THE IMPACT OF ESTIMATION METHODS IN THE ACCURACY OF O-D MATRICES ESTIMATED FROM TRAFFIC COUNTS UNDER EQUILIBRIUM CONDITION

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Abstract: Many problems in transport planning and management tasks require an origin-destination (O-D) matrix to represent the travel pattern. However, O-D matrices obtained through a large scale survey such as home or road side interviews, tend to be costly, labour intensive and time disruptive to trip makers. Therefore, the alternative of using traffic counts to estimate O-D matrices is particularly attractive. The previous research concluded that estimation method is a significant factor in the accuracy of O-D matrices estimated from traffic counts. In this paper, four estimation methods have been analysed and tested to calibrate the transport demand models from traffic counts, namely: Non-Linear-Least-Squares (NLLS), Maximum-Likelihood (ML), Maximum-Entropy (ME) and Bayes-Inference (BI). The type of demand model used in this paper is gravity model (GR). The Bandung’s Urban Traffic Movement survey has been used to test the developed method. Based on several statistical tests, the estimation methods are found to perform satisfactorily since each calibrated model reproduced the observed matrix fairly closely. The tests were carried out using two assignment techniques, all-or-nothing and equilibrium assignment.

Key Words: OD matrix, equilibrium assignment, traffic counts, maximum-entropy, impact, optimization

1. INTRODUCTION

Travel has become an integral part of our daily life. This activity generates its good share of problems to any community, including traffic congestion, delay, air pollution and visual intrusion. In order to alleviate these problems, it is necessary to understand the underlying travel pattern. The concept of an “O-D matrix” has been adopted by transport planners to represent the most important features of this travel pattern. An O-D matrix gives a very good indication of travel demand, and therefore, it plays a very important role in various transport studies, transport planning and management tasks.

The conventional methods to estimate O-D matrices requires very large surveys such as: home and roadside interviews; which are very expensive, lengthy, labour intensive, subject to large errors, and moreover, time disruptive to trip makers. All of these have led researchers to investigate alternative, less expensive methods for estimating O-D matrices.

The need for inexpensive methods, which require low-cost data, less time and less manpower generally called as ‘unconventional method’ is therefore obvious due to time and money constraint. Traffic counts, the embodiment and the reflection of the O-D matrix;
Some conclusions can also be drawn from Table 3. They are as follows:

- Taking into account the results of using other criteria, it can be concluded that the best overall estimation methods are the combination of GR model with NLLS estimation method.
- With evidence so far, it was found that the estimated models and therefore O-D matrices are only slightly less accurate than those obtained directly from the full O-D surveys. This finding concludes that the transport demand model estimation approach is found encouraging in term of data collection and transport model estimation costs.

In terms of trip assignment technique used, Table 4 shows the comparison result of using all-or-nothing assignment and equilibrium assignment.

<table>
<thead>
<tr>
<th>Assignment Method</th>
<th>$R^2$</th>
</tr>
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<tbody>
<tr>
<td>Equilibrium Assignment</td>
<td>0.863</td>
</tr>
<tr>
<td>All-Or-Nothing Assignment</td>
<td>0.519</td>
</tr>
</tbody>
</table>

It can be seen from Table 4, that equilibrium assignment gives better result than those of all-or-nothing assignment, in the process of O-D matrices estimation using traffic count data by applying several estimation methods.

7. CONCLUSIONS

The paper explains the impact of estimation methods developed to calibrate the parameters of transport demand model from traffic counts information. Some conclusions can be drawn from the result obtained:

- The number of observed traffic counts required are at least as many as the number of parameters. The more traffic counts you have, the more accurate the estimated O-D matrix. From several application, it can be concluded that the optimal number of traffic counts required is between 25 – 30 % of total number of links in the network.
- In general, it can be concluded that the GR model with NLLS estimation method shows the best ranking performance based on several types of criteria.
- The calibrated model can then be used to forecast the future O-D matrices.
- The results are encouraging since the estimated O-D matrices obtained using traffic count information are only marginally worse than those obtained by full O-D survey.
- Equilibrium assignment gives better result than those of all-or nothing assignment in the process of O-D matrices estimation using traffic count data by applying several estimation methods, especially in urban area.
- The level of accuracy of the estimated O-D matrices depends on some following factors:
  - The choice of the transport demand model itself to be used in representing the trip behaviour within the study area;
  - The estimation method used to calibrate the parameters of the transport model from traffic count information;
  - The trip assignment techniques in determining the route choice;
  - The location and number of traffic count data;
  - The level of errors in traffic counts; and finally
  - The level of resolution of the zoning system and the network definition.
Further research is underway to analyse the impact of other factors of the O-D matrices estimation from traffic count estimation.

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