Using value-of-time distributions in auto assignment to forecast effects of road pricing schemes with non-additive charges

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We present implementation in EMME and application of an innovative method for auto assignment with value-of-time (VoT) distributions to assess the route choice effects of road pricing measures. It is apparent that VoT differ among individuals and many researchers have been investigating VoT distributions as new discrete modelling techniques became operational. Even though the VoT distributions provide many new insights and information, there is still a hurdle to be taken in applying value of time distributions in many model applications.

The VoT is a key driver in the auto assignment where there is a trade-off between costs and travel times. Many assignment models use deterministic route choice equilibrium where all the traffic is assigned to the routes with the lowest generalised costs. When road pricing fees are changed the generalised costs may lead to a reassignment of all the traffic between a particular origin-destination pair to other routes. In reality only a small amount of traffic would change as for the best route alternative changes only for a group with a small bandwidth in VoT. Using distributions of VoT would thus improve the forecasts and smooth the effects of changes in charging levels.

Another issue is that in most current models, only road charging schemes can be investigated that have additive charges on links. Thus the total road pricing charge for a trip is the sum of all the charges on links of the chosen route. In Gothenburg, policy makers are looking at charging schemes were travellers only need to pay once even if the pass the cordon multiple times within a certain time limit. This Multiple Passage rule could not be investigated with conventional assignment technique.

We have therefore developed and implemented in EMME an assignment method that uses a distribution of VoT instead of discrete VoT classes of drivers and at the same time allows us to investigate the effect of non-additive schemes for Gothenburg. We used VoT distribution obtained in the new Swedish VoT study.

The method is iterative, and each iteration consists of two stages. In stage 1 the total demand is split up into two classes, a class that pays a charge and a class that does not.

This is done based on differences in costs and travel times on the shortest route avoiding charged links and the shortest route in the complete network. Here the distribution of VoT is used to determine the cut-off point for each origin-destination pair. In stage 2 the auto assignment with the two classes is performed based only on travel time and distance. The first class is assigned to the complete network while the second class is assigned to the subnetwork consisting of the links that are not charged. This results in updated travel times on the network that are used in stage 1 of the next iteration. In the presentation we will discuss advantages and limitations of the method and demonstrate results of the study.