167-15 and 167-25

SUMMARY REPORT

167-1(S) 167-2(S)

TEXAS TRIP DISTRIBUTION PACKAGE

SUMMARY REPORT
of
Research Reports 167-1 and 167-2
Study 2-10-71-167

FILE

Cooperative Research Program of the
Texas Transportation Institute and the Texas Highway Department
In Cooperation with the
U. S. Department of Transportation, Federal Highway Administration

December, 1972

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College Station, Texas

Texas Trip Distribution Package

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The Texas Transportation Institute, in cooperation with the Texas Highway Department, has developed a computer program package for trip distribution which is being used in the several urban transportation studies throughout the State.

This group of computer programs, known as the Texas Trip Distribution Package, is designed to interface with the Texas Large and Small Network Traffic Assignment Packages. It was prepared for and has been implemented on IBM 360/50, IBM 360/65, and IBM 370/155 computer systems. Although it is programmed largely in the FORTRAN IV language for these computers, it does take advantage of many options under these operating systems and may require some modification for use on other individual computer installations.

The package is capable of accommodating up to 4800 zones on a computer having 512,000 bytes of core storage. By making one minor program modification, the capacity can be varied to conform to the amount of core storage available. The minimum amount of core storage required by the package is about 120,000 bytes.

All data sets either created or used by the package are sequential and may, therefore, be placed on either sequential devices such as tape drives or on direct-access devices such as disk drives or data cell drives. There are a total of twenty-two data sets associated with the package; however, it is doubtful that all of these data sets would ever be used in any one application of the package.

The "Operating Manual for the Texas Trip Distribution Package," Research Report 167-1, provides the user with all the information necessary to execute the several programs contained in the package. The information contained in this manual includes: a description of each of the routines available in the package, the format specifications for both data cards and data sets, the error messages which may be encountered in using the packages, a description of the printed information produced by each of the routines, the data sets used or created by each of the routines, and the necessary operational procedures for using the package. A separate document, Research Report 167-2, entitled "Program Documentation Manual for the Texas Trip Distribution Package" is designed to provide data processing personnel with detailed information and flow charts for the several programs contained in the package. This detailed information on the internal operations of the computer programs is of primary interest to computer programming personnel charged with the responsibility for modifying and maintaining the package.

Texas Trip Distribution Model

The Texas Trip Distribution Model, which might be described as a constrained interactance model, allows an interaction constraint to be imposed upon the distribution. When the interaction constraint is applied, only a selected subset of the possible attraction zones for a given production zone are allowed to enter into the distribution process. The model applies trip lengths directly in the distribution process and, consequently, does not involve an iterative calibration process. A sector structure may be imposed to permit a statistical analysis for, and correction of, sector interchange bias created by socio-economic-topographical travel barriers.

The Model Formula

Mathematically, the Texas Trip Distribution Model is stated as follows:

$$T_{ij} = \frac{P_i \; A_j \; F_{t_{ij}} \; B_{s_i s_j} \; E_{ij}}{\sum_{x=1}^{n} A_x \; F_{t_{ix}} \; B_{s_i s_x} \; E_{ix}}$$

Where:

T_{ij} = trips produced in zone **i** and attracted to zone **j**

P_i = trips produced by zone **i**

A_j = the relative attraction factor for zone **j**

$F_{t_{ij}}$ = the relative trip length factor for the separation equal to $\mathbf{t}_{ij}$ **(note:** $\mathbf{t}_{ij}$ is the separation between zone **i** and zone **j)**

$B_{s_i s_j}$ = the sector interchange bias factor for the sector containing zone **i** (noted as $\mathbf{s}_i$) and the sector containing zone **j** (noted as $\mathbf{s}_j$) which may be used to define socio-economic-topographical travel barriers which are not otherwise accounted for in the model.

E_{ij} = the eliminator function which is used to apply the interaction constraint. It is assigned the value of one if zone **j** is eligible to attract trips from zone **i** otherwise it is assigned the value of zero.

In order to apply the interaction constraint, the user provides a production-interaction curve. As is illustrated in Figure 1, this curve is a boundary condition which specifies the maximum number of attraction zones which will be allowed to be considered in the distribution process for a production zone of a given production volume. For each production zone, the subset of eligible attraction zones are selected based on their accessibility to the given production zone. For convenience, the production-interaction curve may be entered as the coordinates of a series

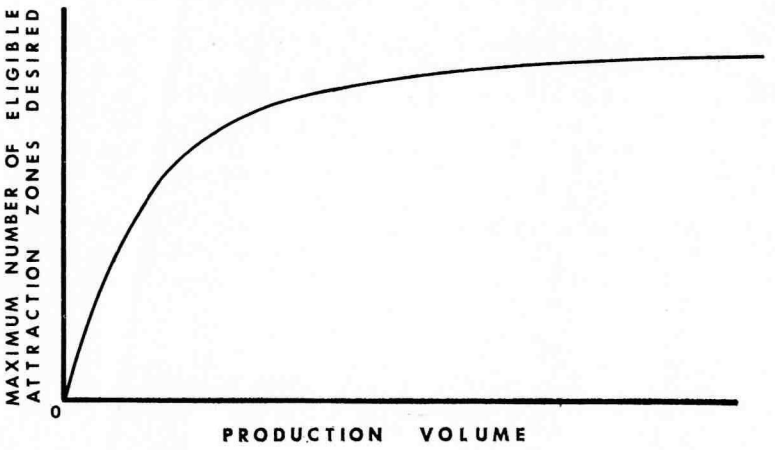

Figure 1.

of points which are the end points of a collection of line segments which approximate the desired production-interaction curve as illustrated in Figure 2.

In the distribution process, trips are computed for each eligible zone pair and residual rounding is performed. Due to this residual rounding, the interchange volume of some of the eligible zone pairs may round to zero and the resulting number of interactions (i.e., zone pair combinations with a non-zero interchange volume) will be less than or equal to the total number of eligible zone pair combinations.

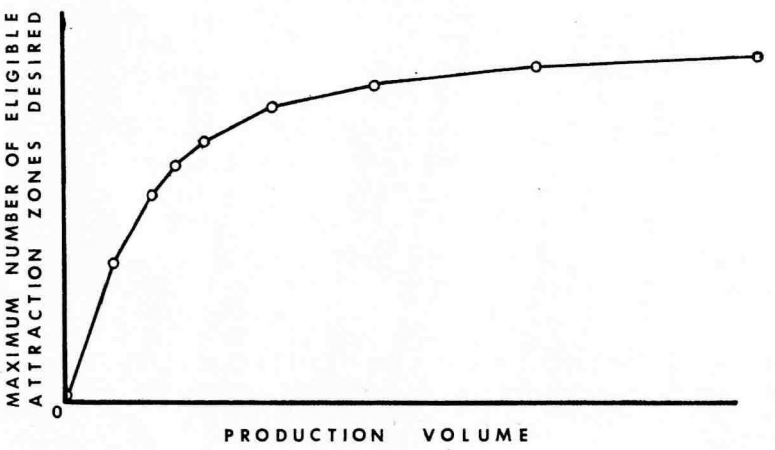

Figure 2.

The Iterative Process

The user may specify the number of iterations to be performed. Normally five or fewer iterations are sufficient. An option is provided in the package whereby the iterative process may be restarted to perform addition iterations without rerunning previous iterations.

The initial values for both the relative attraction factors and the relative trip length factors are computed by the package based on the interaction constraint and either the desired attraction volumes or the desired trip length frequency. During the iterative process, both the relative attraction factors and the relative trip length factors are adjusted. The adjustment of the relative attraction factors is based on the ratio of the desired attraction volume for a zone versus the resulting attraction volume from the previous iteration. Likewise, the adjustment of the relative trip length factors is based on the ratio of the desired number of trips at a given separation versus the resulting number of trips at that separation from the previous iteration.

Operational Perspective

The Texas Trip Distribution Package is basically a collection of 24 routines. Each routine performs a specific function(s) in conjunction with the trip distribution process. The user of the package must specify which routines are to be executed and their order of execution subject to certain constraints. The selection of routines is dependent upon the type of data available or required, the type of distribution to be performed, the analysis to be performed, and the desired output from the package.

There are two fundamental types of routines contained in the Texas Trip Distribution Package: basic routines and auxiliary routines. The basic routines must normally be executed in a specific sequence to achieve a planned objective. Execution of the auxiliary routines is an option of the user; they generally contribute supplementary results.

Basic Routines

The following is a brief summary of the functions performed by each of the basic routines:

MODIFY: This routine provides an instrument to define or modify any parameter value at any desired point during program execution.

UNPACK: This routine reformats a trip matrix from the format used in the Texas Large Network Package and the Texas Small Network Package and writes the trip matrix in the format used by this package.

SCREEN: This routine screens out everything but trip reports from the origin/destination survey data set, and

writes another data set with abbreviated trip records containing only the data from the trip reports which are required for the trip distribution.

BUILD: This routine builds trip matrices of the type and trip purpose specified by a trip CATEGORY card from the sorted, abbreviated, trip records.

EDIT: This routine edits the interzonal travel separations obtained from the assignment package, and writes a separation matrix for use in trip distribution.

REFINE: This routine refines the parameter estimates of a set of auxiliary models.

ACCEPT: This routine accepts trip generations, trip lengths, and sector interchange bias compensations from data cards.

IMPOSE: This routine imposes movements which are to be included in the trip distribution.

MODEL: This routine models the distribution of travel interchanges and writes a modeled trip matrix.

EXPAND: This routine expands a trip matrix, directionally.

SUM: This routine sums two to five trip matrices.

SWITCH: This routine switches a production/attraction trip matrix to an origin/destination trip matrix.

PACK: This routine reformats any trip matrix prepared by this package into the format required by the Texas Large Network Package and the Texas Small Network Package.

SET: This routine sets arrays with trip generation, trip length, and sector interchange data. It can also produce a copy of the separation matrix data set in which the zone to zone movements which were detected from the survey data are "flagged." If this separation matrix is subsequently used as input to the MODEL routine, the "flagged" zone pairs will be imposed as eligible zone pairs.

Auxiliary Routines

The functions performed by each of the auxiliary routines are as follows:

PERUSE: This routine provides a means to print the current parameter values at any desired point during program execution.

PRINT: This routine prints a trip matrix for inspection.

WRITE: This routine prints the separation matrix.