

NYMTC Best Practice Model Peer Exchange

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Introduction: Day I

Staff from the New York Metropolitan Transportation Council (NYMTC) provided a review of the general characteristics of the regional model. The New York Best Practice Model – deployed in 2002 – is a model structure that knits together a series of micro-simulation based choice models that estimate behavior tied to mode, destination, and stop decisions on household “tours”, thereby reflecting household-level interactions that occur on a daily basis. Considerable demographic detail about each household is managed through the model chain, enabling a more precise consideration of individual attributes through each ‘choice’ component of the model.

Key characteristics of the model:

- Approximately 3,600 traffic analysis zones
- 22,000,000 journeys
- 28 counties (although fewer for certain regional applications)

The NYMTC staff briefly described the level of travel complexity with respect to mode selection, trip purposes, and “priced facilities” for both short and long-distance travel markets. The regional model is used by both regional applications – support long range plan development, conformity analyses, and other Federal planning requirements – in addition to project level

studies in Manhattan and throughout the region. Subsequently, there is a considerable level of coordination that occurs between NYMTC and its partner agencies (including New York State DOT, New York City DOT, the Metropolitan Transportation Authority, the Port Authority of New York and New Jersey, and the numerous county governments that comprise the New York City metropolitan area).

Overview of Data Resources and Model Update Activities

NYMTC staff reviewed key data resources that support model development and maintenance activities. The New York region benefits from considerable data resources, including household 24 hour activity survey comprised of over 11,000 households, an intercept survey with 6,000 records targeted to important regional cordon stations, and speed data for approximately 4,500 network links, providing considerable insight for model calibration efforts. The 2010 model will benefit from a re-weighting of the HIS based on 2010 census data, and incorporate 2010 SED data, 2010 Census products (ACS and PUMS), and trans-Hudson flow data.

NYMTC staff briefly outlined key aspects of the 2002 and 2005 model recalibration efforts, followed by focal points for the 2010 update, which is envisioned to be the final update prior to the development of BPM 2.0. Key elements included updates to network files, assignment procedures, representation of times and costs in the model, and treatment of external travel markets; mode specific detail about each followed later in the meeting. A chart demonstrating model run-time performance was distributed and revealed a dramatic improvement in model run-times – *from 173 hours to 87 hours* – as the models continue to be updated; NYMTC's model appears to benefit from a multi-core application (parallelization across two 64bit, 12g cores) that produces highway assignments in 16 hours. Transit network skimming and assignment collective take over 50 hours (of the 87 hour total run-time).

Model Exploration Program

NYMTC staff then discussed the key aspects of a model improvement process that begins with a compilation of past experience with current NYBPM – including users' feedback, experts' comments, independent evaluations, existing applications, and other suggestions regarding the current NYBPM - which is to be used as the basis for guiding model development efforts.

Objectives of the exploration effort

- Prioritize needed improvements based on capabilities and resources.
- Learn from others' experience in model features and application.
- Explore options/available tools to achieve desired modeling capabilities.

The peer exchange panel discussed the potential value of a formal model "peer review" as another potential source for insights to help guide the development of NYMTC's work plan. NYMTC is tentatively targeting sometime in early spring 2011 for a formal peer review of the model, organized through FHWA's Travel Model Improvement Program (TMIP).

Day II: Summary of model updates activities (2005, 2010)

NYMTC staff discussed reviews to the Best Practice Model as part of the 2005 model update. One major revision was the update/replacement of the external auto model. New O/D survey data was used to revise external flows to/from New York, largely through the application of an adjustment factor for trips destined for the NY boroughs. The most significant reductions appear to be for Manhattan-bound trips, with a net reduction of 36m to approximately 11m VMT. Another refinement to the model included the update of travel times and costs to more accurately reflect the share of work and non-work travel occurring in each time period.

The highway skims for auto modes (SOV, HOV2, HOV3+ and Taxis) for four time periods were weight-averaged based on direction, purpose and origin-destination group (within, to/from Manhattan). The net effect of this improvement is more reliable representation of the sensitivity of travel based on (i) the type of trip; (ii) the time that the trip occurs; and (iii) the destination of that trip.

Transit and highway networks were updated and modified (for 2005, planned for 2010), and modifications were made to multi-class highway assignment procedures (redefining the PCU for trucks, restrictions by vehicle classes and separation of Taxi trips from HOV2).

Toll rate adjustments were made (for 2005) to better reflect the distribution of tolls paid with cash (~30%) vs. EZ pass implied by O/D survey data. The implicit “value of time” was scaled to the CPI to year 2005 dollars and varied by trip purpose. In the earlier version of BPM, AM period skims (only) were used for mandatory tour-level mode and destination choice modeling, and midday skims were used for non-mandatory purposes. This created an inconsistency for origin-destination interchanges that involve one-way auto toll collection. This problem has been corrected in the 2005 BPM version by using highway skims that are “blended” across all four time periods in both inbound and outbound directions using blending weights by purpose.

Adjustments to capacity “look up” tables were made to target low speeds in urban areas. As noted above, the 2010 update will benefit from additional data resources, and including a reconciliation process to match highway networks with screenline count databases.

Model Calibration and Validation Experience: 2005 Update Discussion

NYMTC staff noted that calibration experience tended toward being “on the low size”; one potential reason may be that visitors and airport access trips aren’t dealt with explicitly by the model. The calibration process is essentially a “three tiered” process, starting with county to county – or quadrant to quadrant flows (342 links), followed by intra-county movements (942 links) and finally sub-quadrant flows (960 links). The calibration process follows a “top down” approach, targeting screenlines first, followed by individual facilities via incremental adjustments to constants and scaling parameters.

Screenline data for calibration: As part of its screenline count update effort, NYMTC identified and compiled a set of traffic volume databases and documents from the various regional and sub-regional agencies, including the New York State Department of Transportation (NYSDOT) TF3 files, the New York City Department of Transportation's (NYCDOT) intersection counts and county volume databases/reports. Transit flows were provided by the Hub-bound report, with additional insights (on borough to borough) movements by an analysis of MetroCard data.

The peer exchange panel discussed tabulations of work and non-work travel flows reported in NYMTC's documentation report. In particular, the group discussed comparisons between estimated and observed trip flows for particular screenlines where estimated values deviated by more than 25% (e.g. Rockland-Orange and Putnam-Dutchess); while these travel markets are small, FHWA expressed further clarification about what the model may be "missing" in terms of understanding flows between certain interchanges. In order to better achieve a balance between estimated and observed flows, distance scaling factors (unchanged from 2002) were used along with sub-regional constants (11x11). These factors helped improve the overall match with the observed trip length trip distribution and achieved an acceptable regional level calibration.

Adjustment (or scaling) factors are also applied to increase the magnitude of trips produced at the district level. Noteworthy adjustments in the 2005 BPM update include a factor of .4 for Dutchess County, and .5 for Rockland County trip ends. Additional adjustments are made for external trips to dampen the External-to-Manhattan markets (briefly discussed above) that reduce the population and employment weights for dense zones in Manhattan. The net effect of the weighting scheme is to "shift" trip ends from denser locations (like Manhattan) to more suburban locations, achieving a better match with observed traffic data.

A comparison of pre and post-adjustment tables indicated a significant improvement with respect to meeting calibration targets; however, *there was general agreement that scaling factors and the district-to-district factors may be compensation for some aspect of behavior that may not be sufficiently captured by the model* – e.g. housing cost imbalances producing long trip distances than those reflected by the HIS (sample bias), possible bias against taking bridges, and significant variation in transit fares for certain long-distance zone interchanges. A comment was made about the application of these factors in future years as well.

The Peer Exchange panel also discussed the model's representation of travel speeds as highway networks become more congested. NYMTC staff noted that revisions to the alpha parameters of the volume-delay equation had been made – most dramatically for all arterial types (reduced from 2.0 to 1.0) – to ease network congestion effects. As noted previously, cross-class tables (by facility type and area type) were adjusted that provide additional capacity in an attempt to better match observed travel speeds. FHWA inquired about how well the existing BPR curves differentiate between arterial operations in a suburban vs. rural setting; NYMTC consultants suggested that volume-delay relationships are not likely to vary much across area-types as much as capacity variance that results from intersection operations and other geometric characteristics.

NYMTC shared several slides that revealed the results of sensitivity tests; these tests were intended to look at the impact of a network (bridge) disruption, changes in truck demand, revisions in toll policies, and shifts in demographic composition (household income) and employment density. The resulting impacts were generally intuitive. One panel member suggested a validation effort that utilizes “before and after” data for an actual disruption (e.g. a bridge closure)

Project Level Analysis

The peer exchange panel discussed NYMTC’s role in supporting project level studies. NYMTC described its role as a “clearinghouse” for insights revealed through project studies led by partner agencies or other consultants. NYMTC has developed a user document that describes the intermediate step required to execute the model and develop input files. The model contains a sub-area extraction tool that is widely used by NYMTC’s partners. The general reaction is that the approach is relatively straight-forward, and the evolution to TRANSCAD 6.0 has resulted in a much more user-friendly GUI, which makes network extraction steps more straight-forward. The panel discussed the potential benefit of a set of application guidelines - essentially a digest version of the user documentation, with additional recommendations on how the model should be applied in different study contexts – could be useful. FHWA noted that a handful of DOTs had project forecasting guidelines published for traffic analysis and may offer some valuable insights (Ohio, Florida).

NYMTC invited the New York City DOT to present on their Lower Manhattan Traffic Simulation Model, and how the BMP outputs are interfaced with the Aimsun simulation model. BPM outputs are disaggregated, and a temporal distribution of travel is applied to develop inputs for the Aimsun model. The macro model adjustment process includes O/D matrix refinement as well as adjustments to BPR functions that more closely reflect the increased network fidelity incorporated into meso/micro modeling. The presentation underscored the value of a multi-resolution modeling platform for evaluating operations strategies, as well as pointing out specific issues in the regional model (e.g. network capacity changes or coding errors).

MTA staff followed with a short presentation on how the BMP model interfaces with MTA’s transit forecasting. Transit networks used by the MTA for transit forecasting are developed by a consultant, and MTA’s RFT M model uses identical transit networks and level-of-service matrices produced by NYMTC; however, MTA uses a CTPP derived trip table to represent work travel, while adopting the BPM’s non-work matrix files. Modeling for a 24 hour period, peak and off-peak trips and represented with different times and costs (6-10 AM morning peak). Path-building parameters are calibrated from the assignment of transit on-board survey trips.

Model Application for Conformity

NYMTC staff described the Project Information Management System (PIMS) -- a tool for collecting detail information of all TIP projects that will be analyzed for conformity analysis. This

is a WEB Based tool that has been successfully used by NYMTC staff and TCC staff to share information. The information entered in PIMS is translated into a scenario-builder to support network coding activities; key attributes about projects are accounted for (completion date, project years to be analyzed, etc.). The conformity process involves running between 10-14 projects, typically twice a year, under a very tight time-frame. *Delays that occur are primarily tied to bottlenecks in getting the most reliable and accurate set of project details into the networks prior to running the models.* The socioeconomic data inputs include forecasts by 16 variables, and are updated in each conformity year.

After a conformity model run, the PPSuite air quality post-processor is run to refine speed estimates to reflect link speeds and approach delay, and to reconcile VMT estimates across area type and facility type combinations (with HPMS). Then Mobile 6.2 is run to produce an estimate of total regional emissions.

NYMTC staff showed several examples of model outputs, including an accessibility “contour” for Manhattan bound trips. A set of performance measures used by NYMTC to convey system performance is included in a “score-card” for the public and decision-makers.

Observations

The Best Practice Model plays a vital role in providing analytical support for transportation planning and project development in the New York Region. The discussion with NYMTC and supporting presentations revealed the significant role NYMTC plays in the development, maintenance, and stewardship of valuable technical resources. Indeed, NYMTC staff has a myriad of responsibilities tied to the management of a technical process that goes well beyond potential model improvement efforts that may be uncovered through the model exploration program.

With that as a backdrop, one concern is that challenges in managing a modeling program – including simultaneously performing maintenance, development, quality control, communication and processing of model results, and providing technical assistance to partner agencies – may place a particularly difficult challenge on staff to pursue the types of model validation steps necessary to ensure that the models behave properly, and are capable of producing reliable forecasts.

Although the model contains tables and charts that demonstrate a reasonable level of agreement with global “targets”, *the application of scaling parameters and adjustment factors (some of which are geography-specific) may be masking behavior that may warrant further scrutiny as part of a detailed validation plan.* In developing the BPM, NYMTC followed a top down approach, avoiding the use of facility-specific correction factors when possible. There may further opportunity to eliminate adjustment factors – some geographic in nature – that are not behaviorally based and are likely compensating for errors elsewhere in the model stream. While much of the discussion focused on demand matrices, some consideration was given to the relatively narrow range of volume-delay functions used to derive travel speeds in the

assignment process. The ability to account for variance in capacity across different area-type and facility-type roadway classes is provided, although those inputs are “compressed” and are applied across four different volume-delay curves that may not sufficiently portray differences in operational performance within facility type classes (primarily arterials).

One useful element of a validation process would be to test a real or hypothetical scenario – ideally one where before and after data exists – to thoroughly assess the model’s performance. The planned update of the 2010 model seems to offer a good opportunity for NYMTC to take a fresh look at specific markets that presented the greatest challenges for model calibration, and to target them more closely as part of a comprehensive validation process. A better approximation of travel flows –in both the base and forecast years – will be important for other potential down-stream model improvements.

Significant improvements to model run-times have been reported. Additional consideration should be given to steps to improve the transit path-building and assignment process, particularly for those applications that may not necessarily require a full application of the assignment process to produce volumes by sub-mode. NYMTC may also want to further explore the potential for computational improvements through additional multi-threading of the regional origin-based assignment algorithm. Steps to gain additional efficiency in the tracking and dissemination of project data for network coding may be useful for improving the overall time needed to produce forecasts that support air quality conformity determinations.

Conclusion

December 2010’s Best Practice Model peer exchange provided a useful forum that enabled NYMTC modeling staff to sit down with modelers from the MPO’s partner agencies to discuss the current state of modeling and analysis in the New York City Metropolitan Area. The discussion revealed a model that appears to provide a solid foundation for technical analysis for a variety of different applications. Some of these applications include: bridge and tolling studies, transit forecasting for all the regional sub-modes, operations analysis in and around Manhattan, and regional applications that support long-range planning and air quality requirements. Although now over a decade old, the New York Best Practice Model replicates many of the theoretical advancements that have been or will be adopted by larger regions across the United States, and will undoubtedly continue to serve the NYMTC region today and into the future.

As with any travel forecasting model, continual investment is required to support maintenance and updates, and to incorporate improvements that relate to specific analytical needs for evaluating plans, policies and programs. That said, the existing BPM is likely in need of further investment to continue to improve its representation of travel sub-markets – particularly with respect to replicating the geographic distribution of travel. Perhaps these improvements can be attained through the inclusion of additional explanatory variables, or a possible re-specification of the existing model.

NYMTC's model exploration program is likely to identify a range of enhancements that may provide expanded capabilities for evaluating freight and commercial vehicle travel, pricing and tolling alternatives, and the interaction between transportation and land-use. *However, prior to initiating this exploration program, there may be opportunities for NYMTC to implement short-term improvements – at a comparatively low cost – that target the generation and distribution stages of the model* (for both internal and external markets). These improvements could be incorporated within the upcoming model validation effort. This may be a focus area for the planned FHWA Travel Model Improvement Program review. Another suggestion would be to establish a compendium of application “guidelines” for applying the New York BPM – emphasizing a consistent set of recommended practices for developing data inputs (networks, zone structures) and executing the model.