CALIBRATION OF NESTED-LOGIT MODE-CHOICE MODELS FOR FLORIDA

PROBLEM STATEMENT

In recent years, urban policymakers, faced with the growing and complex problems of air pollution and traffic congestion have begun to ask for more sophisticated decision-making tools, including models to forecast travel demand and its effect under various circumstances. Discrete choice models have played an important role in transportation modeling for the last 25 years. They are used chiefly to provide a detailed representation of the complex aspects of transportation demand, based on strong theoretical justifications. The art of finding the appropriate model for a particular application requires from the analyst both a close familiarity with the reality under interest and a strong understanding of the methodological and theoretical background of the model.

Generally, the nested-logit mode-choice model is applied by a set of three model parameters. These model parameters include nesting coefficients, mode-specific constants, and level-of-service coefficients. So far, the common practice in developing a mode-choice model in Florida is to borrow coefficients from other cities (e.g., Minneapolis/St. Paul). Then, the model is implemented by (1) adjusting the modal bias coefficients (constants of the utility equation) to replicate the transit ridership data and (2) examining the validation results to identify any additional adjustments to coefficients or other parameters that were appropriate. The validity of such an approach is questionable, especially considering that the basis for nested-logit mode-choice models in Florida was the Miami model, which was originally borrowed from Minneapolis, which in turn was borrowed from Shirley Highway. This situation stressed the need to develop a Florida model based on Florida travel data.

OBJECTIVES

The initial objective of this research effort was to develop a universal nested-logit mode-choice model for the State of Florida. After intensive investigation of mode-choice modeling in the state, the research team discovered that the foundation for the models was flawed and that basing a universal model on flawed models would be of questionable benefit. Therefore, the focus of the project was modified. New models based on actual Florida travel data were warranted and were possible because of a recently completed major survey in Southeast Florida. The research team sought to calibrate nested-logit mode-choice models, based on Florida travel data, for different trip purposes, and to use those models to replace the ones currently used in the state.

FINDINGS AND CONCLUSIONS

Data from the 1999 travel survey conducted in Southeast Florida were used in the calibration of the models. The travel time and cost of the highway and transit systems, which were obtained from the skim files of the southeast model, were also used in the calibration. The selection of the proper universal nesting structure is critical to the development of a nested-logit mode-choice model. The nesting structure must address the existing transit service as well as provide suitable flexibility to permit the addition of future modes that might be considered. The selection of a nesting structure must also consider the data that are available for estimating the model.

Several alternative nesting structures were investigated. Ultimately, the mode-choice model was estimated as a

three-level nested-logit structure. All models included seven transit mode/access combinations and two highway modes. The transit mode/access combinations were local bus, walk to express bus, walk to metro rail, walk access to tri rail, auto access to express bus, auto-access to metro rail, and auto-access to tri-rail. The highway modes were drive alone and share riding. Also, different models were calibrated for three different trip purposes: home-based work trips (HBW), home-based non-work trips (HBNW), and non-home-based trips (NHB).

Two separate surveys were used in the estimation process. The first was the on-board transit survey, and the second was the household survey. In conducting the 1999 Southeast Florida surveys, the sampling methodology used in the household travel survey was different from the one used in the on-board transit survey. In the household travel survey, sequences of decision makers were drawn and their choice behaviors were observed. In contrast, in the on-board transit survey, sequences of chosen alternatives were drawn and the characteristics of the decision makers selecting those alternatives were observed. This kind of sampling scheme is called choice-based sampling.

Researchers adopted a weighted exogenous sampling maximum likelihood (WESML) methodology to estimate the models. The weights are the ratio of population market shares to the sample (survey data) market shares. The modeling estimation approach was based on the estimation of two nested-logit models, one of which was based on the on-board transit survey and the other of which was based on the household travel survey. The two models were linked through the use of inclusive value of transit.

The transit section of the model was calibrated using the full information weighted exogenous sampling maximum likelihood (FI-WESML) approach. The FI-WESML estimation is the most efficient statistical approach because different nesting levels are estimated simultaneously rather than sequentially, as is the case with a limited information approach. The overall model was also calibrated using Full Information Maximum Likelihood (FIML).

Researchers recommend that the developed models replace the current southeast (SERPM) model. Also, all models used in Miami, Orlando, Tampa, Jacksonville, and Volusia should be re-validated based upon the new model coefficients. Further, they suggest that the concept of a universal model should be revisited and defined clearly, and, if warranted, investigated further in a future research study. The models developed within this project would constitute the basis for such a universal model.

The value of this research is that it will significantly enhance the state of transportation modeling in Florida. In the 1980s, nearly all of Florida's 25 MPO transportation models were highway-only models. Over the past fifteen years, more emphasis has been placed on the transit component of urban travel. Many more cities have adopted transit models, and since the mid 1990s, nested-logit mode-choice modeling has become the preferred method for metropolitan areas served by multiple transit travel modes. One glaring weakness common to all of Florida's eight nested-logit models, however, was that the model equations were borrowed from studies conducted in other regions of the country. All of Florida's nested-logit models were based on the Miami model equations, which were originally developed for Minneapolis and Northern Virginia. This research provides Florida modelers with a nested-logit model that is estimated using travel survey data specific to Florida. The developed model provides a much improved, more accurate foundation upon which to base other Florida nested-logit mode-choice models.

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