DEVELOPMENT OF FSUTMS LIFECYCLE AND SEASONAL RESIDENT TRIP PRODUCTION MODELS FOR FLORIDA URBAN AREAS

Contract No. BC532

Prepared for

State Transportation Planner
Systems Planning Office
Florida Department of Transportation
605 Suwannee Street, MS 19
Tallahassee, FL 32399-0450

Prepared in Cooperation with the State of Florida Department of Transportation

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March 2003

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
Supplemental Report for BC532		

4. Title and Subtitle	5. Report Date
TRIP GENERATION MPO SURVEY SUMMARY – A SUPPLMENTAL REPORT	March 2003
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Fang Zhao, Lee-Fang Chow, Min-Tang Li, Albert Gan	

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Lehman Center for Transportation Research, Department of Civil and Environmental Engineering, Florida International University, Miami, Florida 33199	11. Contract or Grant No. Contract No. BC532

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Systems Planning Office, Florida Department of Transportation, 650 Suwannee Street, MS 19, Tallahassee, FL 32399-0450	Final Report March 2000 – March 2003
	14. Sponsoring Agency Code 99700-3596-119

15. Supplementary Notes

16. Abstract

As part of the project, a survey of Florida Metropolitan Planning Organizations (MPOs) was conducted in 2001. The survey results were summarized in this report. The survey covered issues in the following areas:

- Agencies responsible for developing socioeconomic data;
- Frequency of model updates;
- Existing travel survey data;
- Anticipated survey in the future
- Data and methods used to estimate or project socioeconomic variables for standard FSUTMS model;
- Data and methods used to estimate or project socioeconomic variables for lifestyle FSUTMS models;
- Problems with special generators; and
- Possible improvements to trip generation models.

Accuracy of socioeconomic data, availability of household survey data, a lack of standard methodologies and procedures for forecasting lifestyle variables, special trip generators, the inability to handle trip chaining, and trip rates for seasonal and retired households were identified as problems requiring more attention.

17. Key Word	18. Distribution Statement
Trip Generation, Lifestyle Models, Lifestyle Variables, Variable Forecasting, Retired Households, Seasonal Households, Household Survey, MPO.	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified.	Unclassified.	148	

ACKNOWLEDGEMENTS

We would like to thank many people who helped in this study, especially Mr. Mike Neidhart of Volusia County MPO, Mr. Glen Ahlert of Lee County, Mr. Imran Ghani of FDOT District 2, Mr. Daniel Lamb of FDOT District 7, Mr. Wade White of Gannet Fleming, Mr. Robert Shiffer of PBSJ for providing survey data used in this study and related technical reports. The project team is also grateful to the members of the Florida Model Task Force for their technical guidance and advice. Special thanks go to Mr. Imran Ghani and Mr. Harry Gramling, the project managers, for their guidance, support, and help throughout the study.

This project was funded by the Research Center of the Florida Department of Transportation. The opinions, findings and conclusions expressed in this publication are those of the authors and not necessarily those of the State of Florida Department of Transportation.

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EXECUTIVE SUMMARY

INTRODUCTION

Like many other urban areas in the U.S., the travel demand models used in Florida are four-step models. The first step is trip generation that estimates trip productions and attractions. The most important aspect of trip production is the determination of a set of household trip production rates for different trip purposes. Prior to 1995, trip rates had been solely based on household characteristics including dwelling type, household size, and vehicle ownership. In the early 1990s, following a national trend, research began in Florida to investigate lifestyle trip production models. Lifestyle models consider family lifestyles and use variables such as numbers of adults or workers, retirees, children, age of householders and children, etc., in a household to help predict trip production. The development of lifestyle models was motivated by recognitions such as that the standard household size based models overestimated work trips for retired households, this being especially significant in this study because of the large number of retirees living in Florida. The 1995 Tampa Bay Regional Model and the 1996 Broward County Model became the first lifestyle models in Florida. In the late 1990s, more and more urban areas in Florida became interested in lifestyle models. Some MPOs have already adopted or are considering adopting lifestyle models. More MPOs are interested but are unsure if it would be worthwhile to adopt a lifestyle model and which lifestyle model they should consider. A few MPOs are not interested in lifestyle models because they believe that the characteristics of their urban areas would not lend well to lifestyle models. Such believes lead to an important question: under what conditions will lifestyle models perform better than the traditional models? This research, therefore, was designed to help answer this and other relevant questions. It was a statewide effort by the Florida Department of Transportation (FDOT) to evaluate the needs for other Florida urban areas to adopt lifestyle models and the feasibility of developing a set of standard lifestyle trip production rates.

The usefulness of lifestyle variables in travel demand forecasting has been examined since the 1960s but the results have not been conclusive. This study took advantage of the recently available household survey data in several urban areas in Florida and examined the benefits of lifestyle models. In particular, the research was focused on answering the following questions:

(1) Do lifestyle models perform better than household sized based models?
(2) What types of urban areas will benefit from lifestyle models?
(3) Are lifestyle models developed in one urban area transferable to other urban areas?
(4) Do seasonal households have a lifestyle and trip generation rates different from those of retired households, thus warranting special treatment?

This report discusses the procedure and results of analyses of household travel survey data from three Florida urban areas. The analyses involved calibrating trip production rates using the two Florida lifestyle models for home-base work (HBW) trip, home-based shopping (HBS), home-based social-recreational (HBSCR), and home-based other (HBO) trip purposes. The performance of the lifestyle models was evaluated by comparing the predictions from lifestyle models and those from the standard FSUTMS trip production model (thereafter referred to as the

standard FSUTMS model) against the expected trips based on survey and census data. Trip rates for seasonal households were also analyzed to determine if seasonal household shared similar travel behavior as retired households and if a separate set of trip rates were needed for seasonal households.

LITERATURE REVIEW

The review focuses on research that helps answer the following questions:

- What kinds of lifestyle models have been developed and where have they been applied?
- What data for these lifestyle variables are available?
- Are lifestyle models transferable to other urban areas?
- How are lifestyle model variables forecast?

Lifestyle Trip Production Models in Florida

There are currently two lifestyle model structures in application, which employ different set of stratification variables:

Tampa Bay Regional Model (applied in Citrus, Hernando, Hillsborough, Pasco, and Pinellas counties)

- All Trip Purposes
  - Working households without children
  - Working households with children
  - Retired households
  - Seasonal households
  - Vehicle ownership (0, 1, 2, 3+)

The Southeast Florida Lifestyle Model (applied in Broward, Palm Beach, Miami-Dade, Martin, Indian River, and St. Lucie counties)

- Home-based work trip purpose
  - Workers in household (0, 1, 2+);
  - Presence of children (with children, without children); and
  - Vehicle ownership (0, 1, 2, 3+).
- Other trip purposes (home-based shopping, home-based social/recreational, home-based school, and home-based other trip purposes)
  - Household size (1, 2, 3, 4+)
  - Presence of children (with children, without children)
  - Vehicle ownership (0, 1, 2, 3+)

Lifestyle Trip Production Models Outside Florida

A number of urban areas in the U.S. have also developed models that incorporated lifestyle variables such as Atlanta, Detroit, Reading Pennsylvania, Puget Sound, New York, and Phoenix. The lifestyle variables used in their models included number of workers, lifestyle categories based on the age of the household head, presence of children, and age of children, household

type (with retirees, with workers and without children, with workers and with children, without retirees and without children, without retirees and with children), etc.

Lee County Trip Generation Model for Seasonal Residents

According to a 1992 Lee County study, significant differences existed between seasonal and permanent residents in terms of number of trips per household, percent of trips by purposes, average household size, average trip lengths, vehicle occupancies, and time-of-day of travel (PBSJ 1992). Seasonal residents, who were mostly retirees, made relatively fewer work trips but more shopping trips than permanent residents. The study recommended the restructuring of the FSUTMS trip generation model to permit separate trip rate matrices for permanent and seasonal households to benefit urban areas that had a significant number of seasonal residents.

Comparison with Traditional Models

The lifestyle variables have been shown to improve trip generation forecasting through the inclusion of measures of household structure and residential location in existing travel forecasting procedures (Allaman et al. 1982, Chicoine and Boyle (1984). However, Simonsen and Neveu (1985) found no improvement in HBW work trip estimates from lifestyle models when compared to a traditional household sized based model.

Data Availability

The availability of socioeconomic data with suitable variable segmentation is a critical consideration in adopting a particular lifestyle variable. Therefore, a lifestyle classification scheme using readily available data is desirable for practicality.

One main source of data is the census. FDOT Central Office obtained special tabulations, STP 266 and STP 283, derived from the 1990 census. Data included in the STP 266 and STP 283 provided statistics of household based on the existing FSUTMS trip generation model, the Southeast Florida model, and the Tampa Bay Regional Model.

Temporal and Spatial Stability and Forecastibility of Lifestyle Variables

For a model to be able to predict future travel demand, its land use relationship with trip making must be reasonably stable over a long period of time between the base year and forecast year. Walker and Peng (1991) found that models based on household size stratification were generally unstable, income-based models were more stable, and models based on automobile ownership strata were the most stable over time. They also concluded that a trip generation model based on auto ownership or area type or both produced reasonably stable trip generation results for different trip purposes and total household travel. Kollo and Purvis (1984) found that the overall household trip generation rates did not change significantly over time. Kitamura and Kostyniuk (1986) concluded that the effect of automobile ownership had declined between 1960 and 1974, and that lifestyle stage in 1974 influenced many aspects of household travel behaviors, particularly the total number of trips, more than vehicle ownership did.

A standard trip production model must exhibit the ability to be transferable from one area to another without losing the validity of the basic relationships in the model. A study by Chicoine and Boyle (1984) on the lifestyle-based trip rates calibrated from the 1973 Niagara Frontier Transportation Committee (NFTC) data and the 1974 Genesee Transportation Council (GTC) data concluded that the NFTC trip rates were generally replicable using the GTC data.

The forecastibility of variables means that the variables can be forecast for future with reasonable ease, an important criterion that a new model must satisfy. Forecasting methods vary and land use models, population and housing disaggregate models, multiple regression models, cohort-component methods, and nested logit models are some that have been reported.

A BRIEF SUMMARY OF A TRIP GENERATION MPO SURVEY

A survey of MPOs in Florida was conducted in the fall of 2001 to collect information related to FUSTMS trip generation models to identify current practices in data collection, data preparation for base year models, forecasting of data for future year models, and problems and issues encountered by MPOs in trip generation. The survey collected information in the following areas:

- Agencies responsible for developing socioeconomic data;
- Frequency of model updates;
- Existing travel survey data;
- Anticipated survey in the future;
- Data and methods used to estimate or project socioeconomic variables for standard FSUTMS model;
- Data and methods used to estimate or project socioeconomic variables for lifestyle FSUTMS models;
- Problems with special generators; and
- Possible improvements to trip generation models.

Twenty-five survey forms were mailed out, of which 14 were returned, 13 from MPOs and one from FDOT District 7 (Tampa Bay). Complete survey responses may be found in a supplementary report (Zhao 2003). The findings from the MPO survey included:

1. Lacking of household survey data. Many counties have not conducted household surveys in the past nor have they had a plan to conduct household surveys in the future. This means that these counties will need to borrow trip rates from other urban areas if lifestyle models are to be adopted. While borrowing trip rates may be acceptable, opportunities to identify local unique travel patterns and behaviors in their own areas may be missed.

2. There is no standard method and procedure for forecasting lifestyle variables for future year models. Different methodologies are currently used by the MPOs.

3. Many MPOs did not indicate an interest in lifestyle models, possibly because of lack of information. It is hoped that this report and the newly released 2000 census data will

help the MPOs be more informed about lifestyle models thus to be able to make a decision as whether to look into lifestyle models or not.

DATA USED FOR STUDY

For this research, the lifestyle models were applied to three participating MPOs/MSA: Lee County MPO, Volusia County MPO, and the Jacksonville MSA[1]. These urban areas were selected based on the fact that they had recent household survey data and were not using a lifestyle model.

The data used in the analysis included the Lee County Urban Travel Characteristics Study surveys conducted in 1992 targeting specific quotas of both permanent and seasonal households (PBSJ 1993), the 2000 North Florida household survey conducted in Clay, St. Johns, Nassau, and Duval counties (Jacksonville MSA), and the 2001 Volusia County household survey. Additional data included the 1990 census special product STP 266 and STP 283.

CALIBRATION AND EVALUATION OF TRIP PRODUCTION MODELS FOR HBW TRIPS

Survey Districts

To reach valid conclusions about the entire study population based on the survey results and for the purpose of model performance evaluation, it was necessary to expand the survey data to arrive at total trips at district and regional levels. In this study, to expand the data based on geographic location, the surveyed households were first grouped into several districts according to their spatial locations. For Lee County, since no survey districts were defined for the survey, five districts were created based on postal zip codes. The Jacksonville region was divided into eight survey districts, and Volusia County was divided into six geographic regions.

Average HBW Trip Rates in Survey Districts

The household samples were grouped into the survey districts according to their locations, and the average HBW trip rates for each survey district as well as the entire MPO/MSA were calculated. The differences between the average HBW trip rates for a given district and the MPO/MSA-wide mean trip rate were analyzed to examine if the trip rates sampled from different regions in a given urban area were significantly different. The results showed that the Jacksonville MSA and Lee County MPO only needed one set of trip rates while for Volusia County MPO, two sets of HBW trip rates were necessary.

Survey District and Region-Wide Total HBW Trips

For evaluation purposes, total HBW trips expanded from the survey were necessary to provide a benchmark against which different models could be compared. Trips were expanded from the survey data for each district by multiplying the total number of households with workers by the

[1] Metropolitan Statistics Area defined by the U.S. Census Bureau.

average HBW trip rate of that district. The expanded trips were interpreted as the expected district-wide HBW trips and were used for comparison purposes. The 1990 census STP 266 data were employed to estimate the total HBW trips in each district of the three urban regions.

Region-Wide Mean Trip Rates

Based on the expected total HBW trips, region-wide mean trip rates and their 95% confidence intervals were complied, which are shown in Table E.1. These mean trip rates and their confidence intervals were used to the best way to calibrate trip rates as described next.

Table E.1 HBW Trip Rate Statistics for Survey Districts for the Three Urban Regions

MPO/MSA	Region-Wide HBW Trip Rates	Variance	95% confidence interval
Lee County	1.74	0.1001	(1.54, 1.93)
Volusia County Districts 1, 2	1.48	0.0810	(1.32, 1.63)
Volusia County Districts 3, 4, 5, 6	1.83	0.0883	(1.66, 2.00)
Jacksonville MSA	2.14	0.0792	(1.98, 2.29)

Calibration of Trip Rates and Comparisons of Model Estimates with Expected Number of Trips

Three methods (cross-classification, multiple classification analysis (MCA), and adjusted MCA) were used to calibrate HBW trip rates and the method with the best results was selected. The HBW trips estimated based on the lifestyle models and the standard FSUTMS model were compared with the expected district totals.

For Lee County, the differences between the predicted and expected HBW trips at the region and district levels indicated that the Tampa Bay model provided better HBW estimates than the standard FSUTMS model. Although the difference between the two models was small at the regional level, it was significant for District 1, which also had the largest number of HBW trips among the districts.

For Volusia County, the Southeast Florida and Tampa Bay models performed similarly with the former performed marginally better. For District 1, which had the largest number of HBW trips, the Tampa Bay model yielded the largest improvement.

For the Jacksonville MSA, the Southeast Florida model structure resulted in the smallest difference from the expected HBW trips at both district and regional levels, although at the regional level the differences between different models were rather small.

COMPARSION OF MDOELS FOR HOME-BASED NON-WORK TRIPS

The same procedures for calibrating and evaluating HBW trip production models were applied in the analyses of trip rates of HBNW purposes.

Home-Based Shopping Trips

For the Jacksonville MSA, two sets of HBS trip rates were calibrated. The HBS trips estimated from the lifestyle models and the standard FSUTMS model were compared with the expected regional and district totals. For Lee County, all three models performed similarly, although the Tampa Bay model provided slightly better estimation at region and district levels than the other two models. For Volusia County, again all three models had similar performance with the Southeast Florida model performed slightly better. For the Jasonville MAS, the Tampa Bay model performed the best, which brought 9.2% and 7.4% improvements over the standard FSUTMS model at both the district (District 3) and regional levels.

Home-Based Social and Recreational Trips

For the Jacksonville MSA, two sets of HBS trip rates were calibrated. Similar to the results for the HBS trip purpose, the Tampa Bay model performed slightly better than the other two models at both district and regional levels for Lee County, although the differences were smaller (within 3%). For Volusia County, the Southeast Florida model structure provided better approximations of both district and region-wide expected trips although the results produced by the other two models were close. For the Jasonville MSA, since the overall average trip rates from the Southeast Florida and standard FSUTMS models fell outside the 95% confidence intervals, both models significantly overestimated the HBSR trips. The Tampa Bay model, on the other hand, was statistically valid and the comparison indicated that Tampa Bay model provided better HBSR estimates.

Home-Based Other Trips

Again, for the Jacksonville MSA, two sets of HBO trip rates were calibrated. A comparison of the performance of three models for the three urban areas showed that in all cases, the Tampa Bay model structure produced better results at both district and regional levels.

SPATIAL TRANSFERABILITY OF TRIP RATES

If lifestyle models are transferable, many counties in Florida will be able to borrow lifestyle trip rates from MPOs that share similar demographics. For this purpose, the spatial transferability of the trip rates from the lifestyle models was investigated by comparing the trip rates of Lee County, Volusia County, and the Jacksonville MSA using the Wilcoxon Rank-Sum test. Ten percent difference in trip rates was used as the criterion for overriding the results of the Kruskal-Wallis test (Schimpeler-Corradino Associates 1980).

The test results showed that the HBW trip rates for Lee County and Volusia County were closer, probably due to their similarity in demographics as both had a significant population of retirees. The HBNW trip rates were tested as a whole instead of being separated into HBS, HBSR, and HBO trip purposes and home-based school trips were excluded from the total HBNW trips due to the differences in the surveys (trip purpose definition, reporting requirement, household size definition, and age definitions of children). Again, the test results showed the combined HBNW trip rates for Lee County and Volusia County were closer to each other for most cells than they

were to those for the Jacksonville MSA. Results indicated replicability for the HBW and combined HBNW trip rates between Lee County and Volusia County.

ANALYSIS OF TRIP RATES OF SEASONAL HOUSEHOLDS

Based on data collected in Florida so far, seasonal households seem to share certain similarities with retired households when compared with the other types of permanent households in a given urban area. For example, seasonal household members are usually unlikely to be full-time or part-time workers or children. Therefore, it is possible that seasonal and retired households may share similar characteristics in travel behaviors, including trip productions. In this research, trip productions by seasonal households are analyzed to determine whether their household structures and trip generation rates actually resemble those of the retired households and, as a result, whether separate sets of trip rates are necessary for seasonal households.

Analysis of Trip Rates of the Tampa Bay Seasonal Households

From an analysis of the data on seasonal household trip making from 1996 and 2000 household surveys conducted in Tampa Bay, it was observed that:

- The average sizes of the seasonal and retired households were similar, while the average size of non-retired households with children was much larger.
- At the household level, seasonal and retired households produced about the same number of trips per household, while working households produced significantly more trips.
- Working households with or without children on average owned about two vehicles per households, while seasonal and retired households owned 1.14 and 1.36 vehicles per household, respectively.
- Seasonal and retired households rarely made HBW or HBSCH trips but significantly more HBS and HBSR trips. The differences in HBO trips were also noticeable.
- Retired households seemed to be more active than seasonal households.

Wilcoxon Rank-Sum Tests showed that seasonal households might share similar trip rates with the following household groups:

HBW: none
HBS: working households with children
HBSR: retired households
HBO: working households without children

The above results suggested that a separate set of trip production rates was necessary for seasonal households since they did not share similar trip rates with any specific household group. However, based on an analysis of the trip rates of different vehicle ownership groups, it was found that the number of vehicles did not appear to influence the number of trips a seasonal household would produce. Consequently, there is no need to further stratify seasonal households by auto ownership.

Analysis of Trip Rates of the Lee County Seasonal Households

Data from the 1992 Lee County Urban Travel Characteristics Study surveys were analyzed in a similar manner. The seasonal and retired households' travel behaviors were similar to those in the Tampa Bay area except that seasonal households in Lee County were more active and made more trips than their counterparts in the Tampa Bay region.

Wilcoxon Rank-Sum Tests showed that seasonal households might share similar trip rates with the following household groups:

HBW: one-vehicle seasonal and retired households
HBS: seasonal households and working households with children
HBSR: seasonal and retired households
HBO: seasonal and retired households and seasonal and working households without children.

The test results suggested that seasonal households needed their own trip rates and that there was no need to further stratify seasonal households by auto ownership.

Potential Impact of Separate Trip Rates for Seasonal Households

Given that the ratio of seasonal households to permanent households varies greatly from county to county or even within a county, it is necessary to examine the effect of not having a separate set of trip rates for seasonal households to be able to make a decision on whether or not seasonal households warrant special treatment.

If no separate set of trip rates is to be applied to seasonal households, and instead trip rates for permanent households are to be used for seasonal households, there will be errors introduced into the calculation of total trips. Assuming seasonal households will be treated as retired households, the errors will grow with the ratio of seasonal to permanent households and the difference in trip rates for seasonal and retired households. The maximum errors for Lee County were estimated to be 7.98% if FSUTMS model structure was used, -11.93% if the Tampa Bay model structure was used, and 9.23% if the Southeast Florida model structure was used. The maximum errors for the Tampa Bay region were estimated as 29.29% if FSUTMS model structure was used, 12.28% if the Tampa Bay model structure was used, and 30.14% if the Southeast Florida model structure was used.

In Florida, the county that had the highest seasonal to permanent household ratio according to the 2000 census was Walton County (46.6%) (see Appendix A). While this ratio was high at county level, it might be even higher in areas within a county where seasonal residents congregate. The highest ratio of seasonal to permanent households in percentage reached 448.07% at census block group level in Walton County. For Lee County, the countywide seasonal households were 20.94% of the permanent households. In some areas, however, this percentage reached 1365.38%. An MPO will need to study the seasonal household distribution within its urban area to determine if an effort should be made to collect data on seasonal household travel behavior

and use a separate set of trip rates for seasonal households. When the ratio between seasonal households and permanent households is low, e.g., less than 20% (state average is 7.62%), or when the number of seasonal households is small even when they are concentrated in a few areas, they may be treated as permanent households without resulting in significant errors. On the other hand, if the ratio of seasonal to permanent households is high in some areas and the number of seasonal households is also large, then it may be appropriate to model the seasonal households separately.

CONCLUSIONS

This research attempted to answer questions regarding the benefits of lifestyle models, the spatial transferability of lifestyle models, and the need to consider seasonal households as a separate household type. Procedures were developed for evaluating two Florida lifestyle trip production models using the household travel survey data from Lee County MPO, Volusia County MPO, and the Jacksonville MSA. The numbers of trips of different purposes predicted by the lifestyle and FSUTMS models were compared with those expanded from the survey data based on the geographic locations of sampled households.

The results from this study indicated that lifestyle models improved the trip production estimations for the four trip purposes for all three Florida urban regions to different degrees. Areas with more retired population were found to benefit more from lifestyle models when HBW trips were concerned. For example, Lee County and Volusia County both had an above average percentage of retired population, at 25.41% and 22.12%, respectively. The improvements from the Tampa Bay lifestyle model were up to about 10 percent at the district level. However, the size of the retired population in an urban area should not be used as the sole basis for adopting or rejecting lifestyle models, since the spatial distribution of retired population will also affect a model's ability to produce accurate results in sub-areas. In the case of Lee County and Volusia counties, the most significant improvements were at district level, particular the districts that contained the central business districts.

The lifestyle models also performed better than the current FSUTMS standard models for HBNW trip purposes. In particular, the Tampa Bay lifestyle model performed better for the HBS, HBSR, and HBO trip purposes for Lee County and the Jacksonville MSA. For Volusia County, the Southeast Florida lifestyle model performed better for HBS and HBSR trip purposes while the Tampa Bay model performed better for the HBO trip purpose. However, the performances of the lifestyle models were not significantly different except in the cases of HBS and HBO trips for the Jacksonville MSA.

Tests of spatial transferability of HBW trips offered evidence that trip rates might be applied to different urban areas if they shared similar demographics. However, other characteristics of population, such as the size of seasonal residents, also need to be accounted for. Studies of more urban areas will be needed to draw more definite conclusions.

Based on the Lee County and Tampa Bay survey data on seasonal households, no consistent similarities in the trip rates could be found between the retired and seasonal households. For

example, the seasonal households seemed to share more similarities with the retired households in Lee County than in the Tampa Bay area. Additionally, the seasonal households in Lee County appeared to be more active than those in the Tampa Bay area. Possible reasons may include, for example, the age and income of the seasonal household members and land use patterns thus opportunities for activities. However, due to inadequate information, the causes for the differences in the seasonal household trip rates between the two urban areas cannot be identified. Therefore no firm recommendations can be made regarding possible borrowing of trip rates for seasonal households. More research is necessary to further understand the travel behaviors of seasonal households.

The results from this study evidenced the strength of lifestyle models in estimating travel demand. However, due to the lack of reliable data for model validation, it remains a challenge to estimate the amount of improvement resulting from adopting a lifestyle trip production model. For instance, the HBW trip production estimates based on lifestyle structure may be compared to the 2000 census data on work trips, which will be released as part of the Census Transportation Planning Package. More research will be needed to quantify the benefits and costs for implementing and maintaining a lifestyle trip production model.

RECOMMENDATIONS

Based on the results of this study, the following recommendations are made:

- In deciding on whether to switch to a lifestyle model or stay with the current standard FSUTMS model, individual MPOs need to examine the potential benefits. The benefits may be estimated based on the size of the retired population and seasonal population. In addition to potential region-wide improvement, the spatial distribution of retired population and seasonal households also need to be carefully examined to determine if there are significant enclaves of such population and whether a lifestyle model should be adopted if they are present. In particular, if seasonal households are fewer than 10% of the permanent households region-wide and in sub-areas, separate trip rates for seasonal households will not be necessary (the state average of seasonal to permanent household ratio is 7.62). In Appendix A, county level demographic information from the 2000 census is provided, which includes the percentage of retired population (defined as population over 65 years of age) and seasonal households as a percentage of permanent households. In Appendix B, the spatial distributions of retired population and seasonal households are illustrated for each county at census block group level.

- The adoption of a lifestyle model may include the need of conducting household survey to develop local trip rates and calibrating a new lifestyle trip production model if trips rates are not borrowed from another area, and updating and forecasting the socioeconomic data for the lifestyle variables. Currently, there are no standard procedures for forecasting or updating lifestyle variables for a non-census year in Florida. As a result, some MPOs may hesitate to switch to lifestyle models even if they believe that lifestyle models will be beneficial. Therefore, it is recommended that more research

be conducted to develop a methodology and the necessary tools for lifestyle variable estimation and forecast.

- If a lifestyle model is to be adopted, the decision will need to be made regarding the selection of a specific model structure. For areas with a large retired and seasonal population, the Tampa Bay model structure is recommended since HBNW trips will be relatively more important. For areas with a small retired or seasonal population, the HBW trips will be relatively more significant. Since the Southeast Florida HBW trip production model is more disaggregate, it may be able to produce more accurate results for such an area. However, careful design of household survey is necessary to ensure that adequate samples are available for cells that often have few household samples, such as households with low vehicle ownership.

- MPOs may compare their urban characteristics with those of other urban areas that share similar demographics, especially the retired and seasonal population, in deciding which set of trip rates may be borrowed.

- It is recommended that trip rates for seasonal households not be stratified by vehicle ownership or household size and that a single trip rate be use for each trip purpose.

To facilitate the development of standard trip rates in the future, it is also recommended that survey design to be as standard as possible, at least for the same model structures. This may include standard definition of trip purposes, trip reporting requirements, and household and household member information.

1. INTRODUCTION

Like many other urban areas in the U.S., the travel demand models used in Florida are four-step models. The first step is trip generation that estimates trip productions and attractions. The most important aspect of trip production is the determination of a set of household trip production rates for different trip purposes. Prior to 1995, trip rates had been solely based on household characteristics including dwelling type, household size, and vehicle ownership. In the early 1990s, following a national trend, research began in Florida to investigate lifestyle trip production models. Lifestyle models consider family lifestyles and use variables such as numbers of adults or workers, retirees, children, age of householders and children, etc., in a household to help predict trip production. The 1995 Tampa Bay Regional Model and The 1996 Broward County Model became the first models in Florida to adopt life style trip generation models. The development of the lifestyle models was motivated by recognitions such as that the standard household size based models overestimated work trips for retired households, this being especially significant in this study because of the large number of retirees living in Florida.

In the late 1990s, more and more urban areas in Florida became interested in lifestyle models. In fact, several urban areas including Miami-Dade, Palm Beach, Martin, Indian River, and St. Lucie county Metropolitan Planning Organizations (MPOs) have either implemented or are in the process of implementing lifestyle models. Several counties including Lee and Volusia counties are considering the possibility of adopting a lifestyle model in their model update effort. More MPOs are interested but are unsure if it would be worthwhile to adopt a lifestyle model and which lifestyle model they should consider. In fact, according to the results of a survey of the MPOs in Florida conducted as part of this study, some of the MPOs were not interested in lifestyle models because they believed that the characteristics of their urban areas would not lend well to lifestyle models. Such believes lead to an important question: under what conditions will lifestyle models perform better than the traditional models? This research, therefore, was designed to help answer this and other relevant questions. It was a statewide effort by the Florida Department of Transportation (FDOT) to evaluate the needs for other Florida urban areas to adopt lifestyle models and the feasibility of developing a set of standard lifestyle trip production rates.

The usefulness of lifestyle variables (such as numbers of adults, workers, retirees, children, seasonal residents, etc., in a household) in travel demand forecasting has been examined since the 1960s and a number of urban areas in the U.S. have developed models that incorporate lifestyle variables (MTC 1995, Allen and Curley 1997, Barton-Aschman Associates 1983, Portland METRO 1998). There have been studies that evaluated lifestyle models in terms of their capability to improve the prediction of trip production (Allaman 1982, Simonsen and Neveu 1985, Chicoine and Boyle 1984). However, it seems that there have been no definite conclusions regarding the benefits of lifestyle models or the amount of benefits from lifestyle models.

This study took advantage of the recently available household survey data in several urban areas in Florida and examined the benefits of lifestyle models. In particular, the research was focused on answering the following questions:

(1) Do lifestyle models perform better than household sized based models?
(2) What types of urban areas will benefit from lifestyle models?
(3) Are lifestyle models developed in one urban area transferable to other urban areas?
(4) Do seasonal households have a lifestyle and trip generation rates different from those of retired households, thus warranting special treatment?

This report discusses the procedure and results of analyses of household travel survey data from several Florida urban areas. The analyses involved calibrating trip production rates using two Florida lifestyle models for home-base work (HBW) trip purpose and home-based non-work (HBNW) trip purposes including home-based shopping (HBS), home-based social-recreational (HBSCR), and home-based other (HBO) trips. The performance of the lifestyle models was evaluated by comparing the predictions from lifestyle models and those from the standard FSUTMS trip production model (thereafter referred to as the standard FSUTMS model) against the expected trips based on survey and census data.

In the remainder of this report, Chapter 2 summarizes literature on lifestyle models, including the two different lifestyle models structures currently used in Florida, lifestyle models applied elsewhere in the nation, and model evaluation criteria. Literature on model variable selection, data availability and forecastibility, and temporal and spatial transferability is also presented. Chapter 3 provides a brief summary of the findings from the MPO survey, focusing primarily on the lifestyle model applications. Chapter 4 briefly describes the data used in this study. Calibration of trip generation rates using lifestyle models for HBW trip purpose and evaluation of lifestyle models are described in Chapter 5. Lifestyle applications and evaluation for other home-based non-work trip purposes are described in Chapter 6. Chapter 7 analyzes the spatial transferability of the lifestyle model trip generation rates. The difference in trip production rates between retired households and seasonal households is analyzed in Chapter 8. Finally, conclusions and recommendations are provided in Chapter 9 and Chapter 10, respectively. In Appendix A, selected demographic characteristics are tabulated for all Florida counties. Appendix B illustrates the spatial distribution of retired population and seasonal households in 25 urban areas that have a MPO. The information in Appendices A and B is intended to facilitate MPOs' decision as whether they will benefit from adopting a lifestyle model for their urban areas.

2. LITERATURE REVIEW

This literature review is concerned with current practices and research on trip generation models that consider lifestyle and seasonal resident variables. While the calibration of new trip rates and the software implementation of new models are relatively straightforward, the proper design and application of these new models are not. This review focuses on research that helps answer the following questions:

- What kinds of lifestyle models have been developed and where have they been applied?
- What data for these lifestyle variables are available?
- Are lifestyle models transferable to other urban areas?
- How are lifestyle model variables forecast?

The next section provides a brief description of the existing trip generation models in FSUTMS, referred to as the standard FSUTMS models. Section 2.2 reviews current lifestyle models used in Florida and in other urban areas in the U.S., as well as the seasonal resident model developed by Lee County, Florida. Section 2.3 describes various criteria used in past analyses for model selection and evaluation, including the sensitivity tests used to select lifestyle variables for trip production analysis, model comparison, data availability, temporal stability, spatial transferability and variable forecastibility.

2.1 FSUTMS Trip Production

This section provides a brief summary of the trip production models currently used in FSUTMS. Most of the information in this section is taken from the FSUTMS technical report for trip generation (FDOT 1997). FSUTMS uses cross-classification method to estimate trip productions for home-based trip purposes. The process is implemented in a module called "GEN". Home-based trip productions are determined for the following four trip purposes: home-based work, home-based shop, home-based social/recreational, and home-based other. The independent variables used for the production analysis were originally selected following a review of trip generation literature and analysis of origin-destination survey data originally collected. The number of people occupying a dwelling unit, vehicles possessed by a household, and dwelling types were identified as the significant variables in trip production. Subsequently, trip rates were calibrated using these three variables. Additionally, the trip generation characteristics and rates were compared among urban areas in Florida. Urban area samples were combined to create common models for urban areas with insignificant differences in their trip rates. Finally, six standard cross-classification tables were recommended for four home-based production purposes. These matrices were recommended for use in the following areas in absence of locally calibrated trip rates:

- Home-based work (set 1) - All urban areas except Jacksonville and Tallahassee.
- Home-based work (set 2) - Jacksonville and Tallahassee urban areas.
- Home-based shopping - All urban areas in Florida.
- Home-based social/recreation - All urban areas in Florida.
- Home-based other (set 1) - All urban areas except Gainesville and Tallahassee.
- Home-based other (set 2) - Gainesville and Tallahassee urban areas.

As an example to illustrate the structure of the standard FSUTMS trip production models, Table 2.1 shows the first set of the home-based work cross-classification trip rate matrix.

Table 2.1 Standard FSUTMS Home-Based Work Trip Rates for All Urban Areas Except Jacksonville and Tallahassee

Dwelling Type	Vehicle	Household Size				
		1	2	3	4	5+
Single-Family	0	0.40	0.85	1.20	1.50	1.65
	1	0.90	1.55	1.85	1.95	2.00
	2+	1.80	2.25	2.50	2.70	2.80
Multi-Family	0	0.20	0.70	1.00	1.25	1.45
	1	0.70	1.15	1.45	1.70	1.90
	2+	1.25	1.65	1.95	2.15	2.35
Transient		0.95	0.65	0.45	0.35	0.35

The FSUTMS standard trip attraction models were calibrated using multiple regression analysis. Six standard trip rate equations are used to calculate trip attractions in all urban areas for the following purposes: home-based work, home-based shopping, home-based social/recreation, home-based other, non-home-based, and internal-external trips. The non-home-based and internal-external trip rate equations are also used to calculate trip productions.

2.2 Lifestyle Model Structures

This section describes a number of trip generation models that consider lifestyle effects by the metropolitan areas in Florida and other states with an emphasis on stratification structures of the lifestyle trip production models. The seasonal resident model developed by Lee County is also described.

2.2.1 Lifestyle Trip Production Models in Florida

A number of Florida urban regions have implemented lifestyle regional trip production models. They include Broward, Palm Beach, and Miami-Dade counties in Southeast Florida and the Tampa Bay region, which includes Citrus, Hernando, Hillsborough, Pasco, and Pinellas counties. Treasure Coast (Martin, Indian River, and St. Lucie counties) and Volusia County are also currently implementing lifestyle models. The Broward, Palm Beach, Miami-Dade, and Treasure Coast models shared the same structure but were calibrated using separate sets of data and are described in Section 2.2.1.1. The Tampa Bay model is described in Section 2.2.1.2.

2.2.1.1 Tampa Bay Regional Model

The Tampa Bay region conducted an extensive home interview origin-destination survey in 1991 to identify the factors that influenced travel behavior the most (Lamb et al. 1993). Significant variations were found in trip making patterns among three major household categories:

- Households without children;
- Households with children; and
- Households with retirees.

The 1995 Tampa Bay Regional Planning Model (TBRPM) employed a cross-classification model that stratified dwelling units into the above three lifestyle categories. In 1996, another data collection effort was undertaken to update the 1995 model (Gannet Fleming 1999). The data collection also included a survey of seasonal residents. The households were classified into four categories:

- Retired households: households that include at least one retired household member and no full-time employed members;
- Working households with no children: households, other than retired households, with no household members under the age of 16;
- Working households with children: households, other than retired households, with at least one household member under the age of 16; and
- Seasonal households: households whose residents live in the region more than one month, but less than six months per year.

The 1996 updated TBRPM included trip rates for seasonal residents. Since the seasonal population seemed to have trip making patterns similar to those of the permanent retired residents based on information from the seasonal resident survey, the same trip rates were used for permanent retired and seasonal households. As in the Broward and Palm Beach models, a new stratum of auto ownership was added based on the evidence of additional mobility of high auto ownership households found in both the 1991 and 1996 surveys. In 2000, another survey, the West Central Florida Travel Survey 2000, was conducted. The goal of the survey was to capture low auto ownership and seasonal households and those households that utilize transit (Gannett Fleming 2002). The new trip rates with additional home-based school purpose were calibrated based on the combined data collected during the household surveys in 1996 and 2000. The trip rates for seasonal households were separated from retired households and were not dependent on auto ownership. Table 2.2 shows the trip rates for each trip purpose in the new TBRPM.

Table 2.2 Trip Production Rates for the Tampa Bay Regional Planning Model

Trip Purpose	Vehicle	Permanent Resident Household Type			Seasonal Resident Households
		Retired	Working Without Children	Working With Children	
Home-Based Work	0	0.06	0.50	0.60	0.02
	1	0.07	1.45	1.80	0.02
	2	0.15	2.41	3.34	0.02
	3+	0.78	3.33	3.89	0.02
Home-Based Shopping	0	1.00	0.44	0.67	1.51
	1	2.10	1.13	1.65	1.51
	2	2.35	1.26	2.22	1.51
	3+	2.47	1.53	2.55	1.51
Home-Based Social/Recreation	0	0.26	0.22	0.20	0.89
	1	0.86	0.44	0.64	0.89
	2	1.15	0.67	1.14	0.89
	3+	1.44	0.88	1.41	0.89
Home-Based School	0	0.00	0.00	0.17	0.02
	1	0.02	0.07	0.66	0.02
	2	0.05	0.19	1.73	0.02
	3+	0.15	0.55	2.03	0.02
Home-Based Other	0	0.77	0.33	1.06	1.03
	1	1.23	0.75	1.23	1.03
	2	1.65	0.76	1.62	1.03
	3+	1.65	0.89	1.86	1.03

2.2.1.2 The Southeast Florida Lifestyle Model

The FDOT District 4 modified the traditional FSUTMS household classification scheme for the lifestyle trip generation process based on a statistical analysis of the 1991 Palm Beach County and 1996 Broward County home interview travel surveys (Carr Smith Corradino 1997). Two separate sets of variables were used in the enhanced trip production cross-classification model. For the home-based work trip purpose, the variables were workers, presence of children, and vehicle ownership. For home-based shopping, home-based social/recreational, home-based school, and home-based other trip purposes, the variables were number of persons, presence of children, and vehicle ownership. Unlike the FSUTMS standard models, which included home-based school trips as part of the home-based other trips, the Southeast Florida lifestyle model separates home-based school trips from home-based other trips. Furthermore, a new category of auto ownership (three or more autos) was added to reflect the additional mobility of high auto ownership households. For illustration purposes, Tables 2.3 and 2.4 give the Southeast Florida model structures for home-based work and home-based non-work trips, respectively (Carr Smith Corradino 1997).

Table 2.3 Southeast Florida Lifestyle Model Structure for Home-Based Work Trip Purpose

Presence of Children	Vehicle	Workers in Household		
		0	1	2+
Without Children	0 1 2 3+			
With Children	0 1 2 3+			

Table 2.4 Southeast Florida Lifestyle Model Structure for Home-Based Non-Work Trip Purpose

Presence of Children	Vehicle	Household Size			
		1	2	3	4+
Without Children	0 1 2 3+				
With Children	0 1 2 3+				

Similar to home-based non-work trips, the production rates for non-home-based (NHB) trips were also calibrated using the lifestyle cross-classification structure. The NHB trips generated from the production rates for each travel zone were summed to derive the control total for the study area. This control total was then allocated to zones in proportion to the FSUTMS NHB regression equation trip ends. It was believed that this modification had strengthened the generation of NHB trips.

In 1998, both Broward and Palm Beach counties completed their model updates, which involved the adoption of lifestyle trip production models based on the FDOT District 4 study (Carr Smith Corradino 1998, Gannett Fleming 1998).

The Treasure Coast Regional Planning Model (TCRPM) includes the geographic area covering Indian River, St. Lucie, and Martin counties. The trip generation model was updated and calibrated based on the 1995 Treasure Coast Travel Characteristics Survey (Carr Smith Corradino 2000). The trip production models were enhanced with the lifestyle variables. Two model structures, one for home-based work and purpose and one for home-based non-work purposes, were developed with the same stratifications as those of the Broward and Palm Beach models.

2.2.2 Lifestyle Trip Production Models Outside Florida

A number of urban areas in the U.S. have also developed models that incorporated lifestyle variables. This section reviews four such models: the metropolitan Detroit regional model, the Reading, Pennsylvania model, the metropolitan San Francisco Bay regional model, and the metropolitan Phoenix regional model.

2.2.2.1 Atlanta Metropolitan Area

The Atlanta Regional Commission (ARC) travel demand model developed trip production rates for eight trip purposes: home-based work, home-based shopping, home-based grade school, home-based university, home-based other, and three non-home-based trips (journey-to-work, journey-at-work, and non-home-based non-work) (Atlanta Regional Commission 2002). All eight models shared the same basic structure of a 3-way cross-classification matrix of trip rates per household. The three dimensions were persons per household (1, 2, 3, 4+), workers per household (0, 1, 2, 3+), and vehicles available per household (0, 1, 2, 3+). For any two cells in a cross-classification table, if the t-test, which computed the ratio of the difference in the means to the difference in the standard errors of the two groups, indicated that the two means were not significantly different from one another, the two groups of observations might be combined and the new trip rate based on this combined sample represented the trip rate for both cells. There were up to 52 trip rates for each purpose. Tables 2.5 and 2.6 show the trip rates for HBW and HBS purposes, respectively. As indicated in Table 2.5, all worker categories were left un-joined since HBW trip rates increased significantly as the number of workers increases, while Table 2.6 shows that most worker cells were combined with at least one adjacent cell for HBS trips.

Table 2.5 Home-Based Work Trip Rates for Atlanta Regional Commission Travel Demand Model

Persons	Workers	Vehicles			
		0	1	2	3+
1	0	0.0000	0.0000	0.0000	0.0000
	1	1.2226	1.2226	1.3470	1.3470
	2	-	-	-	-
	3+	-	-	-	-
2	0	0.0000	0.0000	0.0000	0.0000
	1	1.2226	1.2226	1.3470	1.3470
	2	2.1000	2.1000	2.5834	2.5834
	3+	-	-	-	-
3	0	0.0000	0.0000	0.0000	0.0000
	1	1.2226	1.2226	1.3470	1.3470
	2	2.1000	2.1000	2.5834	2.5834
	3+	2.9787	2.9787	2.9787	4.1137
4	0	0.0000	0.0000	0.0000	0.0000
	1	1.2226	1.2226	1.3470	1.3470
	2	2.1000	2.1000	2.5834	2.5834
	3+	2.9787	2.9787	2.9787	4.1137

Table 2.6 Home-Based Shopping Trip Rates for Atlanta Regional Commission Travel Demand Model

Persons	Workers	Vehicles			
		0	1	2	3+
1	0	0.2171	0.7314	0.7314	0.7314
	1	0.2171	0.4308	0.4308	0.4308
	2	-	-	-	-
	3+	-	-	-	-
2	0	0.2171	1.4003	1.4003	1.6671
	1	0.2171	1.1924	0.9546	1.6671
	2	0.2171	1.1924	0.7647	0.7647
	3+	-	-	-	-
3	0	1.0706	1.0706	1.5012	1.5012
	1	1.0706	1.0706	1.5012	1.5012
	2	0.8102	0.8102	0.8102	0.8102
	3+	0.8102	0.8102	0.8102	0.8102
4	0	0.9210	0.9210	1.3882	1.3506
	1	0.9210	0.9210	1.3882	1.3506
	2	0.9210	0.9210	1.3882	1.3506
	3+	0.9210	0.9210	2.4485	1.3506

2.2.2.2 Metropolitan Detroit Region

The Southeast Michigan Council of Governments' (SECOG) trip generation model forecast productions and attractions based on travel surveys conducted in 1965 and 1980 (Newhouser 1994). The conventional variables were used to predict the productions for the home-based shopping and home-based other trip purposes, while the lifestyle variables were adopted for the home-based work and home-based school trip purposes. The trip production for the home-based work purpose was determined by a regression equation, while that for the home-based school trip purpose was based on the cross-classification method. The 1980 home-based work production (trip rates) was 1.29 trips per worker. The 1980 home-based school production rates are shown in Table 2.7.

Table 2.7 Home-Based School Trip Rates For Metropolitan Detroit Region

Household Size	Lifestyle Category*	
	1 - 4	5
1 - 3	0.18	1.37
4+	1.52	3.09

* Lifestyle Category:
1 - No children, household head under 35 years of age
2 - No children, household head 35-64 years of age
3 - No children, household head 65 or older
4 - Youngest child under 6, household head any age
5 - Youngest child 6-17, household head any age

2.2.2.3 Metropolitan Phoenix Region

The trip production model in the Phoenix Maricopa Association of Governments (MAG) Travel Demand Model was calibrated using the 1988-1989 home interview survey and 1990 census data (MAG 2002). The trip purposes used in modeling were: (1) home-based work; (2) home-based shopping; (3) home-based primary and secondary school; (4) home-based Arizona State University; (5) home-based university (not ASU); (6) home-based other; and (7) non-home based. For HBW trip purpose, the trip production model used household size, household income level, workers per household, and autos per household as the primary independent variables. Cross-classification was the major calibration technique. For other purposes, in addition to income, household size, the trip production model also accounted for whether the household was situated in a "retirement" zone or not. A zone was classified as a "retirement" zone if 50% or more of its population is retired.

2.2.2.4 *Metropolitan Portland Region*

In the Metro Travel Forecasting Model for Portland-Vancouver Region, the HBW trips were computed solely on the basis of number of workers in a household, with the trip rates shown in Table 2.8.

Table 2.8 Home-Based Work Trip Rates for Portland-Vancouver Region

Workers	Rate
1	1.383
2	2.391
3+	3.887

Home-based shopping productions were generated by a cross-classification model with household size and number of workers as the explanatory variables, while home-based recreation and home-based other trips were generated based on household size and worker status. Tables 2.9, 2.10, and 2.11 show the trip rates for HBS, HBSR, and HBO trip purposes, respectively.

Table 2.9 Home-Based Shopping Trip Rates for Portland-Vancouver Region

HH size	Workers			
	0	1	2	3+
1	0.654	0.365		
2	1.475	0.965	0.668	
3	1.440	1.170	0.937	1.006
4+	1.793	1.807	1.511	1.235

*The resulting trips are multiplied by a calibration factor of 1.2

Table 2.10 Home-Based Recreation Trip Rates for Portland-Vancouver Region

HH size	All household members work	Some household members do not work
1	0.503	0.479
2	0.580	0.881
3	1.166	1.214
4+	.	2.240

*The resulting trips are multiplied by a calibration factor of 1.2

Table 2.11 Home-Based Other Trip Rates for Portland-Vancouver Region

HH size	All household members work	Some household members do not work
1	0.544	0.894
2	1.242	1.628
3	1.449	2.226
4+	.	3.488

*The resulting trips are multiplied by a calibration factor of 1.2

2.2.2.5 Reading, Pennsylvania

In 1994, Pennsylvania DOT funded a project to collect new data and subsequently calibrated a travel demand model for the Reading region (Allen and Curley 1997). Two sets of three-way cross-classification trip production models were developed to stratify households by lifestyle variables. Households were classified based on the presence of retirees and children, the number of workers, and income quartile for home-based work trip purpose. For non-work purposes, the households were stratified by presence of retires, presence of children, number of persons in the household, and income quartile. Tables 2.12 and 2.13 show the structures of these two models.

Table 2.12 Home-Based Work Trip Rates for Reading, Pennsylvania Model

Household Type	Workers	Income Level*			
		1	2	3	4
Household with Retirees	0	0.000	0.000	0.000	0.000
	1	1.306	1.350	1.384	1.615
	2	2.640	2.606	2.672	4.149
	3+	3.740	3.692	2.523	5.888
Household without Retiree, with Children	0	0.000	0.000	0.000	0.000
	1	1.297	1.558	1.833	2.273
	2	2.328	2.464	3.185	2.730
	3+	5.859	5.784	4.951	4.141
Household without Retiree, without Children	0	0.000	0.000	0.000	0.000
	1	1.536	1.517	1.742	1.911
	2	3.337	3.294	3.268	3.440
	3+	5.544	5.473	5.610	6.630

* Income quartile break points were established from 1990 census data:
Level 1 - low 25%, less than $17,500
Level 2 - low to middle 25%, $17,500 to $32,500
Level 3 - middle to high 25%, $32,501 to $49,000
Level 4 - high 25%, over $49,000

Table 2.13 Home-Based Other Trip Rates for Reading, Pennsylvania Model

Household Type	Household Size	Income Level*			
		1	2	3	4
Household with Retirees	1	1.159	1.755	1.779	1.801
	2	2.879	3.252	3.190	3.920
	3	2.879	3.252	3.190	3.920
	4	3.413	6.674	6.764	8.759
	5+	3.413	3.335	3.379	3.422
Household without Retiree, with Children	2	2.473	2.416	2.448	3.995
	3	4.071	3.999	4.136	4.255
	4	3.504	5.664	5.580	7.309
	5+	8.608	8.726	7.593	7.949
Household without Retiree, without Children	1	0.826	1.117	0.862	0.874
	2	1.598	2.314	2.104	1.952
	3	4.244	4.147	2.835	3.323
	4	4.244	4.147	5.485	1.700
	5+	9.101	8.892	9.012	9.127

* Income quartile break points are the same as for Table 6.

2.2.2.6 Metropolitan San Francisco Bay Region

The Metropolitan Transportation Commission (MTC) of the San Francisco Bay area developed a new travel demand model using a major household travel survey conducted in 1990 (Purvis 1997). Except for the home-based school trip production model, the new trip production models were calibrated using multiple regression analysis. The home-based shopping trip production model was a hybrid of a cross-classification model (stratified by workers at the household level) and a multiple regression model. The home-based work and home-based school trip production models are applied to persons who are eligible to take either work or school trips, e.g., workers or students. The following equations specify the regression models for HBW and HBS trip productions.

Home-Based Work

$$\text{Trips/employee} = 1.0525 + 1.632\text{E-}02 \times \text{HHINC} - 2.190\text{E-}04 \times \text{HHINC}^2 + 8.50\text{E-}07 \times \text{HHINC}^3$$

where

HHINC = household income in thousands of 1989 constant dollars

Home-Based Shopping

$$\text{Trips/ZWHH} = 0.3141 + 0.4709 \times \text{PHH} + 0.4034 \times \text{VHH} + 0.02052 \times \text{HHINC} - 0.000131 \times \text{HHINC}^2$$

$$\text{Trips/SWHH} = -0.4419 + 0.7299 \times \text{PHH} + 0.2279 \times \text{VHH} + 0.005123 \times \text{HHINC}$$

$$\text{Trips/MWHH} = -0.4288 + 0.5921 \times \text{PHH} + 0.09071 \times \text{VHH} + 0.009143 \times \text{HHINC} - 6.054\text{E-}5 \times \text{HHINC}^2$$

where

ZWHH = non-working household
SWHH = single-worker household
MWHH = multiple worker household
PHH = average household size (persons per household)
VHH = average vehicles per household

2.2.2.7 Metropolitan Seattle Regional Model

The trip production models in the Puget Sound Regional Council's Travel Demand Forecasting Model were estimated using the 1985-1988 household travel surveys (Cambridge Systmatics 2001a, 2001b). Except for the home-based college and school trip production models, the home-based trip production rates were estimated for each category of households by number of workers and household size. Home-based college trips were estimated based on the number of persons age 18 through 24 in a household, while home-based school trips were estimated based on the number of persons age five through 17 in a household. Table 2.14 gives the home-based work trip rates by household classification. These two numbers in each cell represent the trip rates for motorized modes only and trip rates for all modes.

Table 2.14 Home-Based Work Trip Rates for Puget Sound Region

HH size	Workers			
	0	1	2	3+
1	0/0	1.43/1.47	-	-
2	0/0	1.43/1.47	2.43/2.48	-
3	0/0	1.43/1.47	2.43/2.48	3.77/3.87
4+	0/0	1.43/1.47	2.43/2.48	3.87/4.02

2.2.3 Lee County Trip Generation Model for Seasonal Residents

The FDOT initiated the Lee County Urban Travel Characteristics Study to identify differences in travel behaviors between permanent and seasonal residents of the Fort Myers-Cape Coral Metropolitan area in 1992 (PBSJ 1992). The permanent residents were defined as having their primary residences in Lee County. All other respondents were classified as seasonal residents.

Two distinct sampling procedures were established to target specific quotas of permanent and seasonal households in Lee County. Targeted trip log completions by cell were different for permanent and seasonal households because these two groups differed considerably in terms of household size, auto availability, and dwelling unit type. The number of trips, as well as the mean trip rates, was generated for each trip matrix cell by trip purpose for both permanent and seasonal resident households. The mean survey trip rates for permanent and seasonal resident households were then compared.

It was found that significant differences existed between seasonal and permanent residents in terms of number of trips per household, percent of trips by purposes, average household size, average trip lengths, vehicle occupancies, and time-of-day of travel. It was also found that seasonal residents, who were mostly retirees, made relatively fewer work trips but more

shopping trips than permanent residents. The study recommended the restructuring of the FSUTMS trip generation model to permit separate trip rate matrices for permanent and seasonal households to benefit urban areas that had a significant number of seasonal residents. Sensitivity tests were recommended to verify whether the trip rates calibrated from Lee County survey data would be directly transferable to other areas. For illustration purpose, the home-based work trip production rates recommended for permanent and seasonal households are given in Tables 2.15 and 2.16, respectively.

Table 2.15 Home-Based Work Trip Rates for Permanent Households Recommended in the Lee County Study

Dwelling Type	Vehicle	Household Size				
		1	2	3	4	5+
Resident Single Family	0	0.27	0.55	0.79	0.96	1.06
	1	0.43	0.77	0.88	1.20	1.30
	2+	0.72	1.28	1.53	1.90	2.20
Resident Multi-Family	0	0.10	0.24	0.37	0.54	0.67
	1	0.36	0.44	0.60	0.67	0.74
	2+	0.81	1.17	1.33	1.38	1.44
Transient		Not Surveyed				

Table 2.16 Home-Based Work Trip Rates for Seasonal Households Recommended in the Lee County Study

Dwelling Type	Vehicle	Household Size				
		1	2	3	4	5+
Resident Single Family	0	0.06	0.12	0.17	0.21	0.23
	1	0.07	0.18	0.22	0.26	0.28
	2+	0.16	0.29	0.36	0.39	0.39
Resident Multi-Family	0	0.03	0.07	0.11	0.16	0.20
	1	0.09	0.13	0.18	0.20	0.22
	2+	0.24	0.31	0.37	0.41	0.43
Transient		Not Surveyed				

2.3 Model Evaluation Criteria

This section discusses potential criteria for evaluating the performance and applicability of trip generation models that incorporate lifestyle variables. The model evaluation procedure may be used to determine whether new model schemes are suitable for application for Florida urban areas. The criteria include the following: variable selection, comparison with traditional model, data availability, temporal stability, spatial transferability, and variable forecastibility.

2.3.1 Variable Selection

For forecasting purposes, all relationships within a model must be closely associated with some type of independent variables input by the user. In other words, model variables should have a strong causal relationship with trip making behaviors. The parameters used to describe lifestyles vary considerably among studies. To provide a better understanding of the lifestyle models,

methodologies reported in the literature for selecting lifestyle variables for trip production model development are described in this section.

2.3.1.1 One-way Analysis of Variances (ANOVA)

The ANOVA procedure attempts to analyze the variation of a response and assign portions of this variation to each independent variable. When applied to variable selection for trip generation, the analysis of variance includes variables that describe the travelers in the model specification so that the effects of cross-sectional variations can be estimated.

A study conducted for FDOT District 4 by the FAU/FIU Joint Center for Environmental and Urban Problems (FAU/FIU Joint Center) concluded that a model based on number of workers, presence of children, and vehicle availability had better performance over the household size and dwelling type variables in the standard FSUTMS (DeAnna et al. 1998). Vehicle availability was used to classify two types of households: those with more vehicles than workers and those with the same number of or fewer vehicles than workers. Subsequently, the FDOT Central Office acquired a Census Special Tabulation Product (STP) that classified households by workers, presence of children, and vehicle ownership for a feasibility test. The vehicle availability was replaced by vehicle ownership since it was not widely used elsewhere in modeling. The significance of the potential lifestyle and household variables recommended by the FAU/FIU Joint Center was later analyzed using one-way ANOVA (Carr Smith Corradino 1997). The statistical analysis showed that vehicle ownership and presence of children were significant variables for all trip purposes. However, the number of workers, which had a strong explanatory power for the home-based work trips, did not perform as well for the home-based non-work trip purposes as the household size did. Therefore, two separate sets of variables for the enhanced trip production cross-classification model were developed. Since some of the cells in the cross-classification matrix had less than 25 observations, an alternative methodology for calibrating cross-classification models, i.e., Multiple Classification Analysis (MCA), was used to overcome this problem and derive the average trip rates. This method is based on ANOVA with an important advantage that the cell values are not based solely on the size of the data sample within a given cell, but also on the mean of the entire data set.

Allen and Curley (1997) selected the presence of children and/or retired people as lifestyle variables based on data availability and observations made on the household survey conducted in Berks County, Pennsylvania in 1994. Three combinations of the lifestyle variables were proposed. ANOVA was employed to test which group performed better based on the F statistics. The larger the F statistic, the better the subject variables were at distinguishing among groups on the basis of trip rates.

2.3.1.2 Descriptive Analysis

As an exploratory analysis, descriptive analysis presents quantitative results, such as the distribution of the variables of interest, from the collected data. Descriptive analysis can be used for the development of a comprehensive representation and framework analysis.

Based on literature and data collected on travel by elderly people in Arizona, Witkowski and Buick (1985) found that the travel behaviors of residents of retirement communities, who were adults or senior citizens, not only were uniquely different from those of "ordinary other" travelers but also varied within their own group. Using descriptive analysis to study the possible variables, Witkowski and Buick proposed a cross-classification trip generation model on the basis of lifestyle using measures of age, dwelling unit type, employment status, and trip purposes to estimate travel demand of residents of retirement communities.

Regarding the lifestyle classification scheme found in previous studies, Zimmerman (1982) analyzed the 1977 Nationwide Personal Transportation Study (NPTS) and identified five household types: the traditional family, the single-parent family, the childless married couple household, the single person household, and the household of unrelated individuals. Each of these five household types was further segmented into several lifestyle stages according to the relationship among household members and the age of household members.

2.3.1.3 Cluster Analysis

Cluster analysis is an exploratory analysis that allows the analyst to search for different structures that may exist in the data. The use of cluster analysis requires the exercise of judgment. Despite being a suggestive rather than a testing procedure, its use can provide valuable insights into a population structure by varying the specification and the relative weight assigned to each variable. Salomon and Ben-Akiva (1982) applied cluster analysis to analyze a data set from a 1977 Federal Highway Administration survey of travel demand in Baltimore. The result was a set of five lifestyle groups based on the diversities of household size, age of head of household, income, highest education level, number of adults in household, employment status of male household head and female household head, and presence of children.

2.3.1.4 Automatic Interaction Detector (AID) Program

AID is a sequential search procedure that divides a data set into subgroups through a number of binary splits based on the ability of the independent variables to account for the variation of a dependent variable. From a series of binary splits, a "tree" with various branches can be developed. Chicoine and Boyle (1984) used the AID program to analyze the 1973 Buffalo and 1974 Rochester travel surveys. Four dependent variables were used: total number of trips, home-based work trips, home-based non-work trips, and non-home-based trips. The result of the AID analysis showed that vehicle ownership, household size, and presence and age of children were important factors that affected the household trips.

2.3.2 Comparison with Traditional Models

One way to evaluate lifestyle models is to compare the estimated results from the lifestyle trip generation model with those from the household-size-based models. Although lifestyle models are expected to perform better in estimating production trips, they must be evaluated with respect to the range of possible error values. The lifestyle variables have been shown to improve trip generation forecasting through the inclusion of measures of household structure and residential

location in existing travel forecasting procedures (Allaman et al. 1982). Simonsen and Neveu (1985) compared the predictive capability of the traditional and lifestyle variables in trip generation analysis. Work trip rates were calibrated using two data sets from household travel surveys undertaken in two upstate New York urban areas, Buffalo in 1973 and Rochester in 1974. Forecasts of work trips using the 1973/1974 trip rates and the 1980 households from the census were compared to the 1980 work trips estimated from the census data. However, the percentage deviation between predicted and actual trips indicated that the lifestyle classification scheme did not estimate trip generation rates better than the traditional family size classification scheme.

Another comparative study was conducted by Chicoine and Boyle (1984). With the number of household trips as the dependent variable, they ran a two-way ANOVA by using vehicle ownership and either the lifestyle or the household size classification as the two independent variables. According to the F-values from ANOVA, the two schemes were comparable. However, when the accuracy was tested for these two trip generation tables by applying each to a data set and comparing the predicted and actual results, the results showed that the lifestyle trip generation procedure produced more accurate results over the household-size-based procedures.

2.3.3 Data Availability

The availability of socioeconomic data with suitable variable segmentation is a critical consideration in adopting a particular lifestyle variable. Therefore, a lifestyle classification scheme using readily available data is desirable for practicality.

Chicoine and Boyle (1984) identified vehicle ownership, household size, and presence and age of children as important factors that affected the number of household trips using the AID program. However, the effort of breaking down households by presence and age of children was unsuccessful after an examination of the published 1980 census information.

To test the feasibility of lifestyle trip production models, FDOT Central Office obtained a special tabulation, STP 266, from the Census Bureau, which was derived from the 1990 census. Four sets of tables were included in the STP 266 (PAB 1998). Table 1 was based on the existing FSUTMS trip generation model and identified the number of households by dwelling type, vehicles available, and household size. Table 2 was for the proposed lifestyle model developed by the FAU/FIU Joint Center and applied to Broward County model, and provided the number of households by presence of children under the age of 18, vehicle availability, and number of workers in the household. Table 3 was based on the Tampa Bay Regional Model and identified the number of households by age of individuals, presence of children under 18, and vehicle available. Table 4 was consistent with the Modified Tampa Bay Regional Model and included the number of households by presence of full-time workers, children under 16, and vehicles available.

To support the implementation of the Southeast Florida lifestyle trip production models for non-work trip purposes, which required a separate set of variables, the FDOT Central Office obtained

another special tabulation, STP 283, from the Census Bureau (Carr Smith Corradino 1997). The STP 283 data were classified by household characteristics:

- Presence of children (with or without children)
- Number of vehicles (0, 1, 2, 3+)
- Number of workers (0, 1, 2, 3+)
- Number of persons (1, 2, 3, 4, 5+)

This classification resulted in a total of 160 cells, which could be aggregated to fit the District 4 lifestyle model structure with 28 cells for the home-based non-work purposes.

The number of permanent and seasonal households can be obtained from the Census of Population and Housing data, which identify the occupancy status and vacancy status of dwelling units for each census tract. For example, in 1990 there were 140,124 primarily occupied households and 48,927 vacant dwelling units in Lee County. Table 2.17 shows the status of these vacant households. There were a total of 31,408 seasonal dwelling households in Lee County in 1990.

Table 2.17 Vacancy status for Vacant Households in Lee County in 1990

Vacancy Status	Households
For rent	7,328
For sale only	5,142
Rented or sold, not occupied	1,700
For seasonal, recreational, or occasional use	31,408
For migrant workers	70
Other vacant	3,279

2.3.4 Temporal Stability

For a model to be able to predict future travel demand, its land use relationship with trip making must be reasonably stable over a long period of time between the base year and forecast year. The accuracy of the forecasts, produced by a transportation demand model, depends on how the coefficients and parameters of the model vary over time since these coefficients and parameters are determined for the base year conditions and are often assumed to remain unchanged for the forecast year.

The long-range stability of cross-classification structures based on trip purpose, family size, income, automobile ownership, and area types was analyzed for the Delaware Valley region by Walker and Peng (1991). The cross-classification technique was employed to compare the trip generation rates derived from the 1987-1988 surveys with those from the 1960 survey. This method was similar to the multiple regression technique in that changes in trip rates were measured while changes in two or more independent variables were accounted for. Results of two comparisons were presented. The first examined the differences in the trip rates calibrated from the two survey data sets. To compare the differences, the average trip rate, the number of observations, and the standard deviation were calculated for each cell in the cross-classification matrix. The *t*-test was then used to test the statistical significance of the differences between the

two mean trip rates of each stratum. Both simple two-dimensional cross-classification structures based on trip purpose versus family size, income, and automobile ownership, and multidimensional cross-classification schemes for home-based non-work travel were presented.

The second comparison was concerned with the trip estimations, which were obtained by applying the 1960 and 1987-1988 trip rates to the 1980 census traffic zonal data. The total regional trips and the root mean squared difference were summarized with three decomposition measures of the mean square difference: the portion attributable to discrepancies in the means, the portion resulting from unequal standard deviations, and that resulting from incomplete covariation. Walker and Peng found that models based on household size stratification were generally unstable, income-based models were more stable, and models based on automobile ownership strata were the most stable over time. They also concluded that a trip generation model based on auto ownership or area type or both produced reasonably stable trip generation results for different trip purposes and total household travel.

Kollo and Purvis (1984) used the same technique to compare the trip generation rates derived from a home interview survey conducted in the San Francisco Bay Area in 1981 and from an original 1965 survey. The variables used in the cross-classification scheme for different trip purposes were household size, automobile ownership, and income. They found that the overall household trip generation rates did not change significantly over time. Moreover, significant changes in trip rates calibrated using the data from those two surveys for a given socioeconomic strata were counterbalanced by shifts in the distribution of households between strata.

Another approach to the evaluation of the temporal stability of the trip generation model is to analyze whether the relative statistical importance of the variables that are thought to influence travel behavior changes over time. To confirm the conjecture that in a motorized society, out-of-home activity engagements were determined by the composition of a household and not by vehicle ownership, Kitamura and Kostyniuk (1986) used a detailed factor analysis to examine the changes in the relative importance of a number of household variables to the trip generation behaviors measured in 1960 and 1974 home interview surveys for Rochester, New York. These variables included household size, income, number of workers and drivers, automobile ownership, and household lifestyle stage defined in terms of the presence of a male-female couple, the age of the head of household, the presence of children, and, if present, the age of the youngest child. The log-linear model of cross-classification analysis was used to examine the above factors. This method was useful to identify the variation in the cell frequencies by using a log-linear function of main and interaction effects of the number of trips and household descriptors. It was concluded that the effect of automobile ownership had declined, and that lifestyle stage in 1974 influenced many aspects of household travel behaviors, particularly the total number of trips, more than vehicle ownership did.

2.3.5 Spatial Transferability

A standard trip production model must exhibit the ability to be transferable from one area to another without losing the validity of the basic relationships in the model. That the trip rates

may be applied to different areas where the actual number of tours is known will indicate whether the use of these trip rates produce consistently accurate results.

To preliminarily test the replicability of the lifestyle-based trip rates that were calibrated from the 1973 Niagara Frontier Transportation Committee (NFTC) data, Chicoine and Boyle (1984) derived a set of tables from the 1974 Genesee Transportation Council (GTC) data and compared the trip rates in each cell between the two regions. The trip rates by classification scheme and by trip purpose were examined for differences between the two regions. Only six cells out of 52 were found to have trip rates different at a significance level of 0.05 in the two regions. The authors concluded that the NFTC trip rates were generally replicable using the GTC data, although the results could not be used to proclaim the replicability of the lifestyle-based trip rates.

The common parametric statistical procedures for comparing a pair of means, which assume that the distributions being tested are normal and symmetrical in form, may not be appropriate unless these assumptions are correct. The standard FSUTMS procedure used Kruskal-Wallis, a nonparametric test that does not assume an underlying probability distribution, to compare the travel survey data in different urban areas (FDOT 1997). The Kruskal-Wallis one-way ANOVA test is perhaps the most used nonparametric technique for testing the null hypothesis that several samples have been drawn from the same population versus the broad alternative hypothesis that at least one of the populations shifts from another by some amount (Mendenhall et al. 1990). Its test hypotheses are defined as follows (Hines and Montgomery 1990):

H_o: The *k* population distributions are identical.
H_a: At least two of the population distributions differ in location.

The test statistic is defined as:

$$H = \frac{12}{n(n+1)} \sum_{i=1}^{k} \frac{R_i^{\,2}}{n_i} - 3(n+1)$$

where n_i = number of measurements in sample from population *i*; and
R_i = rank sum for sample *i*, where the rank of each measurement is computed according to its relative size in the overall set of $n = n_1 + n_2 + \ldots + n_k$ observations formed by combining the data from all *k* samples.

The test will favor the alternative hypothesis with large *H* values. If n_i's are larger than or equal to five, the *H* statistic can be approximated by a Chi-Square distribution with *k-1* degrees of freedom.

2.3.6 Variable Forecastibility

The forecastibility of variables means that the variables can be forecast for future with reasonable ease. This is an important criterion that a new model must satisfy. To develop projected future trip productions, the production models will require zonal forecasts of the cross-classification variables. In the standard FSUTMS procedure, the average household size for each

type of household and the average number of autos owned in single- and multi-family dwelling units must be estimated for zones by local planning agencies. These data are stored in the ZDATA1 file. Stratification curves developed using the 1980 census data are then used to distribute the aggregate zonal level data to the discrete classes used in the trip production matrices (FDOT 1997).

In the Palm Beach's 1996 transportation model, a population disaggregate model developed by the county planning department was used to estimate total zonal dwelling units and resident population in 1996 (Carr Smith Corradino 1998). In order to estimate the number of households within each cell of the lifestyle cross-classification matrix, the data from the STP 283 was used to provide the zonal factors needed to convert housing units and resident population to the following lifestyle categories in the ZDATA1A file, the revised ZDATA1 file:

- Number of households with children
- Number of households without children
- Number of vehicles owned in households with children
- Number of vehicles owned in households without children
- Number of workers in households with children
- Number of workers in households without children
- Number of persons in households with children
- Number of persons in households without children

From the ZDATA1A file, the following information can be obtained for each TAZ: the average number of autos, the average number of workers, and average number of persons in households with and without children. To distribute the above average numbers to the discrete strata, stratification curves were developed by performing polynomial regression analysis with the data from STP 283. The deviation of the average of the strata of the variable from its grand mean was used as the independent variable. The dependent variables were the frequencies of each strata of the variable.

In the Broward's 1996 transportation model (Gannett Fleming 1998), a similar procedure was applied to estimate the number of households within each classification. The 1996 dwelling units by zone were estimated by the Broward County Growth Management Department (BCGMD) and were used to develop the ZDATA1 data set.

Ewing and Kooshian (1998) also employed regression analysis to estimate the relationship between the 1980 and 1990 census data. They suggested the following model for forecasting the lifestyle household composition for census tracts in 1990 based on the 1980 census data:

$$Y = 0.733\, X_1 + 0.017\, X_2 + 0.137\, X_3$$

Where Y = proportion of households with children in 1990
X_1 = proportion of households with children in 1980
X_2 = proportion of households without children in 1980
X_3 = average proportion of households with children countywide in 1990

The following multiple regression model was also suggested to estimate the average number of full-time workers per household:

$$Y = 1.035\ X_1 + 0.492\ (X_2 - X_3)$$

where Y = average workers per household in 1990
X_1 = average workers per household in 1980
X_2 = countywide average workers per household in 1990
X_3 = countywide average workers per household in 1980

The estimated number of workers per household was then translated to proportions of households in the three worker classes: 0, 1, and 2+ workers per household. This was accomplished by using a DUWEIGHT-type lookup table that related the ranges of the number of workers per household variable to the distributions of the proportion of households with a specific number of workers.

Another approach to forecasting lifestyle composition information is using a popular projection method, often referred to as the cohort-component method. In developing and testing the Reading, Pennsylvania model, Allen and Curly (1997) used the 1990 census data as a starting point to project lifestyle classifications for households with an age-based population model. A modified cohort-component population model was developed utilizing the three basic principles of population change – births, deaths, and migration. The components of population change (fertility, mortality, and net migration) were projected separately for each birth cohort (persons born in a given year). The base population was advanced each year by using projected survival rates and net migration by single year of age. This process was repeated until the projection "grew" to the forecast year. The projections of population by age were then linked to households. The households of interest in the lifestyle model (see Section 2.2.2.2) were those that had either a retired person or a child. The per child average number of households with children was calculated for each tract based on the1990 census data, which was then applied to the projected population under the age of 18 for each tract to obtain the total number of households with children in each tract. A similar method was applied to obtain the number of households with retirees for each tract after the likelihood that a person at any age was retired was calculated based on the self-reported data in the home interview survey.

As opposed to the typical "four-step" model, the travel demand models developed by the MCT of San Francisco Bay Area included a nested logit model, which preceded the four-step model, for determining the number of workers and vehicles in households (MTC 1997). The upper level nest of this logit model split households at each zone into households by number of workers in households (0, 1, 2+ workers per household). The lower level nest further split these households by auto ownership (0, 1, 2+ vehicles per household). Variables in this choice model included mean household income, mean household size, the proportion of households residing in multi-family dwelling units, the proportion of persons aged 62 or older, and the population density for the entire study area. Data on mean household income, mean household size, and gross population density were from the forecasts by the Association of Bay Area Governments (ABAG). Future year data on the share of multi-family units and the share of persons aged 62 or

older could be derived from the 1990 decennial census data and the ABAG county-level age forecasts. The output from this model was the number of households by household income quartile (four quartiles), by workers in household level (three levels), and by auto ownership level (three levels), or 36 different market segments per travel analysis zone.

3. A BRIEF SUMMARY OF A TRIP GENERATION MPO SURVEY

This chapter provides a brief summary of a survey of MPOs in the state of Florida. The survey was conducted in the fall of 2001, designed and administered by FDOT District 2. The purpose of the survey was to collect information related to FUSTMS trip generation models to identify current practices in data collection, data preparation for base year models, forecasting of data for future year models, and problems and issues encountered by MPOs in trip generation. The information will be useful to provide future directions to further improve the FSUTMS trip generation process. The survey collected information in the following areas:

- Agencies responsible for developing socioeconomic data;
- Frequency of model updates;
- Existing travel survey data;
- Anticipated survey in the future;
- Data and methods used to estimate or project socioeconomic variables for standard FSUTMS model;
- Data and methods used to estimate or project socioeconomic variables for lifestyle FSUTMS models;
- Problems with special generators; and
- Possible improvements to trip generation models.

Twenty-five survey forms were mailed to MPOs, of which 13 were returned. FDOT District 7 (Tampa Bay), which represents Citrus, Hernando, Hillsborough, Pasco, and Pinellas counties, also returned the survey form because the significant role the district office played in model development, validation, and forecast. The responses from the 13 MPOs and one FDOT district office that are related to lifestyle model applications are summarized here. A complete survey form and a full summary of the survey responses may be found in a supplementary report (Zhao 2003).

3.1 Data Collection

Table 3.1 provides information on the primary agencies that are responsible for the development of socioeconomic data. It may be seen that for most urban areas listed in the table, MPO or the County Planning Department (CPD) was the sole or primary agency that was in charge of model data development. In two counties, Hillsborough and Indian River, FDOT took the lead role, while in Miami-Dade and Tallahassee-Leon counties, county planning departments were primarily responsible for model data development.

Table 3.2 provides the information on the frequency of model data updates. Generally, all the 13 MPOs update their highway networks and socioeconomic data every three to five years, when Long-Range Transportation Plan (LRTP) is updated. Gainesville, Miami-Dade, and Volusia counties also update their data (socioeconomic data only for Volusia County) when improvements are made to the model or when a household survey is conducted. Moreover, Miami-Dade County MPO updates the network and socioeconomic data every 10 years, when new census data become available.

Table 3.1 Agencies Responsible for Developing Socioeconomic Data Sets

Urban Area	MPO	Agencies
First Coast	First Coast MPO	MPO, CPD
Ft. Walton Beach	Okaloosa-Walton TPO*	MPO
Gainesville	Gainesville MPO	MPO (primary), CPD
Hillsborough	Hillsborough County MPO	FDOT, MPO, CPD
Indian River	Indian River County MPO	FDOT
Miami-Dade	Miami Urbanized Area MPO	CPD
Ocala/Marion	Ocala/Marion County MPO	MPO
Palm Beach	Palm Beach MPO	MPO
Panama City	Panama City MPO	MPO
Pensacola	Pensacola MPO	MPO
Volusia	Volusia County MPO	MPO
Tallahassee-Leon	Tallahassee-Leon County MPO	CPD
Sarasota/Manatee	Sarasota/Manatee MPO	MPO, CPD

* Transportation Planning Organization, formerly known as the Ft. Walton Beach MPO prior to July 2002.

Miami-Dade, Broward (for which no survey was returned), and Palm Beach counties conducted a survey in 1999 as part of a new model update effort. The survey, referred to as 2000 Southeast Florida Travel Characteristics Study, included a household survey, transit onboard survey, employer workplace survey, and freight survey.

Two counties, Indian River and Volusia, reported plans to conduct household surveys in 2002, which have been completed since. The Indian River County survey was a part of the Treasure Coast Travel Characteristics Study, which also included two other counties in the region: Martin and St. Lucie counties. Tallahassee-Leon County MPO and FDOT District 7 also reported plans to conduct household survey in 2003. The remaining MPOs being surveyed did not have plans to conduct household survey in the near future.

Table 3.3 gives information on surveys that were completed in the past. The MPOs were asked to list each survey conducted in the past 10 years, with information on sample size, agencies that conducted the survey, and special groups that were targeted by the surveys. Fort Walton Beach County, Panama City, Pensacola County, and Volusia County had never conducted any household surveys prior to the survey. The survey sample sizes varied, and information on some of the sample sizes was missing. A number of the surveys have targeted special groups. For example, seasonal households were targeted in the Hillsborough and Indian River surveys, and tourists in Hillsborough, Ocala, and Marion counties.

Table 3.2 Frequency of Model Input File Updates

MPO Name	Highway/Transit Network	Socio-Economic Files	A household survey anticipated in the near future?
First Coast	• Every 3-5 years, when LRTP[1] is updated	• Every 3-5 years, when LRTP is updated	No
Fort Walton Beach	• Every 3-5 years, when LRTP is updated	• Every 3-5 years, when LRTP is updated	No
Gainesville	• Every 3-5 years, when LRTP is updated • Other (When improvements are made to the model, household survey is conducted, etc)	• Every 3-5 years, when LRTP is updated • Other (When improvements are made to the model, household survey is conducted, etc)	No
Hillsborough	• Every 3-5 years, when LRTP is updated	• Every 3-5 years, when LRTP is updated	Yes, 2003
FDOT District 7[2]	• Every 3-5 years, when LRTP is updated	• Every 3-5 years, when LRTP is updated	Yes, 2003
Indian River	• Every 3-5 years, when LRTP is updated	• Every 3-5 years, when LRTP is updated	Yes, 2002
Miami-Dade	• Every 3-5 years, when LRTP is updated • Every 10 years, when new census data is available • Other (When improvements are made to the model, household survey is conducted, etc)	• Every 3-5 years, when LRTP is updated • Every 10 years, when new census data is available • Other (When improvements are made to the model, household survey is conducted, etc)	No
Ocala/Marion County	• Every 3-5 years, when LRTP is updated	• Every 3-5 years, when LRTP is updated	No
Palm Beach County	• Every 3-5 years, when LRTP is updated	• Every 3-5 years, when LRTP is updated	No
Panama City	• Every 3-5 years, when LRTP is updated	• Every 3-5 years, when LRTP is updated	No
Pensacola	• Every 3-5 years, when LRTP is updated	• Every 3-5 years, when LRTP is updated	No
Volusia County	• Every 3-5 years, when LRTP is updated	• Other (When improvements are made to the model, household survey is conducted, etc)	Yes, January 2002
Tallahassee-Leon County	• Every 3-5 years, when LRTP is updated	• Every 3-5 years, when LRTP is updated	Yes, 2003
Sarasota/Manatee	• Every 3-5 years, when LRTP is updated	• Every 3-5 years, when LRTP is updated	No

Notes: [1] LRTP – long-Range Transportation Plan.
[2] FDOT District 7 encompasses Citrus, Hernando, Hillsborough, Pasco, and Pinellas counties.

Table 3.3 Surveys Conducted in the Past

MPO Name[1]	Year of last HH travel survey	Sample size of the travel survey in the last 20 years				Certain Segment of population been targeted in the last 20 years travel survey
		Survey	**Year**	**Sample Size**	**Name of agency conducting survey**	
First Coast	2000	1	2000	4160	FDOT District 2, URS	–
		2	1995	Unknown	Gannett Fleming. Inc.	–
Gainesville	2000	1	2000	1937	FDOT District 2, URS	–
		2	2000	Unknown	Renaissance Planning Group	–
Hillsborough	2000	1	2000	10,100	FDOT Dist 7	Seasonal residents; tourists; low income households; transit oriented
		2	1996	20,000 – 7,500	FDOT Dist 7	Low income households
		3	1993	Unknown	FDOT Dist 7	Tourists
FDOT District 7[2]	2000	1	2000	10,100	FDOT Dist 7	Retirees, seasonal residents, tourists, low income households
		2	1996	7,800	FDOT Dist 7	Retirees, seasonal residents, low income households
		3	1993	4,208	FDOT Dist 7	Tourists
Indian River	1995-1999	1	1996	200	FDOT Dist 4/Walter H. Keller Inc.	Seasonal residents 10.2%[3]
Miami-Dade County	1995-1999	1	1999	1,742	FDOT Dist 4, Gannet Flemming, Corradino Group	Employer's survey, transit onboard survey, workplace survey, freight survey
		2	1993	Unknown	CUTR	Transit onboard survey
		3	1993	800		Freight and transit[4]
		4	1986	Unknown	MDTA, Corradino Group	Transit onboard survey
		5	1986	Unknown	MDTA	Transit onboard and telephone survey
		6	1980/81	~23,000	MDTA	Transit onboard survey
Ocala/Marion County	2001	1	2001	1%	FDOT Dist 5/TEI	Tourists
Palm Beach County	1999-2000	1	1999	1,676	FDOT Dist 4, Corradino Group	Selected hotels-visitors survey; selected place of work-workplace survey; transit on-board survey; truck survey
		2	1991	2,300 screener 966 diaries	FDOT Dist 4, Gannet Flemming, Corradino Group	
Tallahassee-Leon County	1985-1989	1	1989	Unknown	Post Buckley Schuhs Jernigan	–
Volusia County	2002	1	1999			Transit onboard survey in 1999
		2	2002	1,397	PBS&J	

Notes: [1] Ft. Walton Beach, Panama City, Pensacola, and Volusia County have never conducted survey prior to this survey.
[2] FDOT District 7 encompasses Citrus, Hernando, Hillsborough, Pasco, and Pinellas counties.
[3] Survey findings, not targeted.
[4] 800 freight or freight-oriented firms were surveyed. Survey targeted the freight sector including providers, users, warehouses, etc. 100 responses were received.

Presently, there are twelve counties/MPOs that are known to have adopted lifestyle models. They are Broward, Palm Beach (already using lifestyle models since 1996), Indian River, Martin, and St. Lucie (validating 2000 models using a lifestyle model) counties in FDOT District 4; Miami-Dade County in FDOT District 6; Citrus, Hernando, Hillsborough, Pasco, and Pinellas counties in FDOT District 7; and Volusia County. The next three sections will deal with socioeconomic data development for base year that is a census year or non-census year, and for a future year. Survey responses from Hillsborough, Indian River, Miami-Dade, Palm Beach county MPOs and FDOT District 7 are summarized.

3.2 Socioeconomic Data Development When Base Year Is a Census Year

A set of questions were asked in the survey regarding the methodologies used to estimate the following lifestyle model variables:

(a) Number of household with children
(b) Number of household without children
(c) Number of vehicles owned in household with children
(d) Number of vehicles owned in household without children
(e) Number of workers in household with children
(f) Number of workers in household without children
(g) Number of persons in household with children
(h) Number of persons in household without children
(i) Number of households with retirees
(j) Number of vehicles owned in household with retirees
(k) Number of seasonal households
(l) Other lifestyle variables
(m) Employment
(n) School enrollment

Palm Beach County was the only MPO that provided information on the development of socioeconomic data for the lifestyle model when the base year is a census year. Decennial census data were used to produce information about households with children and without children, the number of households, vehicles owned in households, the number of workers in households, and household size. Employment data were estimated using GIS data and data from the tax appraiser's office, mainly on square footage of nonresidential properties. School enrollment data were estimated by MPO based on information provided by the county school board.

3.3 Socioeconomic Data Development and Projection When Base Year Is a Non-Census Year

The MPOs that had been using a lifestyle trip generation model were asked to provide information on their methodologies to estimate the same lifestyle model variables as described in Section 3.2 for a non-census year or a future year. To simplify the survey, a predefined set of methods was provided to allow the person filling out the survey to identify the ones that were used at their MPOs. These methodologies are given below:

1. Regression
2. Cohort and migration
3. Trend analysis
4. Other (Please explain)

Four MPOs and FDOT District 7 answered the questions. The survey responses indicated that there were a variety of combinations of methods used. In addition to Methods 1, 2, and 3, other methods were also used, which are defined as below:

4A. Sub-allocation of population to census tracts using seven to eight methods. The planning team met and discussed each census tract method as to the preferred method applied. (*Hillsborough County*)
4B. Census derived and adjusted. (*Hillsborough County*)
4C. 1990 census data adjusted by MPOs using a variety of methodologies, primarily Methods 2 and 3. (*FDOT District 7*)
4D. Factoring ratios of base year (e.g. percentage of households with children versus total households). Note that this method was used either as the default or as the benchmarks for checking the reasonableness of the results from other methods. (*Indian River County*)
4E. Estimated using factors derived from Census Public Use Microdata Samples for 1980 and 1990. The "vehicles available by household" variable was used and the change in the number of vehicles available was extrapolated to the target years. The 2000 estimates were compared with the total increase in motor vehicles reported by the State for 2000. (*Miami-Dade County*)
4F. Interim years are generally interpolated with emphasis placed on the first five years. (*Palm Beach County*)

The responses from the four MPOs and FDOT District 7 are summarized in Tables 3.4, which provides information on model input estimates for the base year, which is a non-census year, and Table 3.5 on future year data projection.

Hillsborough County estimated future employment using a gravity model. FDOT District 7 reported that employment data were provided by individual county MPOs, which used a combination of trend analysis, regression, and analysis of development trends. Indian River County applied ULAM (Urban Land Allocation Model) to project employment data for the future year.

For school enrollment projection, Hillsborough County divided schools into five categories, the enrollment of each being projected based on different methods such as capital improvement projects, fixed growth rates, revision of the population to student enrollment in each planning area, etc. The estimates were then summed together at the TAZ level. According to FDOT District 7, school enrollment information was provided by the school board, which was developed using a combination of data about in-migration analysis and trend analysis. Indian River County projected school enrollment using a ratio of households to number of children, which was determined for the base year and was assumed to remain the same for the future.

Table 3.4 Estimation of Lifestyle Variables for a Non-Census Base Year

MPO	Hillsborough	FDOT District 7	Indian River	Miami-Dade[1]	Palm Beach County
Number of households with children	4B	4C	2, 3, 4D	3	4F
Number of households without children	4B	4C	2, 3, 4D	3	4F
Number of vehicles owned in households with children	4B	4C	4D	4E	4F
Number of vehicles owned in households without children	4B	4C	4D	4E	4F
Number of workers in households with children	N/A	N/A	3, 4D	4E	4F
Number of workers in households without children	N/A	N/A	3, 4D	4E	4F
Number of persons in households with children	4B	N/A	2, 3, 4D	4E	4F
Number of persons without children	4B	N/A	2, 3, 4D	4E	4F
Number of households with retirees	4B	N/A	N/A	N/A	4F
Number of vehicles owned in households with retirees	4B	4C	N/A	N/A	4F
Number of seasonal households	4B	4C	2, 3	N/A	4F
Other lifestyle variable	N/A	N/A	None	None	4F
Employment	• ES 202-Dept of Labor • Proprietary Database InfoUSA (raw data); • U.S. BEA sole proprietors (control total)	Similar to Hillsborough, ES 202 and U.S. BEA data used as control totals	ULAM	• Es 202-Dep of Labor P&Z projection	4E
School enrollment	• County School Board • Department of Education data on higher education facilities, individual locations, universities, college, tech.	• County School Board • Department of Education on non-public schools, individual higher educational institutes	Used a ratio of HH of children of the base year	County School Board	4E

Note:
1 Trend analysis for the first attempt from the 1980-1990 census.

3.4 Summary of Survey Findings

Regarding the lifestyle model application, the findings from the MPO survey included:

4. Lacking of household survey data. Many counties have not conducted household surveys in the past nor have they had a plan to conduct household surveys in the future. This means that these counties will need to borrow trip rates from other urban areas if lifestyle models are to be adopted. While borrowing trip rates may be acceptable, opportunities to identify local unique travel patterns and behaviors in their own areas may be missed.

5. There is no standard method and procedure for forecasting lifestyle variables for future year models. Different methodologies are currently used by the MPOs.

6. Many MPOs did not indicate an interest in lifestyle models, possibly because of lack of information. It is hoped that this report and the newly released 2000 census data will help the MPOs be more informed about lifestyle models thus to be able to make a decision as whether to look into lifestyle models or not.

Table 3.5 shows the interests in lifestyle models from MPOs that participated in the survey but did not use a lifestyle model. While five out of the eight MPOs did not answer the questions, one had a definite negative answer, one positive, and one unsure. However, Volusia County has subsequently decided to implement a lifestyle model at the time of this report. Another observation was that there were few MPOs that had recent household survey data, thus limiting their participations in this study.

Table 3.5 Interest in Lifestyle Models and Survey Data Availability

MPO Name	Improvement Possible Using Lifestyle Model	Interest in Participation	Survey Data Year
First Coast	No	No	
Ft. Walton Beach	N/A	N/A	
Gainesville	N/A	N/A	
Panama City	N/A	N/A	
Pensacola	N/A	N/A	
Volusia County	Not sure	Yes	2001
Tallahassee-Leon County	N/A	N/A	1985-1989, 2003
Sarasota/Manatee	Yes	Need more info	Unknown

4. DATA USED FOR STUDY

For this research, the lifestyle models were applied to three participating MPOs/MSA: Lee County MPO, Volusia County MPO, and the Jacksonville MSA[1]. These urban areas were selected based on the fact that they had recent household survey data and were not using a lifestyle model.

Lee County is located on the west coast of Florida south of Tampa Bay. It had a significant population of seasonal residents and retirees. Volusia County also had seasonal and retired populations that were above the state average. The Jacksonville MSA consists of four counties, with significantly smaller population of seasonal and retired residents than the state average.

The Lee County Urban Travel Characteristics Study surveys were conducted in 1992 targeting specific quotas of both permanent and seasonal households (PBSJ 1993). A total of 686 household trip logs were completed, of which logs were from 372 permanent households. The rest of the trip logs were completed by seasonal households and were used in the analysis of seasonal household trip rates.

The original 2001 Volusia County travel survey data included the travel/household information for 1,397 households. A total of 1,164 records of permanent households remained in the data set after excluding the following households:

- Thirty one (31) seasonal households;
- Thirty (30) households with missing information such as number of persons, household type, residential status, auto ownership, etc.; and
- One hundred seventy two (172) households with household members not completing personal information in the survey form.

For the Jacksonville MSA, the 2000 North Florida household survey was conducted in Clay, St. Johns, Nassau, Duval, and Alachua counties. The survey data collected from Clay, St. Johns, Nassau, and Duval counties were to support the Jacksonville Urban Area Transportation Study (JUATS), while the survey conducted in Alachua County was to be used in the Gainesville Urban Area Transportation Study. Only the survey data from the four counties in the Jacksonville MSA were analyzed in this report.

Two data sets were compiled from the 2000 North Florida household survey. The first data set contained all valid survey records completed by the participating households. In this data set, some members in a given household did not fill out their trip logs for unknown reasons. The second data set, or the match data set, contained only the records that had been fully completed by each and every household member. From the matched data set, a total of 2,512 households with valid information on number of persons and workers, household type, residential status, auto ownership, home locations, etc., were selected.

[1] Metropolitan Statistics Area defined by the U.S. Census Bureau.

The household attributes in the household travel surveys that were utilized in the preparation of lifestyle model trip rates included: primary residence, auto ownership, household size, number of workers, number of full-time workers, and number of children 15 years old or under. Household members were classified as workers if they reported work trips in their trip logs. For example, 29 persons in Volusia County who reported work trips during the surveyed period did not state their employment status. These persons were consequently classified as workers.

This study also utilized data on households from a 1990 census special product STP 266, which provided the number of different types of households classified in the Southeast Florida lifestyle model for HBW trip purpose (STP 266 Table 2), the Tampa Bay lifestyle model (STP 266 Table 4), and standard FSUTMS models (STP 266 Table 1). However, the information about whether a household had retired members or not was not available from the census data. Consequently, the retired household was redefined as a household without full-time workers, and the information from Table 4 of STP 266 was used.

Another census production used was STP 283, which provided census household information based on the Southeast Florida model structure for HBNW trip purposes.

5. CALIBRATION AND EVALUATION OF TRIP PRODUCTION MODELS FOR HBW TRIPS

In this chapter, the methodology and procedure used to calibrate HBW trip rates and evaluate the lifestyle model structures are described. The same methodology and procedure were applied to analyze other trip purposes, which will be described in Chapter 6.

The procedure of applying lifestyle models to the three MSA/MPOs consisted of two basic steps: calibration of trip generation rates using the two lifestyle and standard FSUTM model structures and then evaluation of lifestyle model performance by comparing the trip productions to those from the standard FSUTMS models. The household information used for estimating the total trip productions was from STP 266. The following subsections describe the procedures of the analysis in detail.

5.1 Characteristics of Survey and Census Data

The characteristics of survey and census data (STP 266) for the three urban regions are described in Tables 5.1 through 5.9. Tables 5.1 through 5.3 give the sample size, the number of sampled HBW trips, and the number of 1990 census households based on the Southeast Florida model structure, while Tables 5.4-5.6 and Tables 5.7-5.9 provide the same information based on the Tampa Bay Regional Model structure and the standard FSUTMS model structure, respectively.

Table 5.1 Household Sample Size Based on the Southeast Florida Model Structure for HBW Trip Purpose for the Three Urban Regions

MPO/MSA	Presence of Children	Vehicle	Workers		
			0	1	2+
Lee County	Without Children	0	5	1	0
		1	100	37	10
		2	32	22	44
		3+	2	2	25
	With Children	0	1	1	0
		1	2	14	6
		2	3	18	33
		3+	0	2	12
Volusia County	Without Children	0	14	1	0
		1	350	107	12
		2	171	86	93
		3+	36	41	74
	With Children	0	0	2	0
		1	4	30	4
		2	4	32	53
		3+	3	8	39
Jacksonville	Without Children	0	69	16	1
		1	400	280	19
		2	286	294	349
		3+	58	98	260
	With Children	0	3	5	0
		1	8	39	11
		2	12	69	133
		3+	9	21	72

Table 5.2 Sampled HBW Trips Based on the Southeast Florida Model Structure for the Three Urban Regions

MPO/MSA	Presence of Children	Vehicle	Workers		
			0	1	2+
Lee County	Without Children	0	0	2	0
		1	0	38	29
		2	0	21	94
		3+	0	2	54
	With Children	0	0	2	0
		1	0	9	18
		2	0	17	81
		3+	0	1	27
Volusia County	Without Children	0	0	1	0
		1	0	101	22
		2	0	92	235
		3+	0	45	200
	With Children	0	0	2	0
		1	0	16	7
		2	0	45	98
		3+	0	5	83
Jacksonville	Without Children	0	0	19	2
		1	0	337	52
		2	0	357	1,005
		3+	0	148	883
	With Children	0	0	5	0
		1	0	35	23
		2	0	87	349
		3+	0	28	188

Table 5.3 1990 Census Households Based on the Southeast Florida Model Structure for HBW Trip Purpose for the Three Urban Regions

MPO/MSA	Presence of Children	Vehicle	Workers		
			0	1	2+
Lee County	Without Children	0	5,091	987	397
		1	35,587	15,488	3,837
		2	11,009	9,258	14,669
		3+	793	1,725	5,511
	With Children	0	604	574	203
		1	946	4,804	2,902
		2	566	5,526	11,858
		3+	137	1,335	6,239
Volusia County	Without Children	0	7,904	1,806	433
		1	36,090	16,534	3,767
		2	11,648	10,602	13,903
		3+	1,480	2,247	6,760
	With Children	0	796	701	230
		1	1,539	5,723	2,890
		2	765	6,554	12,676
		3+	188	1,770	6,309
Jacksonville	Without Children	0	15,191	6,079	1,391
		1	32,527	44,412	8,605
		2	14,977	24,337	36,978
		3+	2,380	6,162	19,373
	With Children	0	4,177	3,361	1,550
		1	3,883	19,899	10,565
		2	1,798	22,382	38,393
		3+	484	5,149	18,990

Table 5.4 Sample Size Based on the Tampa Bay Regional Model Structure for HBW Trip Purpose for the Three Urban Regions

MPO/MSA	Vehicle	Household Type		
		Retired	Working	
			Without Children	With Children
Lee County	0	6	1	1
	1	107	42	20
	2	37	64	51
	3+	2	27	14
Volusia County	0	15	1	1
	1	386	90	31
	2	203	157	79
	3+	56	100	45
Jacksonville	0	77	13	4
	1	472	238	47
	2	421	533	189
	3+	114	317	87

Table 5.5 Sampled HBW Trips Based on the Tampa Bay Regional Model Structure for the Three Urban Regions

MPO/MSA	Vehicle	Household Type		
		Retired	Working	
			Without Children	With Children
Lee County	0	0	2	2
	1	8	59	27
	2	0	115	98
	3+	0	56	28
Volusia County	0	2	1	0
	1	23	100	23
	2	43	293	134
	3+	20	228	85
Jacksonville	0	6	15	5
	1	85	310	52
	2	205	1,178	415
	3+	76	965	206

Table 5.6 1990 Census Households Based on the Tampa Bay Regional Model Structure for HBW Trip Purpose for the Three Urban Regions

MPO/MSA	Vehicle	Household Type		
		Retired	Working HH	
			Without Children	With Children
Lee County	0	6,258	1,070	528
	1	41,715	15,243	6,606
	2	15,613	21,462	15,811
	3+	1,792	8,076	5,872
Volusia County	0	9,487	1,681	702
	1	43,012	16,516	7,015
	2	16,814	22,024	17,310
	3+	2,908	9,337	6,509
Jacksonville	0	22,146	6,072	3,531
	1	46,686	47,150	26,055
	2	24,336	59,078	55,451
	3+	5,002	27,929	19,607

Table 5.7 Sample Size Based on the Standard FSUTMS Model Structure for HBW Trip Purpose for the Three Urban Regions

MPO/MSA	Dwelling Type	Vehicle	Household Size				
			1	2	3	4	5+
Lee County	Single-Family	0	2	1	0	0	1
		1	23	43	8	5	3
		2	4	68	36	21	15
	Multi-Family	0	1	1	2	0	0
		1	36	48	3	1	0
		2	2	29	9	8	2
Volusia County	Single-Family	0	8	2	1	0	1
		1	178	136	8	5	3
		2	49	348	66	73	25
	Multi-Family	0	5	0	0	0	0
		1	102	70	5	0	0
		2	8	60	6	5	0
Jacksonville	Single-Family	0	36	5	1	0	0
		1	305	87	10	5	0
		2	62	794	200	128	48
	Multi-Family	0	43	6	3	0	0
		1	271	53	16	10	0
		2	38	282	49	43	17

Table 5.8 Sampled HBW Trips Based on the Standard FSUTMS Model Structure for the Three Urban Regions

MPO/MSA	Dwelling Type	Vehicle	Household Size				
			1	2	3	4	5+
Lee County	Single-Family	0	0	0	0	0	0
		1	10	38	7	3	7
		2	0	87	60	43	31
	Multi-Family	0	0	2	2	0	0
		1	13	12	4	2	0
		2	0	38	13	17	6
Volusia County	Single-Family	0	1	0	2	0	0
		1	53	44	3	5	1
		2	28	411	102	140	55
	Multi-Family	0	0	0	0	0	0
		1	30	6	4	0	0
		2	5	51	4	7	0
Jacksonville	Single-Family	0	2	2	2	0	0
		1	146	50	12	11	0
		2	49	1,229	521	331	123
	Multi-Family	0	11	4	5	0	0
		1	170	26	15	17	0
		2	30	475	121	118	48

Table 5.9 1990 Census Households Based on the Standard FSUTMS Model Structure for HBW Trip Purpose for the Three Urban Regions

MPO/MSA	Dwelling Type	Vehicle	Household Size				
			1	2	3	4	5+
Lee County	Single-Family	0	1,411	515	190	136	164
		1	9,305	12,435	2,342	1,505	1,012
		2	1,470	20,978	11,113	9,455	6,265
	Multi-Family	0	3,527	1,096	322	237	258
		1	15,260	17,654	2,150	1,141	760
		2	1,142	11,633	3,612	1,825	1,133
Volusia County	Single-Family	0	2,748	1,075	369	179	183
		1	14,014	15,196	3,209	2,060	1,287
		2	2,272	24,181	14,006	11,757	7,008
	Multi-Family	0	4,944	1,366	478	274	254
		1	15,086	12,144	2,006	1,026	515
		2	1,129	9,195	3,136	1,383	835
Jacksonville	Single-Family	0	6,563	2,547	1,337	948	945
		1	25,049	17,562	6,954	4,897	3,940
		2	5,752	50,647	34,401	32,268	18,452
	Multi-Family	0	10,670	3,273	2,424	1,627	1,415
		1	30,573	15,061	7,931	4,909	3,015
		2	3,353	22,216	11,280	7,959	5,075

5.2 Geographical Districts

To reach valid conclusions about the entire study population based on the survey results and for the purpose of model performance evaluation, it was necessary to expand the survey data to arrive at total trips at district and regional levels. For most household travel and activity surveys, one of the key expansion variables is geographic location (Cambridge Systematics 1996). In this study, to expand the data based on geographic location, the surveyed households were first grouped into several districts according to their spatial locations.

For Lee County, since no survey districts were defined for the survey, the postal zip code information for each sampled household was utilized. The GIS map for Lee County's ZIP codes from the 1997 Data & Maps published by Environmental and System Research Institute (ESRI) was used as the base map. However, seven zip codes specified in the 1992 surveyed permanent households could not be located on the ZIP code reference map. Three zip code areas (33923, 33939, and 33959) were changed to new zip codes (34135, 33936, and 34135, respectively). The other four zip code areas were merged with their adjacent areas. To solve this problem, the zone numbers from the geocoded trip destinations were used to identify these seven zip areas. The surveyed households were grouped into five districts according to their locations, each with nearly equal number of sampled households. Figure 5.1 shows the map of districts.

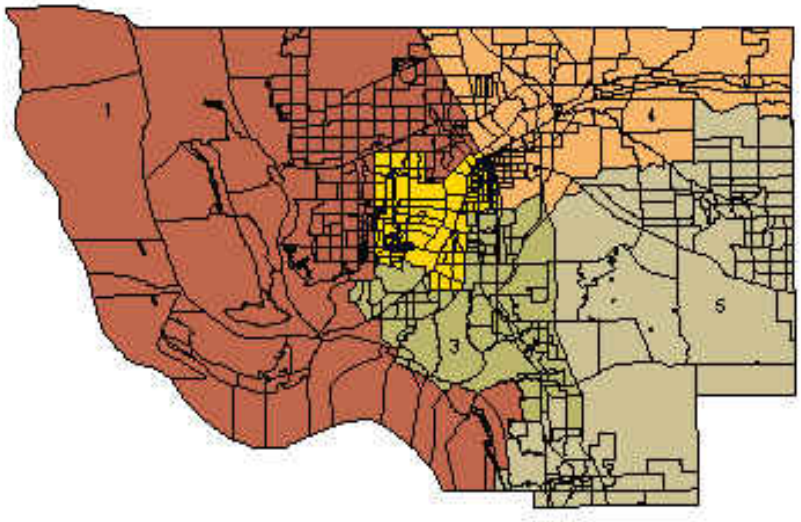

Figure 5.1 Lee County Districts Based on Postal Zip Codes

The Jacksonville region was divided into eight survey districts as shown in Figure 5.2. Among these geographical regions, the area type of District 1, 4 and 8 were beach areas, District 3 was urban, and Districts 2, 5, 6, and 7 were rural. The information about the home locations of the 2,512 useful sampled households was extracted from the survey records.

As shown in Figure 5.3, Volusia County was divided into six geographic regions: northeast, southeast, central, northwest, center-west, and southwest. The information about the home locations of the sampled households was obtained from the survey trip log database. Among the 1,164 useful sampled households, 137 households (or 11.77%) did not submit trip logs. Possible

reasons may be that these households either never traveled during the surveyed period or they did not fill out the travel diaries. These 137 households were assumed to have not made trips during the surveyed period based on the following two considerations. One was that each member of these 137 sampled households completed his or her personal information, which meant that these households participated in the survey. The other was that the percentage of households making no trips during the survey period (11.77%) was comparable to those from the Lee County and the Jacksonville MSA surveys, which were about 8.3 % and 10% of valid surveyed households, respectively. Because from the household database the location or the survey district of these households could not be identified, these households were randomly assigned a home location based on the proportion of census households in each district. Additionally, Survey District 4 was combined with its adjacent district, i.e., District 5, because only 11 households were sampled in District 4.

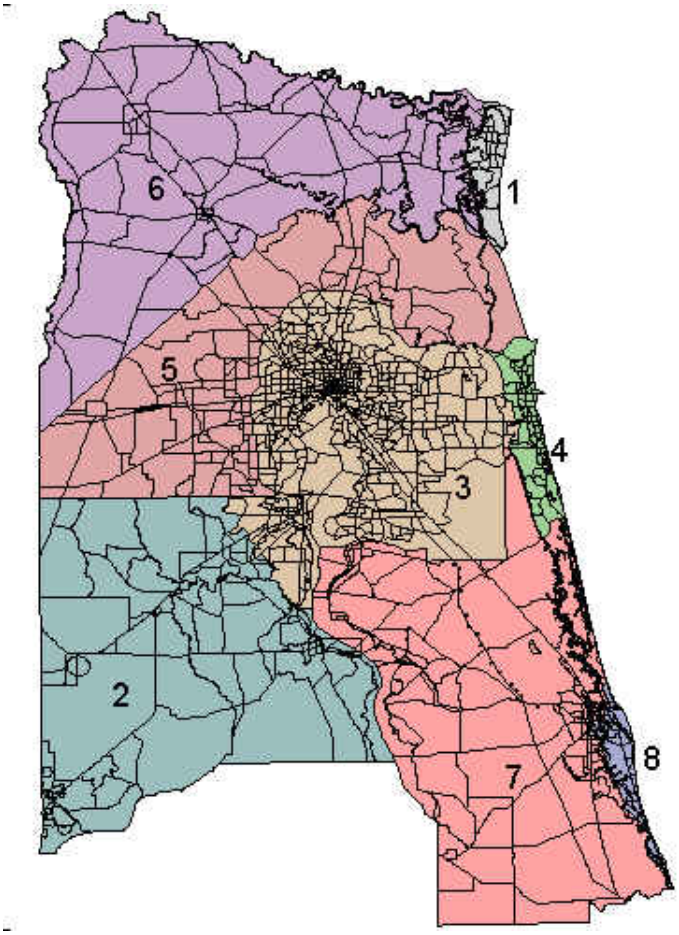

Figure 5.2 Jacksonville Region Survey Districts

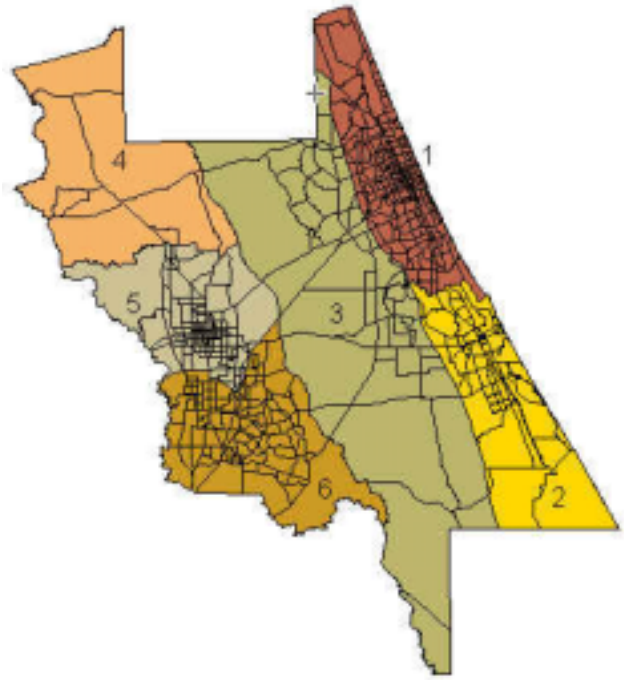

Figure 5.3 Volusia County Survey Districts

5.3 Average HBW Trip Rates in Survey Districts

The household samples were grouped into the survey districts according to their locations, and the average HBW trip rates for each survey district as well as the entire MPO/MSA were calculated. Table 5.10 gives the average HBW trip rates at the district and regional levels, as well as the percentages of difference between the two rates. When the difference between the average trip rate for a given district and the MPO/MSA-wide mean trip rate was greater than 10 percent, a Kruskal-Wallis (KW) test was performed to examine if the trip rates sampled from different regions in a given urban area were significantly different. The results showed there was no significant difference in HBW trip rates from the survey districts in the Jacksonville MSA and Lee County MPO. For Lee County District 3, the BBW trip rate was higher with a more than 10% deviation from the region-wide average trip rate, the KW test did not indicate that the difference was significant. For Volusia County MPO, the mean HBW trip rates for households with workers were different between the costal area and the inland area. Therefore, two sets of HBW trip rates were calibrated: one set of trip rates for District 1 and 2 and another set for District 3, 4, 5, and 6.

Table 5.10 Comparison of Average HBW Trip Rates for Survey Districts and for Regions

MPO/MSA	District	Sample HHs w/ Workers	Sampled HBW Trips	Average HBW Trip Rates	% Difference from Region-Wide Average
Lee County	1	44	83	1.8864	8.41
	2	51	91	1.7843	2.54
	3	47	72	1.5319	-11.96
	4	50	82	1.6400	-5.75
	5	35	67	1.9143	10.01
	Total	227	395	1.7401	
Volusia County	1	254	371	1.4606	-10.70
	2	77	119	1.5455	-5.51
	3	26	50	1.9231	17.57
	4&5	65	117	1.8000	10.04
	6	160	295	1.8438	12.72
	Total	582	952	1.6357	
Jacksonville MSA	1	178	378	2.1236	2.52
	2	221	461	2.0860	-1.16
	3	252	542	2.1508	1.91
	4	247	473	1.9150	0.92
	5	203	459	2.2611	7.14
	6	161	372	2.3106	9.49
	7	218	474	2.1743	3.03
	8	187	359	1.9198	-9.03
	Total	1,667	3,518	2.1104	

5.4 Survey District and Region-Wide Total HBW Trips

For evaluation purposes, total HBW trips expanded from the survey were necessary to provide a benchmark against which different models could be compared. Trips were expanded from the survey data for each district by multiplying the total number of households by the average HBW trip rate of that district. However, including households without workers in the calculations would result in underestimated HBW trip rates. Therefore, the number of households was taken as that of the households with workers in a given district. The expanded trips were interpreted as the expected district-wide HBW trips and were used for comparison purposes. The 1990 census STP 266 data were employed to estimate the total HBW trips in each district of the three urban regions because the 2000 STP data have not been released at the time of this report. However, not using the 2000 census household information did not render the procedures for evaluating the models invalid or inaccurate because the numbers of trips estimated from the models, which were to be compared with the number of trips expanded from the survey data, would also be based on the same, thus consistent, household numbers. An assumption underlying this data expansion was that the percentages of different types of household within a district did not change significantly between 1990 and 2000. Verification of this assumption will require the use

of 2000 census in the same format as STP 266. The results of survey data expansion are presented in Table 5.11.

Table 5.11 Data Expansions for the Three Urban Regions

MPO/MSA	District	Total HHs* N_h	Sample HHs n_h	Sampled HBW Trips Σy_{hi}	Average HBW Trips $\bar{y}_h$	Sample Variance s_h^2	Expanded Trips
Lee County	1	16,863	44	83	1.8864	3.2193	31,810
	2	24,494	51	91	1.7843	2.2125	43,705
	3	17,732	47	72	1.5319	1.3848	27,164
	4	16,769	50	82	1.6400	1.7861	27,501
	5	9,455	35	67	1.9143	2.7277	18,100
	Total	85,313	227	395			148,279
Volusia County	1	48,360	254	371	1.4606	2.0598	70,636
	2	10,472	77	119	1.5455	2.7249	16,184
	3	2,590	26	50	1.9231	2.9538	4,981
	4&5	12,315	65	117	1.8000	1.6313	22,167
	6	19,168	160	295	1.8438	1.9817	35,341
	Total	92,905	582	952			149,309
Jacksonville MSA	1	4,308	178	378	2.1236	2.8886	9,148
	2	12,531	221	461	2.0860	1.9880	26,139
	3	183,278	252	542	2.1508	3.2680	394,193
	4	21,217	247	473	1.9150	2.1919	40,630
	5	19,154	203	459	2.2611	2.8375	43,309
	6	8,062	161	372	2.3106	2.3905	18,628
	7	12,460	218	474	2.1743	2.3013	27,092
	8	6,616	187	359	1.9198	2.4720	12,701
	Total	267,626	1,667	3,518			571,841

* Number of households with workers from the 1990 Census

5.5 Region-Wide Mean Trip Rates

Using the information in Table 5.11 and the household survey data, statistics such as estimated region-wide mean trip rates and their confidence intervals can be complied. By assuming households were randomly sampled from each district, the population mean trip rates and the associated variance for HBW trips can be estimated as follows (Thompson 1992):

$$\bar{y}_{st} = \frac{1}{N}\sum_{h=1}^{L} N_h \bar{y}_h$$

$$\hat{\text{var}}\left(\bar{y}_{st}\right) = \sum_{h=1}^{L}\left(\frac{N_h}{N}\right)^2\left(\frac{N_h - n_h}{N_h}\right)\frac{s_h^{\,2}}{n_h}$$

$$\bar{y}_h = \frac{1}{n_h}\sum_{i=1}^{n_h} y_{hi}$$

$$s_h^{\,2} = \frac{1}{n_h - 1}\sum_{i=1}^{n_h}\left(y_{hi} - \bar{y}_h\right)^2$$

where

$\bar{y}_{st}$ = stratified sample mean, which is an unbiased estimator of the population HBW trip rate;

$\hat{\text{var}}\left(\bar{y}_{st}\right)$ = unbiased estimator of sample mean variance;

y_{hi} = number of HBW trips sampled from the i^{th} household in district h;

n_h = number of valid households sampled from district h;

$\bar{y}_h$ = sampled HBW trip rate for district h;

N_h = total number of households in district h;

L = number of districts (strata) in a given urban area; and

N = total number of households in a given urban area.

When all the sample sizes for each district are least 30, the confidence interval for the sample mean can be determined as follows:

$$\bar{y}_{st} \pm t_{1-\frac{\alpha}{2}}\sqrt{\hat{\text{var}}\left(\bar{y}_{st}\right)}$$

Table 5.12 gives the estimated population mean HBW trip rates, variances, and the approximate 95% confidence intervals for the means for the three urban regions calculated using the above equations.

Table 5.12 HBW Trip Rate Statistics for Survey Districts for the Three Urban Regions

MPO/MSA	Region-Wide HBW Trip Rates	Variance	95% confidence interval
Lee County	1.74	0.1001	(1.54, 1.93)
Volusia County Districts 1, 2	1.48	0.0810	(1.32, 1.63)
Volusia County Districts 3, 4, 5, 6	1.83	0.0883	(1.66, 2.00)
Jacksonville MSA	2.14	0.0792	(1.98, 2.29)

5.6 Calibration of Trip Rates and Comparisons of Model Estimates with Expected Number of Trips

A common problem in calibrating trip rates using the cross-classification method is that some cells in the cross-classification matrix may have small or zero observations. A technique used to populate null values in the matrix is Multiple Classification Analysis (MCA). This method uses grand mean and group means to develop estimates of values for all cells. A grand mean is

computed for the entire set of observations. Group means are computed for each of the strata. Deviations are the differences between the group means and the grand mean. Individual cell values are computed by adding the grand mean and the deviations associating with the groups of variables. The adjusted MCA was also used to calculate the group means. In adjusted MCA, the group means are adjusted for variations attributed to all other nonmetric factors in the design of cross-classification. The group means are calculated using a least-square best-fit method such that the adjusted values express the magnitude of category effects for a given factor that remains after variation due to other factors and/or covariates has been partialled out. Both the MCA and adjusted MCA were applied for trip rate calibration in this study. The SPSS subprogram ANOVA was used to calculate the deviations. In some instances where the trip rate for a particular cell was less than zero, the cell value was set to a small positive number, 0.01.

The zonal HBW trips were calculated by multiplying the trip rates for each cell and the number of households for that cell. The estimated HBW trips based on the tip rates calibrated by the MCA and adjusted MCA approaches for the lifestyle models and the standard FSUTMS model were compared with the expected district totals. Trip rates calibrated by either the MCA or adjusted MCA were selected for each model based on (1) region-wide mean trip rate, (2) performance in terms of the difference between the estimated and expected region-wide total trips, and (3) logical relationship between cells.

For Lee County, the MCA method was chosen for the Tampa Bay model structure and the standard FSUTMS model structure. For the Southeast Florida model structure, the adjusted MCA method were selected because the region-wide average trip rate based on the MCA method fell outside the 95% confidence interval and because trip rates based on the adjusted MCA method provided closer estimation to the expected district total. However, the trip rates did not follow the logical trends between cells.

Volusia County was similar to Lee County. The trip rates from the adjusted MCA method based on the Southeast Florida model did not always follow the expected trends, although these trip rates provided a closer estimation at the region level than trip rates based on either the Tampa Bay or standard FSUTMS models.

For the Jacksonville MSA, the region-wide average trip rates were 2.14, 2.05, and 2.09 based on the Southeast Florida, Tampa Bay, and standard FSUTMS model structures, respectively, which all fell within the 95% interval of population mean. However, the Southeast Florida model structure provided better HBW trip estimates than the other two model structures at both district and regional levels.

Table 5.13 summarizes for each study area the method that provided better estimates of the total HBW trips for different model structures and the bets performing models.

Table 5.13 Trip Calibration Methods and Best Performing Model for HBW Trips

Region	Model Structure			
	Southeast Florida	Tampa Bay	Standard FSUTMS	Best Performing Model
Lee County	Adjusted MCA	MCA	MCA	Tampa Bay
Volusia County	Adjusted MCA	MCA	MCA	Southeast Florida
Jacksonville MSA	MCA	MCA	MCA	Southeast Florida

Tables 5.14 through 16 provide the HBW trip rates calibrated for the three urban areas based on each of the three model structures with their corresponding best performing method as specified in Table 5.13.

Table 5.14 Lifestyle HBW Trip Rates Based on the Southeast Florida Model Structure

MPO/MSA	Presence of Children	Vehicle	Workers		
			0	1	2+
Lee County	Without Children	0		1.21	2.69
		1		0.99	2.47
		2		0.85	2.33
		3+		0.71	2.19
	With Children	0		1.26	2.74
		1		1.05	2.52
		2		0.91	2.39
		3+		0.76	2.24
Volusia County Districts 1, 2	Without Children	0		0.91	2.25
		1		0.95	2.29
		2		1.02	2.36
		3+		1.00	2.34
	With Children	0		0.59	1.93
		1		0.63	1.98
		2		0.70	2.04
		3+		1.68	2.03
Volusia County Districts 3, 4, 5, 6	Without Children	0		1.36	2.58
		1		1.11	2.33
		2		1.31	2.53
		3+		1.47	2.70
	With Children	0		0.98	2.20
		1		0.73	1.95
		2		0.93	2.15
		3+		1.09	2.32
Jacksonville	Without Children	0		0.03	1.75
		1		0.34	2.07
		2		1.32	3.05
		3+		2.16	3.88
	With Children	0		0.58	2.31
		1		0.90	2.62
		2		1.88	3.60
		3+		2.71	4.44

Table 5.15 Lifestyle HBW Trip Rates Based on the Tampa Bay Model Structure

MPO/MSA	Vehicle	Household Type		
		Retired HH	Working without Children	Working with Children
Lee County	0	0.01	1.17	1.24
	1	0.01	1.22	1.29
	2	0.39	2.07	2.14
	3+	0.94	2.62	2.69
Volusia County Districts 1, 2	0	0.01	1.01	0.80
	1	0.01	1.20	1.00
	2	0.40	1.89	1.69
	3+	0.82	2.31	2.11
Volusia County Districts 3, 4, 5, 6	0	0.01	1.34	1.00
	1	0.01	1.33	0.99
	2	0.38	2.25	1.91
	3+	1.09	2.97	2.63
Jacksonville	0	0.01	1.12	0.95
	1	0.01	1.43	1.26
	2	0.52	2.41	2.25
	3+	1.35	3.25	3.08

Table 5.16 HBW Trip Rates Based on the Standard FSUTMS Model Structure

MPO/MSA	Dwelling Type	Vehicle	Household Size				
			1	2	3	4	5+
Lee County	Single Family	0	0.01	0.43	1.20	1.51	1.39
		1	0.01	0.49	1.26	1.56	1.45
		2+	0.98	1.46	2.22	2.53	2.42
	Multi-Family	0	0.01	0.01	0.73	1.03	0.92
		1	0.01	0.01	0.78	1.09	0.97
		2+	0.50	0.98	1.75	2.05	1.94
Volusia County Districts 1, 2	Single Family	0	0.01	0.19	0.69	1.31	1.48
		1	0.04	0.39	0.89	1.51	1.67
		2+	0.85	1.20	1.69	2.31	2.48
	Multi-Family	0	0.01	0.01	0.33	0.95	1.11
		1	0.01	0.03	0.52	1.14	1.31
		2+	0.48	0.83	1.33	1.95	2.12
Volusia County Districts 3, 4, 5, 6	Single Family	0	0.01	0.47	0.92	1.29	1.35
		1	0.01	0.46	0.91	1.28	1.34
		2+	0.91	1.64	2.08	2.46	2.51
	Multi-Family	0	0.01	0.01	0.15	0.53	0.58
		1	0.01	0.01	0.15	0.52	0.57
		2+	0.14	0.87	1.32	1.69	1.75
Jacksonville	Single Family	0	0.01	0.41	1.37	1.51	1.58
		1	0.01	0.72	1.69	1.83	1.89
		2+	1.05	1.96	2.93	3.07	3.14
	Multi-Family	0	0.01	0.18	1.15	1.29	1.36
		1	0.01	0.50	1.46	1.61	1.67
		2+	0.82	1.74	2.71	2.85	2.91

The HBW trips estimated based on the lifestyle models and the standard FSUTMS model were compared with the expected district totals. Table 5.17 presents the results of comparison. The absolute differences between the expected and estimated HBW trips for each district are given in the *Diff* column. Table 5.18 performs the same comparison by measuring the differences between the expected trips and model estimated trips in percentages.

Table 5.17 Comparison of Estimated HBW Trips for the Three Urban Regions

MPO/MSA	District	Expanded Trips	Southeast Florida		Tampa Bay		FSUTMS	
			Estimated	*Diff*	*Estimated*	*Diff*	*Estimated*	*Diff*
Lee County	1	31,810	28,486	3,324	30,484	1,326	29,383	2,427
	2	43,705	40,828	2,877	43,658	47	39,540	4,165
	3	27,164	30,483	3,319	31,618	4,454	25,099	2,065
	4	27,501	28,438	937	29,590	2,089	27,234	267
	5	18,100	16,171	1,929	17,242	858	17,441	659
	Total	148,279	144,407	12,386	152,593	8,774	138,697	9,583
Volusia County	1	70,636	73,537	2,901	72,139	1,503	62,125	8,511
	2	16,184	16,217	33	17,058	874	17,123	939
	3	4,981	4,708	273	5,332	351	4,891	90
	4&5	22,167	21,597	570	23,159	992	20,910	1,257
	6	35,341	34,128	1,213	36,863	1,522	37,798	2,457
	Total	149,309	150,187	4,991	154,550	5,241	142,847	13,253
Jacksonville MSA	1	9,148	10,012	864	9,281	133	9,387	239
	2	26,139	31,948	5,809	28,606	2,467	30,844	4,705
	3	394,193	402,552	8,359	370,495	23,698	372,673	21,520
	4	40,630	45,492	4,862	41,740	1,110	40,789	159
	5	43,309	46,947	3,638	41,922	1,387	44,518	1,209
	6	18,628	19,293	665	17,782	846	18,936	308
	7	27,092	29,364	2,272	26,295	797	28,841	1,749
	8	12,701	13,295	594	12,721	20	13,277	576
	Total	571,841	598,903	27,062	548,842	30,458	559,265	30,465

Table 5.18 Comparison of Estimated HBW Trips for the Three Urban Regions in Percentages

MPO/MSA	District	Expanded Trips	Southeast Florida		Tampa Bay		FSUTMS	
			Estimated	*% Diff*	*Estimated*	*% Diff*	*Estimated*	*% Diff*
Lee County	1	31,810	28,486	10.45	30,484	4.17	29,383	7.63
	2	43,705	40,828	6.58	43,658	0.11	39,540	9.53
	3	27,164	30,483	12.22	31,618	16.40	25,099	7.60
	4	27,501	28,438	3.41	29,590	7.60	27,234	0.97
	5	18,100	16,171	10.66	17,242	4.74	17,441	3.64
	Total	148,279	144,407	8.35	152,593	5.92	138,697	6.46
Volusia County	1	70,636	73,537	4.11	71,908	1.80	62,125	12.05
	2	16,184	16,217	0.20	16,994	5.00	17,123	5.80
	3	4,981	4,708	5.48	5,326	6.93	4,891	1.81
	4&5	22,167	21,597	2.57	23,113	4.27	20,910	5.67
	6	35,341	34,128	3.43	36,779	4.07	37,798	6.95
	Total	149,309	150,187	3.34	154,120	3.22	142,847	8.88
Jacksonville MSA	1	9,148	10,012	9.44	9,281	1.45	9,387	2.61
	2	26,139	31,948	22.22	28,606	9.44	30,844	18.00
	3	394,193	402,552	2.12	370,495	6.01	372,673	5.46
	4	40,630	45,492	11.97	41,740	2.73	40,789	0.39
	5	43,309	46,947	8.40	41,922	3.20	44,518	2.79
	6	18,628	19,293	3.57	17,782	4.54	18,936	1.65
	7	27,092	29,364	8.39	26,295	2.94	28,841	6.46
	8	12,701	13,295	4.68	12,721	0.16	13,277	4.54
	Total	571,841	598,903	4.73	548,842	5.33	559,265	5.33

Compared with the Tampa Bay and FSUTMS models, Southeast Florida model significantly overestimated HBW trips for Lee County. The differences between the predicted and expected HBW trips at the region and district levels indicated that the Tampa Bay model provided better HBW estimates than the standard FSUTMS model. While the difference between the Tampa Bay and the standard FSUTMS models was small at the regional level, it was significant for District 1, which also had the largest number of HBW trips among the districts.

For Volusia County, the Southeast Florida model provided better regional estimates for HBW trips as indicated by the difference between expected and predicted trips at the regional level. However, the difference between the estimates based on the Southeast Florida model and the Tampa Bay model was not significant at the regional level as the difference was 0.12% between the two models. For District 1, which had the largest number of HBW trips, the Tampa Bay model yielded the largest improvement, outperforming the Southeast Florida model by 2.31% and the standard FSUTMS model by 10.24%.

For the Jacksonville MSA, the Southeast Florida model structure resulted in the smallest difference from the expected HBW trips at both district and regional levels, although at the regional level the differences between different models were rather small. For District 3, which had the most HBW trips, the differences between the Southeast Florida model and the Tampa

Bay and Standard FSUTMS models, respectively, were 15,339 and 13,161, which represented 3.9% and 3.3% of the expected HBW trips.

5.7 Demographics and Benefits of Lifestyle Models

The results from Table 5.17 indicated that for all three Florida urban regions, lifestyle models would improve the accuracy of trip production estimation for HBW trip purpose depending on the lifestyle model structures and to different degrees. Lee County MPO would benefit using the Tampa Bay Regional Model structure, while the Jacksonville MSA would benefit using the Southeast Florida model structure. For Volusia County MPO, either lifestyle models will improve trip production estimation. Although at the regional level the Southeast Florida model performed slightly better, the Tampa Bay model produced better result for the district with the largest number of trips.

While no definite conclusions can be drawn regarding which models will perform better for a urban area with given demographic characteristics, it may be reasonable to postulate that model performance is related to demographic characteristics. For example, the Jacksonville MSA had a smaller retired population, as compared to Lee County and Volusia County MPOs. Table 5.19 provides the information on population, percentages of seasonal households, and percentages of population age groups based on the 2000 census for several Florida counties. By assuming the differences in demographic characteristics in each county between 1990 and 2000 are negligible, it may be observed that the Jacksonville MSA shared more similarity in demographics with Broward County, for which the Southeast Florida model structure was originally developed, while the demographics of Lee and Volusia counties resembled more closely to that of the Tampa Bay region.

It should be noted, however, that it is not just the region-wide percentage of retired population that makes a particular lifestyle model work better. The spatial distribution of this population is also important. For instance, in Broward and Miami-Dade counties, while the percentage of the retired population may be considered relatively low, their absolute numbers may be large because of the large total populations. Uneven distribution of the retired population can also result in significant errors in subareas. Figures 5.4 and 5.5 show the distributions of population of age 60 and over in terms of their percentages by census tract (2000 census) in Broward and Miami-Dade counties and in the Jacksonville MSA, respectively. It may be seen that Broward County had many enclaves where the retired population congregated. In contrast, the distribution of the older population was more even in the counties in the Jacksonville MSA. Figures 5.6 and 5.7 illustrate the distributions of population of age 60 and over for Volusia County and Lee County, respectively, both showing large areas with high percentages of retired population. Note that Lee County also had a significant proportion of seasonal households. In Chapter 8 it will be shown that the majority of the seasonal households in Lee County were also retired households.

Table 5.19 Demographics of Florida Counties Participating in the Study and Using Lifestyle Models

Region	County	Population	Seasonal HHs (%)	Population			HH Median Income ($)
				Under 18 (%)	18-64 (%)	65+* (%)	
Lee	Lee	440,888	20.94	19.57	55.02	25.41	40,319
Volusia	Volusia	443,343	8.44	20.18	57.70	22.12	35,219
Jacksonville	Clay	140,814	1.61	27.88	62.34	9.78	48,854
	Duval	778,879	0.48	26.28	63.29	10.43	40,703
	Nassau	57,663	6.38	25.01	62.44	12.55	46,022
	St. Johns	123,135	8.69	23.06	61.04	15.90	50,099
Southeast Florida	Broward	1,623,018	7.10	23.59	60.32	16.09	41,691
	Palm Beach	1,131,184	11.15	21.15	55.64	23.20	45,062
	Miami-Dade	2,253,362	3.81	24.74	61.94	13.33	35,966
Tampa Bay	Citrus	118,085	9.86	17.22	50.59	32.19	31,001
	Hernando	130,802	6.43	18.81	50.26	30.93	32,572
	Hillsborough	998,948	1.55	25.23	62.81	11.96	40,663
	Pasco	344,765	10.11	20.08	53.09	26.80	32,969
	Pinellas	921,482	8.22	19.21	58.19	22.59	37,111
Florida		15,982,378	7.62	22.74	59.70	17.56	38,819

Note: Census data do not include information on retirees. Population of age 65 and older was considered retired population.

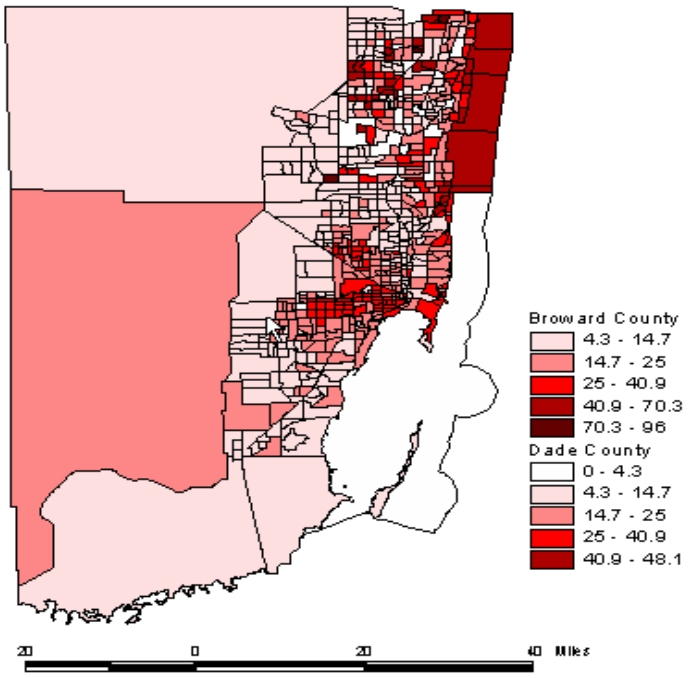

Figure 5.4 Percentage of Population of Age 60 and Over by Census Tract in Miami-Dade and Broward Counties

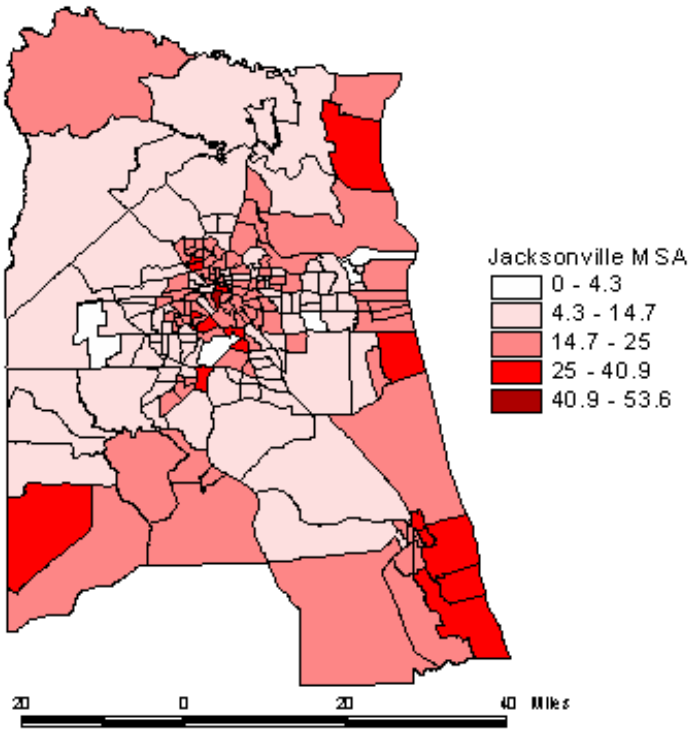

Figure 5.5 Percentage of Population of Age 60 and Over by Census Tract in the Jacksonville MSA

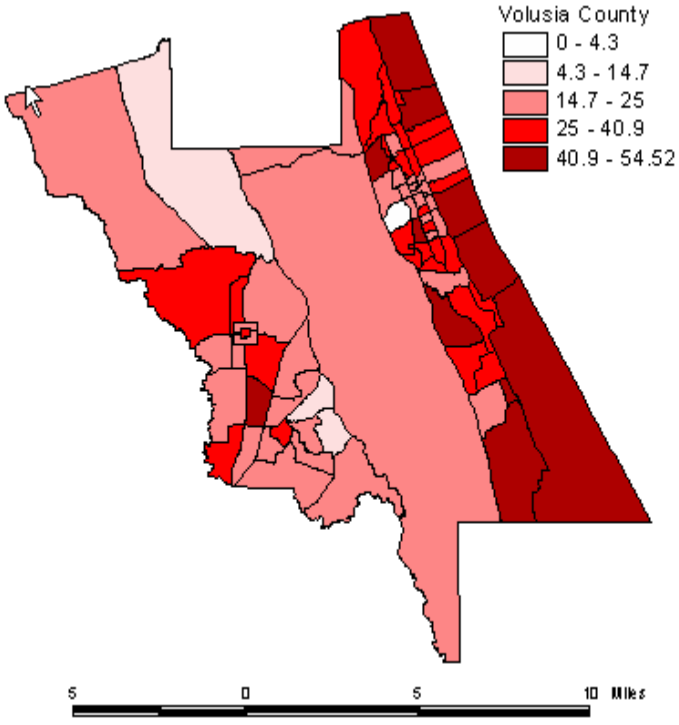

Figure 5.6 Percentage of Population of Age 60 and Over by Census Tract in Volusia County

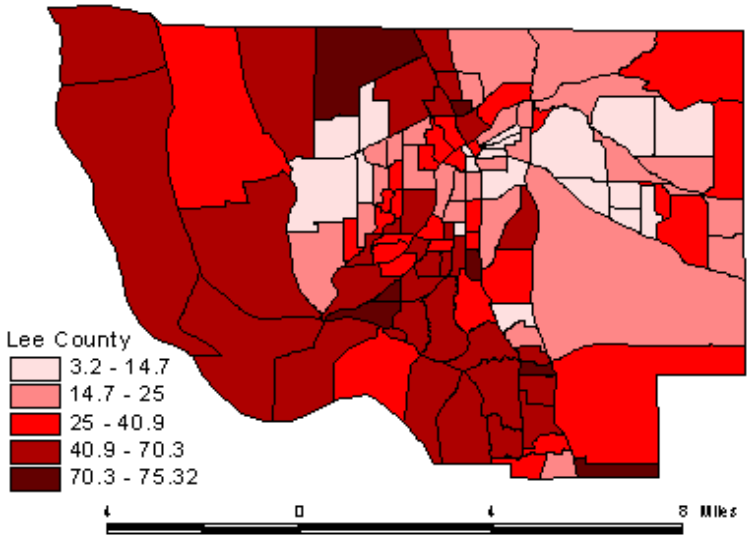

Figure 5.7 Percentage of Population of Age 60 and Over by Census Tract in Lee County

6. COMPARSION OF MDOELS FOR HOME-BASED NON-WORK TRIPS

The same procedures for calibrating and evaluating HBW trip production models were applied in the analyses of trip rates of HBNW purposes. The statistics of the total census households and the sample sizes for the Tampa Bay and FSUTMS models were the same as those given in Tables 5.4, 5.6, 5.7, and 5.9 since these two model structures remained the same for all trip purposes. For the Southeast Florida Model, Tables 6.1 and 6.2 give the information on different lifestyle classifications for HBNW trip purposes. The census data in Table 6.1 were from STP 283, which provided census household information based on the Southeast Florida model structure for HBNW trip purposes.

Table 6.1 1990 Census Households Based on the Southeast Florida Model Structure for HBNW Trip Purposes for the Three Urban Regions

MPO/MSA	Presence of Children	Vehicle	Household Size			
			1	2	3	4+
Lee County	Without Children	0	4,938	1,306	176	55
		1	24,565	28,560	1,454	333
		2	2,406	28,758	3,265	507
		3+	206	3,394	3,091	1,338
	With Children	0		305	336	740
		1		1,529	3,038	4,085
		2		410	6,596	10,944
		3+		49	1,773	5,889
Volusia County	Without Children	0	7,692	2,116	299	36
		1	29,100	25,476	1,459	356
		2	3,018	28,630	3,764	741
		3+	383	4,318	4,013	1,773
	With Children	0		325	548	854
		1		1,864	3,756	4,532
		2		359	7,513	12,123
		3+		69	1,852	6,346
Jacksonville MSA	Without Children	0	17,233	4,420	661	347
		1	55,622	26,034	3,139	749
		2	7,648	60,379	6,859	1,406
		3+	1,457	11,069	10,896	4,493
	With Children	0		1,400	3,100	4,588
		1		6,589	11,746	16,012
		2		1,301	22,256	39,016
		3+		114	5,670	18,839

Table 6.2 Sample Size Based on the Southeast Florida Model Structure for HBNW Trip Purposes for the Three Urban Regions

MPO/MSA	Presence of Children	Vehicle	Household Size			
			1	2	3	4+
Lee County	Without Children	0	3	2	1	0
		1	58	83	5	1
		2	7	71	14	6
		3+	0	9	12	8
	With Children	0		0	0	2
		1		3	6	13
		2		0	16	38
		3+		0	6	8
Volusia County	Without Children	0	13	2	0	0
		1	280	186	3	0
		2	44	299	7	0
		3+	13	104	24	10
	With Children	0		0	1	1
		1		20	10	8
		2		3	29	57
		3+		2	12	36
Jacksonville	Without Children	0	79	6	1	0
		1	576	117	5	1
		2	90	795	36	8
		3+	10	243	122	41
	With Children	0		5	3	0
		1		23	21	14
		2		31	69	114
		3+		7	22	73

In the next three sections, the calibration of trip rates and comparison between the three different models are described for the HBS, HBSR, and HBO trip purposes.

6.1 Home-Based Shopping Trips

Tables 6.3 through 6.5 summarize the sampled HBS trips based on the Southeast Florida, Tampa Bay, and standard FSUTMS model structures, respectively. The results of survey data expansion for HBS trips are presented in Table 6.6.

Table 6.3 Sampled HBS Trips Based on the Southeast Florida Model Structure for the Three Urban Regions

MPO/MSA	Presence of Children	Vehicle	Household Size			
			1	2	3	4+
Lee County	Without Children	0	1	2	0	0
		1	26	126	5	8
		2	1	73	14	12
		3+	0	4	10	0
	With Children	0		0	0	26
		1		4	0	43
		2		0	13	6
		3+		0	6	0
Volusia County	Without Children	0	1	0	0	0
		1	122	212	4	0
		2	21	274	5	0
		3+	0	93	19	15
	With Children	0		0	0	0
		1		7	7	6
		2		0	23	54
		3+		0	5	19
Jacksonville	Without Children	0	19	3	1	0
		1	298	147	4	4
		2	44	805	55	7
		3+	2	197	126	49
	With Children	0		6	1	0
		1		9	8	28
		2		26	63	149
		3+		7	49	101

Table 6.4 Sampled HBS Trips Based on the Tampa Bay Regional Model Structure for the Three Urban Regions

MPO/MSA	Vehicle	Household Type		
		Retired	Working without children	Working with children
Lee County	0	3	0	0
	1	124	34	29
	2	47	52	53
	3+	2	24	12
Volusia County	0	0	1	0
	1	299	40	19
	2	218	85	74
	3+	51	78	22
Jacksonville	0	26	1	3
	1	335	133	30
	2	544	398	207
	3+	147	260	124

Table 6.5 Sampled HBS Trips Based on the Standard FSUTMS Model Structure for the Three Urban Regions

MPO/MSA	Dwelling Type	Vehicle	Household Size				
			1	2	3	4	5+
Lee County	Single-Family	0	1	2	0	0	0
		1	6	52	1	7	8
		2	0	58	36	21	16
	Multi-Family	0	0	0	0	0	0
		1	20	79	6	8	0
		2	1	29	12	7	10
Volusia County	Single-Family	0	1	0	0	0	0
		1	75	156	2	5	1
		2	19	321	50	60	25
	Multi-Family	0	0	0	0	0	0
		1	47	63	9	0	0
		2	2	46	2	3	0
Jacksonville	Single-Family	0	1	6	1	0	0
		1	154	90	6	8	0
		2	30	773	248	131	115
	Multi-Family	0	18	3	1	0	0
		1	144	66	6	24	0
		2	16	262	45	36	24

Table 6.6 Data Expansions for HBS Trips

MPO/MSA	District	Total HHs	Sample HHs	Sampled HBS Trips	Average HBS Trips	Sample Variance	Expanded Trips
Lee County	1	28,327	75	75	1.0000	1.6828	28,327
	2	39,707	82	85	1.0366	2.9211	41,160
	3	28,606	78	100	1.2821	2.4176	36,674
	4	26,572	71	68	0.9577	2.4190	25,449
	5	16,834	66	52	0.7879	1.9944	13,263
	Total	140,046	372	380			144,873
Volusia County	1	80,086	506	348	0.6877	1.3637	55,079
	2	19,594	176	122	0.6932	1.4253	13,582
	3	3,573	52	47	0.9038	2.0887	3,229
	4&5	19,514	152	111	0.7303	1.4830	14,250
	6	30,548	278	259	0.9317	2.3383	28,460
	Total	153,315	1,164	887			114,601
Jacksonville	1	5,793	311	327	1.0514	2.1070	6,091
	2	16,050	317	228	0.7192	1.3291	11,544
	3	234,473	359	216	0.6017	1.1621	141,070
	4	26,050	350	361	1.0314	2.2770	26,869
	5	23,570	285	215	0.7544	1.6296	17,781
	6	10,389	222	220	0.9910	2.2443	10,295
	7	16,954	343	334	0.9738	2.3414	16,509
	8	9,764	325	307	0.9446	1.7130	9,223
	Total	343,043	2,512	2,208			239,382

The results of KW tests showed there was no significant difference in HBS trip rates among the survey districts in Lee County and Volusia County. However, for the Jacksonville MSA, the mean HBS trip rates per household for Districts 2, 3, and 5 and those for Districts 1, 4, 6, 7, and 8 were different. Therefore, two sets of HBS trip rates were calibrated for the Jacksonville MSA. Table 6.7 provides the estimated population mean HBS trip rates, variances, and approximate 95% confidence intervals for the means for the three urban regions.

Table 6.7 HBS Trip Rate Statistics for Survey Districts for the Three Urban Regions

MPO/MSA	Region-Wide HBS Trip Rates	Variance	95% confidence interval
Lee County	1.03	0.0819	(0.87, 1.20)
Volusia County	0.75	0.0370	(0.67, 0.82)
Jacksonville Districts 2, 3, 5	0.62	0.0492	(0.53, 0.72)
Jacksonville Districts 1, 4, 6, 7, 8	1.00	0.0411	(0.92, 1.08)

Tables 6.8 through 6.10 give the calibrated HBS trip rates for the two lifestyle models and the standard FSUTMS model. For Lee County, the MCA method was selected to calibrate the trip rates for the three models. The region-wide averages were 0.99, 1.01, and 0.99, for the Southeast Florida, Tampa Bay, and standard FSUTMS model structures, respectively, which all fell within

the 95% interval of population mean. However, the average HBS trip rates did not increase with number of vehicles or household size. A possible reason was that most retired households had no more than two household members, and during the weekday, the retired households might make more HBS trips than households with working parents and children.

For Volusia County, the MCA method was selected for the three models. The region-wide average trip rates were 0.71, 0.70, and 0.71, for the Southeast Florida, Tampa Bay, and standard FSUTMS model structures, respectively, all within the 95% interval of the population means. Again, the average HBS trip rates did not increase with number of vehicles or household size.

For the Jasonville MSA, the MCA method was selected for the standard FSUTMS model while the adjusted MCA method was selected for the Southeast Florida and Tampa Bay models. Although the average HBS trip rates followed the expected trends, the overall average trip rates from the Southeast Florida and standard FSUTMS models were outside the 95% confidence intervals.

The methods used to calibrate the final HBS trip rates as well as the best performing models are given in Table 6.11.

The HBS trips estimated from the lifestyle models and the standard FSUTMS model were compared with the expected regional and district totals. The results of the comparison are presented in Table 6.12. For Lee County, all three models performed similarly, although the Tampa Bay model provided slightly better estimation at region and district levels than the other two models. For Volusia County, again all three models had similar performance with the Southeast Florida model performed slightly better. For the Jasonville MAS, the Tampa Bay model performed the best, bringing 9.2% and 7.4% improvements over the standard FSUTMS model at both the district (District 3) and regional levels.

Table 6.8 HBS Trip Rates Based on the Southeast Florida Model Structure for the Three Urban Regions

MPO/MSA	Presence of Children	Vehicle	Household Size			
			1	2	3	4+
Lee County	Without Children	0	0.01	0.58	0.14	0.59
		1	0.48	1.31	0.87	1.32
		2	0.37	1.21	0.76	1.21
		3+	0.26	1.09	0.65	1.10
	With Children	0		0.64	0.20	0.65
		1		1.37	0.93	1.38
		2		1.26	0.82	1.27
		3+		1.15	0.70	1.15
Volusia County	Without Children	0	0.01	0.26	0.04	0.15
		1	0.37	0.91	0.69	0.80
		2	0.52	1.06	0.84	0.95
		3+	0.41	0.95	0.74	0.84
	With Children	0		0.16	0.01	0.05
		1		0.81	0.59	0.70
		2		0.96	0.74	0.85
		3+		0.85	0.63	0.74
Jacksonville Districts 2, 3, 5	Without Children	0	0.20	0.61	0.74	0.95
		1	0.46	0.87	1.00	1.21
		2	0.39	0.79	0.93	1.14
		3+	0.30	0.71	0.84	1.05
	With Children	0		0.44	0.57	0.78
		1		0.70	0.83	1.04
		2		0.63	0.76	0.97
		3+		0.54	0.67	0.88
Jacksonville Districts 1, 4, 6, 7, 8	Without Children	0	0.30	0.93	1.23	1.56
		1	0.56	1.19	1.48	1.82
		2	0.48	1.12	1.41	1.74
		3+	0.34	0.98	1.27	1.60
	With Children	0		0.92	1.21	1.54
		1		1.17	1.47	1.80
		2		1.10	1.39	1.72
		3+		0.96	1.25	1.58

Table 6.9 HBS Trip Rates Based on the Tampa Bay Regional Model Structure for the Three Urban Regions

MPO/MSA	Vehicle	Household Type		
		Retired	Working without children	Working with children
Lee County	0	0.51	0.17	0.45
	1	1.24	0.90	1.18
	2	1.13	0.80	1.07
	3+	1.02	0.68	0.95
Volusia County	0	0.16	0.01	0.03
	1	0.80	0.53	0.68
	2	0.96	0.68	0.83
	3+	0.85	0.57	0.72
Jacksonville Districts 2, 3, 5	0	0.29	0.08	0.33
	1	0.63	0.42	0.66
	2	0.88	0.67	0.92
	3+	0.90	0.68	0.93
Jacksonville Districts 1, 4, 6, 7, 8	0	0.45	0.10	0.49
	1	0.87	0.39	0.90
	2	1.35	0.87	1.38
	3+	1.47	0.99	1.50

Table 6.10 HBS Trip Rates Based on the Standard FSUTMS Model Structure for the Three Urban Regions

MPO/MSA	Dwelling Type	Vehicle	Household Size				
			1	2	3	4	5+
Lee County	Single-Family	0	0.01	0.48	0.03	0.12	1.01
		1	0.38	1.21	0.77	0.86	1.74
		2	0.25	1.08	0.63	0.72	1.61
	Multi-Family	0	0.01	0.79	0.34	0.43	1.32
		1	0.69	1.52	1.07	1.16	2.05
		2	0.55	1.39	0.94	1.03	1.92
Volusia County	Single-Family	0	0.01	0.28	0.06	0.14	0.22
		1	0.38	0.92	0.70	0.79	0.87
		2	0.50	1.04	0.82	0.91	0.99
	Multi-Family	0	0.01	0.14	0.01	0.01	0.09
		1	0.25	0.79	0.57	0.66	0.74
		2	0.37	0.91	0.69	0.78	0.85
Jacksonville Districts 2, 3, 5	Single-Family	0	0.01	0.36	0.41	0.41	0.95
		1	0.30	0.65	0.70	0.70	1.24
		2	0.53	0.87	0.93	0.93	1.47
	Multi-Family	0	0.01	0.32	0.37	0.37	0.91
		1	0.26	0.61	0.66	0.66	1.20
		2	0.48	0.83	0.88	0.88	1.42
Jacksonville Districts 1, 4, 6, 7, 8	Single-Family	0	0.01	0.55	0.78	0.72	2.30
		1	0.32	0.89	1.12	1.06	2.64
		2	0.75	1.32	1.55	1.49	3.07
	Multi-Family	0	0.01	0.33	0.56	0.50	2.08
		1	0.10	0.67	0.90	0.84	2.42
		2	0.53	1.10	1.33	1.27	2.85

Table 6.11 Trip Calibration Methods and Best Performing Model for HBS Trips

Region	Southeast Florida	Tampa Bay	Standard FSUTMS	Best Performing Model
Lee County	MCA	MCA	MCA	Tampa Bay
Volusia County	MCA	MCA	MCA	Southeast Florida
Jacksonville MSA	Adjusted MCA	Adjusted MCA	MCA	Tampa Bay

Table 6.12 Comparison of the Estimated HBS Trips for the Three Urban Regions

MPO/MSA	District	Expanded Trips	Southeast Florida		Tampa Bay		FSUTMS	
			Estimated	*Diff*	*Estimated*	*Diff*	*Estimated*	*Diff*
Lee County	1	28,327	28,806	479	29,267	940	28,685	358
	2	41,160	37,903	3,257	39,858	1,302	37,600	3,560
	3	36,674	27,899	8,775	28,918	7,756	29,466	7,208
	4	25,449	25,687	238	26,251	802	26,717	1,268
	5	13,263	16,738	3,475	17,351	4,088	16,409	3,146
	Total	144,873	137,032	16,224	141,645	14,888	138,876	15,540
Volusia County	1	55,079	55,236	157	54,718	361	53,620	1,459
	2	13,582	14,402	820	14,261	679	14,329	747
	3	3,229	2,878	351	2,644	586	2,945	284
	4&5	14,250	13,786	465	13,549	701	13,927	323
	6	28,460	23,195	5,265	22,349	6,111	24,066	4,394
	Total	114,601	109,497	7,058	107,521	8,437	108,888	7,206
Jacksonville	1	6,091	6,457	366	5,546	545	6,400	309
	2	11,544	12,517	973	11,645	101	12,957	1,413
	3	141,070	171,208	30,138	153,163	12,093	166,265	25,195
	4	26,869	29,954	3,085	23,829	3,040	28,141	1,272
	5	17,781	18,359	578	16,812	969	18,793	1,012
	6	10,295	12,736	2,441	10,621	326	12,593	2,298
	7	16,509	20,226	3,717	16,573	64	20,142	3,633
	8	9,223	10,325	1,102	8,886	337	9,379	156
	Total	239,382	281,782	42,400	247,075	17,477	274,671	35,289

6.2 Home-Based Social and Recreational Trips

Tables 6.13 through 6.15 provide the sampled HBSR trips based on the Southeast Florida, Tampa Bay, and standard FSUTMS model structures, respectively. The results of survey data expansion for HBSR trips are presented in Table 6.16.

The results of KW tests showed there were no significant differences in HBSR trip rates among the survey districts in Lee County and Volusia County. However, for the Jacksonville MSA, the mean HBSR trip rates per household were different between Districts 1 and 8 and Districts 2, 3, 4, 5, 6, and 7. Consequently, two sets of HBS trip rates were calibrated for the Jacksonville MSA. Table 6.17 gives the estimated population mean HBSR trip rates, variances, and the approximate 95% confidence intervals for the means for the three urban regions.

Table 6.13 Sampled HBSR Trips Based on the Southeast Florida Model Structure for the Three Urban Regions

MPO/MSA	Presence of Children	Vehicle	Household Size			
			1	2	3	4+
Lee County	Without Children	0	0	0	2	0
		1	26	64	11	4
		2	9	61	15	6
		3+	0	9	11	13
	With Children	0		0	0	4
		1		0	0	11
		2		0	15	33
		3+		0	2	7
Volusia County	Without Children	0	2	0	0	0
		1	81	118	8	0
		2	9	174	5	0
		3+	3	67	19	19
	With Children	0		0	0	0
		1		12	3	5
		2		2	24	30
		3+		0	9	13
Jacksonville	Without Children	0	6	0	0	0
		1	247	72	4	0
		2	42	704	38	3
		3+	7	193	195	51
	With Children	0		0	0	0
		1		21	25	26
		2		17	89	228
		3+		0	43	152

Table 6.14 Sampled HBSR Trips Based on the Tampa Bay Regional Model Structure for the Three Urban Regions

MPO/MSA	Vehicle	Household Type		
		Retired HH	Working HH without children	Working HH with children
Lee County	0	4	0	2
	1	69	38	9
	2	52	43	44
	3+	5	28	9
	0	2	0	0
	1	181	29	17
	2	129	64	51
	3+	40	68	22
Jacksonville	0	5	1	0
	1	223	110	62
	2	442	363	316
	3+	164	309	168

Table 6.15 Sampled HBSR Trips Based on the Standard FSUTMS Model Structure for the Three Urban Regions

MPO/MSA	Dwelling Type	Vehicle	Household Size				
			1	2	3	4	5+
Lee County	Single-Family	0	0	0	0	0	2
		1	12	33	8	2	9
		2	6	48	33	30	18
	Multi-Family	0	0	0	4	0	0
		1	14	35	3	0	0
		2	3	32	5	6	0
Volusia County	Single-Family	0	2	0	0	0	0
		1	60	82	8	2	3
		2	10	200	57	54	5
	Multi-Family	0	0	0	0	0	0
		1	21	48	3	0	0
		2	2	43	0	3	0
Jacksonville	Single-Family	0	3	0	0	0	0
		1	136	62	5	3	0
		2	34	732	306	242	107
	Multi-Family	0	3	0	0	0	0
		1	111	31	24	23	0
		2	15	182	59	53	32

Table 6.16 Data Expansions for HBSR Trips

MPO/MSA	District	Total HHs	Sample HHs	Sampled HBSR Trips	Average HBSR Trips	Sample Variance	Expanded Trips
Lee County	1	28,327	75	44	0.5867	1.5430	16,619
	2	39,707	82	75	0.9146	2.4000	36,317
	3	28,606	78	72	0.9231	2.6693	26,406
	4	26,572	71	53	0.7465	1.7634	19,835
	5	16,834	66	59	0.8939	2.7732	15,049
	Total	140,046	372	303			114,225
Volusia County	1	80,086	506	296	0.5850	1.4908	46,849
	2	19,594	176	94	0.5341	1.1989	10,465
	3	3,573	52	28	0.5385	1.3122	1,924
	4&5	19,514	152	57	0.3750	0.8849	7,318
	6	30,548	278	128	0.4604	1.5129	14,065
	Total	153,315	1,164	603			80,621
Jacksonville MSA	1	5,793	311	349	1.1222	3.4624	6,501
	2	16,050	317	216	0.6814	2.3570	10,936
	3	234,473	359	310	0.8635	2.5372	202,461
	4	26,050	350	273	0.7800	2.0174	20,319
	5	23,570	285	217	0.7614	2.6048	17,946
	6	10,389	222	190	0.8559	2.4317	8,891
	7	16,954	343	254	0.7405	1.9938	12,555
	8	9,764	325	354	1.0892	2.8038	10,635
	Total	343,043	2,512	2,163			290,245

Table 6.17 HBSR Trip Rate Statistics for Survey Districts for the Three Urban Regions

MPO/MSA	Region-Wide HBSR Trip Rates	Variance	95% confidence interval
Lee County	0.82	0.0782	(0.66, 0.97)
Volusia County	0.53	0.0351	(0.46, 0.59)
Jacksonville District 1, 8	1.10	0.0689	(0.97, 1.24)
Jacksonville District 2, 3, 4, 5, 6, 7	0.84	0.0612	(0.71, 0.95)

Tables 6.18 through 6.20 provide the calibrated HBSR trip rates for the two lifestyle models and the standard FSUTMS model. For Lee County, the MCA method was selected for the Southeast Florida model while the adjusted MCA method was selected for the Tampa Bay and FSUTMS models. The region-wide averages were 0.78, 0.81, and 0.79, for the Southeast Florida, Tampa Bay, and FSUTMS model structures, respectively, all within the 95% interval of the population means. Note that the average HBSR trip rates did not increase with vehicle number or household size.

For Volusia County, the MCA method was selected for the Tampa Bay model while the adjusted MCA method was selected for the Southeast Florida and FSUTMS models. The region-wide trip rate averages were 0.54, 0.49, and 0.52 for the Southeast Florida, Tampa Bay, and standard

FSUTMS model structures, respectively, all falling within the 95% intervals of the population means. Again, the average HBSR trip rates did not increase with the number of vehicles or household size.

For the Jasonville MSA, adjusted MCA method was selected to calibrate the trip rates for the three models and the average HBSR trip rates were consistent with the expected trends. However, the average trip rate for Districts 1 and 8 from the Southeast Florida and FSUTMS models fell outside the 95% confidence interval.

Table 6.21 provides a summary of the methods used to calibrate the HBSR trip rates for different model structures and different urban areas, as well as the best performing models.

The HBSR trips estimated from the lifestyle models and the standard FSUTMS model were compared with the expected district and regional totals. The comparison is shown in Table 6.22. Similar to the results for the HBS trip purpose, the Tampa Bay model performed slightly better than the other two models at both district and regional levels for Lee County, although the differences were smaller (within 3%). For Volusia County, the Southeast Florida model structure provided better approximations of both district and region-wide expected trips although the results produced by the other two models were close. For the Jasonville MSA, since the overall average trip rates from the Southeast Florida and standard FSUTMS models fell outside the 95% confidence intervals, both models significantly overestimated the HBSR trips. The Tampa Bay model, on the other hand, was statistically valid and the comparison indicated that Tampa Bay model provided better HBSR estimates.

Table 6.18 HBSR Trip Rates Based on the Southeast Florida Model Structure for the Three Urban Regions

MPO/MSA	Presence of Children	Vehicle	Household Size			
			1	2	3	4+
Lee County	Without Children	0	0.46	0.74	0.87	0.97
		1	0.39	0.68	0.81	0.90
		2	0.62	0.90	1.04	1.13
		3+	0.68	0.97	1.10	1.19
	With Children	0		0.70	0.83	0.93
		1		0.63	0.77	0.86
		2		0.86	1.00	1.09
		3+		0.92	1.06	1.15
Volusia County	Without Children	0	0.03	0.41	0.81	0.74
		1	0.29	0.67	1.07	1.00
		2	0.22	0.59	1.00	0.92
		3+	0.24	0.62	1.02	0.95
	With Children	0		0.04	0.44	0.37
		1		0.30	0.70	0.63
		2		0.22	0.63	0.55
		3+		0.25	0.65	0.58
Jacksonville Districts 1, 8	Without Children	0	0.01	0.13	0.50	0.96
		1	0.38	0.51	0.89	1.35
		2	0.58	0.71	1.09	1.55
		3+	0.60	0.73	1.10	1.57
	With Children	0		0.35	0.72	1.19
		1		0.74	1.11	1.58
		2		0.94	1.31	1.78
		3+		0.96	1.33	1.80
Jacksonville Districts 2, 3, 4, 5, 6, 7	Without Children	0	0.09	0.59	1.77	1.96
		1	0.53	1.03	2.21	2.41
		2	0.62	1.12	2.30	2.49
		3+	0.84	1.34	2.52	2.71
	With Children	0		0.72	1.90	2.09
		1		1.16	2.34	2.54
		2		1.25	2.43	2.62
		3+		1.47	2.65	2.84

Table 6.19 HBSR Trip Rates Based on the Tampa Bay Regional Model Structure for the Three Urban Regions

MPO/MSA	Vehicle	Permanent Household Type		
		Retired	Working without children	Working with children
Lee County	0	0.81	0.61	0.52
	1	0.76	0.57	0.48
	2	1.09	0.89	0.80
	3+	1.19	0.99	0.90
Volusia County	0	0.13	0.06	0.18
	1	0.46	0.39	0.51
	2	0.57	0.50	0.62
	3+	0.66	0.59	0.71
Jacksonville Districts 1, 8	0	0.05	0.01	0.70
	1	0.49	0.27	1.14
	2	0.88	0.65	1.53
	3+	1.10	0.87	1.74
Jacksonville Districts 2, 3, 4, 5, 6, 7	0	0.14	0.01	1.63
	1	0.69	0.46	2.18
	2	1.19	0.96	2.68
	3+	1.88	1.65	3.36

Table 6.20 HBSR Trip Rates Based on the Standard FSUTMS Model Structure for the Three Urban Regions

MPO/MSA	Dwelling Type	Vehicle	Household Size				
			1	2	3	4	5+
Lee County	Single-Family	0	0.57	0.81	0.91	1.06	0.91
		1	0.54	0.78	0.87	1.03	0.88
		2	0.63	0.87	0.96	1.12	0.97
	Multi-Family	0	0.51	0.75	0.84	1.00	0.85
		1	0.47	0.71	0.81	0.96	0.81
		2	0.56	0.80	0.90	1.05	0.90
Volusia County	Single-Family	0	0.05	0.40	0.59	0.51	0.08
		1	0.30	0.64	0.84	0.76	0.33
		2	0.25	0.60	0.79	0.71	0.28
	Multi-Family	0	0.03	0.38	0.57	0.49	0.06
		1	0.28	0.62	0.82	0.74	0.31
		2	0.23	0.58	0.77	0.69	0.26
Jacksonville Districts 1, 8	Single-Family	0	0.11	0.27	0.73	1.20	1.57
		1	0.47	0.63	1.09	1.56	1.94
		2	0.61	0.77	1.23	1.70	2.07
	Multi-Family	0	0.01	0.08	0.54	1.01	1.39
		1	0.29	0.45	0.91	1.37	1.75
		2	0.42	0.58	1.04	1.51	1.89
Jacksonville Districts 2, 3, 4, 5, 6, 7	Single-Family	0	0.16	0.68	1.98	2.00	2.81
		1	0.60	1.12	2.42	2.45	3.25
		2	0.69	1.21	2.51	2.53	3.34
	Multi-Family	0	0.01	0.51	1.81	1.84	2.64
		1	0.44	0.96	2.26	2.28	3.09
		2	0.52	1.04	2.34	2.37	3.17

Table 6.21 Trip Calibration Methods and Best Performing Model for HBSR Trips

Region	Southeast Florida	Tampa Bay	Standard FSUTMS	Best Performing Model
Lee County	MCA	Adjusted MCA	Adjusted MCA	Tampa Bay
Volusia County	Adjusted MCA	MCA	Adjusted MCA	Southeast Florida
Jacksonville MSA	Adjusted MCA	Adjusted MCA	Adjusted MCA	Tampa Bay

Table 6.22 Comparison of Estimated HBSR Trips for the Three Urban Regions

MPO/MSA	District	Expanded Trips	Southeast Florida		Tampa Bay		FSUTMS	
			Estimated	*Diff*	*Estimated*	*Diff*	*Estimated*	*Diff*
Lee County	1	16,619	22,498	5,879	23,508	6,889	22,575	5,956
	2	36,317	30,645	5,672	32,284	4,033	31,010	5,307
	3	26,406	21,800	4,606	23,021	3,385	21,806	4,600
	4	19,835	21,158	1,323	21,315	1,480	21,170	1,335
	5	15,049	13,167	1,882	13,836	1,213	13,378	1,671
	Total	114,225	109,268	19,362	113,964	16,999	109,940	18,868
Volusia County	1	46,849	41,997	4,852	37,949	8,900	40,724	6,125
	2	10,465	10,731	266	9,786	679	10,481	16
	3	1,924	2,091	167	1,937	13	2,065	141
	4&5	7,318	10,442	3,124	9,633	2,315	10,104	2,786
	6	14,065	17,289	3,224	15,737	1,672	17,059	2,994
	Total	80,621	82,550	11,633	75,043	13,580	80,433	12,061
Jacksonville MSA	1	6,501	8,690	2,189	7,947	1,446	8,826	2,325
	2	10,936	16,797	5,861	15,031	4,095	16,578	5,642
	3	202,461	212,492	10,031	185,124	17,337	213,201	10,740
	4	20,319	23,526	3,207	20,664	345	22,972	2,653
	5	17,946	24,894	6,948	21,903	3,957	24,537	6,591
	6	8,891	10,753	1,862	9,489	598	10,316	1,425
	7	12,555	16,071	3,516	14,189	1,634	16,192	3,637
	8	10,635	12,917	2,282	11,320	685	13,055	2,420
	Total	290,245	326,141	35,897	285,666	30,096	325,677	35,433

6.3 Home-Based Other Trips

Tables 6.23 through 6.25 show the sampled HBO trips based on the Southeast Florida, Tampa Bay, and standard FSUTMS model structures, respectively. The results of survey data expansion for HBO trips are presented in Table 6.26.

Table 6.23 Sampled HBO Trips Based on the Southeast Florida Model Structure for the Three Urban Regions

MPO/MSA	Presence of Children	Vehicle	Household Size			
			1	2	3	4+
Lee County	Without Children	0	1	2	0	0
		1	58	181	9	6
		2	14	137	28	19
		3+	0	19	22	51
	With Children	0		0	0	4
		1		8	10	36
		2		0	40	157
		3+		0	13	52
Volusia County	Without Children	0	4	0	0	0
		1	269	364	4	0
		2	43	564	29	0
		3+	12	224	48	39
	With Children	0		0	0	0
		1		38	39	59
		2		3	81	262
		3+		8	33	160
Jacksonville	Without Children	0	22	1	1	0
		1	198	86	25	0
		2	27	550	19	9
		3+	2	141	81	33
	With Children	0		2	0	0
		1		26	13	24
		2		24	77	158
		3+		12	27	79

Table 6.24 Sampled HBO Trips Based on the Tampa Bay Regional Model Structure for the Three Urban Regions

MPO/MSA	Vehicle	Household Type		
		Retired	Working without children	Working with children
Lee County	0	7	0	0
	1	193	62	53
	2	77	126	192
	3+	3	89	65
Volusia County	0	4	0	0
	1	542	115	116
	2	423	235	324
	3+	149	188	187
Jacksonville	0	21	3	2
	1	243	73	56
	2	363	265	236
	3+	109	174	92

Table 6.25 Sampled HBO Trips Based on the Standard FSUTMS Model Structure for the Three Urban Regions

MPO/MSA	Dwelling Type	Vehicle	Household Size				
			1	2	3	4	5+
Lee County	Single-Family	0	1	2	0	0	4
		1	24	84	13	7	16
		2	14	138	86	97	96
	Multi-Family	0	0	0	0	0	0
		1	34	124	6	0	0
		2	0	47	27	41	6
Volusia County	Single-Family	0	4	0	0	0	0
		1	188	253	31	27	32
		2	46	681	177	307	149
	Multi-Family	0	0	0	0	0	0
		1	81	149	12	0	0
		2	9	118	14	5	0
Jacksonville	Single-Family	0	10	1	1	0	0
		1	123	70	6	13	0
		2	24	533	179	140	66
	Multi-Family	0	12	2	0	0	0
		1	75	42	32	11	0
		2	5	194	25	26	47

Table 6.26 Data Expansions for HBO Trips

MPO/MSA	District	Total HHs	Sample HHs	Sampled HBO Trips	Average HBO Trips	Sample Variance	Expanded Trips
Lee County	1	28,327	75	179	2.3867	7.5376	67,607
	2	39,707	82	215	2.6220	9.8183	104,110
	3	28,606	78	174	2.2308	8.9850	63,813
	4	26,572	71	162	2.2817	6.3767	60,629
	5	16,834	66	137	2.0758	6.8095	34,943
	Total	140,046	372	867			331,103
Volusia County	1	80,086	506	963	1.9032	5.7431	152,417
	2	19,594	176	338	1.9205	4.8279	37,629
	3	3,573	52	103	1.9808	5.2349	7,077
	4&5	19,514	152	285	1.8750	5.1432	36,589
	6	30,548	278	594	2.1367	7.8730	65,272
	Total	153,315	1,164	2,283			298,984
Jacksonville	1	5,793	311	213	0.6849	1.3778	3,968
	2	16,050	317	180	0.5678	1.9550	9,114
	3	234,473	359	293	0.8162	2.4298	191,367
	4	26,050	350	199	0.5686	1.4150	14,811
	5	23,570	285	206	0.7228	2.4334	17,037
	6	10,389	222	140	0.6306	1.2657	6,552
	7	16,954	343	194	0.5656	1.2406	9,589
	8	9,764	325	212	0.6523	1.6164	6,369
	Total	343,043	2,512	1,637			258,805

The results of KW tests revealed no significant differences in HBO trip rates among the survey districts in Lee County and Volusia County. Again, for the Jacksonville MSA, the mean HBO trip rates per household were different between District 3 and the other districts. Consequently, two sets of HBO trip rates were calibrated for the Jacksonville MSA. The estimated population mean HBO trip rates, variances, and the approximate 95% confidence intervals for the means for the three urban regions are listed in Table 6.27.

Table 6.27 HBO Trip Rate Statistics for Survey Districts for the Three Urban Regions

MPO/MSA	Region-Wide HBO Trip Rates	Variance	95% confidence interval
Lee County	2.36	0.1523	(2.07, 2.66)
Volusia County	1.95	0.0723	(1.81, 2.09)
Jacksonville Districts 3	0.62	0.0308	(0.56, 0.68)
Jacksonville Districts 1-2, 4-8	0.82	0.0822	(0.66, 0.98)

Tables 6.28 through 6.30 give the calibrated HBO trip rates for the two lifestyle models and the standard FSUTMS model. For Lee County, adjusted MCA method was selected to calibrate the trip rates for the three models. The region-wide trip rate averages were 2.19, 2.25, and 2.17 for the Southeast Florida, Tampa Bay, and standard FSUTMS model structures, respectively, all

within the 95% intervals of the population means, and the average HBO trip rates increased with the number of vehicles and household size.

For Volusia County, the MCA method was selected for the FSUTMS model while the adjusted MCA method was selected for the Southeast Florida and Tampa Bay models. The region-wide trip rate averages were 2.21, 1.96, and 2.16 for the Southeast Florida, Tampa Bay, and standard FSUTMS model structures, respectively. The overall average trip rates from the Southeast Florida and FSUTMS models fell outside the 95% confidence intervals. The average HBO trip rates also increased with number of vehicles and household size.

For the Jasonville MSA, the adjusted MCA method was selected to calibrate the trip rates for the Tampa Bay and Southeast Florida models while the MCA method was selected for the standard FSUTMS model. The average HBO trip rates were consistent with the expected trends generally. However, the overall average trip rates from the Southeast Florida and FSUTMS models fell outside the 95% confidence intervals.

Table 6.31 summarizes the methods used for calibrating the HBO trip rates based on each model structure and the best performing model for each urban area.

A comparison of the performance of three models for the three urban areas is presented in Table 6.32. In all cases, the Tampa Bay model structure produced better results at both district and regional levels.

Table 6.28 HBO Trip Rates Based on the Southeast Florida Model Structure for the Three Urban Regions

MPO/MSA	Presence of Children	Vehicle	Household Size			
			1	2	3	4+
Lee County	Without Children	0	0.01	0.72	0.37	2.67
		1	1.11	1.96	1.61	3.91
		2	1.26	2.10	1.75	4.05
		3+	2.19	3.04	2.68	4.99
	With Children	0		0.83	0.48	2.78
		1		2.07	1.72	4.02
		2		2.22	1.86	4.16
		3+		3.15	2.80	5.10
Volusia County	Without Children	0	0.01	0.78	1.38	3.20
		1	1.00	2.00	2.59	4.41
		2	0.90	1.90	2.50	4.32
		3+	0.92	1.92	2.52	4.34
	With Children	0		1.13	1.73	3.55
		1		2.34	2.94	4.76
		2		2.25	2.85	4.67
		3+		2.27	2.87	4.69
Jacksonville District 3	Without Children	0	0.18	0.55	0.65	1.13
		1	0.53	0.90	1.00	1.48
		2	0.26	0.63	0.74	1.22
		3+	0.56	0.93	1.04	1.52
	With Children	0		1.00	1.10	1.58
		1		1.35	1.45	1.93
		2		1.08	1.19	1.67
		3+		1.38	1.49	1.97
Jacksonville Districts 1-2, 4-8	Without Children	0	0.17	0.58	0.72	0.90
		1	0.33	0.74	0.88	1.06
		2	0.29	0.70	0.83	1.02
		3+	0.11	0.52	0.65	0.84
	With Children	0		0.79	0.92	1.11
		1		0.94	1.08	1.26
		2		0.90	1.04	1.22
		3+		0.72	0.86	1.04

Table 6.29 HBO Trip Rates Based on the Tampa Bay Regional Model Structure for the Three Urban Regions

MPO/MSA	Vehicle	Household Type		
		Retired	Working without Children	Working with Children
Lee County	0	0.74	0.50	2.04
	1	1.73	1.49	3.03
	2	2.26	2.02	3.56
	3+	3.38	3.14	4.68
Volusia County	0	0.14	0.01	2.15
	1	1.48	1.04	3.49
	2	2.03	1.59	4.04
	3+	2.37	1.94	4.38
Jacksonville District 3	0	0.38	0.01	0.99
	1	0.78	0.33	1.39
	2	0.90	0.44	1.51
	3+	1.36	0.91	1.98
Jacksonville Districts 1-2, 4-8	0	0.26	0.01	0.56
	1	0.52	0.24	0.82
	2	0.83	0.54	1.13
	3+	0.78	0.49	1.08

Table 6.30 HBO Trip Rates Based on FSUTMS Model Structure for the Three Urban Regions

MPO/MSA	Dwelling Type	Vehicle	Household Size				
			1	2	3	4	5+
Lee County	Single-Family	0	0.01	0.66	0.52	2.27	3.53
		1	1.11	1.94	1.81	3.56	4.82
		2	1.42	2.25	2.12	3.87	5.13
	Multi-Family	0	0.01	0.63	0.50	2.24	3.50
		1	1.09	1.92	1.78	3.53	4.79
		2	1.40	2.23	2.10	3.84	5.10
Volusia County	Single-Family	0	0.01	0.36	1.13	2.49	4.65
		1	0.64	1.65	2.42	3.78	5.94
		2	1.46	2.48	3.25	4.61	6.77
	Multi-Family	0	0.01	0.01	0.52	1.88	4.04
		1	0.02	1.04	1.81	3.17	5.33
		2	0.85	1.87	2.64	4.00	6.16
Jacksonville District 3	Single-Family	0	0.01	0.29	0.71	0.83	2.38
		1	0.31	0.63	1.05	1.17	2.71
		2	0.53	0.84	1.26	1.38	2.93
	Multi-Family	0	0.06	0.38	0.79	0.91	2.46
		1	0.40	0.71	1.13	1.25	2.79
		2	0.61	0.93	1.35	1.46	3.01
Jacksonville Districts 1-2, 4-8	Single-Family	0	0.01	0.33	0.47	0.62	1.15
		1	0.19	0.55	0.69	0.84	1.37
		2	0.45	0.82	0.96	1.11	1.63
	Multi-Family	0	0.01	0.17	0.32	0.47	0.99
		1	0.03	0.40	0.54	0.69	1.21
		2	0.30	0.66	0.81	0.95	1.48

Table 6.31 Trip Calibration Methods and Best Performing Model for HBO Trips

Region	Southeast Florida	Tampa Bay	Standard FSUTMS	Best Performing Model
Lee County	Adjusted MCA	Adjusted MCA	Adjusted MCA	Tampa Bay
Volusia County	Adjusted MCA	Adjusted MCA	MCA	Tampa Bay
Jacksonville MSA	Adjusted MCA	Adjusted MCA	MCA	Tampa Bay

Table 6.32 Comparison of Estimated HBO Trips for the Three Urban Regions

MPO/MSA	District	Expanded Trips	Southeast Florida		Tampa Bay		FSUTMS	
			Estimated	*Diff*	*Estimated*	*Diff*	*Estimated*	*Diff*
Lee County	1	67,607	63,388	4,219	64,995	2,612	62,744	4,863
	2	104,110	84,378	19,732	88,388	15,722	83,615	20,495
	3	63,813	60,152	3,661	63,119	694	59,551	4,262
	4	60,629	61,311	682	60,427	202	61,071	442
	5	34,943	37,058	2,115	38,025	3,082	37,117	2,174
	Total	331,103	306,288	30,410	314,954	22,313	304,098	32,235
Volusia County	1	152,417	166,164	13,747	146,255	6,162	154,180	1,763
	2	37,629	43,209	5,580	38,671	1,042	42,111	4,482
	3	7,077	9,356	2,279	8,360	1,283	9,948	2,871
	4&%	36,589	44,424	7,835	39,756	3,167	45,185	8,596
	6	65,272	75,908	10,636	67,759	2,487	79,772	14,500
	Total	298,984	339,061	40,077	300,801	14,142	331,196	32,212
Jacksonville MSA	1	3,968	4,162	194	3,693	275	3,951	17
	2	9,114	13,004	3,890	11,412	2,298	12,625	3,511
	3	191,367	234,071	42,704	202,615	11,248	237,476	46,109
	4	14,811	19,550	4,739	16,305	1,494	17,206	2,395
	5	17,037	19,392	2,355	16,654	383	18,334	1,297
	6	6,552	8,371	1,819	7,274	722	7,720	1,168
	7	9,589	13,180	3,591	11,194	1,605	12,329	2,740
	8	6,369	6,601	232	5,794	575	5,764	605
	Total	258,805	318,329	59,522	274,941	18,600	315,404	57,842

6.4 Summary

In the case of HBW trips, it has been demonstrated that the Tampa Bay model performed better for Lee County. For Volusia County, the Southeast Florida model and the Tampa Bay model performed nearly equally at the regional level, with the Tampa Bay model yielding a larger improvement for the district that generated the most trips. Southeast Florida model also performed better for the Jacksonville MSA. The differences in the performance of the lifestyle models were speculated to be attributable to the similarities in demographics.

For HBNW trips, the results showed that lifestyle models again outperformed the standard FSUTMS models, although in some cases the improvements were insignificant. In particular, the Tampa Bay model performed noticeably better for the HBO trip purpose for all the three urban areas. For the HBS and HBSR trip purposes, however, while the Tampa Bay model produced significant improvements for the Jacksonville MSA, the lifestyle models did not produce noticeable improvements for Lee and Volusia counties.

7. SPATIAL TRANSFERABILITY OF TRIP RATES

Many counties in Florida share similar demographics and can potentially benefit from lifestyle models. However, not all will embrace lifestyle models for reasons such as lack of resources to collect lifestyle data. These counties will be able to benefit from lifestyle models if they can borrow trip rates from "similar" areas. For this purpose, the spatial transferability of the trip rates from the lifestyle models was tested by comparing the trip rates of Lee County, Volusia County, and the Jacksonville MSA.

The tests were similar to those conducted by Chicoine and Boyle (1984), who derived a set of tables from the 1973 Niagara Frontier Transportation Committee (NFTC) data and the 1974 Genesee Transportation Council (GTC) data and compared the trip rates in each cell between the two regions. Only the cells with differences of greater than ten percent were tested. The results showed that six cells out of 52 had different trip rates at a significance level of 0.05. The authors concluded that the NFTC trip rates were generally replicable using the GTC data.

The Wilcoxon Rank-Sum test, also known as Mann-Whitney test and equivalent to Kruskal-Wallis test with two samples, was used to test the differences between the HBW trip rates for the three urban regions. Ten percent difference in trip rates was used as the criterion for overriding the results of the Kruskal-Wallis test (Schimpeler-Corradino Associates 1980). The hypotheses for the Wilcoxon Rank Sum test are (Hines and Montgomery 1990):

H_o: The two population frequency distributions are identical.
H_a: The two population frequency distributions are shifted with respect to their relative locations.

In the following two sections, HBW trip rates and HBNW trip rates of the three urban areas from the lifestyle models are compared.

7.1 Spatial Transferability of HBW Trip Rates

Tables 7.1 and 7.2 provide the P-values of statistical tests on the HBW trip rates from the two lifestyle models for the three urban regions. For Volusia County, which was divided into costal area and the inland area during HBW trip rate calibration, only Districts 1 and 2 (the coastal area) were investigated since more than 65% of the total households in the region were located in these two districts. Table 7.3 summarizes the results and shows the number of cells with significant differences in trip rates between the three urban regions.

Table 7.1 P-Value of Wilcoxon Rank-Sum Tests on HBW Trip Rates Based on the Southeast Florida Model Structure

MPO	Presence of Children	Vehicle	Workers		
			0	1	2+
Lee vs. Volusia	Without Children	0		-	+
		1		0.743	+
		2		0.842	+
		3+		0.885	0.290
	With Children	0		-	-
		1		0.826	0.293
		2		+	+
		3+		0.221	+
Lee vs. Jacksonville	Without Children	0		0.388	-
		1		0.321	0.725
		2		0.248	0.003*
		3+		0.542	0.001*
	With Children	0		0.343	+
		1		0.392	+
		2		+	+
		3+		0.156	0.692
Volusia vs. Jacksonville	Without Children	0		0.830	-
		1		0.051	0.331
		2		+	0.012*
		3+		0.005*	0.019*
	With Children	0		0.343	-
		1		0.178	0.834
		2		0.872	0.103
		3+		0.017*	0.044*

+ = cells with less than a 10 percent difference
- = zero sample for either or both MPOs
* = cells found to have trip rates different at significance level of 0.05

Table 7.2 P-Value of Wilcoxon Rank-Sum Tests on HBW Trip Rates Based on the Tampa Bay Model Structure

MPO	Vehicle	Household Type		
		Retired	Working without children	Working with children
Lee vs. Volusia	0	+	+	-
	1	+	+	0.216
	2	+	+	0.458
	3+	+	+	0.555
Lee vs. Jacksonville	0	+	+	0.429
	1	+	0.858	+
	2	0.001*	0.055	+
	3+	0.324	0.008*	0.485
Volusia vs. Jacksonville	0	+	+	+
	1	+	0.437	0.242
	2	0.000*	0.002*	0.087
	3+	0.108	0.000*	0.040*

+ = cells with less than a 10 percent difference
- = zero sample for either or both MPOs
* = cells found to have trip rates different at significance level of 0.05

Table 7.3 Comparison of HBW Trip Rates between the Three Urban Regions

	Number of cells with trip rates different (significance level = 0.05)		
Model	Lee vs. Volusia	Lee vs. Jacksonville	Volusia vs. Jacksonville
Southeast Florida Model Structure (16 cells)	0 out of 13 cells	2 out of 15 cells	5 out of 14 cells
Tampa Bay Model Structure (12 cells)	0 out of 11 cells	2 out of 12 cells	4 out of 12 cells

The results showed that the trip rates for Lee County and Volusia County were closer, probably due to their similarity in demographics. The results in Table 7.3 cannot be used to claim spatial transferability of the lifestyle models, but they indicated replicability.

7.2 Spatial Transferability of HBNW Trip Rates

The HBNW trip rates listed in Tables 6.8 through 10, 18 through 20, and 28 through 30 for HBS, HBSR, and HBO purposes, respectively, show noticeable differences between the three urban regions. Before testing the spatial transferability of the lifestyle models for the HBNW trip purposes, it is necessary to examine the differences in the survey designs of these three urban regions.

(1) Definitions of Trip Purposes

The 3,130 interzonal trips from the 1992 Lee County household survey were classified into different trip purposes based on the definitions given in Table 7.4.

Table 7.4 Trip Purpose Definitions for Lee County

Trip Purpose	% of Total Trips	One End	Other End
HBW	13.0	Home	Work
HBS	15.8	Home	Shopping, meal
HBSR	9.7	Home	Social, recreation, visit
HBO	30.4	Home	Work-related, personal business, medical/dental, change to other mode, school, daycare
NHB	31.2	All but Home	All but home
Internal-External			Destination outside Lee County

For trips that served other passengers, such as drop-off or pick-up, the trip purposes were determined by the final destinations. For example, a parent dropping off a child at school before going to work was considered to be making a home-based other trip and a home-based work trip.

Table 7.5 shows the trip purpose definitions of the 6,796 trips collected from the 1,164 useful household samples in the Volusia County's survey, while Table 7.6 provides the definitions for the 16,377 trips made by the 2,512 sampled households in the Jacksonville MSA.

Table 7.5 Trip Purpose Definitions in the Volusia County Household Survey

Trip Purpose	% of Total Trips	One End	Other End
HBW	14.0	Home	Work
HBS	12.6	Home	Shopping
HBSR	8.5	Home	Social, recreation
HBSCH	1.3	Home	Attend school, childcare
HBO	30.8	Home	Drop-off/pick-up passenger, personal business, work-related, meal, religious, other
NHB	32.8	All but home	All but home

Table 7.6 Trip Purpose Definitions in the Jacksonville Household Survey

Trip Purpose	% of Total Trips	One End	Other End
HBW	21.5	Home	Work
HBS	13.5	Home	Shopping
HBSR	13.2	Home	Meal, recreation, friend/relative's home
HBO	20.1	Home	Other, school, daycare
NHB	31.8	All but home	All but home

For Lee County, excluding trips for meals, districts 4 and 5 had lower shopping trip rates than other districts but the differences were not significant. However, if trips for meals were included, the differences became much larger. Therefore, the trips for meals in HBS were excluded and reclassified as HBO trips for Lee County in Section 6.1 and Section 6.3. Additionally, in Section 6.3 school trips were excluded from HBO trip purpose for Lee County and the Jacksonville MSA since lifestyle models classify home-based school trips as a separated trip purpose. However, even with these adjustments, there were still differences in the trip

purpose definitions, especially because Lee County used trip chains to determine the trip purposes for serving passenger trips.

(2) Who Completed Trip Logs?

For Lee County, household members aged 5 years or older were required to report trips. For the Jacksonville MSA, all household members were required to report trips. For Volusia County, the travel form required only household members 16 years of age or older to submit trip logs. Perhaps this was the reason that the HBSCH trips were only 1.3% of the total trips in Volusia County, while HBSCH trips were 6.3% and 10.1% for Lee County and the Jacksonville MSA, respectively. In Chapter 6, when trip rates for HBS, HBSR, and HBO trip purposes were calibrated, the unreported trips made by children of age 15 or under were added to the trip logs by checking the original trip records regarding the number of passengers, whether they reported trips, their ages, and trip purposes. For example, for a family with four members: Perry (38 years old), Jan (40 years old), Kevin (10 years old) and Zac (4 year olds), the reported trips are as follows.

Perry:
1. left home at 7:00 to drop off Kevin (HBO trip)
2. went to work at 8:00 (NHB trip)
3. returned home at 12:00 (HBW trip)
4. picked up Kevin at 13:00 with Jan and Zac (HBO trip)
5. made a personal business trip at 14:00 with Jan, Kevin and Zac (NHB trip)
6. made a work-related trip at 16:00 with Jan, Kevin and Zac (NHB trip)
7. went shopping at 17:00 with Jan, Kevin and Zac (NHB trip)
8. returned home with Jan, Kevin and Zac at 19:00 (HBS trip)

Jan:
1. left home at 8:00 with Zac for social and recreation purpose (HBSR trip)
2. returned home with Zac at 9:00 (HBSR trip)
3. picked up Kevin at 13:00 with Perry and Zac (HBO trip)
4. made a personal business trip at 14:00 with Perry, Kevin and Zac (NHB trip)
5. made another trip at 16:00 with Perry, Kevin and Zac (NHB trip)
6. went shopping at 17:00 with Perry, Kevin and Zac (NHB trip)
7. returned home with Perry, Kevin and Zac at 19:00 (HBS trip)

The following trips were added into the trip logs for this family.

Kevin:
1. left home to school at 7:00 with Perry (HBSCH trip)
2. made a trip at 14:00 with Perry, Jan and Zac (NHB trip)
3. made another trip at 16:00 with Perry, Jan and Zac (NHB trip)
4. went shopping at 17:00 with Perry, Jan and Zac (NHB trip)
5. returned home with Perry, Jan and Zac at 19:00 (HBS trip)

Zac:
1. left home at 8:00 with Jan for social and recreation purpose (HBSR trip)
2. went home with Jan at 9:00 (HBSR trip)
3. picked up Kevin at 13:00 with Perry and Jan (HBO trip)
4. made a trip at 14:00 with Perry, Jan and Kevin (NHB trip)

5. made another trip at 16:00 with Perry, Jan and Kevin (NHB trip)
6. went shopping at 17:00 with Perry, Jan and Kevin (NHB trip)
7. returned home with Perry, Jan and Kevin at 19:00 (HBS trip)

(3) Household Size

The Lee County survey report indicated that an attempt was made to reassign each sampled household to a cell number corresponding to a particular household size by excluding children under the age of five in the household. However, final cell corrections were not made concurrently with changes to the individual household's characteristics that defined the appropriate cells for the households (PBSJ 1992). Therefore, all household members were considered when determining the household size for Lee County. Although children were not required to submit trip logs, they were counted when determining household size in Volusia County. For the Jacksonville MSA, since all members had reported trip logs, they were all accounted for in household size.

(4) Age Definitions of Children

In Southeast Florida and Tampa surveys, children were considered to be those under the age of 18. Therefore, in STP 266 and STP 283, presence of children means that household with members under 18. In the Lee County survey, however, household members under 16 were considered as children.

Considering the differences in trip purpose definitions in the surveys, the spatial transferability of HBNW trip rates was tested for all the HBNW trips as a whole instead of separating them into HBS, HBSR, and HBO trips. Additionally, because the three surveys had different requirements about if children needed to fill out the trip logs, HBSCH trips were excluded from the total HBNW trips. This was because the majority trips made by children were school trips.

Tables 7.7 and 7.8 provide the P-values of statistical tests on the combined HBNW trip rates from the two lifestyle models for the three urban regions. Table 7.9 summarizes the results and shows the number of cells with significant differences in trip rates between the three urban regions.

Table 7.7 P-Value of Wilcoxon Rank-Sum Tests on Combined HBNW Trip Rates Based on the Southeast Florida Model Structure

MPO/MSA	Presence of Children	Vehicle	Household Size			
			1	2	3	4+
Lee vs. Volusia	Without Children	0	0.723	0.317	-	-
		1	0.539	0.028*	0.536	-
		2	0.126	0.235	0.275	-
		3+	-	0.708	0.813	0.422
	With Children	0		-	-	0.221
		1		0.355	0.124	0.049*
		2		-	0.527	0.948
		3+		-	0.705	0.138
Lee vs. Jacksonville	Without Children	0	0.965	0.643	-	-
		1	0.012*	0.000*	0.671	-
		2	0.047*	0.001*	0.370	0.030*
		3+	-	0.387	0.611	0.011*
	With Children	0		-	-	-
		1		0.232	0.651	0.660
		2		-	0.355	0.174
		3+		-	0.332	0.038*
Volusia vs. Jacksonville	Without Children	0	0.438	0.383	-	-
		1	0.000*	0.000*	1.000	-
		2	0.056	0.000*	0.046*	-
		3+	0.844	0.000*	0.269	0.01*
	With Children	0		-	0.564	-
		1		0.229	0.090	0.141
		2		0.780	0.093	0.069
		3+		0.544	0.374	0.317

- = zero sample for either or both MPOs
* = cells found to have trip rates different at significance level of 0.05

Table 7.8 P-Value of Wilcoxon Rank-Sum Tests on Combined HBNW Trip Rates Based on the Tampa Bay Model Structure

MPO	Vehicle	Household Type		
		Retired	Working without children	Working with children
Lee vs. Volusia	0	0017*	-	-
	1	0.001*	0.022*	0.930
	2	0.046*	0.022*	0.709
	3+	0.545	0.266	0.567
Lee vs. Jacksonville	0	0.042*	0.604	0.468
	1	0.000*	0.000*	0.169
	2	0.001*	0.000*	0.046*
	3+	0.284	0.011*	0.130
Volusia vs. Jacksonville	0	0.107	0.212	0.429
	1	0.000*	0.001*	0.029*
	2	0.016*	0.026*	0.002*
	3+	0.144	0.003*	0.313

Table 7.9 Comparison of Combined HBNW Trip Rates between the Three Urban Regions

	Number of cells with trip rates different (significance level = 0.05)		
Model	Lee vs. Volusia	Lee vs. Jacksonville	Volusia vs. Jacksonville
Southeast Florida Model Structure (28 cells)	2 out of 19 cells	7 out of 19 cells	6 out of 22 cells
Tampa Bay Model Structure (12 cells)	5 out of 10 cells	7 out of 12 cells	7 out of 12 cells

From Table 7.9, the test results showed that other than the cells that did not have any survey samples to allow the test, the combined HBNW trip rates for Lee County and Volusia County were closer to each other for most cells than they were to those for the Jacksonville MSA. When the trip rates based on the Southeast Florida model structure for Lee and Volusia counties were compared, two cells out of the 19 cells were tested as being statistically different, while for the Tampa Bay model structure, five out of 10 cells were tested as being statistically different. Results from Table 7.8 indicate replicability for the combined HBNW trip rates of working households with children between Lee County and Volusia County. It seems that for retired and working households without children, HBNW trip rates cannot be transferred spatially. The travel demands of non-work trips for residents of these two groups of households, which have more freedom than working households with children, were different probably due to different activity opportunities, different areas, or different household income levels.

8. ANALYSIS OF TRIP RATES OF SEASONAL HOUSEHOLDS

Based on data collected in Florida so far, seasonal households seem to share certain similarities with retired households when compared with the other types of permanent households in a given urban area. For example, seasonal household members are usually unlikely to be full-time or part-time workers or children. Therefore, it is possible that seasonal and retired households may share similar characteristics in travel behaviors, including trip productions. In this chapter, trip productions by seasonal households are analyzed to determine whether their household structures and trip generation rates actually resemble those of the retired households and, as a result, whether separate sets of trip rates are necessary for seasonal households. In Section 8.1, the survey data on seasonal households from the Tampa Bay region are analyzed. Section 8.2 presents the analysis results of the Lee County survey data. In Section 8.3, the impact of not using a separate set of trip rates for seasonal households is examined.

8.1 Analysis of Trip Rates of Tampa Bay Seasonal Households

A major household survey was conducted in 1996 in Tampa Bay with more than 20,000 survey forms mailed. The survey provided the basis for updating trip generation rates for the region. However, because the survey was a random sample survey, traditional "low response" cells, including households with low auto ownership as well as seasonal households, had relatively small sample sizes (Gannett Fleming 2002).

In 2000, another survey, the West Central Florida Travel Survey 2000, was conducted. One of the objectives of the survey was to include more seasonal households for comparing their trip generation characteristics with those of the permanent households (Gannett Fleming 2002). To target the seasonal households, the survey was carried out between February 10 and April 3 to coincide with the 2000 census and the area's peak for seasonal residents. A random sample of 53,000 households within the Tampa Bay Region was cross-matched to the United States Postal Service (USPS) Delivery Sequence File. This file identified those addresses for which temporary forwarding of mail had been requested. The cross-matching netted 2,311 addresses that were targeted for receipt of the household survey using a mail-mailback distribution. In total, 2,309 households provided valid household member information and useful person trip logs on the surveyed day. A weighting factor was applied to the records to compensate for under-reporting of trips. The weighting factor was determined by dividing the household size reported in the household information section in the survey form by the number of household members returning person trip logs. Twelve records were dropped because of excessive weights of less than 0.1 or greater than 3. The remaining 2,297 records were then stratified by household status and auto ownership. Finally, there were 1,762 useful records with valid information about auto ownership, and employment and residence status. Table 8.1 shows the sample sizes based on these valid records and based on the Tampa Bay Regional Model structure.

Table 8.1 Sample Size of the Permanent and Seasonal Households in the 2000 Tampa Bay Regional Survey

Vehicle	Seasonal HH	Retired HH	Working HH without Children	Working HH with Children	Subtotal
0	5	24	7	29	65
1	428	511	23	141	1,103
2	49	182	9	218	458
3+	4	20	0	112	136
Subtotal	486	737	39	500	1,762

The useful household samples from the 2000 survey were used to supplement the general household surveys collected in 1996. After applying the same data processing as mentioned above, there were 5,246 useful samples from the 1996 household survey. The sample sizes from the 1996 household survey are given in Table 8.2.

Table 8.2 Sample Size of the Permanent and Seasonal Households in the 1996 Tampa Bay Regional Survey

Vehicle	Seasonal HH	Retired HH	Working HH without Children	Working HH with Children	Subtotal
0	1	23	2	5	31
1	98	1,431	617	111	2,257
2	24	658	1,019	465	2,166
3+	5	101	470	216	792
Subtotal	128	2,213	2,108	797	5,246

The household survey data collected in 2000 were combined with the 1996 survey data to give a complete data set that could be used to estimate trip rates with a much higher degree of confidence for the lifestyle trip generation model. Table 8.3 provides the sample sizes for the combined data set. The total useful samples are 7,008.

Table 8.3 Sample Size Based on Tampa Bay Regional Model Structure for Permanent and Seasonal Households from the Combined 1996 and 2000 Surveys

Vehicle	Seasonal HH	Retired HH	Working HH without Children	Working HH with Children	Subtotal
0	6	47	9	34	96
1	526	1,942	640	252	3,360
2	73	840	1,028	683	2,624
3+	9	121	470	328	928
Subtotal	614	2,950	2,147	1,297	7,008

Table 8.4 summarizes the data sample statistics for the combined data set. Table 8.5 summarizes the overall household size, trip rate, and auto ownership for the four household types: seasonal households, retired households, working households without children, and working households with children. The trip rates are given at both the person and household levels. It may be observed from the tables that:

- The average sizes of the seasonal and retired households were similar, while the average size of non-retired households with children was much larger.

- Working households with children made the largest number of trips per person, followed by working households without children, then retired households, and finally seasonal households. At the household level, seasonal and retired households produced about the same number of trips per household, while working households produced significantly more trips.

- Working households with or without children on average owned about two vehicles per households, while seasonal and retired households owned 1.14 and 1.36 vehicles per household, respectively.

Table 8.4 Data Sample Statistics for the Tampa Bay Region Survey Data

	Seasonal HH	Retired HH	Working HH without Children	Working HH with Children
Number of Households	614	2,950	2,147	1,297
Number of Persons	1,136	5,118	4,321	4,152
Number of Trips	2,877	16,343	15,199	17,362

Table 8.5 Comparison of Overall Household Characteristics in the Tampa Bay Region

Characteristics	Seasonal HH	Retired HH	Working HH without Children	Working HH with Children
Household Size	1.85	1.73	2.01	3.20
Trips/Person	2.53	3.19	3.52	4.18
Trips/Household	4.69	5.54	7.08	13.39
Autos/Person	0.62	0.78	1.00	0.65
Autos/Household	1.14	1.36	2.01	2.08

Figure 8.1 illustrates the distribution of household trip rates by trip purpose for the four household groups. The figure indicates that seasonal and retired households rarely made HBW or HBSCH trips. For home-based shopping, social and recreational, and other trip purposes, retired households seemed to be more active than seasonal households. The trip rate distributions for working households are generally different from those for the seasonal and retired households.

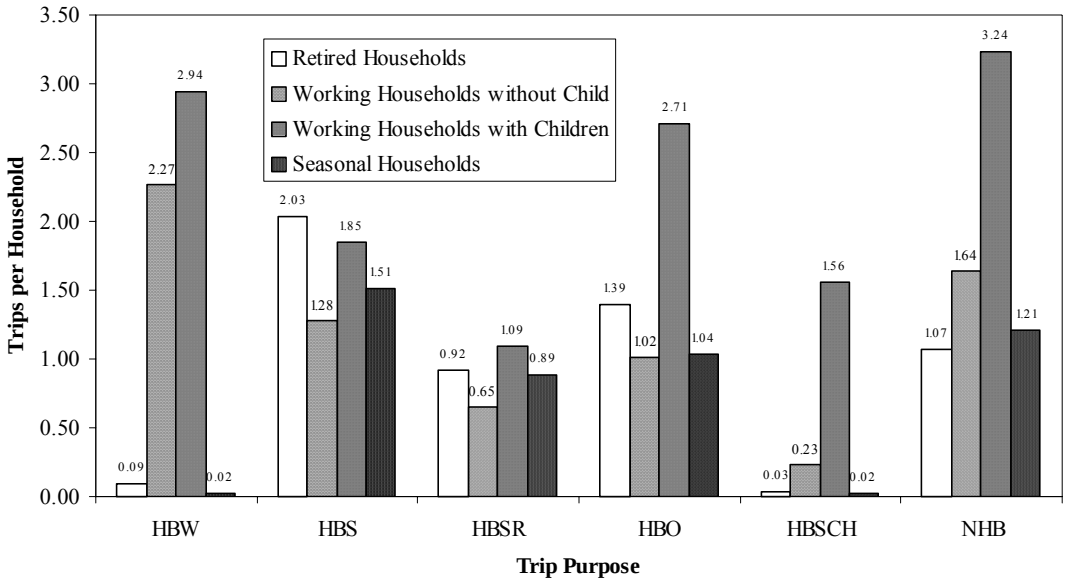

Figure 8.1 Household Trip Rate Distribution by Trip Purpose in Tampa Bay

Table 8.6 gives the percentages of trips by trip purposes for the four household groups. It may be seen that seasonal and retired households made a significantly higher percentage of HBS and HBSR trips than working households and insignificant numbers of work trips and school trips. The differences in HBO trips were also noticeable. Overall, about 35% of trips made by working households were compulsory trips (work and school) while this percentage was only 1% to 2% for seasonal and retired households.

Table 8.6 Percentages of Trips by Purpose from the Tampa Bay Survey Data

Trip Purpose	Trip Percentage			
	Seasonal HH	Retired HH	Working HH without Children	Working HH with Children
HBW	0.50	1.60	32.00	21.97
HBS	32.26	36.67	18.05	13.85
HBSR	18.93	16.63	9.14	8.12
HBO	22.15	25.11	14.37	20.25
HBSCH	0.40	0.59	3.29	11.62
NHB	25.75	19.40	23.14	24.18

The Wilcoxon Rank-Sum test was applied to determine which permanent household groups share identical trip production distribution with the seasonal households. HBW, HBS, HBSR, and HBO trip rates were compared. The test results would suggest whether a separate set of trip rates is required for seasonal households.

As can be seen from Table 8.3, seasonal households with zero and 3+ vehicles were too few to allow any meaningful statistical analysis. Therefore, the tests were conducted for the one- and two-vehicle categories as well as for combined zero-and-one-vehicle group and two-and-plus-vehicle group. Table 8.7 gives the average HBW trip rates for the one-vehicle and two-vehicle

categories, as well as the two combined categories for the four household types. The average HBW trip rates for the seasonal households were significant lower than those for the households with workers, regardless whether children were present. The average HBW trip rates for seasonal and retired households were closer in comparison.

Table 8.7 Average HBW Trip Rates Based on the Tampa Bay Survey

Vehicle	Seasonal HH	Retired HH	Working HH without Children	Working HH with Children
1	0.01	0.05	1.39	1.55
2	0.10	0.13	2.38	3.14
0 and 1	0.01	0.05	1.39	1.49
2+	0.09	0.17	2.64	3.35

Table 8.8 shows the resulted P-values for the Wilcoxon Rank-Sum tests by comparing the sampled HBW trip rates between seasonal households and the other three household types. The results indicated that only the trip rates for the retired households with two or more vehicles were not significantly different from those for the seasonal households in the corresponding category. Consequently, a separate set of HBW trip rates should be provided for seasonal households.

Table 8.8 P-Values for Wilcoxon Rank-Sum Test on HBW Trip Rates Based on the Tampa Bay Survey

Vehicle	Seasonal HH vs. Retired HH	Seasonal HH vs. Working HH without Children	Seasonal HH vs. Working HH with Children
1	0.048	0.000	0.000
2	0.520	0.000	0.000
0 and 1	0.036	0.000	0.000
2+	0.275	0.000	0.000

Table 8.9 shows the average HBS trip rates for different vehicle ownership groups. The average HBS trip rates for seasonal households were different from those of any group of permanent households, regardless of the level of auto ownership. The Wilcoxon Rank-Sum tests were performed again to verify if the HBS trip rates for seasonal households were significantly different from those for the other three household types. The test results are presented in Table 8.10, which showed that the HBS trip rates for seasonal households could not be combined with any group of permanent households except for the working households with children.

Table 8.9 Average HBS Trip Rates Based on the Tampa Bay Survey

Vehicle	Seasonal HH	Retired HH	Working HH without Children	Working HH with Children
1	1.50	1.97	1.13	1.37
2	1.54	2.17	1.26	1.97
0 and 1	1.49	1.95	1.12	1.25
2+	1.64	2.21	1.35	2.02

Table 8.10 P-Values of Wilcoxon Rank-Sum Tests on HBS Trip Rates Based on the Tampa Bay Survey

Vehicle	Seasonal HH vs. Retired HH	Seasonal HH vs. Working HH without Children	Seasonal HH vs. Working HH with Children
1	0.011	0.000	0.079
2	0.093	0.113	0.786
0 and 1	0.014	0.000	0.011
2+	0.093	0.115	0.603

The average HBSR trip rates are provided in Table 8.11. The average HBS trip rates for seasonal households and retired households were similar. The results from the Wilcoxon Rank-Sum tests, shown in Table 8.12, indicated that HBSR trip rates for seasonal households and retired households could be combined.

Table 8.11 Average HBSR Trip Rates Based on the Tampa Bay Survey

Vehicle	Seasonal HH	Retired HH	Working HH without Children	Working HH with Children
1	0.87	0.82	0.44	0.64
2	1.03	1.15	0.67	1.14
0 and 1	0.86	0.81	0.44	0.59
2+	1.04	1.16	0.74	1.23

Table 8.12 P-Value of Wilcoxon Rank-Sum Test on HBSR Trip Rates Based on the Tampa Bay Survey

Vehicle	Seasonal HH vs. Retired HH	Seasonal HH vs. Working HH without Children	Seasonal HH vs. Working HH with Children
1	0.826	0.000	0.024
2	0.477	0.107	0.773
0 and 1	0.719	0.000	0.004
2+	0.405	0.156	0.924

The average HBO trip rates for different types of households are provided in Table 8.13 and the Wilcoxon Rank-Sum test results in Table 8.14. The Wilcoxon Rank-Sum tests suggested that the HBO trip rates for seasonal households were not significantly different from those for working households without children.

Table 8.13 Average HBO Trip Rates Based on the Tampa Bay Survey

Vehicle	Seasonal HH	Retired HH	Working HH without Children	Working HH with Children
1	0.99	1.25	0.81	1.46
2	1.39	1.70	0.95	3.07
0 or 1	0.99	1.24	0.81	1.37
2+	1.34	1.71	1.11	3.09

Table 8.14 P-Values of Wilcoxon Rank-Sum Tests on HBO Trip Rates Based on the Tampa Bay Survey

Vehicle	Seasonal HH vs. Retired HH	Seasonal HH vs. Working HH without Children	Seasonal HH vs. Working HH with Children
1	0.000	0.125	0.083
2	0.108	0.115	0.000
0 and 1	0.000	0.093	0.202
2+	0.051	0.466	0.000

In summary, trip rates for seasonal households were generally lower than those for retired households. The Wilcoxon Rank-Sum Tests showed that seasonal households might share similar trip rates with the following household groups:

HBW: none
HBS: working households with children
HBSR: retired households
HBO: working households without children

The above results suggested that a separate set of trip production rates was necessary for seasonal households since they did not share similar trip rates with any specific household group.

The trip rates of the two auto ownership groups were further examined to verify if the classification structure for seasonal households could be reduced. Table 8.15 gives the sample sizes and average trip rates by purpose for the seasonal households in the two auto ownership groups, i.e., less than 2 and 2+. The Wilcoxon Rank-Sum tests were performed again to verify if the samples in the two groups could be combined. As indicated in Table 8.16, the number of vehicles did not appear to influence the number of trips a seasonal household would produce. Consequently, there is no need to further stratify seasonal households by auto ownership.

Table 8.15 Sample Sizes and Trip Rates by Purpose for Seasonal Households Based on the Tampa Bay Survey

Vehicle	Sample Size	HBW	HBS	HBSR	HBO
0 or 1	532	0.01	1.49	0.86	0.99
2+	82	0.09	1.64	1.04	1.34

Table 8.16 P-Values for Seasonal Households in Two Auto ownership Groups for Tampa Bay Region

HBW	HBS	HBSR	HBO
0.074	0.419	0.390	0.154

Table 8.17 shows the average trip rates for seasonal households without any stratification. The trip rates are identical to those that were used in the recently validated transportation model for the Tampa regional area.

Table 8.17 Average Trip Rates for Seasonal Households Based on the Tampa Bay Survey

HBW	HBS	HBSR	HBO
0.02	1.51	0.89	1.03

8.2 Analysis of Trip Rates of the Lee County Seasonal Households

The Lee County Urban Travel Characteristics Study surveys were conducted during the months of January through April 1992, usually considered the peak season for seasonal residents. In Lee County, permanent residents were defined as having their primary residence in Lee County, and the rest were classified as seasonal residents. Telephone numbers were drawn randomly from Lee County prefixes. The targeted number of trip log completions for permanent resident households was decided based on the 1988 Tallahassee Urban Travel Characteristics Evaluation Study. Cell targets were adjusted for the seasonal resident households to account for anticipated differences in household size, auto ownership, and dwelling type. A total of 685 household trip logs were completed. Out of these samples, 313 were from seasonal resident households.

In Chapters 6 and 7, it has been shown that the Tampa Bay model structure performed better for estimating trip productions for permanent households in Lee County. This model structure was used here to compare the trip rates by purpose between permanent and seasonal households in Lee County. Table 8.18 summarizes the data sample statistics for the four household types: seasonal households, retired households, working households without children, and working households with children.

Table 8.18 Sample Statistics for Lee County Survey Data

	Seasonal HHs	Retired HHs	Working HHs without children	Working HHs with children
Number of Households	313	152	134	86
Number of Persons	616	288	301	347
Number of Trips	2,022	888	1,135	1,096

Table 8.19 gives the overall household size, trip rate, and vehicle ownership for the four household types. The average trip rates are given at both the person and household levels. The table shows that:

- Household sizes of seasonal and retired households were similar. As expected, working households with children tended to have a significantly larger household size.
- At the person level, working households without children made the largest number of trips per person, followed by seasonal households, working households with children, and finally retired households. At the household level, seasonal and retired households produced about the same number of trips per household, while working households produced significantly more trips.
- Seasonal and retired households on average owned about the same number of vehicles, while working households with children owned fewer vehicles per person. This is expected since, unlike the other two groups, the working households included not only adults but also children who did not drive. At the household level, however, non-retired households have the highest level of vehicle ownership.

Table 8.19 Comparison of Overall Characteristics of Households in Lee County

Characteristics	Seasonal HH	Retired HH	Working HH without Children	Working HH with Children
Household Size	1.97	1.89	2.25	4.03
Trips/Person	3.28	3.08	3.77	3.16
Trips/Household	6.46	5.84	8.47	12.74
Autos/Person	0.59	0.65	0.88	0.48
Autos/Household	1.16	1.23	1.99	1.94

Figure 8.2 depicts the distribution of person trips for the four groups. It may be seen that seasonal and retired residents had similar distribution of person trips, while a lower percentage of residents from working households stayed at home and a higher percentage of them made two trips a day. Figure 8.3 illustrates the distribution of household trip rates by trip purposes for the four groups. The figure indicates that the trip rate distributions for seasonal and retired households were similar except for HBS and HBSR trip purposes. Unlike their counterparts in the Tampa Bay region, the seasonal households in Lee County tended to make more HBS and HBSR trips than retired households. The trip rate distributions for working households were generally different from the seasonal and retired households.

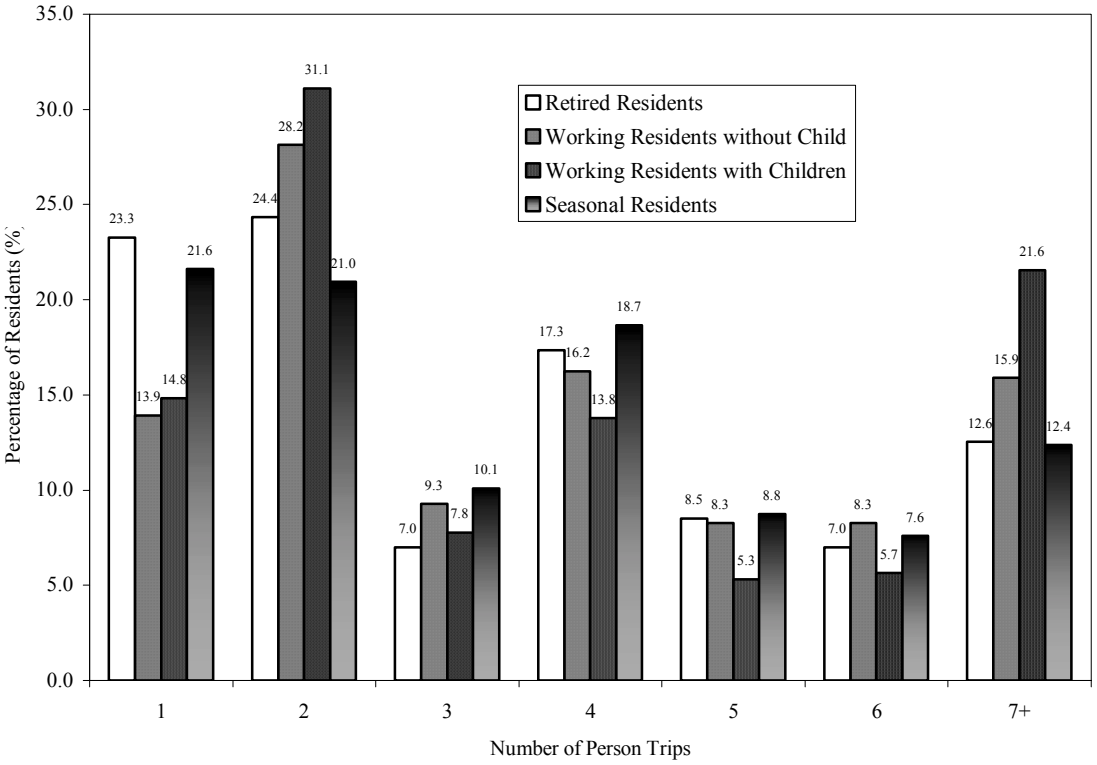

Figure 8.2 Distribution of Number of Person Trips Based on Lee County Survey Data

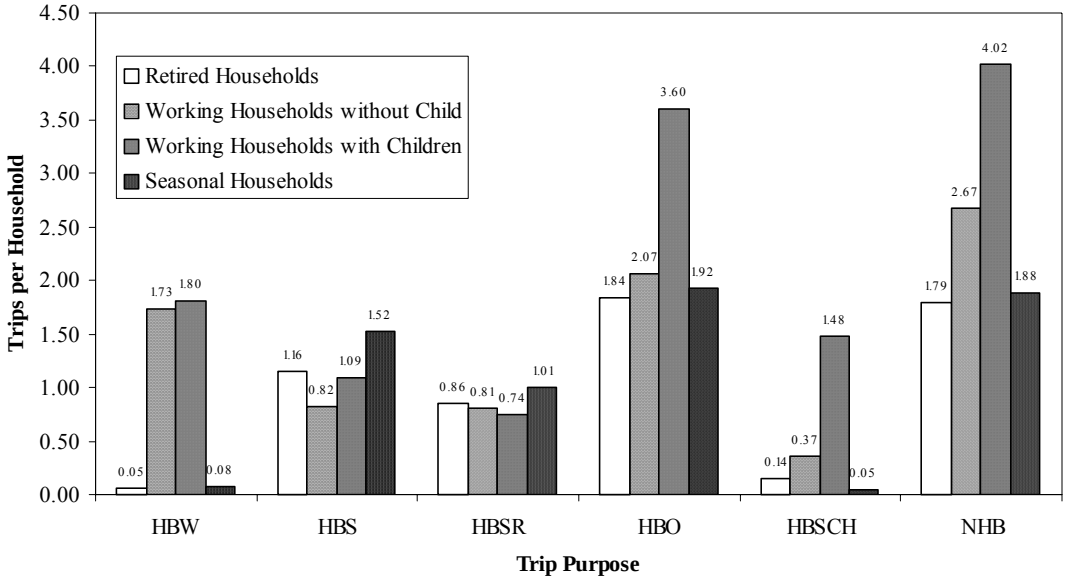

Figure 8.3 Distribution of Household Trip Rate by Trip Purpose for Lee County

Table 8.20 gives the percentages of trips by trip purposes for the four household groups. The table shows that all four groups made about the same percentages of NHB trips. Seasonal and retired households made a significantly higher percentage of HBS and HBSR trips than working households. Overall, about a quarter of the trips made by working household were compulsory trips (work and school).

Table 8.20 Percentages of Trips by Purpose from Lee County Survey Data

Trip Purpose	Seasonal HH	Retired HH	Working HH without Children	Working HH with Children
HBW	1.19	0.90	20.44	14.14
HBS	23.59	19.82	9.69	8.58
HBSR	15.58	14.64	9.60	5.84
HBO	29.77	31.53	24.41	28.28
HBSCH	0.79	2.48	4.32	11.59
NHB	29.08	30.63	31.54	31.57

The sampled data showed that trip generation by the seasonal households was similar to that by the retired households and different from that by the working households (with or without children). The Wilcoxon Rank-Sum tests were performed to determine which permanent household types among these three groups shared identical trip production distribution with seasonal households. The tests were performed for each of the HBW, HBS, HBSR, and HBO trip purposes.

Table 8.21 provides the sample sizes by auto ownership of 0, 1, 2, and 3+ cars for four types of households as classified in the Tampa Bay trip production model structure. As shown in the table, the numbers of seasonal households in the categories of zero and 3+ cars were too small to allow any meaningful statistical analysis. As a result, these two categories were combined with

the one- and two-car categories. The analysis was therefore conducted for one-car and two-car groups and for zero-and-one car and two-and-more-car groups.

Table 8.21 Sample Sizes Based on the Tampa Bay Regional Model Structure for Permanent and Seasonal Households in Lee County

Vehicle	Seasonal HHs	Retired HHs	Working HHs without Children	Working HHs with Children
0	2	6	1	1
1	261	107	42	20
2	47	37	64	51
3+	3	2	27	14

The sample sizes and percentages of the four types of households after combining the samples based on vehicle ownership are provided in Table 8.22. It may be seen that the majority of the retired and seasonal households had one or zero vehicle. Only 25.7% of the surveyed retired households and 16.0% of the surveyed seasonal households had two or more vehicles. Retired and seasonal households with either zero vehicle or three or more vehicles were rare.

Table 8.22 Sample Sizes for Combined Categories Based on Lee County Survey

Vehicle	Seasonal HHs		Retired HHs		Working HHs Without Children		Working HHs With Children	
0 and 1	263	84.0%	107	74.3%	43	31.7%	21	24.4%
2+	50	16.0%	37	25.7%	91	68.3%	65	75.6%

The average HBW trip rates are provided in Table 8.23. The trip rates for both seasonal and retired households were significant lower than those for the working households. The statistics also showed that the HBW average trip rates for seasonal households and retired households were closer. Particularly, the trip rates for seasonal and retired households with zero or one vehicle were close.

Table 8.23 Average HBW Trip Rates Based on Lee County Survey

Vehicle	Seasonal HH	Retired HH	Working HH without Children	Working HH with Children
1	0.03	0.07	1.40	1.35
2	0.23	0.00	1.80	1.92
0 and 1	0.03	0.07	1.42	1.38
2+	0.32	0.00	1.88	1.94

Table 8.24 gives the P-values from the Wilcoxon Rank-Sum tests comparing the sampled HBW trip rates between seasonal households and the other three household types. The results indicated that only the trip rate for the retired households with zero or one auto was not significantly different from that for the seasonal households in the corresponding category. This suggests that a separate set of HBW trip rates is needed for seasonal households in Lee County.

Table 8.24 P-Values for Wilcoxon Rank-Sum Test on HBW Trip Rates Based on Lee County Survey

Vehicle	Seasonal HH vs. Retired HH	Seasonal HH vs. Working HH without Children	Seasonal HH vs. Working HH with Children
1	0.190	0.000	0.000
2	0.025	0.000	0.000
0 and 1	0.216	0.000	0.000
2+	0.009	0.000	0.000

The average HBS trip rates are provided in Table 8.25. It may be seen that the trip rates for the retired households with two or more vehicles were the same or almost identical as those for the seasonal households in the same vehicle ownership category. However, the Wilcoxon Rank-Sum tests (see Table 8.26) showed that only the HBS trip rates for seasonal households and households with workers/children have the same distribution across vehicle ownership categories.

Table 8.25 Average HBS Trip Rates Based on Lee County Survey

Vehicle	Seasonal HH	Retired HH	Working HH without Children	Working HH with Children
1	1.55	1.16	0.81	1.45
2	1.26	1.27	0.81	1.04
0 and 1	1.54	1.12	0.79	1.38
2+	1.26	1.26	0.84	1.00

Table 8.26 P-Value of Wilcoxon Rank-Sum Test on HBS Trip Rates Based on Lee County Survey

Vehicle	Seasonal HH vs. Retired HH	Seasonal HH vs. Working HH without Children	Seasonal HH vs. Working HH with Children
1	0.033	0.008	0.491
2	0.611	0.180	0.476
0 and 1	0.023	0.007	0.391
2+	0.969	0.060	0.167

Table 8.27 gives the average HBSR trip rates. Again, the trip rates for the retired households with two or more autos were the same or similar as those for the seasonal households in the corresponding category. The results from the Wilcoxon Rank-Sum tests, as shown in Table 8.28, also indicated that HBSR trip rates for seasonal households and retired households could be combined.

Table 8.27 Average HBSR Trip Rates Based on Lee County Survey

Vehicle	Seasonal HH	Retired HH	Working HH without Children	Working HH with Children
1	0.92	0.64	0.90	0.45
2	1.51	1.41	0.67	0.86
0 and 1	0.92	0.65	0.88	0.52
2+	1.46	1.46	0.78	0.82

Table 8.28 P-Value of Wilcoxon Rank-Sum Test on HBSR Trip Rates Based on Lee County Survey

Vehicle	Seasonal HH vs. Retired HH	Seasonal HH vs. Working HH without Children	Seasonal HH vs. Working HH with Children
1	0.253	0.693	0.047
2	0.750	0.052	0.124
0 and 1	0.255	0.776	0.094
2+	0.539	0.052	0.122

The average HBO trip rates for different types of households are shown in Table 8.29. Again, the trip rates for the seasonal and retired households were closer than those for other household groups. The results from the Wilcoxon Rank-Sum tests, given in Table 8.30, confirmed that HBO trip rates for seasonal households and retired households were not significantly different. They also showed that the HBO trip rates for seasonal households were not significantly different from those for working households without children.

Table 8.29 Average HBO Trip Rates Based on Lee County Survey

Vehicle	Seasonal HH	Retired HH	Working HH without Children	Working HH with Children
1	1.93	1.80	1.48	2.65
2	1.91	2.08	1.97	3.76
0 and 1	1.92	1.77	1.44	2.52
2+	1.96	2.05	2.36	3.95

Table 8.30 P-Value of Wilcoxon Rank-Sum Test on HBO Trip Rates Based on Lee County Survey

Vehicle	Seasonal HH vs. Retired HH	Seasonal HH vs. Working HH without Children	Seasonal HH vs. Working HH with Children
1	0.411	0.305	0.160
2	0.895	0.945	0.023
0 and 1	0.378	0.264	0.243
2+	0.959	0.530	0.006

In summary, unlike the Tampa Bay region, the seasonal households shared more similarity in HBW, HBSR, and HBO trip rates with the retired households. The only exception was that the HBS trip rates for the seasonal households were similar to those for the working households with

children. The seasonal residents in Lee County with zero or one auto also seemed to be more active than retired residents compared to their counterparts in the Tampa Bay region.

The trip rates in the two auto ownership groups were further examined to verify if the classification structure for seasonal households could be reduced. Table 8.31 shows the sample size and average trip rate by purpose for the seasonal households in the two vehicle ownership groups, i.e., households with zero or vehicle and those with two or more vehicles. The Wilcoxon Rank-Sum test results are given in Table 8.32, which indicated that the number of vehicles did not affect the number of HBNW trips produced by seasonal households. Table 8.33 provides the average HBNW trip rates for seasonal households without any stratification.

Table 8.31 Sample Sizes and Trip Rates by Purpose for Seasonal households for Lee County

Vehicle	Sample Size	HBW	HBS	HBSR	HBO
0 and 1	263	0.03	1.54	0.92	1.92
2+	50	0.32	1.26	1.46	1.96

Table 8.32 P-Values for Seasonal Households in Two Auto ownership Groups for Lee County

HBW	HBS	HBSR	HBO
0.000	0.754	0.146	0.992

Table 8.33 Average Trip Rates for Seasonal Households for Lee County

HBS	HBSR	HBO
1.52	1.00	1.92

8.3 Potential Impact of Separate Trip Rates for Seasonal Households

From the analyses of the Lee County and Tampa Bay survey data, it has been concluded that trip production rates for seasonal households were different from those for both permanent and retired households. Given that the ratio of seasonal households to permanent households varies greatly from county to county or even within a county, it is necessary to examine the effect of not having a separate set of trip rates for seasonal households to be able to make a decision on whether or not seasonal households warrant special treatment.

Assuming that no separate set of trip rates is to be applied to seasonal households, and instead trip rates for permanent households are to be used for seasonal households, there will be errors introduced into the calculation of total trips. For simplicity, trip purposes were not considered individually. Instead, the following discussion was based on all home-based trips. The error may be approximated as below:

$$Error = \frac{\left(r_p \times PH + r_p \times SH\right) - \left(r_p \times PH + r_s \times SH\right)}{\left(r_p \times PH + r_s \times SH\right)} \times 100\% = \frac{\left(1 - \frac{r_s}{r_p}\right)a}{1 + \frac{r_s}{r_p}a} \times 100\% \qquad (1)$$

where $Error$ = difference of production trips in percentage ;
r_p = average trip rate for permanent households;
r_s = average trip rate for seasonal households;
PH = number of permanent households;
SH = number of seasonal households; and
a = ratio between seasonal households and permanent households, $a = SH/PH$.

In the above formula, r_p is the average trip rate for permanent households to be applied to seasonal households. An analysis of the seasonal household data from both Lee County and the Tampa Bay region showed that a majority (over 60 percent) of the seasonal households were two-person one-car households and that they produced few work trips. Consequently, the analysis that follows will be based on this type of seasonal households. If there will be no seasonal household trip rates, seasonal households will be defined as retired households with one car based on the Tampa Bay model structure; two-person, no-children, and one-car households for HBNW trip purposes based on the Southeast Florida model structure (seasonal households produced few work trips and they would be classified as zero worker households therefore producing no work trips based on the Southeast Florida model); and multi-family two-person one-car households based on the standard FSUTMS model structure.

Tables 8.34 and 8.35 show the average trip rates derived from the Lee County and Tampa Bay survey data sets, respectively, for the seasonal households and permanent households as defined above. Note that based on the Lee County survey data and the Tampa Bay model structure, the average trip rate for seasonal households was higher than that for the retired on-car permanent households. In this case, applying trip rates for retired on-car permanent households to seasonal households would underestimate trips as opposed to overestimate trips if other model structures were used.

Table 8.34 Average Trip Rates for Seasonal Households and Permanent Households Based on Lee County Survey Data

Data Set	Model Structure	Household Type	Sample Size	Average Trip Rate
Lee County	Survey Data	Seasonal (all)	313	6.46
		Permanent (all)	372	8.41
	FSUTMS	Seasonal (Multi Family, 2 Persons, 1 Auto)	181	6.77
		Permanent (Multi Family, 2 Persons, 1 Auto)	48	7.31
	Tampa Bay	Seasonal (Retired, 1 Auto)	242	6.37
		Permanent (Retired, 1 Auto)	107	5.61
	Southeast Florida	Seasonal (2 persons, 0 child, 1 Auto)	213	6.61
		Permanent (2 persons, 0 child, 1 Auto)	83	7.22

Table 8.35 Average Trip Rates for Seasonal Households and Permanent Households Based on the Tampa Bay Survey Data

Tampa Bay	Survey Data	Seasonal (all)	614	4.69
		Permanent (all)	6,394	7.65
	FSUTMS	Seasonal (Multi Family, 2 Persons, 1 Auto)	341	4.95
		Permanent (Multi Family, 2 Persons, 1 Auto)	579	6.40
	Tampa Bay	Seasonal (Retired, 1 Auto)	515	4.56
		Permanent (Retired, 1 Auto)	1,942	5.12
	Southeast Florida	Seasonal (2 persons, 0 child, 1 Auto)	370	5.11
		Permanent (2 persons, 0 child, 1 Auto)	1,406	6.65

The errors from not applying separate trip rates for seasonal households based on the Lee County survey data set are listed in Table 8.36 and those based on the Tampa Bay survey data set in Table 8.37. It may be seen that the magnitude of the error depends on the relative values of the two trip rates, with larger differences in the trip rates resulting in larger errors. Additionally, the error also increases with the ratio of seasonal households to permanent households. For instance, based on the Lee County data set, the average seasonal household trip rate was 114% of that for the permanent households defined based on the Tampa Bay model structure, and the error ranged from -1.22% of total trips for a = 10% (seasonal and permanent households are one to ten) to -10.97% for a = 1000% (seasonal and permanent households are ten to one). Based on the Tampa Bay survey data, the error ranged from 1% for a = 10% to 11.04% for a = 1000% if the Tampa Bay model structure was used. If the standard FSUTMS model was used, then the error would range from 2.10% for a = 10% to 25.94% for a = 1000%. The curves defined by Equation (1) based on different model structures are plotted in Figures 8.4 and 8.5, for the Lee County and Tampa Bay data sets, respectively.

In Florida, the county that had the highest seasonal to permanent household ratio according to the 2000 census was Walton County (46.6%) (see Appendix A). While this ratio was high at county level, it might be even higher in areas within a county where seasonal residents congregate. From Figure B.60 it can be seen that the highest ratio of seasonal to permanent households in percentage reached 448.07% at census block group level in Walton County. For Lee County, the countywide seasonal households were 20.94% of the permanent households. In some areas, however, this percentage reached 1365.38%. The limit of error when a approaches infinity is

$$\lim_{a\to\infty} Error = \lim_{a\to\infty} \frac{\left(1-\frac{r_s}{r_p}\right)a}{1+\frac{r_s}{r_p}a} \times 100\% = \left(\frac{r_p}{r_s}-1\right)\times 100\%.$$

Table 8.36 Errors Introduced by Applying the Same Trip Rates to Permanent and Seasonal Households Based on the Lee County Survey Data

$a = SH/PH$ (%)	Error (%)		
	FSUTMS r_s= 6.77, r_p = 7.31 r_s/r_p = 0.93, $\lim_{a\to\infty} Error$ = 7.98%	Tampa Bay r_s= 6.37, r_p = 5.61 r_s/r_p = 1.14 $\lim_{a\to\infty} Error$ = 11.93%	Southeast Florida r_s= 6.21, r_p = 7.22 r_s/r_p = 0.92, $\lim_{a\to\infty} Error$ = 9.23%
10	0.68	-1.22	0.77
20	1.25	-2.21	1.43
30	1.73	-3.03	1.99
40	2.16	-3.73	2.47
50	2.52	-4.32	2.90
60	2.85	-4.83	3.27
70	3.14	-5.28	3.60
80	3.39	-5.68	3.90
90	3.63	-6.03	4.17
100	3.84	-6.34	4.41
200	5.18	-8.28	5.97
300	5.87	-9.22	6.77
400	6.28	-9.78	7.25
500	6.56	-10.14	7.57
600	6.76	-10.40	7.81
700	6.91	-10.60	7.98
800	7.03	-10.75	8.12
900	7.12	-10.87	8.23
1000	7.20	-10.97	8.32
1500	7.44	-11.27	8.60
2000	7.57	-11.43	8.75

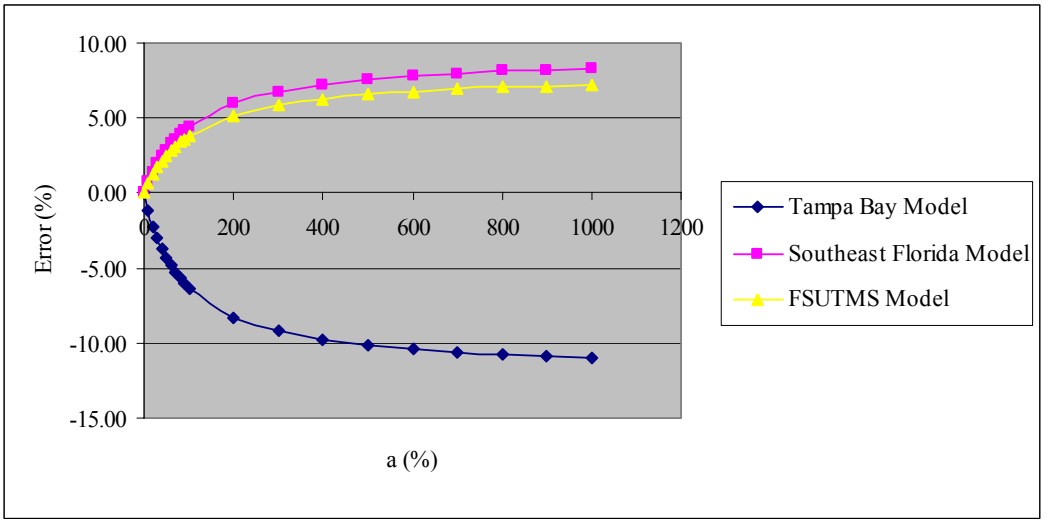

Figure 8.4 Relationship between *Error* and *a* based on the Lee County Data

Table 8.37 Errors Introduced by Applying the Same Trip Rates to Permanent and Seasonal Households Based on the Tampa Bay Survey Data

$a = SH/PH$ (%)	Error (%)		
	FSUTMS $r_s = 4.95$, $r_p = 6.40$ $r_s/r_p = 0.77$, $\lim_{a\to\infty} Error = 29.29\%$	Tampa Bay $r_s = 4.56$, $r_p = 5.12$ $r_s/r_p = 0.89$, $\lim_{a\to\infty} Error = 12.28\%$	Southeast Florida $r_s = 5.11$, $r_p = 6.65$ $r_s/r_p = 0.77$, $\lim_{a\to\infty} Error = 30.14\%$
10	2.10	1.00	2.15
20	3.92	1.86	4.01
30	5.52	2.59	5.65
40	6.92	3.23	7.09
50	8.17	3.78	8.37
60	9.28	4.28	9.51
70	10.29	4.72	10.54
80	11.20	5.11	11.47
90	12.02	5.46	12.32
100	12.78	5.79	13.10
200	17.79	7.87	18.26
300	20.47	8.94	21.02
400	22.14	9.59	22.74
500	23.27	10.03	23.91
600	24.10	10.34	24.77
700	24.73	10.58	25.41
800	25.22	10.77	25.92
900	25.61	10.92	26.33
1000	25.94	11.04	26.67
1500	26.97	11.43	27.73
2000	27.51	11.63	28.30

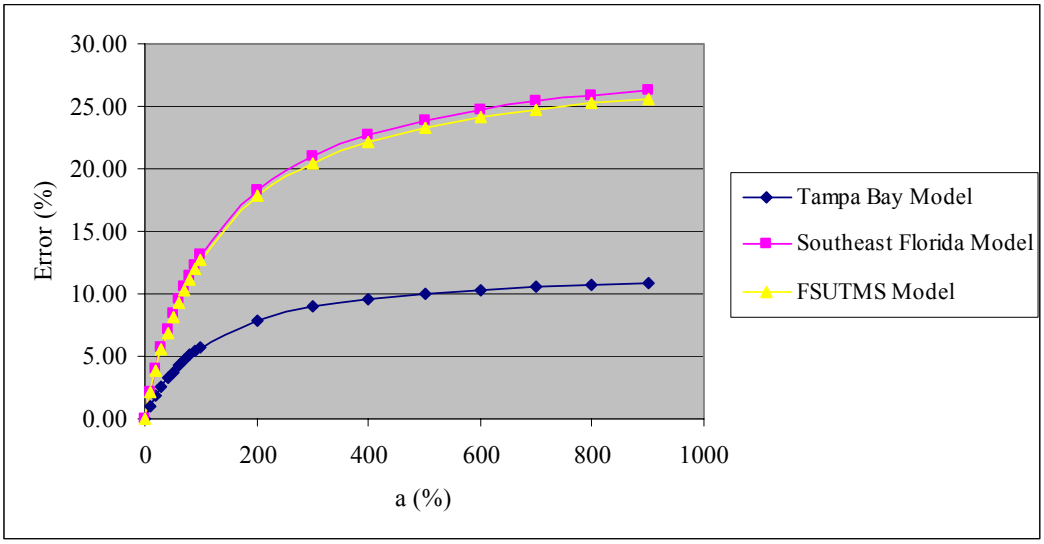

Figure 8.5 Relationship between *Error* and *a* based on the Tampa Bay Survey Data

An MPO will need to study the seasonal household distribution within its urban area to determine if an effort should be made to collect data on seasonal household travel behavior and use a separate set of trip rates for seasonal households. When the ratio between seasonal households and permanent households is low, e.g., less than 20% (state average is 7.62%), or when the number of seasonal households is small even when they are concentrated in a few areas, they may be treated as permanent households without resulting in significant errors. On the other hand, if the ratio of seasonal to permanent households is high in some areas and the number of seasonal households is also large, then it may be appropriate to model the seasonal households separately.

The above discussion has been based on the assumption that seasonal households are mostly two-person one-car households that have few children and produce few work trips. For other types of households, the errors from not applying a separate set of trip rates for seasonal households may vary. The amount of errors may be estimated based on the information provided in Tables 8.37 and 8.38 and based on the model structure to be used.

9. CONCLUSIONS

This research attempted to answer questions regarding the benefits of lifestyle models, the spatial transferability of lifestyle models, and the need to consider seasonal households as a separate household type. Procedures were developed for evaluating two Florida lifestyle trip production models using the household travel survey data from Lee County MPO, Volusia County MPO, and the Jacksonville MSA. The numbers of trips of different purposes predicted by the lifestyle and FSUTMS models were compared with those expanded from the survey data based on the geographic locations of sampled households.

The results from this study indicated that lifestyle models improved the trip production estimations for the four trip purposes for all three Florida urban regions to different degrees. Areas with more retired population were found to benefit more from lifestyle models when HBW trips were concerned. For example, Lee County and Volusia County both had an above average percentage of retired population, at 25.41% and 22.12%, respectively. The improvements from the Tampa Bay lifestyle model were up to about 10 percent at the district level. However, the size of the retired population in an urban area should not be used as the sole basis for adopting or rejecting lifestyle models, since the spatial distribution of retired population will also affect a model's ability to produce accurate results in sub-areas. In the case of Lee County and Volusia counties, the most significant improvements were at district level, particular the districts that contained the central business districts.

The lifestyle models also performed better than the current FSUTMS standard models for HBNW trip purposes. In particular, the Tampa Bay lifestyle model performed better for the HBS, HBSR, and HBO trip purposes for Lee County and the Jacksonville MSA. For Volusia County, the Southeast Florida lifestyle model performed better for HBS and HBSR trip purposes while the Tampa Bay model performed better for the HBO trip purpose. However, the performances of the lifestyle models were not significantly different except in the cases of HBS and HBO trips for the Jacksonville MSA.

Tests of spatial transferability of HBW trips offered evidence that trip rates might be applied to different urban areas if they shared similar demographics. However, other characteristics of population, such as the size of seasonal residents, also need to be accounted for. Studies of more urban areas will be needed to draw more definite conclusions.

Based on the Lee County and Tampa Bay survey data on seasonal households, no consistent similarities in the trip rates could be found between the retired and seasonal households. For example, the seasonal households seemed to share more similarities with the retired households in Lee County than in the Tampa Bay area. Additionally, the seasonal households in Lee County appeared to be more active than those in the Tampa Bay area. Possible reasons may include, for example, the age and income of the seasonal household members and land use patterns thus opportunities for activities. However, due to inadequate information, the causes for the differences in the seasonal household trip rates between the two urban areas cannot be identified. Therefore no firm recommendations can be made regarding possible borrowing of trip rates for seasonal households. More research is necessary to further understand the travel behaviors of seasonal households.

The results from this study evidenced the strength of lifestyle models in estimating travel demand. However, due to the lack of reliable data for model validation, it remains a challenge to estimate the amount of improvement resulting from adopting a lifestyle trip production model. For instance, the HBW trip production estimates based on lifestyle structure may be compared to the 2000 census data on work trips, which will be released as part of the Census Transportation Planning Package. More research will be needed to quantify the benefits and costs for implementing and maintaining a lifestyle trip production model.

10. RECOMMENDATIONS

Based on the results of this study, the following recommendations are made:

- In deciding on whether to switch to a lifestyle model or stay with the current standard FSUTMS model, individual MPOs need to examine the potential benefits. The benefits may be estimated based on the size of the retired population and seasonal population. In addition to potential region-wide improvement, the spatial distribution of retired population and seasonal households also need to be carefully examined to determine if there are significant enclaves of such population and whether a lifestyle model should be adopted if they are present. In particular, if seasonal households are fewer than 10% of the permanent households region-wide and in sub-areas, separate trip rates for seasonal households will not be necessary (the state average of seasonal to permanent household ratio is 7.62). In Appendix A, county level demographic information from the 2000 census is provided, which includes the percentage of retired population (defined as population over 65 years of age) and seasonal households as a percentage of permanent households. In Appendix B, the spatial distributions of retired population and seasonal households are illustrated for each county at census block group level.

- The adoption of a lifestyle model may include the need of conducting household survey to develop local trip rates and calibrating a new lifestyle trip production model if trips rates are not borrowed from another area, and updating and forecasting the socioeconomic data for the lifestyle variables. Currently, there are no standard procedures for forecasting or updating lifestyle variables for a non-census year in Florida. As a result, some MPOs may hesitate to switch to lifestyle models even if they believe that lifestyle models will be beneficial. Therefore, it is recommended that more research be conducted to develop a methodology and the necessary tools for lifestyle variable estimation and forecast.

- If a lifestyle model is to be adopted, the decision will need to be made regarding the selection of a specific model structure. For areas with a large retired and seasonal population, the Tampa Bay model structure is recommended since HBNW trips will be relatively more important. For areas with a small retired or seasonal population, the HBW trips will be relatively more significant. Since the Southeast Florida HBW trip production model is more disaggregate, it may be able to produce more accurate results for such an area. However, careful design of household survey is necessary to ensure that adequate samples are available for cells that often have few household samples, such as households with low vehicle ownership.

- MPOs may compare their urban characteristics with those of other urban areas that share similar demographics, especially the retired and seasonal population, in deciding which set of trip rates may be borrowed.

- It is recommended that trip rates for seasonal households not be stratified by vehicle ownership or household size and that a single trip rate be use for each trip purpose.

- To facilitate the development of standard trip rates in the future, it is also recommended that survey design to be as standard as possible, at least for the same model structures. This may include standard definition of trip purposes, trip reporting requirements, and household and household member information.

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APPENDIX A. CENSUS 2000 DEMOGRAPHICS OF FLORIDA COUNTIES

County	Population	Permanent Households	Seasonal to Permanent Household Ratio (%)	Population			HH Median Income ($)
				Under 18 (%)	18-64 (%)	65+* (%)	
Alachua	217,955	87,509	0.79	20.16	70.24	9.60	31,426
Baker	22,259	7,043	1.39	27.49	63.30	9.21	40,035
Bay	148,217	59,597	14.78	24.05	62.58	13.37	36,092
Bradford	26,088	8,497	2.61	21.94	65.11	12.94	33,140
Brevard	476,230	198,195	5.28	21.98	58.13	19.88	40,099
Broward	1,623,018	654,445	7.10	23.59	60.32	16.09	41,691
Calhoun	13,017	4,468	4.79	23.21	62.84	13.95	26,575
Charlotte	141,627	63,864	16.46	15.67	49.62	34.72	36,379
Citrus	118,085	52,634	9.86	17.22	50.59	32.19	31,001
Clay	140,814	50,243	1.61	27.88	62.34	9.78	48,854
Collier	251,377	102,973	33.35	19.87	55.66	24.47	48,289
Columbia	56,513	20,925	1.99	25.37	60.64	14.00	30,881
DeSoto	32,209	10,746	16.83	22.70	58.33	18.98	30,714
Dixie	13,827	5,205	26.42	22.09	60.77	17.13	26,082
Duval	778,879	303,747	0.48	26.28	63.29	10.43	40,703
Escambia	294,410	111,049	2.77	23.53	63.17	13.30	35,234
Flagler	49,832	21,294	9.08	17.91	53.46	28.63	40,214
Franklin	11,057	4,096	33.28	17.99	66.27	15.75	26,756
Gadsden	45,087	15,867	1.45	26.44	61.39	12.17	31,248
Gilchrist	14,437	5,021	7.65	24.44	61.92	13.63	30,328
Glades	10,576	3,852	36.40	22.10	59.09	18.82	30,774
Gulf	13,332	4,931	25.82	21.71	62.10	16.19	30,276
Hamilton	13,327	4,161	4.61	23.54	65.28	11.18	25,638
Hardee	26,938	8,166	11.43	27.60	58.48	13.92	30,183
Hendry	36,210	10,850	4.86	30.03	59.91	10.06	33,592
Hernando	130,802	55,425	6.43	18.81	50.26	30.93	32,572
Highlands	87,366	37,471	16.46	19.17	47.83	33.00	30,160
Hillsborough	998,948	391,357	1.55	25.23	62.81	11.96	40,663
Holmes	18,564	6,921	2.18	23.08	62.11	14.81	27,923
Indian River	112,947	49,137	10.77	19.21	51.60	29.19	39,635
Jackson	46,755	16,620	4.04	22.35	63.10	14.55	29,744
Jefferson	12,902	4,695	1.94	22.71	62.84	14.46	32,998
Lafayette	7,022	2,142	12.37	21.69	65.94	12.38	30,651
Lake	210,528	88,413	7.60	20.29	53.30	26.41	36,903
Lee	440,888	188,599	20.94	19.57	55.02	25.41	40,319
Leon	239,452	96,521	0.73	21.30	70.39	8.31	37,517
Levy	34,450	13,867	7.82	23.60	58.48	17.92	26,959

County	Population	Permanent Households	Seasonal to Permanent Household Ratio (%)	Population	HH Median Income ($)	County	Population
Liberty	7,021	2,222	5.36	21.81	68.00	10.20	28,840
Madison	18,733	6,629	4.22	25.28	60.17	14.55	26,533
Manatee	264,002	112,460	14.98	20.70	54.43	24.87	38,673
Marion	258,916	106,755	4.92	21.41	54.07	24.52	31,944
Martin	126,731	55,288	12.15	18.64	53.12	28.24	43,083
Miami-Dade	2,253,362	776,774	3.81	24.74	61.94	13.33	35,966
Monroe	79,589	35,086	35.15	17.09	68.27	14.64	42,283
Nassau	57,663	21,980	6.38	25.01	62.44	12.55	46,022
Okaloosa	170,498	66,269	6.43	24.71	63.17	12.12	41,474
Okeechobee	35,910	12,593	9.26	25.20	58.47	16.33	30,456
Orange	896,344	336,286	1.59	25.25	64.71	10.04	41,311
Osceola	172,493	60,977	10.82	26.79	61.78	11.43	38,214
Palm Beach	1,131,184	474,175	11.15	21.15	55.64	23.20	45,062
Pasco	344,765	147,566	10.11	20.08	53.09	26.80	32,969
Pinellas	921,482	414,968	8.22	19.21	58.19	22.59	37,111
Polk	483,924	187,233	10.20	24.43	57.24	18.34	36,036
Putnam	70,423	27,839	10.61	24.57	56.96	18.47	28,180
St. Johns	123,135	49,614	8.69	23.06	61.04	15.90	50,099
St. Lucie	192,695	76,933	11.77	22.62	54.68	22.71	36,363
Santa Rosa	117,743	43,793	2.22	26.56	62.43	11.02	41,881
Sarasota	325,957	149,937	13.64	16.21	52.32	31.47	41,957
Seminole	365,196	139,572	0.84	25.36	64.00	10.64	49,326
Sumter	53,345	20,779	10.99	16.07	56.53	27.40	32,073
Suwannee	34,844	13,460	4.37	24.02	59.03	16.95	29,963
Taylor	19,256	7,176	18.45	24.57	61.37	14.06	30,032
Union	13,442	3,367	1.43	21.85	70.69	7.46	34,563
Volusia	443,343	184,723	8.44	20.18	57.70	22.12	35,219
Wakulla	22,863	8,450	6.07	25.65	64.07	10.28	37,149
Walton	40,601	16,548	46.42	21.66	62.50	15.84	32,407
Washington	20,973	7,931	7.88	23.39	60.91	15.70	27,922
Florida	15,982,378	6,337,929	7.62	22.74	59.70	17.56	38,819

Note: Census data do not include information on retirees. Population of age 65 and older was considered retired population.
The shaded cells in the first column represent counties with MPOs.
The shaded cells the third and sixth columns indicate significantly higher percentage of seasonal households or retired population in the jurisdiction of the MPOs.

APPENDIX B. MAPS OF DISTRIBUTIONS OF RETIRED POPULATION AND SEASONAL HOUSEHOLDS FOR SELECTED FLORIDA COUNTIES

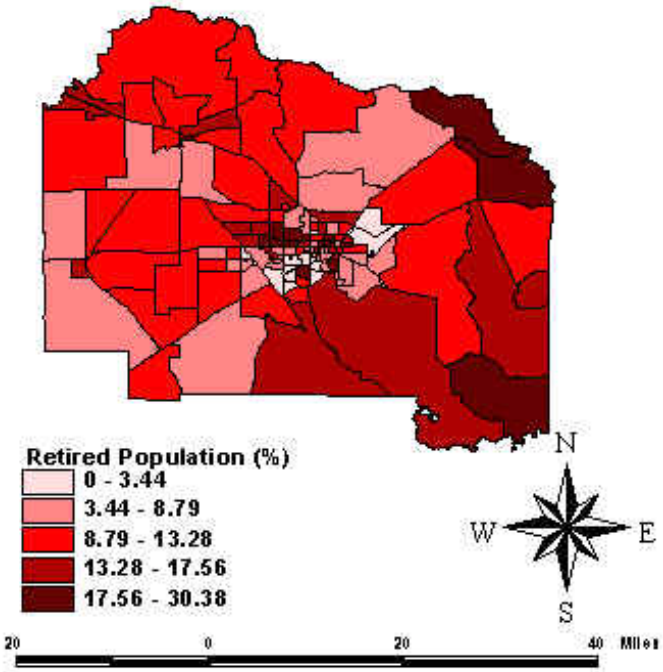

Figure B.1 Distribution of Retired Population in Alachua County

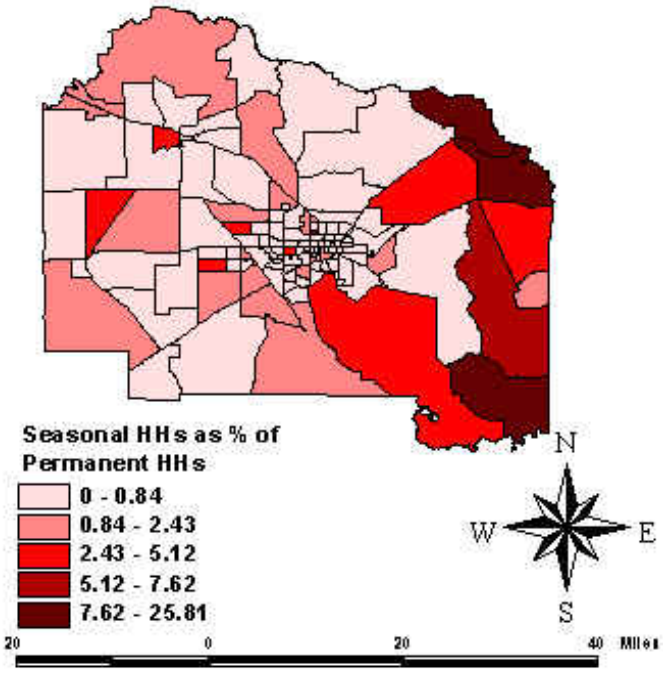

Figure B.2 Distribution of Seasonal Households in Alachua County

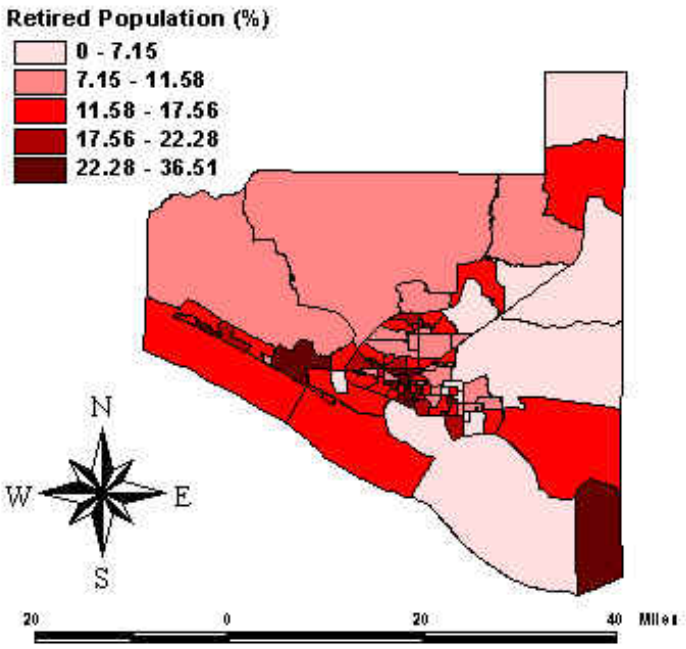

Figure B.3 Distribution of Retired Population in Bay County

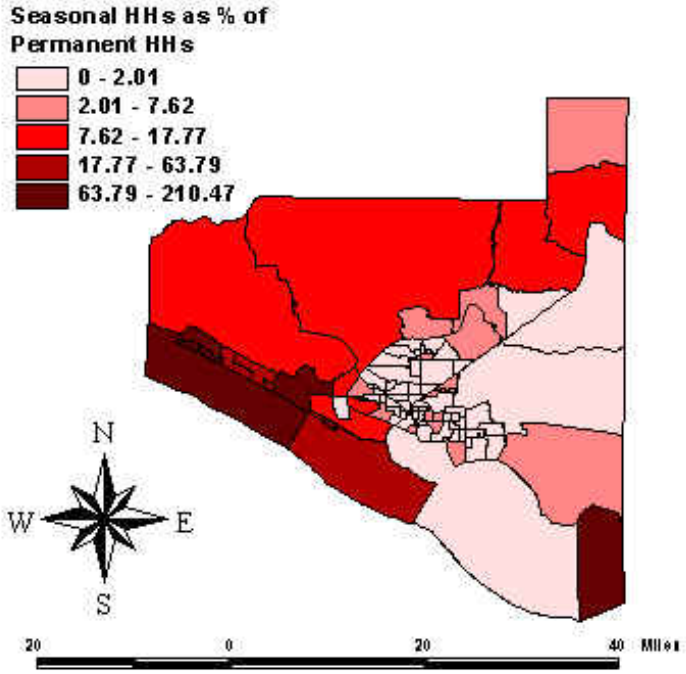

Figure B.4 Distribution of Seasonal Households in Bay County

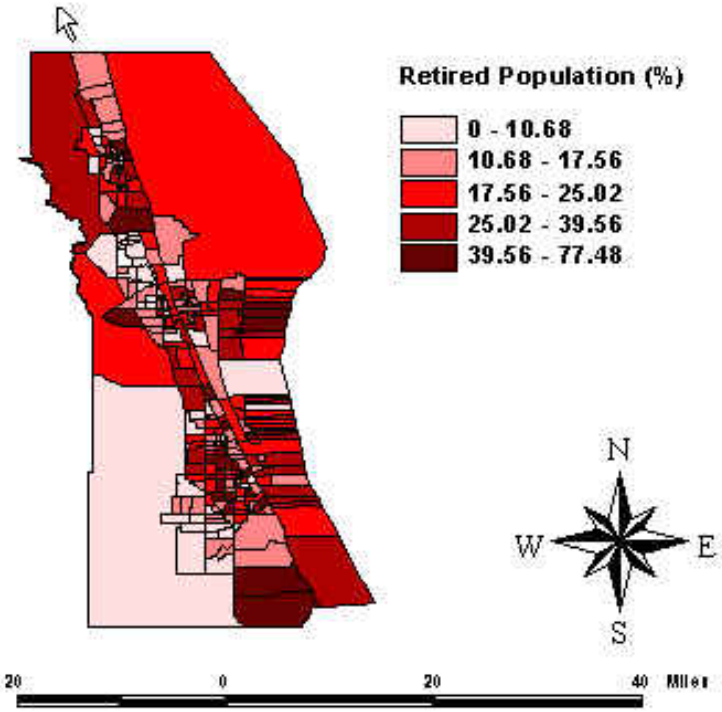

Figure B.5 Distribution of Retired Population in Brevard County

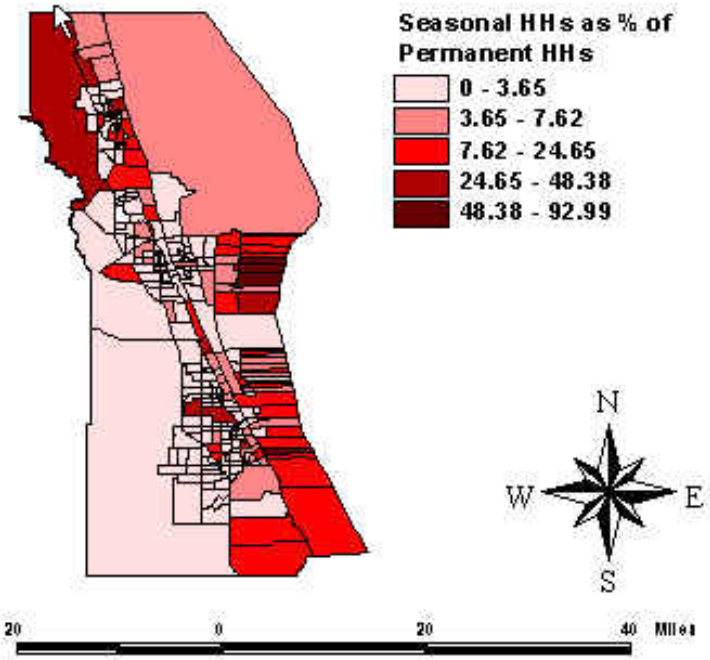

Figure B.6 Distribution of Retired Population in Brevard County

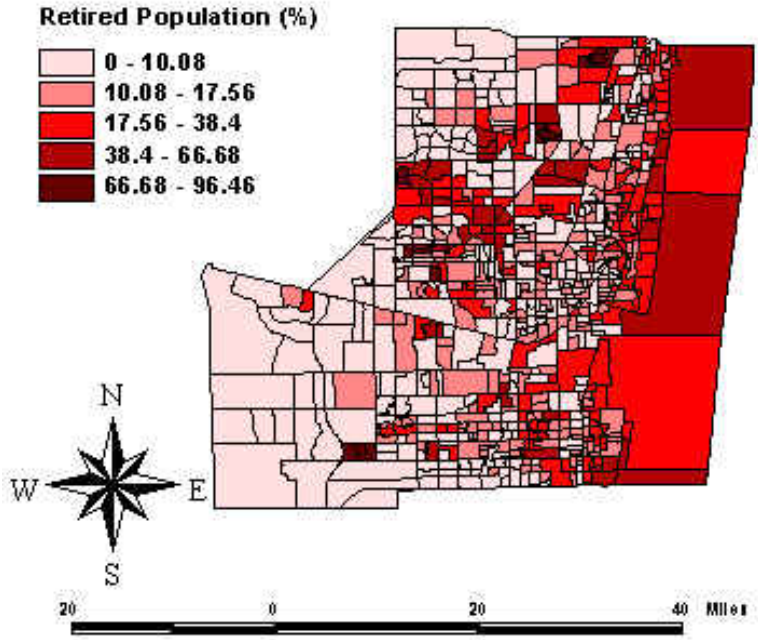

Figure B.7 Distribution of Retired Population in Broward County

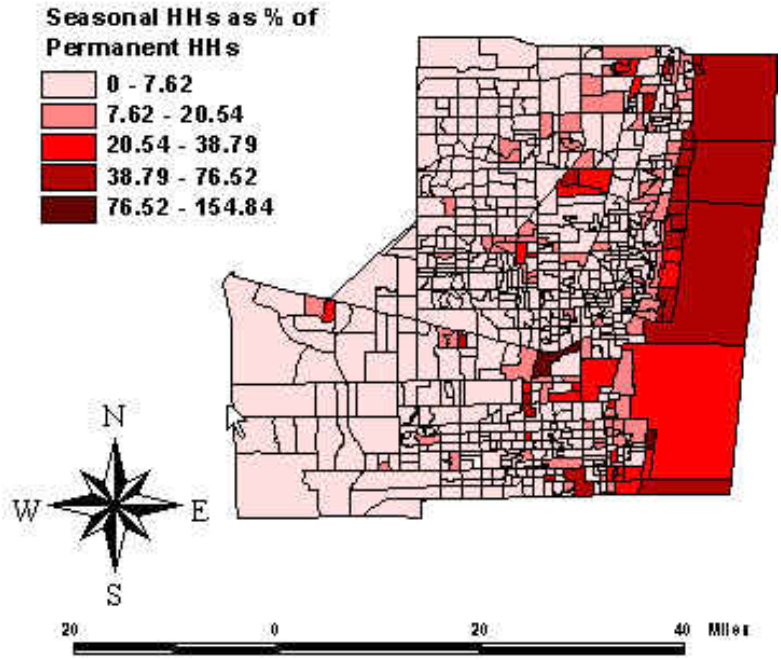

Figure B.8 Distribution of Seasonal Households in Broward County

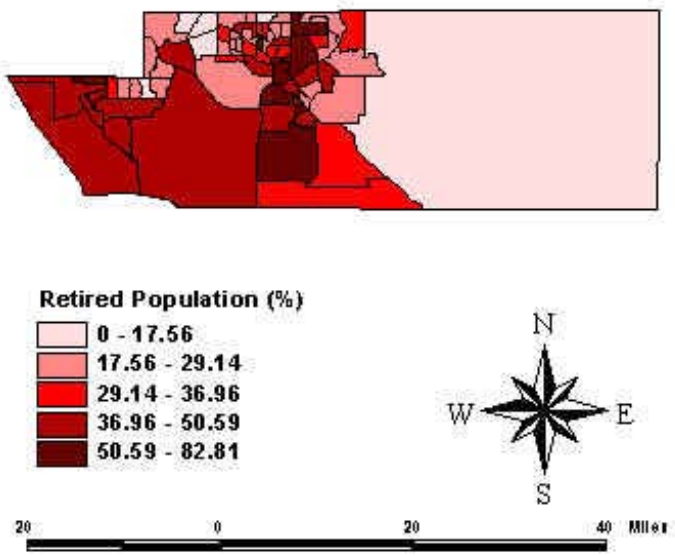

Figure B.9 Distribution of Retired Population in Charlotte County

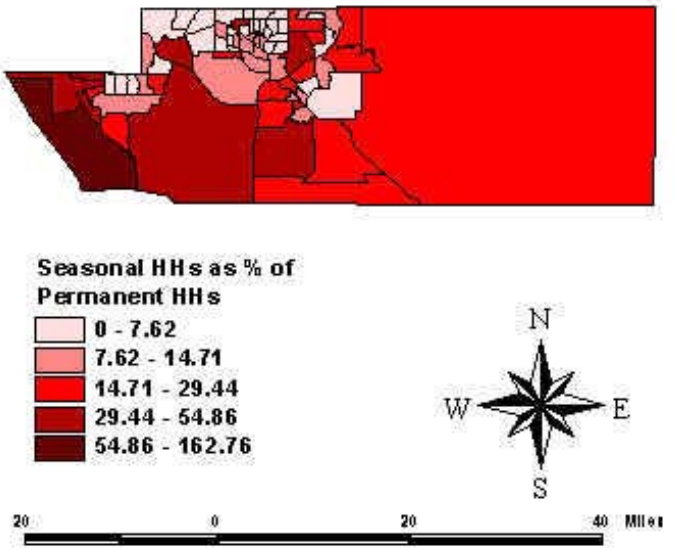

Figure B.10 Distribution of Seasonal Households in Charlotte County

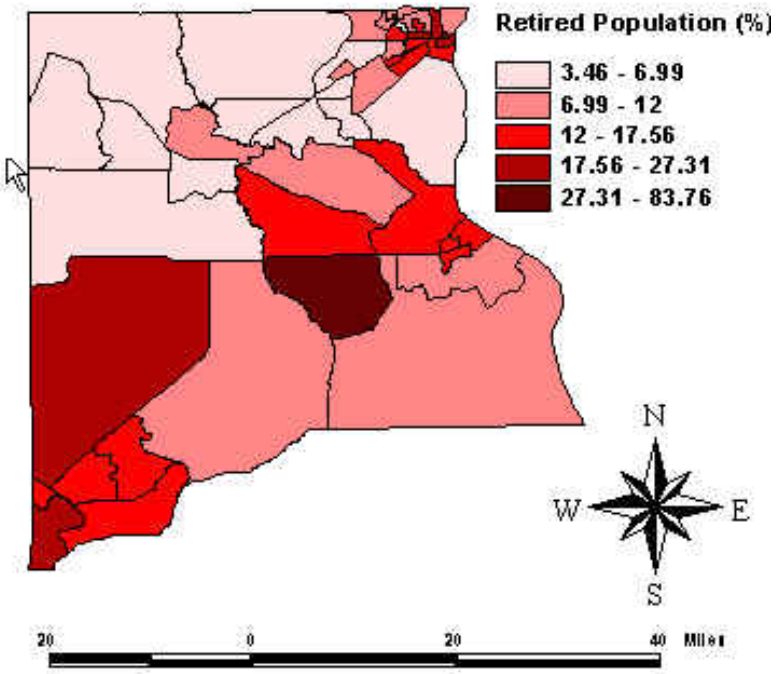

Figure B.11 Distribution of Retired Population in Clay County

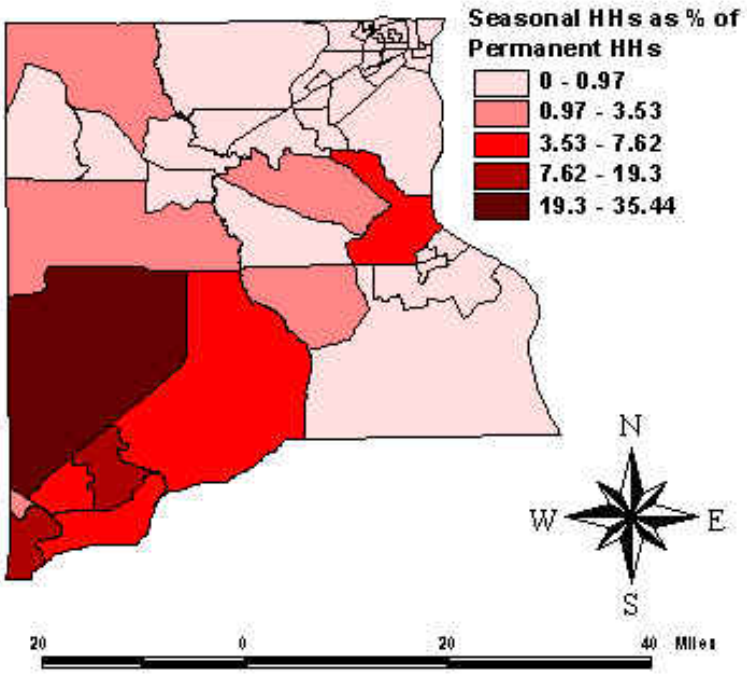

Figure B.12 Distribution of Seasonal Households in Clay County

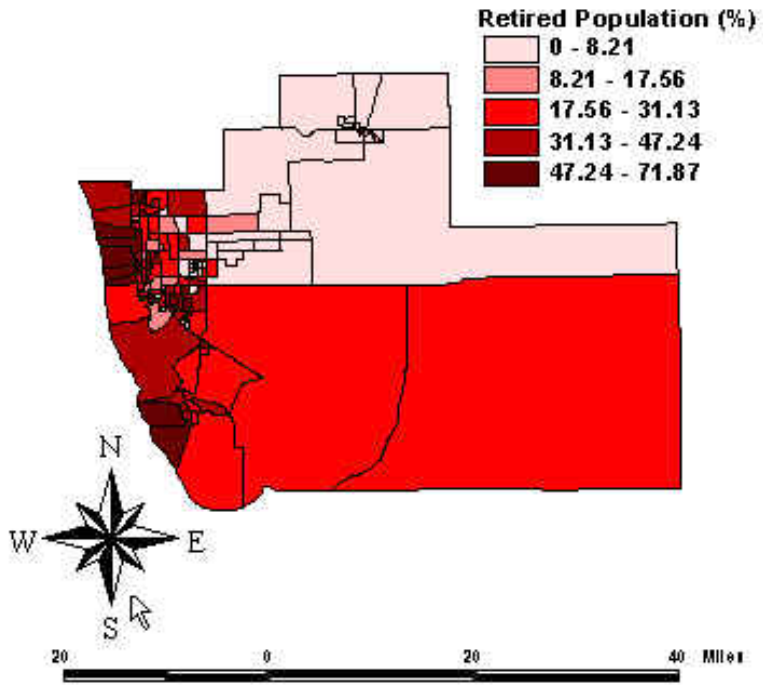

Figure B.13 Distribution of Retired Population in Collier County

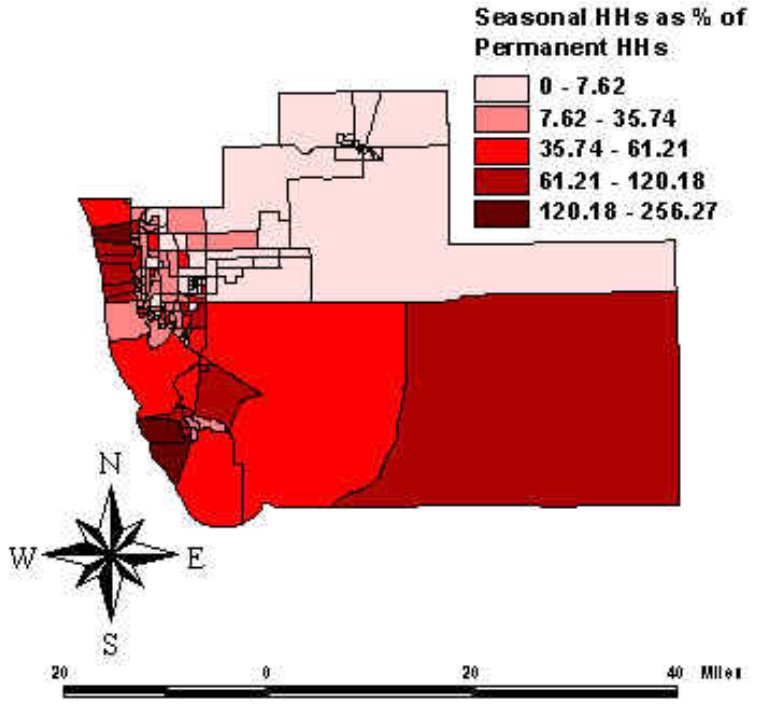

Figure B.14 Distribution of Seasonal Households in Collier County

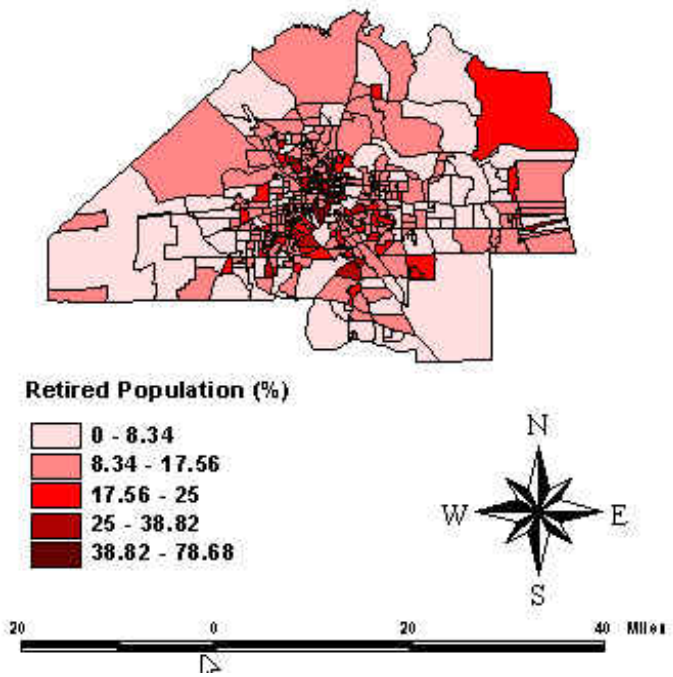

Figure B.15 Distribution of Retired Population in Duval County

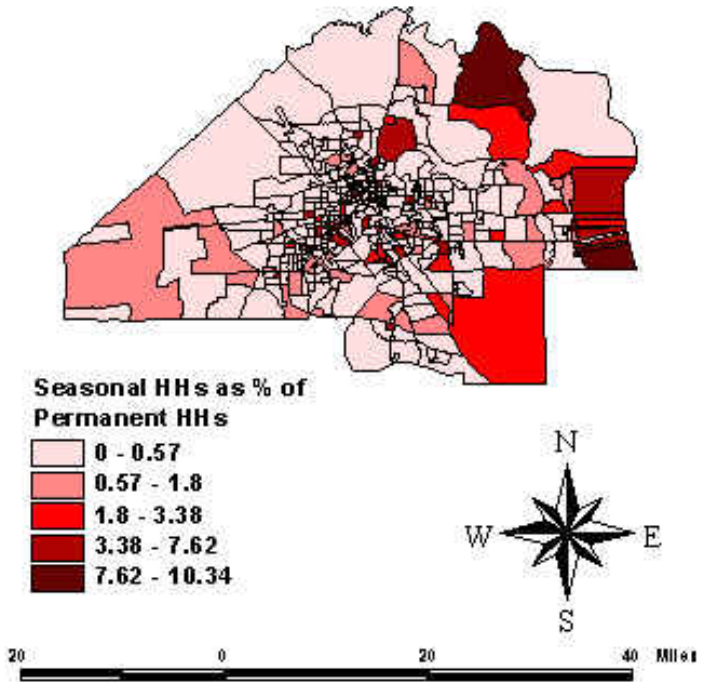

Figure B.16 Distribution of Seasonal Households in Duval County

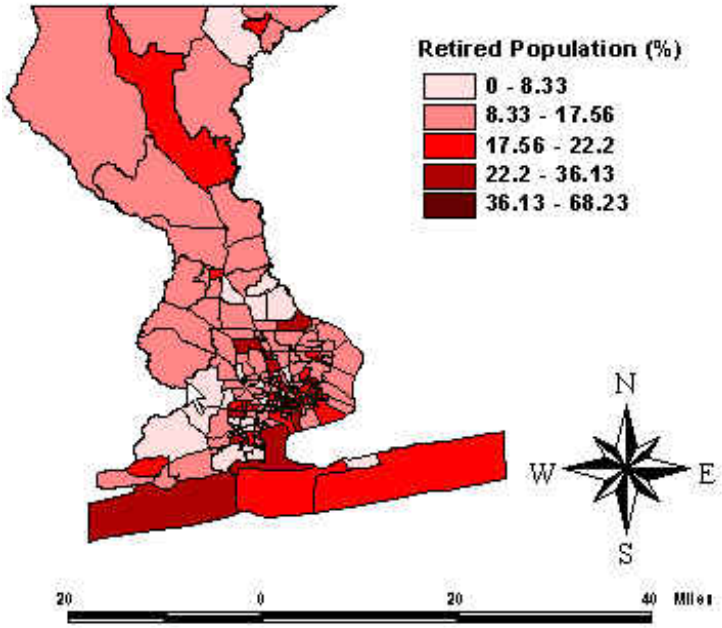

Figure B.17 Distribution of Retired Population in Escambia County

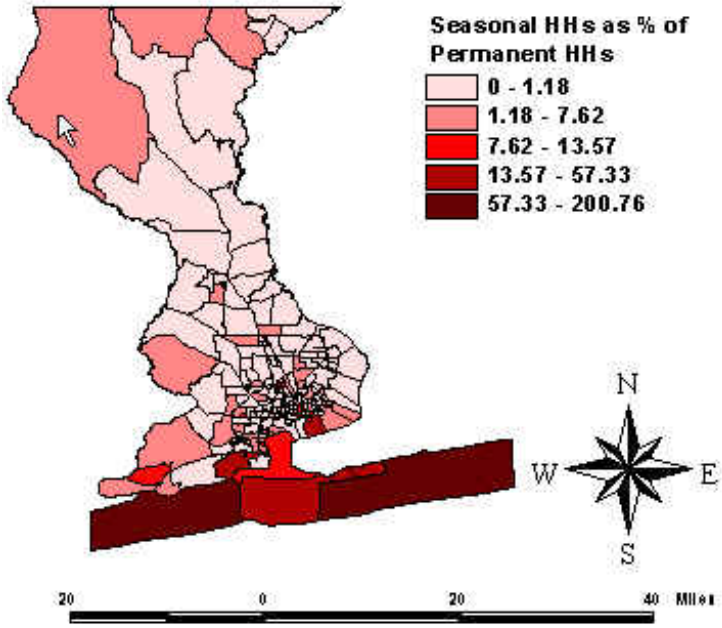

Figure B.18 Distribution of Seasonal Households in Escambia County

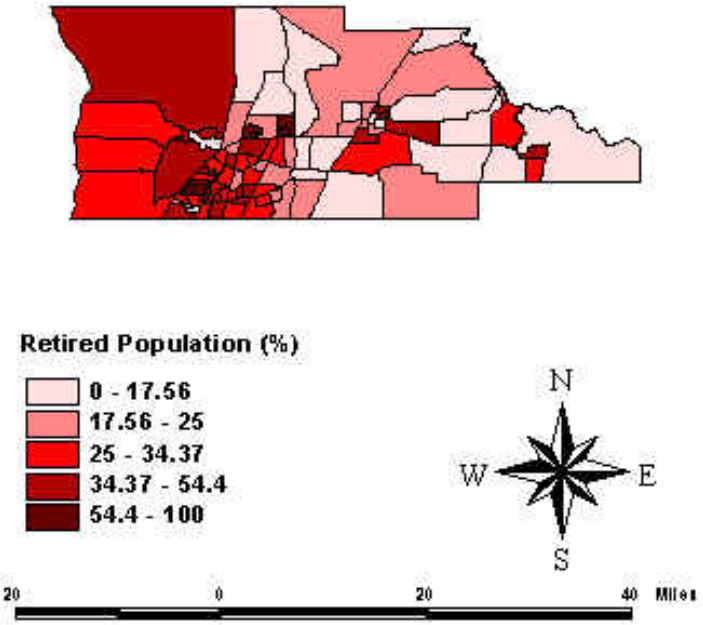

Figure B.19 Distribution of Retired Population in Hernando County

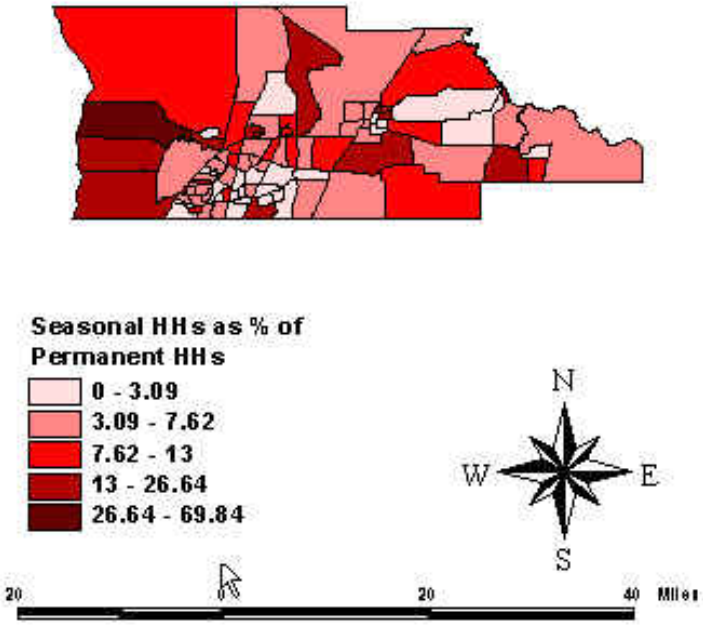

Figure B.20 Distribution of Seasonal Households in Hernando County

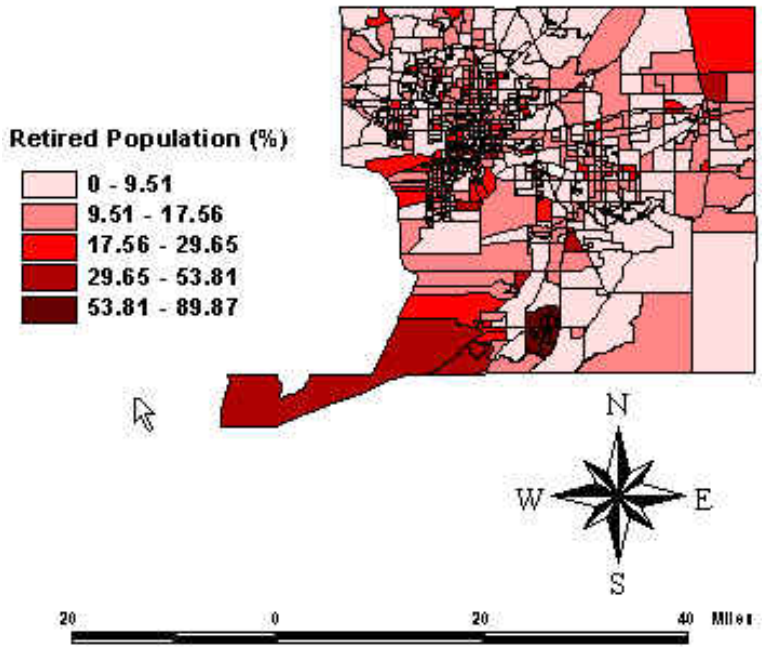

Figure B.21 Distribution of Retired Population in Hillsborough County

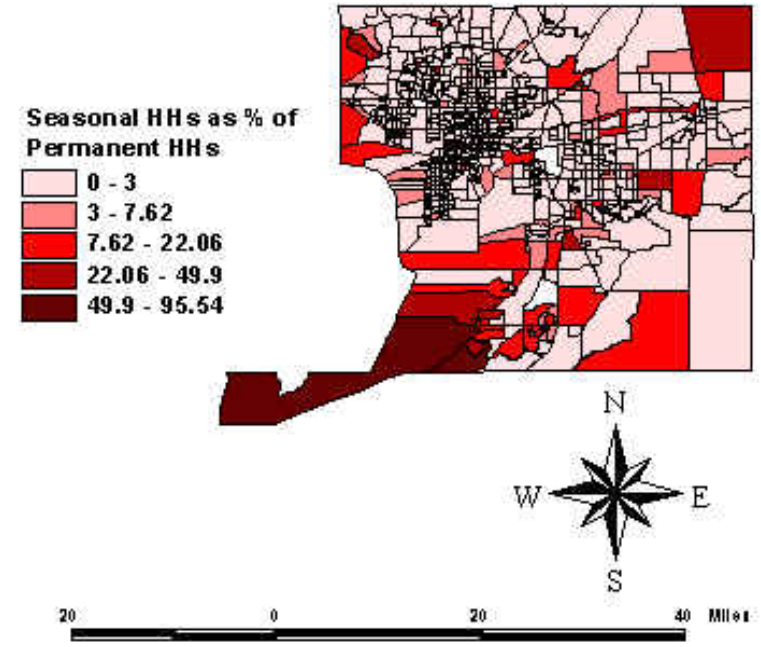

Figure B.22 Distribution of Seasonal Households in Hillsborough County

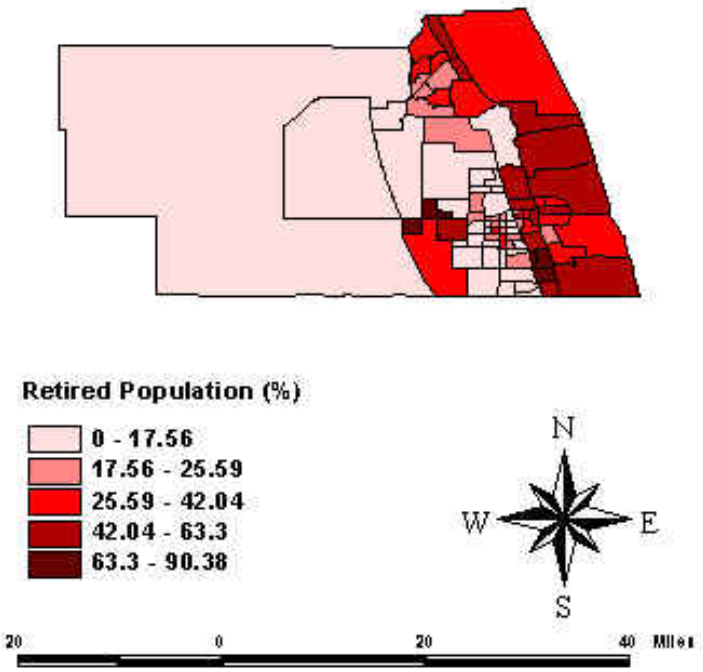

Figure B.23 Distribution of Retired Population in Indian River County

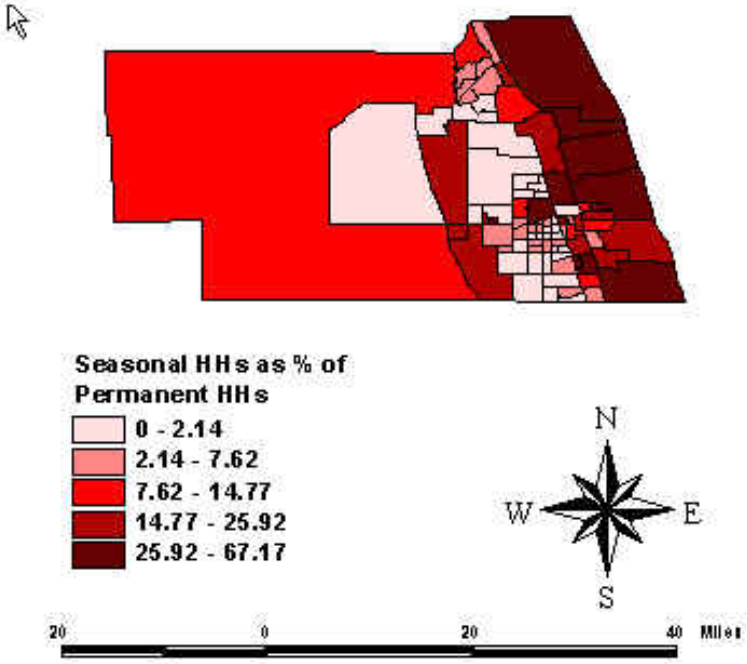

Figure B.24 Distribution of Seasonal Households in Indian River County

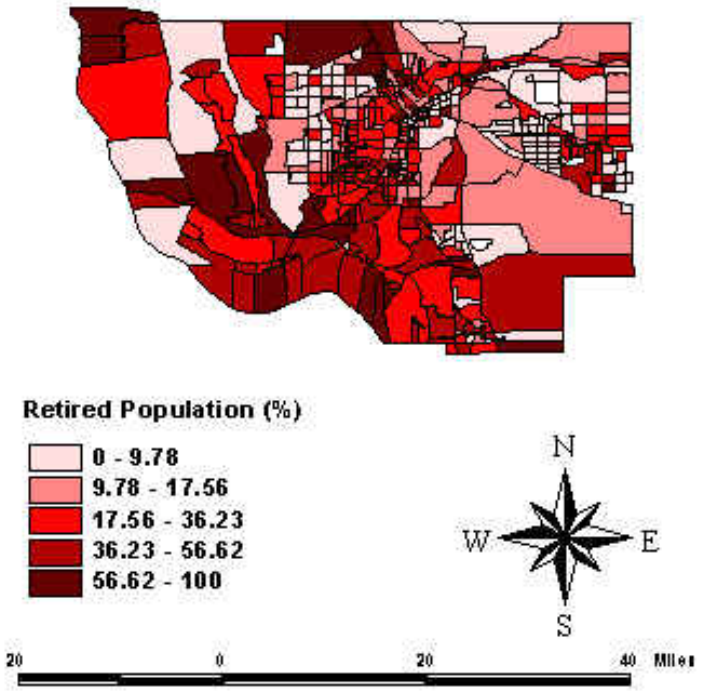

Figure B.25 Distribution of Retired Population in Lee County

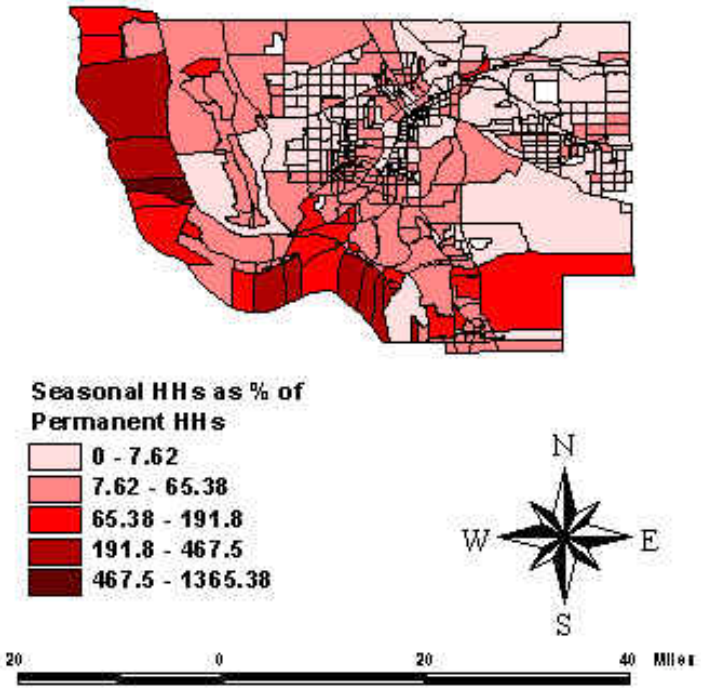

Figure B.26 Distribution of Seasonal Households in Lee County

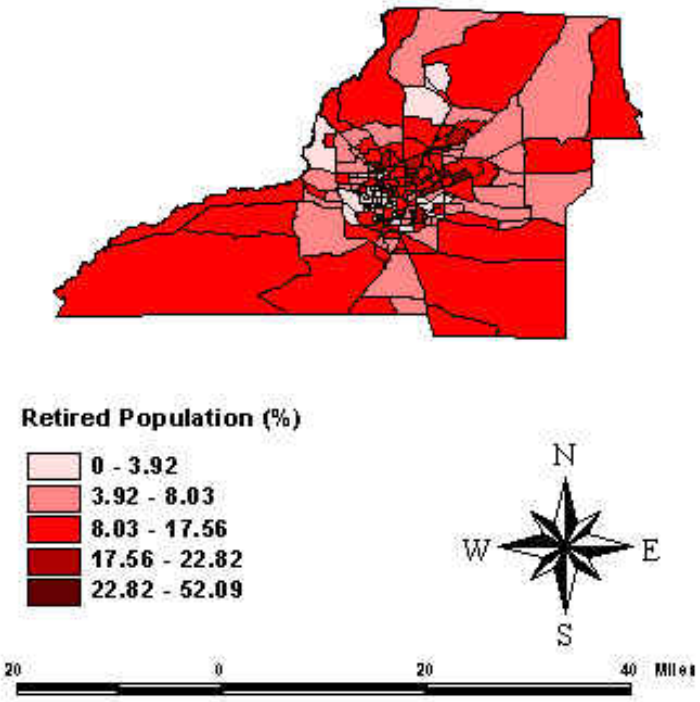

Figure B.27 Distribution of Retired Population in Leon County

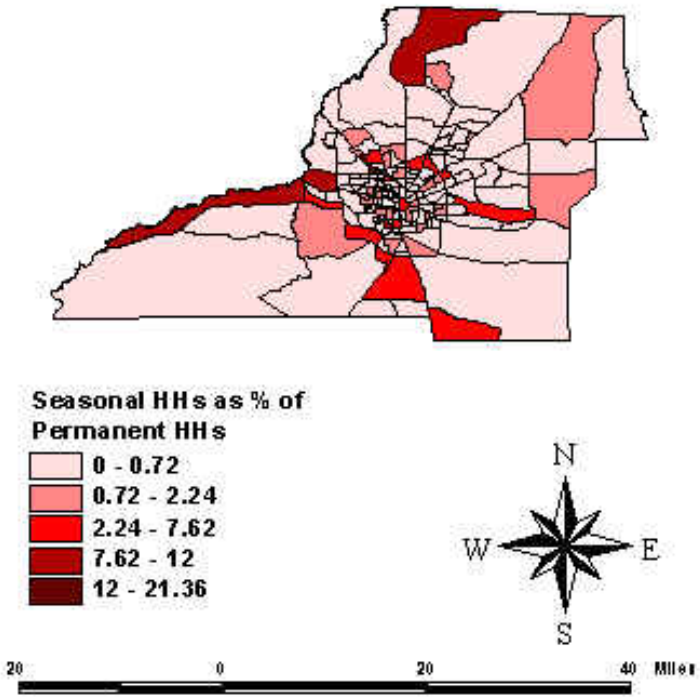

Figure B.28 Distribution of Seasonal Households in Leon County

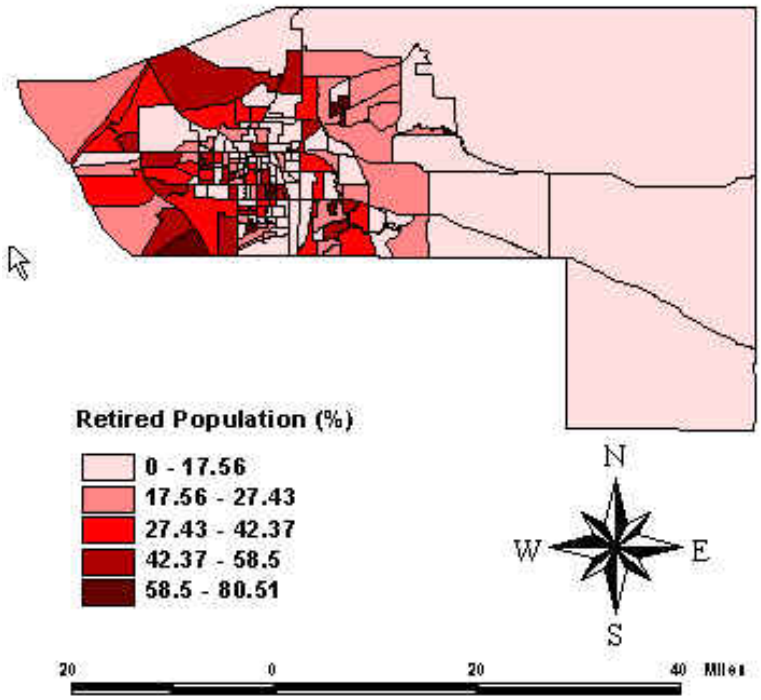

Figure B.29 Distribution of Retired Population in Manatee County

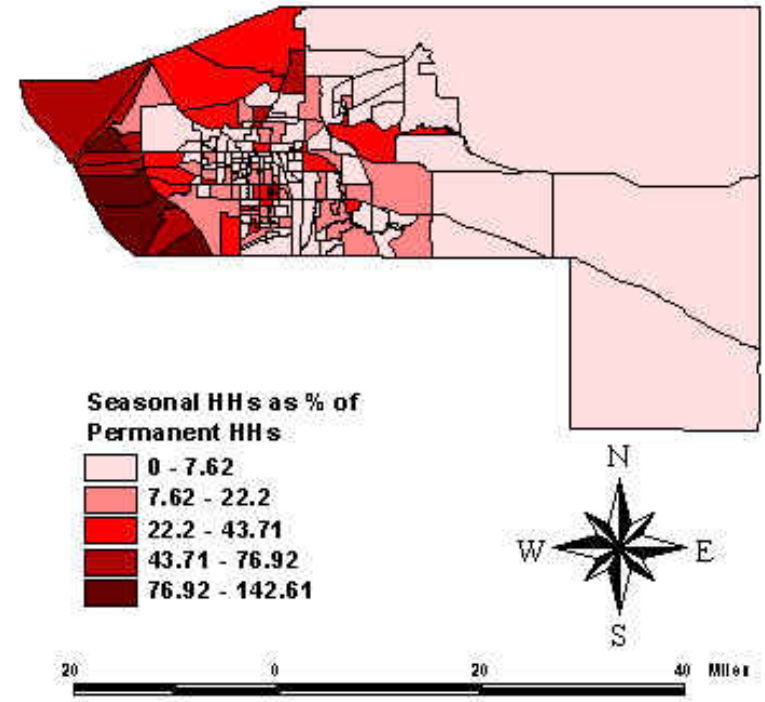

Figure B.30 Distribution of Seasonal Households in Manatee County

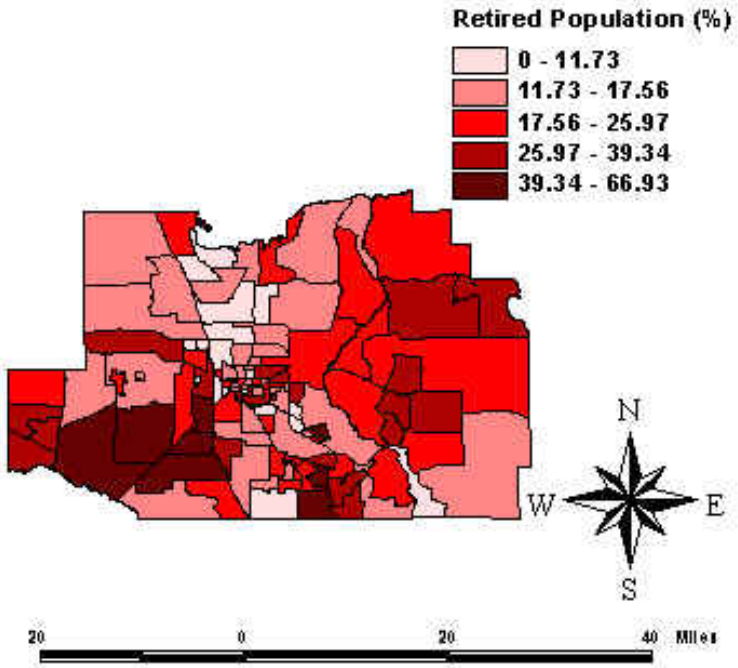

Figure B.31 Distribution of Retired Population in Marion County

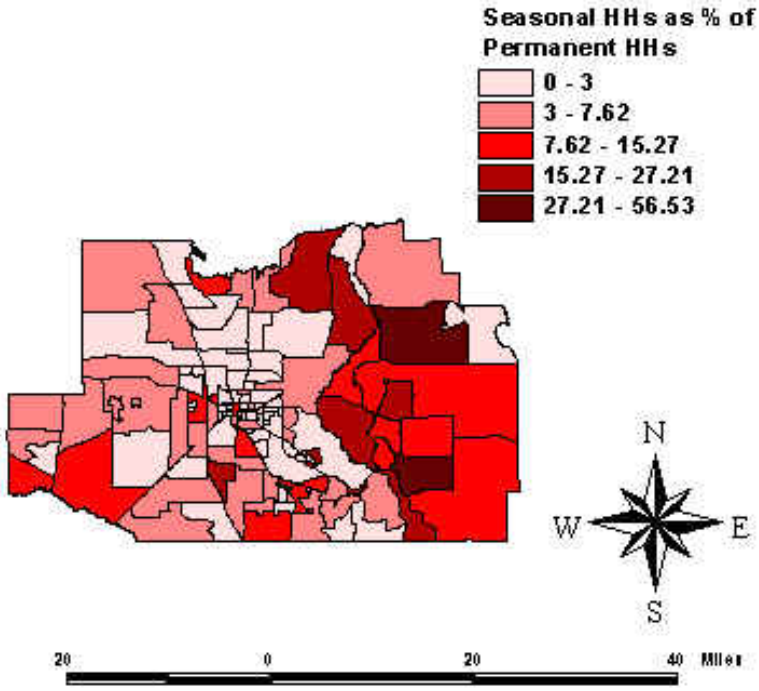

Figure B.32 Distribution of Seasonal Households in Marion County

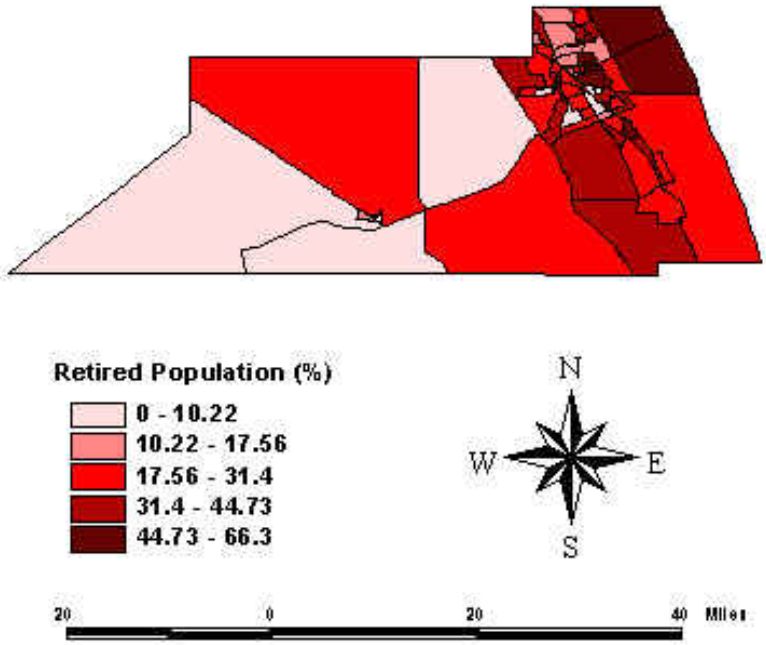

Figure B.33 Distribution of Retired Population in Martin County

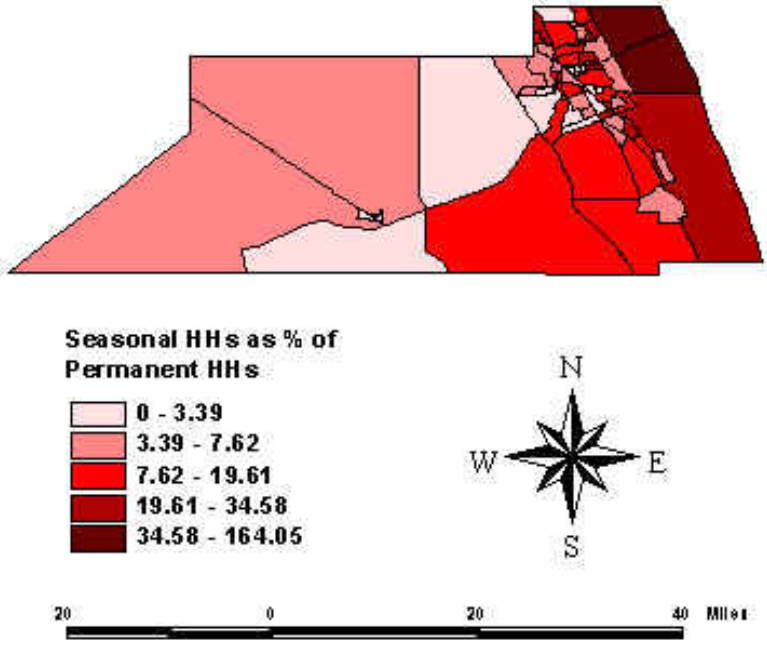

Figure B.34 Distribution of Seasonal Households in Martin County

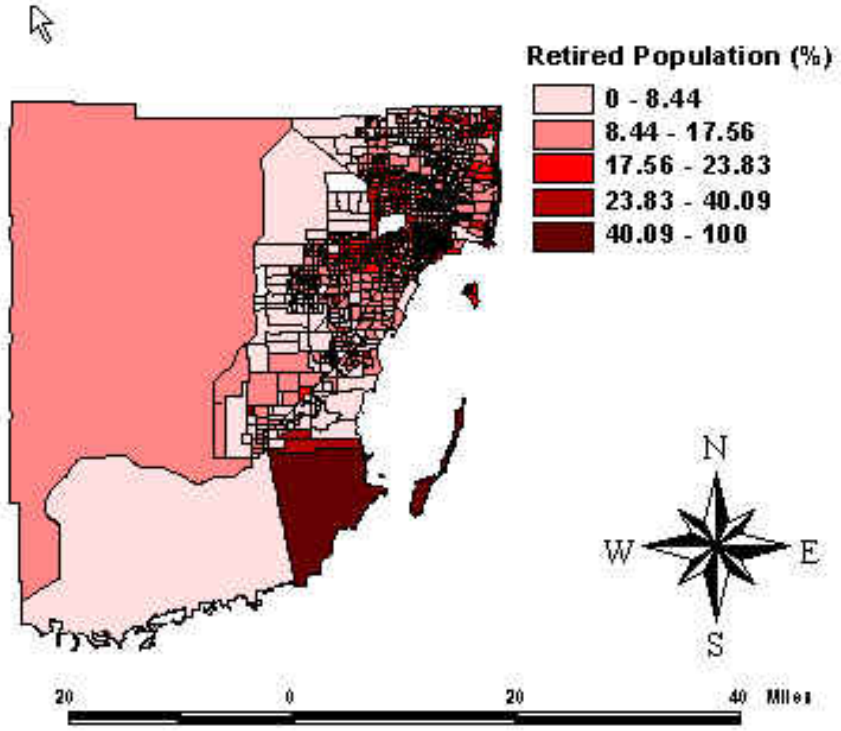

Figure B.35 Distribution of Retired Population in Miami-Dade County

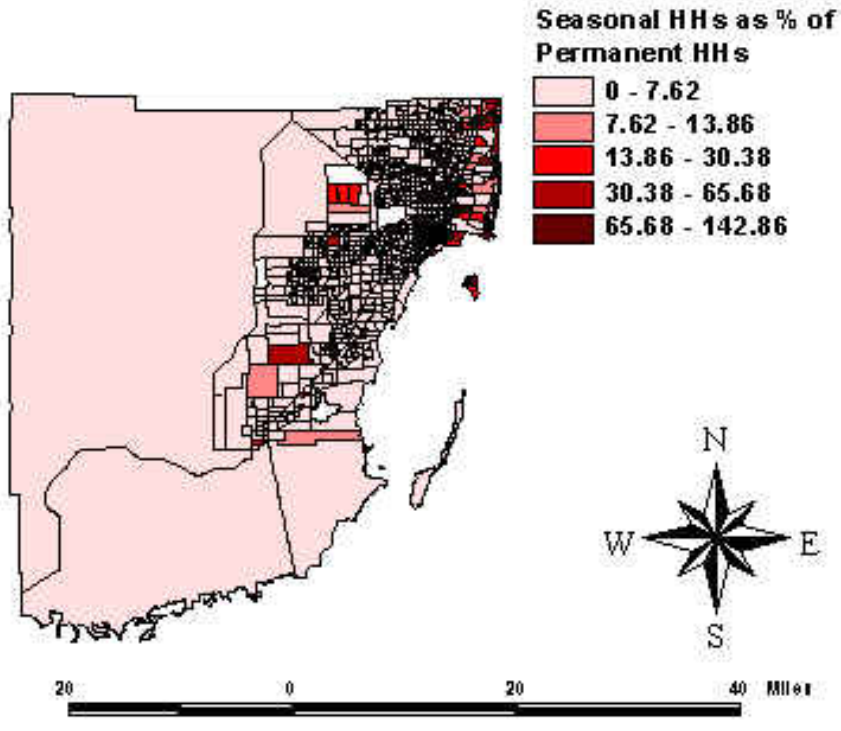

Figure B.36 Distribution of Seasonal Households in Miami-Dade County

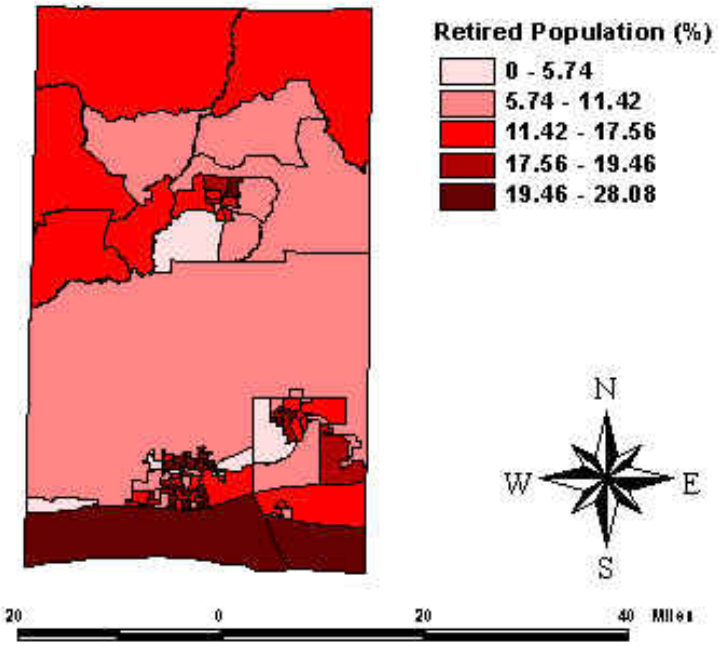

Figure B.37 Distribution of Retired Population in Okaloosa County

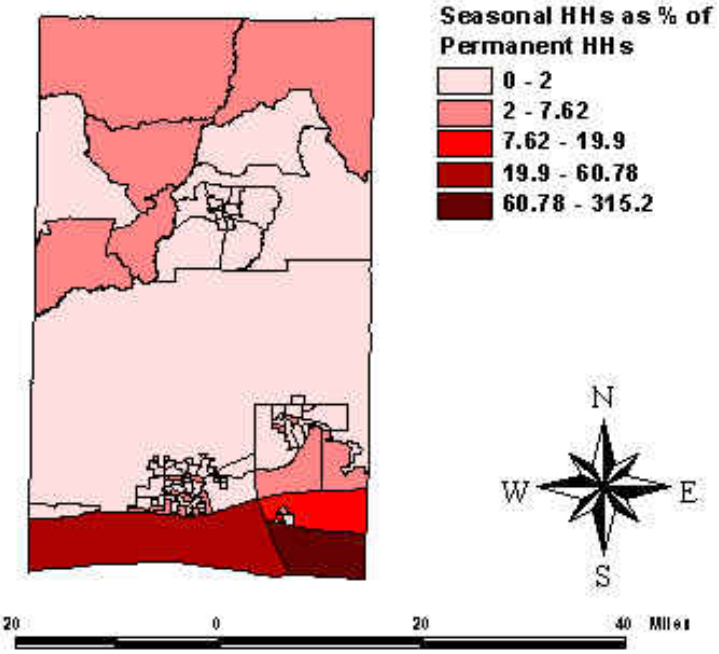

Figure B.38 Distribution of Seasonal Households in Okaloosa County

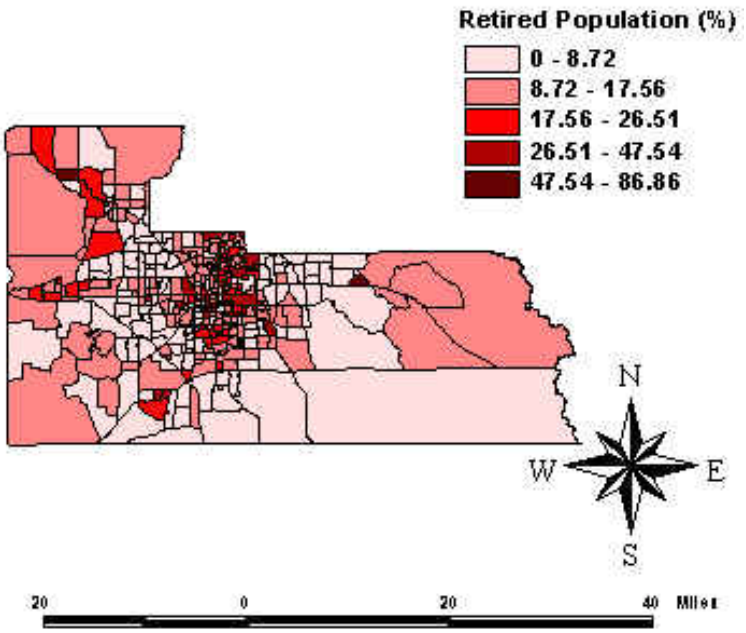

Figure B.39 Distribution of Retired Population in Orange County

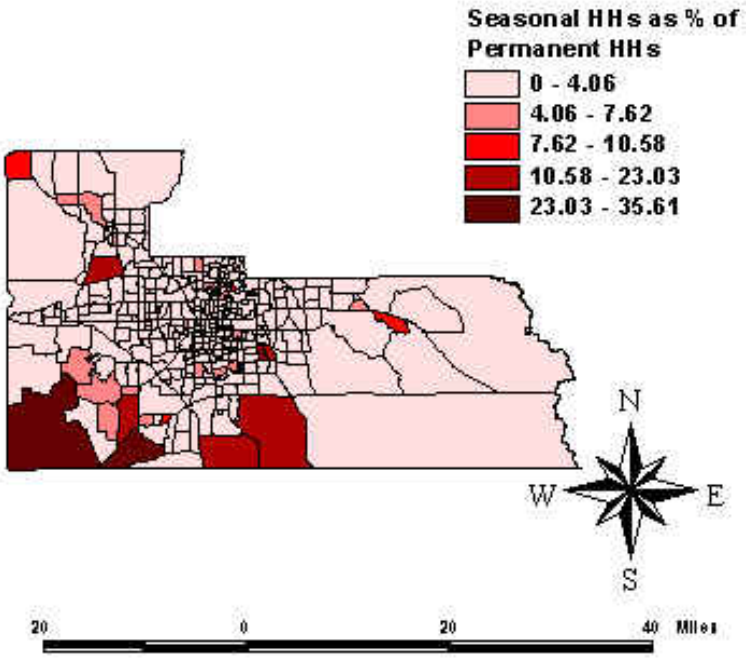

Figure B.40 Distribution of Seasonal Households in Orange County

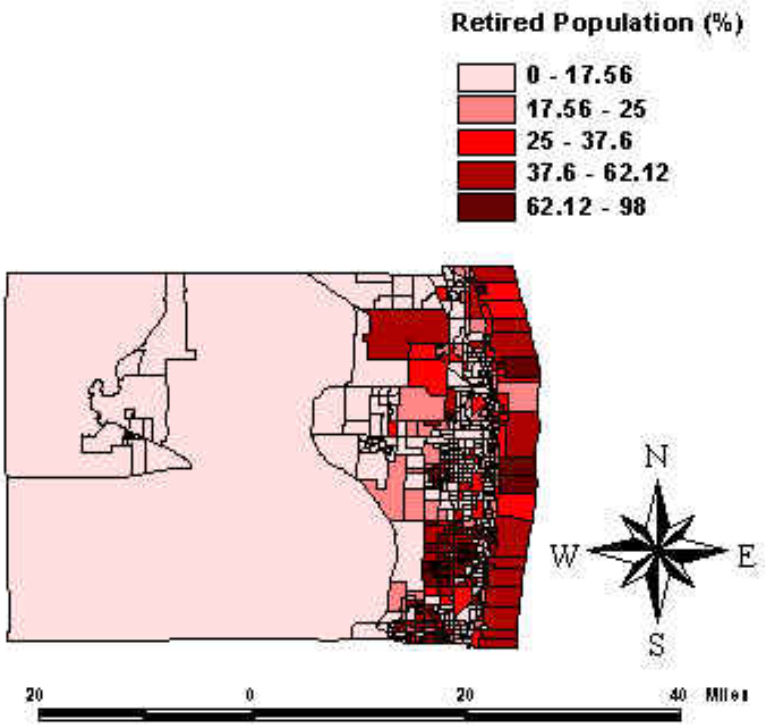

Figure B.41 Distribution of Retired Population in Palm Beach County

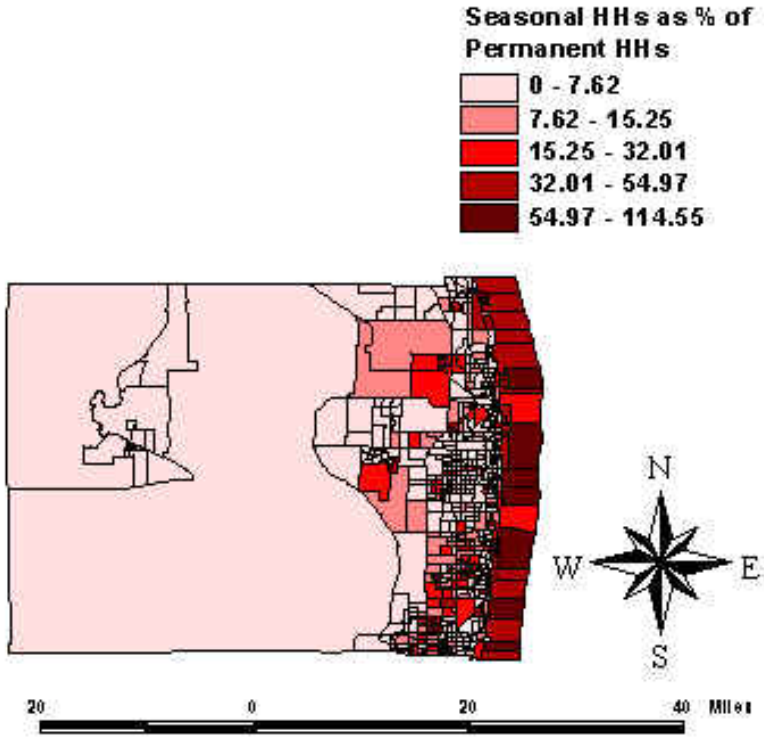

Figure B.42 Distribution of Seasonal Households in Palm Beach County

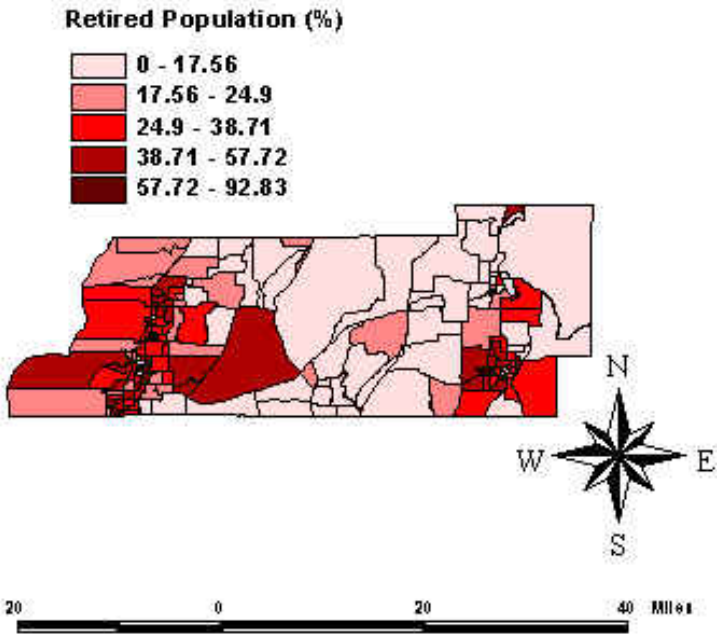

Figure B.43 Distribution of Retired Population in Pasco County

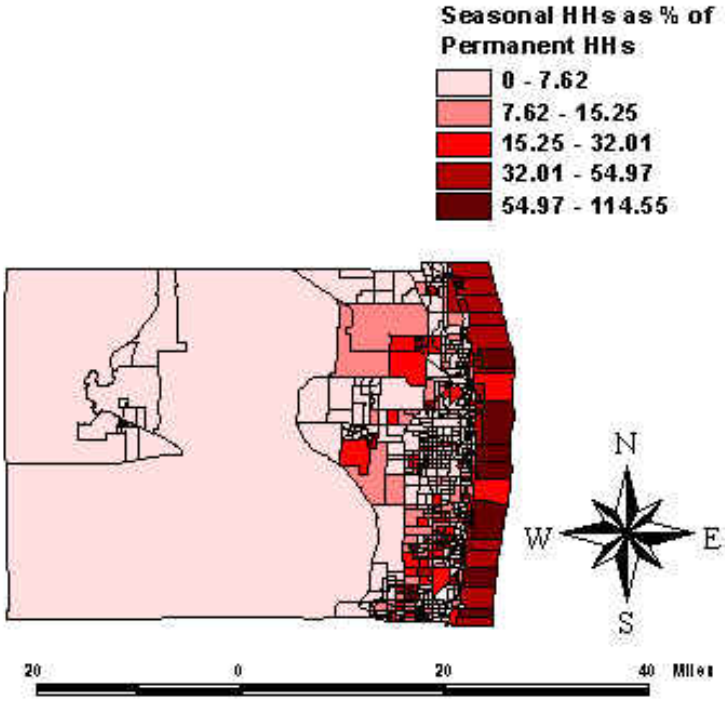

Figure B.44 Distribution of Seasonal Households in Pasco County

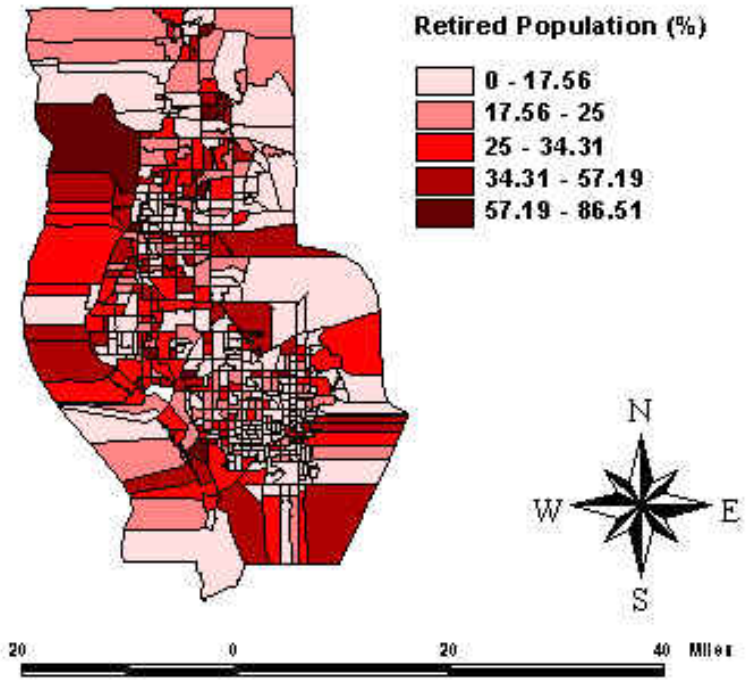

Figure B.45 Distribution of Retired Population in Pinellas County

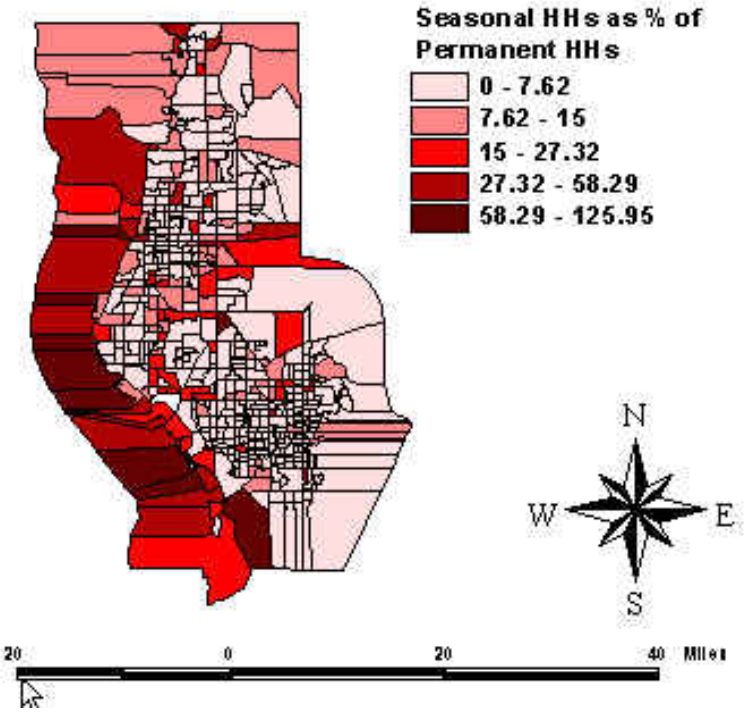

Figure B.46 Distribution of Seasonal Households in Pinellas County

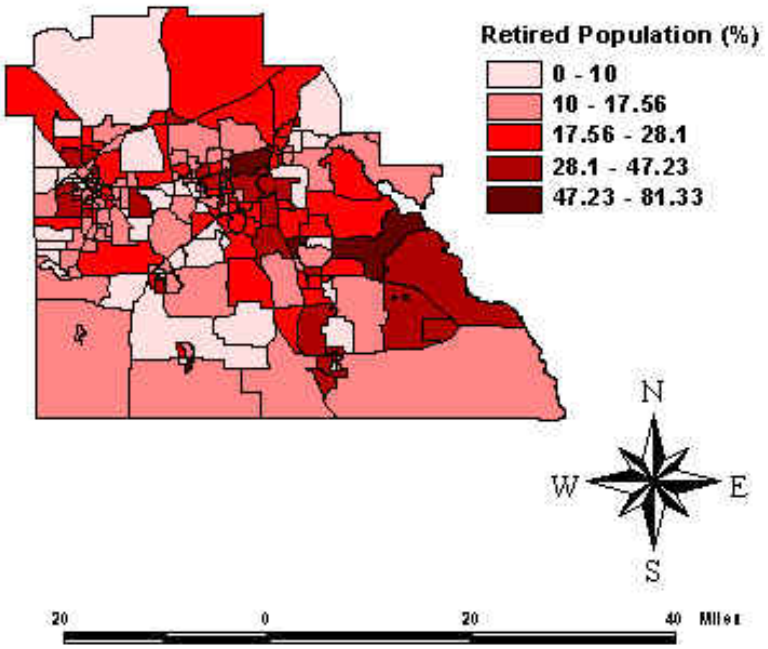

Figure B.47 Distribution of Retired Population in Polk County

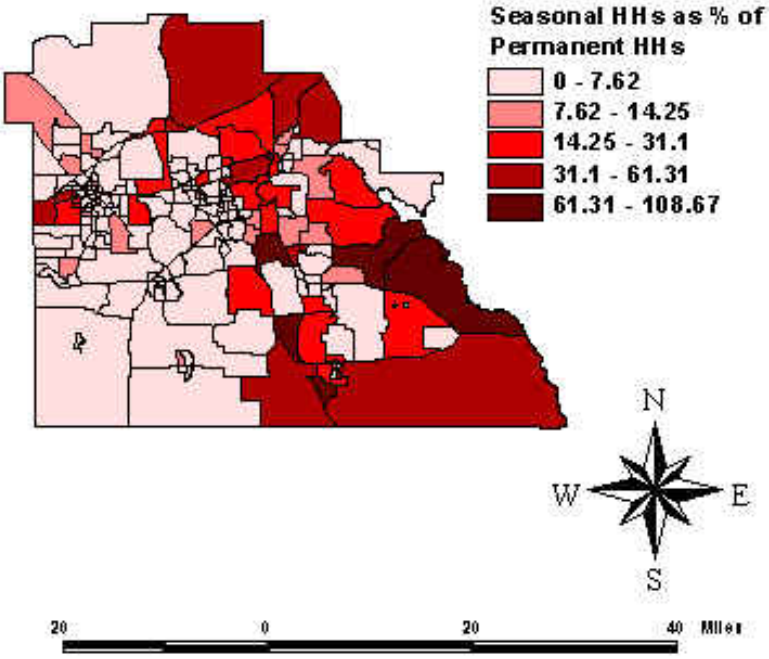

Figure B.48 Distribution of Seasonal Households in Polk County

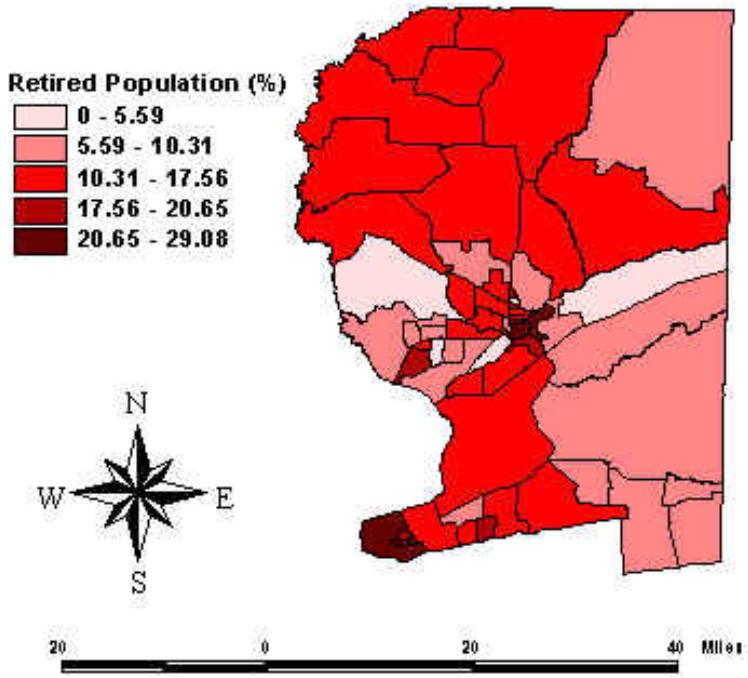

Figure B.49 Distribution of Retired Population in Santa Rosa County

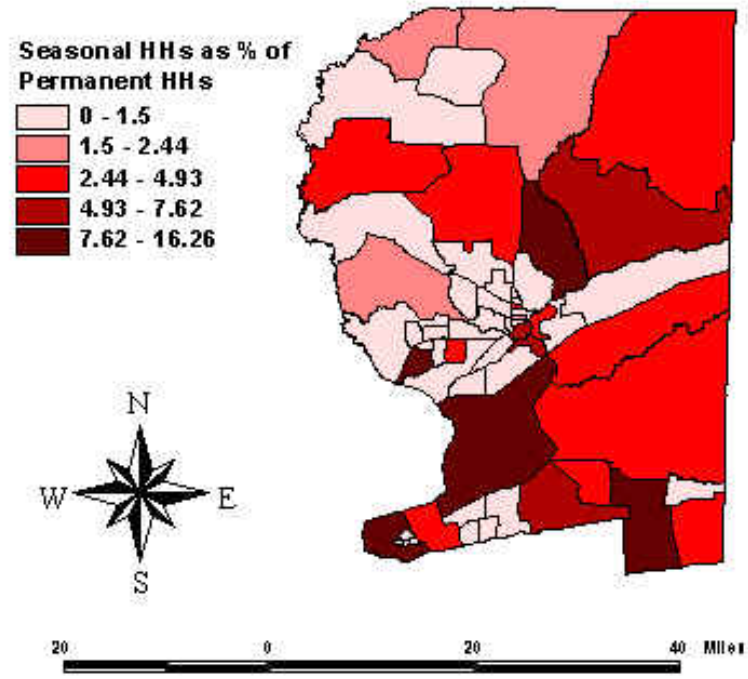

Figure B.50 Distribution of Seasonal Households in Santa Rosa County

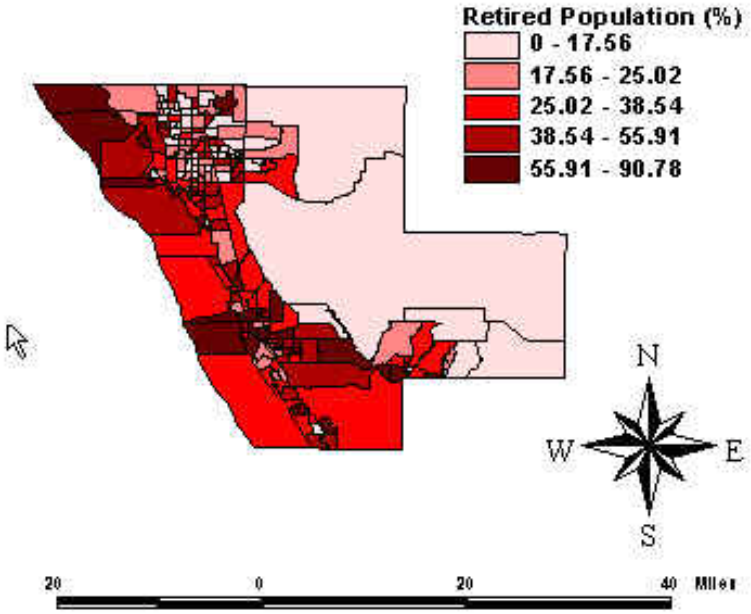

Figure B.51 Distribution of Retired Population in Sarasota County

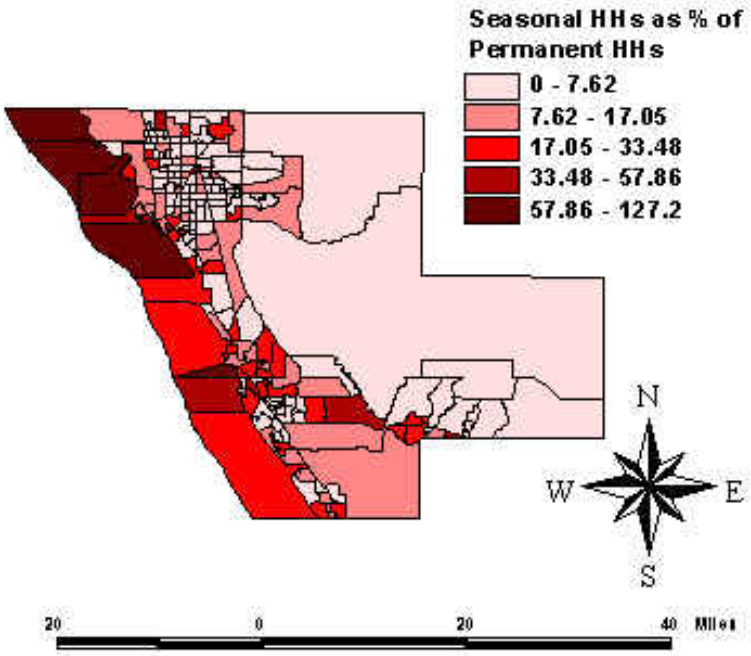

Figure B.52 Distribution of Seasonal Households in Sarasota County

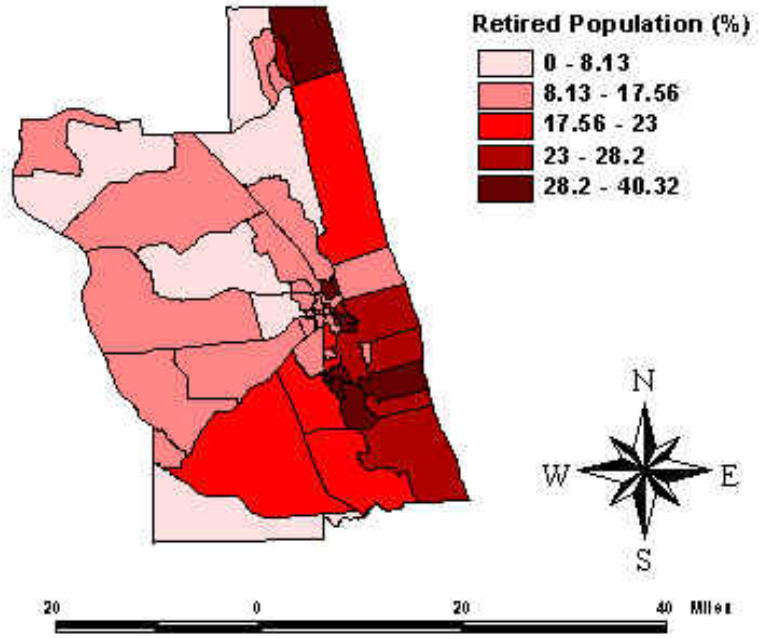

Figure B.53 Distribution of Retired Population in St. Johns County

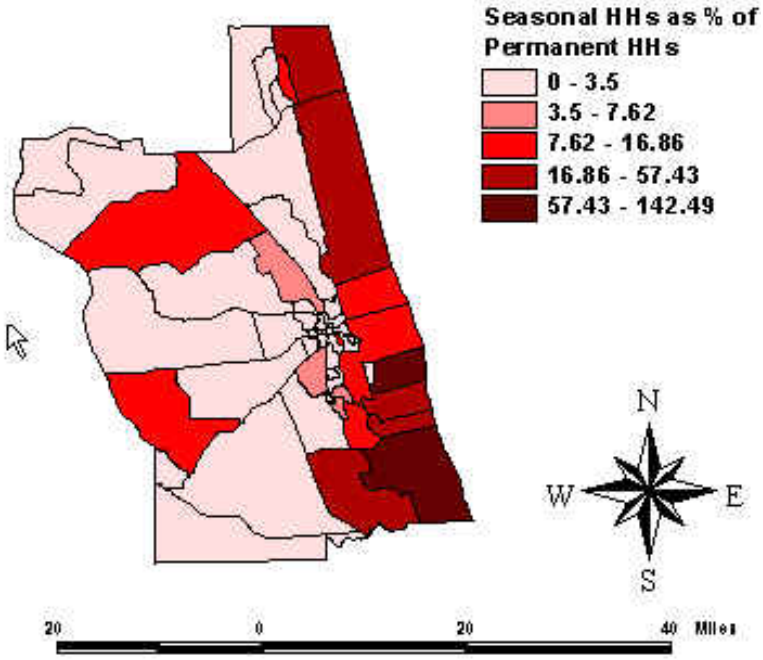

Figure B.54 Distribution of Seasonal Households in St. Johns County

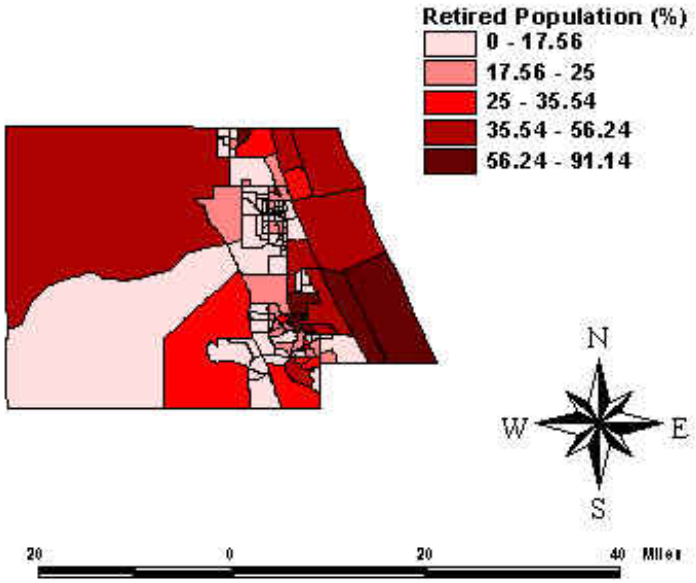

Figure B.55 Distribution of Retired Population in St. Lucie County

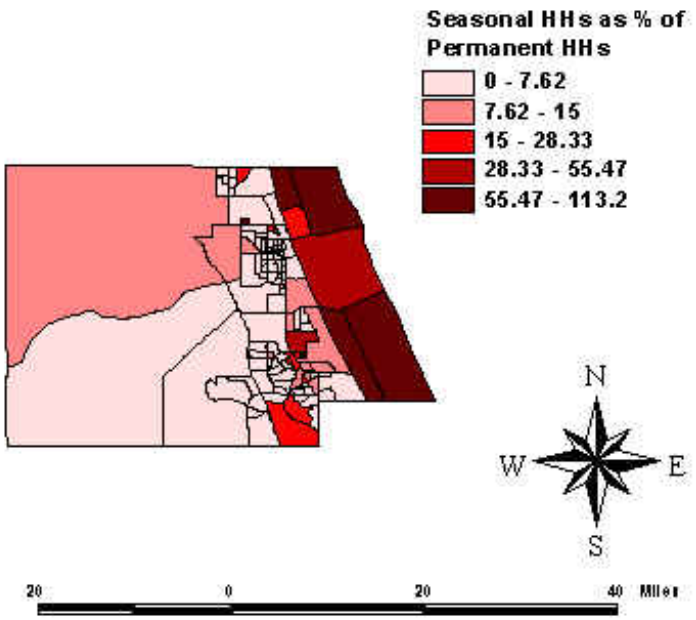

Figure B.56 Distribution of Seasonal Households in St. Lucie County

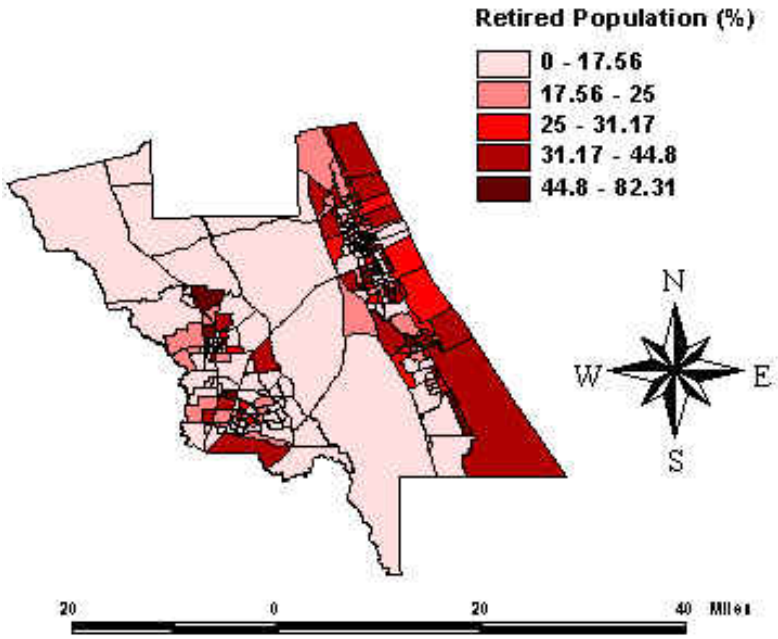

Figure B.57 Distribution of Retired Population in Volusia County

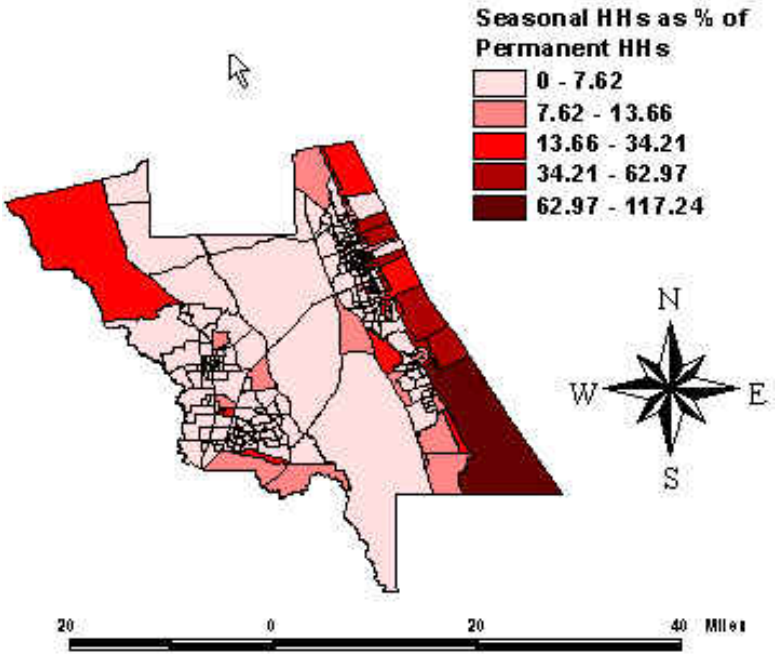

Figure B.58 Distribution of Seasonal Households in Volusia County

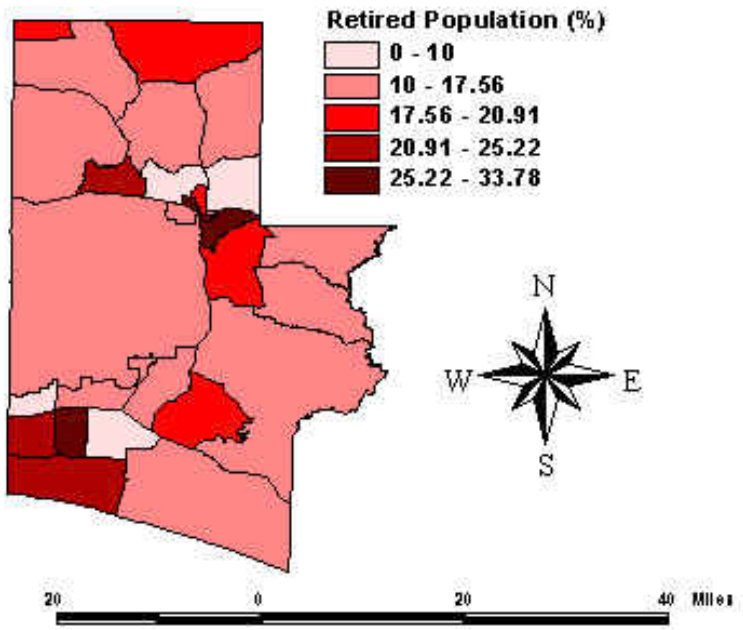

Figure B.59 Distribution of Retired Population in Walton County

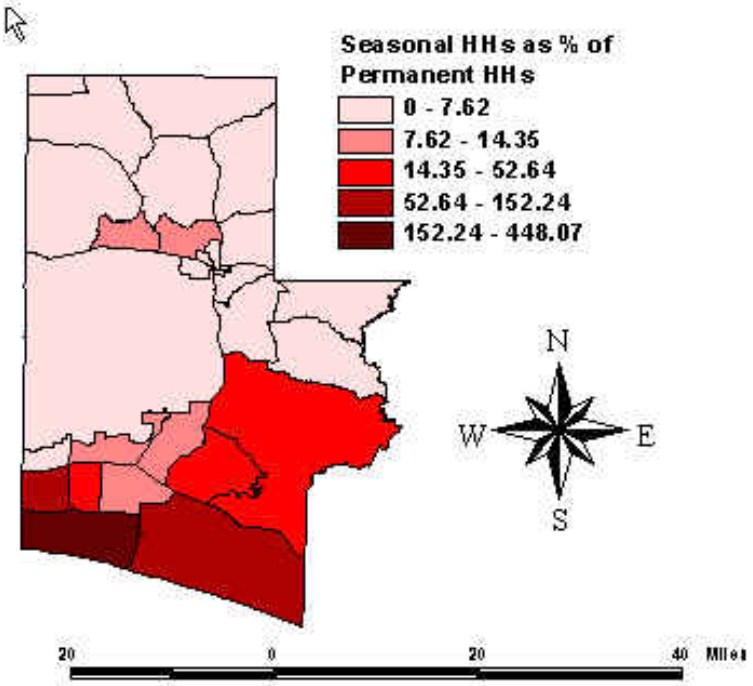

Figure B.60 Distribution of Seasonal Households in Walton County