Route choice modelling based on empirical evidence
Case study Alkmaar

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Route choice modelling is one of the major processes in modelling road traffic. The rational thought to use the fastest route available, i.e. a minimisation of travel time, is a logical one, though would require perfect knowledge of travel times with travellers. In reality this will not be the case with all travellers; they may assume that another route is the fastest, and therefore choose that route. Therefore, multiple routes between an origin and a destination would be used, each with a certain ratio.

Many different route choice models exist, from quite simple to very elaborate. The quite simple logit-based models are often used to determine a route's choice probability within a set of routes, though they are still up for improvement on accuracy.

Research into this field requires empirical data. A recent addition in road side systems in the Netherlands is the Bluetooth detection system by the traffic information provider VID. This system is currently available in several regions in the Netherlands, of which the Alkmaar region is one. The data captured by seven detectors in Alkmaar in February 2011, courtesy of VID, has provided the opportunity to look at both the use of VBM systems in route research and to route choice behaviour itself. The aim of this research has therefore been to ascertain the ability of the VBM systems to be used in route choice research and, using the data, to determine relevant route attributes to be included in route choice models to improve accuracy.

Road side systems, like Bluetooth detection, is not able to directly determine the exact route of a detected device, but only can provide a sequence of locations using the passage times and IDs acquired by the detectors. To determine what routes are likely to be used with a certain sequence, a choice set has been generated using the Constrained K Shortest Path method by van der Zijpp and Fiorenzo Catalano (2005), based on 42 ODpairs – for each of the seven detector locations as an origin, six other locations can be a destination – and a network comprising of collector roads, arterial roads and carriageways. 126 routes have been generated, and compared to the sequences from the data.

Using the unique identifier of every captured Bluetooth device, sequences have been made for each device. The time between subsequent detections has been used to determine if a stop has been made between those locations, which would mean that a trip would have ended and a new one started. The cut-off point has been set at 1.5 times of the typical travel time between the locations, or in case of a double detection at one location at 30 seconds. 320 different trip sequences have been found, each with 1 or more observations.

Comparison of the generated routes and the observed trip sequences has learned that many sequences are not logical, either overly long or (partly) circular. Another problem has revealed to be detection-based: it has appeared possible that devices can pass a detector, but may not be detected (false-negative), as well as that a device that nears a VBM detector, though its route does not directly pass the detector, may be detected (false-positive). This has seemed to be the case in at least 32 per cent of all observed node sequences. By altering the sequences, i.e. adding or removing a node, nearly half of the sequences involved could be allocated to a likely route. The sequences that could not be allocated have been discarded. The attached number of observations with an illogical sequence however has appeared to be very low, such that over 99 per cent of all observations has been attributable to a generated route. Although requiring correction for errors, data from Bluetooth detectors does provide substantial evidence to be used for route choice research.

Using the observed route ratios and observed travel time differences, two relationships have been estimated, based on logit. The evidence has suggested that route utility is not linearly related to travel time, and it may even include an offset below which routes are evaluated as being equal. However, there still are some large residuals between the estimated model and observations. To improve the accuracy, the effects of easy-to-collect route attributes have been analysed using a regression analysis. Five attributes appeared to be of interest, all based in the type of road, directional changes and signage.

The devised model including route attributes, i.e. using a generalised travel time, outperforms a model using only the observed travel time. However, a comparison with the basic logit model and the model devised by Thomas and Tutert (2009, 2010) has revealed that neither of the estimated models of this research are performing best. The most accurate results have been found by using a model as proposed by Thomas and Tutert (2009, 2010), though with alteration to the scale parameter. The differences however are quite small.