

1.0 INTRODUCTION

1.1 Background

An origin-destination (O-D) trip table is a two-dimensional matrix of elements whose cell values represent the number of trips made between various O-D zone pairs in a given region.

Establishing a current O-D trip table for an urban area through conventional surveys, such as home interviews, license plate surveys, and road side surveys, is an expensive, time consuming, and labor intensive proposition. In addition, most of these approaches involve sampling, with the associated sampling errors. Even if all the trips on a particular day are recorded, the O-D table so determined may not be stable over time, due to variations from day to day (Willumsen, 1978). There are other inherent drawbacks associated with conventional techniques. One common problem is the changes in travel pattern, due to changes in influencing factors. For instance, as the land use develops or changes rapidly, so will the trip table. Thus, the previously established trip table becomes outdated and obsolete. This will necessitate re-surveying, leading to further expenditures and efforts.

Many transportation planning organizations are in need of O-D tables for transportation planning as well as traffic operations. Recognizing the budgetary, time, and manpower constraints faced by such organizations, researchers began exploring alternative techniques of establishing O-D tables, leading to the evolution of theoretical approaches in the early 1970s. Several approaches and models have been developed since then for establishing the trip tables without the need for surveys by exploiting the information present in the link volumes .

In an earlier research effort sponsored by Virginia Transportation Research Council (VTRC) and conducted by Virginia Tech's Center for Transportation Research (Sivanandan et al., 1996), a comprehensive review of models that estimate trip tables from link volume information (from now on referred to as "synthetic models") was performed, and two of these, the Linear

Programming model developed at Virginia Tech (Sivanandan, 1991; Sherali et al., 1994a,b; Narayanan, 1995) and The Highway Emulator (THE) (Bromage, 1991) were selected for evaluation. Detailed and extensive tests were conducted to evaluate the validity of these models, and to determine the sensitivity of the models to various levels of available information in the form of link volumes and target tables. The LP model was judged to be generally superior, both in terms of closeness of modeled trip tables to the “correct/surveyed” tables, and in terms of replicating observed link volumes. One of the validation case studies was performed by comparing the models’ output tables with the tables surveyed by the Virginia Department of Transportation (VDOT) (assumed to be “true”) for the town of Pulaski in Virginia.

Like most of the models in this family, the LP and THE models can also employ an old/prior trip table as target/seed to guide the model solution. However, such tables are not always available, leading to the questionable performance of some of these models. In the Pulaski study VDOT was interested in the case where the target table constitutes a structural table. This case represents a situation when no prior trip table information is available to be provided as target. This case has a very practical significance in that many of the urban areas for which a trip table is sought may not have a previously established table for use as a target. Thus, the use of a structural target table, which is a table with 0 or 1 as cell value (0 signifying that the O-D interchange represented by the cell is not feasible, and 1 where it is feasible) is the only option. While THE model produced better results than the LP for this case, both the models’ results turned out to be poor in general. Hence, the amount of information contained in the seed table, for guiding the model results, seems to play a key role in determining the quality of the output table. With the availability of easily accessible socio-economic/census data, it is possible to establish an O-D table based on this data that is a better representation of the travel patterns in the region than the structural table. This table can then be provided as target/seed to the selected O-D table estimation models, and their performances can be measured. Similar to the earlier research effort, the models’ performances for varying levels of available link volumes can also be assessed. This was the goal of the research presented in this thesis.

The validity of these models must be verified before they can be used with confidence. This research effort is a validation attempt. The availability of a surveyed (assumed to be “true”) trip table for Pulaski network makes this case study and the validation exercise more meaningful. Economies in terms of cost, time and manpower can be achieved by adopting these approaches, when validated. The ready availability and easy accessibility of Census Transportation Planning Package (CTPP) data will be another incentive for transportation agencies to look favorably to this approach.

As learned from the earlier research effort, target/seed table was observed to enhance the models’ performances, if it portrays a better travel pattern of the study area. Hence, based on the results from earlier research, it was concluded that considerable potential exist in improving the modeled outputs (in terms of replicating the surveyed trip table) on using a superior target/seed. This was the main motivation for this thesis, and was considered worthwhile to pursue. From the easily available socio-economic/census data for the town of Pulaski, it was possible to develop an improved and more realistic target/seed table, which replicated the actual travel behavior to considerable extent. Thus, the comparisons of models’ results obtained using the improved target/seed table to the structural target outputs were considered worth investigating. This also provided an opportunity for studying the models’ behavior in terms of the quality of input information. This approach also attempts to gain more confidence in using the synthetic O-D models’ in general.

1.2 Organization of this Thesis

Chapter 2.0 presents the problem statement and research objectives of this research. Chapter 3.0 reviews the relevant literature. Chapter 4.0 details the approach. Establishing a target/seed table is presented in Chapter 5.0, and Chapter 6.0 contains the evaluation of THE and LP models for Pulaski Network. Conclusions and recommendations form Chapter 7.0.