Application of Time-of-Day Choice Models Using EMME/2

– Washington State DOT (WSDOT) Congestion Relief Analysis

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ABSTRACT

The primary objective of the WSDOT Congestion Relief Analysis project, in coordination with the Puget Sound Regional Council (PSRC), is to include model improvements in the PSRC's travel demand forecasting model for the Puget Sound region. These model improvements are specifically aimed at improving the accuracy and reliability of the models and increasing the usability of the forecasting models for pricing studies. This includes updating trip generation and distribution models based on 1999 weighted household survey, constraining mode choice models that comply with FTA's guidelines, estimating and applying new time-of-day choice models, and segmenting values of time by different vehicle classes, trip purpose and traveler income level. This model will be used by various member jurisdictions which will help them provide sufficient information for decision-makers to evaluate future transportation investments with a strong degree of confidence.

The focus of this paper will be the time-of-day choice model which provides sensitivity to traveler's temporal decisions with respect to sociodemographic and trip characteristics. This sensitivity to temporal decision-making is expected to have significant impacts on forecasting results, as peak-period travel is more likely to occur in saturated conditions. Though the current time-of-day choice models predict the travel by time-of-day to a reasonable extent, it does not fully account for peak spreading, that is, persons rescheduling their travel from daily periods of high demand to the portions of the day where travel takes less time and is more reliable. Travel surveys and other travel behavior research have indicated the correlation between decreasing service quality and longer peak periods. Also, many planning agencies need to test the effectiveness of policy initiatives specifically targeted at shifting travel demand to off-peak periods.

In order to accommodate peak spreading issues, two main features were added to make them more sensitive to congestion pricing. First, the three periods where congestion occurs (AM peak, Midday, PM peak) were further divided into 30 minute sub-periods, in order to model peak-spreading behavior. Second, in addition to auto travel time variations between periods, the model has been structured such a way that it will be sensitive to auto travel cost differences between periods, for instance from time-of-day-specific congestion pricing. The new time-of-day choice models were estimated for the 8 trip purpose/direction combinations, but using a new set of 32 alternatives. While the current models predict the occurrence of trips in a particular time period based on the mid-point of the trip travel time, the new models used arrival times for trips from home and departure times for trips to home and for non-home based trips.

All the choice models were estimated using ALOGIT in a multinomial logit framework and implemented within EMME/2. The updated time-of-day choice models were calibrated using a two-stage approach – first, against the household survey data to ensure that trip purpose and directions are calibrated correctly, and second, against the traffic counts to ensure that the overall volumes by time-of-day are calibrated correctly. In the second stage, the bias constants by trip purpose and direction were adjusted uniformly so that the underlying relationship between trip purpose and direction are retained.

Finally, it must be noted that although it is an objective of this project to estimate the effects of pricing policies that may vary by time of day on time of day choices, cost variables are not explicitly included in these model specifications. This is due to the lack of pricing that varied by time of day in the data sets available for model estimation. The models however include a delay variable which measures the difference between the generalized costs (expressed in minutes) for each of the first four time periods and the night time period.

This study demonstrated the capabilities of EMME/2 in implementing complex time-of-day choice models and also showed that these models have the potential to effectively evaluate alternative pricing strategies and projects focused to improve congestion. The paper will include a detailed account on model estimation, application, calibration and validation of time-of-day choice models. It will also include various tests of sensitivity for different pricing strategies that will help determine whether the trends of the model results are reasonable.