Dat.mobility

ADVANCING ANALYTICS

VACANCY: Detecting inconsistencies in observed mobility data from gradient information

INTRODUCTION

Traditionally, travel demand origin-destination (OD) matrix estimation for road traffic is a process in which a prior OD matrix specifying travel demand between origin and destination nodes in the road network is enriched using observed flows on link level from e.g. loop detectors. Recently, a method is developed that extends the supported set of datatypes for estimation with observed (link- or route-) travel times and observed congestion patterns (locations of queues) from e.g. floating car data (Brederode et al., 2023).

PROBLEM DESCRIPTION

One of the problems in application of travel demand estimation methods is data inconsistency. This may occur when demand is estimated using flows observed on different links that are used by flow on the same OD-pair. In the example in Figure 1, travel demand on O_1-D should decrease by 25 to match count A, whereas it should increase by 50 to match count B. To remove the inconsistency, either count A or count B (the most unreliable data source) should be removed before starting the travel demand estimation method.

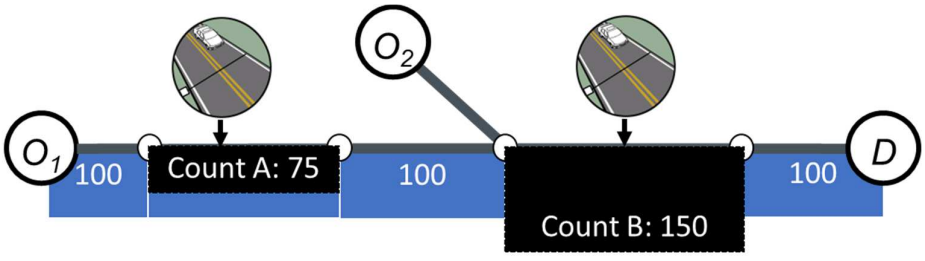

Figure 1: example where the observed flow value on link A suggests an increase of modelled flows ((blue boxes), whereas the observed flow value on link B suggests a decrease of modelled flows between O and D.

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Note that the situation depicted in Figure 1 only contains an inconsistency because there is no prior demand on O_2-D. If there would be prior demand on O_2-D, the OD estimator can use this OD-pair to match count B, given the demand from O_1-D that is used to match count A. Further note, that when count A would be higher than count B there would be an inconsistency irrespective of the existence of prior demand on O_2-D.

As demonstrated by this example, even with only two observed flow values and two OD pairs, detection of inconsistencies is not a trivial task, let alone when detection needs to be done on real scale networks that typically contain millions of OD-pairs and hundreds of count locations. This task only becomes more difficult when adding observed travel times (on sets of links) and observed queue locations (on nodes), as in this case inconsistencies may occur due to any combination of observed flow, travel time and congestion pattern observations on different (sets) of links and nodes that are used by the same OD-pair.

Fortunately, the matrix estimation method from (Brederode et al., 2023) explicitly calculates gradient information that describes the relationship between demand and the deviation from observed values for all combinations of observed datapoints and – OD pairs, along with its sensitivities.

RESULT / OBJECTIVE

The goal of this research is to develop a method to identify clusters of observed datapoints that form inconsistencies during travel demand estimation, using the gradient information available in the estimation method from (Brederode et al., 2023). If time allows, the method should be extended to automatically remove data points, given their reliability and their level of contribution to inconsistencies.

ASSIGNMENT

The student is encouraged to come up with his/her own approach, but an obvious rough work break down would be:

1. Review the matrix estimation method from (Brederode et al., 2023) and the meaning of gradient information in general, Also Take note of the dimensions of typical real scale matrix estimation problems (number of datapoint – odpair combinations)

2. Conduct literature research on selection and clustering methods of conflicting gradient information.
3. Select and/or develop viable methods for selection and clustering of inconsistent datapoint-odpair combinations.
4. Implement the most viable method(s) in prototypical form and test and compare the most viable method(s) by application on theoretical networks
5. Improve the prototypical implementation of the most viable method such that it scales to the real scale strategic transport model of the province of Noord-Brabant (Heynicks et al., 2016).
6. Demonstrate the added value of the solution algorithm by comparing results with and without removal of inconsistencies on the real scale problem

INFORMATION

When interested in this internship assignment please contact: Luuk Brederode (lbrederode@dat.nl). More information on Dat.mobility and Goudappel can be found via www.dat.nl and www.goudappel.nl .

References

Brederode, L., Pel, A.J., Wismans, L., Rijksen, B., Hoogendoorn, S.P., 2023. Travel demand matrix estimation for strategic road traffic assignment models with strict capacity constraints and residual queues. Transp. Res. Part B Methodol. 167, 1–31. https://doi.org/10.1016/j.trb.2022.11.006

Heynicks, M., Koopal, R., Zantema, K., 2016. The approach of traffic modelling in Noord-Brabant. Presented at the European Transport Conference, Barcelona.