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Demand Model Estimation and Validation

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THE URBAN TRAVEL DEMAND FORECASTING PROJECT
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DEMAND MODEL ESTIMATION AND VALIDATION

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EXECUTIVE SUMMARY

The overall objective of the Urban Travel Demand Forecasting Project is to provide transportation engineers and planners with the information necessary to select and use policy-oriented disaggregate behavioral travel demand models, and to assess the applicability and limits of specific alternative models. This volume is devoted to the investigations of demand, forming the core of this project.

The research plan underlying this demand research was to:

- Collect data on a sample of individual commuters in the San Francisco Bay Area before the initiation of Bay Area Rapid Transit (BART) service;
- Predict BART patronage from demand models fitted to the pre-BART data, and
- Compare the predictions with actual BART patronage, using a second survey taken after BART was in service.

Attention was concentrated on work mode-choice. A number of parallel questions in demand analysis were addressed:

- What variables influence demand?
- How does the method of measurement of variables affect demand model estimates?

- What functional forms for demand achieve the multiple objectives of validity, practicality, and simplicity? (In particular, is the multinomial logit (MNL) model, with its structural property of independence from irrelevant alternatives (IIA), a valid forecasting model for a new mode?
- How can socioeconomic and demographic variables be forecast as inputs to transportation policy forecasts?
- How can transportation level-of-service attributes be calculated under alternative policy scenarios without building complete networks?
- To what degree are disaggregate behavioral models transferable from one population to another within, or between, cities?
- How can aggregate travel demands be conveniently calculated from disaggregate behavioral models?
- What is the role of attitudes and perceptions in travel behavior?
- How can disaggregate behavioral models be adapted to equilibration of transportation supply and demand?

The conclusions of the research can be summarized:

- A short list of traditional transportation system attributes (e.g., travel times and costs) explain most travel demand behavior. Socioeconomic variables improve overall fits significantly. Inclusion or exclusion of most socioeconomic variables from the models does not greatly affect the importance attributed to on-vehicle time and costs--thus, policies affecting only these variables may be validly analyzed in models without great socioeconomic detail. Variables that are related to the "availability" of alternatives, such as auto ownership, are extremely important.
- Disaggregate behavioral models fitted to pre-BART data provided relatively accurate forecasts of BART patronage. Forecasting accuracy was significantly better in models with socioeconomic detail than in models employing only traditional transportation variables. The forecasts were best for BART with bus- or walk-access but substantially overpredicted

BART-with-walk-access patronage.

- The use of network travel times, compared with travel times calculated directly from trip timing studies, showed considerable dispersion and some systematic biases. Overall fits were not greatly affected, but implied values of time changed substantially depending on the method of variable measurement used.
- The multinomial logit model is found to provide a valid functional form for a variety of transportation applications. Empirical tests are developed for the independence from irrelevant alternatives (IIA) property, and are not rejected for the travel demand behavior observed by the project.
- A pragmatic method for synthesizing census data into a transportation demand data base at any desired date for policy analysis has been developed.
- Analytic supply models, giving transportation level-of-service attributes as parametric functions of policies and of patronage, provide a relatively inexpensive, policy sensitive supply counterpart to disaggregate demand models.
- Disaggregate behavioral models fail tests of transferability between urban and suburban residents, indicating either significant taste variations with residential locations or geographical variations in network coding practices. There is also some evidence of non-transferability between cities, most probably attributable to differences in variable measurements.
- A market segmentation based on summary "utility levels" of alternatives is found to be a particularly effective method of obtaining reasonably accurate aggregate forecasts. Random sampling from the population is a second effective method.
- Attitude and perception measurements complement traditional transportation measures as explanations of travel behavior, in the sense that adding attitude variables to a model containing traditional transportation variables has little effect on the importance assigned to the traditional variables. Generally, adding attitude variables to a model does not substantially increase its explanatory power.

- Equilibration of disaggregate demand models and parametric supply models in a corridor has been achieved using a computational procedure for approximating fixed points of a mapping. This method provides a practical alternative to conventional network equilibration methods.

Overall, the demand studies summarized in this volume have demonstrated disaggregate travel demand forecasting to be a practical policy-analysis tool. The limitations of the current generation of these models are spelled out, and suggest that considerable care is needed in their application to new mode forecasting, and in transferring models across populations. Some limitations of the models appear to be amenable to improved variable specification, achievable with further research and improved disaggregate data collection.