Fundamental Properties of Synthetic O-D Generation Formulations and Solutions

by

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(ABSTRACT)

Origin-Destination (O-D) matrices are required in order to model traffic routing behavior in networks. Direct techniques for collecting O-D information from home and roadside interviews have historically been utilized to estimate O-D tables. However, these techniques are not only very costly, labor intensive, and disruptive to trip makers, but traditionally also do not capture traffic peaking behavior, which is often required for traffic operational purposes. Consequently, more cost-effective indirect or synthetic O-D estimation techniques have been developed, and continue to be developed. They utilize readily available traffic volume counts to estimate the most likely O-D tables that may have generated the observed link counts.

This thesis describes the basic formulations that have been proposed to formulate and solve the static O-D problem synthetically using link flow observations based on Maximum Entropy techniques. As is the case with many mathematical solutions to engineering problems, a number of simplifying assumptions have been made in order to solve the synthetic O-D problem. Unfortunately, the descriptions of these simplifying assumptions are often not fully described in the literature, and in some cases, these assumptions are not mentioned at all. Furthermore, the literature fails to systematically demonstrate what impact these assumptions have on the final O-D table estimate. Therefore, this thesis utilizes simple hypothetical networks to;

1. Demonstrate and compare the two main types of synthetic O-D formulations, namely the trip and volume based formulations.
2. Track the O-D estimation procedure from its initial formulation to its final formulation, demonstrating all significant assumptions that have been made and the implications of these assumptions on the final solution.
3. Demonstrate to what extent the final O-D estimation formulation remains valid when these assumptions are invoked.
4. Test the applicability of some packages which implement the various formulations and solution techniques that are available.

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Symbol	Description
T_{ij}	The actual but often unknown number of trips going from origin *i* to destination *j*.
t_{ij}	Initial estimate of number of trips going from origin *i* to destination *j* sometimes referred to as the seed matrix.
$T = \sum_{ij} T_{ij}$	Total number of trips traversing the network (The summation of all trips across all origin/destination combinations).
$t = \sum_{ij} t_{ij}$	Total number of trips traversing the network for the seed matrix (The summation of all trips across all origin/destination combinations within the seed matrix).
T_k	Number of trips available in the k^{th} cell of a $p \times p$ O-D matrix; $k = i + (j-1) \times p$.
$T_n = T - \sum_{k=1}^{k=n-1} T_k$	Total number of trips available to be considered in selecting T_{ij} trips.
p_{ij}^a	The fraction of trips going from origin *i* to destination *j* that use link *a*.
$v_a = \sum_{ij} t_{ij} p_{ij}^a$	Volume on link *a* associated with seed matrix *t*.
$V_a = \sum_{ij} T_{ij} p_{ij}^a$	Estimated volume on link *a*.
V_a'	Complementary traffic flows to V_a which satisfy flow continuity.