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Addendum to the SACOG Model Design Report

Proposed Changes to the "New Standard" Travel Demand Model System

Section 4.3. in the Model Design Report contains a description of what was envisioned at the "New Standard" Travel Demand Model system. Since then, through work with data from Columbus, Atlanta, and Portland, and collaboration with modelers at PBConsult, we have gained experience with some specific model design enhancements that can be included in the New Standard Model. For the work to be completed in the next fiscal year, we propose two substantial changes to the New Standard design: (1) including land use at a much finer level of geographical detail, and (2) treating time-of-day at a finer level of detail as well.

(1) The Level of Spatial Detail

We propose to locate households and destinations (i.e. trip ends) at either the grid cell level or the parcel level, whichever integrates most easily with the land use model. In the Atlanta region, we are working with grid cells 200 meters square. In Sacramento, it may be easiest to work directly at the parcel level, or some system of aggregating parcels that works best for land use modeling. In terms of the travel models, there is little practical difference between using parcels or grid cells.

Variables that we envision using at the parcel or grid cell level include:

BASIC ATTRIBUTES OF EACH GRID CELL (OR PARCEL)
Employment by type:
- total
- retail goods
- retail services
- office
- other categories if available

School enrollment by type:
- pre-elementary
- elementary school
- middle school
- high school
- post-secondary

Households by type
- with and without children
- age category of primary income earner
- by income category

- by HH size

Other land use attributes

- primary land use category (water, parks, farm land, commercial, high residential, low residential, etc.)
- perhaps a measure that captures building size and type

Transportation system attributes

- walk access time to transit
- 3-way intersections
- 4-way intersections
- dead-ends
- lane-miles non-limited access roadway with sidewalks
- lane-miles of non-limited access roadway without sidewalks
- lane-miles of limited access roadway
- ID and roadway (or crow-fly) distance to each grid cell or parcel within 1 mile
- parking availability by type: monthly, hourly
- parking price by type: monthly, hourly

DERIVED ATTRIBUTES OF EACH GRID CELL (OR PARCEL)
(measured in concentric rings of various sizes surrounding the cell – e.g. ½ mile radius)

- Population and employment densities by type
- Diversity of land use and employment (e.g. mixed-use measures)
- Sidewalk coverage
- Street network density
- Green space/recreational acreage
- Parking cost and availability
- Any expertly developed pedestrian environment factors

Many of these variables could also be used at the TAZ level, but there can be a great deal of heterogeneity within a single TAZ, so definition at a finer level of detail is important in allowing us to estimate relationships in the data. This is particularly true for variables related to pedestrian accessibility and walk access to transit, but is also true for other variables.

Note that the list of variables above (which could be extended if additional information is available in the land use data base) account for three of the D's in the 4D process – the Density, Diversity and Design indices. The fourth D, Destination, is accounted for in the structure of the model system, with accessibility to destinations having effects on tour generation and patterns.

Also note that although household and business locations and trip ends will be forecast to the parcel or grid cell level, aggregation to larger areas is useful and/or necessary for certain elements of the travel model system. For example, highway and transit assignment will be done at the TAZ level, and the resulting network travel time skims will be stored and used in the form of TAZ-to-TAZ matrices, with each parcel or grid cell pair using the values for the associated TAZ pair.

(2) The Level of Temporal Detail

Although one typically performs network assignments and travel time skims for only a few specific hours of the day, there is a benefit in being able to predict the start and end times of each trip in finer detail. For example, predicting the start and end times of each trip and activity to within a one-hour interval makes the modeling of activity sequencing and scheduling much more straightforward and intuitive. In recent projects with PBConsult, we have gained experience with very concise ways of formulating such models, effectively mimicking a continuous duration-based model within the familiar logit discrete choice framework. We propose to apply this specification for SACOG as well.

Assignments can still be done either for specific hour periods, or for averages over aggregates of the hourly periods, but the additional information for relative numbers of trips across all hours of the day may be quite useful, particularly for looking at spreading within the peak periods.

(3) Including 4D Variables directly into the travel demand models

Based on experience elsewhere, and assuming the high quality of the Sacramento region land use database, we expect that several different types of local land use effects can be estimated directly in the various travel demand models:

Auto ownership

Several of the 4Ds variables may influence auto ownership:

- Density and diversity of land use and employment in immediate and surrounding cells
- Street network density
- Sidewalk coverage or PEF
- Non-work activity pattern or tour mode/destination accessibility variable would capture effect of land use, transport and environmental variables indirectly via travel demand models

These effects will indirectly affect all the models below for which auto ownership explains choice, including tour frequency, destination and mode choice.

Work and school location

There are two primary ways that 4Ds effects should appear in work and school location models

- Employment by type, and school enrollment by grade level category, defined at the grid cell level, and used as size variables in the model, will very strong ly impact work and school location choice, with differences for different categories of employee (measured via HH income or personal attributes, such as part-time vs fulltime employment). Through these variables, the balance of residential and employment location by type should have a very strong impact on work and school location choice, and hence on aggregate measures such as average commute length.
- Work tour mode/time accessibility variable would capture effect of 4Ds to the extent that they directly affect the tour mode and time-of-day models.

The use of grid cells instead of TAZs for work and school location choice virtually eliminates the need for crude estimates of intra-zonal commutes, replacing them with the direct use of standard size and accessibility variables, which are sensitive to the 4Ds as described immediately above.

The direct 4Ds effects on work and school location will indirectly affect tour frequency and mode choice, because they depend on work and school location.

Tour frequency (and type)

The ability to capture the effects of 4Ds on the number and type of tours that people take is one of the strengths of the activity schedule approach used in the new standards model.

- For work and non-work tours, accessibility logsum variables will collect the effect of the 4Ds variables on (a) the nonwork tour destination and mode choice models and (b) the work mode and time-of-day choice models. These logsums will help determine how many tours are taken.
- For work patterns, we expect the 4Ds attributes of the home and work (or school) locations to directly affect the decisions to (a) make chained intermediate stops on the way to or from work, (b) make work-based subtours, and possibly also (c) make additional tours on the work day. For non-work patterns, the 4Ds attributes of the home location can be used in the same way.

Other destination choice

- Employment, school enrollment and number of households by type, defined at the grid cell level, and used as size variables in the model, will strongly impact non-work tour destination choice, with significant differences by tour purpose. For example, shopping tours will be most influenced by retail goods and servicxe employment, whereas escorting purposes will also be influenced by school enrollment. The same effects will occur for intermediate (chained) stops on all tour purposes.
- Tour mode choice accessibility variables will capture the effect of 4Ds to the extent that they directly affect the tour mode choice models.
- We expect the 4Ds attributes of the tour's origin and destination to directly influence the likelihood of choosing a destination very near (within walking distance) when chaining intermediate stops onto commutes and other tours.

The direct 4Ds effects on destination choice will indirectly affect tour mode choice, because mode choice attributes depend on destination, and will indirectly affect time of day, because time of day profiles also depend on destination land use type.

Mode choice

- Walk time to transit, an important design attribute, measured at the grid cell level on both ends of each trip, will significantly influence mode choice for tours and intermediate stops on tours.
- Other 4Ds transport system attributes, especially transport system attributes, may also influence mode choice.

Time of travel

- Different land-use types tend to have different usage/patronage patterns across the day. Thus, the combination of finer geographical land use detail with finer temporal detail will allow us to model trips arriving and leaving each type of destination at appropriate hours of the day.

(4) Recommended work plan and budget for the coming fiscal year

We propose a budget in the range of $175K to $200K for estimating all of the travel demand models in the New Standard system during the coming fiscal year. This budget would cover the model estimation, but not the full model application and implementation at SACOG.

We further recommend an additional budget of $150 to $200K to develop software for model application and implementation. This additional budget could be put out for bid to interested parties, which might include PBConsult, Cambridge Systematics and Citilabs. This separate software development contract could cover the land use models as well as the travel models. The additional support from such a contract would ensure that the resulting models could be implemented sooner, perhaps taking advantage of interfaces with existing software.