Transportation Model Focused on First and Last Mile of Trip

Recent enactment of Senate Bill 375 (and State Orders) in California has suggested that new land use and transportation policy initiatives must occur in order to meet the State goals of reducing green house gases (GHG) to 20% below those in 1990 for 2020 and 80% below 1990 levels for 2050. Although the exact amount of reducing GHG attributable to land use and transportation policy has not been defined, what is clear is that these initiatives will be an aggressive component of the total reduction plan, and especially for the four major MPOs of the State with populations over 2 million people. Such policies would include compact household and employment based land development through increased density over significant extents of each region, easily walked and biked neighborhoods, multi-use areas and good connections to both local and regional transit that provide good access to other similar land developments elsewhere within the region. Pricing may also be a component to encourage reductions in GHG through reductions in vehicle miles of travel (VMT).

Current trip based models have been well documented as not being able to accurately forecast the types of policies necessary to reduce vehicle miles of travel (VMT). Lately, several reports have been issued which provide direction concerning the relationship between many of these types of policies and their effect on reducing trip making and VMT for projects. This paper will propose a new model that will be able to define the relationship between these policies and the effect on reducing trip making and VMT for small and large regions, using the Southern California Association of Governments (SCAG) model as basis. The model will be based upon the individual trip, starting and ending within a census block.

Although the model will use the trip based SCAG 2008 RTP model as a base, it will be able to be extended to become an activity based model through modifications to the code associated with each trip purpose. The model will be able to act as a transition from trip based models to activity based models.

The model will be based upon census blocks, or in areas with commercial development, individual blocks defined by the street pattern or land use. For the SCAG region, there will be about 220,000 blocks which contain about 19,000,000 people in 2008. These people as well as the other standard socio-economic data (SED) will be listed by block, as a disaggregation of the SCAG zone system of 4109 traffic analysis zones (TAZ). The method selected for disaggregation will be described in the final paper. Parts of these blocks will then be aggregated to each closest intersection. The model will be using as a base each household, so the model will calculate as a random variable the travel time by mode the time and cost for each household that makes a trip to another block. Each household and the individuals in each household could be described in a population synthesizer, and trips could be calculated from the attributes of each synthesized household. The code will provide for this technique, but as an initial simplification, only SCAG SED will be used to calculate the trips based upon existing trip rates.

Using SCAG person trip rates, the model will calculate for each of the 14 trip purposes the number of trips coming out of and into each intersection, acting as a zone centroid. Of course, other trips will also be passing through each intersection to some other final destination. We have decided to use intersections rather than parcels for the calculation of the shortest path and the aggregation of the path attributes. This choice will reduce significantly the number of links in the network, the chance of error and coding time and the computer processing time. Travel within a census block to the nearest intersection will be treated a random variable and attribute values will be added to the total skim values.

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Destination choice models will be used to distribute each individual trip in the model; for the SCAG region that will be about 63,000,000 trips in 2008. Thus, the model will be calculating person trips as a list, not as a demand matrix. Following the application of the discrete models for destination, mode choice and time of day, the lists will aggregated into the standard SCAG 4109 zone system as matrices, and added to the other truck, internal/external type trips, port and visitor/seasonal trips (as matrices) and assigned to the networks in the conventional manner. The assumption is that the first and last miles of each mode can be accurately simulated using only a detailed network that is connected to conventional highway and transit networks through loading nodes at either the collector/arterial system or transit stops. Part of the model development process will be how to connect the detailed block level network to the TAZ based transit and highway networks.

The destination choice models will use a single impedance function; the log sum of the four modes, walk, bike, transit and auto. Additional attributes will also be examined as components in the impedance calculation. From each origin block, a path will be calculated using Dijkstra's algorithm or the Pathfinder algorithm found in TransCAD, by mode to a TAZ, selected by a sampling method, and then a specific block within the selected TAZ using the Importance Sampling method. The trip productions and attractions will be balanced by purpose through an iterative process. The intent of this work will be to make the destination choice process sensitive to modal specific attributes as well as cost, time and distance. This process may also be done by 4 time periods.

The destination of the trips will be controlled by the zonal attractions so that the productions will equal the attractions but the choice models will include both destination and mode attributes from the zone selection set. The exact process selected will be further described in the final paper.

The mode choice model will be used to determine the mode through the concept of random utility maximization, as applied to each listed trip and using both the specific and error terms in the calculation. The application of this technique is described in *Discrete Choice Methods with Simulation by Kenneth Train*. Trip records used in the estimation process will come from the SCAG 2001 dataset. The intent of this project is not to develop a fully specified model generated through testing of various structures; rather it is to create a model at the individual trip based level that works and is sensitive to regional and local government policies. The choice structure will follow the work that SCAG and LA Metro are re-evaluating from the 2008 SCAG RTP Model. Further specification of model coefficients will happen following initial model development and testing, and will not be part of the final paper.

Paths for walk and cycling trips will be calculated using a certain cutoff for each mode. Trips beyond these two cutoff times will only be done by car or transit. As trips are made further from the origin, fewer destinations are chosen, but in a conventional model paths are built to all zones. Substantial processing time reductions can be achieved if the number of paths built from an origin to a destination is more in proportion to the chance that each destination has of being selected.

Time of day factors will be used to assign a trip to a particular time period for departure or return through sampling or some other method.

The lists will then be aggregated to trip matrices, by purpose, time period and mode and the remaining operations of the model will be conducted as in the 2008 SCAG RTP Model. Traffic assignment of the matrices will be done using TransCAD based algorithms

There are several challenges to the development of this model:

First, the size of the model area as defined by population, employment, zoning, mode choice structure, number of blocks, total area, among others requires a solution that relies on sampling and distributed computing using many high speed processors. Choice model surrogates and other methods may be needed to reduce model processing time.

Second, our assumption about using blocks will be tested. We intend to select only a few destinations for each origin rather than all of them in the present matrix based model regime. This will enter additional randomness to the calculation. How much randomness is allowable is unknown.

Third, a well documented process using elasticities has be developed, as described in several TRB publications; *TCRP 128* and *Driving and the Built Environment, TRB Special Report 298*. The results of this model should be consistent with those findings for their project areas.

Fourth, the model will more accurately describe the travel to and from local and regional transit than the present model, which uses 4109 zones to describe 38,000 square miles of land (although at least 13,000 square miles of that is desert or National Forest or military bases). The present choice models were developed using some attributes in each trip record generated from the present model. This may have introduced a bias into the choice estimation process that will need to be defined and re-estimated.

Fifth, the use of distributed computers will need to be optimized in relationship to the other methods to reduce the computing burden. Dynamic calculation of path building will need to be investigated based upon destination sampling. Models for the SCAG region should run in no more than 24 hours, and with a simplified process in 4 hours.

Sixth, the modeling of walking and cycling trips will be modeled using the coefficients in the SCAG model. Cut off distances for these two modes will need to be defined, such as ½ mile for walking and 2 miles for cycling. For these two modes, we will examine using a function based upon distance and quality of the experience to weight the time or distance attribute.

Seventh, the scale of solutions to be examined to solve the GHG problem, as defined by SB 375 will likely require new transit systems that offer competitive times to the present highway system, with order of magnitude increases in transit ridership. The reasonableness of these forecasts compared to the present models will need to be compared.

The model code as an executable will be adaptable to any area through the use of a binary file that will provide file paths to each input file. The files will list data (networks, SED, parking and other data) or model coefficients.

The work to develop the model will be conducted over the next few months and an interim report on progress and findings will be prepared by April 15, 2010 for presentation to the conference. Several individuals will be asked to provide peer review of the process and report prior to April 15, 2010.

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