



Project Summary Report 4198-5

Project O-4198: Evaluation of Travel Demand Models

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Recommendations for Examining Texas Travel Demand Models

Demand for future travel has been modeled since the 1960s using a four-step process that includes trip generation, trip distribution, mode choice, and trip assignment. This modeling process was developed to assist in evaluating major capital improvements, and since that time planning decisions for transportation infrastructure have been based, to a large extent, on the resulting estimates of future travel. Although the models have been improved and refined over the past 40 years, limited research has been conducted to evaluate how well the models predict future travel. The purpose of this project was to perform an evaluation of the current four-step travel demand models used by the Texas Department of Transportation (TxDOT) in a forecasting application.

Most prior efforts to evaluate travel demand forecasts involved a comparison of a previous travel forecast to what was actually observed during the forecast year. These studies found that the root cause of discrepancies between the modeled travel and the observed travel was in the model input data (various socioeconomic characteristics) and the ability to accurately

forecast the input data. No previous research had attempted to examine the accuracy of the travel demand models from the view of the underlying assumptions within the models and within the confines of a controlled experimental design. Because of the emphasis placed on travel forecasts in the decision-making process, a need exists to evaluate how well the models perform.

What We Did...

This project used a controlled experimental design that controlled the effects of the socioeconomic input data and the transportation network, thus allowing the models to be

evaluated. The San Antonio–Bexar County urban area was selected for this research due to the availability of the area’s 1969 origin-destination survey, a 1970 travel model, and the researchers’ knowledge of the area.

The general approach was to utilize the 1970 computerized network and traffic analysis zone population, household, income, and employment data, checked for consistency with the 1970 census data, in conjunction with the 1969 origin-destination survey to calibrate a new 1970 travel demand model. This combination would result in a 1970 model calibrated with current state-of-the-practice procedures that would be used to forecast 1980 and 1990 travel



The San Antonio-Bexar County area served as the basis for model testing.



demand. The socioeconomic model inputs and network for these two forecast years would be controlled by using census data and the networks that actually existed for each of those years. Thus, the travel model results could be evaluated and interpreted relative to the model structure and theory when applied in a forecast scenario. The key element of the research was the development and calibration of a 1970 travel model.

Unfortunately, the San Antonio – Bexar County 1970 network (including links and link attributes), traffic analysis zone system, and model input data (including population, number of households, income, employment, as well as trip production and attraction rates) were no longer available. Additionally, 1970 traffic count data were found for only 35 percent of the network links. Thus, researchers developed the zones, network and link data, input data, and traffic counts using secondary sources. This effort had a number of components:

- 1970 socioeconomic inputs of population and households from the census data at the block level;
- median household income using 1980 census median household income and the Consumer Price Index (median household income for 1970 was not used because median household income was not computed at the census tract level until the 1980 census);
- estimates of zonal employment using employment from the 1969 origin-destination survey;
- 1990 network data used in conjunction with maps of the 1970 network to develop a computerized 1970 network and zonal system; and
- 1970 network link data developed from 1964 street inventories and the 1968 Highway Functional Classification Map.

The 1970 trip production and attraction rates were calculated from

the 1969 origin-destination survey data files using current state-of-the-practice methodology. These rates, along with the zonal data for population, households, income, and employment, created input to the trip generation program TRIPCAL5 to estimate zonal trip productions for home-based work (HBW), home-based non-work (HBNW), and non-home-based (NHB) trips. Total trips for truck/taxi and NHB external-

number of trips estimated to be traveling between each zone (as developed in trip distribution) was assigned to the 1970 network using the speed/capacity look-up table developed for this model and trip assignment model default values representing level-of-service E capacity.

An important part of this research effort was the establishment of a peer

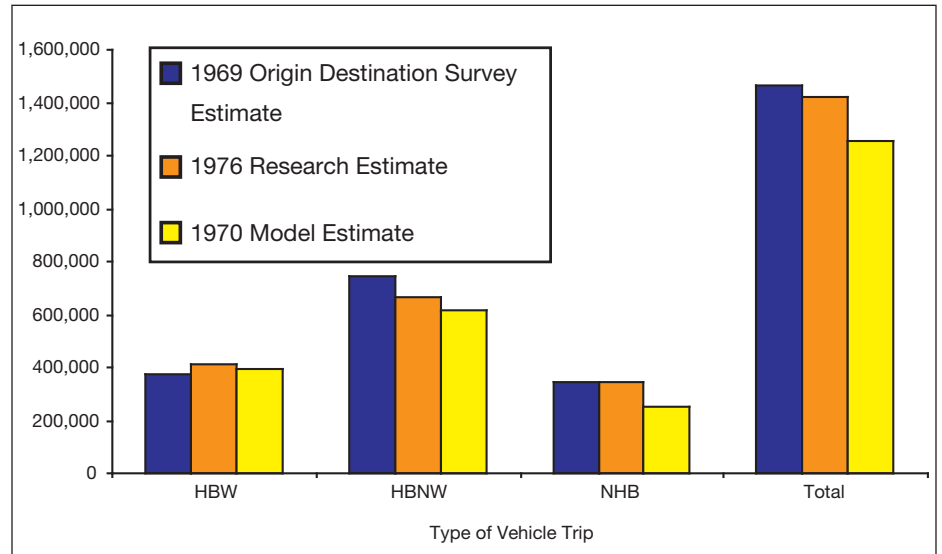


Figure 1. Comparison of 1970 trip generation model results with estimates from the 1969 origin-destination survey and a 1976 research report.

local trips were input directly to TRIPCAL5. The zonal attractions were estimated using attraction rates for these purposes applied to the zonal data and then attractions were adjusted to balance to productions.

Zonal productions and attractions from TRIPCAL5, the impedance matrix, and the trip length frequency distribution for each trip purpose were input to the trip distribution model, ATOM2. ATOM2 is a modified gravity model that produces trip tables for each trip purpose that show the number of trips interchanged between each zone.

Trip assignment used an equilibrium algorithm that is an iterative method that adjusts link speeds after each assignment relative to change in assigned volume. The

review panel. The development and calibration of travel demand models require a great deal of professional judgment, and the potential impact of findings from this project could be significant. As a result, the project team selected a panel of experts in travel demand modeling to provide guidance and comment at critical stages in the research.

What We Found ...

The 1970 trip generation model produced the results shown in Figure 1. The comparison to published estimates of trips for 1969 and 1976 in Figure 1 shows the model produced between 14 percent and 13 percent fewer total trips, respectively. The difference in trips by trip purpose varied.



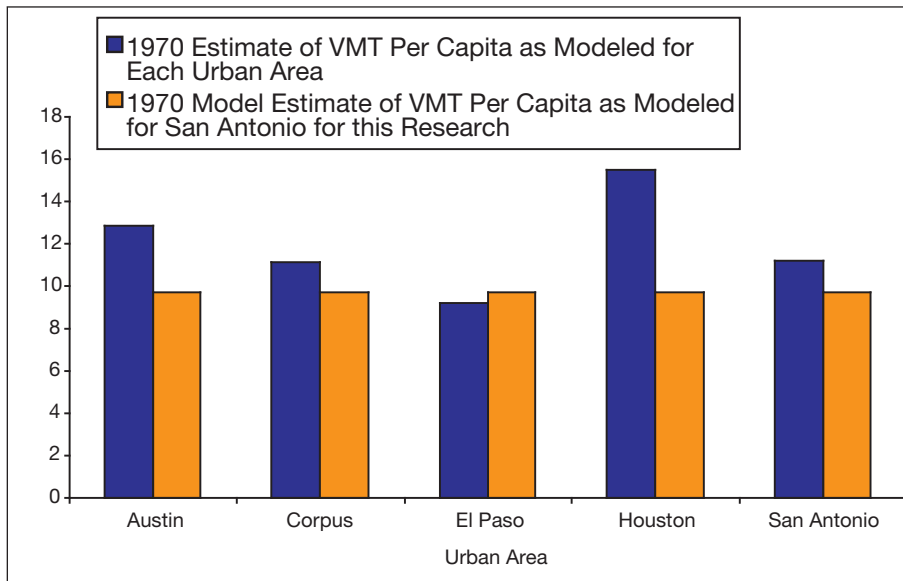


Figure 2. Comparison of estimates of vehicle miles of travel per capita.

The results of the trip distribution model were reasonable. The model matched the desired average trip length, the trip length frequency distribution, and the zonal attractions from the trip generation model for all trip purposes except external-local.

The trip assignment resulted in an assigned total volume on all links less than 1 percent under the sum of vehicle counts (actual and estimated) on all links. This is well within the recommended level of plus or minus 5 percent. Likewise, the 1970 modeled vehicle miles of travel (VMT) were within 1 percent of the counted VMT, which is also within the recommended level of plus or minus less than 5 percent. However, the results, when put in the context of VMT per capita and compared with 1970 modeled VMT for other urban areas and previously modeled San Antonio results (in this case the 1976 research), indicate that the 1970 model estimate is low. As illustrated in Figure 2, the 1970 modeled VMT per capita for San Antonio was lower by between 13 and 37 percent than that for each city except El Paso. The 1970 modeled VMT per capita was also lower by almost 14 percent than that resulting from the 1976 research for San

Antonio and by more than 33 percent than that for the original 1970 model.

The peer review panel reviewed and commented on the results of the 1970 model application. The group felt that the lack of data limited the research effort and created sufficient questions in the results to compromise any research findings. The importance of the research project in terms of its findings and how those might impact current and future modeling efforts warranted a higher standard for model calibration, which was not met in their opinion. The panel agreed that the primary reason the model could not be calibrated was the lack of demographic data (primarily employment) and information on the transportation network and vehicle counts for 1969/1970.

The Researchers Recommend...

The need to evaluate the effectiveness of current travel demand models and modeling practice to predict future travel within the context of a controlled experimental design still exists. The results of this project indicate the need to retain data and

model results to address the original objectives. In light of this, researchers recommend the following actions:

- Retain the transportation network used for the base year model calibration/validation. This network should include all link-data attributes including the saturation counts and estimated counts.
- Retain the zone system used in the base year for model calibration/validation in electronic form.
- Retain the saturation count maps for the base year in an electronic form. These maps should delineate the facility name, location, and vehicle count and document whether they represent average daily traffic adjusted for seasonal and axle loadings, annual average daily traffic, and/or axle counts divided by two.
- Retain the TRIPCAL5 setup (final) used in the base year model calibration/validation. This file will reflect the trip rates, area type equivalencies, demographic data, special generator data, and any add-on trips that may have been used in the final model runs.
- Retain the trip distribution model setups and runs for the base year model calibration/validation. These data files should contain the average trip lengths by purpose and trip length frequency distributions used in model calibration. In addition, the final calibrated friction factor curves by trip purpose should be contained in separate, clearly delineated files.
- Retain all of the trip tables by purpose, including the external-local and external-through trip tables, in TransCAD or a compatible format.
- Retain the results of each step of the base year model calibration/validation. These steps would include trip generation, trip distribution, mode split (if used), and trip assignment.



For More Details . . .

The research is documented in report 4198-2, *Calibration of a Past Year Travel Demand Model for Model Evaluation*.

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Because the 1970 travel demand model could not be calibrated, the peer review panel recommended establishing “a framework for the archiving of data and information in travel demand models” for each urban area. This framework could be used by TxDOT and metropolitan planning organizations so that in the future, similar model evaluations could be successfully conducted. The framework is included in the final research report.

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Disclaimer

This research was performed in cooperation with the Texas Department of Transportation and the U.S. Department of Transportation, Federal Highway Administration (FHWA). The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the FHWA or TxDOT. This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. Trade names were used solely for information and not for product endorsement. The researcher in charge of this project was Mr. David F. Pearson.