WINTER 2008

TMIP Connection

The Travel Model Improvement Program Newsletter

An Incremental Way of Incorporating Activity-Based and Tour-Based (ABTB) Modeling within the Context of an MPO Model Development Effort, the Example of the Atlanta Regional Commission Strategic Vision:

By Guy Rousseau, Modeling Manager, Atlanta Regional Commission

The Atlanta Regional Commission (ARC) strives to improve its travel demand model procedures to be responsive to the requirements of local communities, federal conformity regulations, decisionmakers and policymakers. At the same time the ARC needs to maintain its ability to provide travel demand estimates to the state and local governments and to the transit operating agencies. Thus, while the present procedures are being improved or new procedures are being developed, the technical services provided by the ARC must go on, within the context of long range plan updates and air quality conformity determinations.

The development of travel demand models and procedures should be an ongoing process. The state of the practice is continually being improved; the Atlanta region is growing and constantly changing its character, while nationally, life styles and economics are also changing. It is therefore challenging to develop a set of models which are perfect both for today and the future. The best one can hope to do consists of developing procedures that are acceptable both for planning in today's environment and which are capable of being improved and modified as new data and procedures become available.

There is considerable discussion on the inadequacies of the 4-step trip-based process throughout the modeling community. At present nearly all urban areas use this process in one form or another. With the advent of population synthesizer, the household formation tool, alternative methods such as activity-based and tour-based modeling (ABTB) have moved into the experimental stage here at ARC.

Historical Context and Evolution of ABTB Modeling at ARC:

In 2001, ARC and its consultants conceived an ABTB system design for the 13-county non-attainment model domain, mostly looking at land use, household formation (PopSyn, which eventually became the population synthesizer), activity travel, traffic assignment, goods movement, and special generators.

In 2002, the efforts focused mainly on preparatory work, consisting of analyzing the 2001 SMARTRAQ household travel survey. Problems were identified with the data, mostly dealing with missing and/or incomplete survey diaries. Once these issues were resolved, the survey was deemed adequate for additional model system design. Realizing the variety and complexity of activity and travel patterns encountered throughout Atlanta was a key motivation to implement a management vision and transition strategy from 4-step trip-based to ABTB modeling.

The ARC ABTB model design combined the most attractive and realistic features of previously developed ABTB models (SF, NY, MORPC, etc…), without having to "re-invent the wheel". One goal consisted of maintaining and managing an open-source architecture and modular design, allowing features to be easily added and shared with others (i.e. ARC sharing PopSyn with MTC). The approach also placed a special emphasis upon the integrity of model system components, rather than a simple linear sequence of models. This allowed ARC to manage an on-going vision of the model structure in place.

By 2003, all main sub-models were estimated, which led to the implementation of the population synthesizer. In the case of the population synthesizer, ARC developed procedures to validate resulting synthetic population (base-year population and forecast population), ARC then used Census data in order to emulate land use backcasts, used land use backcasts to synthesize population, and then compared synthetic population to Census summary tables. ARC also maximized the quality of the synthetic population, both for base and forecast years, and implemented robust validation procedures (i.e. backcast validation),

SEE ATLANTA ON PAGE 2 ➤

U.S.Department of Transportation
Federal Highway Administration

ATLANTA CONTINUED FROM PAGE 1 ➤

while remaining flexible enough to use available locally developed land use forecasts via DRAM/EMPAL. Using an object-oriented JAVA program, the goals consisted of synthesizing a base-year population from Census, incorporating available aggregate population forecasts into a synthetic forecast year population, and then validating the accuracy of the synthesized member characteristics at multiple levels of demographic and geographic aggregations.

In early 2004, ARC conducted a TMIP Model Peer Review, which recommended the early deployment of the population synthesizer. However, ARC's ABTB model development effort was slowed significantly by several factors. In late 2004, EPA designated 20 whole counties and two partial counties within metro Atlanta as non-attainment under PM 2.5 (fine particulate matter). As a result of this non-attainment designation, ARC initiated the effort to expand its 4-step trip-based model from 13 to 20 counties in order to meet the federal requirements for performing conformity analysis. This addition of seven new counties brought 500,000 persons and 1.5 million acres to the model area. In 2005, ARC expanded and calibrated/validated its 4-step trip-based model. In 2006, ARC revived its program and expanded its 13-county population synthesizer to a 20-county model architecture. The 13-county PopSyn was presented at the May 2006 TRB in Austin.

What have we been doing lately?

The ARC population synthesizer has been expanded to 20 counties, with base year and forecasts results. The JAVA jar directory runs base year and forecasts for 52, 128 and 316 household classifications. It maximizes the quality of the synthetic population, both for the base and forecast years, implementing robust validation procedures (backcast validation to 1990). It is flexible enough to use available land use forecasts via ARC's DRAM/EMPAL land use model. This JAVA object-oriented program synthesizes base year population from census tables, and incorporates available aggregate population forecasts into synthetic forecast year population. It validates the accuracy of the synthesized member characteristics at multiple levels of demographic and geographic aggregations. Its run-time on a standard desktop PC (one featuring a 3 GHz Pentium IV with 2 GB of RAM) is about ten minutes for the synthesizer portion, and about three minutes for the validator portion. It writes out household and person files in about 90 minutes. Its flexibility is such that cells and controls are individually defined without extensive JAVA programming, can have a mix of zonal and regional controls, and can differ between base and forecast year.

How does ARC intend to get from where it is now to a full implementation and use of an activity-based model system? ARC has chosen to implement a simulator in stages. At each stage, ARC ends up with a working simulator; not one that simulates the whole output, but rather, at each stage, more and more of an output is being generated. Here is the staged phasing:

Stage 1: Population synthesizer
Stage 2: Population synthesizer plus long term model improvements
Stage 2.1: Connect partial simulator to existing 4-step trip-based model system
Stage 3: Add day-tour-trip simulator
Stage 4: Integration with traffic assignment

What is happening now?

ARC's goal consists of making use of PopSyn within the trip-based 4-step model via a pre-deployment in trip generation. As such, ARC will re-engineer its population synthesizer so that it can create a synthetic population of persons in households, then aggregate results into the existing matrix of households by income and size, to be used by the 4-step trip-based model. By incorporating the synthesizer and the aggregator into the model job stream, ARC will accomplish another concrete step toward implementing ABTB modeling by incorporating the front-end into the model.

What are the next steps?

ARC is contemplating the possibility of enhancing its population synthesizer in order to integrate the American Community Survey (ACS). Using ACS data to provide control data will possibly allow a synthetic population to be generated for any year for which ACS data is available. This approach would use ACS PUMS to supply households in the synthetic population, using 2006 distribution of 2005 ACS data and a combination of county and PUMA data, since tract-level data is not expected until 2010. This would require that the population synthesizer balancer be modified to handle controls at the 2005 ACS level of geography simultaneously using TAZ, ACS and ARC regional control totals. The population synthesizer's draw function would take households from 2000 PUMS or ACS PUMS.

What else is on tap for ABTB at ARC?

First, ARC will complete the workplace / school location model, and the car ownership model. This, together with the Population Synthesizer, will become the next set of ABTB models. Special tabulations from Census allow using auto ownership as a control variable in validating the base year. Over time, ARC will attach the entire "day-tour-trip" section to the assignment portion using cube Voyager.

By the end of 2008, ARC shall have a streamlined activity-based model system running for analysis and planning, in parallel with its 4-step trip-based model.

What lessons have we learned?

Activity-based and tour-based model development requires detailed quality assurance and quality control of datasets, especially the household travel survey. It is important to design and conceptualize the surveys, especially the household travel one, with a pre-designed activity-based model system in mind. It is also imperative to maintain a parallel model development track. The 4-step trip based model and the ABTB should overlap; the results of one can be compared to the other before transitioning to a sole ABTB approach. Like anything else, ABTB model development requires lots of dedicated staff resources, on-going training, as well as consultants' assistance. Atlanta's most crucial step consists of moving ARC's ABTB model to practice, in a streamlined fashion. Rigorous practical testing and cross-comparisons of ABTB model and 4-step trip-based model, once they're both well calibrated and validated, is imperative to the success of model transition. ■

Transit Modelers' Corner

By Ken Cervenka, FTA

I will kick off this new column with an overview of the "FTA Travel Forecasting for New Starts" workshop held in St. Louis, Missouri on September 19-20, 2007. Over 90 people attended--primarily from consulting firms and MPOs, but with some transit agency and software vendor representation. The presentations by FTA staff and peers in the sponsor and consultant communities, along with workshop and "Participant Comments" summaries, can be found at: *http://www.fta.dot.gov/planning/newstarts/planning_environment_7275.html*

Some highlights:

- The goal of travel forecasting for transit projects is to produce information that is useful for decision making. That goal requires forecasts that are internally consistent and that yield coherent and reasonable differences across the investment alternatives. The goal also requires that the forecasts are presented to decision-makers in a way that will help them understand the benefits of a proposed major transit investment versus other investment alternatives and the uncertainties that may exist in even the best forecasts. FTA has identified two key products – both directly related to the travel forecasts – that emphasize the importance of information for decision-making: a formal analysis of uncertainties in the forecasts and their potential implications, and a well-written "make-the-case" document that describes the principal transportation benefits and related impacts of a proposed New Starts project. Both of these products extend the responsibilities of travel forecasters beyond the routine application of computer programs.

- FTA's review of travel forecasts for proposed transit projects has revealed general inattention to quality control. Good quality control practices entail careful examination of the forecasts in much greater detail than is common practice. In particular, scrutiny of the differences in the transportation benefits among alternatives (changes in riders, travel time, user benefits, etc.) ensures the reasonableness of the forecasts for individual travel markets stratified by trip purpose, mode of access, socio-economic class, and trip geography. FTA has emphasized the importance of quality control through the introduction of a congressionally mandated assessment of the performance of travel forecasting in the prediction of ridership for New Starts projects.

- An uncertainty analysis identifies the key drivers of the most likely forecasts and significant upside/downside risks. A series of cumulative build-up forecasts is a useful way to identify the individual contributions of various model inputs. The build-up starts with a forecast of current conditions and then prepares a new forecast based on the replacement of one input with its future-year values (switch to the future year transit network; then also switch to the future year person trip table, then also switch to the future congested highway times, etc.).

- FTA requires a before-and-after study for projects receiving New Starts funding. A before-and-after study examines both the impacts of completed projects and the accuracy of the forecasts prepared to support its planning and development. Consequently, the study requires preservation of the detailed travel forecasts at several milestones during project development, the collection of ridership data before and after the project is completed, and an assessment of the accuracy of the forecasts – including the identification of sources of error. Key to understanding the causes of the differences in ridership is analysis of the uncertainties inherent in the forecasts. This requirement effectively establishes a new discipline – "forensic travel forecasting" – charged with the investigation of successes and failures in the prediction of ridership on major new transit facilities.

- Transit rider data is needed for both model testing and the before-and-after studies, with FTA making resources available to support New Starts forecasts. Good data collection practice includes major attention to the sampling plan, necessary data items, and questionnaire design. Different or hybrid sampling approaches may be useful for different markets. For example, personal intercept interviews may help with development of control totals for sample expansion of self-administered surveys to control for non-response biases.

- Several provisions of SAFETEA-LU demonstrate Congressional interest in planning estimates being consistent with actual outcomes. The SAFETEA-LU requirement for an annual report from FTA documenting the performance of contractors' forecasts versus actual ridership means that FTA must understand the particular responsibilities of each private and public entity involved in making a forecast at several milestones in project development. The private firm rather than the individual doing the forecast gets rated, so there is an incentive for the firm to create an environment that produces reliable forecasts. The information and analysis conducted for the before-and-after studies will be used to assess contractor performance.

FTA distributed a comment form that asked, among other questions, "What specific things can FTA do to help you with New Starts travel forecasting?" Three interconnected themes emerged in the responses from workshop participants:

- More outreach, training, documentation, and dissemination of information (including more education of project sponsors on the importance of good forecasts).

- Published guidance on what FTA wants to see.

- More case studies and examples representing good practice (plus "lessons learned" examples).

SEE TRANSIT ON PAGE 4 ➤

Hot Topics – Average Household Size: declining, constant or increasing?

By Bud Reiff, Principal Planner – Lane County Council of Governments

In Eugene, Oregon, the region's 20-year supply of buildable residential land within the existing Urban Growth Boundary is extremely tight, and the difference between the current average household size, (2.38) and the assumed 2.25 in 2031, when applied to the future population control total, translates into a demand for an additional 7,300 dwellings and 1,400 residential acres. This dilemma prompted a question to the TMIP Listserv, regarding practices applied to long-range land use and demographic forecasts regarding average household size.

The household, which is a group of related or unrelated people sharing a dwelling unit, is the genesis of travel in most forecasting models. Household members participate in daily activities, many of which require travel. The quantity of travel demand generated by the household is influenced by household characteristics such as number of people, their age and life cycle, and their combined income.

The forecasted overall population of a region is often an exogenous variable in the regional land use and travel forecasting model. For our region, the county-level control totals are estimated by state demographers, and then the sub-allocation to the Eugene metropolitan area is the result of a local political process. The distribution of the population to households by size (persons per household) for the land use and travel forecasting models is done by extrapolating historic trends in average household size. Then, Households by size and income are then sub-allocated to TAZ's using 2000 Census distributions by structure type, which essentially matches forecasted households to the housing stock.

Several respondents on the TMIP Listserv report that their regions also extrapolate local historic trends and assume household size will continue to decline, but that the rate of decline will decrease over time. The Baltimore MPO assumes a 6.3% decline in regional average household size from 2000 to 2035, from an average of 2.55 down to 2.39. The Hampton Roads, Virginia area forecasts a 4% decline in average household size over the same period. The Lansing, Michigan region also uses a declining-rate-of-decrease curve for average household size, which results in a 3.6% decrease from 2000 to 2035, from an average of 2.48 to 2.39.

One twist from the Listserv was the discussion of "fit" between households and housing stock. A California city assumes that new households will be smaller to fit the forecasted multi-family housing stock. Interestingly, higher land prices are assumed to limit dwelling size, and thus household size. Zvi Leve talked about changes he has observed in two nearby Montreal neighborhoods, one of which has 'gentrified' and one of which has not (or at least not YET). How households and neighborhoods adapt to one another could perhaps be another whole discussion, but we assume that in the long run, the older empty-nesters will leave the neighborhood of 4-bedroom houses and those houses will again become occupied by larger families.

However, the use of trend-based assumptions with respect to household size projections in our 2031 planning horizon should be carefully considered, since a halt or reversal of the historic trend could significantly alter not only forecasted travel demand, but the projected demand for housing and buildable residential land as well. Indeed, there are some indications that call this assumption into question. For example, average household sizes in each of the 9 counties in the San Francisco Bay region increased between 1990 and 2000, and in all but one of those counties, the increasing trend may extend back to 1980. Three of the four Portland metropolitan area counties also showed increases in average household size from 1990 to 2000, according to Census data, and the Denver region showed an increase from 2.46 t o2.51 during that same period.

There is quite a lot of uncertainty in our forecasted distribution of households by size and income. Demographers take into account a number of factors when forecasting population growth, including consideration of age cohorts, migration into and out of the region, and fertility and mortality rates. Travel forecasters might not be privy to all the factors that were considered in population projections for their own regions. Furthermore, the demographic forecasts might not even consider, at least in detail, just how the projected population is likely to be arrayed in households of various types as well as in group quarters. The number of persons living in a household might be influenced by cultural and ethnic factors, household wealth, housing costs, and other factors that might not play a very large role in the demographic forecasts per se. Furthermore, this distribution

SEE HOT TOPICS ON PAGE 5 ➤

TRANSIT CONTINUED FROM PAGE 3 ➤

FTA's next steps will address these themes, with relevant materials placed (as they become available) on the web site noted in this column.

To increase opportunities for timely two-way information sharing, a "New Starts Forecasting" e-mail Listserv has been created, with registration details available on the TMIP web site. This Listserv does not replace the use of the Travel Model Improvement Program (TMIP) Listserv for discussion of all aspects of travel modeling (including transit modeling), but is instead a forum where travel forecasters involved with (or soon to be involved with) New/Small Starts evaluations can 1) keep up-to-date on FTA guidelines, web postings, and workshops; 2) share information on good forecasting practice; and 3) ask/answer questions. Given the large attendance at the 2007 workshops and the importance of interaction with and among participants, FTA is contemplating two workshops in 2008 – one on each coast rather than a single centrally located session. So stay tuned to this new Listserv for the latest info on dates and topics.

And finally: please send an email to Kenneth.Cervenka@dot.gov (or call me at 202/493-0512) for any ideas you have about future transit modeling topics for this column. ■

TMIP MUG Profile – Puget Sound Regional Council

By Chris Johnson, Senior Modeler, Puget Sound Regional Council

Background

The Model Users Group (MUG) for the Seattle, Washington region convenes monthly (every 3rd Wednesday) at the offices of the Puget Sound Regional Council (PSRC), the MPO for the area. The official origins of the MUG can be traced back approximately 3½ years (April 2004) when a handful of users began to meet regularly to discuss and evaluate the readiness of an updated regional model for upcoming planning applications and studies. Since then, membership on the MUG has swelled and interest in the regional travel model is as strong as ever.

PSRC MUG Composition

Today, the MUG roster consists of approximately 35 members, although 10 to 15 "core users" attend on a regular basis. Participants from the public and private sectors are equally welcome as representatives from the Washington DOT, Washington State Ferries, Sound Transit, and the region's counties, cities, and consulting firms all contribute. Since the MUG is an informal gathering, the meetings are open to anyone with an interest in the regional travel model. Those seeking membership need only request that their name be added to the mailing list.

Modeling in the PSRC Region

In the State of Washington, the Growth Management Act ties the approval of new development to transportation infrastructure capacity. Thus, each of the four counties and many of the larger cities in the region maintain their own travel model to demonstrate consistency between their land use and transportation plans. In addition, many of the region's transit operators (e.g., Sound Transit and Washington State Ferries) maintain travel models to carry out their planning objectives.

PSRC MUG Role

Since many of the sub-regional models rely on the same data and assumptions contained in the regional model, the MUG provides an important forum to review the synchronization between the most current version of the regional model and smaller-area models. In addition to its regional coordination role, the MUG serves three other basic purposes:

1) to evaluate updates, revisions, and improvements to the regional model;
2) to suggest, discuss, and help prioritize future model improvements; and
3) to troubleshoot model shortcomings and brainstorm solutions.

Future of PSRC MUG

With the release of a significantly updated version of the preferred software package used in the region, it is envisioned that the MUG will devote more effort to helping ease the software transition and to support a software knowledge base and clearinghouse for the region's users.

In addition, as the PSRC model framework begins the transition from a trip-based to an activity- and tour-based platform, the MUG will continue to play a valuable role in helping to guide the direction and evolution of the regional travel model and to ensure that future generations of the model are ready for important planning analyses and studies. ■

For more information on the PSRC MUG, contact Chris Johnson at cjohnson@psrc.org.

HOT TOPICS CONTINUED FROM PAGE 4 ➤

uncertainty is propagated in the forecasts from our land use and transport models

So, it seems that practices applied to long-range land use and demographic forecasts regarding Average Household size are mostly uniform, with a bit of innovative thinking to accommodate some localized factors.

To view the thread in its entirety or to browse or post questions to the TMIP Listserv, go to:
http://listserv.tamu.edu/archives/tmip-l.html ■

GRATITUDE

TMIP wishes to thank the many volunteers without whom our program would never be as successful as it is! TMIP has conducted a number of Peer Reviews and Web Knowledge and Information Exchanges (WKIE) recently, and we would like to take this opportunity to thank members of our community who have volunteered to review and inform their peers.

For their work on the Peer Review program, our gratitude goes to:

- Frank Spielberg, Vanasse, Hangen, Brustlin, Inc.;
- Jennifer John, Tri-County Metropolitan Transportation District of Oregon;
- Mick Crandall, Utah Transit Authority;
- Mark Schlappi, Maricopa Association of Governments; and
- Karl Quackenbush, Central Transportation Planning Staff

And for generously donating their time, knowledge, skill and expertise to raise the state of information sharing within the practice by presenting at Web Knowledge and Information Exchanges also to:

- Ed Christopher; FHWA
- Nanda Srinivasan; formerly of Cambridge Systematics;
- Matthew Gates; Delaware Valley Regional Planning Commission
- Kristin Rohanna, San Diego Association of Governments
- Branislav Dimitrijevic, New Jersey Institute of Technology;
- Dmitry Messen, Houston-Galveston Area Council;
- Sonny Conder, Portland Metro;
- Nancy McGuckin;
- Rob Case, Hampton Roads Planning District Commission;
- Heather Contrino, FHWA;
- Arash Mirzaei, North Central Texas Council of Governments;
- Guy Rousseau, Atlanta Regional Commission;
- Mike Conger, Knoxville Regional TPO;
- Erik Sabina, Denver Regional Council of Governments;
- Brian Gardner, FHWA
- David Roden, AECOM Consult; and
- Doug Laird, FHWA

TMIP Calendar

January 13-17, 2008
87th TRB Annual Meeting
Washington, DC

January 29, 2008
2008 TRB Annual Meeting Highlights
Online Webinar

June 19-20, 2008
5th Oregon Symposium on Integrated Land Use-Transport Models
Portland, OR

June 22-24, 2008
TRB Innovations in Transportation Modeling (ITM)
Portland, OR

TMIP wishes to express its thanks to all the members of the travel model community that step up and participate in our many projects. Without the voluntary support and cooperation of these planners and modelers, TMIP would not be the program that it is today. We rely on you, and thank you.

THE TMIP MISSION

TMIP will...

Do What?

Support and empower planning agencies.

How?

Through leadership, innovation, and support of planning analysis improvements.

Why?

To provide better information to support transportation and planning decisions.

To subscribe to this free newsletter, unsubscribe, or change your mailing address, please send a detailed email to:

TMIP@tamu.edu

Put "TMIP Connection" in the subject.

FHWA-HEP-08-007

Help us maintain our database by sending any address corrections to TMIP@tamu.edu.

c/o Texas Transportation Institute
Center for Professional Development
3135 TAMU
College Station TX 77843-3135

TMIP
Travel Model Improvement Program