

A calibrated and validated travel demand model provides the basis for evaluating a wide variety of possible impacts of future population, employment, income, and travel behavior on the street and highway system. The model also provides the basis for evaluating the impacts on parts of the system that would result from proposed changes in land use, construction of new streets or highways, increased capacity of streets or highways, construction of HOV lanes, increased transit service, etc. Evaluations of impacts on either all or part of the system are called subarea studies or subarea analyses.

III.2. SUBAREA ANALYSIS IN LARGE OR SMALL AREAS

A subarea assignment technique (i.e., windowing, focusing, etc.) is primarily applicable in large urban areas. Due to the relatively low cost associated with running the distribution and assignment models in small urban areas, it is expected that the potential cost savings from the use of a subarea assignment technique in small urban areas would be relatively small and probably of little benefit. Furthermore, the current TRANPLAN capacities are sufficient to handle any transportation network in small urban areas. The microcomputer packages have different network design limits. The network size limits also vary according to the amount of main memory available. TRANPLAN is designed for 3000 zones and 32,000 links; however, 1500 zones, 8000 nodes, and 9000 links can be processed on a 640 Kbytes-RAM microcomputer.

In essence, the subarea assignment technique is primarily applicable to studies in large areas such as Houston-Galveston, San Antonio, Dallas-Fort Worth, and El Paso. For this report, the definition of subarea analysis is an analysis that can still be performed in small areas without any redefining or recoding of the study area. The small area as used in this report is defined by the following meanings: (1) any urban area in Texas over 50,000 population excluding the defined large areas and/or (2) any urban area maintaining transportation network data less than the TRANPLAN network size (i.e., less than 1500 zones, 8000 nodes, and 9000 links).

III.3. APPLICATION OF SUBAREA ANALYSIS

Subarea analysis is appropriate for a variety of problems routinely faced by the Department, metropolitan planning organizations, cities, counties, and developers. A major application of subarea analysis is to study feasible land use and transportation alternatives for the future.

For example, it might be applicable to test and evaluate land use/ transportation alternatives in the Arlington portion of the Dallas-Fort Worth Network. Another application is to assess the impact of a new land use development such as a shopping center, hospital, university, residential development, and/or industrial park that will be served by an existing or future roadway system. Subarea analysis is also appropriate for testing proposed corridor or major intersection geometrics, alternative locations for major intersections, and public transit alternatives.

In focusing on a specific subarea of the urban area, the analyst would be looking at alternatives which would involve transportation system changes and/or land use changes. A subarea assignment technique would be primarily applicable to problem situations involving either major changes in the transportation system or major land use changes or both.

A subarea assignment technique generally would not be applicable to situations involving only minor land use and/or transportation system changes since the basic distribution and assignment models are not sufficiently sensitive to such minor changes to produce reliable data for evaluating such alternatives. Indeed, a manual adjustment process, performed by experienced analysts, would probably produce more reliable results at substantially less cost than could be obtained from computerized results. There may be, however, a few situations involving both minor land use changes and minor transportation system changes such that in combination, they constitute a major change sufficient for evaluation using a subarea assignment technique.

III.4. SUBAREA ANALYSIS TECHNIQUES

In previous studies conducted by the Texas Transportation Institute (TTI), several alternative techniques for obtaining subarea assignments were examined in identifying the subarea assignment algorithm for implementation. The purpose of this section is to briefly describe the alternatives studied. The subarea windowing or subarea focusing techniques described in the following section are applicable in large areas as mentioned earlier. The subarea analysis in a small area network containing less than 1500 zones does not need to use subarea windowing or subarea focusing techniques; however, the conversion procedures (i.e., downloading and/or uploading), which are the parts of subarea analysis, are required.

Subarea Windowing Approach

One of the subarea assignment approaches initially considered might be described as a "subarea window approach." Under this approach, the subarea would be identified and only those zones and the network within the subarea would be carried forward in the subarea analysis procedure. In essence, the network and zones within the subarea would be "isolated" and treated as a small "stand-alone" study area. All traffic entering or leaving the subarea would be treated as "external" traffic relative to the subarea. It should be noted that in most applications, the subarea's "external" traffic would be predominantly composed of internal traffic relative to the larger study area. The implementation of such an approach would likely involve obtaining selected link assignments for each link crossing the subarea cordon. This information, together with the trip matrix for the entire urban area would then be processed to build a trip matrix for the subarea.

It was generally felt that this approach has two major inherent weaknesses:

1. Since the trip matrix for the subarea is essentially a condensation of the trip matrix for the entire urban area, the technique assumes that there will be no land use changes which will affect travel across the subarea cordon.
2. The technique basically allows only the rerouting of traffic (i.e., new minimum paths) within the subarea. In other words, the technique provides no opportunity for rerouting traffic either through or around the subarea.

Subarea Focusing Approach

Another approach considered might be described as a "subarea focusing technique using a revised network and zone structure." Using this approach, the portion of the study area outside the subarea would be carried forward into the subarea analysis, but at a substantially reduced level of detail. The consideration of a subarea within an area wide context would, of course, overcome many of the inherent weaknesses in the "subarea windowing approach." The use of this approach, however, involves the recoding of the network using a very sparse system and very large zones outside the subarea. A technique to automate the recoding of the network outside the subarea was studied when consideration was being given to this approach.

While this approach has some conceptual appeal, it does require either manual or automated recoding of the network outside of the subarea which is expensive. The Collapse Trip Matrix program (MATRCLS) in the Texas Large Network Assignment Models converts a traditional "square" trip table to a "rectangular" trip table for a subarea assignment; in other words, the subarea focusing approach in the Texas Package maintains the same number of zones as the entire network for the destinations.

III.5. SELECTION OF SUBAREA WINDOWING APPROACH

In considering the feasibility of implementing a subarea assignment technique, neither of the approaches initially studied were felt to be worthy of implementation. Nevertheless, the need for a subarea assignment technique remained apparent. Since the focusing approach in the Texas Package cannot reduce the number of zones, it was evaluated that the focusing approach should not be used for a subarea analysis using TRANPLAN.

However, if the subarea being delineated is defined as an area that is a substantially larger area than the subarea of interest, the two major weaknesses in the windowing technique could be overcome simply. The conceptual framework for the subarea windowing technique, therefore, was recommended. This would appear to overcome the basic inherent weaknesses in the windowing approaches being considered and yet remain feasible for consideration and worthy of implementation and testing.

A brief review of trip length frequency distributions for urbanized areas in Texas would suggest that only a small portion of the urban trips have a trip duration of 30 minutes or more. Further, of those trips at these longer separations, only a portion would likely traverse a subarea being studied. Also, with the longer trips, they are again generally oriented to the higher level facilities so that the distortion would generally be their points of access and egress on the higher level facility which lies outside of the subarea. Again, with a carefully defined subarea being delineated, these trips would generally be subject to only limited distortion relative to their assignment to links within the subarea of interest. The following guidelines are offered in delineating the study area:

1. Choose the study area to cover not only the facilities being analyzed, but also the zones that might affect the use of those facilities. The Selected Link option of the Texas Large Network Assignment Models might be used to locate which zones may affect the use of certain facilities.
2. Choose the study area boundary lines to coincide with the system-level transportation analysis zone boundaries.
3. Include all internal circulation roadways within the study area.

There will be no distortion of the paths for the study area external-through trips because each external station is treated as a separate zone. However, the paths for external-local trips traversing the subarea are subject to some possible distortion. Again, since these are generally longer trips oriented to higher level facilities, it is likely that the possible path distortions will be minimal in their impact on subarea assignment results by using the large enough subarea.

CHAPTER IV. SUBAREA ANALYSIS PROCEDURE

IV.1. SUBAREA WINDOW IN TEXAS PACKAGE

1. Choose the approximate area of the subarea (see Figure 10).

2. Draw a cordon line on the map which surrounds the subarea (see Figure 11). These two rules must be followed:

   o The subarea cordon line shall not pass through any nodes or centroids.
   o When the cordon line intersects a centroid connector, the associated centroids are inside the cordon line. Each node immediately outside the cordon becomes an external station for the subarea. A centroid cannot function as an external station.

   Note: The first step in using the windowing technique, of course, would be to define the subarea of interest. This can be easily accomplished using a network map and simply drawing a subarea cordon line around the subarea of delineation which should be much larger than the subarea of interest.

3. Check the cordon line to insure that it completely surrounds the subarea and that it follows the rules above.

4. Pick a link intersected by the cordon line. Record all links and connectors crossed by the cordon line (see Figure 12). Each link, called an External Station Link, is entered on an External Station Link card image. Only one link is entered on each card. The External Station Link nodes outside the cordon are the external stations for the subarea.

5. Pick a centroid inside the cordon line and enter the centroid number on the Direction Card image. Do not choose a centroid that is part of an external station link.

6. Set up a run of the Texas Large Network Package to assemble the full study area network, and then run the Subarea Windowing program. This program renumbers the centroids within the subarea starting at one (1). Then the nodes which constitute the external stations are renumbered. If a number other than zero is entered on the Turn Penalty Card in columns 13-18, a gap in the numbering as specified will occur. This is to allow for subdivision of various zones in the subarea if greater analytical detail is needed. Set up the JCL for this run to save FORTRAN units 81 and 82. The subarea network, FT81F001, will probably be saved on a ROSCOE data set while the unsorted subarea trip matrix will probably be saved on a tape data set. The program does not build a network for the remainder of the study area network (see JCL1).

   Note: If an unedited separation matrix is created for the Texas Trip Distribution Models by running BUILD TREES, special action must be taken if the gap value on the Turn Penalty card is not zero. The *TREE card must show a continuous range of centroids from one to the last external station. If the gap is not zero, the centroids to be added for detailed analysis and the associated network structure must be added to the subarea link data prior to running BUILD TREES.

Figure 10. Study Area for Subarea Analysis.

Figure 11. Windowed Area for Subarea Analysis.

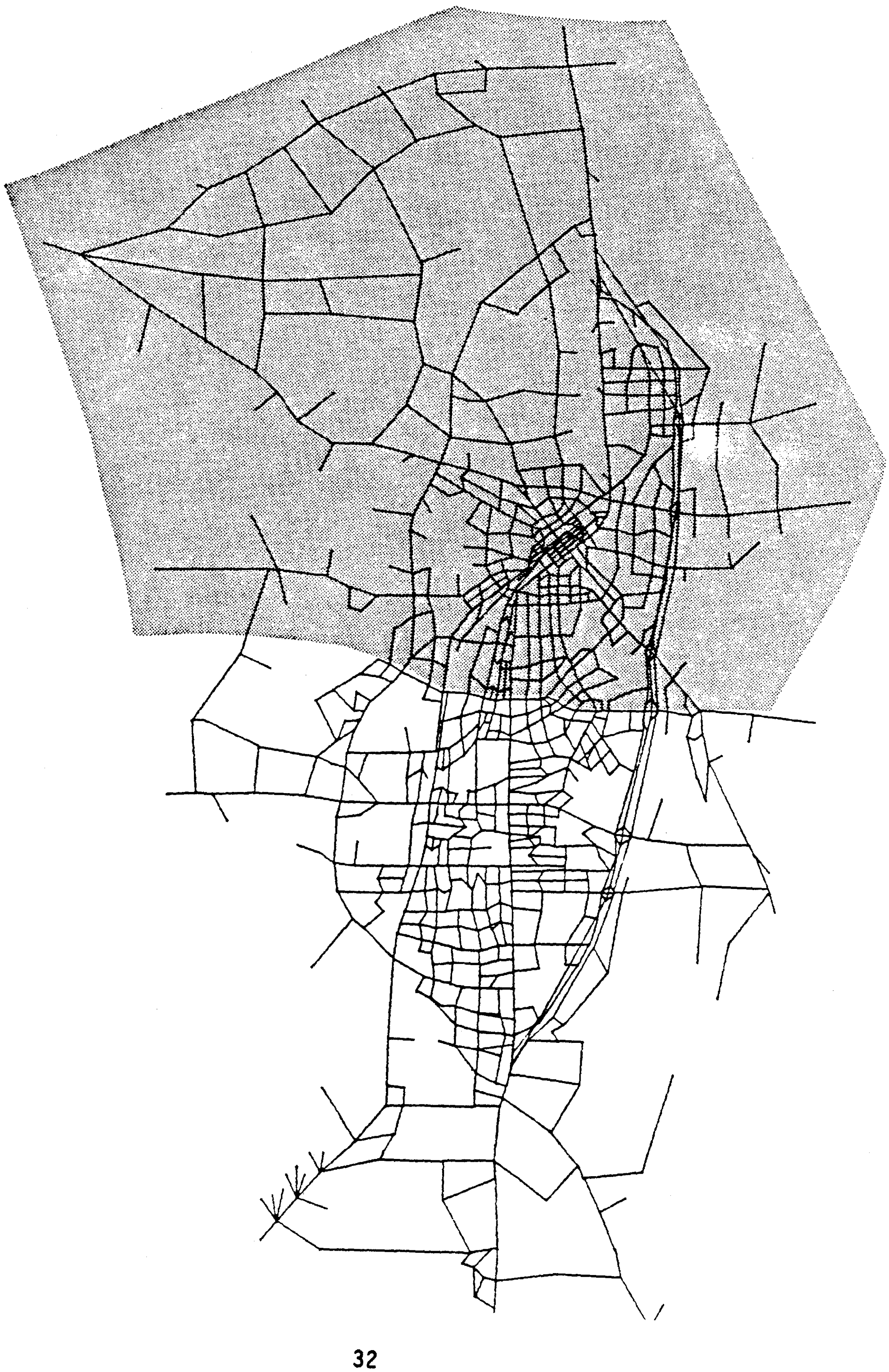


Figure 12. External Stations in Subarea.

PLOT HIGHWAY NETWORK
USING BRYAN AREA AS SUBAREA 179-ZONE NETWORK
WITH CENTROID CONNECTORS

02JUN88 02: 16: 39

7. Examine the run. If there are any errors in the external station links, correct and rerun the program.

8. Run steps two and three of trip matrix collapse and save the resulting trip matrix (see JCL2).

9. If any of the external stations are connected by one-way links, run the Assemble Network for the subarea in a separate job step. This will allow one-way centroid connectors in the subarea network. One-way external station centroid connectors will not cause problems in the assignment because there will be no trips in the reverse direction for them.

10. Set up the assignment or Assign Self-Balancing run for the subarea.

The following JCL and data was used to make a subarea windowing run on the test network Bryan/College Station using the TAMU CSC computer. The STEPLIB data set names and program names will be different for this reason.

JCL1:

```
//WINDOW JOB  ( ,60A,5,25,CB),'BELL WNDW BRYAN'
//*TAMU H,P=5,NOTIFY
//GO  EXEC  PGM=LARGENET,REGION=1024K
//STEPLIB  DD  DISP=SHR,DSN=USR.W103.C2.LARGNET9
//         DD  DISP=SHR,DSN=USR.X069.SG.FORTLIBV
//SYSUDUMP  DD  SYSOUT=A
//FT01F001  DD  SPACE=(TRK,(20,10)),UNIT=SYSDA,
//  DCB=(RECFM=VBS,LRECL=184,BLKSIZE=6232)
//FT03F001  DD  UNIT=SYSDA,SPACE=(TRK,(20,20)),
//  DCB=(RECFM=VBS,LRECL=6228,BLKSIZE=6232)
//FT04F001  DD  UNIT=SYSDA,SPACE=(TRK,(20,20)),
//  DCB=(RECFM=FB,LRECL=80,BLKSIZE=3120)
//FT60F001  DD  DISP=SHR,DSN=USR.W106.CB.LINKDAT2
//FT09F001  DD  SPACE=(TRK,(20,10)),UNIT=SYSDA,
//  DCB=(RECFM=VBS,LRECL=184,BLKSIZE=6232)
//FT50F001  DD  UNIT=SYSDA,SPACE=(TRK,(20,20)),
//  DCB=(RECFM=VBS,LRECL=184,BLKSIZE=6232)
//FT20F001  DD  UNIT=SYSDA,SPACE=(TRK,(20,20)),
//  DCB=(RECFM=VBS,LRECL=6228,BLKSIZE=6232)
//FT25F001  DD  UNIT=SYSDA,SPACE=(TRK,(20,20)),
//  DCB=(RECFM=VBS,LRECL=6228,BLKSIZE=6232)
//FT11F001  DD  UNIT=SYSDA,SPACE=(TRK,(20,20)),
//  DCB=(RECFM=VBS,LRECL=6228,BLKSIZE=6232)
//FT08F001  DD  DISP=SHR,DSN=USR.W106.CB.BCS24HRM
//FT81F001  DD  DISP=OLD,UNIT=DISK,SPACE=(TRK,5),
//  DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160),
//  DSN=USR.W106.CB.NET.TEX
//FT82F001  DD  DISP=OLD,UNIT=DISK,SPACE=(TRK,5),
//  DCB=(RECFM=VBS,LRECL=6226,BLKSIZE=6230),
//  DSN=USR.W106.CB.BRYANTRP
//FT06F001  DD  SYSOUT=A
//FT05F001  DD  *
$HEADER  WINDOW BRYAN ABOVE VILLA MARIA BCS 85-84-1; SDHPT TRIPS
$INLNK,60
$ASSEMBLE NETWORK
$WINDOW
*TURN     0
```

```
  1011  1010
   886   222
   887   501
   888    86
   600   503
   599    80
   598   597
   596    79
   594   595
   578    78
   579   577
   576    51
   575   524
   573   531
   571    60
   572   880
   555    59
   556   554
   997    58
   552   553
   551  1054
  1049  1053
  1051  1052
   918   215
   546   153
   547   998
     1
$STOP
```

JCL2:

```
//COLSPW JOB  ( ,60A,S30,2,CB),'BELL  TEST COLSP'
//*TAHU H,P=5
//MATRCLS2  EXEC  SORTD,REGION=256K,COND=(4,LT)
//SYSOUT  DD  SYSOUT=A
//SORTMSG  DD  SYSOUT=A
//SORTWK01  DD  UNIT=SYSDA,SPACE=(TRK,(50),,CONTIG)
//SORTWK02  DD  UNIT=(SYSDA,SEP=SORTWK01),SPACE=(TRK,(50),,CONTIG),
//  SEP=SORTWK01
//SORTWK03  DD  UNIT=(SYSDA,SEP=(SORTWK01,SORTWK02)),
//  SPACE=(TRK,(50),,CONTIG),SEP=(SORTWK01,SORTWK02)
//SORTIN       DD  DISP=OLD,DSN=USR.W106.CB.BRYANTRP
//SORTOUT      DD  UNIT=DISK,SPACE=(TRK,(5)),
//  DSN=USR.W106.CB.BRYANTP.SORT,DISP=OLD,
//  DCB=(RECFM=VBS,LRECL=6226,BLKSIZE=6230)
//SYSIN  DD  *
  SORT FIELDS=(5,4,BI,A),SIZE=E40000
  RECORD TYPE=V,LENGTH=(416,416,416,20,416)
//MATRCLS3   EXEC  PGM=MATRCL3,REGION=192K
//STEPLIB  DD  DISP=SHR,DSN=USR.W103.C2.LARGNET9
//FT06F001  DD  SYSOUT=A
//FT07F001  DD  SYSOUT=B
//FT01F001  DD  DISP=OLD,DSN=USR.W106.CB.BRYANTP.SORT
//FT02F001  DD  DISP=NEW,DSN=USR.W106.CB.BRYANTP2,
//  UNIT=DISK,SPACE=(TRK,5),
//  DCB=(RECFM=VBS,LRECL=6226,BLKSIZE=6230)
```

There is no way to download a binary record data set which is generated from the Window program in the Texas Package to microcomputer. An intermediate program is required for the conversion of binary trip matrix to 12I6 formatted trip matrix. The following JCL3 and data were used to make the intermediate program run on the test network Bryan/College Station using the TAMU CSC computer.

JCL3:

```
//CVTRP2  JOB  ( ,60A,S20,5,CB),'BELL CONVERT TRIPS'
//*TAMU NOTIFY
//CVT  EXEC  PGM=CVTRP,REGION=64K
//STEPLIB  DD  DISP=OLD,DSN=USR.W103.C2.LARGNET9
//FT06F001  DD  SYSOUT=A
//FT08F001  DD  DISP=OLD,DSN=USR.W106.CB.BRYANTP2
//FT10F001  DD  DISP=OLD,DSN=USR.W106.CB.TRIP.TEX
```

IV.2. INTERFACE BETWEEN TEXAS PACKAGE AND TRANPLAN

Downloading/Uploading Menu

The conversion programs between the mainframe and the microcomputer were developed and tested. The program documentation is attached in Appendix C. The documentation will be incorporated into the documentation manuals for the Texas Travel Demand Package. The programs for downloading from Texas Package to TRANPLAN included the following: link data, X and Y coordinate data, trip table, production and attraction data, and Friction-Factor, zonal radii data. Also, the programs for uploading from TRANPLAN to Texas Package included the following: link data and production and attraction data. The menu-driven batch files were developed to execute the conversion programs. The batch files are user friendly and make full use of the interactive capability of the microcomputer. The following diagram shows the main menu of the conversion programs:

```
****************************************************
*  CONVERSION PROGRAM MENU FOR SUBAREA ANALYSIS    *
*                                                  *
*  - DOWNLOADING (FROM TEXAS PACKAGE TO TRANPLAN)  *
*         1.  LINK DATA CONVERSION                 *
*         2.  COORDINATE DATA CONVERSION           *
*         3.  TRIP TABLE CONVERSION                *
*         4.  P/A DATA CONVERSION                  *
*         5.  FRICTION-FACTOR CONVERSION           *
*         6.  ZONAL RADII CONVERSION               *
*                                                  *
*  - UPLOADING (FROM TRANPLAN TO TEXAS PACKAGE)    *
*         7.  LINK DATA CONVERSION                 *
*         8.  P/A DATA CONVERSION                  *
*                                                  *
*         E.  EXIT TO DOS                          *
****************************************************
```

Use of Data Conversion Programs (Downloading)

1. *Link data Conversion*

```
*************************************************
*                                               *
*   LINK DATA CONVERSION PROGRAM FOR LARGENET   *
*                                               *
*   TO TRANPLAN LINK DATA    09MAY88 15:51:53   *
*                                               *
*************************************************

1.  INPUT LARGENET Link Data File Name: ? NET.TEX

2.  OUTPUT TRANPLAN Link Data File Name: ? NET.DAT
      LAST ZONE =   179  and  LAST NODE =  1119

  500 Links Finished
  792 Links Processed
Stop - Program terminated.
```

2. XY Coordinate Data Conversion

```
***********************************************
*                                             *
*   CONVERSION PROGRAM FOR COORDINATE DATA    *
*                                             *
*   TO TRANPLAN NODE DATA   09MAY88 15:50:38  *
*                                             *
***********************************************

1.  INPUT Type of XY Data Conversion (F=Full-Area or S=Subarea): ? S
2.  INPUT Windowed Table of Equals: ? TOE.TEX
3.  INPUT Texas Format Windowed Link Data: ? NET.TEX
      LAST ZONE =   179  and  LAST NODE =  1119
4.  INPUT X and Y Coordinate File Name: ? XY.TEX
5.  OUTPUT TRANPLAN X and Y Coordinate File Name: ? XY.DAT
6.  OUTPUT option (L=Large Coordinates Option or D=Default): ? D
       250 Records read in searching for coordinate limits
       500 Records read in searching for coordinate limits
       750 Records read in searching for coordinate limits
       The minimum X coordinate is      3396805.15
       The maximum X coordinate is      3452040.52
       The minimum Y coordinate is       382981.95
       The maximum Y coordinate is       432530.62
       3396804.50 Will be subtracted from the X coordinates.
       382980.50 Will be subtracted from the Y coordinates.
      A divisor of  1 will be used to scale the coordinates < 100000.
      134 Coordinate records translated
Stop - Program terminated.
```

3. Trip Table Conversion

```
***********************************************
*                                             *
*   CONVERSION PROGRAM FOR CHARACTER FORMAT   *
*         (12I6 FORMAT TRIP TABLE)            *
*                                             *
*  TO TRANPLAN TRIP TABLE   09MAY88 15:53:19  *
*                                             *
***********************************************

1.  ENTER Header 1 for Trip Table (up to 80 columns), return if none: ?
    WINDOWED BCS TRIPS FOR BRYAN NORTH OF VILLA MARIA
2.  ENTER Header 2 for Trip Table (up to 80 columns), return if none: ?
    TEXAS TRIP MATRIX PROCESSED BY WINDOW, SORT, AND MATRCLS3
3.  ENTER Header 3 for Trip Table (up to 80 columns), return if none: ?


4.  ENTER the Maximum Zone Number: ? 179

5.  INPUT Name of 12I6 Format Trip Table: ? TRIP.TEX

6.  OUTPUT Name of TRANPLAN Trip Table: ? TRIP.DAT
     Stop - Program terminated.
```

4. P/A Data Conversion

```
***********************************************
*                                             *
*      CONVERSION PROGRAM FOR TEXAS P/A       *
*                                             *
*     TO TRANPLAN P/A    11AUG88 15:17:05     *
*                                             *
***********************************************

1.  INPUT Texas Format P/A File Name: ? TEXPA

*** Columns 1-79 of Two Records are as follows:
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----
GENERATION    1  722  722  295  598  591 1058    0  722  338  338   85-85-10198
GENERATION    2  286  286  174  144  386  374    0  286  131  131   85-85-10198
*** Three Options for Input Format are as follows:
    1 = (T5,I4,10I7), 2 = (T11,I5,10I5), or 3 = User Supplied from Console

    2.  Select INPUT Format: ? 2

    3.  OUTPUT TRANPLAN GP and GA Data File Name: ? TPA1.DAT

         *** 252 P/A Records Processed
    Stop - Program terminated.
```

5. Friction-Factor Conversion

```
***********************************************
*                                             *
*    CONVERSION PROGRAM FOR RELATIVE VALUE    *
*                                             *
*   TO TRANPLAN F-FACTOR   11AUG88 15:19:42   *
*                                             *
***********************************************

1.  INPUT Texas Format PURPOSE 1 File Name: ? NHB
2.  INPUT Texas Format PURPOSE 2 File Name: ? HBW
3.  INPUT Texas Format PURPOSE 3 File Name: ? HBNW
4.  INPUT Texas Format PURPOSE 5 File Name: ? TRTX

5.  OUTPUT TRANPLAN F-Factor Data File Name: ? GF1.DAT
Stop - Program terminated.
```

6. Zonal Radii Conversion

```
***********************************************
*                                             *
*     CONVERSION PROGRAM FOR TEXAS RADII      *
*                                             *
*     TO TRANPLAN INTRA    11AUG88 15:21:11   *
*                                             *
***********************************************
```

```
1.  INPUT Texas Format RADII File Name: ? TEXRADII

2.  OUTPUT TRANPLAN Data File Name: ? MUP1.DAT

3.  ENTER the Maximum Internal Zone Number: ? 220
Stop - Program terminated.
```

<u>Use of Data Conversion Programs (Uploading)</u>

7. Link data Conversion

```
***********************************************
*                                             *
*   LINK DATA CONVERSION PROGRAM FOR TRANPLAN *
*                                             *
*   TO LARGENET LINK DATA   01MAY89 15:17:28  *
*                                             *
***********************************************

1.  INPUT TRANPLAN Link Data File Name: ? NET.TRN

2.  OUTPUT TEXAS LARGENET Link Data File Name: ? NET.UP

  500 Links Finished
  792 Links Processed
Stop - Program terminated.
```

8. P/A Data Conversion

```
***********************************************
*                                             *
*      CONVERSION PROGRAM FOR TRANPLAN P/A    *
*                                             *
*         TO TEXAS P/A   01MAY89 15:17:05     *
*                                             *
***********************************************

1.  INPUT TRANPLAN Format P/A File Name: ? TAP1.DAT

*** Columns 1-79 of Two Records are as follows:
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----
GP    1 1     722     295     591       0    338
GP    2 1     286     174     386       0    131

2.  OUTPUT Texas Format GENE Data File Name: ? TEXPA.UP

*** 252 P/A Records Processed
Stop - Program terminated.
```

IV.3. ANALYSIS OF WINDOWED AREA

The subarea assignments should be incorporated with both a trip distribution phase and a traffic assignment phase. The inclusion of the trip distribution phase is optional; however, it is important for two reasons:

1. It allows the analyst to look at alternatives involving different land uses.
2. It provides a mechanism to account for the impact of transportation system changes on the urban travel pattern (i.e., the trip matrix).

Transportation System Changes

As previously noted, a key feature of the subarea analysis is that it does not require either the computerized or manual recoding of the network outside the study area. Instead, the procedure utilizes the already available network for the windowed area. If the subarea alternative to be studied involves transportation system changes, the already available network would simply be modified to reflect these changes. The revised network (i.e., the revised link data for the windowed area) would then be input into the traffic assignment of the TRANPLAN package to obtain a new link volume data set reflecting the system changes to be studied.

At this point, the analysis is ready to build trees and skim trees. This is accomplished by using the traffic assignment procedure in TRANPLAN. In other words, the trees built during the assignment procedure would now be loaded using the trip matrix determined in the trip distribution phase. It should be noted that only the portion of the assignment results associated with the portion of the network within the subarea are valid for study and evaluation. Link assignment for links outside of the area being investigated may be subject to substantial distortion and should not be considered for analyzing the assignment results. An option has, therefore, been provided to suppress the printing of link assignments outside the subarea.

Land Use Changes

If the subarea alternative to be studied involves the land use changes, the zonal productions and attractions by trip purpose for the zones in the subarea should be modified to reflect the new land uses. The revised production-attraction data would then be inserted in the trip distribution for the windowed urban area. Thus, the productions and attractions for the windowed area would be put into the new subarea assignment procedure.

As previously noted, one aspect of the subarea windowing procedure is the provision of the option for interfacing a trip distribution phase in the subarea analysis process. That is, of course, an optional phase. If the changes in the subarea are felt to be of the nature which would not significantly change the travel patterns (i.e., trip matrix) within the subarea, the analyst may elect to collapse an available trip matrix modeled at the detailed zonal level (use Matrix Expand function in TRANPLAN). If minor land use changes are anticipated, the analyst may elect to simply use a Fratar growth factor technique to adjust an available trip matrix before it is collapsed (use Fratar function in TRANPLAN). However, the analyst may elect to perform a new trip distribution at the subarea level of detail.

User Perspective

An important criterion in the development and implementation of a subarea assignment technique is ease of use. Therefore, the following summarizes (from the users point of view) the step-by-step procedure which would be required in applying the algorithm for subarea assignment.

1. Delineation of subarea: This step basically involves simply enumerating the zones contained in the subarea.
2. Transportation system changes: The transportation system changes to be considered under the subarea alternative being studied will require modifying the network of urban area to reflect the proposed changes. The modified link data would then be input into the subarea assignment.
3. Land use changes: If land use changes are to be considered under the subarea alternative being studied, the production-attraction data for the urban area would need to be modified to reflect the proposed land use changes.
4. Computer runs: At this point, the user would be ready to make the computer runs necessary to obtain the subarea assignment.
5. Posting and assignment: Having completed the computer runs, the assignment results for those links contained in the subarea would be posted for analysis.

IV.4. EVALUATION AND IMPLEMENTATION

The assignment of existing trips to the existing network is compared to ground counts to determine if the modeling process produces realistic results. Measures of how well the assignment reproduces traffic counts can be divided into two groups: macro-level measures which are network wide analyses including screenlines, cutlines, selected links, travel routes, and vehicle miles of travel analyses; and micro-level measures which are link-by-link comparisons including distribution of link differences by error ranges, statistical measures of link differences, and statistical tests. The differences between the assignment results may be due to inaccuracies in the trip generation, in the zone-network configuration established, in the selection of links impedances, in the accuracy of the ground counts, or any combination of these.

Macro-level measurements of assignment accuracy are those measures that analyze the entire network or specific portions of the network by comparing the total assigned volumes across some aggregation. The macro-level measures include the following:

1. *SCREENLINES* compare the total assigned volumes from the windowed subarea trip matrix to total counted volumes of all links intersecting an imaginary line dividing the study area into two parts.

2. *CUTLINES* are similar to screenlines but intersect links of a travel corridor rather than the entire study area. This measure is somewhat more precise than screenlines in that it evaluates the assignment's ability to replicate travel on a more narrowly defined travel corridor.

3. *SELECTED LINKS* compare the total assigned volumes from the windowed subarea trip matrix to the total counted volumes of all selected links.

4. *TRAVEL ROUTES* compare counted and/or assigned link volumes. The volumes are accumulated along selected travel routes as opposed to volumes accumulated on specific links which are intersected by a screenline or by a cutline.

5. *VEHICLE-MILES OF TRAVEL (VMT)* are calculated by multiplying the length of a link by its respective volume. The degree to which the assigned VMT matches the counted VMT is measured by the ratio (in percent) of the assigned VMT to the counted VMT.

Micro-level measurements of assignment accuracy are those measures that analyze the differences between counted and assigned volumes on a link-by-link basis. The common statistical measures and nonparametric statistical tests can be employed in the evaluation of link difference. The micro-level measures include the following:

1. *Distribution of link differences by error ranges*: The differences between assigned and counted link volumes can be tabulated for each link for absolute error ranges and percent error ranges. The accumulated number of links in each range is converted to a percentage of the total links. The distribution of differences by error ranges gives a perspective of the dispersion of error.

2. *Statistical measures of link differences*: Five common statistical measures might be employed in the evaluation of link differences. The mean difference (MD) is a measure of the central tendency of the distribution. The root-mean-square (RMS) error is a measure of the dispersion of the differences relative to a zero difference, whereas the standard deviation (SD) involves a bias which is the mean. Percent SD (PSD) or percent RMS (PRMS) error measure the relationship between SD or RMS error and the average counted volume. If the counted volume remains the same for a given network, the PSD or the PRMS will be simply the SD or RMS divided by a constant. The following relationships are used for calculation:

$$MD = \sum(A_i - C_i) / N$$

$$SD = \sqrt{(\sum(A_i - C_i)^2 / (N-1)) - (\sum(A_i - C_i) / N)^2}$$

$$RMS = \sqrt{(\sum(A_i - C_i)^2 / (N-1))}$$

$$PSD = 100 \times (SD / (\sum C_i/N))$$

$$PRMS = 100 \times (RMS / (\sum C_i/N))$$

where: A_i = assigned volume for link i

C_i = counted volume for link i

N = total number of links

3. *Statistical tests of link differences*: Two different tests might be employed to determine if the differences between assigned and counted volumes are statistically significant. Also, the statistical tests can be used to compare the results based on different traffic assignment techniques. These tests were *the Chi-Square and Large-Sample Wilcoxon Signed-Rank* tests.

The *Chi-Square* (X^2) *Goodness-of-Fit* test is performed using volume group intervals and comparing the number of links (assigned and counted) in each volume group. The hypothesis tested is that assigned link volumes are distributed the same as counted link volumes. The *Chi-Square* test requires that the expected cell counts should not be too small. It is recommended that fewer than 20 percent of the cells should have an expected frequency of less than five, and no cell should have an expected frequency of less than one, when the degrees of freedom are larger than one. If these requirements are not met, cells with counts of less than five are combined with an adjacent cell(s). The test concerning k-specified cell volume counts is as follows:

H_0: Assigned volumes are distributed the same as ground counts.

H_a: Volumes are distributed independent of ground counts.

Test Statistic: $X^2 = \sum_{i=1}^{k} [(O_i - E_i)^2 / E_i]$

where: O_i = observed cell counts in volume group i

E_i = expected cell counts in volume group i

k = total number of volume group

Accept Region: Accept H_a if the calculated X^2 exceeds the tabulated critical value for $\alpha = 0.10$ and $df = k-1$.

The *Large-Sample Wilcoxon Signed-Rank* test is used to determine if assignment results produced by the windowed trip matrix differ from the counted volumes. The test is as follows:

H_0: Assigned volumes are the same as ground counts.

H_a: Assigned volumes are not the same as ground counts.

Test Statistic: $Z = (T - u_T) / s_T$

where: T = the smaller of the sum of the positive ranks and the sum of the negative ranks, ignoring signs

u_T = rank mean, $n(n+1)/4$

s_T = rank variance, $\sqrt{n(n+1)(2n+1)/24}$

Accept Region: Accept H_a if the calculated value Z exceeds the critical value Z for $\alpha = 0.10$. The test is valid provided $n > 50$.

It is obvious that no subarea assignment procedure will exactly replicate the assignment results which would be produced using full distribution and assignment. The subarea assignment procedure should, however, reasonably replicate the assignment results from the full modeling process. There are, of course, two primary sources of variation which may affect the assignment results:

1. The urban travel patterns described by the trip table.
2. The assignment procedure itself.

APPENDIX A: Trip Table Difference between TRANPLAN and Atomistic Model.

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VERSION 5.0

REPORT MATRIX COMPARISON BETWEEN TRANPLAN AND ATOMISTIC
TYLER TEST NETWORK COMPARISOM OF 252x252 TRIP MATRICES
USING RADII AND ATOM RELATIVE VALUE FOR F-FACTORS

PAGE NO. 1
DATE 05AUG88
TIME 17:38:53

VOLUME COMPARISON REPORT ---- FREQUENCY DISTRIBUTION (V1-V2 / V1+V2).
MAXIMUM CENTROID NUMBER = 252 NUMBER OF PURPOSES = 1
INTERCHANGES WITH ZERO VOLUME TAPE 1 = 28255 TAPE 2 = 28212

===== PERCENT DIFFERENCES =====

VOLUME GRP V1		NEGATIVE														POSITIVE					
		1.00 TO .75	.75 TO .50	.50 TO .40	.40 TO .30	.30 TO .20	.20 TO .10	.10 TO .05	.05 TO .02	.02 TO .01	-.01 TO +.01	.01 TO .02	.02 TO .05	.05 TO .10	.10 TO .20	.20 TO .30	.30 TO .40	.40 TO .50	.50 TO .75	.75 TO 1.00	TOT
0-	1	3260	15	248	1326	0	0	0	0	0	29172	0	0	0	0	0	0	0	0	2922	36943
2-	2	0	1	14	181	0	890	0	0	0	1784	0	0	0	0	0	1664	0	0	284	4818
3-	3	0	0	0	17	152	638	0	0	0	1240	0	0	0	0	843	0	0	235	11	3136
4-	4	0	0	0	1	11	648	0	0	0	928	0	0	0	637	0	172	0	19	0	2416
5-	5	0	0	0	0	15	85	406	0	0	661	0	0	0	464	136	0	14	1	0	1782
6-	6	0	0	0	0	0	88	317	0	0	542	0	0	339	0	97	8	0	0	0	1391
7-	7	0	0	0	0	0	74	282	0	0	464	0	0	286	92	11	0	4	1	0	1214
8-	8	0	0	0	0	0	74	268	0	0	380	0	0	219	81	16	3	0	0	0	1041
9-	9	0	0	0	0	0	8	264	0	0	322	0	0	174	65	21	0	0	0	0	854
10-	10	0	0	0	0	0	3	61	178	0	238	0	0	169	64	1	0	0	0	0	714
11-	15	0	0	0	0	0	25	218	627	0	969	0	589	128	82	13	3	0	0	0	2654
16-	20	0	0	0	0	0	1	108	455	0	579	0	318	100	33	7	1	0	0	0	1602
21-	25	0	0	0	0	0	2	35	334	42	343	0	249	25	17	3	0	0	0	0	1050
26-	30	0	0	0	0	0	0	17	79	188	238	147	47	22	12	5	0	0	0	0	755
31-	35	0	0	0	0	0	0	2	81	164	161	93	31	4	9	2	0	0	0	0	547
36-	40	0	0	0	0	0	0	8	68	102	118	60	25	5	14	1	1	0	0	0	402
41-	45	0	0	0	0	0	0	10	63	58	86	54	29	4	2	1	0	0	0	0	307
46-	50	0	0	0	0	0	0	4	48	64	73	51	17	2	15	2	0	0	0	0	276
51-	60	0	0	0	0	0	0	2	46	67	271	18	16	4	11	1	0	0	0	0	436
61-	70	0	0	0	0	0	0	2	38	40	124	10	13	8	4	1	0	0	0	0	240
71-	80	0	0	0	0	0	0	3	15	39	78	8	10	5	5	0	0	0	0	0	163
81-	90	0	0	0	0	0	0	0	15	28	64	17	6	3	2	3	0	0	0	0	138
91-	100	0	0	0	0	0	0	0	14	23	39	5	6	4	2	1	0	0	0	0	94
101-	150	0	0	0	0	0	2	7	31	61	138	12	17	8	3	0	0	0	0	0	279
151-	200	0	0	0	0	0	0	0	17	25	43	1	5	1	7	5	0	0	0	0	104
201-	250	0	0	0	0	0	1	4	7	15	17	6	2	3	2	2	0	0	0	0	59
251-	300	0	0	0	0	0	0	0	0	7	9	0	4	2	1	0	0	0	0	0	23
301-	350	0	0	0	0	0	0	0	2	7	10	0	0	1	0	0	0	0	0	0	20
351-	400	0	0	0	0	0	0	0	0	4	8	0	2	0	0	1	0	0	0	0	15
401-	450	0	0	0	0	0	0	0	0	0	2	0	0	2	2	0	0	0	0	0	6
451-	500	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	2
501-	1000	0	0	0	0	0	0	0	3	5	8	3	0	1	0	1	0	0	0	0	21
1001-	2000	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2
TOTAL		3260	16	262	1525	178	2539	2018	2121	939	39111	485	1387	1519	1627	1174	1852	18	256	3217	63504
0-	5	3260	16	262	1525	178	2261	406	0	0	33785	0	0	0	1101	979	1836	14	255	3217	49095
6-	10	0	0	0	0	0	247	1192	178	0	1946	0	0	1187	302	146	11	4	1	0	5214
11-	50	0	0	0	0	0	28	402	1755	618	2567	405	1305	290	184	34	5	0	0	0	7593
51-	100	0	0	0	0	0	0	7	128	197	576	58	51	24	24	6	0	0	0	0	1071
101-	2000	0	0	0	0	0	3	11	60	124	237	22	31	18	16	9	0	0	0	0	531

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TRANPLAN SYSTEM
VERSION 5.0

REPORT MATRIX COMPARISON BETWEEN TRANPLAN AND ATOMISTIC
TYLER TEST NETWORK COMPARISOM OF 252x252 TRIP MATRICES
USING RADII AND ATOM RELATIVE VALUE FOR F-FACTORS

PAGE NO.
DATE 05AU
TIME 17:42

VOLUME COMPARISON REPORT ---- FREQUENCY DISTRIBUTION (V1-V2).
MAXIMUM CENTROID NUMBER = 252 NUMBER OF PURPOSES = 1
INTERCHANGES WITH ZERO VOLUME TAPE 1 = 28255 TAPE 2 = 28212

===== ABSOLUTE DIFFERENCES =====

VOLUME GRP V1		NEGATIVE -50 TO -31	-30 TO -21	-20 TO -11	-10 TO -8	-7 TO -6	-5 TO -4	-3 TO -3	-2 TO -2	-1 TO -1	-0 TO +0	+1 TO +1	+2 TO +2	+3 TO +3	+4 TO +5	POSITIVE +6 TO +7	+8 TO +10	+11 TO +20	+21 TO +30	+31 TO +50	TOT
0-	1	0	0	0	0	0	2	33	515	4299	29172	2922	0	0	0	0	0	0	0	0	36943
2-	2	0	0	0	0	0	2	13	181	890	1784	1664	284	0	0	0	0	0	0	0	4818
3-	3	0	0	0	0	0	1	16	152	638	1240	843	235	11	0	0	0	0	0	0	3136
4-	4	0	0	0	0	0	1	11	121	527	928	637	172	19	0	0	0	0	0	0	2416
5-	5	0	0	0	0	0	1	14	85	406	661	464	136	14	1	0	0	0	0	0	1782
6-	6	0	0	0	0	0	0	10	78	317	542	339	97	8	0	0	0	0	0	0	1391
7-	7	0	0	0	0	0	0	9	65	282	464	286	92	11	5	0	0	0	0	0	1214
8-	8	0	0	0	0	0	0	6	68	268	380	219	81	16	3	0	0	0	0	0	1041
9-	9	0	0	0	0	0	0	8	55	209	322	174	65	20	1	0	0	0	0	0	854
10-	10	0	0	0	0	0	0	3	61	178	238	169	52	12	1	0	0	0	0	0	714
11-	15	0	0	0	0	0	6	32	205	627	969	589	167	36	18	5	0	0	0	0	2654
16-	20	0	0	0	0	0	2	14	131	417	579	318	81	26	25	8	1	0	0	0	1602
21-	25	0	0	0	0	0	12	25	119	257	343	205	53	14	15	4	3	0	0	0	1050
26-	30	0	0	0	0	0	7	21	68	188	238	147	47	12	12	10	0	5	0	0	755
31-	35	0	0	0	0	0	2	20	61	164	161	93	26	5	3	7	3	2	0	0	547
36-	40	0	0	0	0	3	9	19	45	102	118	60	17	8	2	6	11	2	0	0	402
41-	45	0	0	0	0	3	12	15	43	58	86	54	17	10	3	3	0	3	0	0	307
46-	50	0	0	0	0	3	3	25	34	63	61	51	12	3	2	1	7	11	0	0	276
51-	60	0	0	2	0	0	17	29	67	100	111	60	18	12	4	3	2	11	0	0	436
61-	70	0	0	0	1	6	14	19	40	49	45	30	10	6	7	0	7	5	1	0	240
71-	80	0	0	0	4	6	4	19	24	33	26	19	6	5	5	2	2	8	0	0	163
81-	90	0	0	0	0	5	10	9	19	26	20	18	14	3	3	3	0	5	0	3	138
91-	100	0	0	0	2	2	12	13	10	5	17	15	4	1	4	2	0	4	2	1	94
101-	150	0	2	8	4	16	39	32	39	43	26	19	12	6	10	6	7	5	4	1	279
151-	200	0	0	5	7	10	20	16	5	8	3	2	5	4	1	0	3	2	0	13	104
201-	250	2	2	4	4	9	6	4	1	0	4	3	0	1	7	1	2	1	0	8	59
251-	300	0	0	0	4	3	3	2	1	1	0	0	2	0	0	0	0	4	0	3	23
301-	350	0	0	4	2	5	2	0	2	2	0	0	0	1	1	0	0	0	0	1	20
351-	400	0	0	3	1	1	1	0	0	0	0	0	0	2	2	2	0	0	2	1	15
401-	450	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	4	6
451-	500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
501-	1000	0	3	3	0	1	1	0	0	1	0	2	1	0	2	0	0	1	2	4	21
1001-	2000	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
TOTAL		2	7	29	29	73	189	437	2295	10158	38538	9402	1706	267	140	63	48	69	11	41	63504
0-	5	0	0	0	0	0	7	87	1054	6760	33785	6530	827	44	1	0	0	0	0	0	49095
6-	10	0	0	0	0	0	0	36	327	1254	1946	1187	387	67	10	0	0	0	0	0	5214
11-	50	0	0	0	0	9	53	171	706	1876	2555	1517	420	114	80	44	25	23	0	0	7593
51-	100	0	0	2	7	19	57	89	160	213	219	142	52	27	23	10	11	33	3	4	1071
101-	2000	2	7	27	22	45	72	54	48	55	33	26	20	15	26	9	12	13	8	37	531

APPENDIX B: Statistical Comparisons between TRANPLAN and Atomistic Model.

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VERSION 5.0

REPORT MATRIX COMPARISON BETWEEN TRANPLAN AND ATOMISTIC
TYLER TEST NETWORK COMPARISOM OF 252x252 TRIP MATRICES
USING RADII AND ATOM RELATIVE VALUE FOR F-FACTORS

PAGE NO. 2
DATE 05AUG88
TIME 17:42:08

VOLUME COMPARISON REPORT ---- STATISTICAL CALCULATIONS.

MAXIMUM CENTROID NUMBER = 252 NUMBER OF PURPOSES = 1

PURPOSE 1

VOLUME GRP V1	VOL. TAPE1	AVG. VOL.	VOL. TAPE2	AVG. VOL.	AVG. DIFF.	STD. DEV.	PRCNT S.D.	PRCNT TOTAL	WGHTD AVG.	ROOT MN SQ.	PRCNT RMS	SUM OF SQ DIFF
0- 1	8688	.2	11202	.3	-.07	.51	2.15	2.03	4.36	.5	216.87	9610
2- 2	9636	2.0	8704	1.8	.19	.95	.48	2.25	1.07	1.0	48.71	4572
3- 3	9408	3.0	9056	2.9	.11	1.02	.34	2.20	.75	1.0	34.13	3288
4- 4	9664	4.0	9432	3.9	.10	1.04	.26	2.26	.59	1.0	26.04	2622
5- 5	8910	5.0	8750	4.9	.09	1.07	.21	2.08	.44	1.1	21.39	2038
6- 6	8346	6.0	8292	6.0	.04	1.04	.17	1.95	.34	1.0	17.41	1518
7- 7	8498	7.0	8413	6.9	.07	1.10	.16	1.99	.31	1.1	15.69	1465
8- 8	8328	8.0	8309	8.0	.02	1.13	.14	1.95	.27	1.1	14.12	1329
9- 9	7686	9.0	7661	9.0	.03	1.15	.13	1.80	.23	1.2	12.79	1131
10- 10	7140	10.0	7136	10.0	.01	1.15	.12	1.67	.19	1.2	11.53	950
11- 15	33893	12.8	33912	12.8	-.01	1.22	.10	7.92	.75	1.2	9.52	3925
16- 20	28429	17.7	28433	17.7	.00	1.33	.08	6.64	.50	1.3	7.52	2850
21- 25	24003	22.9	24152	23.0	-.14	1.51	.07	5.61	.37	1.5	6.62	2407
26- 30	21060	27.9	21024	27.8	.05	1.84	.07	4.92	.32	1.8	6.59	2550
31- 35	18080	33.1	18163	33.2	-.15	1.81	.05	4.22	.23	1.8	5.50	1809
36- 40	15222	37.9	15239	37.9	-.04	2.51	.07	3.56	.24	2.5	6.63	2531
41- 45	13216	43.0	13290	43.3	-.24	2.32	.05	3.09	.17	2.3	5.43	1676
46- 50	13227	47.9	13151	47.6	.28	3.55	.07	3.09	.23	3.6	7.42	3490
51- 60	24135	55.4	24219	55.5	-.19	2.95	.05	5.64	.30	3.0	5.34	3816
61- 70	15697	65.4	15733	65.6	-.15	3.75	.06	3.67	.21	3.7	5.73	3372
71- 80	12234	75.1	12236	75.1	-.01	4.64	.06	2.86	.18	4.6	6.18	3504
81- 90	11777	85.3	11673	84.6	.75	6.45	.08	2.75	.21	6.5	7.61	5818
91- 100	8924	94.9	8884	94.5	.43	6.46	.07	2.09	.14	6.5	6.82	3938
101- 150	33120	118.7	33416	119.8	-1.06	6.50	.05	7.74	.42	6.6	5.55	12112
151- 200	18007	173.1	17608	169.3	3.84	20.34	.12	4.21	.49	20.7	11.96	44567
201- 250	13067	221.5	13009	220.5	.98	25.56	.12	3.05	.35	25.6	11.55	38602
251- 300	6313	274.5	6171	268.3	6.17	20.63	.08	1.48	.11	21.5	7.85	10666
301- 350	6526	326.3	6591	329.5	-3.25	12.12	.04	1.52	.06	12.5	3.85	3149
351- 400	5619	374.6	5443	362.9	11.73	39.39	.11	1.31	.14	41.1	10.97	25344
401- 450	2581	430.2	2297	382.8	47.33	32.70	.08	.60	.05	57.5	13.37	19858
451- 500	936	468.0	817	408.5	59.50	28.50	.06	.22	.01	66.0	14.10	8705
501- 1000	13592	647.2	13444	640.2	7.05	59.48	.09	3.18	.29	59.9	9.25	75332
1001- 2000	2012	1006.0	2003	1001.5	4.50	.50	.00	.47	.00	4.5	.45	41
TOTAL	427974	6.7	427863	6.7	.00	2.20	.33	100.00	32.71	2.2	32.71	308585

APPENDIX C: Conversion Program Documentation

The mainframe software required to provide an interface between the Texas Travel Demand Package and the TRANPLAN/NEDS package was developed during this research. One of the research tasks provided for development and testing of a comprehensive set of programs that will download and/or upload the applicable products of the Texas Travel Demand Package for use by the microcomputer package. The conversion programs between the mainframe and the microcomputer were tested. This documentation (appendix) will be incorporated into the documentation manuals for the Texas Travel Demand Package.

The programs for downloading from Texas Package to TRANPLAN included the following: link data, X and Y coordinate data, trip table, production and attraction data, and Friction-Factor, zonal radii data. Also, the programs for uploading from TRANPLAN to Texas Package included the following: link data and production and attraction data. The menu-driven batch files were developed to execute the conversion programs. The batch files are user friendly and make full use of the interactive capability of the microcomputer.

1. Link Data Conversion (CONVNET)

This program reads link data from the Texas Travel Demand Package including the Network Parameter Card and Link Data Card images and converts this into link data format for TRANPLAN. Subnetwork Parameter Card in the Texas Travel Demand Model shown in the first line of Link Data Card is as follows: First centroid number in columns 7-12, Last centroid number in columns 13-18, Last arterial node number in columns 19-24, and Last freeway node number in columns 25-30. An example of link data from the Texas package and TRANPLAN are shown in Figure 13. The following is the format of the link data records in Texas Package and TRANPLAN. All fields are right-justified.

Texas Package Column	Contents	**TRANPLAN** Column	Contents
7-11	A-node Number	1- 5	A-node
13-17	B-node Number	6-10	B-node
19-20	Direction Sign or Code	25-26	Direction Code
22	One-Way Flag	45	B-A Field Option
24-26	Length	12-15	Link Distance
28-29	Speed	21-24	Field 2 (Speed or Time)
31-36	Traffic Count	39-44	Volume (directional)
38-43	Capacity	33-38	Capacity (directional)
45	Functional Classification	27-28	Link Group 1
47	Administrative Jurisdiction	29-30	Link Group 2
71-80	Location of A-node (literal)	74-80	User Identification

Figure 13. An Example of Link Data Format (Download).

Texas Package

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+-
           1   252   998   998      TYLER     SCHEME 85-85-1
          1   475 00 2 024 20            1300 0 0
          1   465 00 2 010 20            1300 0 0
          1   472 00 2 024 20            1300 0 0
          1   473 00 2 016 15            1300 0 0
          2   475 00 2 010 20             500 0 0
          2   476 00 2 014 15             800 0 0
          2   478 00 2 009 15             500 0 0
          2   480 00 2 016 15             200 0 0
          3   497 00 2 019 25             600 0 0
          3   483 00 2 008 20             600 0 0

        982   983 00 2 044 45    900     8200 E 4
        984   985 00 2 191 45    500     7200 E 4
        986   987 00 2 098 50    900     7200 E 4
        987   988 00 2 140 50    800     7200 E 4
        990   991 00 2 107 50   2000     7200 E 4
        991   992 00 2 015 50   1900     7200 E 4
        994   995 00 2 037 30    800     4000 E 8
        996   997 00 2 120 40    200     7200 E 8
        997   998 00 2 100 55   1400     7200 E 8
L
N
```

TRANPLAN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+-
    1  4751 024S    2000 1 0 0     650       2
    1  4651 010S    2000 1 0 0     650       2
    1  4721 024S    2000 1 0 0     650       2
    1  4731 016S    1500 1 0 0     650       2
    2  4751 010S    2000 1 0 0     250       2
    2  4761 014S    1500 1 0 0     400       2
    2  4781 009S    1500 1 0 0     250       2
    2  4801 016S    1500 1 0 0     100       2
    3  4971 019S    2500 1 0 0     300       2
    3  4831 008S    2000 1 0 0     300       2

  982  9831 044S    4500 114 4    4100    4502
  984  9851 191S    4500 114 4    3600    2502
  986  9871 098S    5000 114 4    3600    4502
  987  9881 140S    5000 114 4    3600    4002
  990  9911 107S    5000 114 4    3600   10002
  991  9921 015S    5000 114 4    3600    9502
  994  9951 037S    3000 114 8    2000    4002
  996  9971 120S    4000 114 8    3600    1002
  997  9981 100S    5500 114 8    3600    7002
```

2. XY Coordinate Data Conversion (CONVXY)

This program reads a set of coordinates from the SDHPT interactive graphics coordinate conversion output, and then it creates XY coordinates in the node data card format for TRANPLAN. Optionally, this program reads the windowed link data to build a Table of Equals for a subarea analysis (see Figure 14). An example of XY coordinate data from the interactive graphics output and TRANPLAN are shown in Figure 15. The following is the format of the node data records in Texas Package and TRANPLAN. All fields are right-justified.

Texas Package

Column	Contents
1- 8	Description (Centroid or Node)
16-20	Zone or Node Number
24-37	X Coordinate (F13.4)
41-54	Y Coordinate (F13.4)

TRANPLAN

Column	Contents
1- 1	Record Identifier (N)
2- 6	Zone or Node Number
9-13	X Coordinate (I5)
14-18	Y Coordinate (I5)

Note, Node Data Record in TRANPLAN allows alternate node fields in columns 20-36, 38-54, and 56-72 which are similar to those of columns 2-18. In other words, four sets (nodes) of XY coordinate can be input to each line.

Figure 14. An Example of Table of Equals.

----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8----+----9----+----0----+----1----+----2----+

1	1	2	2	3	3	4	11	5	12	6	13	7	14	8	15
9	16	10	17	11	18	12	19	13	20	14	21	15	22	16	23
17	24	18	25	19	26	20	27	21	28	22	29	23	30	24	31
25	32	26	33	27	34	28	35	29	36	30	37	31	38	32	39
33	40	34	41	35	42	36	43	37	44	38	45	39	46	40	47
41	48	42	49	43	50	44	51	45	52	46	53	47	54	48	55
49	56	50	57	51	58	52	59	53	60	54	78	55	79	56	80
57	81	58	82	59	83	60	84	61	85	62	86	63	93	64	94
65	95	66	96	67	97	68	98	69	99	70	100	71	101	72	102
73	103	74	104	75	105	76	106	77	107	78	108	79	109	80	110
81	111	82	112	83	113	84	114	85	115	86	116	87	117	88	118
89	119	90	120	91	121	92	122	93	123	94	124	95	125	96	126
97	127	98	128	99	129	100	130	101	131	102	132	103	133	104	134
105	135	106	136	107	137	108	138	109	139	110	140	111	141	112	142
113	144	114	145	115	146	116	147	117	148	118	149	119	151	120	152
121	153	122	205	123	206	124	207	125	208	126	209	127	210	128	211
129	212	130	213	131	214	132	215	133	222	134	223	135	225	136	226
137	227	138	228	139	229	140	230	141	231	142	232	143	235	144	236
145	270	146	271	147	272	148	273	149	274	150	275	151	276	152	277
153	285	154E	546	155E	547	156E	551	157E	552	158E	555	159E	556	160E	571
161E	572	162E	573	163E	575	164E	576	165E	578	166E	579	167E	594	168E	596
169E	598	170E	599	171E	600	172E	886	173E	887	174E	888	175E	918	176E	997
177E	1011	178E	1049	179E	1051										

Figure 15. An Example of XY Coordinate Data Format.

Interactive Graphics

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+-
CENTROID           1      2797912.6100      262502.1600
CENTROID           2      2799917.8600      262268.5300
CENTROID           3      2801124.9100      262307.4700
CENTROID           4      2803169.1000      262385.3500
CENTROID           5      2803150.6600      260469.5900
CENTROID           6      2801297.6500      260840.9400
CENTROID           7      2800064.0700      260737.9300
CENTROID           8      2797965.8400      260830.0500
CENTROID           9      2798056.2800      259174.5400
CENTROID          10      2800145.9500      259233.3700
CENTROID          11      2801353.7100      259212.9000
CENTROID          12      2803697.5500      259325.4900
CENTROID          13      2803329.0900      257984.6700
CENTROID          14      2801292.2800      257974.4400
CENTROID          15      2798979.1400      257943.7300

NODE             984      2772420.7300      230542.5300
NODE             985      2762826.6300      228276.1100
NODE             986      2781753.8600      215618.3400
NODE             987      2776558.8500      215499.3700
NODE             988      2770322.6500      217335.1900
NODE             989      2800697.8800      226954.0400
NODE             990      2759586.7500      241660.9200
NODE             991      2759427.1900      247305.6700
NODE             992      2759452.7200      248110.7500
NODE             993      2816180.9800      238453.1300
NODE             994      2821802.8900      228293.0600
NODE             995      2823676.8600      228857.5100
NODE             996      2824777.5800      220254.6700
NODE             997      2818468.7400      220119.7200
NODE             998      2818839.8500      225365.8500
```

TRANPLAN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+-
N    1 2083829002    2 2184128886    3 2244428905    4 2346628944
N    5 2345727986    6 2253128172    7 2191428120    8 2086528166
N    9 2091027339   10 2195527368   11 2255927358   12 2373127414
N   13 2354626744   14 2252826738   15 2137126723   16 2159925922
N   17 2277126025   18 2396825815   19 2406124699   20 2215225027

N  975 1327714139  976 1498415954  977 1564116848  978 1621917590
N  979 1535316868  980 1336516356  981  995014663  982  996715161
N  983  991616310  984  809213023  985  329511889  986 12759 5560
N  987 10161 5501  988  7043 6419  989 2223111228  990  167518582
N  991  159521404  992  160821807  993 2997216978  994 3278311898
N  995 3372012180  996 34271 7879  997 31116 7811  998 3130210434
```

3. Trip Table Conversion (CONVTRIP)

As mentioned earlier, there is no way to download a binary record data set which is generated from the Window program in the Texas Package to the microcomputer. An intermediate program is required for the conversion of the binary trip matrix to 12I6 format (character format) trip matrix. This program reads the 12I6 format trip matrix generated from the intermediate program and writes an unformatted trip table for TRANPLAN environment using the subroutines OUTAB (writes matrices) written in ANSI FORTRAN. An example of the 12I6 formatted trip matrix generated from the intermediate program is shown in Figure 16.

Figure 16. An Example of 12I6 Formatted Trip Matrix.

----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+-

1	1	15	12	18	24	76	92	42	33	27	20
1	11	47	32	22	23	7	9	19	16	23	33
1	21	12	18	22	33	27	14	20	11	2	9
1	31	15	18	12	10	28	9	5	12	7	7
1	41	2	9	13	9	31	31	14	22	12	3
1	51	4	10	11	5	8	1	2	2	0	3
1	61	2	0	0	0	0	2	3	5	5	9
1	71	1	2	8	6	0	0	0	1	25	4
1	81	0	0	1	0	0	2	0	6	12	3
1	91	9	19	6	23	9	10	23	9	1	1
1	101	0	0	2	3	3	9	5	3	1	0
1	111	2	1	5	1	1	2	2	1	4	13
1	121	5	2	11	35	11	27	7	15	9	4
1	131	2	3	1	3	4	0	5	1	4	7
1	141	30	43	12	24	6	26	77	19	4	5
1	151	2	9	0	7	1	1	2	3	11	1
1	161	7	1	8	34	32	20	23	43	82	0
1	171	3	0	3	9	0	2	1	18	11	18
1	181	15	22	14	9	7	0	0	1	0	0
1	191	1	4	3	5	1	3	1	1	7	4
1	201	6	0	2	6	22	25	3	10	5	10
1	211	10	8	7	4	2	0	2	2	5	0
1	221	3	0	42	3	13	3	8	1	20	1
1	231	6	14	4	15	4	5	27	3	4	22
1	241	6	1	19	1	2	1	32	3	9	3
1	251	0	3								
2	1	13	2	6	9	38	33	18	15	12	9
2	11	23	18	8	9	3	3	9	9	12	12
2	21	4	7	13	17	11	4	8	7	1	5
252	171	0	0	0	1	0	0	0	1	1	1
252	181	1	2	2	1	1	0	0	0	0	0
252	191	0	1	0	0	0	0	0	1	1	1
252	201	1	0	1	1	3	3	2	2	3	3
252	211	3	3	4	2	1	1	4	0	9	0
252	221	0	0	0	0	0	0	0	0	24	0
252	231	3	24	3	18	4	0	3	0	3	24
252	241	3	0	12	0	0	0	0	1	0	0

4. Production and Attraction Data Conversion (CONVPA)

This program converts a fixed or variable format from Generation cards to the GP and GA formats for TRANPLAN. The Generation cards in the Texas Travel Demand Package are read in a variable format depending upon what is supplied by the preceding FORMAT card. Four items are read from each card. An example of P/A data for the Texas Package and TRANPLAN are shown in Figure 17. The following is the format of the P/A data records. All fields are right-justified.

Texas Package Column	Contents	TRANPLAN Column	Contents
1-10	Literal 'GENERATION'/'FORECAST'	1- 2	Record Identifier (GP/GA)
11-15	Zone Centroid Number	4- 7	Zone Number
16-20	Purpose 1 Production (NHB)	11-17	Purpose 1 Production
21-25	Purpose 1 Attraction (NHB)	11-17	Purpose 1 Attraction
26-30	Purpose 2 Production (HBW)	18-24	Purpose 2 Production
31-35	Purpose 2 Attraction (HBW)	18-24	Purpose 2 Attraction
36-40	Purpose 3 Production (HBNW)	25-31	Purpose 3 Production
41-45	Purpose 3 Attraction (HBNW)	25-31	Purpose 3 Attraction
46-50	Purpose 4 Production (LOEX)	32-38	Purpose 4 Production
51-55	Purpose 4 Attraction (EXLO)	32-38	Purpose 4 Attraction
56-60	Purpose 5 Production (TRTX)	39-45	Purpose 5 Production
61-65	Purpose 5 Attraction (TRTX)	39-45	Purpose 5 Attraction

5. Friction-Factor Conversion (CONVFF)

The trip distribution of TRANPLAN uses the classical gravity model formula with "Friction-Factors." The interactance model (MODEL) and the Atomistic Model (ATOM) in the Texas Travel Demand Package applies trip lengths directly in the distribution process and, consequently, needs no calibration. Other properties of the MODEL and ATOM are similar to a gravity model without "Friction-Factors."

In order to get compatible results between TRANPLAN and the Texas Trip Distribution Models, it was recommended that the final (or fifth) relative values from MODEL or ATOM be used for the Friction-Factors in the TRANPLAN trip distribution. This program reads a final relative value output (see Figure 1) from the Texas Trip Distribution Models (either MODEL or ATOM) and converts to the Friction-Factors for the TRANPLAN format. An example of the Friction-Factors format for TRANPLAN is shown in Figure 18. The following is the format of the relative values from Texas Package and the format of the Friction-Factor record in TRANPLAN. All fields are right-justified.

Texas Package Column	Contents	TRANPLAN Column	Contents
6- 10	Separation (Minutes)	4- 7	Impedance (Minutes)
91-102	Relative Value (NHB)	11-17	Purpose 1 F-Factor
91-102	Relative Value (HBW)	18-24	Purpose 2 F-Factor
91-102	Relative Value (HBNW)	25-31	Purpose 3 F-Factor
91-102	Relative Value (TRTX)	32-38	Purpose 4 F-Factor

Figure 17. An Example of P/A Data (Download).

Texas Package

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+-----
GENERATION    1  722  722  295  598  591 1058    0  722  338  338     85-85-101985
GENERATION    2  286  286  174  144  386  374    0  286  131  131     85-85-101985
GENERATION    3  411  411  126  353  335  597    0  411  251  251     85-85-101985
GENERATION    4  743  743   44  550  117  955    0  743  430  430     85-85-101985
GENERATION    5 3318 3318   45 1630  119 3706    0 3318 1617 1617     85-85-101985
GENERATION    6 3476 3476    4 1730   11 4016    0 3476 1689 1689     85-85-101985
GENERATION    7 1298 1298   37  806   83 1933    0 1298  675  675     85-85-101985

GENERATION  247                                  9526    0
GENERATION  248                                   880    0
GENERATION  249                                  2598    0
GENERATION  250                                   812    0
GENERATION  251                                   180    0
GENERATION  252                                  1956    0
```

TRANPLAN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+-
GP    1 1    722    295    591      0    338
GP    2 1    286    174    386      0    131
GP    3 1    411    126    335      0    251
GP    4 1    743     44    117      0    430
GP    5 1   3318     45    119      0   1617
GP    6 1   3476      4     11      0   1689
GP    7 1   1298     37     83      0    675

GP  247 1      0      0      0   9526      0
GP  248 1      0      0      0    880      0
GP  249 1      0      0      0   2598      0
GP  250 1      0      0      0    812      0
GP  251 1      0      0      0    180      0
GP  252 1      0      0      0   1956      0

GA    1 1    722    598   1058    722    338
GA    2 1    286    144    374    286    131
GA    3 1    411    353    597    411    251
GA    4 1    743    550    955    743    430
GA    5 1   3318   1630   3706   3318   1617
GA    6 1   3476   1730   4016   3476   1689
GA    7 1   1298    806   1933   1298    675

GA  247 1      0      0      0      0      0
GA  248 1      0      0      0      0      0
GA  249 1      0      0      0      0      0
GA  250 1      0      0      0      0      0
GA  251 1      0      0      0      0      0
GA  252 1      0      0      0      0      0
```

Figure 18. An Example of Friction-Factor Records.

TRANPLAN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+-
GF    1 1  78602   4710  85787    871
GF    2 1 100000   7452  99999    836
GF    3 1  83623   7983  83810    658
GF    4 1  66351   7857  64410    532
GF    5 1  46649   7026  45049    398
GF    6 1  34074   6460  32125    317
GF    7 1  24197   5494  21140    254
GF    8 1  17147   4716  13789    212
GF    9 1  13642   3946   8984    201
GF   10 1  10756   3473   5815    199
GF   11 1   7914   3036   3827    183
GF   12 1   6192   2701   2572    183
GF   13 1   4692   2422   1764    184
GF   14 1   3772   2229   1266    194
GF   15 1   3169   1997    931    204
GF   16 1   2371   1761    717    198
GF   17 1   1884   1534    553    195
GF   18 1   1532   1258    425    197
GF   19 1   1100   1244    322    200
GF   20 1    961   1387    282    234
GF   21 1    899   1255    206    268
GF   22 1    771   1230    180    369
GF   23 1    819   1378    121    506
GF   24 1    633   1485     93    613
GF   25 1    857   1522     87    788
GF   26 1    949   2011     79   1249
GF   27 1   1069   3225     80   2088
GF   28 1    181   4841     32   3566
GF   29 1    223  10454     51   8342
GF   30 1    298  32869     32  26192
GF   31 1    431 100000     50  99999
GF   32 1      0      0      0      0
GF   33 1      0      0      0      0
GF   34 1      0      0      0      0
GF   35 1      0      0      0      0
```

6. Zonal Radii Data Conversion (CONVRAD)

This program converts a fixed format radii card image to the data formats for changing intra-separation for TRANPLAN (see Figure 19). RADIUS cards that are not required as input into TRANPLAN or MODEL are used to define the centroid area in ATOM. This card simply presents the dimension (in minutes) of each zone radius as input into ATOM. Where zones or sectors are not performing correctly during the validation process, the adjustment of the radius value can increase or decrease intrazonal trips as needed to establish proper interchange volumes.

In order to obtain the close results between TRANPLAN and ATOM, it was decided that the R-VALUE should be used in the TRANPLAN trip distribution.

The Matrix Update function in TRANPLAN should be used to change the intra-separation (default value for intrazonal impedance = 1.0 minute) into "assumed average" intra-separations. The Matrix Update function reads the generated intra-separation and updates transactions on intrazonal elements for the separation matrix using the data specification. The following formula was recommended to generate the "assumed average" intrazonal impedances for the separation matrix based on the R-VALUE:

$$I_{aa} = 2R_a \times 2/3$$

where, I_{aa} = calculated intrazonal impedance in zone A and

R_a = R-VALUE in zone A

Texas Package

Column	Contents
1- 7	Literal 'R-VALUE' or 'RADIUS'
9-12	Zone Number
15-20	R-VALUE for the Zone (minutes)

TRANPLAN

Column	Contents
6-10	Literal 'TIME2'
12-19	Zone Number (from/to)
23-25	Intrazonal Impedance

Figure 19. An Example of R-VALUE and Intra-Separation Data.

R-VALUE in Texas Package

```
----+----1----+----2----
R-VALUE    1      0.7
R-VALUE    2      0.6
R-VALUE    3      0.7
R-VALUE    4      0.7
R-VALUE    5      0.5
R-VALUE    6      0.5
R-VALUE    7      0.6
R-VALUE    8      0.7
R-VALUE    9      0.8
R-VALUE   10      0.6
R-VALUE   11      0.6
R-VALUE   12      0.7

R-VALUE  209      0.5
R-VALUE  210      0.5
R-VALUE  211      0.7
R-VALUE  212      0.9
R-VALUE  213      1.2
R-VALUE  214      0.6
R-VALUE  215      0.6
R-VALUE  216      0.5
R-VALUE  217      0.5
R-VALUE  218      0.5
R-VALUE  219      0.5
R-VALUE  220      0.5
```

Data for Intra-Separation in TRANPLAN

```
----+----1----+----2----+----
     TIME2,   1,   1, R 93
     TIME2,   2,   2, R 80
     TIME2,   3,   3, R 93
     TIME2,   4,   4, R 93
     TIME2,   5,   5, R 67
     TIME2,   6,   6, R 67
     TIME2,   7,   7, R 80
     TIME2,   8,   8, R 93
     TIME2,   9,   9, R107
     TIME2,  10,  10, R 80
     TIME2,  11,  11, R 80
     TIME2,  12,  12, R 93

     TIME2, 209,209, R 67
     TIME2, 210,210, R 67
     TIME2, 211,211, R 93
     TIME2, 212,212, R120
     TIME2, 213,213, R160
     TIME2, 214,214, R 80
     TIME2, 215,215, R 80
     TIME2, 216,216, R 67
     TIME2, 217,217, R 67
     TIME2, 218,218, R 67
     TIME2, 219,219, R 67
     TIME2, 220,220, R 67
```

7. Link Data Conversion (UPNET)

This program reads link data from TRANPLAN and converts into link data format for the Texas Travel Demand Package. The first and last two lines of Link Data Card in the Texas Travel Demand Model should be generated manually. The format of the first line of Link Data Card is as follows: First centroid number in columns 7-12, last centroid number in columns 13-18, last arterial node number in columns 19-24, and last freeway node number in columns 25-30. The format of the last two lines is as follows: "L" in column 1 and "N" in column 1 of the next line (i.e., the end of the link data). An example of link data from TRANPLAN and the Texas package are shown in Figure 20. The following is the format of the link data records in TRANPLAN and Texas Package. All fields are right-justified.

TRANPLAN Column	TRANPLAN Contents	Texas Package Column	Texas Package Contents
1- 5	A-node	7-11	A-node Number
6-10	B-node	13-17	B-node Number
25-26	Direction Code	19-20	Direction Sign or Code
45	B-A Field Option	22	One-Way Flag
12-15	Link Distance	24-26	Length
21-24	Field 2 (Speed or Time)	28-29	Speed
39-44	Volume (directional)	31-36	Traffic Count
33-38	Capacity (directional)	38-43	Capacity
27-28	Link Group 1	45	Functional Classification
29-30	Link Group 2	47	Administrative Jurisdiction
74-80	User Identification	71-80	Location of A-node (literal)

8. Production and Attraction Data Conversion (UPPA)

This program converts the GP and GA formats from TRANPLAN to a fixed format (T5,I4,10I7) for Generation cards in the Texas Travel Demand Package. An example of P/A data for TRANPLAN and the Texas Package are shown in Figure 21. The following is the format of the P/A data records in Texas Package and TRANPLAN. All fields are right-justified.

TRANPLAN Column	TRANPLAN Contents	Texas Package Column	Texas Package Contents
1- 2	Record Identifier (GP/GA)	1- 4	Literal 'GENE'
4- 7	Zone Number	5- 8	Zone Centroid Number
11-17	Purpose 1 Production	9-15	Purpose 1 Production (NHB)
11-17	Purpose 1 Attraction	16-22	Purpose 1 Attraction (NHB)
18-24	Purpose 2 Production	23-29	Purpose 2 Production (HBW)
18-24	Purpose 2 Attraction	30-36	Purpose 2 Attraction (HBW)
25-31	Purpose 3 Production	37-43	Purpose 3 Production (HBNW)
25-31	Purpose 3 Attraction	44-50	Purpose 3 Attraction (HBNW)
32-38	Purpose 4 Production	51-57	Purpose 4 Production (LOEX)
32-38	Purpose 4 Attraction	58-64	Purpose 4 Attraction (EXLO)
39-45	Purpose 5 Production	65-71	Purpose 5 Production (TRTX)
39-45	Purpose 5 Attraction	72-78	Purpose 5 Attraction (TRTX)

Figure 20. An Example of Link Data Format (Upload).

TRANPLAN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+-
    1  4751 024S    2000 1 0 0     650      2
    1  4651 010S    2000 1 0 0     650      2
    1  4721 024S    2000 1 0 0     650      2
    1  4731 016S    1500 1 0 0     650      2
    2  4751 010S    2000 1 0 0     250      2
    2  4761 014S    1500 1 0 0     400      2
    2  4781 009S    1500 1 0 0     250      2
    2  4801 016S    1500 1 0 0     100      2
    3  4971 019S    2500 1 0 0     300      2
    3  4831 008S    2000 1 0 0     300      2

  982  9831 044S    4500 114 4    4100   4502
  984  9851 191S    4500 114 4    3600   2502
  986  9871 098S    5000 114 4    3600   4502
  987  9881 140S    5000 114 4    3600   4002
  990  9911 107S    5000 114 4    3600  10002
  991  9921 015S    5000 114 4    3600   9502
  994  9951 037S    3000 114 8    2000   4002
  996  9971 120S    4000 114 8    3600   1002
  997  9981 100S    5500 114 8    3600   7002
```

Texas Package

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+-
           1  252   998   998      TYLER     SCHEME 85-85-1  <- Manual Input
          1  475 00 2 024 20           1300 0 0
          1  465 00 2 010 20           1300 0 0
          1  472 00 2 024 20           1300 0 0
          1  473 00 2 016 15           1300 0 0
          2  475 00 2 010 20            500 0 0
          2  476 00 2 014 15            800 0 0
          2  478 00 2 009 15            500 0 0
          2  480 00 2 016 15            200 0 0
          3  497 00 2 019 25            600 0 0
          3  483 00 2 008 20            600 0 0

        982  983 00 2 044 45    900    8200 E 4
        984  985 00 2 191 45    500    7200 E 4
        986  987 00 2 098 50    900    7200 E 4
        987  988 00 2 140 50    800    7200 E 4
        990  991 00 2 107 50   2000    7200 E 4
        991  992 00 2 015 50   1900    7200 E 4
        994  995 00 2 037 30    800    4000 E 8
        996  997 00 2 120 40    200    7200 E 8
        997  998 00 2 100 55   1400    7200 E 8
L  <--- Manual Input
N  <--- Manual Input
```

Figure 21. An Example of P/A Data (Upload).

TRANPLAN

----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+-

GP	1	1	722	295	591	0	338
GP	2	1	286	174	386	0	131
GP	3	1	411	126	335	0	251
GP	4	1	743	44	117	0	430
GP	5	1	3318	45	119	0	1617
GP	6	1	3476	4	11	0	1689
GP	7	1	1298	37	83	0	675
GP	247	1	0	0	0	9526	0
GP	248	1	0	0	0	880	0
GP	249	1	0	0	0	2598	0
GP	250	1	0	0	0	812	0
GP	251	1	0	0	0	180	0
GP	252	1	0	0	0	1956	0
GA	1	1	722	598	1058	722	338
GA	2	1	286	144	374	286	131
GA	3	1	411	353	597	411	251
GA	4	1	743	550	955	743	430
GA	5	1	3318	1630	3706	3318	1617
GA	6	1	3476	1730	4016	3476	1689
GA	7	1	1298	806	1933	1298	675
GA	247	1	0	0	0	0	0
GA	248	1	0	0	0	0	0
GA	249	1	0	0	0	0	0
GA	250	1	0	0	0	0	0
GA	251	1	0	0	0	0	0
GA	252	1	0	0	0	0	0

Texas Package

----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+-----

GENE	1	722	722	295	598	591	1058	0	722	338	338
GENE	2	286	286	174	144	386	374	0	286	131	131
GENE	3	411	411	126	353	335	597	0	411	251	251
GENE	4	743	743	44	550	117	955	0	743	430	430
GENE	5	3318	3318	45	1630	119	3706	0	3318	1617	1617
GENE	6	3476	3476	4	1730	11	4016	0	3476	1689	1689
GENE	7	1298	1298	37	806	83	1933	0	1298	675	675
GENE	247	0	0	0	0	0	0	9526	0	0	0
GENE	248	0	0	0	0	0	0	880	0	0	0
GENE	249	0	0	0	0	0	0	2598	0	0	0
GENE	250	0	0	0	0	0	0	812	0	0	0
GENE	251	0	0	0	0	0	0	180	0	0	0
GENE	252	0	0	0	0	0	0	1956	0	0	0