REACTIONS TO VALUE PRICING BY DIFFERENT SUBURBAN POPULATION GROUPS

A Thesis

by

JOHN LOWERY

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

May 2010

Major Subject: Civil Engineering

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Approved by:

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ABSTRACT

Reactions to Value Pricing by Different Suburban Population Groups. (May 2010)

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Value pricing strategies are beginning to be considered for future improvements in suburban areas that currently do not experience significant congestion but are expected to become congested in the future. This is a significant departure from implementing these strategies in congested urban areas as is commonly done now. Therefore, traveler reaction in these suburban areas is unknown. To plan and design value pricing projects most effectively, it will be necessary to gain an understanding of suburban travelers' potential reaction to value pricing.

Responses to a survey of travelers using the eastern and western segments of Interstate 10 (I-10) outside of San Antonio were used to study differences in response to value pricing by suburban population groups. These surveys collected information on travelers' socioeconomic and trip characteristics as well as their attitudes towards value pricing in the form of potential Express Toll Lanes (ETLS). Stated preference scenarios presented to survey respondents were used to develop mode choice models. These models were used to determine characteristics that may impact the decision to choose to travel on the general purpose lanes (GPLs) or the ETLs.

This research suggests that the implementation of value pricing strategies on suburban corridors may pose a challenge from a policy standpoint. The populations using these corridors appear to be more varied in their responses toward value pricing than populations using congested urban corridors. Overall, it was found that the majority of travelers on I-10E and I-10W are not favorable to the implementation of value pricing for the future expansion of these corridors. However, I-10W travelers seem to be more willing to pay for travel time savings. This is likely due to the fact that travelers on I-10W earn higher average incomes, are more likely to use I-10W on a regular basis for commute purposes, and are more often exposed to some traffic congestion. Conversely, travelers on I-10E are more likely to use I-10E less frequently for non-commute trips, travel longer distances, and probably do not have an intuitive sense of the value they would place on travel time savings since they do not regularly experience congestion.

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CHAPTER I

INTRODUCTION

1.1 Overview

Metropolitan areas across the country are facing the challenges associated with increasing demand on already congested highways coupled with diminishing sources of revenue for capacity improvements. With limited funds to construct and maintain new transportation infrastructure projects, many agencies are beginning to favor projects that seek to manage demand. The term "managed lanes" is frequently being used to refer to projects that provide an enhanced level of service by controlling the number of vehicles that use a facility (FHWA 2008a). Limiting access, implementing eligibility requirements, and pricing are strategies that can be used individually, or in combination with one another, to ensure that managed lanes remain congestion free. High-occupancy vehicle (HOV) lanes are a classic example of a lane management strategy that incentivizes carpooling by providing enhanced levels of service for vehicles with multiple occupants. However, there has been increasing interest in recent years to incorporate pricing as a supplement to the traditional HOV eligibility requirements, as it can be used to optimize existing capacity in HOV lanes, or can provide a revenue source to finance and maintain new managed lane projects (Poole and Orski 1999).

This thesis follows the style of *Journal of Transportation Engineering.*

The implementation of a user charge to maintain a reasonably high level of service is referred to as value pricing (Lee 2008). The primary goal of value pricing is to ensure free flow conditions on a facility rather than revenue generation, which sets value pricing apart from traditional toll facilities (Bhatt et al. 2008). The most common manifestation of value pricing in the United States is in the form of High-Occupancy/Toll (HOT) lanes. HOT lanes provide free or reduced cost travel for vehicles meeting established occupancy requirements and allow other vehicles not meeting occupancy requirements to access the lane for a price (Perez and Sciara 2003). To maintain enhanced operating conditions throughout the day value pricing projects may impose fees that vary by time of day or by level of congestion, and as a result these strategies are often referred to as congestion pricing or variable pricing (FHWA 2006).

There has been an increased interest in projects such as HOT lanes in the United States since the authorization of the Congestion Pricing Pilot Program in 1992, later renamed the Value Pricing Pilot Program, which has provided funding to support the evaluation and implementation of value pricing projects. As of 2009, six states have implemented HOT lanes, each with differing pricing strategies designed to ensure optimal operating conditions. The increasing appeal of value pricing projects has resulted in numerous research studies being conducted to evaluate how different socioeconomic and trip characteristics affect a person's willingness to pay (Brownstone et al. 2003; Burris et al. 2007; Yan et al. 2002; and others). Many of these studies have focused on how certain individual characteristics are likely to influence a person's willingness to pay a toll. Some of the characteristics that have been found to influence willingness to pay include study location, gender, age, income, and education.

Value pricing strategies are beginning to be considered for future improvements in suburban areas that currently do not experience significant congestion but are expected to become congested in the future. This is a significant departure from placing these lanes in congested urban areas as is commonly done now. Therefore, traveler reaction in these suburban areas is unknown. To plan and design these lanes most effectively it will be necessary to gain an understanding of suburban travelers' potential reaction to value pricing.

1.2 Problem Statement

Value pricing projects such as HOT lanes are attracting more serious attention as transportation agencies continue to struggle with limited revenue sources available to combat increasing congestion. Many of these projects are being planned or have been implemented in areas to serve an immediate need such as increasing capacity along congested corridors or utilizing excess capacity on HOV facilities. However, it is likely that the applicability of value pricing as a strategy to manage demand and help finance construction will be expanded to more long-term capacity improvements, particularly as transportation agencies struggle to obtain funding for future projects. Populations being served by short-term projects are likely to be living in rapidly developing areas that experience moderate to heavy congestion, whereas populations to be served by long-term projects may live in sparsely developed areas with little current traffic congestion.

Without a better understanding of how value pricing projects are likely to be accepted by these distinctly different populations, transportation professionals cannot plan and design these facilities for maximum effectiveness and benefits.

The two segments of I-10 in San Antonio analyzed in this research do not currently experience significant congestion and are sparsely populated, so the study of the response to value pricing by population groups along these corridors is rather unique. Further, these two segments exhibit very different characteristics and provide an opportunity to discern any differences that may exist between dissimilar suburban populations.

1.3 Research Objectives

The goal of this research is to gain an understanding of suburban traveler response to value pricing. To achieve this goal the following research objectives were undertaken:

1. Explore and quantify the differences between the populations living along the northwestern and eastern segments of I-10 outside of San Antonio.
2. Determine which factors influence the use of value-priced lanes for each population group.
3. Report differences towards value pricing that may exist between these two population groups.

These objectives were accomplished using U.S. census data as well as a data set consisting of 497 responses to a travel survey designed to capture their information.

1.4 Outline of Thesis

This thesis consists of six chapters. Chapter I serves as an introduction to the research topic including background and motivation. Chapter II provides a review of the literature as it relates to this research. Topics covered in the literature review include examples of value pricing in the United States, factors affecting response to pricing projects, and a background on mode choice modeling. Information related to the study area, survey administration, and data preparation is presented in Chapter III. In Chapter IV, census data and survey responses are compared to identify key differences between travelers using each corridor. Mode choice models are developed and analyzed in Chapter V. Finally, Chapter VI summarizes the findings of this research and provides recommendations for further research.

CHAPTER II

LITERATURE REVIEW

This chapter provides a review of the relevant literature as it pertains to this research. The chapter begins with a brief introduction to the transportation finance problem facing the United States and the resulting increase in the popularity of transportation demand management strategies such as HOV and HOT lanes. Examples of HOT lanes around the country are presented next. Then factors that have been found to impact traveler response to value pricing are reviewed. Finally, mode choice modeling and analysis techniques that will be used in this research are discussed.

2.1 The State of Transportation Finance

In recent years there has been much debate about the sustainability of the current system of transportation finance in the United States. In a testimony before congress, the United States Government Accountability Office (GAO) reported that revenues supporting the Highway Trust Fund are not keeping pace with spending which will ultimately affect the ability of the United States Department of Transportation (U.S. DOT) to continue to fund transportation programs at current levels (2009). State departments of transportation around the country are coming to similar realizations as transportation revenues continue to fall short of the increasing burden placed on our nation’s aging transportation system. The American Association of State Highway Transportation Officials (AASHTO) warns that a potential reduction in transportation funding due to revenue shortfalls would harm the ability of the U.S. to compete in the global economy (2007).

One of the most cited problems with our current system of transportation finance is a reliance on motor fuel taxes levied on a per-gallon basis. These motor fuel taxes are the largest sources of revenue for transportation but are losing their purchasing power due to inflation, increasing maintenance and construction costs, and improved vehicle fuel efficiency (Wachs 2006). The federal tax on a gallon of gasoline has remained at 18.4 cents per gallon since it was last increased in 1993, and if left unchanged is estimated to decrease in real value to 8.3 cents per gallon by 2015 (AASHTO 2007).

The inability of motor fuel taxes as they exist now to keep pace with spending has given rise to new ideas about how transportation projects could be operated and financed. The National Surface Transportation Infrastructure Finance Commission (the "Financing Commission"), charged with offering recommendations to federal policy makers regarding transportation funding, established the following principles to guide future transportation activities in this country (2009):

- the finance framework must generate sufficient and sustainable funding and work towards closing the current funding gap,
- direct users of the transportation system should incur the cost of using the transportation system to the greatest extent possible to promote more efficient use of the system, and

- efficient investment in the transportation system should be encouraged to ensure cost-effective uses of resources.

The principles listed above are indicative of a new approach to transportation finance that encourages more efficient operation of the current system as well as more responsible investment in future projects. As congestion in metropolitan areas expands into surrounding suburban areas, there will be a real need for solutions that make the most efficient use of scarce transportation resources. One solution that helps ensure efficient use of the transportation system and establishes a reliable financial framework is to require users to directly incur the costs of using the transportation system.

2.2 Demand Management Strategies

With limited funds to construct new capacity projects as well as maintain existing infrastructure, many agencies are beginning to favor projects that seek to manage demand. The term "managed lanes" was coined to refer to such projects that provide an enhanced level of service by actively managing conditions on a facility (FHWA 2008a). The HOV concept is a classic example of a managed lane strategy that incentivizes carpooling to reduce the number of vehicles on the roadway during congested peak periods. More recently, the incorporation of a pricing mechanism to ensure efficient use of highway facilities has become popular. This concept, referred to as value pricing, has often been used in conjunction with vehicle occupancy restrictions in the form of HOT lanes. The ability of these value pricing projects to make more efficient use of roadway capacity and generate sources of revenue will likely lead to their increased usage by state departments of transportation.

2.2.1 HOV Lanes

High occupancy vehicle (HOV) lanes are an example of a demand management strategy that has been widely implemented in metropolitan areas throughout the United States. They consist of separate lanes that limit access to vehicles meeting specified occupancy requirements including carpools, vanpools, and busses. One goal of HOV lanes is to provide incentives for individuals to switch from driving alone. These incentives often include travel time savings and trip reliability (Turnbull 2003). Increasing the number of occupants per vehicle can improve the people moving capacity of a corridor allowing for more efficient use of freeways. There are currently 126 HOV projects in 27 metropolitan areas across the United States (FHWA 2008a). The range of peak hour travel time savings for the 91 HOV facilities that have data available is 0.4 minutes to 37 minutes (FHWA 2008b).

While HOV lanes can be successful in increasing the throughput of congested freeway corridors, they can also be a target of criticism when underutilized. The term "empty lane syndrome" refers to situations where underutilization of HOV lanes on heavily congested corridors leads to public criticism (Swisher et al. 2003). In 1998 a 20.2 mile segment of HOV lanes opened on I-287 in New Jersey. Underutilization of the lanes during peak periods caused such a negative drop in public opinion that the governor announced the elimination of the HOV lanes (Kuhn et al 2002). A survey of

HOV operators revealed that underutilization is a common issue that has resulted in policy changes across the country (FHWA 2008b). HOV performance issues such as underutilization have traditionally been addressed by changes in occupancy requirements and hours of operation. However, these changes often do not allow for the optimal redistribution of road capacity and can cause HOV facilities to operate at conditions that are less than ideal (Safirova et al. 2003). Another potential method to ensure the efficient use of the lanes is to allow more vehicles to use the lane – for a price.

2.2.2 Value Pricing and HOT Lanes

The shortcomings of traditional HOV lane restrictions to ensure the most efficient use of lane capacity has given rise to the popularity of pricing as a tool capable of better allocating existing roadway capacity. The term value pricing, as applied to transportation projects, refers to the idea of charging users a toll that is specifically set to ensure a high level of service on a facility (Lee 2008). The goal of value pricing, sometimes called congestion pricing, is to use the power of the market to fight congestion by encouraging drivers to switch their travel to off-peak periods (FHWA 2009). This makes value pricing strategies distinctly different from traditional toll facilities where the primary goal is revenue generation.

In 1991, the Intermodal Surface Transportation Equity Act (ISTEA) authorized the creation of the Congestion Pricing Pilot Program to encourage nationwide research and testing of experimental pricing projects. Subsequent legislation changed the name of this program to the Value Pricing Pilot Program (VPPP) and reauthorization provided

$59 million in funds for the years 2005 to 2009. These funds were allocated to pay for pre-implementation research studies as well as implementation costs for value pricing projects. Over 50 pricing projects and studies in 14 states have been sponsored by Federal pricing pilot programs, and of those, 16 have become operational (Bhatt et al. 2008).

The most common manifestation of value pricing in the United States is in the form of High-Occupancy/Toll (HOT) lanes. A HOT lane allows vehicles that do not meet HOV lane occupancy restrictions to use the lane for a price. The Federal Highway Administration's guidance on HOV lanes suggests conversion to HOT lanes to increase efficiency and allow drivers to have more choices (2008).

2.3 Examples of HOT Lanes in the United States

There are currently nine HOT lane facilities in operation in the United States:

- I-394 in Minneapolis, Minnesota;
- SR-91 Express Lanes in Orange County, California;
- I-15 FasTrak Lanes in San Diego, California;
- Katy Freeway (IH 10) and Northwest Freeway (US-290) in Houston, Texas;
- SR-167 in Seattle, Washington;
- I-25 in Denver, Colorado;
- I-15 in Utah; and

- I-95 in Miami, Florida.

The first four projects listed above are the most well established. Therefore, there are many studies documenting the acceptability and usage of these facilities by different groups of travelers. This type of information is not available for the last four projects, as these facilities are relatively new.

2.3.1 I-394 in Minneapolis, Minnesota

In May of 2005, 11 miles of existing HOV lanes on I-394 were converted to HOT lanes. This segment of HOV lanes consists of three miles of reversible barrier-separated lanes, which are always priced, and eight miles of double white line-separated single lanes, which are priced only in the peak direction during peak periods. Vehicles with two or more occupants (HOV-2+), busses, and motorcycles are able to use the lanes for free. Single occupant vehicles (SOVs) pay a toll that is automatically collected and deducted from the driver's pre-paid MnPass account.

The amount of the toll charged to single occupant vehicles varies based on the level of congestion on the lanes and is displayed to motorists using variable message signs (see Figure 1). A computer algorithm uses traffic density data collected by sensors spaced every half mile along the lanes to calculate the toll rate. The traffic density is used to determine the level of service on the lanes as well as whether or not traffic is increasing or decreasing, which dictates whether or not the toll will increase or decrease and by how much. The toll is updated every three minutes with average peak period tolls ranging from $1.00 to $4.00.   The maximum toll charged during the peak period is currently set at $8.00.

Figure 1. I-394 MnPass Express Lanes and Variable Message Sign (FHWA 2007)

On September 30, 2009 MnPass Express Lanes were also introduced on a nearly twelve mile segment of I-35W connecting downtown Minneapolis with the southern suburbs. This segment includes a two mile Priced Dynamic Shoulder Lane (PDSL) that allows vehicles to drive on the left shoulder during peak periods. The PDSL is always tolled when open during peak periods, but the other 10 miles is only tolled during peak periods and is open to general traffic otherwise.

An attitudinal panel survey was conducted before and after the implementation of the I-394 MnPass express lanes. This survey was conducted in three waves which took place in fall 2004, fall 2005, and spring 2006 (Zmud et al. 2007). Of the 1,000 respondents who were interviewed during the first wave of the survey, 549 participated in the second wave and 343 participated in the third wave. The majority of respondents in the first wave of the survey (62 percent) thought congestion was a problem and half reported a stressful travel experience on I-394 (NuStats 2006). Also, 60 percent of respondents in the first wave of the survey thought that allowing single occupant drivers to use the HOV lanes for a price was a good idea. All of these observations indicate that I-394 experienced regular traffic congestion during peak periods and travelers saw the potential benefit of HOT operations prior to implementation of the express lanes. Response data from the second and third waves of the survey, after implementation of the express lanes, revealed smaller percentages of travelers who thought congestion was a problem and who reported stressful traveling experiences on I-394.

Respondents in each wave of the survey were also asked stated preference questions to measure how much travelers were willing to pay to use the MnPass express lanes. Binary logit models were created and results showed that willingness to pay to use the express lanes was significantly related to income, age, trip purpose, time-of-day, trip distance, and amount of travel time savings (NuStats 2006). As expected, willingness to pay was found to be higher among those with higher incomes and among those making commute trips in the peak periods. It was also found that younger travelers and travelers making longer trips had higher calculated values of travel time savings.

2.3.2 State Route 91 Express Lanes in Orange County, California

The State Route 91 (SR-91) Express Lanes were constructed in 1995 to alleviate growing congestion on the SR-91 corridor that connects suburban communities in

Riverside County with employment centers in Orange County. This 10 mile section of freeway includes four HOT express lanes in the median of eight general-purpose lanes separated by a painted buffer and pylons. Access to the SR-91 Express Lanes is provided only at the east and west ends to provide express service to long distance travelers. Vehicles with three or more occupants (HOV-3+), zero emission vehicles, and motorcycles are able to use the facility for free during off-peak hours and at a 50 percent discount during the most congested weekday afternoon peak hours (OCTA 2009). All vehicles traveling on the lanes must carry a transponder used to deduct the toll from a prepaid account. Vehicles eligible to use the lanes for free or at a discounted rate are required to travel in a designated lane as shown in Figure 2.

Figure 2. SR-91 Lane Designation Overhead Sign (OCTA 2009)

Tolls on the SR-91 Express Lanes vary by time of day with the highest tolls being charged during the morning and afternoon peak periods. Currently, tolls vary from a minimum of $1.30 to $9.90 to travel the entire corridor. The highest toll of $9.90 is charged during the most congested period on Thursdays from 4:00 pm to 5:00 pm (see Figure 3), which equates to a toll rate of nearly $1.00 per mile. The toll policy currently in place allows tolls to be increased for any time period designated as a "Super Peak" hour (OCTA 2003). If traffic volumes are consistently above the predetermined Super Peak levels then tolls can be raised, provided that travelers are notified ten days in advance. Traffic levels during Super Peak hours are reviewed after six months to determine whether further toll increases or decreases are warranted.

	Sun	M	Tu	W	Th	F	Sat
Noon	$3.00	$2.05	$2.05	$2.05	$2.05	$3.10	$3.00
1:00 pm	$3.00	$2.85	$2.85	$2.85	$3.10	$4.85	$3.00
2:00 pm	$3.00	$4.05	$4.05	$4.05	$4.15	$4.10	$3.00
3:00 pm	$2.50	$4.35	$3.70	$5.45	$5.90	$9.50	$3.00
4:00 pm	$2.50	$5.55	$7.75	$8.25	$9.90	$9.30	$3.00
5:00 pm	$2.50	$5.35	$7.25	$7.75	$9.05	$7.25	$3.00
6:00 pm	$2.50	$4.35	$4.10	$3.60	$4.90	$5.25	$2.50
7:00 pm	$2.50	$3.10	$3.10	$3.10	$4.45	$4.90	$2.05
8:00 pm	$2.50	$2.05	$2.05	$2.05	$2.85	$4.45	$2.05
9:00 pm	$2.05	$2.05	$2.05	$2.05	$2.05	$2.85	$2.05
10:00 pm	$1.30	$1.30	$1.30	$1.30	$1.30	$2.05	$1.30
11:00 pm	$1.30	$1.30	$1.30	$1.30	$1.30	$1.30	$1.30

Figure 3. SR-91 Eastbound Afternoon Toll Schedule Effective October 1, 2009 (OCTA 2009)

In 1998, a report detailing an extensive evaluation of the impacts of the variable priced Express Lanes on SR-91 was released (Sullivan 1998). Data collected before and after the lanes were opened were used to document changes in travel. After the express lanes were opened, typical peak period delay dropped from 30 to 40 minutes to less than ten minutes. By June 1997, eighteen months after the express lanes were opened, roughly 90 percent of peak period travelers on SR-91 had obtained a toll transponder. Of those who used the express lanes, more than half reported using them more than once a week. Roadside counts revealed a more than 40 percent increase in the number of peak period HOV-3+ vehicles and vanpools due to the fact that these vehicles were able to travel for free during peak periods. However, the growth in the volume of toll paying single occupant vehicles far outpaced the growth in vehicles using the express lanes for free.

Survey data was also used in the 1998 report to analyze public opinion of the new SR-91 Express Lanes. Results showed that income, gender, age, and trip distance had an impact on express lane usage (Sullivan 1998). High income commuters making more than $100,000 per year were more than twice as likely to be frequent users of the express lanes. It was also found that females were more likely to be express lane users while individuals in the youngest and oldest age groups were less likely to be express lanes users. Trip distance also appeared to have an influence on the frequency of express lane usage. The percentage of travelers that were frequent users of the express lanes increased with increasing trip distance even though the likelihood that individuals would shift to higher vehicle occupancy categories did not appear to increase with increasing trip distance.

Several developments occurred after the conclusion of the 1998 study prompting a continuation study, which included the analysis of another travel survey conducted in 1999 (Sullivan 2000). These developments included a change to the toll schedule that charged different hourly tolls and the charging of HOV-3+ vehicles at 50 percent of the toll rate. Again it was found that commuters with higher incomes were more likely to choose the toll lanes. However, results from the 1999 travel survey showed a significant decrease in the percentage of trips on the toll lanes for individuals in the $40,000 to $60,000 income group indicating that middle income travelers may not have been willing to pay the increased tolls (Sullivan 2000). Results of this continuation study also revealed that the percentage of trips reported in the toll lanes increased with increasing education level.

Travel choice models were also estimated using revealed preference data obtained from travel surveys administered during the 1998 and 2000 studies. These models confirmed women, people age 30 to 50, and people with higher incomes were more likely to choose the toll lanes (Sullivan 2002). However, further analyses revealed that many factors including high income, middle age, and higher education favor a willingness to obtain a toll transponder, which is required to use the SR-91 Express Lanes. Therefore, these factors affect toll usage in an indirect way. Model results also indicated that people were more likely to shift routes rather than the time of day of their travel in response to a toll increase (Yan et al. 2002). This result may show that people are not likely to make drastic adjustments to their travel behavior in response to variable pricing as long as unpriced lanes are available as an alternative (Sullivan 2000).

2.3.3 Interstate 15 FasTrak Lanes in San Diego, California

The San Diego Interstate 15 (I-15) Express Lanes began in 1998 when an eight mile segment of reversible HOV lanes was converted to HOT lanes. The Express Lanes have since been expanded to include an additional eight mile segment consisting of four lanes separated by a moveable barrier. When completed in 2012 the entire project will include four Express Lanes that will run 20 miles from San Diego to Escondido (see Figure 4). The project will also enhance Bus Rapid Transit (BRT) service along the corridor by including four new transit centers that will connect to the Express Lanes by direct access ramps. Busses, vehicles with two or more occupants (HOV-2+), motorcycles, and permitted hybrid vehicles are able to use the Express Lanes for free. SOVs that wish to use the lanes must carry an electronic transponder in their vehicle which deducts the toll from a prepaid account.

Figure 4. Map of I-15 Express Lanes in San Diego, CA (SANDAG 2009)

Toll rates for SOVs on the I-15 Express Lanes currently range from a minimum of $0.50 to a maximum of $8.00. The toll charged to SOVs is calculated based on a per mile toll rate that changes based on the level of congestion on the lanes and is updated as often as every three minutes. The goal of the congestion pricing is to maintain a minimum Level of Service (LOS) grade “C” on the Express Lanes to ensure free flow conditions at all times (HNTB 2006). Electronic signs relay advance toll information to users at the entrances to the toll lanes (see Figure 5). The toll rate shown to users is the rate that they will pay even if it changes while they are traveling on the lanes (SANDAG 2009).

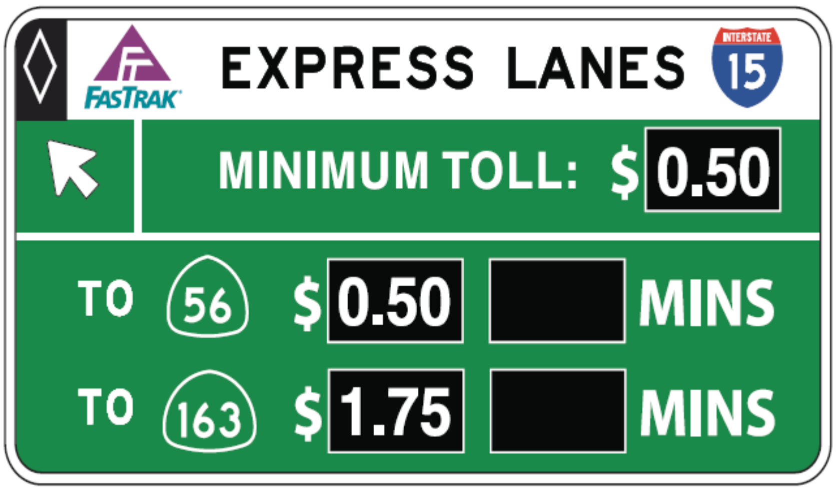

Figure 5. I-15 Express Lanes Variable Toll Message Sign (SANDAG 2009)

The I-15 Congestion Pricing Project was initially designed as a three year test program funded primarily through the FHWA Congestion Pricing Pilot Program that allowed SOVs to use the I-15 HOV lanes for a fee. It has since been expanded and has now been in operation for over 13 years. This project was split into two phases. The first phase began in 1996 and allowed a limited number of SOVs to obtain an ExpressPass for a flat monthly fee that allowed unlimited use of the HOV lanes. After 16 months the second phase began and a per-trip fee that varied based on the time of day was instituted allowing an unlimited number of SOVs to participate. An attitudinal panel survey was conducted while this Congestion Pricing Project was being conducted. This survey interviewed the same groups of respondents five times to measure any changes in demographic and trip characteristics, perceptions, and attitudes in response to the pricing project (Golob 2001).

Survey data collected during the first phase of the Congestion Pricing Project was used to describe characteristics of typical ExpressPass users as well as quantify attitudes towards the pricing project. Responses from ExpressPass users were compared against responses obtained from other users of I-15 and a connecting freeway, Interstate 8 (I-8). Results showed that ExpressPass users were more highly educated, older, and had higher incomes than other users of I-15 and I-8 (Golob et al. 1998). It was also found that 99 percent of ExpressPass users had a work-related purpose for their most recent trip. Although delay studies revealed actual time savings of zero to nine minutes, ExpressPass users reported an average time savings of 19 minutes. Researchers speculated that the overestimation of travel time savings was likely a result of improved trip reliability that allowed ExpressPass users to minimize buffer time typically added to trips to account for variability (Golob et al. 1998).

Logit models were created using survey responses obtained after the second phase of the Congestion Pricing Project was initiated. Brownstone et al. calculated a $30 per hour value of travel time savings for I-15 users using model results (2003). Other models revealed that users of the Express Lanes were different from other users of I-15 in that they were:

- from higher income households,
- more highly educated,

- more likely to be women,
- more likely to be homeowners, and
- predominantly 35 to 54 years old (Supernak et al. 2002).

2.3.4 Katy Freeway (I-10) and Northwest Freeway (US-290) in Houston, Texas

The reversible HOV lane on the Katy Freeway was restricted to buses and vanpools when it opened in 1984. In response to underutilization of the lane, authorized carpools were also permitted to use the facility. The occupancy requirements for carpools started at HOV4+ in 1985, but were soon dropped to HOV2+ in 1986. By 1998, high traffic volumes during the morning peak periods were causing conditions on the HOV lane to deteriorate, so the decision was made to convert the facility to HOV3+ usage during the peak hours. Immediately after the conversion to HOV3+, the total morning peak volumes on the lane dropped 62 percent leaving the lanes once again underutilized (Turnbull 2003).

In 1998 the "QuickRide" program was introduced on the Katy Freeway to improve usage of the HOV lane. This program allows two person carpools to use the facility for a $2.00 toll during the morning and afternoon peak periods. All individuals participating in the QuickRide program must register and obtain an electronic tag. The QuickRide program was expanded in 2000 to include the Northwest Freeway HOV lane during the morning peak hour. In 2003 the average number of QuickRide trips on the Katy and Northwest HOV lanes was 208 (Burris and Stockton 2004). Results from a study by Burris and Appiah revealed that the disutility of forming a carpool was more of a deterrent to participation in the program than the $2.00 toll (2004).

In 2009 the reversible HOT lane on the Katy Freeway was replaced with two managed lanes in each direction. SOVs are able to access the lanes 24 hours a day for a toll. HOVs and motorcycles are able to use the lanes for free during designated HOV hours in the morning and evening, but must pay a toll at all other times. Tolls are collected electronically at three toll plazas where HOVs and motorcycles are directed to travel in the left lane to avoid being charged a toll during HOV hours. The toll rate charged at each toll plaza varies based on the time of day to ensure free flowing conditions on the lanes. Travel along the entire managed lanes costs $1.20 during off-peak periods and on weekends, but costs up to $4.00 during the peak hour (HCTRA 2009).

Surveys of QuickRide users have been used in several research studies to analyze the characteristics of users. Burris and Hannay studied the equity impacts of the QuickRide project using responses obtained from surveys of QuickRide users and nonusers administered in 1998 (2003). This study concluded that QuickRide usage among enrollees who filled out the survey did not vary significantly with income, age, occupation, or household size. However, it was found that QuickRide users who filled out the survey were younger and had higher incomes than Katy Freeway travelers who did not use QuickRide. Another survey of QuickRide participants conducted in March 2003 revealed that midlevel and frequent users of QuickRide were significantly more likely to be:

- 35 to 44 years old,
- female,
- administrative or clerical workers, and
- college graduates or have some college or vocational education (Burris and Appiah 2004).

2.4 Public Acceptance of Value Pricing in Suburban Areas

Most value pricing projects have been implemented in urban areas where there is a need to improve the efficiency of a facility experiencing regular and significant traffic congestion. However, the ability of value pricing projects to generate potential sources of revenue as well as improve the efficiency of highways will likely increase their appeal to state departments of transportation dealing with decreasing transportation resources. As a result, value pricing concepts may be considered as an option for implementation in suburban areas where demand is expected to increase in the future. It is important that transportation planners and engineers have a sense of how travelers in suburban areas will respond to value pricing if the concept is to be successfully implemented in these settings.

A review of operating HOT lanes in the United States revealed that these projects can be successfully implemented in large urban areas where there is significant traffic congestion. Most research to date has focused on analyzing how characteristics of travelers in these specific settings are related to their acceptance of value pricing concepts (Burris and Goel 2010). However, individuals in suburban areas where traffic congestion is not as large a problem are likely to have different attitudes towards the idea of paying a toll for their travel.

Value pricing studies conducted across the country show that travelers with certain characteristics often have different willingness to pay tolls, which suggests that attitudes toward value pricing may differ based on project location. In a paper summarizing attitudes toward pricing around the country, Ungemah and Collier confirm that public acceptance issues are specific to location (2007). These observations support the need for an analysis of the response to value pricing by travelers in different settings, especially since most research has only focused on response to value pricing by travelers on highly congested urban corridors. Of particular interest for this research is the response by individuals living in different suburban settings where traffic congestion is expected to be a problem in the future.

2.5 Mode Choice Modeling

2.5.1 Discrete Choice Modeling

Discrete choice modeling is used to estimate decision makers' choice probabilities among a set of finite, mutually exclusive, and mutually exhaustive alternatives (Train 2003). Transportation planners use discrete choice models to estimate the percentages of individuals within a population that will choose a particular mode when making a trip. Inputs for these models typically include characteristics of the travel modes and characteristics of the individuals within the population, including demographic and travel characteristics. This information is typically obtained by conducting travel surveys for a population of interest.

Discrete choice analysis is based on the assumption that individuals will compare all alternatives and choose the one that gives the greatest level of satisfaction, or utility (Hensher et al. 2005). Utility can be defined as a relative measure of the satisfaction that an individual would obtain from each alternative in the choice set being presented. Discrete choice models are typically derived under the assumption that individuals will choose an alternative that provides the greatest utility (Train 2003). The utility that an individual *n* obtains from alternative *i* is calculated using equation 2.1.

$$U_{i,n} = \beta_i X_i + \beta_n X_n + \varepsilon_{i,n} \qquad (2.1)$$

where:

X_i = a vector of measurable attributes of alternative i

β_i = a vector of the coefficients of X_i

X_n = a vector of measurable attributes of individual n

β_n = a vector of the coefficients of X_n

$\varepsilon_{i,n}$ = random portion of utility

The easiest and most widely used model in discrete choice analysis is the logit model (Train 2003). When the choice set consists of more than two alternatives, then a multinomial logit model is used. Equation 2.2 is used to calculate the probability of an alternative i being chosen by an individual n in a multinomial logit model.

$$P_{i,n} = \frac{e^{U_{i,n}}}{\sum_j e^{U_{j,n}}} \tag{2.2}$$

where:

$P_{i,n}$ = probability of individual n choosing alternative i

$U_{i,n}$ = utility of alternative i for individual n

$U_{j,n}$ = utility of other alternative j for individual n

As shown in equation 2.2, the probability that an individual chooses a particular alternative is expressed as a function of the utility associated with each alternative. The utility that a particular individual associates with each mode is unkown to the modeler, but can be estimated using a sample of stated or revealed preference observations. Maximum likelihood estimation is commonly used to determine the values of the utility equation cofficients for which the observed sample is most likely to have occurred (Ben-Akiva and Lerman 1985). Therefore, the utility equation coefficients are not determined directly, but are instead estimated by maximizing the likelihood that the model would predict the alternative that an individual was actually observed to choose. These coefficients give insight on how the probability of selecting each alternative changes.

There are several limitations associated with the standard multinomial logit model. One of these limiations is that it assumes that there is no correlation in unobserved factors that affect decision makers. This may not be suitabile when fitting a model to a data set where individuals make repeated choices and are likely to exhibit similar behavior when making each choice, such as with stated preference data. A mixed logit model is much more flexible and allows for correlation in unobserved factors. This is accomplished by allowing utility equation coefficients to vary over individuals in the population according to a distribution specified by the modeler (Train 2003). Since stated preference data was used in this research, mixed logit models will be used instead of the standard multinomial logit to account for similarities in decision makers' repeated choices.

2.5.2 Market Segmentation

Separate models can be created for subgroups within a population who are believed to use different criteria when making mode choice decisions. This process is referred to as market segmentation and can reveal whether certain variables impact the decision making process differently among population groups (Koppelman and Bhat 2006).

The market segmentation test is used to determine whether segmented populations are statistically different from one another. This test compares the difference between the collective goodness-of-fit measures of the segmented models and the pooled model (estimated for the entire data set). The null hypothesis for this test is that there are no differences between the coefficients estimated for the segmented models. The formula used to calculate the test statistic for the market segmentation test is shown in Equation 2.2 (Koppelman and Bhat 2006).

$$-2 \times \left[\ell(\beta) - \sum_{s=1}^{S} \ell(\beta_s) \right] \geq \chi^2_{n,(p)} \qquad (2.2)$$

where:

$\ell(\beta)$	is the log-likelihood for the pooled model,
$\ell(\beta_s)$	is the log-likelihood of the sth market segmentation model,
$\chi^2_{n,(p)}$	is the chi-square distribution critical value with n degrees of freedom and significance level p,
n	is equal to the number of restrictions, $\sum_{s=1}^{S} K_s - K$,
K	is the number of coefficients in the pooled model, and
K_s	is the number of coefficients in the sth market segmentation model.

If the left side of Equation 2.3 is found to be greater than the chi-square critical value then the null hypothesis is rejected and it can be concluded that the market segmentation models are statistically different from one another. This test is used in this study to determine whether models estimated for survey respondents using the I-10E and I-10W corridors are statistically different.

2.6 Summary

Increasing traffic congestion and limited transportation resources have caused transportation demand management strategies that incorporate value pricing to increase in popularity. In the United States, value pricing is being successfully used to allow vehicles that do not meet HOV lane occupancy restrictions to use the HOV lane for a price. These HOT lanes have been implemented in metropolitan areas in California, Colorado, Florida, Minnesota, Texas, Washington, and Utah.

Many studies have been conducted around the country to evaluate how different groups of travelers are likely to respond to the value pricing concept. These studies typically use traveler survey response data to analyze how an individual's socioeconomic and trip characteristics affect their travel behavior and attitudes. This information is used to quantify the attitudes of particular traveler groups. Comparing studies administered for different projects reveals that many traveler characteristics often have different impacts on the willingness to pay for travel time savings, which suggests that attitudes toward value pricing vary by location. However, very little is known about how travelers that are not in the traditional urban setting will respond to the value pricing concept, since most projects have been implemented to serve travelers in highly congested urban corridors. The increasing popularity and appeal of value pricing as a transportation demand management solution is already causing the concept to be considered for future improvements in suburban areas that are expected to become congested in the future. The successful implementation of these projects will require an understanding of how suburban travelers may potentially react to value pricing scenarios, which is the goal of this research.

This thesis explores the potential response to value pricing using travel survey response data from two different suburban population groups near San Antonio. Traveler responses to stated preference scenarios that include pricing options are analyzed using discrete choice models. These models help quantify how various traveler characteristics influence the choice of travel mode. Separate market segmentation models are developed for the two populations to compare differences in response to value pricing.

CHAPTER III

STUDY BACKGROUND AND DATA COLLECTION

This chapter provides a background of the study area where survey responses were obtained as well as how the survey was designed and administered. Data preparation procedures are also covered.

3.1 Study Area Characteristics

Data for this research were obtained from a study which evaluated the implementation of value priced Express Toll Lanes (ETLs) on two separate and dissimilar segments of Interstate 10 (I-10) near San Antonio, TX. This study, initiated by the Federal Highway Administration's Value Pricing Pilot Program and the Texas Department of Transportation, and carried out by the Texas Transportation Institute, evaluated value pricing on a 19-mile segment of I-10 just northwest of San Antonio (I-10W) and another 30-mile segment on the east side of the city (I-10E). These two corridors are shown in Figure 6.

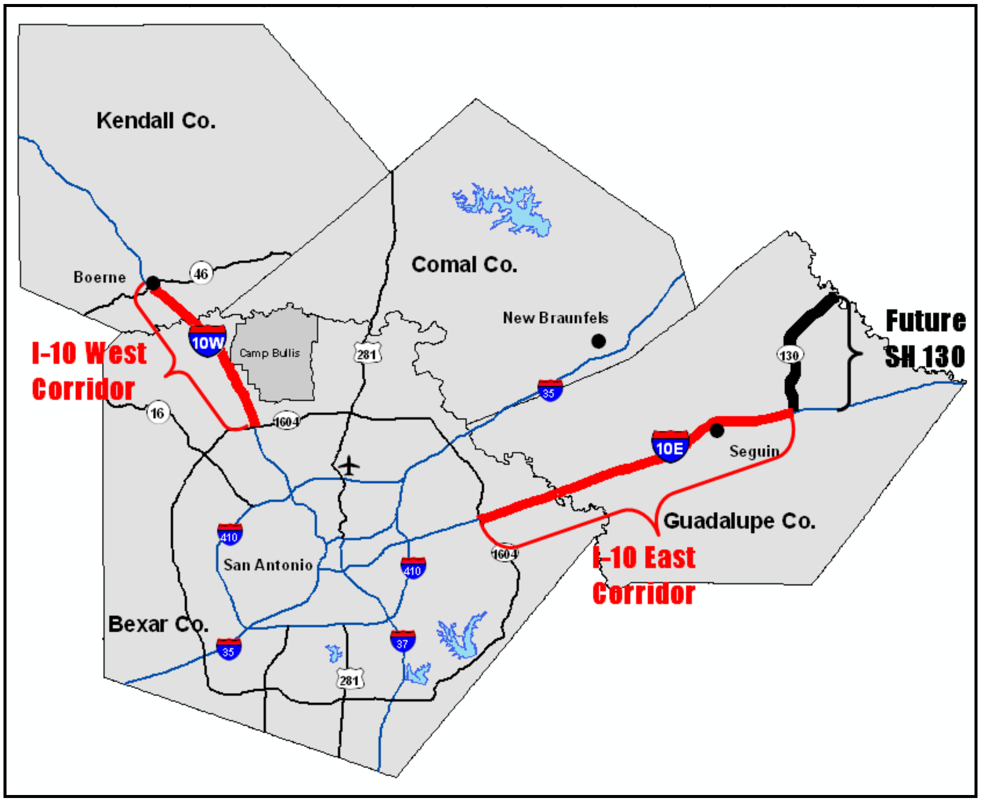

Figure 6. Interstate 10 Value Pricing Study Corridors in San Antonio, TX

One goal of the I-10 Value Priced Express Lane Study was to evaluate how populations using these corridors would respond to value pricing if ETLs were added in the future. According to the San Antonio-Bexar County Metropolitan Planning Organization (SA-BC MPO), the 19-mile stretch of I-10W between Loop 1604 and SH 46 in Boerne, TX currently serves as many as 80,000 vehicles per day and traffic volumes are estimated to reach 200,000 vehicles per day by 2030 (2004). On the east side of San Antonio, the 30-mile segment between Loop 1604 and the future State Highway 130 (SH 130) just outside of Seguin, TX serves as much as 65,000 vehicles per day in 2009 and volumes are estimated to reach 130,000 vehicles per day by 2030.

Both corridors currently consist of two general purpose lanes (GPLs) in each direction (see Figure 7-8), with the exception of a 1.5 mile segment of I-10W closest to Loop 1604 that consists of 3 lanes in both directions. There is no near-term funding in the Texas Department of Transportation's budget for expansion of these facilities, but one potential option is to add ETLs to existing GPLs if the users of the system are willing to pay tolls to help fund construction of the ETLs.

Figure 7. View of the Eastern Segment of the I-10 Study Area

Figure 8. View of the Western Segment of the I-10 Study Area

Other projections made by the SA-BC MPO indicate a need for increased capacity on the I-10E and I-10W corridors. It is estimated that the population of the San Antonio region will increase by 68 percent from 2000 to 2030 (SA-BC MPO 2004). Most of this growth is expected to take place in the northern half of Bexar County outside of Loop 410. The surrounding counties are also expected to see sustained growth, but San Antonio will remain the hub of employment activity in the area (SA-BC MPO 2004). These projections indicate that related traffic congestion on the I-10W and I-10E corridors will extend outwards toward the county line. In addition, traffic growth between Texas and Mexico is expected to continue. The two locations with the third and fourth highest volumes of truck traffic in the San Antonio region are I-10 just east of Loop 410 and I-10 just northwest of San Antonio (SA-BC MPO 2004). The completion of State Highway 130, which will connect to I-10 just east of Seguin, will likely bring even higher truck volumes to I-10 as trucks are diverted from I-35.

The characteristics of these two corridors, as well as the populations living in proximity to them, are vastly different. The western segment of I-10 (I-10W) is currently experiencing a large amount of retail and housing development, a trend that is expected to continue, while the eastern segment of I-10 (I-10E) is largely undeveloped and mostly rural. Data from the 2000 U.S. Census illustrates how the populations living in proximity to these two corridors differ in terms of demographic characteristics such as income, education, and ethnicity. The median income of the I-10W corridor is roughly 75 percent higher than the median income of the I-10E corridor. Higher incomes are likely correlated to the fact that a much higher percentage of the I-10W population has received an education past high school as compared to I-10E. Census data also shows that the population along the I-10W corridor is predominantly white while the I-10E corridor has higher Hispanic and African American populations. Detailed census data are presented in Chapter IV.

3.2 Survey Design and Administration

To collect the necessary traveler information an internet-based survey of I-10 travelers was undertaken. A copy of this survey is included in Appendix A. The survey contained 40 questions in four broad categories:

- trip information,

- traveler opinions regarding I-10 congestion and ETLs,
- stated preference questions, and
- demographic information.

The internet survey went live in English and Spanish on February 19, 2009 and was terminated on April 13, 2009. The web address for the survey was advertised on local websites, in newspapers and newsletters, and was covered briefly on a local news station. A total of 899 survey responses were received. However, only 557 of these had at least one question answered in every section including 102 from drivers using I-10E and 455 from drivers using I-10W.

Survey respondents who visited the survey website were first directed to a screen asking them to indicate which segment of I-10 they traveled on by clicking on a map showing the two corridors. This screen also contained an area where respondents were instructed to click if they did not travel on either I-10 segment. Since the focus was on travel on the I-10E and I-10W corridors, respondents who indicated they never traveled on these segments were directed to a page thanking them for their time and interest and were not included in this research.

The first section of the survey asked travelers about their most recent trip on I-10. The survey was designed so that 50 percent of respondents would be asked about their most recent trip towards San Antonio and 50 percent would be asked about their most recent trip away from San Antonio. A total of 17 questions were asked to obtain a thorough description of the respondent's last trip on I-10, although some questions were only visible depending on answers to previous questions.

After being asked specifically about their most recent trip on I-10, respondents were then asked more general questions about their travel on I-10. This section included four questions asking respondents how many trips they make on I-10 per week, how much they enjoy their travel, if they have an alternative to using I-10, and what they expect traffic on I-10 to be like in 10 years time.

The third section of the survey introduced respondents to the idea of value pricing in the form of express toll lanes (ETLs) then asked them about their attitudes towards the idea. A brief introductory paragraph explained that increasing traffic congestion would require the expansion of I-10 by 2030 and that one option would be the construction of ETLs. The description said that a single ETL would be added in each direction and a toll would be charged electronically for any vehicle wishing to use the lane, but the lanes would remain uncongested. It was also mentioned that toll discounts or free travel on the lane may be available for carpools and busses. After this description, respondents were asked if they would be interested in using the ETLs and what features of the ETLs made them attractive or unattractive. The last two questions in this section asked respondents about their general feelings toward time-of-day and dynamic pricing scenarios after each was described briefly.

In order to understand how the users of I-10 valued their travel time, survey respondents were then asked a series of three stated preference questions. These questions asked respondents to choose between four travel scenarios for the trip they described earlier in the survey and were presented as shown in Figure 9.

Mode: Drive by myself	**Mode:** Carpool with others	**Mode:** Drive by myself	**Mode:** Carpool with 3 or more people
Lane: Main freeway lanes	**Lane:** Main freeway lanes	**Lane:** Toll lanes	**Lane:** Toll lanes
Travel Time: 18 minutes	**Travel Time:** 20 minutes	**Travel Time:** 14 minutes	**Travel Time:** 13 minutes
Toll: $ None	**Toll:** $ None	**Toll:** $ 1.10	**Toll:** $ None
Time of Day: afternoon rush hour	**Time of day:** afternoon rush hour	**Time of Day:** afternoon rush hour	**Time of Day:** afternoon rush hour

Figure 9. Sample Stated-Preference Question

There were a total of five mode and lane combinations from which four were presented to respondents in each stated preference question. The five combinations available were:

- Drive alone – General purpose lanes (DA-GPL)
- Carpool with others – General purpose lanes (CP-GPL)
- Drive alone – Express Toll lanes (DA-ETL)
- Carpool with one other person – Express Toll lanes (CP2-ETL)
- Carpool with 3 or more people – Express Toll lanes (CP3-ETL)

Survey respondents were always presented with their current mode of travel as the first scenario in each stated-preference question, which was either driving alone or carpooling in the main freeway lanes. The mode and lane combinations for the other three scenarios were randomly chosen from the remaining four. The time-of-day was always the same for each scenario and corresponded to the time of day of the respondent's most recent trip, as they indicated at the beginning of the survey. Travel times for each scenario were generated based on the trip length, also indicated earlier in the survey, and a random speed. This random speed was coded so that it would be higher on the toll lanes than the main freeway lanes during peak periods. During off peak periods the speeds on the toll lanes could be close to or possibly even lower than on the main freeway lanes. Tolls were calculated using the trip length and a randomly generated per-mile toll rate. This toll rate was programmed so that most of the time it would be lower for carpooling options compared to the drive alone option, to simulate a tolling policy that charges a lower toll for HOVs. The per-mile toll rates were also programmed to be halved during the off-peak periods. See Appendix C for a thorough description of the stated preference design.

The last section of the survey asked respondents to provide answers to demographic questions about themselves and other members of their household.

3.3 Data Preparation

All survey responses that contained at least one response in every section were exported from the internet database in a spreadsheet format. Since weighting variables were created for I-10E and I-10W respondents based on income, any surveys that did not have an answer for this question had to be excluded from the analysis (see Chapter IV for details of the weighting procedure). This exclusion left 497 valid surveys including 89 surveys from I-10E respondents and 408 surveys from I-10W respondents. There were a total of 12 surveys from I-10E respondents and 47 surveys from I-10W respondents that were dropped. No efforts were made to predict incomes for those that did not respond due to the small number of surveys from I-10E respondents that would be gained.

The program LIMDEP 9.0 was used for analysis of the survey data, including the development of discrete choice models. Although all 497 valid surveys were intended for inclusion in the discrete choice models, some of these surveys were not used because they did not have answers to particular questions. If a particular variable was included in the discrete choice model, but the respondent failed to answer the question from which the value of that variable would be obtained, then the software program would automatically skip that survey. Also, an error in the coding of the survey caused some stated preference scenarios to present respondents with a zero toll for the DA-ETL mode, so these responses were discarded. This error was infrequent and confined to the second and third stated preference questions only, so every survey contained at least one valid stated preference response.

Only surveys that contained answers to all demographic questions including gender, age, ethnicity, income, education, household type, and occupation were included when performing group comparisons between the I-10E and I-10W samples. This was done for two reasons. First, survey responses with all of these questions answered were likely to be fully or mostly completed and therefore would also be included when developing discrete choice models. Second, restricting surveys based on answers to these key demographic questions ensured consistent sample size among all group comparison analyses.

LIMDEP requires that survey responses be “stacked” such that each spreadsheet row corresponds to a single stated preference scenario. Therefore, most responses were coded into twelve rows since all respondents were presented three stated preference questions and each question contained four scenarios. However, since some responses were invalid or left unanswered, there were many surveys that were coded into less than twelve rows. There were a total of 241 stated preference responses from I-10E respondents and 1164 stated preference responses from I-10W respondents.

CHAPTER IV

GROUP COMPARISONS

This chapter provides comparisons of I-10E and I-10W travelers using data collected from the 2000 U.S. Census and the travel survey described in the previous chapter. First, demographic data from census tracts along the I-10E and I-10W corridors were analyzed to make comparisons of demographic and trip characteristics between both groups of travelers. Then responses from the travel survey were used to make further comparisons. Responses from the travel survey were also compared with census data and a weighting procedure was performed to make the survey sample more representative of the populations living near the two sections of I-10.

4.1 Comparisons to U.S. Census Data

In order to understand the demographic makeup of the I-10 corridor and survey respondent areas, year 2000 U.S. Census demographic data from census tracts in proximity to the I-10 corridors were collected from the U.S. Census Bureau's American FactFinder website. Newer data from the American Community Survey, which collects population and household information every year, is not available at the census tract level and could therefore not be used to make distinctions between the two corridors. Figure 10-Figure 11 show the census tracts for which census data was collected for each segment of I-10. These tracts were selected based on their proximity to the study corridors and the likelihood of individuals residing in these tracts traveling on I-10. Data were collected for:

- 6 census tracts in Bexar County,
- 3 census tracts in Kendall County, and
- 11 census tracts in southern Guadalupe County.

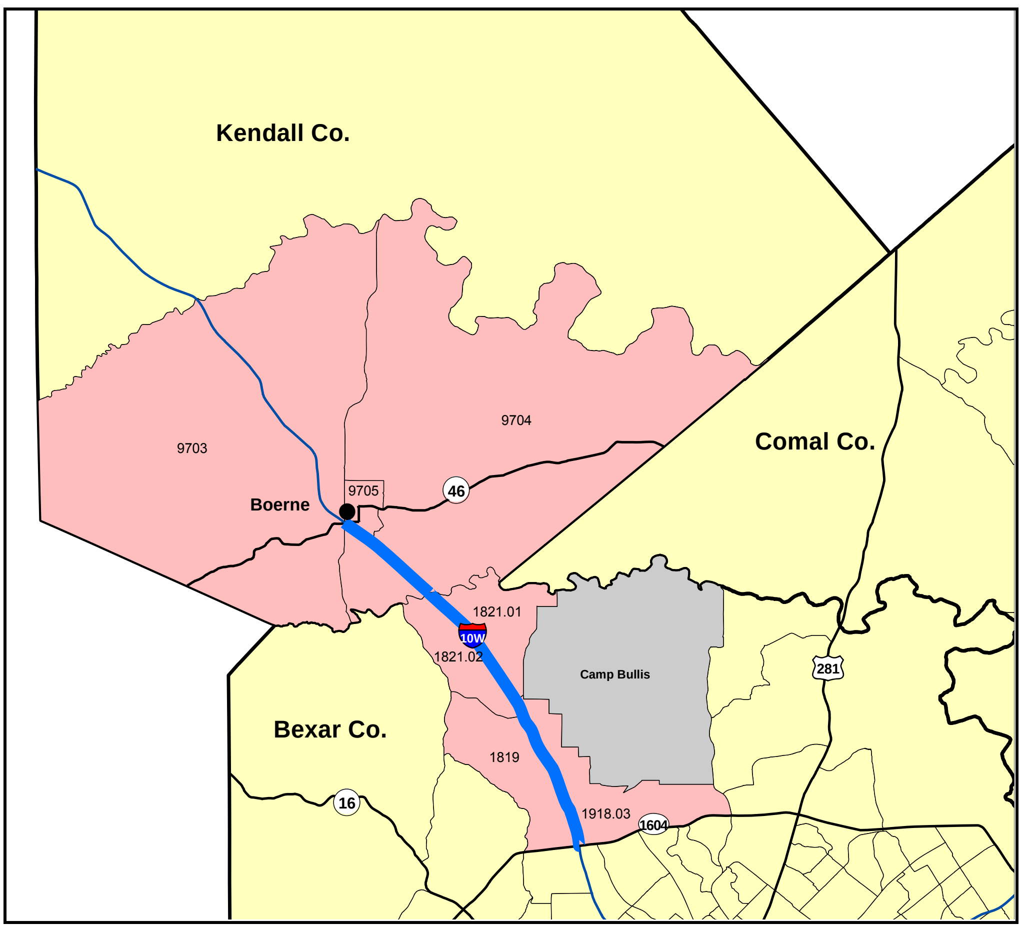

Figure 10. U.S. Census Tracts Surveyed in I-10W Corridor (shaded tracts were surveyed)

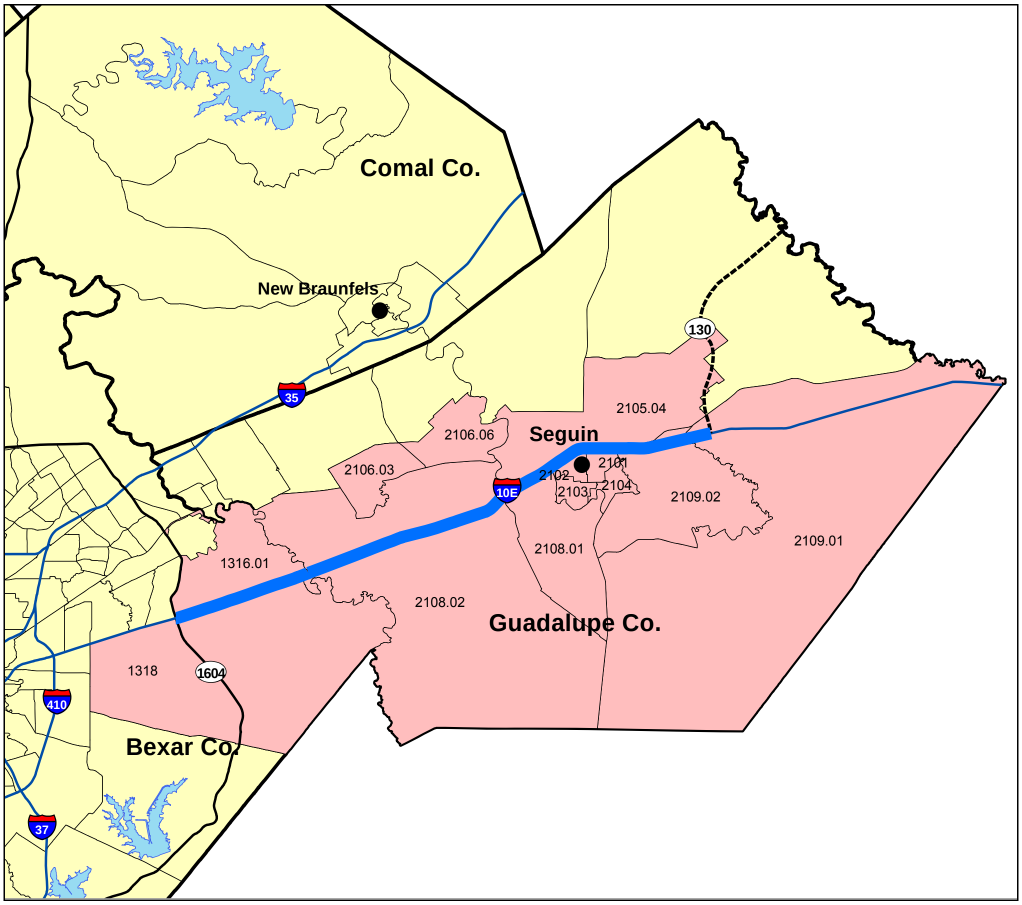

Figure 11. U.S. Census Tracts Surveyed in I-10E Corridor (shaded tracts were surveyed)

The demographic data collected for each census tract are located in Census 2000 Summary Files 1 and 3 of the American FactFinder website. These files are a compilation of the responses to the "short form" sent to every household and the "long form" sent to one in six households during the 2000 Census. Some data collected by the census correspond to the following similar questions asked in the web survey:

- race, age, sex, household income, and education attained;
- household size and type;

- mode of transportation to work;
- vehicle occupancy; and
- travel time to work.

Data from census tracts in proximity to I-10E and I-10W were compiled separately to observe differences that exist between the two populations (see Table 1). This comparison reveals several noticeable demographic differences between the I-10E and I-10W populations. The population living along the I-10W corridor appears to be slightly older, is predominantly white, has a higher percentage of married households, and is more highly educated as compared to the population along the I-10E corridor. Percentages that differ by more than 10 percent are bolded in Table 1 to denote substantial differences between the two populations. The household type percentages for the "married without children" and "married with children" categories were also bolded because the percentage of married households is 10 percent higher among the I-10W population.

Table 1. East and West Demographic Comparison using 2000 U.S. Census Data

Demographic Category	Demographic Subcategory	I-10 East Census Tracts	I-10 West Census Tracts
Gender	**Male**	48.4%	48.3%
	Female	51.6%	51.7%
Age	**18 - 24**	13.2%	10.2%
	25 - 34	16.2%	12.4%
	35 - 44	21.9%	23.0%
	45 - 64	31.3%	38.8%
	>65	17.5%	15.5%
Racial/Ethnic Group	**White**	**57.7%**	**79.8%**
	Black or African American	5.7%	0.9%
	Hispanic	**34.6%**	**16.7%**
	Other	2.1%	2.7%
Household Type	**Single adult**	20.4%	17.5%
	Unrelated adults	4.1%	4.8%
	Married without children	**32.3%**	**37.6%**
	Married with child(ren)	**26.5%**	**31.2%**
	Single parent family	9.6%	5.0%
	Other	7.1%	3.9%
Education Attained	**Less than high school**	**26.5%**	**9.1%**
	High school graduate	**33.2%**	**17.8%**
	Some college/vocational	21.9%	26.3%
	College graduate	**14.1%**	**30.0%**
	Postgraduate degree	4.4%	16.8%

Census data were also used to compare household incomes for the I-10E and I-10W populations. Median household incomes for census tracts along the I-10 corridors as well as the weighted average of the median household incomes are shown in Figure 12. All incomes were adjusted from 1999 dollars to 2008 dollars using the Consumer Price Index (24.5 percent increase). The weighted average median household incomes were determined by obtaining the product of the median household income and the number of households in each tract, summing those products, and then dividing that sum by the total number of households in the corridor. The corridor median household income weighted average for the I-10W corridor was found to be $88,556, which is over 75 percent higher than the I-10E weighted average of $50,425.

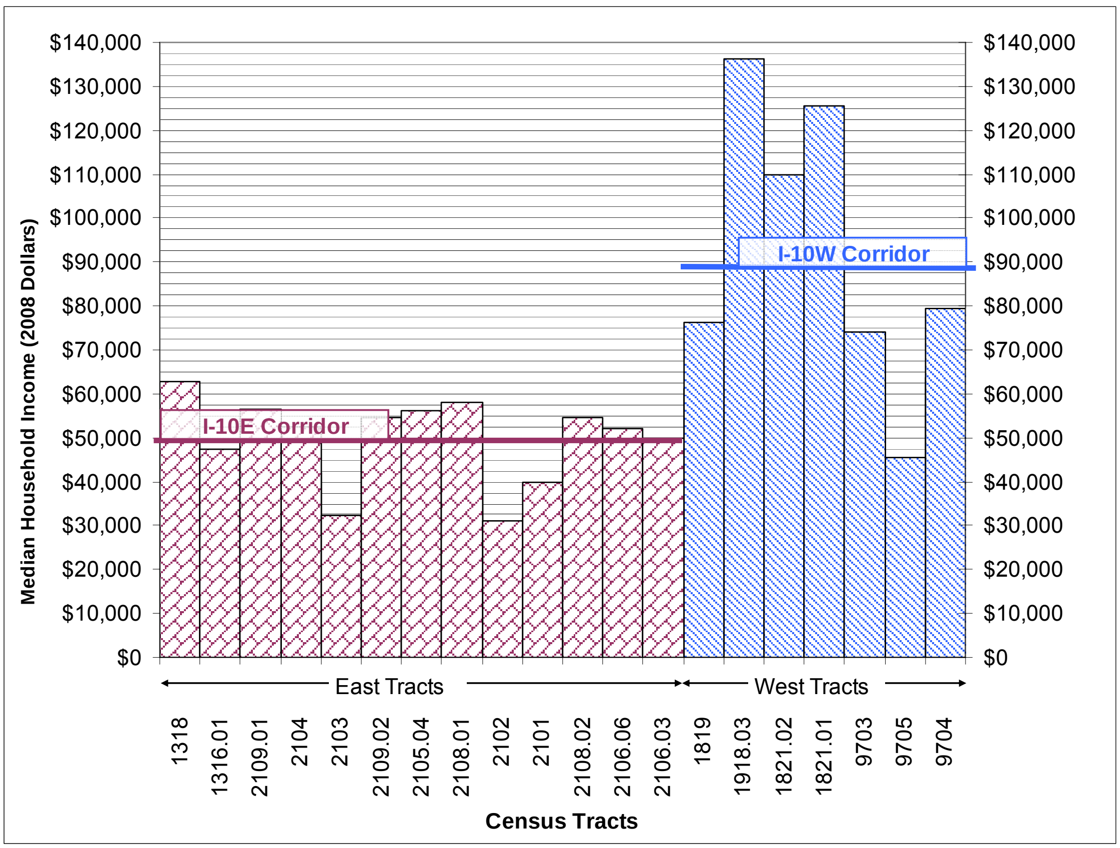

Figure 12. Median Household Incomes Along I-10 Corridors

The distribution of incomes among the populations living along I-10E and I-10W were also examined. Plots of cumulative distribution of incomes generated for both populations using census data are shown in Figure 13. Census percentages were again adjusted from 1999 annual household incomes to 2008 annual household incomes using the Consumer Price Index (24.5 percent increase). In order to do so, an even distribution of census respondents throughout each income category had to be assumed. For example, the census income category of $10,000 to $14,999 had 696 respondents from census tracts along the I-10W corridor. Using the Consumer Price Index of 24.5 percent, it can be calculated that making $12,052 in 1999 would be the equivalent of $15,000 in 2008 dollars. The percent of respondents within the $10,000 to $14,999 income category making more than $12,052 is determined assuming that the 696 respondents were evenly distributed throughout the income category. Therefore, it is found that roughly 60 percent of respondents within the $10,000 to $14,999 income group would have 2008 incomes in the $15,000 to $24,999 range. This procedure was carried out for all income groups to determine the number of respondents to shift to the next highest income group.

The cumulative income distributions depicted in Figure 13 clearly show a large disparity between the populations living in proximity to I-10E and I-10W. This plot shows that over 40 percent of the households around the I-10W corridor make over $75,000 per year as compared to only 15 percent of households around I-10E that make over $75,000 per year. The fact that incomes are much higher for households along the I-10W corridor indicates a potential higher willingness to pay a toll by users of this corridor as compared to users of the I-10E corridor.

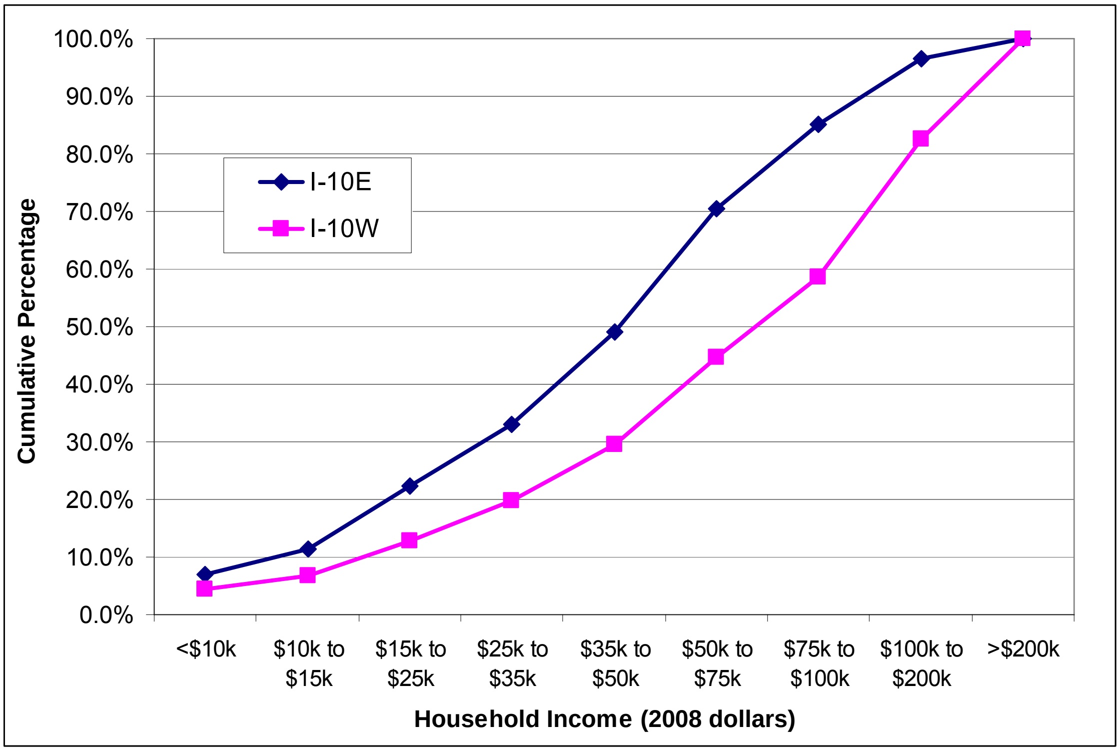

Figure 13. Income Distribution for Populations in Proximity to I-10 Corridors

Census data were also compiled for questions related to transportation characteristics for each population group. The census "long form," which is sent to one in every six households, asks respondents several questions that are directly related to commute travel. One of these questions asks whether or not the individual works in the same county that he or she resides. Table 2 contains the percentage of census respondents from census tracts along I-10E and I-10W that work and reside in the same county. The percentage of individuals who live and work in Bexar County is similar for census tracts along both corridors; however, the percentages are different for Kendall and Guadalupe counties. The majority of individuals living in Kendall County reported working in a different county while the majority of individuals living in Guadalupe

County reported working in the same county. This indicates that a larger percentage of the I-10W population may be using I-10W for commuting purposes as compared to the population along I-10E.

Table 2. Percentage of Population that Work and Reside in Same County

	I-10E Census Tracts		I-10W Census Tracts	
	Guadalupe County	Bexar County	Kendall County	Bexar County
Work and Reside in Same County	64.0%	91.0%	46.4%	93.2%
Do Not Work and Reside in Same County	36.0%	9.0%	53.6%	6.8%

Census respondents were also asked how much time it took for them to commute to work. Respondents were presented with several travel time increments and were asked to select the increment representing their average travel time to work. The average travel time to work for each census tract was calculated by finding the midpoint of each travel time increment, multiplying by the percentage of respondents, summing those products, then dividing by the number of respondents from each census tract. The average travel times that were calculated are portrayed in Figure 14. The census tracts shaded yellow near Seguin along the I-10E corridor indicate that many individuals living in these census tracts are not traveling far for their commute. This result confirms that a substantial proportion of individuals along I-10E are likely not using the corridor for commute purposes.

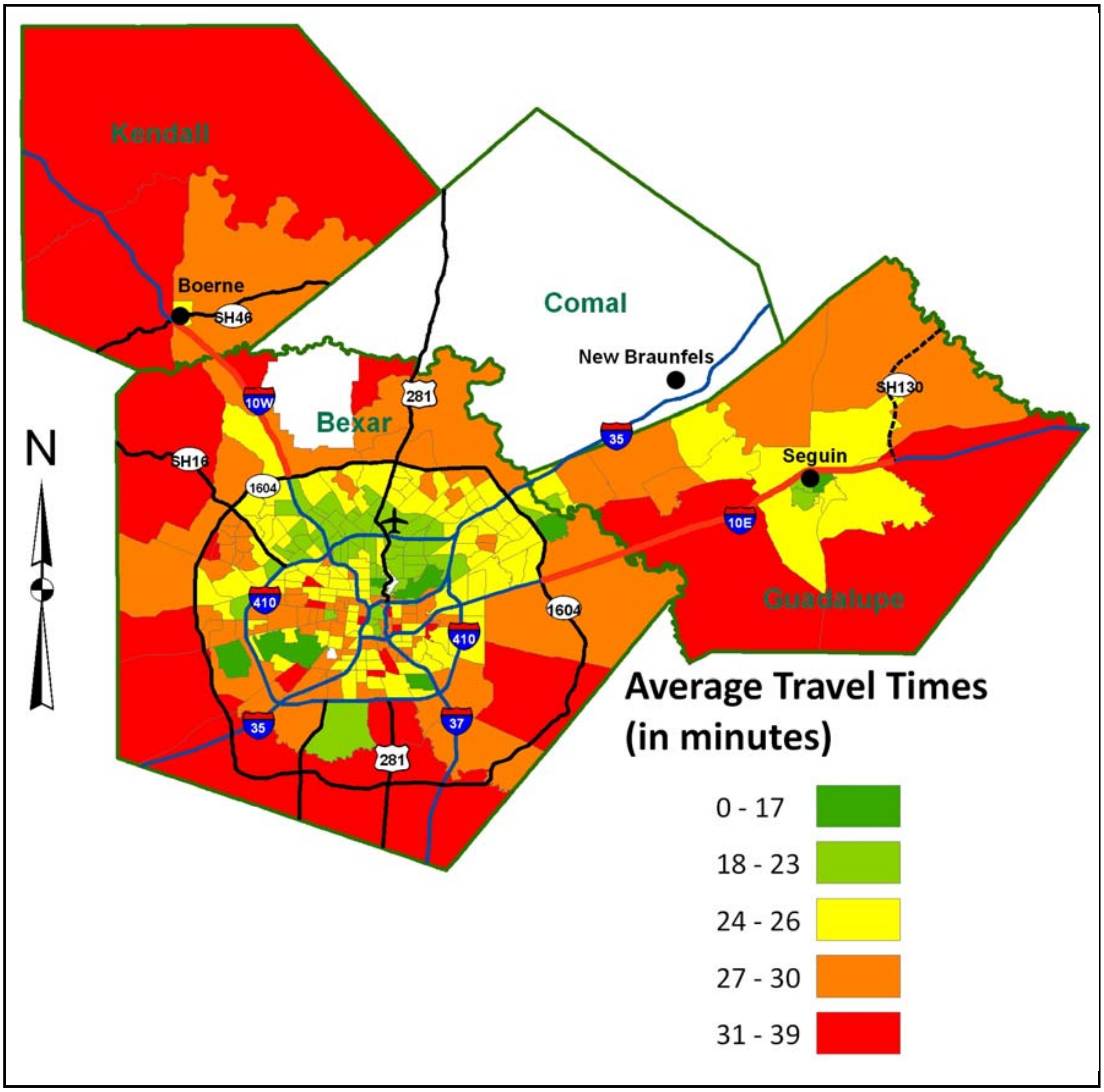

Figure 14. Census Responses - Average Travel Times to Work

Lastly, responses to the census "long form" pertaining to means of transportation to work were compiled. The percentages of respondents from census tracts along both corridors who indicated each specific mode of transportation to work are tallied in Table 3. This tally shows that driving is the most common form of commute transportation for individuals along both corridors. This is expected because many commuters are traveling long distances and there is no public transportation serving either of the I-10 corridors. Results also show that a higher percentage of I-10E commuters reported that they carpool to work. Field data collected during the peak periods in October of 2008 revealed 15.5 percent of travelers carpooling on I-10E and 12.6 percent of travelers carpooling on I-10W. These values match closely with census results shown in Table 3.

Table 3. Census Responses - Means of Transportation to Work

	I-10E Census Tracts	I-10W Census Tracts
Drove Alone	77.0%	82.1%
Carpooled	15.8%	10.7%
Public Transportation	0.4%	0.1%
Motorcycle	0.2%	0.1%
Bicycle	0.2%	0.3%
Walked	2.2%	1.7%
Other Means	1.2%	0.7%
Worked at Home	3.0%	4.2%

A comparison of responses to the 2000 U.S. Census reveals several differences between the populations in proximity to the I-10E and I-10W corridors. In terms of demographics, those living along I-10W have higher incomes and are more highly educated on average as compared to the I-10E population. Furthermore, the I-10W population is less ethnically diverse than the I-10E population. Census results also revealed that a larger percentage of individuals living along the I-10W corridor are likely using I-10 for commuting purposes as compared to individuals living along I-10E. This conclusion was made evident by the fact that average travel times were higher for the I-

10W population and more residents in Kendall County, at the terminus of the I-10W corridor, reported that they worked in a different county than where they resided.

Census data collected for census tracts in proximity to the I-10E and I-10W corridors were compared with survey responses from I-10E and I-10W travelers to determine whether the survey samples were representative of populations living along these corridors. Comparisons of socioeconomic characteristics including household income, ethnicity and education level were made to determine whether distributions of these characteristics among survey respondents matched with census data. Distributions comparing these characteristics for I-10E survey respondents are shown in Figure 15-Figure 17.

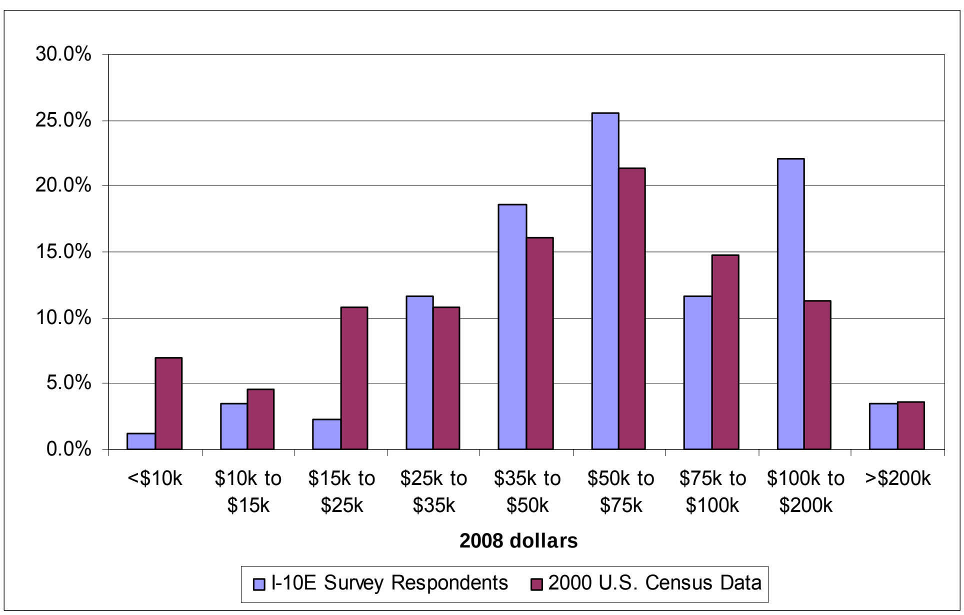

Figure 15. Distribution of Household Incomes Among I-10E Survey Respondents and Population Living in Proximity to I-10E

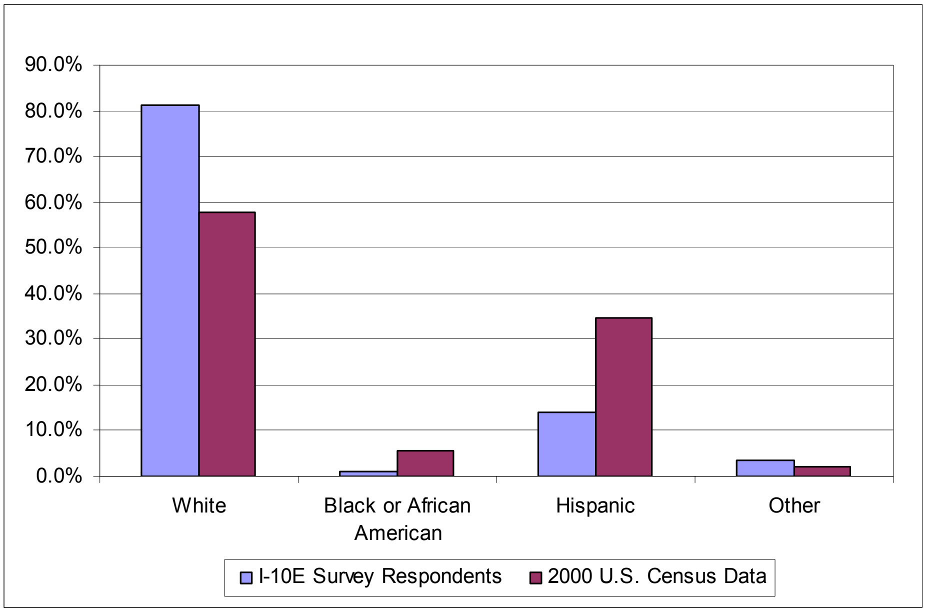

Figure 16. Comparison of Ethnicities of I-10E Survey Respondents and Population Living in Proximity to I-10E

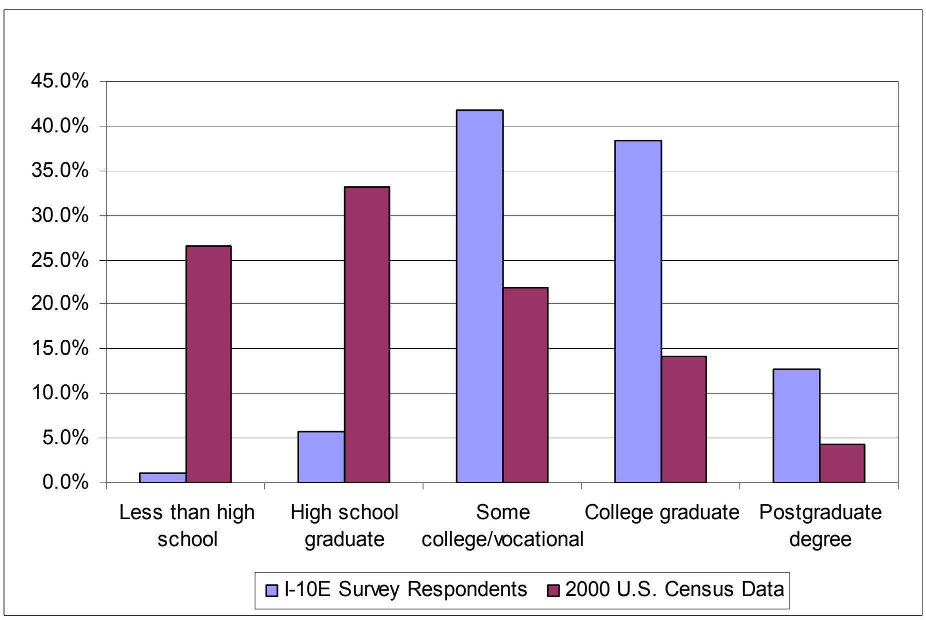

Figure 17. Comparison of Education Level of I-10E Survey Respondents and Population Living in Proximity to I-10E

Results show that characteristics of the I-10E survey sample are not representative of characteristics of those living in proximity to the I-10E corridor. Individuals with household incomes below $25,000 were not well represented in the I-10E sample while individuals with household incomes between $100,000 and $200,000 were overrepresented. Census results show that 58 percent of the population along I-10E is white and 35 percent is Hispanic, but the survey sample consisted of over 80 percent white respondents and only 14 percent Hispanic respondents. The disparity between census data and survey results is even greater when looking at education level. As shown, individuals without a college degree were drastically undersampled while those with college degrees were oversampled.

Distributions comparing the characteristics of I-10W respondents with census data are shown in Figure 18-Figure 20. As was observed for the I-10E sample, individuals with lower household incomes, lower education levels, and minorities were not well represented in the I-10W sample.

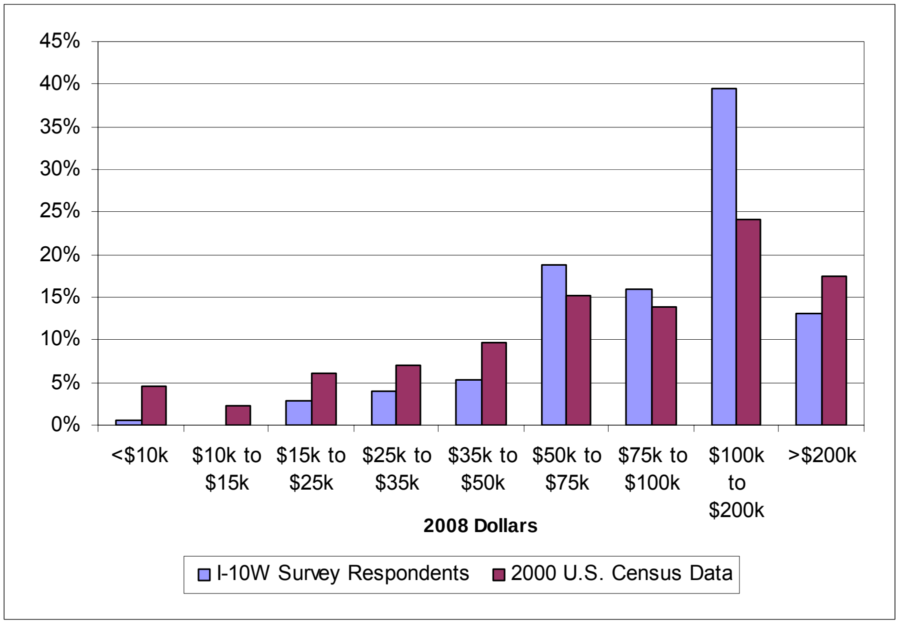

Figure 18. Comparison of Household Incomes Among I-10W Survey Respondents and Population Living in Proximity to I-10W

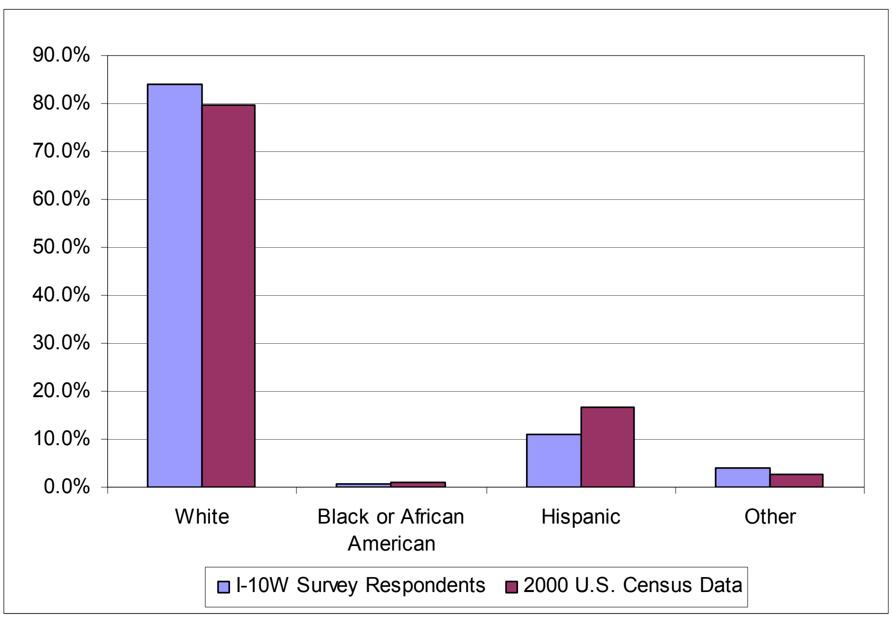

Figure 19. Comparison of Ethnicities of I-10W Survey Respondents and Population Living in Proximity to I-10W

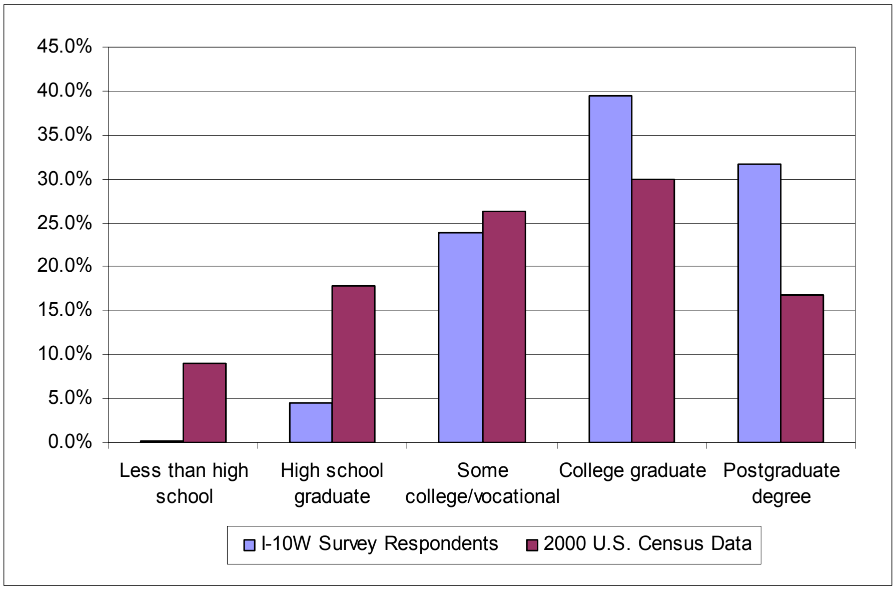

Figure 20. Comparison of Education Level of I-10W Survey Respondents and Population Living in Proximity to I-10W

Comparisons of census data and survey results reveal that survey responses may not be representative of the true populations using the I-10E and I-10W corridors. To make the analysis of survey results more applicable to travelers on these two corridors, the underrepresentation and overrepresentation of individuals with particular characteristics must be compensated for. This was accomplished by applying a set of statistical weights to survey responses.

4.2 Statistical Weighting

Due to the discrepancies between the percentage of travelers in various groups in survey and census data, weights were formulated and applied to each survey respondent to account for whether a particular respondent group was underrepresented or overrepresented in the survey sample. These weights were used to compare characteristics of I-10E and I-10W respondents as well as in formulating mode choice models. Weighting the survey responses helps reduce biases introduced by an unrepresentative sample. Weights are determined using the ratio of the representation of a particular respondent's characteristic in the general population to that respondent's representation in the survey sample, calculated as:

$$W_i = \frac{P_{j,pop}}{P_{j,sample}}, \tag{4.1}$$

where W_i is the weight for respondent *i*, $P_{j,pop}$ is the percentage of people having characteristic *j* in the population, and $P_{j,sample}$ is the percentage of people having characteristic *j* in the survey sample. In this way, the weight will take on a value greater than 1 for individuals who are underrepresented in the sample and a value less than 1 for individuals who are overrepresented in the sample; the magnitude of the deviation from 1 represents the extent of the over- or underrepresentation of each respondent.

A set of weights was calculated for each survey respondent based on his or her income and ethnicity characteristics using the methodology described above (see Table 4). Some income and ethnicity groups were not represented at all in the web survey; therefore, no weights could be calculated for these groups as indicated by dashed lines in Table 4. After observing the weights it was evident that there was not enough diversity in the survey sample to formulate weights using both income and ethnicity characteristics. The weight of 19.11, shown in the top left corner of Table 4, would have the effect of amplifying the responses from the single survey respondent who indicated being of white ethnicity and having a household income of less than $10,000 by a factor of over 19. Doing so places a lot of significance on the responses of a single respondent, who may or may not be a typical representative of that particular income and ethnicity group. Similarly, the weights of 0.32 and 0.14 considerably deflate the significance of responses from respondents indicating African American ethnicity and household incomes greater than $100,000.

Table 4. Weighting Factors for Survey Respondents Using Income and Ethnicity Responses

Income \ Ethnicity	White	African American	Hispanic	Other
Less than $10,000	19.11	--	2.50	--
$10,000 to $14,999	4.14	--	--	--
$15,000 to $24,999	3.41	--	1.64	--
$25,000 to $34,999	1.60	--	1.74	1.93
$35,000 to $49,999	1.84	--	1.78	1.50
$50,000 to $74,999	0.88	1.94	1.19	1.58
$75,000 to $99,999	0.93	--	0.95	0.70
$100,000 to $199,999	0.48	0.32	0.25	0.54
$200,000 or more	0.84	0.14	0.39	0.96

Due to the lack of diversity among all combinations of ethnicity and household income groups among the survey responses, it was decided to formulate weights based on income alone. Income is an important characteristic that has consistently been found to influence travel behavior on toll roads and is therefore an important characteristic by which to formulate weights for a survey focused on managed lane use. The final weights that were calculated by grouping the survey respondents into three income categories are shown in Table 5. Weights were calculated separately for respondents using I-10E and I-10W for the purpose of developing separate models for each corridor. The weights for the $35,000 to $100,000 income range are close to 1, which indicates that this income group was well represented in the survey sample. However, the weights for those having incomes less than $35,000 are greater than 1 to account for the fact that these individuals were underrepresented in the sample and the weights for individuals with income greater than $100,000 are less than 1 to account for the fact that these individuals were overrepresented in the sample.

Table 5. Weighting Factors for I-10E and I-10W Respondents

Income Group	I-10W	I-10E
Less than $35,000	2.60	1.84
$35,000 to $100,000	0.96	0.91
Greater than $100,000	0.80	0.60

4.3 Comparisons using Survey Results

Weighted survey responses from travelers using I-10E and I-10W were compared to determine and quantify differences in demographics, trip characteristics, attitudes toward value pricing, and stated-preference responses. These comparisons, like the census response comparisons, served as a basis to identify key variables to be included in the discrete choice models.

To maintain consistent sample sizes throughout each analysis, only survey responses that had answers for gender, age, ethnicity, income, education, household type, and occupation questions were used in all comparisons in this section. Survey responses with all of these questions answered were likely to be fully or mostly completed and therefore would be included when developing discrete choice models. This restriction limited the I-10W sample to 397 survey responses and limited the I-10E sample to 86 responses.

Hypothesis tests were performed to determine whether differences in the weighted percentage of respondents from each sample were statistically significant at a 95 percent level of confidence. All hypothesis tests were one-sided tests performed to determine whether one percentage was significantly higher than the other. The test statistic used when the null hypothesis assumes that two sample percentages are equal is calculated using Equation 4.2 (Montgomery and Runger 2007). For a one-sided hypothesis test, a test statistic with an absolute value greater than 1.64 indicates that one percentage is statistically higher than the other at a 95 percent level of confidence.

$$Z_0 = \frac{X_1/n_1 - X_2/n_2}{\sqrt{\hat{P}(1-\hat{P})\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}} \tag{4.2}$$

where:

X_1 = number of observations belonging to class of interest in sample 1

$n_1 =$ sample size of sample 1

$X_2 =$ number of observations belonging to class of interest in sample 2

$n_2 =$ sample size of sample 2

$$\hat{P} = \frac{X_1 + X_2}{n_1 + n_2}$$

This hypothesis test is formulated based on the normal approximation to the binomial distribution. The sampling distribution of each percentage follows an approximate normal distribution when the percentage is not close to zero or one and the sample size is large. The normal approximation can be conservatively applied when the following two conditions are met (Montgomery and Runger 2007):

- the sample size multiplied by the percentage is greater than five, and
- the sample size multiplied by one minus the percentage is greater than five.

The two conditions above required the percentage of I-10E respondents to be between 5.8 percent and 94.2 percent and the percentage of I-10W respondents to be between 1.3 percent and 98.7 percent for the normal approximation to be applied. Hypothesis tests were not performed if these conditions were not met.

4.3.1 Socioeconomic Comparisons

First, a comparison of the socioeconomic characteristics of both weighted survey samples was performed to get a general sense of how respondents from the two groups differed. This comparison is shown in Table 6. Percentages shown in bold were found to be significantly higher ($p \leq 0.05$) than the corresponding percentages for the other sample.

Table 6. Demographic Comparison of East and West Survey Respondents

	All Respondents	East Respondents	West Respondents
Gender			
Male	63.5%	70.4%	62.3%
Female	36.5%	29.6%	37.7%
Age			
18-24	4.7%	6.0%	3.5%
25-34	16.1%	13.4%	15.5%
35-44*	20.6%	13.7%	**23.0%**
45-54	24.0%	20.1%	26.3%
55-64	22.4%	27.9%	21.7%
65+*	12.3%	**19.0%**	10.0%
Ethnicity			
White	81.7%	82.8%	81.8%
Black[NC]	0.4%	0.7%	0.6%
Hispanic	13.6%	11.2%	14.0%
Asian[NC]	0.7%	0.0%	0.9%
Other[NC]	3.6%	5.3%	2.7%
Income			
Less than $10,000[NC]	1.8%	2.1%	1.3%
$10,000 to $14,999[NC]	1.8%	6.4%	0.0%
$15,000 to $24,999[NC]	7.9%	4.3%	7.3%
$25,000 to $34,999*	15.9%	**21.3%**	10.6%
$35,000 to $49,999*	8.3%	**16.9%**	5.1%
$50,000 to $74,999	21.8%	23.2%	18.3%
$75,000 to $99,999	16.4%	10.6%	15.3%
$100,000 to $199,999*	19.7%	13.2%	**31.7%**
$200,000 or more[NC]	6.2%	2.1%	10.5%

* East and West Respondents were significantly different at a 95 percent level of confidence.
[NC]The hypothesis test could not be calculated.

Table 6. Continued

	All Respondents	East Respondents	West Respondents
Education			
Less than high school[NC]	0.8%	2.1%	0.2%
High school graduate	7.4%	7.4%	6.3%
Some college or vocational school*	35.5%	**45.5%**	29.0%
College graduate	35.7%	34.8%	37.5%
Postgraduate degree*	20.6%	10.2%	**27.0%**
Household Type			
Single Adult*	19.8%	**28.7%**	13.9%
Unrelated Adults[NC]	3.0%	0.7%	3.2%
Married w/out children	27.0%	23.9%	28.8%
Married w/ children*	41.0%	35.1%	**46.9%**
Single parent family[NC]	4.3%	3.2%	4.1%
Living with family members[NC]	2.0%	5.3%	0.7%
Other[NC]	3.0%	3.2%	2.5%
Occupation			
Working part-time[NC]	2.6%	1.1%	3.2%
Working full-time	69.2%	67.3%	71.2%
Unemployed[NC]	0.3%	0.0%	0.4%
Retired*	13.4%	**20.4%**	11.4%
Permanently disabled[NC]	1.2%	2.1%	0.7%
Homemaker[NC]	5.1%	3.9%	5.5%
Student[NC]	1.9%	0.0%	2.2%
Student and working[NC]	5.6%	5.3%	4.7%
Other[NC]	0.6%	0.0%	0.7%

* East and West Respondents were significantly different at a 95 percent level of confidence.
[NC]The hypothesis test could not be calculated.

The socioeconomic comparison between the two survey samples shown in Table 6 reveals that the majority of respondents from both samples were:

- male,
- over the age of 45,
- white,
- in a household earning more than $50,000 per year,
- highly educated, and

- living in married households.

Results of the statistical comparisons between percentages of I-10E and I-10W respondents reveal several significant differences between the two groups. The percentage of travelers who are over age 65 and retired is higher on I-10E than on I-10W. Individuals with household incomes between $25,000 and $50,000 also make up a higher percentage of I-10E travelers, whereas individuals with household incomes in the $100,000 to $199,999 range make up a higher percentage of I-10W travelers. The percentage of travelers with some college education is higher for I-10E, but the percentage of travelers with postgraduate degrees is higher for I-10W. Finally, there is a larger percentage of travelers on I-10E who live alone and a lower percentage who are married with children as compared to travelers on I-10W.

Several noticeable differences between the I-10E and I-10W samples appear to be in agreement with census data examined in the previous section. The I-10W sample had a higher percentage of white respondents while the I-10E had higher percentages of Hispanic and African American respondents. Also, I-10W respondents were more highly educated and reported having higher household incomes on average as compared to I-10W respondents. Lastly, there were a higher percentage of I-10W respondents living in married households.

4.3.2 Trip Characteristic Comparisons

Weighted trip characteristics for respondents from the I-10E and I-10W survey samples were also compared to determine any differences in travel behavior that existed between the two groups. A tabulation of all travel characteristics where significant differences between the two samples were observed is shown in Table 7. Not all columns for each category in this table sum to 100 percent because some questions were unanswered, although the percentage of unanswered questions was generally small. The vehicle occupant question was only answered by respondents who indicated traveling with another individual. Trip distances were calculated by tallying where respondents indicated getting on and off the freeway. Respondents who did not include both an entrance and an exit location, or indicated the same entrance and exit location were not included. Again, all numbers in bold denote percentages that were found to be statistically different between east and west respondents at a 95 percent level of confidence.

Table 7. Trip Characteristic Comparison for East and West Survey Respondents

Travel Characteristic	All Respondents	East Respondents	West Respondents
Trip Purpose			
Commuting	43.2%	25.6%	**52.4%**
Recreational*	25.0%	**31.4%**	22.1%
Work Related*	10.8%	**14.8%**	8.5%
Other Business*	12.3%	**17.3%**	9.7%
School[NC]	3.5%	2.1%	3.5%
Airport[NC]	0.5%	2.1%	0.0%
Church[NC]	1.9%	2.1%	1.6%
Kids to school[NC]	0.2%	1.1%	0.2%
Visiting Family[NC]	0.7%	0.7%	0.5%
Other[NC]	0.9%	2.8%	1.1%
Vehicle Occupancy			
1*	66.1%	55.6%	**70.6%**
2*	21.8%	**29.2%**	19.5%
3[NC]	5.5%	3.9%	5.5%
4*	3.8%	**7.4%**	2.1%
5[NC]	0.8%	1.1%	0.7%
Vehicle Occupant			
Co-Worker	7.7%	7.2%	8.6%
Neighbor	3.7%	7.3%	2.1%
Adult Family Member*	61.5%	**74.2%**	56.0%
Child	19.7%	6.4%	26.6%
Friend[NC]	7.3%	4.9%	6.7%
Weekly Trips			
0 - 4*	39.5%	**56.7%**	32.2%
5 - 9	29.3%	25.4%	30.5%
10 - 14*	25.4%	12.6%	**30.8%**
15 or more[NC]	4.4%	2.4%	5.5%
Regular Trip?			
Yes*	86.8%	74.9%	**91.4%**
Alternative Route?			
Yes*	40.2%	**52.8%**	35.4%
Trip Distance			
< 5 miles	10.4%	5.8%	10.3%
5 - 10 miles*	22.1%	13.5%	**25.1%**
10 - 15 miles*	25.7%	6.7%	**28.6%**
15 - 20 miles	14.1%	12.5%	16.6%
> 20 miles*	27.7%	**61.6%**	19.4%

* East and West Respondents were significantly different at a 95 percent level of confidence.
[NC]The hypothesis test could not be calculated.

Many of the differences observed in Table 7 are in agreement with results revealed by census data discussed in the previous section. For example, the trip characteristic comparison reveals that more travelers on I-10W use the corridor for commuting, make more frequent trips, and are more likely to make regular trips on I-10 as compared to travelers on I-10E. These same trends were evident from the census data which showed larger average commute travel times for individuals living along I-10W and also showed that a larger percentage of individuals in Kendall County along I-10W worked out of the county. Also in agreement with census data is the observation that I-10W travelers are less likely to travel alone as compared to I-10E travelers.

Comparisons of travel characteristics also revealed other significant differences between the two survey samples. According to the results shown in Table 7, I-10W travelers were less likely to indicate having an alternative to using I-10. This may cause I-10W travelers to be more inclined to use the ETLs if congestion is severe enough since the majority of them are unable to alter their route. Results also show that users of I-10E typically make much longer trips than users of I-10W, which may cause some I-10E travelers to fear paying high tolls to make their long distance trips. Another difference was observed among carpoolers on both corridors. Travelers on I-10E were more likely to be traveling with an adult family member as compared to I-10W travelers. A higher percentage of I-10W users were traveling with a child as compared to users of I-10E, although this difference could not be statistically confirmed due to the small number of I-10E respondents traveling with a child.

4.3.3 Travel Attitudes and Reactions to Value Pricing

Survey respondents were asked a series of questions to gauge their attitudes towards travel on I-10 as well as toward the application of value pricing in the form of ETLs. In order to get a sense of how I-10 travelers felt about their current travel as well as how they foresaw future travel on I-10, respondents were first asked how much they enjoy their travel and then asked how they thought traffic congestion would change in the next 10 years. Weighted responses to these questions are tallied in Table 8. Results indicate that I-10W travelers generally enjoy their travel less than I-10E travelers and foresee traffic being more of a problem in the future.

Table 8. Current and Future Attitudes of Survey Respondents

Travel Attitudes	All Respondents (n = 483)	East Respondents (n = 86)	West Respondents (n = 397)
How Much Enjoy Travel?			
Do not enjoy at all	15.0%	11.6%	16.9%
Usually dislike*	21.8%	**11.3%**	**25.0%**
Neutral	39.1%	35.9%	39.5%
Usually enjoy*	22.7%	**39.5%**	**17.0%**
Always enjoy[NC]	1.5%	1.7%	1.5%
Traffic in 10 years will be…			
Much worse than now*	67.3%	**50.0%**	**72.8%**
Slightly worse than now*	21.6%	**38.7%**	**17.0%**
About the same as now*	7.9%	**11.3%**	**6.0%**
Slightly better than now[NC]	3.3%	0.0%	4.1%

* East and West Respondents were significantly different at a 95 percent level of confidence.
[NC]The hypothesis test could not be calculated.

After the ETL concept was explained to respondents, they were asked whether or not they would be interested in using the lanes and were also asked about their opinions on time-of-day (TOD) and congestion tolling scenarios. Time-of-day tolling was described as a scenario where the toll would change based on the time of day to maintain smooth traffic flow on the lanes. Congestion tolling was explained as a scenario where the toll would change based on the level of congestion on the lanes and would be higher during congested times to maintain a smooth flow of traffic. Weighted responses to these questions are shown in Table 9. I-10W travelers were more likely to indicate a willingness to use the ETLs as compared to I-10E travelers, although the majority of respondents from both corridors said they would not use the lanes. The percentage of respondents who found the idea of congestion tolling to be unfavorable was slightly higher than the percentage who found the idea of TOD tolling to be unfavorable for both the I-10W and the I-10E sample.

Table 9. Attitudes Toward ETL Concept and Variable Pricing Scenarios

Value Pricing Attitudes	All Respondents (n = 483)	East Respondents (n = 86)	West Respondents (n = 397)
Use toll lanes?			
Yes*	20.9%	14.0%	**23.9%**
No	56.5%	61.6%	54.1%
Maybe	22.5%	24.3%	21.6%
Favorable to TOD toll?			
Very unfavorable	55.7%	56.8%	54.2%
Somewhat unfavorable*	13.6%	**20.1%**	12.4%
Neutral / No Opinion	14.4%	11.6%	14.6%
Somewhat favorable	11.6%	9.1%	13.0%
Very favorable[NC]	4.3%	1.4%	5.6%
Favorable to congestion toll?			
Very unfavorable	59.3%	63.1%	57.8%
Somewhat unfavorable	12.6%	12.3%	13.2%
Neutral / No Opinion	12.2%	14.1%	11.3%
Somewhat favorable	11.5%	7.0%	12.9%
Very favorable[NC]	4.4%	3.5%	4.8%

* East and West Respondents were significantly different at a 95 percent level of confidence.
[NC]The hypothesis test could not be calculated.

Survey respondents were also asked what reasons influenced their decision to use the ETLs (see Table 10). Percentages in each column sum to greater than 100 percent since respondents were able to choose multiple reasons. Respondents from I-10W indicated that the ability of the ETLs to remain congestion free during peak periods was the top reason for wanting to use them, but I-10E respondents felt that truck restrictions was a more attractive feature of the ETLs. This again confirms that I-10E travelers may not foresee congestion being much of a problem in the future. Respondents from both corridors who said they would not be interested in using the ETLs cited not wanting to pay a toll as the top reason. Similarly, respondents from both corridors who were unsure whether they would use the ETLs indicated that they could not make the decision until knowing how much the toll would be. Respondents were split on the second most important reason why they were unsure they would use the ETLs; I-10W respondents did not believe the tolls would keep the lane uncongested, while I-10E respondents were unsure whether congestion would even be severe enough to use them.

Table 10. Reasons Influencing Use of ETLs

Reasons to use the ETLs	I-10E Respondents (n = 14)	I-10W Respondents (n = 103)
No congestion during peak periods	42.3%	72.2%
No trucks	57.3%	49.8%
Predictable travel times	37.4%	52.4%
Safer and less stressful	37.4%	44.0%
Free for carpools	17.4%	36.6%
Other	15.2%	3.9%
No answer	7.5%	0.8%
Reasons not to use the ETLs	**I-10E Respondents (n = 53)**	**I-10W Respondents (n = 206)**
I would not want to pay the toll for my trip	85.7%	78.1%
I would not want a toll transponder in my car	30.9%	28.6%
A toll won't keep the lane flowing freely	20.0%	34.6%
The toll lanes will not offer me enough time savings	22.8%	30.3%
Participation in a carpool will be difficult / undesirable	17.1%	27.4%
I can easily use other routes than I-10 so I'll just avoid it if I think there is a lot of traffic	25.7%	12.0%
Congestion will not be bad enough to use the lanes	18.9%	9.0%
One ETL is not enough to handle future traffic	17.7%	24.5%
Toll lanes use is complicated or confusing	14.9%	15.9%
I will have the flexibility to travel at less congested times	10.8%	14.6%
I do not have a credit card needed to set up a toll account	18.9%	4.6%
Already pay taxes	8.6%	13.8%
Other	12.0%	21.1%
No answer	0.0%	0.5%

Table 10. Continued

Why are you unsure if you will use the ETLs?	I-10E Respondents (n = 19)	I-10W Respondents (n = 86)
I do not know how much the tolls will be, so cannot say until I know	57.9%	72.1%
The toll may not keep the lane uncongested	36.2%	51.3%
Congestion may not be bad enough to use the lane	40.5%	21.4%
I don't know if the toll lanes will save me enough time	34.7%	31.8%
One ETL may not be enough to handle future congestion	28.9%	43.8%
I might change jobs/home location by the time the lanes are in operation	34.8%	18.1%
I do not know if I will be able to get into a carpool	4.3%	13.1%
I am not sure about putting a toll transponder in my car	11.6%	9.1%
Toll lane use is complicated or confusing-I don't understand this yet	0.0%	5.3%
Other	11.6%	4.9%
No answer	0.0%	0.0%

Comparisons of survey respondents revealed several significant differences between the two survey samples that could influence the response to potential value pricing scenarios. These include:

- More I-10W respondents use the corridor for commuting, make more frequent trips, and are more likely to make regular trips as compared to I-10E respondents.
- I-10W respondents were less likely to have an alternative to using I-10 as compared to I-10E respondents.
- I-10E respondents made much longer trips than I-10W respondents.
- I-10W respondents generally enjoyed their current travel less than I-10E respondents.

- I-10W respondents foresee traffic being more of a problem in the future as compared to I-10E respondents.
- I-10W respondents were more likely to indicate a willingness to use ETLs.

4.4 Stated-Preference Responses

Analyses of stated preference responses were performed to further explore differences that existed between the two populations as well as to identify variables to include in mode choice models. Cross tabulations of stated preference responses and weighted respondent characteristics were generated for I-10E and I-10W responses to identify characteristics that may influence mode choice. This was accomplished by comparing the aggregated characteristics of the I-10E and I-10W samples with the characteristics of those who selected each of the five modes. Characteristics that were found to be different for a particular mode likely indicate that the characteristic is useful in predicting mode choice.

4.4.1 Cross Tabulation Analyses

Cross tabulations showing the joint distribution of various respondent characteristics and stated preference responses were generated using Limdep 9.0. Only stated preference responses coming from surveys which had answers to demographic questions including gender, age, ethnicity, income, education, household type, and occupation were included in the analysis. Also, invalid stated preference questions were thrown out as described in Chapter III (a few respondents had no toll for the DA-ETL option and were removed).

The purpose of generating these cross tabulations was to examine which socioeconomic and trip characteristics may influence stated preference response. Separate cross tabulations were created for the I-10E and I-10W samples to compare the potential impacts of various socioeconomic characteristics on stated preference response (see Appendix B). Statistical tests to determine differences among the percentage of stated preference responses for each socioeconomic group were not possible due to the presence of many cells with zero responses. Characteristics that may have had an influence on mode choice were identified by comparing the distribution of responses for the entire sample with the distribution of responses among various groups. If the distribution of responses among a particular group of travelers differs greatly from the overall distribution of responses then it is likely that the characteristic used to define that particular group of travelers had an impact on mode choice.

Key observations that were drawn from the cross tabulations of stated preference responses and socioeconomic characteristics for I-10E respondents are shown in Table 11. While not proven to be statistically significant, these observations serve as a starting point to determine which variables to include in the mode choice models.

Table 11. Observations Drawn from Cross Tabulation of Stated Preference Response and Socioeconomic Characteristics for I-10E Sample

Gender	▪ Higher response rate for carpool modes by males
Age	▪ Higher response rate for DA-ETL mode by respondents age 35 to 54 ▪ Higher response rate for ETL carpool modes by respondents age 55 to 64 ▪ Higher response rate for CP-GPL mode by respondents over age 65
Ethnicity	▪ Higher response rate for all carpool modes by respondents of Hispanic ethnicity ▪ Lower response rate for all carpool modes except CP3-ETL by white respondents
Income	▪ Lower response rate for DA-ETL mode by individuals with household incomes between $35k and $75k ▪ Higher response rate for DA-ETL mode by individuals with household incomes greater than $75k
Education	▪ Lower response rate for DA-ETL mode by individuals with some college education ▪ Higher response rate for DA-ETL mode by individuals with college degree and postgraduate degree
Household Type	▪ Lower response rate for carpool modes by individuals living alone ▪ Higher response rate for CP-GPL and DA-ETL modes by respondents in married with children household
Occupation	▪ Higher response rate for DA-ETL modes by respondents with full-time jobs ▪ Higher response rate for carpool modes and lower response rate for DA-ETL mode by retired respondents

Observations noted from the cross tabulations of stated preference response and socioeconomic characteristics for I-10W respondents are presented in Table 12.

Table 12. Observations Drawn from Cross Tabulation of Stated Preference Response and Socioeconomic Characteristics for I-10W Sample

Gender	▪ Higher response rate for CP3-ETL mode by males
Age	▪ Lower response rate for ETL carpool modes by respondents over age 55 ▪ Higher response rate for carpool modes by respondents age 25 to 34 ▪ Higher response rate for DA-ETL mode by respondents age 18 to 34
Ethnicity	▪ Higher response rate for ETL modes by respondents of Hispanic ethnicity
Income	▪ Higher response rate for CP2-ETL mode by respondents with household incomes between \$50k and \$75k ▪ Higher response rate for DA-ETL mode by individuals with household incomes greater than \$75k
Education	▪ Higher response rate for ETL modes by individuals with college degree ▪ Lower response rate for ETL modes by individuals with postgraduate education
Household Type	▪ Higher response rate for CP-GPL and CP3-ETL modes by individuals living alone ▪ Lower response rate for carpool modes by individuals living in married without children households ▪ Higher response rate for CP-GPL and CP2-ETL modes by individuals living in married with children households
Occupation	▪ Higher response rate for DA-ETL mode and lower response rate for CP-GPL mode by respondents with full-time jobs ▪ Higher response rate for CP-GPL mode by respondents who were homemakers

Several similarities were noticed among stated preference responses from I-10E and I-10W responses. First, the response rates for the DA-ETL mode were higher among respondents from both corridors with household incomes greater than $75,000 indicating that individuals with larger incomes in both corridors may be more willing to pay a toll. Respondents from both corridors with full-time jobs also appeared to be more likely to choose the DA-ETL mode. Results also showed that having a college degree may be a good indicator of increased favorability to all ETL modes. All three of these indicators are likely related. Lastly, the response rates for carpool modes appear to be higher among males in both samples, although this trend is slightly less obvious among I-10W respondents.

Many noticeable differences were discovered when comparing the stated preference cross tabulation results from both samples. First, the response rates for the DA-ETL modes was higher among Hispanic respondents from the I-10W sample indicating that I-10W travelers of Hispanic ethnicity may be more likely to pay to use the ETLs. This trend was not observed among I-10E responses where the response rates for all carpool modes were higher among Hispanic respondents, but the response rate for the DA-ETL mode was lower. This may show that Hispanic travelers on I-10E are willing to use the ETLs if there is reduced or free travel for carpools, whereas Hispanic travelers on I-10W may be more willing to pay a higher cost to travel alone on the ETLs. This result also confirms that ethnicity is not a characteristic that can be used to consistently predict mode choice among different groups of travelers, as expected.

The age of respondents impacts their mode choice for both locations, although the effects of age appear to be different among I-10E and I-10W respondents. Among I-10E respondents over the age of 65, the percentage of stated preference responses for the CP-GPL mode seems to indicate a clear preference for this mode. However, the response rates for carpool modes are lower among I-10W respondents over age 65. Results also show that younger respondents age 18 to 34 from the I-10W sample appear to be more likely to choose the DA-ETL mode. In contrast, responses from I-10E respondents seem to indicate that middle-aged travelers age 35 to 54 were more likely to choose the DA-ETL mode. These observations show that age is likely an appropriate variable to consider when predicting mode choice, but its effects are not universal among all groups of travelers.

Respondents' mode preferences also appear to be dependent on household income. However, except for the DA-ETL mode which appears to be favored among those making more than $75,000 per year, there are no other clear trends which would indicate that preference for a particular mode increases or decreases with an increase in household income. Instead, the preference for mode among each income group appears to be unique. As an example, response rates for the DA-ETL mode were noticeably low among I-10E respondents with household incomes between $35,000 and $75,000 indicating that these individuals may not be as willing to pay a toll to use the ETLs as compared to other groups. Response rates for all carpool modes, particularly the CP2-ETL mode, were much higher among respondents making $50,000 to $75,000 in the I-10W sample.

A respondent's education level is another characteristic that appears to be an indicator of mode preference. Among I-10E respondents there was a clear distinction in the response rate for the DA-ETL mode by those with some college education and those with a college degree. These results seem to indicate an indifference towards the DA-ETL mode by I-10E respondents with some college education and a preference for this mode by I-10E respondents with a college degree. The response rate for the DA-ETL mode was also higher among I-10W respondent with a college degree. Postgraduate education seems to influence mode choice differently among respondents from the two corridors. Among I-10E respondents, those with a postgraduate degree appear to be more likely to choose an ETL mode whereas the opposite seems to be true for I-10W respondents. These results show that preference for a particular mode does not necessarily change consistently with an increase in the level of education.

The distribution of stated preference responses among respondents from different household types revealed both expected and unexpected observations. Respondents from I-10E living alone were less likely to choose a carpool mode and seemed to favor the DA-GPL mode. The ability to form a carpool is probably more difficult for individuals who live by themselves, so it is expected that they would be less likely to select carpool modes. However, respondents from I-10W living alone were highly represented among those choosing the CP3-ETL mode and had lower representation among those choosing the DA-GPL mode. Further analyses revealed more indications that household type would have a different impact on the prediction of mode choice for travelers of I-10E and I-10W.

Cross tabulations were also generated to determine the distribution of stated preference responses among respondents with different trip characteristics. Observations noted from these cross tabulations are shown in Table 13 and Table 14.

Table 13. Observations Drawn from Cross Tabulation of Stated Preference Response and Trip Characteristics for I-10E Sample

Trip Purpose	▪ Higher response for carpool modes and lower response rate for DA-ETL mode by respondents who commute
Vehicle Occupancy	▪ Generally higher response rate for carpool modes among respondents who carpooled
Vehicle Occupant	▪ Higher response rate for DA-ETL mode by respondents traveling with an adult family member
Number of Weekly Trips	▪ Higher response rate for ETL mode by respondents making less than 5 trips per week on I-10E ▪ Lower response rate for DA-ETL mode by respondents making between 5 and 14 trips per week
Trip Distance	▪ No responses for any carpool modes by individuals traveling less than 5 miles on I-10E ▪ Higher response rate for DA-ETL mode by respondents traveling 15 to 20 miles on I-10E
Regular Trip	▪ Lower response rate for DA-ETL mode by respondents who make regular trips on I-10E
Alternative Route	▪ Lower response rate for CP-GPL mode by respondents who have an alternative to travel on I-10E

Table 14. Observations Drawn from Cross Tabulation of Stated Preference Response and Trip Characteristics for I-10W Sample

Trip Purpose	▪ Lower response rate for CP-GPL mode by respondents who commute ▪ Higher response rate for CP-GPL mode by respondents making recreational trips
Vehicle Occupancy	▪ Generally higher response rate for carpool modes among respondents who carpooled
Vehicle Occupant	▪ Higher response rate for DA-GPL mode by respondents traveling with an adult family member ▪ Higher response rate for carpool modes by respondents traveling with a child
Number of Weekly Trips	▪ Lower response rate for CP-GPL mode and higher response rate for ETL carpool modes by respondents making 10 to 14 trips per week
Trip Distance	▪ Lower response rate for all modes besides DA-GPL by respondents traveling between 5 and 10 miles on I-10W ▪ Higher response rate for ETL carpool modes by respondents traveling more than 20 miles on I-10W

Comparisons of observations in Table 13 and Table 14 reveal almost no similarities among responses from I-10E and I-10W respondents. This suggests that trip characteristics have different impacts on mode choice among I-10E and I-10W respondents.

The most noticeable and surprising observations were revealed in the cross tabulation of trip purpose and stated preference response. Among I-10E respondents, those who commuted were less likely to choose the DA-ETL mode and those on a recreational trip were more likely to choose the DA-ETL mode. The opposite was observed among I-10W respondents where commuters were more likely to choose the DA-ETL mode. This observation shows that any future ETLs on I-10E or I-10W may be serving different markets and therefore different value pricing scenarios may be appropriate for the two corridors.

The frequency and length of trips on I-10 also seemed to have different impacts on mode choice by respondents from the two corridors. There were no clear trends that indicated an increased or decreased preference for a particular mode as trip frequency or trip length increased or decreased. However, many differences were observed when the number of weekly trips and trip distance were coded into categorical variables. For example, I-10E respondents seemed to be more likely to choose the DA-ETL mode if their trip was between 5 and 10 miles whereas I-10E respondents with trip lengths in this group appeared to be less likely to choose DA-ETL.

4.4.2 Mode Choice Examination

Further analyses were performed to determine how respondents from both corridors answered stated preference questions as well as how stated preference scenarios were presented to respondents from the I-10E and I-10W corridors. Although the survey designs for both corridors were identical, the fact that travelers on the I-10E corridor traveled longer distances caused the travel times and tolls presented in stated preference scenarios to be higher for these individuals. This may have affected how I-10E respondents selected stated preference responses and is therefore worth investigating.

First, the rate of appearance of the five travel modes in each of the stated preference questions was examined to determine if there were any significant differences between stated preference scenarios presented to I-10E and I-10W respondents (see Figure 21). The DA-GPL mode was shown to I-10E and I-10W respondents nearly 100 percent of the time in all stated preference questions. This was expected since the stated preference questions were designed to present this mode more frequently (see Appendix C for description of stated preference designs). The rates of appearance of all other modes in each of the three stated preference questions are nearly equal. This confirms that there were no differences in the rates of mode appearance for stated preference questions presented to I-10E and I-10W respondents.

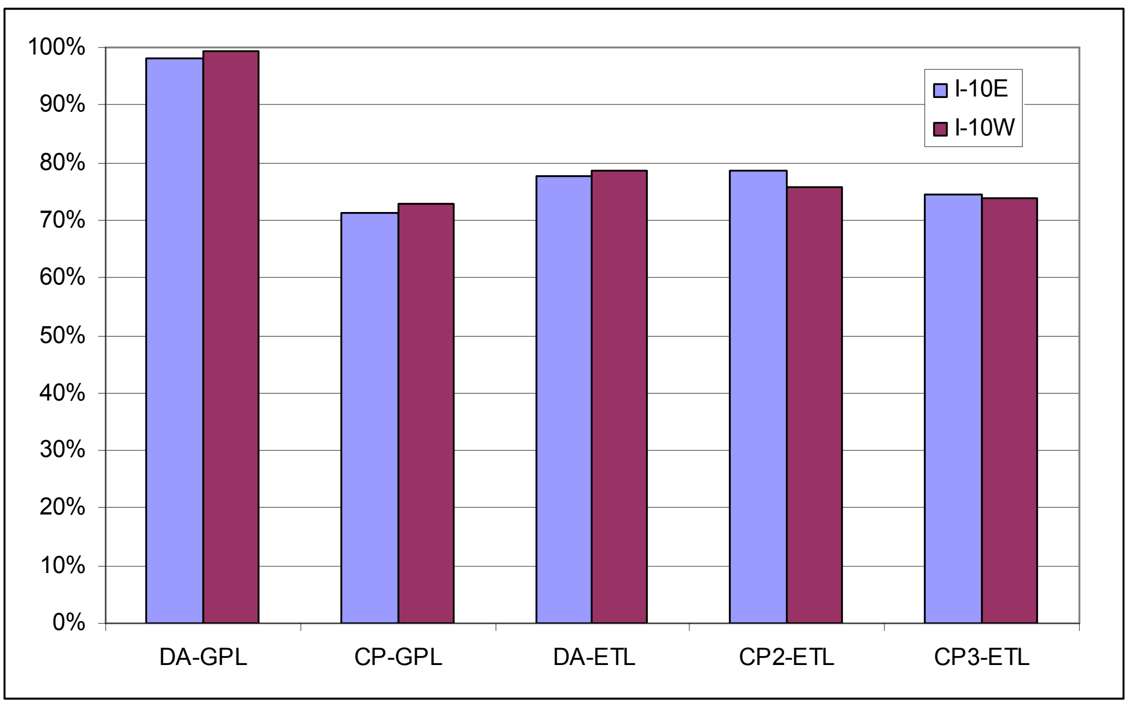

Figure 21. Average Appearance Rate of Travel Modes in Stated Preference Questions Presented to I-10E and I-10W Respondents

First, the percentage of respondents choosing each of the five modes was tallied for each stated preference question. This tally, shown in Table 15, reveals that the DA-GPL mode was by far the most common mode chosen by respondents from both samples although a slightly larger percentage of I-10E respondents chose this mode on average as compared to I-10W respondents. The DA-ETL mode was chosen by a larger percentage of I-10W respondents and the percentage of I-10W respondents who chose this mode seems to remain constant for all three stated preference questions. For I-10E respondents, the percentage that chose the DA-ETL mode increased among responses to the second and third stated preference questions. The CP3-ETL mode was rarely chosen by respondents from either corridor.

Table 15. Percentage of Respondents Choosing Each Mode in Stated Preference Scenarios

Mode	I-10E Respondents				I-10W Respondents			
	Question 1	Question 2	Question 3	Average	Question 1	Question 2	Question 3	Average
DA-GPL	81.4%	75.6%	76.7%	77.9%	75.8%	71.3%	75.1%	74.1%
CP-GPL	9.3%	5.8%	4.7%	6.6%	6.3%	6.5%	2.8%	5.2%
DA-ETL	4.7%	9.3%	9.3%	7.8%	12.6%	11.1%	12.6%	12.1%
CP2-ETL	3.5%	4.7%	5.8%	4.7%	3.0%	8.1%	4.8%	5.3%
CP3-ETL	1.2%	3.5%	1.2%	1.9%	1.8%	2.5%	3.0%	2.4%

Further analyses revealed that among those who were presented the DA-GPL mode in all three stated preference questions, 69 percent of I-10E respondents and 59 percent of I-10W respondents consistently chose this mode. Although not conclusive, this indicates a possible greater interest in the DA-GPL mode among I-10E respondents. It was also found that 9.1 percent of I-10E respondents and 6.3 percent of I-10W respondents who indicated that they would not be interested in using the ETLs actually chose a tolled ETL mode in at least one stated preference question. Among those that said they may be interested in using the ETLs, 21.1 percent of I-10E and 31.4 percent of I-10W respondents chose a tolled ETL mode in at least one of the scenarios. This shows that there may be a small percentage of travelers from both corridors who may at first be opposed to the idea of ETLs, but may change their attitudes once they are exposed to the benefits of value pricing.

The average tolls and travel times presented to respondents from both corridors were also examined to quantify how much larger these values were among stated preference scenarios presented to I-10E respondents (see Table 16 and Table 17). Averages are shown for the entire sample as well as for those who chose each mode. To better compare values shown to I-10E and I-10W respondents, the average cost of travel time savings associated with each ETL mode was also calculated. These values were calculated by dividing the average toll shown for each ETL mode by the average travel time savings offered by the ETL mode with respect to both GPL modes.

Table 16. Average Tolls and Travel Times Presented to I-10E Respondents

Mode	Average Toll		Average Travel Time (min)		Average Cost of Travel Time Savings (/hr)	
	All	Among those that chose mode	All	Among those that chose mode	All	Among those that chose mode
DA-GPL			27.5	27		
CP-GPL			24.3	26		
DA-ETL	$2.62	$2.38	16.8	15.6	$17.27	$13.10
CP2-ETL	$1.84	$0.65	16.8	17.9	$12.13	$4.53
CP3-ETL	$0.97	$0.65	16.8	8.8	$6.40	$2.20

Table 17. Average Tolls and Travel Times Presented to I-10W Respondents

Mode	Average Toll		Average Travel Time (min)		Average Cost of Travel Time Savings (/hr)	
	All	Among those that chose mode	All	Among those that chose mode	All	Among those that chose mode
DA-GPL			21.4	20.3		
CP-GPL			20.9	18.9		
DA-ETL	$1.96	$1.76	13.3	14	$14.98	$18.86
CP2-ETL	$1.40	$1.33	13.2	14.8	$10.57	$16.63
CP3-ETL	$0.76	$0.20	13	16.4	$5.60	$3.75

The values shown in Table 16 and Table 17 confirm that I-10E respondents were presented with higher tolls in relation to the amount of travel time savings offered by the ETL modes. The average toll for all ETL modes presented to I-10E respondents was 32 percent higher as compared to tolls presented to I-10W respondents. This difference is a result of the survey design which calculated tolls based on a per mile toll rate, so tolls were higher among I-10E respondents who traveled longer average distances. The average amount of time savings offered by the ETLs as compared to the GPLs was 9.1 minutes for I-10E respondents and 8.0 minutes for I-10W respondents. Comparing the ratio of tolls and travel times revealed that I-10E respondents were presented with an $11.93 per hour average value of travel time savings and I-10W respondents were presented with an average of $10.32 per hour. These results cast some doubt on comparisons made using stated preference results since the level of tolls in relation to the travel time savings offered by the ETLs was not the same for I-10E and I-10W respondents. However, the difference is quite small.

Analysis of the stated preference scenarios presented to I-10E and I-10W respondents as well as how respondents answered stated preference questions revealed several differences. First, a larger percentage of I-10W respondents chose an ETL mode in each of the stated preference questions. However, the percentage of I-10E respondents that chose the ETL modes seems to increase among responses to the second and third stated preference question indicating that there may have been less of a bias against these modes compared to I-10W respondents. It was also noted that small percentages of respondents from both samples chose an ETL mode even though they indicated that they would not be willing to use the ETLs. Finally, analysis of tolls and travel times presented to I-10E and I-10W respondents revealed that the average value of travel time savings associated with all ETL modes was higher for I-10E respondents.

CHAPTER V

STATED PREFERENCE MODELING ANALYSIS AND RESULTS

This chapter describes how discrete choice models were developed and estimated using the computer program Limdep 9.0. Models were developed separately for the east and west populations to compare how various traveler attributes affect the relative utilities of the five modes presented to respondents. First, an identical set of models were developed using east and west survey responses to compare the significance and magnitude of like coefficients. These models contain variables that were found to be significant for one population but not the other, but were included for the purposes of having a similar basis for comparison. Another set of models were also developed independently which only include variables that were found to be significant in predicting mode choice for each population. These models cannot be used to compare the impacts of individual variables since the utility equations are defined differently, but they can be used to quantify values of time and elasticities as well as to perform simulations of mode choice.

5.1 Market Segmentation Models

As mentioned in Chapter II, market segmentation is used to determine whether the impacts of variables are different among population groups. Models estimated for each population group can be compared to a pooled model to determine if there are statistically significant differences among the market segments. This statistical comparison requires that the same variables be included in the segmented and pooled models.

Mixed logit models were estimated for the I-10E and I-10W populations and for the entire population. These models allow for correlation in utility among alternatives which accounts for the fact that each individual responded to multiple stated preference questions. The travel time coefficients were made to follow a triangular distribution with a standard deviation equal to the mean. This constraint was imposed to ensure that the distribution for the travel time coefficient would not include positive values. All other coefficients were set as fixed parameters.

Variables to be tested for inclusion in the market segmentation models were selected based on crosstab analyses as described in Chapter IV. However, the small sample size of respondents from the I-10E corridor, as well as the low percentages of I-10E respondents that selected modes other than DA-GPL, made it difficult to include many variables in the models. Specifying too many variables in the utility equations for the I-10E model often caused the time and/or toll coefficients to become insignificant. Also, most variables could not be included in the utility equations for the carpool modes on the ETLs due to the low number of I-10E respondents who chose these modes. The final model specification was therefore chosen such that the maximum number of variables could be included without sacrificing the integrity of the I-10E model. Only variables that were found to be significant in at least one of the east or west models were included.

Correlation among variables that were selected for inclusion in the market segmentation models was also examined to ensure that highly correlated variables were not included in the same model. A high level of collinearity among variables included in the same model makes it difficult to draw meaningful conclusions about the impacts of specific variables on model prediction results. Tests for correlation revealed that household income and education level had correlation coefficients of 0.36 and 0.39 for the I-10E and I-10W samples respectively. These values reveal that there is a slight positive relationship between household income and education level. Correlation coefficients of 0.39 and 0.50 were also calculated for the full-time occupation and commute trip dummy variables, indicating a positive relationship between these two variables as well.

The utility equation coefficients and p-values for the variables included in the market segmentation mixed logit models are shown in Table 18. The sign and magnitude of these coefficients give insight on how the probability of selecting each alternative changes for individuals with different characteristics. The sum of the log-likelihood values for the east and west models were compared to the log-likelihood value of the pooled model to determine if the estimated models for the east and west segments are statistically different from one another. This market segmentation test, as described in Chapter II, yielded a chi-square statistic of 103.2, which is much higher than the 95 percent critical value of 28.9 (see last row of Table 18). This result confirms that segmentation of the sample into east and west is appropriate because the estimated coefficients for the east and west models are statistically different at a high level of confidence.

Most of the variables included in the models shown in Table 18 are dummy variables with the exception of the TOLLINC, TTIME, VEHOCC, and CONG10YR variables. The TOLLINC variable represents the toll divided by the logarithm of the respondent's income. Since incomes were reported in ranges, the midpoint of each range was used to calculate the TOLLINC variable. The TTIME variable represents the travel time in minutes and the VEHOCC variable represents the number of vehicle occupants including the driver. The CONG10YR variable represents respondents' perceptions of future congestion on the I-10 corridors. The survey asked respondents to indicate what they expected traffic to be like in 10 years and were able to select from one of four options that were coded in the CONG10YR variable as follows:

- 1 = Much worse than now
- 2 = Slightly worse than now
- 3 = About the same as now
- 4 = Slightly better than now

Table 18. Variables in Market Segmentation Models

Variables	Code	Pooled Model		I-10W Model		I-10E Model	
Toll divided by Ln(Income/1000)	TOLLINC	-1.50	(.000)	-1.90	(.000)	-1.09	(.048)
Travel Time (minutes)	TTIME	-0.059	(.000)	-0.072	(.000)	-0.036	(.029)
Drive Alone - GPLs (DA-GPL)							
Single Adult HHType (dv)	HHTYPESA	-0.245	(.186)	-0.726	(.001)	1.69	(.004)
Carpool - GPLs (CP-GPL)							
Mode Specific Constant	A_B	-4.16	(.000)	-4.59	(.000)	-3.16	(.000)
Vehicle Occupancy	VEHOCC	0.801	(.000)	0.979	(.000)	0.590	(.007)
Married w/children HHType (dv)	HHTYPEMC	0.680	(.007)	0.831	(.005)	-0.060	(.920)
Drive Alone - ETLs (DA-ETL)							
Mode Specific Constant	A_C	-0.740	(.023)	-.725	(.042)	-1.38	(.169)
Age 18-34 (dv)	AGE1834	0.471	(.027)	0.823	(.001)	-0.089	(.915)
Some College or Vocational Education (dv)	EDUCSCV	-0.240	(.253)	-0.013	(.954)	-2.29	(.011)
Trip Length 5 to 10 miles (dv)	TPLN510	-0.226	(.402)	-1.08	(.002)	1.89	(.012)
Commute Trip Purpose (dv)	TPCOMM	0.052	(.787)	0.197	(.355)	-1.99	(.030)
Towards/Away (dv) (1 = Traveling Towards Downtown)	TOFROM	0.236	(.212)	-0.029	(.886)	1.41	(.050)
Perception of congestion in 10 years	CONG10YR	-0.762	(.000)	-0.755	(.000)	-0.282	(.566)
Carpool2 - ETLs (CP2-ETL)							
Mode Specific Constant	A_D	-3.40	(.000)	-2.90	(.000)	-4.17	(.000)
Vehicle Occupancy	VEHOCC	0.801	(.000)	0.979	(.000)	0.590	(.007)
Regular Trip (dv)	REGTRP	-0.771	(.015)	-1.44	(.000)	-0.166	(.817)
Age 55-64 (dv)	AGE5564	0.357	(.244)	-0.319	(.418)	2.36	(.001)
Carpool 3+ - ETLs (CP3-ETL)							
Mode Specific Constant	A_E	-3.64	(.000)	-3.72	(.000)	-4.82	(.000)
Some College Education (dv)	EDUCSCV	0.710	(.028)	0.431	(.254)	2.72	(.048)
Log-likelihood at Zero		-2163.1		-1795.8		-360.5	
Log-likelihood at Constant		-1096.1		-891.6		-167.1	
Log-likelihood at Convergence		-965.3		-783.4		-130.3	
Rho-Squared w.r.t. Zero		0.545		0.555		0.586	
Rho-Squared w.r.t. Constants		0.105		0.104		0.127	
Percent Correct		62.8%		63.5%		68.8%	
Sample Size		1344		1120		224	
Likelihood Ratio Test vs. Pooled Model		$\chi^2_{.05,18} = 28.9 < X^2 = 103.2$					

dv = dummy variable

The specified utility equations for the I-10W segmented model are shown in Equations 5.1 to 5.5.

$$U_{DA\text{-}GPL} = -1.90*TOLLINC - 0.072*TTIME - 0.726*HHTYPESA \quad (5.1)$$

$$U_{CP\text{-}GPL} = -4.59 - 1.90*TOLLINC - 0.072*TTIME + 0.979*VEHOCC + 0.831*HHTYPEMC \quad (5.2)$$

$$U_{DA\text{-}ETL} = -0.725 - 1.90*TOLLINC - 0.072*TTIME + 0.823*AGE1834 - 0.013*EDUCSCV - 1.08*TPLN510 + 0.197*TPCOMM - 0.029*TOFROM - 0.755*CONG10YR \quad (5.3)$$

$$U_{CP2\text{-}ETL} = -2.90 - 1.90*TOLLINC - 0.072*TTIME + 0.979*VEHOCC - 0.319*AGE5564 - 1.44*REGTRP \quad (5.4)$$

$$U_{CP3\text{-}ETL} = -3.71 - 1.90*TOLLINC - 0.072*TTIME + 0.431*EDUCSCV \quad (5.5)$$

The specified utility equations for the I-10E segmented model are shown in Equations 5.6 to 5.10.

$$U_{DA\text{-}GPL} = -1.09*TOLLINC - 0.036*TTIME + 1.69*HHTYPESA \quad (5.6)$$

$$U_{CP\text{-}GPL} = -3.16 - 1.09*TOLLINC - 0.036*TTIME + 0.590*VEHOCC - 0.060*HHTYPEMC \quad (5.7)$$

$$U_{DA\text{-}ETL} = -1.75 - 1.09*TOLLINC - 0.036*TTIME - 0.089*AGE1834 - 2.29*EDUCSCV + 1.89*TPLN510 - 1.99*TPCOMM + 1.41*TOFROM - 0.282*CONG10YR \quad (5.8)$$

$$U_{CP2\text{-}ETL} = -2.96 - 1.09*TOLLINC - 0.036*TTIME + 0.590*VEHOCC - 0.166*REGTRP + 2.36*AGE5564 \quad (5.9)$$

$$U_{CP3\text{-}ETL} = -4.79 - 1.09*TOLLINC - 0.036*TTIME + 2.72*EDUCSCV \quad (5.10)$$

Although the market segmentation test revealed that the I-10E and I-10W models are statistically different, the rho-squared values reveal a key similarity between the two models. The rho-squared values for both models are relatively high when calculated with respect to a model that assumes equal probability of choosing all modes. However, the rho-squared values are much lower when calculated with respect to a constants only model which assumes that the probability of selecting each mode is equal to the percent of stated preference responses observed for that mode. This shows that the inclusion of the 16 variables does very little to improve the model prediction results, which may mean that the sample sizes were not sufficiently robust to precisely determine how various characteristics influence mode choice. Another explanation for the low rho-squared value with respect to the constants only model is the fact that respondents from both corridors consistently selected a favored mode and were not likely to deviate from that choice, as was shown in the previous chapter.

A comparison of the coefficients for the I-10E and I-10W segmented models reveal many differences between the two populations. First, the toll and travel time coefficients estimated for the I-10E model are both smaller in magnitude in relation to the I-10W model suggesting that these variables have less of an influence on I-10E travelers when deciding whether to choose between the GPLs and the ETLs.

The TOLLINC variable represents the toll divided by the natural log of the respondent's income to account for the possibility that the utility effect of the toll may decrease with increasing income. As was shown in previous chapters, I-10E respondents were presented higher average tolls and had lower average incomes than I-10W respondents, so the TOLLINC variable was larger on average for I-10E respondents (see Table 19). This may partially explain why the toll coefficient is smaller in the I-10E model. Similarly, travel times presented to I-10E respondents were higher on average compared to I-10W respondents, which could also account for the smaller magnitude of the travel time coefficient in the I-10E model.

Table 19. Average Toll Divided by Logarithm of Income ($1,000s) for I-10E and I-10W Respondents

Mode	Average of TOLLINC Variable	
	I-10E Respondents	I-10W Respondents
DA-ETL	0.675	0.429
CP2-ETL	0.477	0.305
CP3-ETL	0.248	0.163

Further analysis was performed to better explain the effects of each of the variables in the market segmentation models. A breakdown of several characteristics of respondents represented by each variable in the models is shown in Table 20. For example, characteristics of respondents who indicated being in single adult households are shown in the first row of Table 20. Differences in characteristics shown in this table are helpful in understanding differences in I-10E and I-10W travelers.

Table 20. Characteristics of Respondents by Variable Specification

Variables Included in I-10E and I-10W Models		Percent Commuting	Percent Traveling in Peak Period	Average Income ($1000's)	Average Number of Weekly Trips	Average Trip Length (miles)
Single Adult HHTYPE (HHTYPESA=1)	East	18.5%	55.6%	$22	3.8	18.8
	West	50.5%	60.5%	$34	6.8	12.4
Drive Alone (VEHOCC=1)	East	41.0%	62.6%	$45	4.4	18.9
	West	64.3%	71.6%	$67	7.3	13.3
Carpool (VEHOCC>1)	East	6.7%	56.8%	$35	5.4	20.5
	West	24.1%	48.1%	$56	6.4	13.7
Married with Children HHTYPE (HHTYPEMC=1)	East	38.8%	53.9%	$57	5.2	18.3
	West	61.3%	69.0%	$79	7.9	13.8
Age 18-34 (AGE1834=1)	East	30.8%	30.8%	$33	7.2	18.3
	West	45.5%	67.8%	$41	7.4	12.2
Some College or Vocational School (EDUCSCV=1)	East	19.3%	45.0%	$35	4.2	22.8
	West	41.3%	55.3%	$41	5.7	13.9
Trip Length 5-10miles	East	46.3%	89.3%	$40	6.8	7.1
	West	58.6%	65.8%	$65	8.2	7.8
Regular Trip	East	33.2%	59.6%	$42	5.1	19.9
	West	56.2%	66.6%	$64	7.3	13.6
Traveling Towards Downtown (TOFROM = 1)	East	23.1%	68.6%	$58	4.2	19.6
	West	50.7%	67.1%	$59	6.9	12.9
Commute Trip Purpose (TPCOMM=1)	East	--	67.1%	$60	7.5	16.6
	West	--	82.2%	$75	8.3	14
Age 55-64 (AGE5564=1)	East	22.5%	69.7%	$35	2.9	23
	West	55.2%	61.4%	$78	6.8	13.4
All Respondents	East	26.4%	58.4%	$40	4.7	19.5
	West	52.4%	64.7%	$63	7.1	13.5

5.1.1 Drive Alone Modes Variable Analysis

The coefficient for the HHTYPESA dummy variable, which was included in the utility equation for the DA-GPL and CP-GPL modes, was found to be negative for the I-10W model but was found to be positive for the I-10E model. Analysis of characteristics of respondents in single adult households reveals several key differences that may explain why this coefficient has a different impact on the relative utility of the GPL modes in each model. The following differences were noted:

- The majority of I-10E respondents from single adult households reported last using I-10E for a recreational trip, whereas the majority of I-10W respondents from single adult households used I-10W for commuting.
- The average income of I-10E respondents from single adult households was nearly half of the overall average income of I-10E respondents.

The observations noted above indicate that I-10E travelers that were surveyed made more recreational trips as compared to I-10W travelers. Recreational trips are often not as time sensitive as other trip types, which could explain a preference for non-toll options. Commuters on I-10W traveling during peak periods are more likely to appreciate the travel time savings offered by the ETL modes since they regularly experience congestion, which explains the negative coefficient for the single adult household type variable for the DA-GPL mode. Also, the higher average income of single adult householders in the I-10W sample may increase the likeliness that they would choose to pay a toll to travel on the ETLs.

Of the six variables included in the utility equation for the pooled DA-ETL mode, four were found to be significant in the I-10E model and three were found to be significant in the I-10W model. I-10E travelers that travel between five and ten miles and travel towards San Antonio are estimated to be more likely to choose the DA-ETL mode, but those with some college or vocational education and those making commute trips were less likely to choose this mode according to the model. For I-10W travelers, those who are age 18 to 34 are estimated to be more likely to choose the DA-ETL mode while those traveling between five and ten miles are less likely to choose this mode.

The only variable included in the utility equation for the DA-ETL mode that was found to be significant in both the I-10E and I-10W model was the dummy variable for trip distances between five and ten miles. Results for the I-10E model reveal that travelers making trips between five and ten miles are more likely to choose the DA-ETL mode. The majority of reported trips between five and ten miles on I-10E were made during peak periods and were made to and from downtown San Antonio along the section closest to Loop 1604. Since this is the most heavily traveled segment of I-10E, individuals making these trips would be more likely to experience delay associated with congestion. The I-10W model shows that travelers with trip distances in the five to ten mile range are less likely to choose the DA-ETL mode. The majority of these travelers were not using I-10W to travel all the way into or out of downtown and nearly one fourth were entering from or exiting to Loop 1604. Therefore, many travelers on I-10W traveling between five and ten miles may only be using I-10W for a small portion of their trip into or out of San Antonio.

Level of education seems to be a better indicator of mode choice for the I-10E sample than for the I-10W sample. This may be due to the fact that there is a better representation of different education levels among the I-10E sample. Having some college or vocational education was found to decrease the likelihood of I-10E travelers choosing the DA-ETL mode, but was not significant for I-10W travelers. Survey results show that only 19.3 percent of I-10E travelers with some college or vocational education were making commute trips and less than half were traveling during a peak period. Furthermore, I-10E travelers with some college or vocational education were making much longer trips than other I-10E travelers (22.8 miles vs. 17.1 miles). This suggests that the DA-ETL mode may not be appealing to these I-10E travelers who are making long distance, non-commute trips during off-peak periods.

Model results show that travelers on I-10E traveling towards San Antonio are more likely to choose the DA-ETL mode as compared to travelers heading away from San Antonio. Direction of travel was not found to be significant in predicting mode choice for the I-10W model. The reason for the significance of the TOFROM variable in the I-10E model may be explained by looking at the time of day distribution of trips for the I-10E and I-10W samples shown in Figure 22-Figure 23. For those traveling towards San Antonio on I-10E, 61 percent were traveling in the morning peak period. However, only 25 percent of those traveling away from San Antonio on I-10E were traveling in the afternoon peak. The difference between the percentages of individuals traveling in the peak periods in each direction is not as great for the I-10W sample. This shows that the DA-ETL option may be more appealing among I-10E travelers heading towards downtown San Antonio because a larger percentage of these individuals are traveling in the peak direction during the peak period.

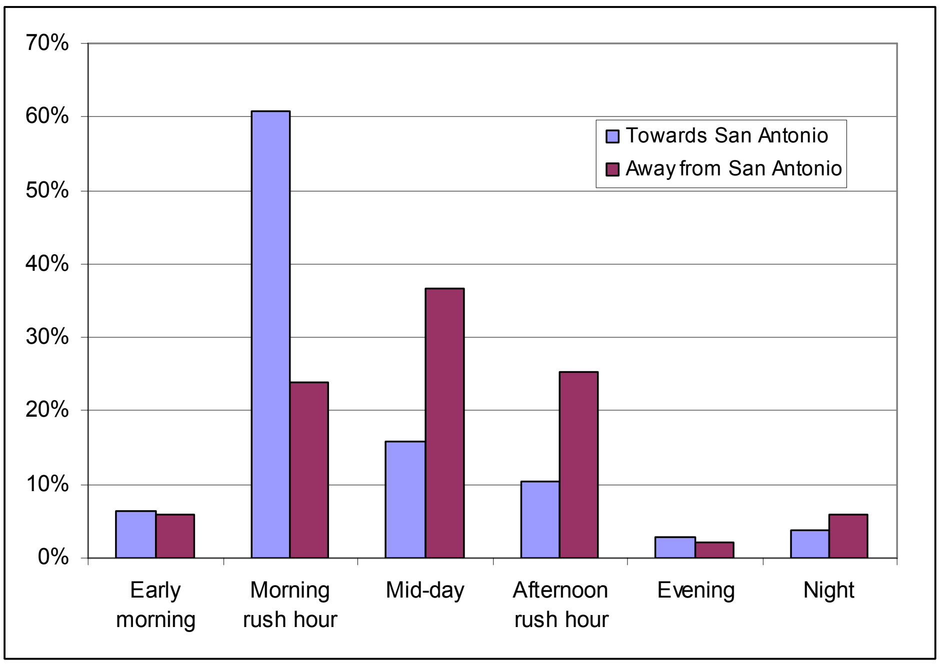

Figure 22. Time-of-day Distribution of Trips for I-10E Sample

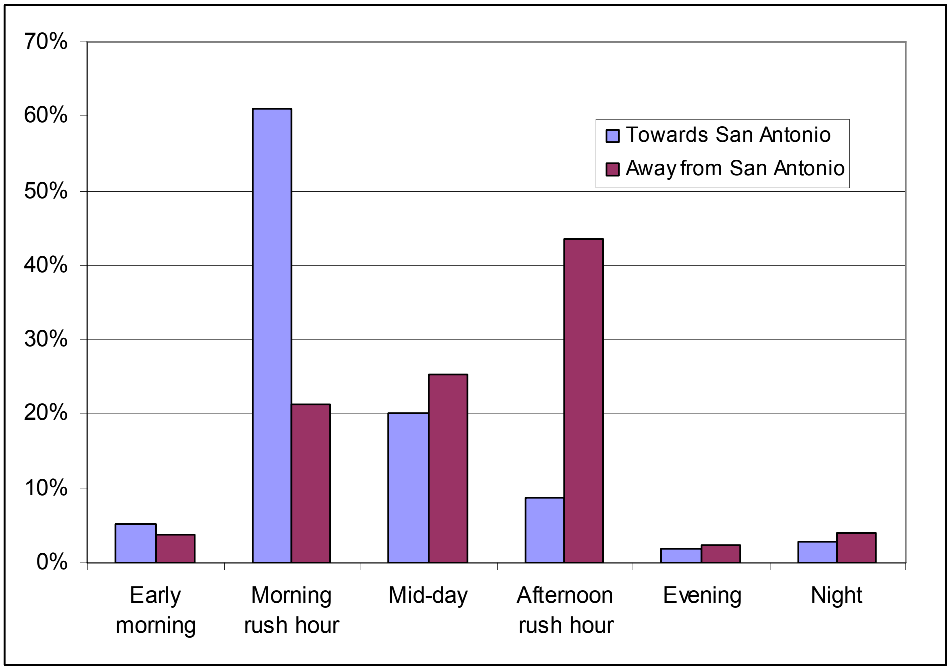

Figure 23. Time-of-day Distribution of Trips for I-10W Sample

Model results show that being on a commute trip reduced the likelihood of the DA-ETL option for I-10E respondents. Those making commute trips on I-10E were more likely to be traveling during a peak period and had much higher average incomes as compared to those making non-commute trips on I-10E. This may confirm that I-10E commuters do not perceive a problem with congestion on I-10E, and although they make more money on average, are not necessarily willing to pay a toll for their trip. Part of the reason why I-10E commuters may be unwilling to pay a toll for the DA-ETL option may be due to the fact that I-10E commuters make more weekly trips on average as compared to non-commuters. Table 21 shows the number of weekly trips made by commuters and non-commuters from both samples. The difference in the average number of weekly trips between commuters and non-commuters is largest among the I-

10E travelers that were surveyed. This result supports the idea that I-10E commuters may be less likely to pay a toll for the DA-ETL option because they make a lot more weekly trips and therefore already pay more for their travel than non-commuters.

Table 21. Average Number of Weekly Trips for I-10E and I-10W Travelers

	Non-commuters	Commuters	Percent Difference
I-10E	3.7	7.5	102.7%
I-10W	5.6	8.3	48.2%

As mentioned previously, I-10W model results show that travelers who are age 18 to 34 are more likely to choose the DA-ETL mode. Cross tabulation analysis for the I-10W sample also seemed to reveal a preference for all ETL modes among individuals in this age group. Among I-10W travelers, those in the 18 to 34 age group had an average household income that was 42 percent lower than older travelers. These younger I-10W travelers also made roughly the same number of weekly trips on average and traveled roughly the same average distance as compared to older I-10W travelers. This suggests that younger I-10W travelers, despite earning much less than older I-10W travelers, still seem to be willing to pay for the DA-ETL option. In comparison, I-10E travelers in the 18 to 34 age group had an average household income that was only 21 percent lower than older travelers and made over three more weekly trips on average than older travelers. However, model results did not reveal a preference for the DA-ETL mode among I-10E travelers in this age group.

The CONG10YR variable was also included in the utility equations for the DA-ETL mode to determine whether perception of future traffic congestion on the I-10 corridors influenced the likelihood of choosing to drive alone on the ETLs. Model results show that the coefficient for this variable is significant in the I-10W model but not in the I-10E model. The coefficient for the CONG10YR variable is negative in the I-10W model which shows that I-10W travelers who feel that traffic congestion will worsen over time are more likely to choose the DA-ETL mode compared to travelers who feel that congestion will improve. The fact that this variable was not found to be significant in the I-10E model shows that perception of future traffic congestion has no impact on the likelihood of I-10E travelers choosing the DA-ETL mode.

Comparison of the coefficient for the CONG10YR variable suggests that I-10E and I-10W travelers may have different perceptions of the severity of future traffic congestion. I-10W travelers, who regularly experience some traffic congestion, are likely more familiar with the delays associated with congestion and therefore would be more willing to pay to drive on the ETLs if they foresee congestion becoming even worse in the future. On the other hand, I-10E travelers may have different ideas about the level of future traffic congestion simply because the level of traffic on the I-10E corridor is less than on the I-10W corridor.

5.1.2 Carpool Modes Variable Analysis

The coefficient for the vehicle occupancy variable was found to be significant and positive for the CP-GPL and CP2-ETL modes in both the I-10E and I-10W models as expected. However, the magnitude of the vehicle occupancy coefficient is higher in the I-10W model suggesting that the utility of these carpooling modes is higher for I-10W travelers that carpool as compared to I-10E travelers that carpool. Results show that commuting is a much less prevalent trip purpose among respondents who carpooled, particularly for I-10E travelers. This indicates that commuters on both corridors may not have opportunities or an incentive to carpool to work. All other trip purposes had much higher rates of carpooling.

The married with children household type dummy variable (HHTYPEMC) was found to be significant and positively affect the relative utility of the CP-GPL mode for the I-10W model only. The majority of I-10E carpoolers living in married with children households were traveling with an adult family member while a majority of I-10W carpoolers in the same household type were traveling with a child. Also, the percentage of carpoolers in married with children households making commute trips was much lower for I-10E respondents as compared to I-10W respondents. These observations seem to indicate that I-10W travelers in married with children households are more likely to choose CP-GPL because they are more likely to be traveling with their children during peak periods while commuting to work. However, I-10E travelers in the same household type are more likely to be traveling with an adult family member, presumably a spouse, for non-commute purpose during non-peak periods.

The relatively small number of respondents choosing the carpool modes on the ETLs made it difficult to find variables that were significant in predicting the choice of these modes. I-10E model coefficients show that travelers age 55 to 64 are more likely to choose the CP2-ETL mode and travelers with some college or vocational education are more likely to choose the CP3-ETL mode. Coefficients for the I-10W model show that travelers who make regular trips on I-10W are more likely to choose the CP2-ETL mode.

5.2 Willingness to Pay Analysis

The market segmentation models described in the previous section were developed for the purposes of comparing coefficients to determine whether like variables have different effects in predicting mode choice for I-10E and I-10W travelers. In order to do further analyses, all coefficients that were not found to be statistically significant at a 95 percent level of confidence were removed (see Table 22 and Table 23). These refined models are more appropriate for running simulations as well as determining values of time and elasticities since they only include variables that were found to be significant in predicting mode choice. Several nesting structures were tried for the I-10E and I-10W models including SOV versus HOV, GPLs versus ETLs, and toll versus no toll. None of these nesting structures were significant for the I-10E model, but the SOV versus HOV nesting structure was found to be significant for the I-10W model. However, for the purposes of comparison a nested model was not used for the I-10W sample.

Table 22. Mode Choice Model for I-10E Sample

Variables	Code	Coefficient	p-value
Toll by Ln(Income) (dollars, 1,000 dollars)	TOLLINC	-1.05	(.047)
Travel Time (minutes)	TTIME	-0.035	(.023)
Drive Alone - GPLs (DA-GPL)			
Single Adult HHType (dv)	HHTYPESA	1.75	(.001)
Carpool - GPLs (CP-GPL)			
Mode Specific Constant	A_B	-3.17	(.000)
Vehicle Occupancy	VEHOCC	0.586	(.005)
Drive Alone - ETLs (DA-ETL)			
Mode Specific Constant	A_C	-1.79	(.016)
College/Vocational Education (dv)	EDUCSCV	-2.22	(.012)
Towards/Away (dv) (1 = Traveling Towards Downtown)	TOFROM	1.36	(.049)
Commute Trip (dv)	TPCOMM	-2.09	(.020)
Carpool2 - ETLs (CP2-ETL)			
Mode Specific Constant	A_D	-4.26	(.000)
Vehicle Occupancy	VEHOCC	0.586	(.005)
Age 55-64 (dv)	AGE5564	-4.26	(.001)
Carpool 3+ - ETLs (CP3-ETL)			
Mode Specific Constant	A_E	-4.81	(.000)
Some College Education (dv)	EDUCSCV	2.74	(.046)
Log-likelihood at Zero		-363.7	
Log-likelihood at Constant		-167.5	
Log-likelihood at Convergence		-130.6	
Rho-Squared w.r.t. Zero		0.602	
Rho-Squared w.r.t. Constants		0.157	
Percent Correct		63.2%	
Sample Size		226	

dv = dummy variable

Table 23. Mode Choice Model for I-10W Sample

Variables	Code	Coefficient	p-value
Toll by Ln(Income) (dollars, 1,000 dollars)	TOLLINC	-1.52	(.000)
Travel Time (minutes)	TTIME	-0.073	(.000)
Drive Alone - GPLs (DA-GPL)			
Single Adult HHType (dv)	HHTYPESA	-0.693	(.002)
Carpool - GPLs (CP-GPL)			
Mode Specific Constant	A_B	-4.59	(.000)
Vehicle Occupancy	VEHOCC	0.971	(.000)
Married w/children HHType (dv)	HHTYPEMC	0.838	(.005)
Drive Alone - ETLs (DA-ETL)			
Mode Specific Constant	A_C	-0.740	(.015)
Age 18 to 34 (dv)	AGE1834	0.746	(.001)
Trip Distance 5 to 10 Miles (dv)	TPLEN510	-0.998	(.004)
Congestion in 10 years	CONG10YR	-0.779	(.000)
Carpool2 - ETLs (CP2-ETL)			
Mode Specific Constant	A_D	-3.08	(.000)
Vehicle Occupancy	VEHOCC	0.971	(.000)
Regular Trip (dv)	REGTRP	-1.36	(.001)
Carpool 3+ - ETLs (CP3-ETL)			
Mode Specific Constant	A_E	-3.61	(.000)
Log-likelihood at Zero		-1821.9	
Log-likelihood at Constant		-902.1	
Log-likelihood at Convergence		-799.1	
Rho-Squared w.r.t. Zero		0.554	
Rho-Squared w.r.t. Constants		0.103	
Percent Correct		63.3%	
Sample Size		1132	

dv = dummy variable

The toll and travel time coefficients estimated by the models shown in Table 22 and Table 23 were used to determine values of time (VOT), which are indicators of how much I-10E and I-10W travelers are willing to pay (WTP) for travel time savings on the ETLs. Distributions of value of time can be created when the toll coefficient is interacted with the income variable. The formula used to calculate the VOT for each income group is shown in equation 5.11.

$$VOT\left(\$/hr\right) = 60 * \left(\frac{\beta_{TT}}{\beta_{TOLL}}\right) * \ln[Income] \quad (5.11)$$

where:

β_{TT} = travel time coefficient

β_{TOLL} = toll coefficient

Income = household income in $1000's of dollars

The midpoints of the household income ranges indicated by survey respondents were used to calculate the average values of time for each income group in the I-10E and I-10W samples (see Table 24). For each income group, the I-10W calculated average VOT is about 44 percent higher than the respective I-10E VOT. This indicates a much higher willingness to pay among I-10W travelers as compared to I-10E travelers.

Table 24. Estimated Average Values of Time by Household Income

Annual Household Income	Value of Time ($/hr)	
	I-10E Travelers	I-10W Travelers
Less than $10,000	$3.22	$4.64
$10,000 to $14,999	$5.05	$7.28
$15,000 to $24,999	$5.99	$8.63
$25,000 to $34,999	$6.80	$9.80
$35,000 to $49,999	$7.50	$10.80
$50,000 to $74,999	$8.27	$11.92
$75,000 to $99,999	$8.94	$12.89
$100,000 to $199,999	$10.02	$14.44
$200,000 or more	$10.60	$15.27

The distribution of incomes for census tracts in proximity to I-10E and I-10W was used in conjunction with the values of time presented in Table 24 to create average VOT distributions for I-10E and I-10W travelers. These distributions are presented in Figure 24. The sum of the product of the VOT and the respective percentage of the population gives an estimation for the overall average VOT for each group of travelers. This calculation results in an average value of time of $7.62 per hour for I-10E travelers and $12.35 per hour for I-10W travelers. When the toll variable is included in the models without an interaction with income, the average values of time estimated by dividing the time coefficient by the toll coefficient were nearly the same. They were $8.09 per hour and $13.06 per hour for I-10E and I-10W travelers, respectively.

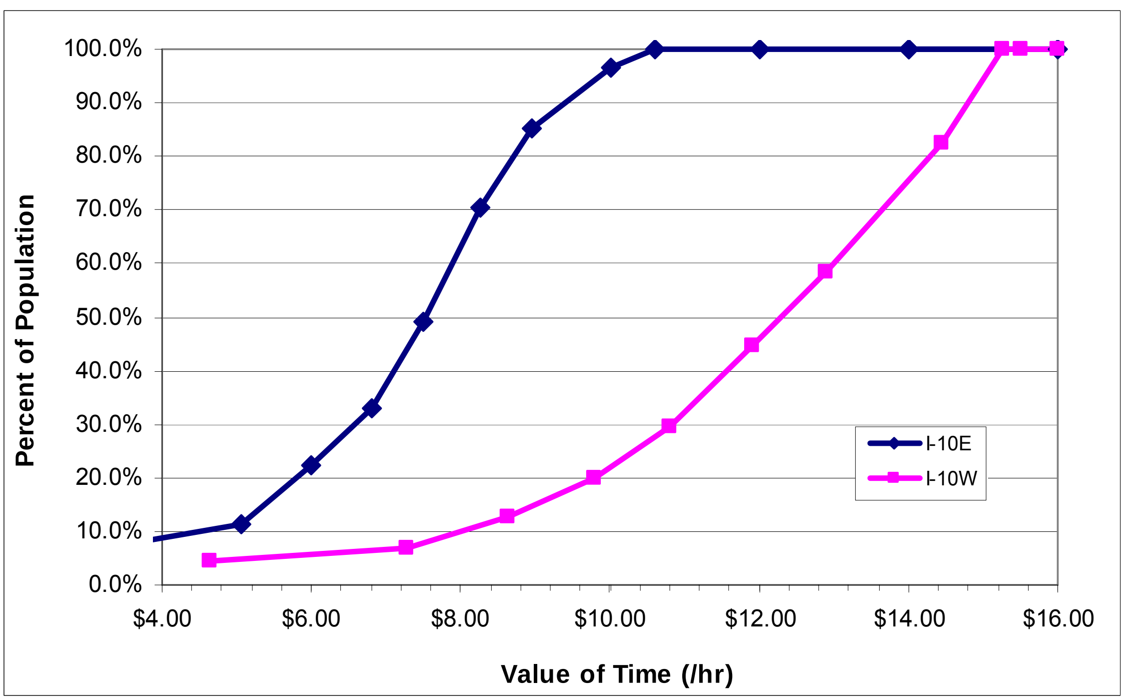

Figure 24. Average VOT Distributions for I-10E and I-10W Travelers

The disparity between average values of time estimated for I-10E and I-10W travelers shows a clear difference in the response to value pricing options by travelers from both corridors. However, estimated values of time for these two groups of travelers should be compared with some caution. As mentioned previously, I-10E respondents were presented with higher average values of travel time savings than I-10W respondents. Also, I-10E travelers were presented with stated preference scenarios that did not represent current conditions on I-10E. Traffic volumes on I-10E are relatively low and do not lead to regular congestion. Travelers on I-10W regularly experience some congestion, unlike travelers on I-10E, and therefore may have a better sense of the value they would place on being able to save time by utilizing an ETL option.

5.3 Analysis of Elasticities

The elasticities of the toll and travel time coefficients were also determined using Limdep 9.0 to quantify how an increase in these variables affects the estimated probability of selecting each mode. Toll elasticities calculated for the I-10E and I-10W models are shown in Table 25 and Table 26. The values shown in these tables represent the percentage change in the probability of selecting each mode shown in the columns with respect to a one percent increase in the toll variable for the mode shown in the rows. Elasticities in the first two columns are all positive showing that an increase in the toll causes the probability of selecting either of the GPL modes to increase. Negative values represent direct elasticities and show that the probability of selecting that mode decreases with an increase in the toll for that mode.

Table 25. Toll Elasticity Effects on Probabilities of Mode Choice for I-10E Model

Mode with a 1% Toll Increase	Percent Change in Mode				
	DA-GPL	CP-GPL	DA-ETL	CP2-ETL	CP3-ETL
DA-ETL	0.031	0.029	-0.368	0.027	0.013
CP2-ETL	0.013	0.022	0.015	-0.263	0.015
CP3-ETL	0.003	0.003	0.001	0.002	-0.089

Table 26. Toll Elasticity Effects on Probabilities of Mode Choice for I-10W Model

Mode with a 1% Toll Increase	Percent Change in Mode				
	DA-GPL	CP-GPL	DA-ETL	CP2-ETL	CP3-ETL
DA-ETL	0.061	0.063	-0.478	0.068	0.093
CP2-ETL	0.016	0.031	0.017	-0.33	0.021
CP3-ETL	0.004	0.003	0.004	0.005	-0.141

Comparison of the toll elasticities calculated for the I-10E and I-10W models show that an increase in the toll variable has less of an impact on the changes in probabilities as predicted by the I-10E model. This is due to the fact that the toll coefficient is smaller in the I-10E model. For the I-10E model, a one percent increase in the toll of the DA-ETL mode causes the largest shift to the DA-GPL mode, as would be expected.

The simulation command in Limdep 9.0 was also used to observe how predicted choice outcomes change as a result of a change in the toll and travel time variables.

Elasticities only show how the probability of choosing a particular mode will change with respect to a change in a single variable. However, the simulation command in Limdep 9.0 allows users to specify increases or decreases in input variables across multiple modes and observe the change in predicted modal split. The predicted choice outcomes for each sample as calculated using Limdep 9.0 are shown as a reference in Table 27.

Table 27. Predicted Modal Split Using Observed Characteristics of I-10E and I-10W Survey Respondents

	Percent choosing each mode	
	I-10E travelers	**I-10W travelers**
DA-GPL	76.64%	75.41%
CP-GPL	7.51%	5.12%
DA-ETL	7.55%	11.77%
CP2-ETL	5.14%	4.87%
CP3-ETL	3.17%	2.83%

Simulations were run to observe how the predicted choice outcomes change with a decrease in the toll variable among all ETL modes. This was accomplished by successively decreasing all tolls by a specified percentage and recalculating the predicted choice outcomes as a result of the decrease. The percentage of travelers predicted to choose the DA-ETL mode is shown in Figure 25. Results show a sharper decrease in the percentage choosing the DA-GPL mode among I-10W travelers indicating that I-10E travelers are less willing to switch from the DA-GPL mode.

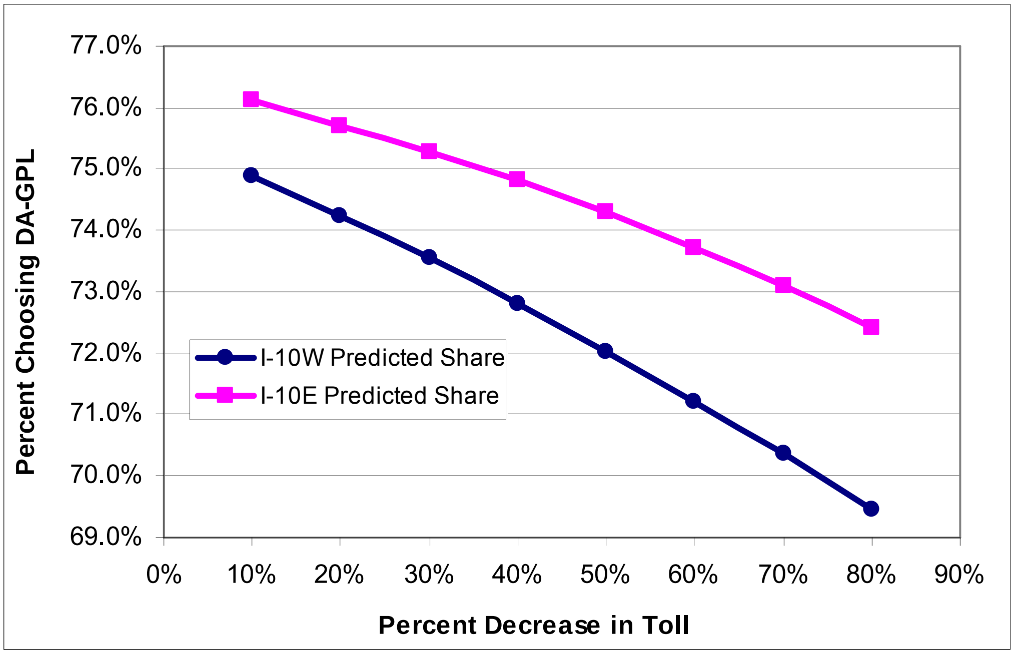

Figure 25. Predicted Share Choosing DA-GPL Mode as Tolls Decrease

The percentage of travelers predicted to choose the CP-GPL mode is shown to decrease only slightly as toll levels on ETL modes decrease (see Figure 26). This shows that travelers on both corridors who currently carpool are not as likely to be enticed to switch modes as tolls on the ETLs decrease.

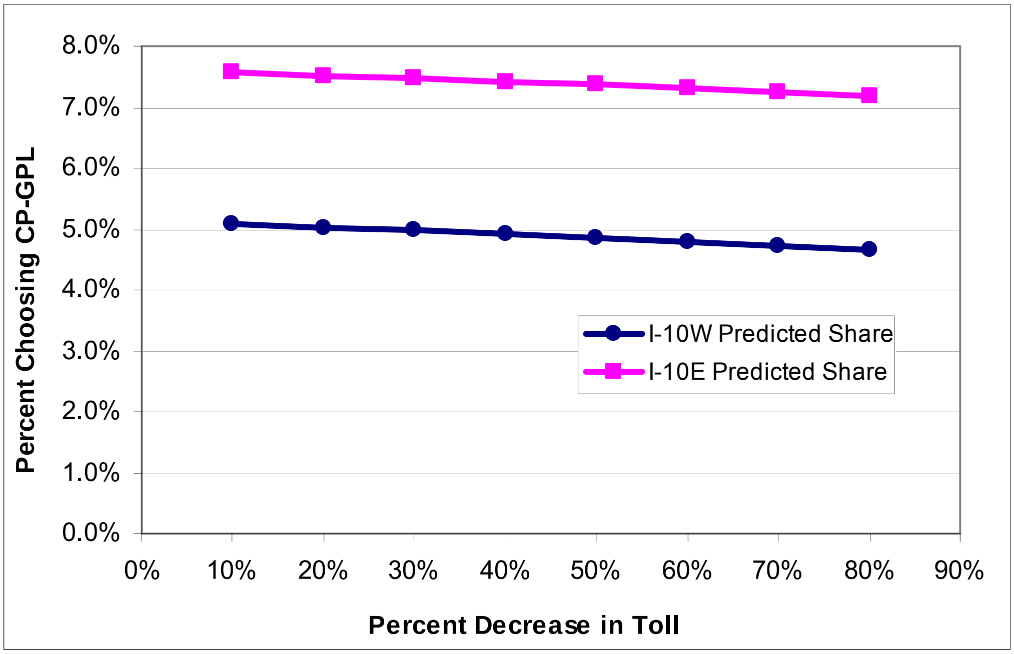

Figure 26. Predicted Share Choosing CP-GPL Mode as Tolls Decrease

The percentages of I-10E and I-10W travelers predicted to choose the DA-ETL mode as tolls decrease is illustrated Figure 27. As shown, there is a sharper increase in the percentage of I-10W travelers predicted to choose the DA-ETL mode as toll levels on all ETL modes decrease.

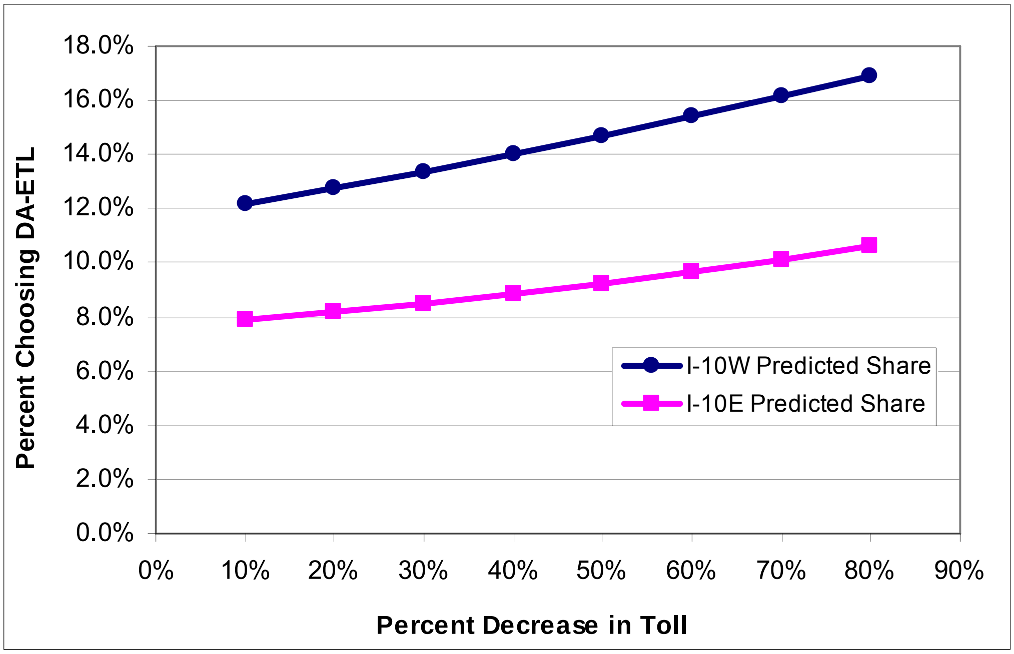

Figure 27. Predicted Share Choosing DA-ETL Mode as Tolls Decrease

Figure 28-Figure 29 show the predicted shares of the CP2-ETL and CP3-ETL modes. Both models predict a similar modest increase in the percent of I-10E and I-10W travelers choosing the CP2-ETL mode as tolls decrease (see Figure 28). However, both models do not show much of a change in the share choosing the CP3-ETL mode as tolls decrease. These observations show that decreasing toll levels may cause a small number of travelers to switch to the CP2-ETL mode, but will likely not affect the number who would be willing to carpool with three or more occupants on the ETLs.

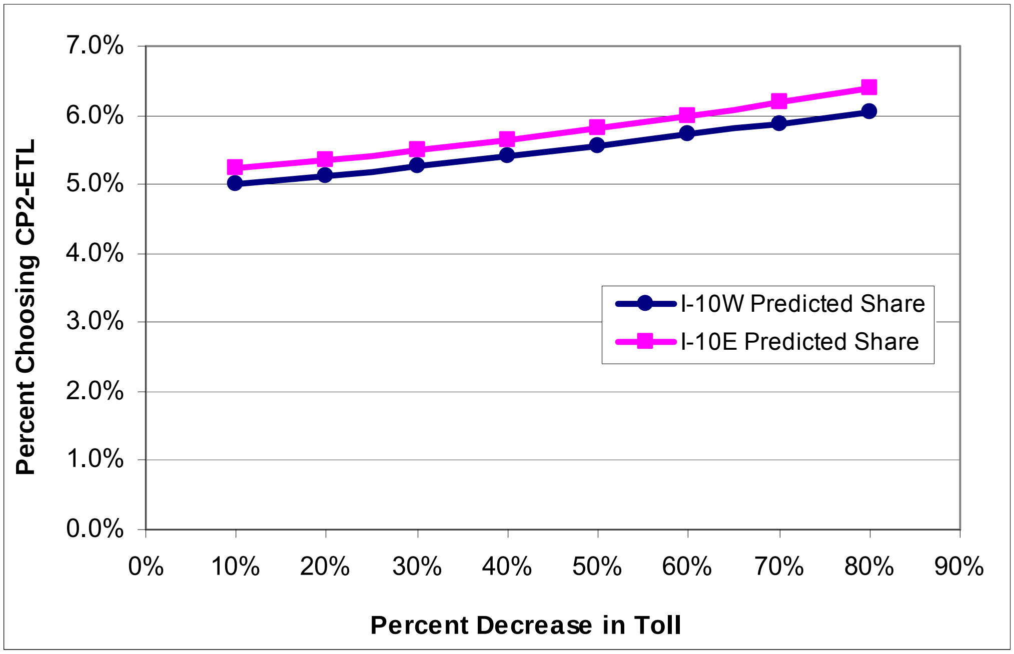

Figure 28. Predicted Share Choosing CP2-ETL Mode as Tolls Decrease

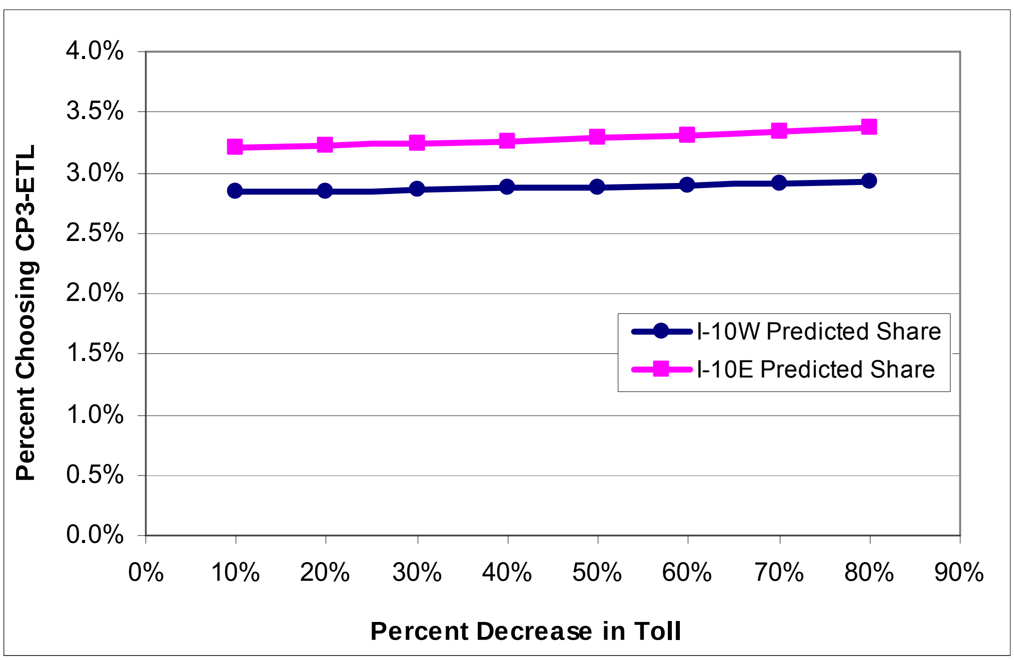

Figure 29. Predicted Share Choosing CP3-ETL Mode as Tolls Decrease

Simulation results show that the percentages of travelers driving alone and carpooling do not change much with a decrease in the toll for all ETL modes. The percentage of I-10E travelers estimated to drive alone drops from 84 percent to 83.1 percent as a result of an 80 percent decrease in the tolls. For I-10W travelers, simulation results show that percentage estimated to drive alone drops from 87.1 percent to 86.4 percent for the same decrease in tolls. These results show that lowering toll levels is estimated to cause only a minor shift from drive alone modes to carpool modes for travelers using both corridors.

CHAPTER VI

CONCLUSIONS

6.1 Findings

The appeal of value pricing as a transportation demand management solution is likely to continue to grow as state departments of transportation continue to face growing congestion and limited transportation resources. Although traditionally implemented in highly congested urban corridors, value pricing projects may be considered for expansions on suburban corridors where congestion is expected to become a problem in the future. However, travelers' reactions to value pricing options in these suburban areas have not been documented since experiences with these projects have typically been confined to congested urban settings. The reactions of travelers in these settings may be quite different and should be studied to optimize any potential implementation of value pricing in these areas.

This research uses travel survey response data from travelers on the I-10E and I-10W corridors outside of San Antonio, Texas to study the response to value pricing by suburban population groups. The I-10W segment is currently experiencing a large amount of retail and housing development, a trend that is expected to continue, while the I-10E segment is largely undeveloped and mostly rural. This travel survey was made available online and advertised to travelers of the I-10 corridors between February and April of 2009. A total of 899 responses were received. However, only 497 surveys were usable for analysis including 89 from I-10E respondents and 408 from I-10W respondents. Respondents were asked about their travel and demographic characteristics and their attitudes towards the potential implementation of value pricing in the form of ETLs on I-10 in the future.

Comparisons of socioeconomic and travel characteristics of travelers on the I-10E and I-10W corridors were made using survey responses as well as data collected for the 2000 U.S. Census. These comparisons revealed several key differences between these two groups of travelers. Data collected for census tracts in proximity to the I-10E and I-10W corridors revealed that those living near I-10W earn much higher incomes and are more highly educated on average as compared to those living near I-10E.

After comparing the household incomes reported by survey respondents and incomes recorded by the census, weighting factors were applied to the survey responses to make the sample more representative of the population. Census and weighted survey response data confirmed that more travelers on I-10W use the corridor for commuting, make more frequent trips, make shorter trips, and are more likely to make regular trips as compared to travelers on I-10E.

When asked about their attitudes towards travel on I-10, it was found that I-10W travelers generally enjoy their travel less than I-10E travelers and foresee traffic being more of a problem in the future. I-10W travelers were more likely to indicate a willingness to use the ETLs as compared to I-10E travelers, although the majority of respondents from both corridors said they would not use the lanes if they were built. Respondents from both corridors cited paying a toll as the number one reason they would not use the ETLs.

A series of three stated preference scenarios were also included in the survey which presented respondents with options to travel on the GPLs or the priced ETLs. A larger percentage of I-10W respondents chose an ETL mode in each of the stated preference questions. It was also noted that a small percentage of respondents from both samples who indicated that they would not be willing to use the ETLs chose an ETL mode anyhow.

Responses to stated preference questions and responses to socioeconomic and trip characteristic questions were used to develop mode choice models. Separate models were developed for I-10E and I-10W travelers to compare how characteristics of the two populations impacted mode choice. Model results generally showed that characteristics which were found to be significant indicators of mode choice in one model were not significant in the other model. This clearly shows that value pricing is appealing to different groups of travelers using the I-10E and I-10W corridors. The differences between the two models were also confirmed using a statistical test. These results suggest that there are fundamental differences between travelers on these two corridors which affect how each group will respond to potential value pricing scenarios.

The characteristics of the I-10E and I-10W corridors may help explain why the response to value pricing seems to differ among different groups of travelers. First, the I-10E corridor extends 30 miles outside of San Antonio and is mostly rural except for suburban communities at both ends. Model results show that those traveling 5 to 10 miles are more likely to choose the DA-ETL option, which suggests that only those individuals living nearest to San Antonio are likely to pay a toll to use the ETLs. Also, model results reveal that commuters on I-10E are less likely to choose the DA-ETL option. This response by commuters is not typical of other variable pricing projects. Survey results from I-394 in Minneapolis revealed an increased willingness to pay among commuters and results from SR-91 in California showed that the percentage of travelers that were frequent users of the express lanes increased with increasing trip distance. If I-10E experienced the level of traffic congestion common to these other projects then the fact that I-10E commuters travel longer distances and make more weekly trips than other travelers may cause them to be more willing to pay for travel time savings offered by the ETLs. However, I-10E commuters do not regularly experience traffic congestion and therefore understandably are not willing to pay an additional cost for their commute.

In contrast to I-10E, the I-10W corridor only extends 16 miles outside of San Antonio and connects many high income suburban communities. Survey results revealed that travelers on I-10W were more likely to make regular trips and did not have an alternative to using I-10W. The fact that model results did not reveal a preference for the ETLs by those making commute trips may confirm that all trip purposes have a necessity to use I-10W. Model results for I-10W travelers show that those traveling 5 to 10 miles are less likely to choose the DA-ETL mode. A majority of these travelers were not using I-10W to travel all the way into or out of San Antonio. This suggests that paying for an ETL option may be more appealing among travelers making more long distance trips, particularly on the more congested segments of I-10.

Model results were also used to calculate distributions of value of travel time savings as well as toll elasticities for I-10E and I-10W travelers. The average value of time for I-10W travelers was found to be $12.89 per hour and $7.57 per hour for I-10W and I-10E respondents, respectively. This difference shows that I-10W travelers may be more willing to pay for travel time savings as compared to I-10E travelers. However, I-10W travelers may have a better sense of the value they would place on being able to save time by utilizing an ETL option since they regularly experience some congestion, unlike travelers on I-10E. Calculated elasticities show that increases in the toll for the ETL options has less of an impact on the predicted number of I-10W travelers switching to non-tolled modes as compared to I-10E travelers.

The following findings and general differences between I-10E and I-10W travelers were noted while conducting this research:

- I-10W travelers earn higher average incomes and are more likely to use I-10W on a regular basis for commute purposes as compared to I-10E travelers,
- I-10E travelers use I-10E less frequently for non-commute trips and travel longer distances than I-10W travelers,
- I-10W travelers seem to have a better sense of the potential time saving benefits associated with the ETLs as compared to I-10E travelers,
- no common characteristics were found to be significant in predicting mode choice among both groups of travelers suggesting differences in the response to value pricing,

- variables that were found to be significant in predicting mode choice often revealed fundamental differences in travelers' trip purpose, time-of-day, and distance suggesting that these characteristics are the most important in explaining differences in the response to value pricing, and
- although the majority of travelers on I-10E and I-10W are not favorable to the implementation of value pricing for the future expansion of these corridors, I-10W travelers had a higher estimated VOT and were more likely to indicate a willingness to use the ETLs as compared to I-10E travelers.

Overall, this research suggests that the implementation of value pricing strategies on suburban corridors may pose a challenge from a policy standpoint. The populations using these corridors appear to be much more varied in their responses toward value pricing than populations using congested urban corridors. Differences in traffic conditions, development patterns, trip characteristics and socioeconomic characteristics are all likely factors that cause differences in attitudes toward pricing projects. These differences must be fully understood to determine whether value pricing could be successfully implemented in a particular scenario.

6.2 Recommendations

It is important to note that the number of usable surveys collected from I-10E and I-10W respondents were small when compared with the population of travelers using both corridors. A better understanding of reactions to value pricing by different suburban population groups could be obtained using a greater number of samples. Larger sample sizes would allow for the estimation of more robust mode choice models. Also, studying a more diverse set of suburban populations would allow for more broad conclusions to be made about reactions to value pricing.

It should also be noted that survey respondents were asked to make travel choices for scenarios in the distant future. The scenarios presented in stated preference questions were not representative of current travel conditions on the I-10E and I-10W corridors. Instead, the scenarios presented to respondents were intended to represent travel conditions in the future when traffic volumes and travel times are estimated to be much higher. As a result, respondents' perceptions of future travel conditions likely had an impact on how they responded to stated preference questions. This impact should be further analyzed, particularly if stated preference surveys are to be used to evaluate the implementation of value pricing projects in the distant future.

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APPENDIX A

SURVEY

San Antonio I-10 Survey

Dear San Antonio Traveler,

The Texas Transportation Institute is working with the Texas Department of Transportation to examine ways to improve traffic flow along segments of the I-10 freeway corridor. We need your help with this. This survey should take about 15 minutes to complete.

While you are not obligated to answer the questions on the survey, the information you provide will be very valuable as we work to investigate future travel improvements for the I-10 corridors. Your answers on the survey will be confidential and not used in any way to identify you. Please use the next and previous buttons at the bottom of the page.

Thank you for your participation.

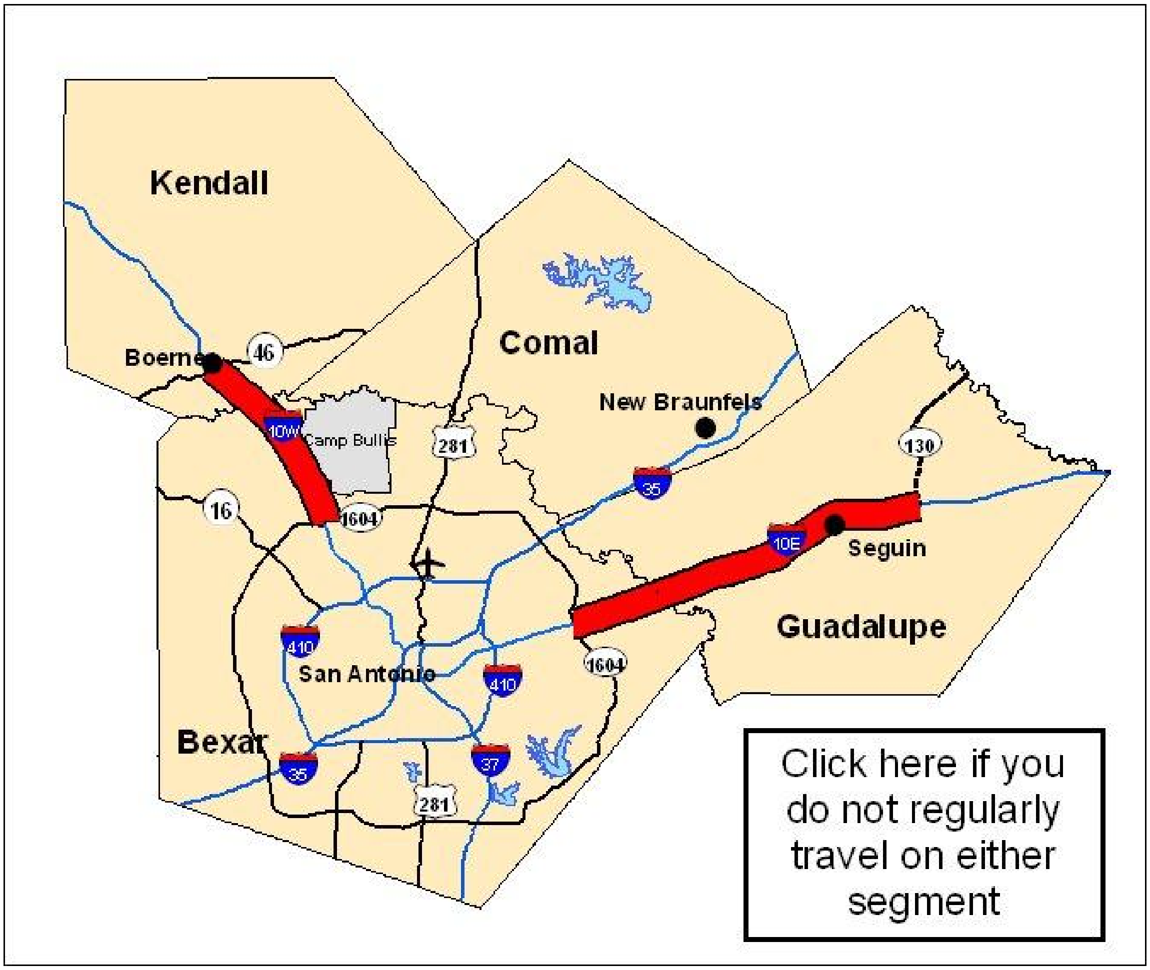
Sincerely,

Mark Burris, Ph.D.
Research Director/Associate Research Engineer
Texas Transportation Institute

This research study has been reviewed by the Human Subjects' Protection Program and/or the Institutional Review Board at Texas A&M University. For research-related problems or questions regarding your rights as a research participant, you can contact these offices at (979)458-4067 or irb@tamu.edu.

Travel Corridor

Please click on the segment of I-10 you use regularly



Recent Travel

Please tell us about your most recent trip on I-10 East/West traveling towards/away from downtown San Antonio during the work week (Monday through Friday). A trip is any time you traveled on I-10 East/West.

Q1: What was the purpose of your most recent trip?
Choose one of the following answers

O Commuting to or from my place of work (going to or from work)
O Recreational / Social / Shopping / Entertainment / Personal Errands
O Work related (other than to or from home to work)
O Other personal business (such as a medical appointment)
O To attend class at school or educational institute
O Traveling to airport
O Going to church
O Other: _________

Q2: On what day of the week was your most recent trip towards/away from downtown San Antonio?
Choose one of the following answers

O Monday
O Tuesday
O Wednesday
O Thursday
O Friday

Q3: What time of day did that trip start?
Choose one of the following answers

[Respondent chooses from dropdown list of times]

Q4: What time of day did that trip end?
Choose one of the following answers

[Respondent chooses from dropdown list of times]

Q5: Is this a trip you regularly take (at least once every 2 weeks)?

O Yes
O No

Q6: Would it have been possible for you to start your trip earlier or later (15 minutes or more)?
Choose one of the following answers

O Yes, I could have easily made the trip a little earlier or later
O Yes, I could have made the trip at any time that day
O No, I could not take the trip at any other time

[Only answer if answered 'Yes, I could have easily made the trip a little earlier or later' to Q6]
Q7: About how much earlier or later could you have made the trip? (in minutes)

[Respondent enters number of minutes]

Q8: Did you allow for extra tavel time due to possible traffic congestion on I-10 East/West for your last trip?

O Yes
O No

[Only answer if answered 'Yes' to Q8]
Q9: How much extra time did you allow (in minutes)?

[Respondent enters number of minutes]

Q10: Where did you get ON and OFF I-10 East/West?

I-10E Choice Set
Inside of Loop 410
Loop 410
Loop 1604
N Graytown Rd.
Pfeil Rd.
FM 1518
Trainer Hale Rd. / FM 2538
Zuehl Rd.
S Santa Clara Rd.
Linne Rd. / FM 465
Schwab Rd.
Nickerson Farms Rd. / FM 775
W Kingsbury St. / US-90
FM 725
FM 464
Old Seguin Rd / Highway 46 / FM 78
N Austin St.
Highway 123
E Kingsbury St. / US-90
FM 2438
East of FM 2438

I-10W Choice Set
Inside of Loop 410
Loop 410
Callaghan Rd.
Wurzbach Rd.
Huebner Rd.
De Zevala Rd.
UTSA Blvd. / Spur 53
Loop 1604
La Cantera Pkwy.
Camp Bullis Rd.
Boerne Stage Rd.
Ralph Fair Rd. / FM 3351
Tarpon Dr. / Fair Oaks Pkwy.
Cascade Caverns Rd. / Old San Antonio Rd
S Main St. / US 87
Highway 46
Ranger Creek Rd. / N Main St.
North of Boerne

Q11: What kind of vehicle did you use for your most recent trip?
Choose one of the following answers

O Motorcycle
O Passenger car, SUV, or pick-up truck

[Only answer if answered ‘Passenger car, SUV, or pick-up truck’ to Q11]
Q12: If you traveled by Passenger Car / SUV / Pick-up Truck, how many people including you, were in the vehicle?
Choose one of the following answers

O 1
O 2
O 3
O 4
O 5+

[Only answer if did not answer ‘1’ to Q12]
Q13: Were you the driver or a passenger on this recent trip?
Choose one of the following answers

O Driver
O Passenger

[Only answer if did not answer ‘1’ to Q12]
Q14: Who did you travel with on this recent trip?
Check any that apply

☐ Child

☐ Adult family member

☐ Co-worker / person in the same, or a nearby, office building

☐ Neighbor

☐ Other: __________

[Only answer if did not answer ‘1’ to Q12]
Q15: How much extra time did it take to pick up and drop off the passenger(s) (minutes)?

[Respondent enters number of minutes]

Q16: Did you have to pay to park in San Antonio?

O Yes
O No

[Only answer if answered ‘Yes’ to Q16]
Q17: How much does it cost per day (in $)?

[Respondent enters number of dollars]

General Travel

We want you to now think about all of your trips on I-10 East/West during the last full week.

Q18: How many total trips did you m ake during the past full work week (Monday to Friday) on I-10 East/West either into, or out of San Antonio? (Each direction of travel is one trip)

Trips per week: __________

Q19: Consider your usual trip into our out of San Antonio on I-10 East/West: On your usual trip, how much do you enjoy the travel?
Choose one of the following answers

O I do not enjoy it at all
O I usually dislike it
O Neutral – neither dislike or like
O I usually enjoy the trip
O I always enjoy the time during my travel

Q19: Do you sometimes use a route into the San Antonio are other than I-10 East/West to make trips with a similar purpose to your usual trip?

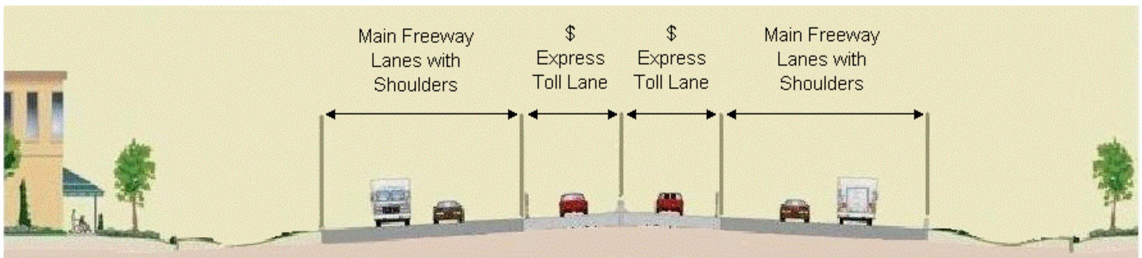
O Yes
O No

Q20: In the next 10 years, what would you expect traffic on I-10 East/West to be like?
Choose one of the following answers

O Much worse than now
O Slightly worse than now
O About the same as now
O Slightly better than now

Introduction to Express Toll Lanes

Traffic congestion on I-10 is expected to increase in the future. There are long range plans to expand the I-10 corridor by the year 2030. One construction option for I-10 are Express Toll lanes. An Express Toll lane would be added in each direction where a toll would be charged but the lanes would not be congested. The existing lanes would remain free, but there may be congestion. There may also be toll discounts or free travel in the Express Toll lanes for carpools and busses.



Q21: Now that you know about the Express Toll lane concept, do you think you would be interested in using them?
Choose one of the following answers

O Yes
O No
O Maybe

[Only answer if answered 'Yes' to Q21]
Q22: What interests you the most about the toll lanes?
Check any that apply

☐ The toll lanes are safer / less stressful than driving on the main freeway lanes

☐ During the peak hours the toll lanes will not be congested

☐ No trucks on the toll lanes

☐ Travel times on the toll lanes are consistent and predictable

☐ Being able to use the toll lanes for free as a carpool

☐ Other: __________

[Only answer if answered ‘No’ to Q21]
Q23: What are the primary reasons why you would not use the proposed toll lanes?
Check any that apply

☐ I would not want to pay the toll for my trip

☐ Congestion will not be bad enough to use the lanes

☐ I will have the flexibility to travel at less congested times

☐ I do not have a credit card needed to set up a toll account

☐ Participation in a carpool will be difficult / undesirable

☐ The toll lanes will not offer me enough time savings

☐ I can easily use other routes than I-10, so I’ll just avoid it if I think there is a lot of traffic

☐ I would not want a toll transponder in my car

☐ One Express Toll lane is not enough to handle future traffic

☐ Toll lanes use is complicated or confusing

☐ A toll won’t keep the lane flowing freely

☐ Other: __________

[Only answer if answered ‘Maybe’ to Q21]
Q24: What are the primary reasons you are not sure that you would use the proposed toll lanes?
Check any that apply

☐ Congestion may not be bad enough to use the lanes

☐ I do not know if I will be able to get into a carpool

☐ One Express Toll lane may not be enough to handle future congestion

☐ I don’t know if the toll lanes will save me enough time

☐ I do not know how much the tolls will be, so cannot say until I know

☐ The toll may not keep the lane uncongested

☐ Toll lane use is complicated or confusing – I don’t understand this yet

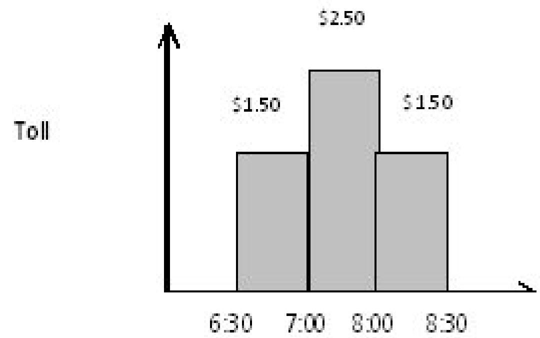
☐ I might change jobs / home location by the time the lanes are in operation

☐ I am not sure about putting a toll transponder in my car

☐ Other: __________

The questions in this part of the survey are to find out your views on a number of potential options for the operation of the proposed Express Toll Lanes. The options raised here are for research purpose, and not official policies.

Q25: To maintain a smooth traffic flow, the toll that you pay on the Express Toll lanes could change with the time of day you drive on the lanes. As shown in the graph, lower tolls could be charged for travel at specific times (for example, 6:30 a.m. to 7:00 a.m.) and higher tolls during the most congested times (for example, 7:00 a.m. to 8:00 a.m.). What is your initial feeling regarding this option?



Choose one of the following answers

O Very unfavorable
O Somewhat unfavorable
O Neutral / No opinion
O Somewhat favorable
O Very favorable

Q26: The toll on the proposed Express Toll lanes could also change with the amount of traffic on the Express Toll lanes. For example, if the toll lanes were not congested then the toll might be lower. However, if the toll lanes were very congested the toll might be higher to maintain the smooth flow of traffic. What is your initial feeling regarding this option?
Choose one of the following answers

O Very unfavorable
O Somewhat unfavorable
O Neutral / No opinion
O Somewhat favorable
O Very favorable

Q27: Have you ever taken a toll road on a regular basis (at least once per month)?
Choose one of the following answers

O Yes
O No

Travel Choices 1

Each of the following questions will ask you to choose between four potential travel choices on I-10 East/West. For your most recent trip, please click on the one option that you would be most likely to choose if faced with these specific options. Remember that main lane traffic tends to be congested and could be slower than shown here if congestion is worse than usual. The toll lane traffic is fast moving. Also, carpooling may require added travel time to pick up or drop off your passenger(s).

You described your most recent trip towards/away from downtown San Antonio on I-10 East/West last [day of week from Q2] as starting at [start time from Q3], ending at [end time from Q4] in a [vehicle type from Q11]. The reason for the trip was [trip purpose from Q1].

Q28: If you had the options below for that trip, which would you have chosen?
Choose one of the following answers
[Values shown below are examples only. Actual mode, lane, travel time, toll, and time of day values shown to respondents varies based on the survey design, described in Appendix C]

Mode: Drive by myself	**Mode:** Carpool with others	**Mode:** Drive by myself	**Mode:** Carpool with 3 or more people
Lane: Main freeway lanes	**Lane:** Main freeway lanes	**Lane:** Toll lanes	**Lane:** Toll lanes
Travel Time: 18 minutes	**Travel Time:** 20 minutes	**Travel Time:** 14 minutes	**Travel Time:** 13 minutes
Toll: $ None	**Toll:** $ None	**Toll:** $ 1.10	**Toll:** $ None
Time of Day: afternoon rush hour	**Time of day:** afternoon rush hour	**Time of Day:** afternoon rush hour	**Time of Day:** afternoon rush hour

Travel Choices 2

The options below have changed

You described your most recent trip towards/away from downtown San Antonio on I-10 East/West last [day of week from Q2] as starting at [start time from Q3], ending at [end time from Q4] in a [vehicle type from Q11]. The reason for the trip was [trip purpose from Q1].

Q29: If you had the options below for that trip, which would you have chosen?
Choose one of the following answers
[Values shown below are examples only. Actual mode, lane, travel time, toll, and time of day values shown to respondents varies based on the survey design, described in Appendix C]

Mode: Drive by myself	**Mode:** Carpool with others	**Mode:** Drive by myself	**Mode:** Carpool with 3 or more people
Lane: Main freeway lanes	**Lane:** Main freeway lanes	**Lane:** Toll lanes	**Lane:** Toll lanes
Travel Time: 18 minutes	**Travel Time:** 20 minutes	**Travel Time:** 14 minutes	**Travel Time:** 13 minutes
Toll: $ None	**Toll:** $ None	**Toll:** $ 1.10	**Toll:** $ None
Time of Day: afternoon rush hour	**Time of day:** afternoon rush hour	**Time of Day:** afternoon rush hour	**Time of Day:** afternoon rush hour

Travel Choices 3

The options below have changed

You described your most recent trip towards/away from downtown San Antonio on I-10 East/West last [day of week from Q2] as starting at [start time from Q3], ending at [end time from Q4] in a [vehicle type from Q11]. The reason for the trip was [trip purpose from Q1].

Q30: If you had the options below for that trip, which would you have chosen?
Choose one of the following answers
[Values shown below are examples only. Actual mode, lane, travel time, toll, and time of day values shown to respondents varies based on the survey design, described in Appendix C]

Mode: Drive by myself	**Mode:** Carpool with others	**Mode:** Drive by myself	**Mode:** Carpool with 3 or more people
Lane: Main freeway lanes	**Lane:** Main freeway lanes	**Lane:** Toll lanes	**Lane:** Toll lanes
Travel Time: 18 minutes	**Travel Time:** 20 minutes	**Travel Time:** 14 minutes	**Travel Time:** 13 minutes
Toll: $ None	**Toll:** $ None	**Toll:** $ 1.10	**Toll:** $ None
Time of Day: afternoon rush hour	**Time of day:** afternoon rush hour	**Time of Day:** afternoon rush hour	**Time of Day:** afternoon rush hour

Demographics

The following questions will be used for statistical purposes only and answers will remain confidential. All of your answers are very important to us and in no way will they be used to identify you or released to any other person outside the research team.

Q31: What is your age?
Choose one of the following answers

O 18 to 24
O 25 to 34
O 35 to 44
O 45 to 54
O 55 to 64
O 65 and over

Q32: What is your gender?
Choose one of the following answers

O Male
O Female

Q33: What is your racial / ethnic group?
Choose one of the following answers

O White
O Black or African American
O Hispanic
O Other: ________

Q34: Please describe the type of household you live in.
Choose one of the following answers

O Single adult
O Unrelated adults
O Married without children
O Married with child(ren)
O Single parent family
O Other: ________

Q35: Including yourself, how many people live in your household?

[Respondent enters number in household]

Q36: All together, how many motor vehicles (including cars, vans, trucks, and motorcycles) are available by use by members of your household?

[Respondent enters number of vehicles]

Q37: What category best describes your occupational or work status?
Choose one of the following answers

O Student
O Student and working
O Permanently disabled
O Homemaker
O Unemployed
O Working part-time (less than 30 hours a week)
O Working full-time (30 or more hours a week)
O Retired
O Other: ________

Q38: What was the last year of school that you have completed:
Choose one of the following answers

O Less than high school
O High school graduate
O Some college or vocational school
O College graduate
O Postgraduate degree

Q39: What was your gross annual household income before taxes in 2008?
Choose one of the following answers

O Less than $10,000
O $10,000 to $14,999
O $15,000 to $24,999
O $25,000 to $34,999
O $35,000 to $49,999
O $50,000 to $74,999
O $75,000 to $99,999
O $100,000 to $199,999
O $200,000 or more

Q40: Thank you for taking the time to fill in this survey. Your responses will be helpful as we work to improve travel in the San Antonio area. If you have any general comments about travel on I-10, or San Antonio in general, please type them below. When you are finished please hit "Submit" below. Thanks!

[Respondent enters comments]

APPENDIX B

CROSS TABULATION TABLES

Table B1. Cross Tabulation of Stated Preference Response and Socioeconomic Characteristics for I-10E Sample

Socioeconomic Characteristic		Mode					Total
		DA-GPL	CP-GPL	DA-ETL	CP2-ETL	CP3-ETL	
Gender	Male	64.9%	__89.9%__	70.4%	75.0%	__100%__	68.8%
	Female	35.1%	__10.1%__	29.6%	25.0%	0.0%	31.2%
Age	18-24	7.0%	0.0%	3.2%	5.5%	__26.2%__	6.6%
	25-34	14.7%	15.2%	9.8%	0.0%	13.0%	13.6%
	35-44	12.5%	5.1%	11.4%	0.0%	0.0%	10.9%
	45-54	21.1%	11.7%	__46.1%__	16.7%	__8.5%__	21.8%
	55-64	28.3%	__11.7%__	__16.4%__	__61.2%__	__52.3%__	28.4%
	65+	16.4%	__56.2%__	13.1%	16.7%	0.0%	18.7%
Ethnicity	White	86.1%	__57.7%__	90.3%	__72.4%__	87.0%	83.7%
	Black	0.3%	0.0%	3.2%	5.5%	0.0%	0.8%
	Hispanic	8.9%	__21.9%__	6.5%	__22.2%__	13.0%	10.5%
	Asian	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Other	4.6%	__20.5%__	0.0%	0.0%	0.0%	5.1%
Income	Less than $10,000	3.1%	0.0%	0.0%	0.0%	0.0%	2.4%
	$10,000 to $14,999	7.2%	0.0%	9.9%	0.0%	__26.2%__	7.1%
	$15,000 to $24,999	5.1%	0.0%	9.9%	0.0%	0.0%	4.7%
	$25,000 to $34,999	15.4%	__51.2%__	29.7%	16.8%	__52.3%__	20.4%
	$35,000 to $49,999	16.2%	10.1%	__4.9%__	__25.0%__	0.0%	14.8%
	$50,000 to $74,999	29.9%	__5.1%__	__4.9%__	25.0%	0.0%	24.9%
	$75,000 to $99,999	8.1%	__20.3%__	14.8%	16.7%	13.0%	10.1%
	$100,000 to $199,999	12.7%	13.3%	22.6%	11.0%	8.5%	13.3%
	$200,000 or more	2.3%	0.0%	3.2%	5.5%	0.0%	2.3%
Education	Less than high school	3.1%	0.0%	0.0%	0.0%	0.0%	2.4%
	High school graduate	8.7%	0.0%	9.9%	16.7%	0.0%	8.2%
	Some college	43.5%	__71.5%__	__16.3%__	__22.3%__	__91.5%__	44.0%
	College graduate	34.3%	__23.5%__	__60.7%__	__47.2%__	__8.5%__	35.4%
	Postgraduate degree	10.4%	5.1%	13.1%	13.8%	0.0%	10.1%
Household Type	Single Adult	34.2%	__5.1%__	__9.9%__	0.0%	26.2%	28.2%
	Unrelated Adults	1.0%	0.0%	0.0%	0.0%	0.0%	0.8%
	Married w/out children	22.1%	__37.3%__	__11.4%__	__61.0%__	0.0%	23.6%
	Married w/ children	28.9%	__57.7%__	__68.8%__	39.0%	__73.8%__	36.1%
	Single parent family	2.5%	0.0%	0.0%	0.0%	0.0%	1.9%
	Living with family members	6.6%	0.0%	9.9%	0.0%	0.0%	5.9%
	Other	4.6%	0.0%	0.0%	0.0%	0.0%	3.5%

Table B1. Continued

Socioeconomic Characteristic		Mode					Total
		DA-GPL	CP-GPL	DA-ETL	CP2-ETL	CP3-ETL	
Occupation	Working part-time	1.5%	0.0%	0.0%	0.0%	0.0%	1.2%
	Working full-time	67.0%	**52.5%**	**78.7%**	**39.0%**	73.8%	65.7%
	Unemployed	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Retired	18.7%	**47.5%**	**6.5%**	**52.7%**	0.0%	21.0%
	Permanently disabled	2.0%	0.0%	9.9%	0.0%	0.0%	2.4%
	Homemaker	4.0%	0.0%	4.9%	8.3%	0.0%	3.9%
	Student	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Student and working	6.6%	0.0%	0.0%	0.0%	**26.2%**	5.9%

Table B2. Cross Tabulation of Stated Preference Response and Socioeconomic Characteristics for I-10W Sample

Socioeconomic Characteristic		Mode					Total
		DA-GPL	CP-GPL	DA-ETL	CP2-ETL	CP3-ETL	
Gender	Male	61.1%	60.6%	61.1%	60.4%	**81.6%**	61.6%
	Female	38.9%	39.4%	38.9%	39.6%	**18.4%**	38.4%
Age	18-24	2.4%	0.0%	5.3%	11.6%	**16.1%**	3.5%
	25-34	12.1%	**27.2%**	24.6%	24.3%	**43.9%**	16.0%
	35-44	24.3%	27.1%	21.9%	19.7%	**7.4%**	23.4%
	45-54	28.4%	**15.5%**	20.0%	18.6%	21.2%	26.0%
	55-64	22.2%	23.1%	20.8%	16.5%	**11.4%**	21.5%
	65+	10.5%	7.0%	7.3%	9.3%	0.0%	9.6%
Ethnicity	White	84.6%	78.2%	76.2%	79.3%	**54.6%**	82.1%
	Black	0.8%	0.0%	0.0%	0.0%	0.0%	0.6%
	Hispanic	11.6%	14.8%	20.9%	15.9%	**40.5%**	13.9%
	Asian	0.2%	1.5%	2.9%	1.6%	4.9%	0.8%
	Other	2.9%	5.5%	0.0%	3.2%	0.0%	2.6%
Income	Less than $10,000	0.0%	0.0%	2.0%	8.7%	**16.1%**	1.2%
	$10,000 to $14,999	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	$15,000 to $24,999	8.0%	8.2%	5.9%	0.0%	16.1%	7.6%
	$25,000 to $34,999	11.4%	16.4%	7.8%	4.3%	8.1%	10.8%
	$35,000 to $49,999	5.2%	3.0%	8.6%	1.6%	0.0%	5.2%
	$50,000 to $74,999	16.6%	24.1%	14.4%	**35.2%**	20.8%	17.9%
	$75,000 to $99,999	15.6%	12.1%	16.6%	14.4%	11.9%	15.4%
	$100,000 to $199,999	32.8%	31.2%	33.4%	22.5%	**9.8%**	31.6%
	$200,000 or more	10.2%	5.0%	11.3%	13.3%	17.2%	10.4%
Education	Less than high school	0.1%	0.0%	1.4%	0.0%	0.0%	0.3%
	High school graduate	5.4%	8.2%	8.5%	9.1%	16.1%	6.4%
	Some college	28.2%	31.4%	28.5%	30.0%	**39.9%**	28.8%
	College graduate	37.3%	33.6%	40.7%	40.7%	38.5%	37.7%
	Postgraduate degree	29.0%	26.8%	20.9%	20.2%	**5.4%**	26.8%
Household Type	Single Adult	11.8%	16.7%	20.2%	10.5%	**37.1%**	13.8%
	Unrelated Adults	3.9%	0.0%	3.6%	0.0%	0.0%	3.3%
	Married w/out children	29.6%	**9.5%**	31.4%	26.1%	18.9%	28.2%
	Married w/ children	47.2%	**63.2%**	40.1%	50.0%	44.0%	47.3%
	Single parent family	4.7%	7.5%	1.4%	1.6%	0.0%	4.2%
	Living with family members	0.6%	3.0%	0.0%	3.2%	0.0%	0.8%
	Other	2.2%	0.0%	3.3%	8.7%	0.0%	2.5%

Table B2. Continued

Socioeconomic Characteristic		Mode					Total
		DA-GPL	CP-GPL	DA-ETL	CP2-ETL	CP3-ETL	
Occupation	Working part-time	3.3%	5.5%	0.7%	4.8%	0.0%	3.1%
	Working full-time	71.9%	**<u>51.4%</u>**	**<u>82.9%</u>**	71.3%	64.8%	71.8%
	Unemployed	0.6%	0.0%	0.0%	0.0%	0.0%	0.5%
	Retired	12.6%	11.3%	3.5%	7.7%	0.0%	10.9%
	Permanently disabled	0.6%	1.5%	0.0%	0.0%	3.0%	0.6%
	Homemaker	4.7%	**<u>20.6%</u>**	3.7%	4.3%	8.1%	5.5%
	Student	1.2%	0.0%	2.0%	8.7%	16.1%	2.1%
	Student and working	4.5%	8.2%	7.2%	0.0%	8.1%	4.9%
	Other	0.6%	1.5%	0.0%	3.2%	0.0%	0.7%

Table B3. Cross Tabulation of Stated Preference Response and Travel Characteristics for I-10E Sample

Travel Characteristic		Mode					Total
		DA-GPL	CP-GPL	DA-ETL	CP2-ETL	CP3-ETL	
Trip Purpose	Commuting	25.8%	27.0%	**9.8%**	33.4%	21.5%	24.8%
	Recreational	32.7%	40.8%	29.4%	30.5%	0.0%	32.0%
	Work Related	11.5%	20.5%	9.7%	16.8%	**52.3%**	13.5%
	Other Business	20.3%	**5.1%**	14.8%	**8.3%**	0.0%	17.6%
	School	2.0%	0.0%	0.0%	0.0%	**26.2%**	2.4%
	Airport	3.0%	0.0%	0.0%	0.0%	0.0%	2.3%
	Church	0.0%	0.0%	**29.7%**	0.0%	0.0%	2.4%
Vehicle Occupancy	1	60.5%	**11.7%**	**30.9%**	58.5%	**87.0%**	55.1%
	2	29.3%	21.9%	39.4%	**41.5%**	0.0%	29.2%
	3	1.0%	**30.6%**	0.0%	0.0%	13.0%	3.5%
	4	3.6%	**35.8%**	**29.7%**	0.0%	0.0%	7.8%
	5	1.5%	0.0%	0.0%	0.0%	0.0%	1.2%
Vehicle Occupant	Co-Worker	2.0%	5.1%	0.0%	0.0%	0.0%	1.9%
	Neighbor	3.6%	0.0%	9.9%	0.0%	0.0%	3.5%
	Adult Family Member	27.3%	**52.6%**	**59.2%**	41.5%	0.0%	31.6%
	Child	2.5%	10.1%	0.0%	0.0%	13.0%	3.1%
	Friend	0.0%	**20.5%**	0.0%	0.0%	0.0%	1.6%
Weekly Trips	0 - 4	55.7%	**27.0%**	**72.1%**	**77.8%**	**78.5%**	56.5%
	5 - 9	23.4%	**68.0%**	**14.8%**	0.0%	21.5%	25.0%
	10 - 14	14.0%	5.1%	9.8%	16.7%	0.0%	12.7%
	15 or more	2.9%	0.0%	3.2%	5.5%	0.0%	2.7%
Trip Distance	< 5 miles	5.6%	0.0%	0.0%	0.0%	0.0%	4.3%
	5 - 10 miles	10.7%	0.0%	**34.7%**	0.0%	0.0%	10.9%
	10 - 15 miles	18.2%	**5.1%**	**3.2%**	0.0%	**26.2%**	15.4%
	15 - 20 miles	8.6%	0.0%	**17.8%**	**25.0%**	0.0%	9.2%
	20 - 25 miles	17.8%	**52.6%**	**4.9%**	**33.4%**	**8.5%**	19.9%
	> 25 miles	23.9%	25.5%	23.0%	13.8%	0.0%	22.8%
Regular Trip?	Yes	79.5%	**64.2%**	**52.2%**	66.5%	**47.7%**	74.6%
Alternative Route?	Yes	55.9%	47.5%	52.5%	44.3%	0.0%	52.8%

Table B4. Cross Tabulation of Stated Preference Response and Travel Characteristics for I-10W Sample

Travel Characteristic		Mode					Total
		DA-GPL	CP-GPL	DA-ETL	CP2-ETL	CP3-ETL	
Trip Purpose	Commuting	53.7%	**42.2%**	62.3%	45.3%	53.1%	53.6%
	Recreational	20.4%	**40.6%**	16.0%	22.9%	38.0%	21.6%
	Work Related	8.5%	3.0%	9.0%	6.4%	8.9%	8.2%
	Other Business	10.4%	11.1%	6.2%	6.4%	0.0%	9.5%
	School	2.7%	0.0%	4.7%	13.2%	0.0%	3.2%
	Airport	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Church	2.0%	0.0%	0.7%	0.0%	0.0%	1.6%
Vehicle Occupancy	1	77.3%	**29.8%**	78.8%	**38.6%**	**24.2%**	71.3%
	2	17.1%	23.8%	14.8%	**45.1%**	14.8%	18.6%
	3	2.8%	**21.4%**	5.1%	14.7%	**36.9%**	5.7%
	4	0.6%	**25.0%**	0.0%	1.6%	8.1%	2.1%
	5	0.0%	0.0%	0.0%	0.0%	**16.1%**	0.5%
Vehicle Occupant	Co-Worker	6.1%	3.6%	18.9%	13.6%	**25.6%**	9.3%
	Neighbor	2.0%	7.1%	0.0%	0.0%	0.0%	2.2%
	Adult Family Member	**64.5%**	**32.7%**	42.8%	**38.4%**	**17.1%**	50.9%
	Child	25.1%	**48.0%**	28.5%	34.2%	36.0%	30.8%
	Friend	2.2%	8.6%	9.8%	13.8%	**21.2%**	6.8%
Weekly Trips	0 - 4	31.7%	37.1%	26.3%	**43.0%**	29.9%	31.9%
	5 - 9	29.4%	36.8%	33.8%	24.8%	39.9%	30.4%
	10 - 14	31.9%	**19.9%**	32.5%	29.5%	30.1%	31.1%
	15 or more	6.3%	1.2%	6.8%	1.3%	0.0%	5.6%
Trip Distance	< 5 miles	7.5%	7.5%	9.1%	2.7%	5.4%	7.4%
	5 - 10 miles	20.9%	12.2%	8.0%	**7.5%**	8.1%	17.8%
	10 - 15 miles	39.4%	**51.4%**	40.7%	45.6%	**51.5%**	40.9%
	15 - 20 miles	12.1%	9.3%	11.7%	17.5%	12.3%	12.2%
	20 - 25 miles	10.7%	4.0%	**21.6%**	10.6%	11.4%	11.6%
	> 25 miles	3.7%	5.3%	3.8%	10.1%	11.4%	4.3%
Regular Trip?	Yes	93.1%	88.7%	90.7%	**80.1%**	94.1%	91.9%
Alternative Route?	Yes	37.4%	**23.8%**	30.6%	35.0%	29.8%	35.5%

APPENDIX C

STATED PREFERENCE DESIGN

Stated Preference Overview

In the first section of the survey, respondents were asked to provide the details of their last trip on I-10. Half of the respondents were asked to describe their most recent trip *towards* San Antonio and the other half were asked about their most recent trip *away from* San Antonio. Respondents were asked when they made their last trip, where they got on and off I-10, and how many occupants were in the vehicle. This information was used to develop the stated preference (SP) questions such that the scenarios presented to respondents were representative of their last trip on I-10.

Each respondent was presented with three SP questions. Each SP question asked respondents to choose from among four mode choice options for the trip described previously. Each mode choice option was presented with a randomly generated toll and travel time. Respondents were able to choose between free travel on the general purpose lanes (GPLs) or travel on the express toll lanes (ETLs), which usually required a toll. Respondents were also able to choose to drive alone or carpool. In total, there were five mode choice options from which four were selected to present to respondents. The five options available were:

1. Drive alone on GPLs (DA-GPL)
2. Carpool on GPLs (CP-GPL)
3. Drive alone on ETLs (DA-ETL)
4. Carpool with one other person on ETLs (CP2-ETL)
5. Carpool with two or more other people on ETLs (CP3-ETL)

The mode choice options presented to respondents were randomly selected according to the specific SP design. Tolls for the ETL options were programmed so that most of the time they would be lower, or possibly even zero, for carpooling options compared to the drive alone option. Travel times were programmed to be lower on the ETLs as compared to the GPLs during peak periods. During off-peak periods travel times on the GPLs could have been close to or possibly even lower than on the ETLs.

Time of Day

The time that the respondent's last trip started was used to set the time of day for the stated preference scenarios. The following logic was used to set the time of day:

If trip started between:	Then time of day was set to:
12:00AM – 4:30AM	Night
4:30AM – 6:00AM	Early Morning
6:00AM – 9:00AM	Morning Rush Hour
9:00AM – 3:30PM	Mid-day
3:30PM – 6:30PM	Afternoon Rush Hour
6:30PM – 8:00PM	Evening

If the respondent did not enter the time that their last trip began then it was set to the morning rush hour if the respondent was being asked about their trip towards San Antonio and was set to the afternoon rush hour otherwise. Toll rates during the morning and afternoon rush hours were programmed to be twice as high as rates during the off-peak periods.

Trip Distance

The entrance and exit locations specified by the respondent were used to calculate the total trip distance. This trip distance was used as an input to calculate the toll and travel time presented for each SP scenario. A random trip distance between 10 and 14 miles was generated if the respondent failed to indicate an entrance and/or exit location. If the respondent traveled a distance longer than either ETL segment, then the total trip distance was segmented into a free distance and a toll distance. The free distance represented travel beyond the limits of the ETLs and the toll distance represented travel within the boundaries of the ETLs.

Calculation of Toll and Travel Time

The tolls presented for ETL options in SP scenarios were calculated using the toll distance and a randomly generated per-mile toll rate. If this toll distance was less than four miles, then an additional four miles was added to the toll distance to ensure reasonable choices. Toll rates were programmed so that most of the time they would be lower for carpooling options compared to the drive alone option, to simulate a tolling policy that charges a lower toll for HOVs. The ranges of the randomly generated per-mile toll rates differed based on the survey design.

The travel times presented in SP scenarios were calculated using the free and toll distances and randomly generated speeds. Speeds for the free distance were randomly generated to fluctuate around 60 mph to simulate free flow conditions beyond the limits of the toll lanes. Speeds for the toll distance varied depending on whether a GPL option or ETL option was being presented. The speeds for the GPLs were typically lower than the ETLs to simulate a travel time savings offered by the ETLs. The ranges of the speeds for the toll distance varied by SP design.

Stated Preference Scenario Design

Three different SP designs were used to generate scenarios presented to survey respondents. Each design had an equal probability of being used to generate SP scenarios. These designs are described below.

Method 1: D-Efficient Design

D-Efficient designs are used to minimize the D-Error, which is an aggregated measure of the variances of estimated utility function parameters. Eight “blocks” with different combinations of travel modes, speeds, and toll rates were generated using computer software to minimize the D-Error. The DA-GPL mode was always presented in each SP question for this design. A random number between 1 and 8 was generated to determine which block of questions would be presented to respondents. The specific modes, speeds, and tolls presented for each block are shown in Table C1. All speeds were programmed to vary by plus or minus five miles per hour. Toll rates were programmed to vary within the ranges shown in the table. Toll rates were halved during off-peak periods.

Table C1. Stated Preference Question Blocks for D-Efficient Design

Block	SP Question	Modes Presented	Speed (+/- 5 mph)	Toll rate (cents/mi)	Block	SP Question	Modes Presented	Speed (+/- 5 mph)	Toll rate (cents/mi)
Block 1	1	DA-GPL	35	0	Block 2	1	DA-GPL	45	0
		CP-GPL	45	0			CP-GPL	25	0
		DA-ETL	55	20 +/- 4			DA-ETL	65	20 +/- 4
		CP3-ETL	55	10 +/- 2			CP2-ETL	65	20 +/- 4
	2	DA-GPL	25	0		2	DA-GPL	25	0
		CP-GPL	45	0			CP-GPL	25	0
		DA-ETL	65	10 +/- 2			DA-ETL	55	20 +/- 4
		CP2-ETL	55	10 +/- 2			CP3-ETL	60	5 +/- 1
	3	DA-GPL	45	0		3	DA-GPL	35	0
		DA-ETL	60	20 +/- 4			CP-GPL	25	0
		CP2-ETL	55	5 +/- 1			DA-ETL	60	10 +/- 2
		CP3-ETL	55	0			CP2-ETL	60	10 +/- 2
Block 3	1	DA-GPL	35	0	Block 4	1	DA-GPL	25	0
		CP-GPL	45	0			CP-GPL	35	0
		DA-ETL	65	20 +/- 4			DA-ETL	60	10 +/- 2
		CP3-ETL	60	0			CP3-ETL	65	0
	2	DA-GPL	25	0		2	DA-GPL	35	0
		CP-GPL	25	0			DA-ETL	65	20 +/- 4
		CP2-ETL	65	20 +/- 4			CP2-ETL	60	5 +/- 1
		CP3-ETL	55	5 +/- 1			CP3-ETL	65	5 +/- 1
	3	DA-GPL	45	0		3	DA-GPL	45	0
		CP-GPL	35	0			DA-ETL	55	10 +/- 2
		DA-ETL	55	20 +/- 4			CP2-ETL	65	10 +/- 2
		CP2-ETL	60	20 +/- 4			CP3-ETL	60	10 +/- 2
Block 5	1	DA-GPL	35	0	Block 6	1	DA-GPL	45	0
		CP-GPL	35	0			CP-GPL	45	0
		CP2-ETL	65	10 +/- 2			CP2-ETL	60	5 +/- 1
		CP3-ETL	55	5 +/- 1			CP3-ETL	60	0
	2	DA-GPL	25	0		2	DA-GPL	25	0
		CP-GPL	35	0			CP-GPL	45	0
		CP2-ETL	55	5 +/- 1			DA-ETL	60	20 +/- 4
		CP3-ETL	60	10 +/- 2			CP2-ETL	65	5 +/- 1
	3	DA-GPL	35	0		3	DA-GPL	25	0
		DA-ETL	55	10 +/- 2			DA-ETL	55	20 +/- 4
		CP2-ETL	65	5 +/- 1			CP2-ETL	60	10 +/- 2
		CP3-ETL	65	0			CP3-ETL	55	0
Block 7	1	DA-GPL	45	0	Block 8	1	DA-GPL	45	0
		CP-GPL	35	0			CP-GPL	45	0
		DA-ETL	65	10 +/- 2			DA-ETL	60	20 +/- 4
		CP3-ETL	55	10 +/- 2			CP3-ETL	65	5 +/- 1
	2	DA-GPL	45	0		2	DA-GPL	25	0
		CP-GPL	25	0			DA-ETL	65	20 +/- 4
		CP2-ETL	55	10 +/- 2			CP2-ETL	60	20 +/- 4
		CP3-ETL	65	10 +/- 2			CP3-ETL	65	10 +/- 2
	3	DA-GPL	35	0		3	DA-GPL	35	0
		DA-ETL	60	10 +/- 2			CP-GPL	35	0
		CP2-ETL	55	20 +/- 4			DA-ETL	55	20 +/- 4
		CP3-ETL	60	5 +/- 1			CP2-ETL	55	5 +/- 1

Method 2: D-Efficient Modes and Speeds with Smart Adjusting Tolls

For this design, the travel modes and speeds were chosen based on the same D-Efficient design discussed previously, but tolls were calculating based on a smart adjusting design. Tolls rates for the first question were randomly generated within the ranges shown in the table below. Tolls for the second and third SP questions were calculated by adjusting the average value of time (VOT) presented in the previous question. The average VOT was calculated using the difference between the average travel time on the GPLs and the average travel time on the ETLs and the toll presented with the DA-ETL mode. If the DA-ETL mode was not presented then the CP2-ETL toll was used to calculate the average VOT. The toll in the second and third SP questions was calculated as VOT*TTS*TollFact. The toll factor was made to range between 1.15 and 1.25 if the user selected a tolled option in the previous SP question and range from 0.75 to 0.85 if the user did not select a tolled option in the previous SP question. This way, toll rates were successively raised in relation to the amount of travel time savings being offered by the ETLs for respondents who selected a tolled ETL mode, and were lowered otherwise.

Table C2. Ranges of Peak Period Tolls for Method 2 SP Design, Question 1

Mode	Peak Toll (cents/mi)	Probability of being selected
DA-ETL	10 +/- 3	33%
	15 +/- 5	33%
	25 +/- 7	33%
CP2-ETL	None	25%
	5 +/- 1	12.5%
	10 +/- 2	12.5%
	10 +/- 3	12.5%
	15 +/- 3	12.5%
	15 +/- 5	12.5%
	25 +/- 7	12.5%
CP3-ETL	None	75%
	5 +/- 1	8.33%
	7.5 +/- 2.5	8.33%
	10 +/- 3	8.33%

Method 3: Current Mode + 3 Other Randomly Chosen Modes

This method always presented the respondent with their current mode of travel (either DA-GPL or CP-GPL) and three other randomly chosen modes. The range of speeds used to calculate the travel times for each lane are shown in Table C3. The tolls were randomly chosen based on Method 2 (see Table C4). The travel time on the ETLs was made to be 3 minutes shorter than the travel time on the GPLs if the ETL travel time was found to be higher than the GPL travel time. The process of mode, travel time, and toll selection was the same for all three SP questions.

Table C3. Ranges of Speeds for Method 3 SP Design, All Questions

Lane	Range of speeds for toll distance (mph)
GPL Peak	32.5 +/- 12.5
GPL Off-Peak	52.5 +/- 12.5
ETL	60 +/- 10

Table C4. Ranges of Peak Period Tolls for Method 3 SP Design, All Questions

Mode	Peak Toll (cents/mi)	Probability of being selected
DA-ETL	10 +/- 3	33%
	15 +/- 5	33%
	25 +/- 7	33%
CP2-ETL	None	25%
	5 +/- 1	12.5%
	10 +/- 2	12.5%
	10 +/- 3	12.5%
	15 +/- 3	12.5%
	15 +/- 5	12.5%
	25 +/- 7	12.5%
CP3-ETL	None	75%
	5 +/- 1	8.33%
	7.5 +/- 2.5	8.33%
	10 +/- 3	8.33%

Stated Preference Code

```
<SCRIPT language="JavaScript">
timeSP2 = new Date();
document.getElementById('answer43912X215X160329').value = timeSP2;

function randnum(a,b)
{
	var randnum = Math.floor(Math.random()*a + b);
	return randnum;
}

function randtoll(TimOfDay, Mode)
{
	var rand=randnum(30,1);
	if (rand < 11)
	{
		var Toll = 7/TimOfDay + randnum(7,0)/TimOfDay;
	}
	else if (rand > 10 && rand < 21)
	{
		var Toll = 10/TimOfDay + randnum(11,0)/TimOfDay;
	}
	else
	{
		var Toll = 18/TimOfDay + randnum(15,0)/TimOfDay;
	}
	if (Mode == 2)
	{
		var rand = randnum(8,1);
		if (rand < 3)
		{
			Toll = -1;
		}
		else if (rand > 2 && rand < 6)
		{
			return Toll;
		}
		else if (rand == 6)
		{
			var Toll = 4/TimOfDay + randnum(3,0)/TimOfDay;
		}
		else if (rand == 7)
		{
```

```
				var Toll = 8/TimOfDay + randnum(5,0)/TimOfDay;
			}
			else
			{
				var Toll = 12/TimOfDay + randnum(7,0)/TimOfDay;
			}
		}
		if (Mode == 3)
		{
			var rand=randnum(12,1);
			if (rand < 10)
			{
				Toll = -1;
			}
			else if (rand == 10)
			{
				var Toll = 4/TimOfDay + randnum(3,0)/TimOfDay;
			}
			else if (rand == 11)
			{
				var Toll = 5/TimOfDay + randnum(6,0)/TimOfDay;
			}
			else
			{
				var Toll = 7/TimOfDay + randnum(7,0)/TimOfDay;
			}
		}
		return Toll;
}

// Set the time of day
document.getElementById('answer43912X215X16035').value =
"{INSERTANS:43912X214X16025}"   ;
document.getElementById('answer43912X215X160310').value =
"{INSERTANS:43912X214X160210}" ;
document.getElementById('answer43912X215X160315').value =
"{INSERTANS:43912X214X160215}" ;
document.getElementById('answer43912X215X160320').value =
"{INSERTANS:43912X214X160220}" ;

// ActDist, TollDist, FreeDist, Peak/Off-Peak, Design, Block
document.getElementById('answer43912X215X160321').value =
"{INSERTANS:43912X214X160221}";
```

```
document.getElementById('answer43912X215X160322').value =
"{INSERTANS:43912X214X160222}";
document.getElementById('answer43912X215X160323').value =
"{INSERTANS:43912X214X160223}";
document.getElementById('answer43912X215X160324').value =
"{INSERTANS:43912X214X160224}";
document.getElementById('answer43912X215X160325').value =
"{INSERTANS:43912X214X160225}";
document.getElementById('answer43912X215X160326').value =
"{INSERTANS:43912X214X160226}";

// Variables
var ValOTime = 0;
var TimODay = "{INSERTANS:43912X214X160224}" ;
var TollDist = "{INSERTANS:43912X214X160222}";
var FreeDist = "{INSERTANS:43912X214X160223}";
var TollFact = 1;
var usedmodes=new Array(5);
usedmodes[0]=0;
usedmodes[1]=0;
usedmodes[2]=0;
usedmodes[3]=0;
usedmodes[4]=0;
usedmodes[5]=0;

// Previous SP Answer and Value of Time
var ValOTimePrev = "{INSERTANS:43912X214X160228}";
var SPAns1 = "{INSERTANS:43912X211X1530}";
var SPAnsA = SPAns1.indexOf(".");
if (SPAnsA == -1)
{
        var TollPaid = 0;
        var TollFact = (randnum(11,75)/100).toFixed(2);
}
else
{
        var TollPaid = Number(SPAns1.substring(SPAnsA-1,SPAnsA+3));
        var TollFact = (1 + (randnum(11,15)/100)).toFixed(2);
}
document.getElementById('answer43912X215X160327').value = TollFact;

//Set Tolls and Travel Times
if ("{INSERTANS:43912X214X160225}" == 1 ||
"{INSERTANS:43912X214X160225}" == 2)
```

```
{ //D-Efficeint
	if ("{INSERTANS:43912X214X160225}" == 1)
	{
		var Design = 1;
	}
	else
	{
		var Design = 2;
	}
	switch ({INSERTANS:43912X214X160226})
	{
	case 1:
		document.getElementById('answer43912X215X16031').value = 'Drive
		by myself';
		document.getElementById('answer43912X215X16032').value = 'Main
		freeway lanes' ;
			var randomnumber=randnum(11,0);
			var speedT = Math.round(20*TimODay + randomnumber) ;
			var speedF = Math.round(60 + randomnumber/10) ;
			var TrvTmGPL1 = Math.round((TollDist * 60/speedT) +
			(FreeDist * 60/speedF));
		document.getElementById('answer43912X215X16033').value =
		TrvTmGPL1;
		document.getElementById('answer43912X215X16034').value = ' None' ;

		document.getElementById('answer43912X215X16036').value ='Carpool
		with others' ;
		document.getElementById('answer43912X215X16037').value = 'Main
		freeway lanes';
			var randomnumber=randnum(11,0);
			var speedT = Math.round(30 + 10*TimODay + randomnumber) ;
			var speedF = Math.round(60 + randomnumber/10) ;
			var TrvTmGPL2 = Math.round((TollDist * 60/speedT) +
			(FreeDist * 60/speedF));
		document.getElementById('answer43912X215X16038').value =
		TrvTmGPL2 ;
		document.getElementById('answer43912X215X16039').value = ' None' ;

		document.getElementById('answer43912X215X160311').value = 'Drive
		by myself' ;
		document.getElementById('answer43912X215X160312').value = 'Toll
		lanes' ;
			var randomnumber=randnum(11,0);
			var speedT = Math.round(60 + randomnumber) ;
```

```
          var speedF = Math.round(60 + randomnumber/10) ;
          var TrvTmML1 = Math.round((TollDist * 60/speedT) + (FreeDist
          * 60/speedF));
document.getElementById('answer43912X215X160313').value =
TrvTmML1;
          if (Design == 1)
          {
                    var Toll = 8/TimODay + randnum(5,0)/TimODay;
                    var TotToll1 = (Math.round(((Toll *
                    TollDist)/5))/20).toFixed(2);
          }
          if (Design == 2)
          {
                    if (ValOTimePrev == 0)
                    {
                              var Toll = randtoll(TimODay, 1);
                              if (Toll == -1)
                              {
                                        var TotToll1 = " None";
                              }
                              else
                              {
                                        var TotToll1 = (Math.round(((Toll *
                                        TollDist)/5))/20).toFixed(2);
                              }
                    }
                    else
                    {
                              var TotToll1 = (Math.round(TollFact *
                              ValOTimePrev * (TrvTmGPL1 - TrvTmML1) *
                              20) * 0.05).toFixed(2);
                    }
          }
document.getElementById('answer43912X215X160314').value =
TotToll1;

document.getElementById('answer43912X215X160316').value =
'Carpool with one other person';
document.getElementById('answer43912X215X160317').value = 'Toll
lanes' ;
          var randomnumber=randnum(11,0);
          var speedT = Math.round(50 + randomnumber) ;
          var speedF = Math.round(60 + randomnumber/10) ;
```

```
        var TrvTmML2 = Math.round((TollDist * 60/speedT) + (FreeDist
        * 60/speedF));
document.getElementById('answer43912X215X160318').value =
TrvTmML2;
        if (Design == 1)
        {
                var Toll = 8/TimODay + randnum(5,0)/TimODay;
                var TotToll2 = (Math.round(((Toll *
                TollDist)/5))/20).toFixed(2);
        }
        if (Design == 2)
        {
                if (ValOTimePrev == 0)
                {
                        var Toll = randtoll(TimODay, 2);
                        if (Toll == -1)
                        {
                                var TotToll2 = " None";
                        }
                        else
                        {
                                var TotToll2 = (Math.round(((Toll *
                                TollDist)/5))/20).toFixed(2);
                        }
                }
                else
                {
                        var TotToll2 = (Math.round(TollFact *
                        ValOTimePrev * (TrvTmGPL2 - TrvTmML2)*
                        20) * 0.05).toFixed(2);
                }
        }
document.getElementById('answer43912X215X160319').value =
TotToll2;
 if (TotToll1 == " None" || (((TrvTmGPL1 + TrvTmGPL2)/2) -
((TrvTmML1 + TrvTmML2)/2)) <= 0)
{
        var ValOTime = 0;
}
else
{
        var ValOTime = TotToll1/(((TrvTmGPL1 + TrvTmGPL2)/2) -
        ((TrvTmML1 + TrvTmML2)/2));
}
```

```
break;

case 2:
        document.getElementById('answer43912X215X16031').value = 'Drive
        by myself';
        document.getElementById('answer43912X215X16032').value = 'Main
        freeway lanes' ;
                var randomnumber=randnum(11,0);
                var speedT = Math.round(20*TimODay + randomnumber) ;
                var speedF = Math.round(60 + randomnumber/10) ;
                var TrvTmGPL1 = Math.round((TollDist * 60/speedT) +
                (FreeDist * 60/speedF));
        document.getElementById('answer43912X215X16033').value =
        TrvTmGPL1;
        document.getElementById('answer43912X215X16034').value = ' None' ;

        document.getElementById('answer43912X215X16036').value ='Carpool
        with others' ;
        document.getElementById('answer43912X215X16037').value = 'Main
        freeway lanes';
                var randomnumber=randnum(11,0);
                var speedT = Math.round(20*TimODay + randomnumber) ;
                var speedF = Math.round(60 + randomnumber/10) ;
                var TrvTmGPL2 = Math.round((TollDist * 60/speedT) +
                (FreeDist * 60/speedF));
        document.getElementById('answer43912X215X16038').value =
        TrvTmGPL2 ;
        document.getElementById('answer43912X215X16039').value = ' None' ;

        document.getElementById('answer43912X215X160311').value = 'Drive
        by myself' ;
        document.getElementById('answer43912X215X160312').value = 'Toll
        lanes' ;
                var randomnumber=randnum(11,0);
                var speedT = Math.round(50 + randomnumber) ;
                var speedF = Math.round(60 + randomnumber/10) ;
                var TrvTmML1 = Math.round((TollDist * 60/speedT) + (FreeDist
                * 60/speedF));
        document.getElementById('answer43912X215X160313').value =
        TrvTmML1;
                if (Design == 1)
                {
                        var Toll = 16/TimODay + randnum(9,0)/TimODay;
```

```
                var TotToll1 = (Math.round(((Toll *
                TollDist)/5))/20).toFixed(2);
        }
        if (Design == 2)
        {
                if (ValOTimePrev == 0)
                {
                        var Toll = randtoll(TimODay, 1);
                        if (Toll == -1)
                        {
                                var TotToll1 = " None";
                        }
                        else
                        {
                                var TotToll1 = (Math.round(((Toll *
                                TollDist)/5))/20).toFixed(2);
                        }
                }
                else
                {
                        var TotToll1 = (Math.round(TollFact *
                        ValOTimePrev * (TrvTmGPL1 - TrvTmML1)*
                        20) * 0.05).toFixed(2);
                }
        }
document.getElementById('answer43912X215X160314').value =
TotToll1;

document.getElementById('answer43912X215X160316').value =
'Carpool with 3 or more people';
document.getElementById('answer43912X215X160317').value = 'Toll
lanes' ;
        var randomnumber=randnum(11,0);
        var speedT = Math.round(55 + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmML2 = Math.round((TollDist * 60/speedT) + (FreeDist
        * 60/speedF));
document.getElementById('answer43912X215X160318').value =
TrvTmML2;
        if (Design == 1)
        {
                var Toll = 4/TimODay + randnum(3,0)/TimODay;
                var TotToll2 = (Math.round(((Toll *
                TollDist)/5))/20).toFixed(2);
```

```
                }
                if (Design == 2)
                {
                        if (ValOTimePrev == 0)
                        {
                                var Toll = randtoll(TimODay, 3);
                                if (Toll == -1)
                                {
                                        var TotToll2 = " None";
                                }
                                else
                                {
                                        var TotToll2 = (Math.round(((Toll *
                                        TollDist)/5))/20).toFixed(2);
                                }
                        }
                        else
                        {
                                var TotToll2 = (Math.round(TollFact *
                                ValOTimePrev * (TrvTmGPL2 - TrvTmML2)*
                                20) * 0.05).toFixed(2);
                        }
                }
        document.getElementById('answer43912X215X160319').value =
        TotToll2;
        if (TotToll1 == " None" || (((TrvTmGPL1 + TrvTmGPL2)/2) -
        ((TrvTmML1 + TrvTmML2)/2)) <= 0)
        {
                var ValOTime = 0;
        }
        else
        {
                var ValOTime = TotToll1/(((TrvTmGPL1 + TrvTmGPL2)/2) -
                ((TrvTmML1 + TrvTmML2)/2));
        }

break;

case 3:
        document.getElementById('answer43912X215X16031').value = 'Drive
        by myself';
        document.getElementById('answer43912X215X16032').value = 'Main
        freeway lanes' ;
                var randomnumber=randnum(11,0);
```

```
        var speedT = Math.round(20*TimODay + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmGPL1 = Math.round((TollDist * 60/speedT) +
        (FreeDist * 60/speedF));
document.getElementById('answer43912X215X16033').value =
TrvTmGPL1;
document.getElementById('answer43912X215X16034').value = ' None' ;

document.getElementById('answer43912X215X16036').value ='Carpool
with others' ;
document.getElementById('answer43912X215X16037').value = 'Main
freeway lanes';
        var randomnumber=randnum(11,0);
        var speedT = Math.round(20*TimODay + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmGPL2 = Math.round((TollDist * 60/speedT) +
        (FreeDist * 60/speedF));
document.getElementById('answer43912X215X16038').value =
TrvTmGPL2 ;
document.getElementById('answer43912X215X16039').value = ' None' ;

document.getElementById('answer43912X215X160311').value =
'Carpool with one other person';
document.getElementById('answer43912X215X160312').value = 'Toll
lanes' ;
        var randomnumber=randnum(11,0);
        var speedT = Math.round(60 + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmML1 = Math.round((TollDist * 60/speedT) + (FreeDist
        * 60/speedF));
document.getElementById('answer43912X215X160313').value =
TrvTmML1;
        if (Design == 1)
        {
                var Toll = 16/TimODay + randnum(9,0)/TimODay;
                var TotToll1 = (Math.round(((Toll *
                TollDist)/5))/20).toFixed(2);
        }
        if (Design == 2)
        {
                if (ValOTimePrev == 0)
                {
                        var Toll = randtoll(TimODay, 2);
                        if (Toll == -1)
```

```
                    {
                        var TotToll1 = " None";
                    }
                    else
                    {
                        var TotToll1 = (Math.round(((Toll *
                        TollDist)/5))/20).toFixed(2);
                    }
                }
                else
                {
                    var TotToll1 = (Math.round(TollFact *
                    ValOTimePrev * (TrvTmGPL2 - TrvTmML1)*
                    20) * 0.05).toFixed(2);
                }
            }
document.getElementById('answer43912X215X160314').value =
TotToll1;
document.getElementById('answer43912X215X160316').value =
'Carpool with 3 or more people';
document.getElementById('answer43912X215X160317').value = 'Toll
lanes' ;
        var randomnumber=randnum(11,0);
        var speedT = Math.round(50 + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmML2 = Math.round((TollDist * 60/speedT) + (FreeDist
        * 60/speedF));
document.getElementById('answer43912X215X160318').value =
TrvTmML2;
        if (Design == 1)
        {
            var Toll = 4/TimODay + randnum(3,0)/TimODay;
            var TotToll2 = (Math.round(((Toll *
            TollDist)/5))/20).toFixed(2);
        }
        if (Design == 2)
        {
            if (ValOTimePrev == 0)
            {
                var Toll = randtoll(TimODay, 3);
                if (Toll == -1)
                {
                    var TotToll2 = " None";
                }
```

```
                    else
                    {
                            var TotToll2 = (Math.round(((Toll *
                            TollDist)/5))/20).toFixed(2);
                    }
                }
                else
                {
                    var TotToll2 = (Math.round(TollFact *
                    ValOTimePrev * (TrvTmGPL2 - TrvTmML2)*
                    20) * 0.05).toFixed(2);
                }
            }
        document.getElementById('answer43912X215X160319').value =
        TotToll2;
        if (TotToll1 > 0 || (((TrvTmGPL1 + TrvTmGPL2)/2) - ((TrvTmML1 +
        TrvTmML2)/2)) <= 0)
        {
            var ValOTime = (TotToll1/(((TrvTmGPL1 + TrvTmGPL2)/2) -
            ((TrvTmML1 + TrvTmML2)/2)));
        }
        else if (TotToll2 > 0 || (((TrvTmGPL1 + TrvTmGPL2)/2) - ((TrvTmML1
        + TrvTmML2)/2)) <= 0)
        {
            var ValOTime = (TotToll2/(((TrvTmGPL1 + TrvTmGPL2)/2) -
            ((TrvTmML1 + TrvTmML2)/2)));
        }
        else
        {
            var ValOTime = 0;
        }

break;

case 4:
        document.getElementById('answer43912X215X16031').value = 'Drive
        by myself';
        document.getElementById('answer43912X215X16032').value = 'Main
        freeway lanes' ;
            var randomnumber=randnum(11,0);
            var speedT = Math.round(15 + 15*TimODay + randomnumber) ;
            var speedF = Math.round(60 + randomnumber/10) ;
            var TrvTmGPL = Math.round((TollDist * 60/speedT) + (FreeDist
            * 60/speedF));
```

```
document.getElementById('answer43912X215X16033').value =
TrvTmGPL;
document.getElementById('answer43912X215X16034').value = ' None' ;

document.getElementById('answer43912X215X16036').value ='Drive by
myself';
document.getElementById('answer43912X215X16037').value = 'Toll
lanes';
        var randomnumber=randnum(11,0);
        var speedT = Math.round(60 + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmML1 = Math.round((TollDist * 60/speedT) + (FreeDist
        * 60/speedF));
document.getElementById('answer43912X215X16038').value =
TrvTmML1 ;
        if (Design == 1)
        {
                var Toll = 16/TimODay + randnum(9,0)/TimODay;
                var TotToll1 = (Math.round(((Toll *
                TollDist)/5))/20).toFixed(2);
        }
        if (Design == 2)
        {
                if (ValOTimePrev == 0)
                {
                        var Toll = randtoll(TimODay, 1);
                        if (Toll == -1)
                        {
                                var TotToll1 = " None";
                        }
                        else
                        {
                                var TotToll1 = (Math.round(((Toll *
                                TollDist)/5))/20).toFixed(2);
                        }
                }
                else
                {
                var TotToll1 = (Math.round(TollFact * ValOTimePrev *
                (TrvTmGPL - TrvTmML1)* 20) * 0.05).toFixed(2);
                }
        }
document.getElementById('answer43912X215X16039').value =
TotToll1;
```

```
document.getElementById('answer43912X215X160311').value =
'Carpool with one other person';
document.getElementById('answer43912X215X160312').value = 'Toll
lanes' ;
        var randomnumber=randnum(11,0);
        var speedT = Math.round(55 + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmML2 = Math.round((TollDist * 60/speedT) + (FreeDist
        * 60/speedF));
document.getElementById('answer43912X215X160313').value =
TrvTmML2;
        if (Design == 1)
        {
                var Toll = 4/TimODay + randnum(3,0)/TimODay;
                var TotToll2 = (Math.round(((Toll *
                TollDist)/5))/20).toFixed(2);
        }
        if (Design == 2)
        {
                if (ValOTimePrev == 0)
                {
                        var Toll = randtoll(TimODay, 2);
                        if (Toll == -1)
                        {
                                var TotToll2 = " None";
                        }
                        else
                        {
                                var TotToll2 = (Math.round(((Toll *
                                TollDist)/5))/20).toFixed(2);
                        }
                }
                else
                {
                        var TotToll2 = (Math.round(TollFact *
                        ValOTimePrev * (TrvTmGPL - TrvTmML2)* 20)
                        * 0.05).toFixed(2);
                }
        }
document.getElementById('answer43912X215X160314').value =
TotToll2;
```

```
document.getElementById('answer43912X215X160316').value =
'Carpool with 3 or more people';
document.getElementById('answer43912X215X160317').value = 'Toll
lanes' ;
        var randomnumber=randnum(11,0);
        var speedT = Math.round(60 + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmML3 = Math.round((TollDist * 60/speedT) + (FreeDist
        * 60/speedF));
document.getElementById('answer43912X215X160318').value =
TrvTmML3;
        if (Design == 1)
        {
                var Toll = 4/TimODay + randnum(3,0)/TimODay;
                var TotToll2 = (Math.round(((Toll *
                TollDist)/5))/20).toFixed(2);
        }
        if (Design == 2)
        {
                if (ValOTimePrev == 0)
                {
                        var Toll = randtoll(TimODay, 3);
                        if (Toll == -1)
                        {
                                var TotToll2 = " None";
                        }
                        else
                        {
                                var TotToll2 = (Math.round(((Toll *
                                TollDist)/5))/20).toFixed(2);
                        }
                }
                else
                {
                        var TotToll2 = (Math.round(TollFact *
                        ValOTimePrev * (TrvTmGPL - TrvTmML2)* 20)
                        * 0.05).toFixed(2);
                }
        }
document.getElementById('answer43912X215X160319').value =
TotToll2;
if (TotToll1 == " None" || (TrvTmGPL - ((TrvTmML1 + TrvTmML2 +
TrvTmML3)/3)) <= 0)
{
```

```
            var ValOTime = 0;
        }
        else
        {
            var ValOTime = TotToll1/(TrvTmGPL - ((TrvTmML1 +
            TrvTmML2 + TrvTmML3)/3));
        }

break;

case 5:
        document.getElementById('answer43912X215X16031').value = 'Drive
        by myself';
        document.getElementById('answer43912X215X16032').value = 'Main
        freeway lanes' ;
            var randomnumber=randnum(11,0);
            var speedT = Math.round(20*TimODay + randomnumber) ;
            var speedF = Math.round(60 + randomnumber/10) ;
            var TrvTmGPL1 = Math.round((TollDist * 60/speedT) +
            (FreeDist * 60/speedF));
        document.getElementById('answer43912X215X16033').value =
        TrvTmGPL1;
        document.getElementById('answer43912X215X16034').value = ' None' ;

        document.getElementById('answer43912X215X16036').value ='Carpool
        with others' ;
        document.getElementById('answer43912X215X16037').value = 'Main
        freeway lanes';
            var randomnumber=randnum(11,0);
            var speedT = Math.round(15 + 15*TimODay + randomnumber) ;
            var speedF = Math.round(60 + randomnumber/10) ;
            var TrvTmGPL2 = Math.round((TollDist * 60/speedT) +
            (FreeDist * 60/speedF));
        document.getElementById('answer43912X215X16038').value =
        TrvTmGPL2 ;
        document.getElementById('answer43912X215X16039').value = ' None' ;

        document.getElementById('answer43912X215X160311').value =
        'Carpool with one other person';
        document.getElementById('answer43912X215X160312').value = 'Toll
        lanes' ;
            var randomnumber=randnum(11,0);
            var speedT = Math.round(50 + randomnumber) ;
            var speedF = Math.round(60 + randomnumber/10) ;
```

```
        var TrvTmML1 = Math.round((TollDist * 60/speedT) + (FreeDist
        * 60/speedF));
document.getElementById('answer43912X215X160313').value =
TrvTmML1;
        if (Design == 1)
        {
                var Toll = 4/TimODay + randnum(3,0)/TimODay;
                var TotToll1 = (Math.round(((Toll *
                TollDist)/5))/20).toFixed(2);
        }
        if (Design == 2)
        {
                if (ValOTimePrev == 0)
                {
                        var Toll = randtoll(TimODay, 2);
                        if (Toll == -1)
                        {
                                var TotToll1 = " None";
                        }
                        else
                        {
                                var TotToll1 = (Math.round(((Toll *
                                TollDist)/5))/20).toFixed(2);
                        }
                }
                else
                {
                        var TotToll1 = (Math.round(TollFact *
                        ValOTimePrev * (TrvTmGPL2 - TrvTmML1)*
                        20) * 0.05).toFixed(2);
                }
        }
document.getElementById('answer43912X215X160314').value =
TotToll1;

document.getElementById('answer43912X215X160316').value =
'Carpool with 3 or more people';
document.getElementById('answer43912X215X160317').value = 'Toll
lanes' ;
        var randomnumber=randnum(11,0);
        var speedT = Math.round(55 + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmML2 = Math.round((TollDist * 60/speedT) + (FreeDist
        * 60/speedF));
```

```
document.getElementById('answer43912X215X160318').value =
TrvTmML2;
        if (Design == 1)
        {
                var Toll = 8/TimODay + randnum(5,0)/TimODay;
                var TotToll2 = (Math.round(((Toll *
                TollDist)/5))/20).toFixed(2);
        }
        if (Design == 2)
        {
                if (ValOTimePrev == 0)
                {
                        var Toll = randtoll(TimODay, 3);
                        if (Toll == -1)
                        {
                                var TotToll2 = " None";
                        }
                        else
                        {
                                var TotToll2 = (Math.round(((Toll *
                                TollDist)/5))/20).toFixed(2);
                        }
                }
                else
                {
                        var TotToll2 = (Math.round(TollFact *
                        ValOTimePrev * (TrvTmGPL2 - TrvTmML2)*
                        20) * 0.05).toFixed(2);
                }
        }
document.getElementById('answer43912X215X160319').value =
TotToll2;
if (TotToll1 > 0 || (((TrvTmGPL1 + TrvTmGPL2)/2) - ((TrvTmML1 +
TrvTmML2)/2)) <= 0)
{
        var ValOTime = (TotToll1/(((TrvTmGPL1 + TrvTmGPL2)/2) -
        ((TrvTmML1 + TrvTmML2)/2)));
}
else if (TotToll2 > 0 || (((TrvTmGPL1 + TrvTmGPL2)/2) - ((TrvTmML1
+ TrvTmML2)/2)) <= 0)
{
        var ValOTime = (TotToll2/(((TrvTmGPL1 + TrvTmGPL2)/2) -
        ((TrvTmML1 + TrvTmML2)/2)));
}
```

```
        else
        {
                var ValOTime = 0;
        }

break;
case 6:
        document.getElementById('answer43912X215X16031').value = 'Drive
        by myself';
        document.getElementById('answer43912X215X16032').value = 'Main
        freeway lanes' ;
                var randomnumber=randnum(11,0);
                var speedT = Math.round(20*TimODay + randomnumber) ;
                var speedF = Math.round(60 + randomnumber/10) ;
                var TrvTmGPL1 = Math.round((TollDist * 60/speedT) +
                (FreeDist * 60/speedF));
        document.getElementById('answer43912X215X16033').value =
        TrvTmGPL1;
        document.getElementById('answer43912X215X16034').value = ' None' ;

        document.getElementById('answer43912X215X16036').value ='Carpool
        with others' ;
        document.getElementById('answer43912X215X16037').value = 'Main
        freeway lanes';
                var randomnumber=randnum(11,0);
                var speedT = Math.round(30 + 10*TimODay + randomnumber) ;
                var speedF = Math.round(60 + randomnumber/10) ;
                var TrvTmGPL2 = Math.round((TollDist * 60/speedT) +
                (FreeDist * 60/speedF));
        document.getElementById('answer43912X215X16038').value =
        TrvTmGPL2 ;
        document.getElementById('answer43912X215X16039').value = ' None' ;

        document.getElementById('answer43912X215X160311').value = 'Drive
        by myself';
        document.getElementById('answer43912X215X160312').value = 'Toll
        lanes' ;
                var randomnumber=randnum(11,0);
                var speedT = Math.round(55 + randomnumber) ;
                var speedF = Math.round(60 + randomnumber/10) ;
                var TrvTmML1 = Math.round((TollDist * 60/speedT) + (FreeDist
                * 60/speedF));
        document.getElementById('answer43912X215X160313').value =
        TrvTmML1;
```

```
        if (Design == 1)
        {
                var Toll = 16/TimODay + randnum(9,0)/TimODay;
                var TotToll1 = (Math.round(((Toll *
                TollDist)/5))/20).toFixed(2);
        }
        if (Design == 2)
        {
                if (ValOTimePrev == 0)
                {
                        var Toll = randtoll(TimODay, 1);
                        if (Toll == -1)
                        {
                                var TotToll1 = " None";
                        }
                        else
                        {
                                var TotToll1 = (Math.round(((Toll *
                                TollDist)/5))/20).toFixed(2);
                        }
                }
                else
                {
                        var TotToll1 = (Math.round(TollFact *
                        ValOTimePrev * (TrvTmGPL1 - TrvTmML1)*
                        20) * 0.05).toFixed(2);
                }
        }
document.getElementById('answer43912X215X160314').value =
TotToll1;

document.getElementById('answer43912X215X160316').value =
'Carpool with one other person';
document.getElementById('answer43912X215X160317').value = 'Toll
lanes' ;
        var randomnumber=randnum(11,0);
        var speedT = Math.round(60 + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmML2 = Math.round((TollDist * 60/speedT) + (FreeDist
        * 60/speedF));
document.getElementById('answer43912X215X160318').value =
TrvTmML2;
        if (Design == 1)
        {
```

```
				var Toll = 4/TimODay + randnum(3,0)/TimODay;
				var TotToll2 = (Math.round(((Toll *
				TollDist)/5))/20).toFixed(2);
			}
			if (Design == 2)
			{
				if (ValOTimePrev == 0)
				{
					var Toll = randtoll(TimODay, 2);
					if (Toll == -1)
					{
						var TotToll2 = " None";
					}
					else
					{
						var TotToll2 = (Math.round(((Toll *
						TollDist)/5))/20).toFixed(2);
					}
				}
				else
				{
					var TotToll2 = (Math.round(TollFact *
					ValOTimePrev * (TrvTmGPL2 - TrvTmML2)*
					20) * 0.05).toFixed(2);
				}
			}
		document.getElementById('answer43912X215X160319').value =
		TotToll2;
		if (TotToll1 == " None" || (((TrvTmGPL1 + TrvTmGPL2)/2) -
		((TrvTmML1 + TrvTmML2)/2)) <= 0)
		{
			var ValOTime = 0;
		}
		else
		{
			var ValOTime = TotToll1/(((TrvTmGPL1 + TrvTmGPL2)/2) -
			((TrvTmML1 + TrvTmML2)/2));
		}

	break;

	case 7:
		document.getElementById('answer43912X215X16031').value = 'Drive
		by myself';
```

```
document.getElementById('answer43912X215X16032').value = 'Main
freeway lanes' ;
        var randomnumber=randnum(11,0);
        var speedT = Math.round(30 + 10*TimODay + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmGPL1 = Math.round((TollDist * 60/speedT) +
        (FreeDist * 60/speedF));
document.getElementById('answer43912X215X16033').value =
TrvTmGPL1;
document.getElementById('answer43912X215X16034').value = ' None' ;

document.getElementById('answer43912X215X16036').value ='Carpool
with others' ;
document.getElementById('answer43912X215X16037').value = 'Main
freeway lanes';
        var randomnumber=randnum(11,0);
        var speedT = Math.round(20*TimODay + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmGPL2 = Math.round((TollDist * 60/speedT) +
        (FreeDist * 60/speedF));
document.getElementById('answer43912X215X16038').value =
TrvTmGPL2 ;
document.getElementById('answer43912X215X16039').value = ' None' ;

document.getElementById('answer43912X215X160311').value =
'Carpool with one other person';
document.getElementById('answer43912X215X160312').value = 'Toll
lanes' ;
        var randomnumber=randnum(11,0);
        var speedT = Math.round(50 + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmML1 = Math.round((TollDist * 60/speedT) + (FreeDist
        * 60/speedF));
document.getElementById('answer43912X215X160313').value =
TrvTmML1;
        if (Design == 1)
        {
                var Toll = 8/TimODay + randnum(5,0)/TimODay;
                var TotToll1 = (Math.round(((Toll *
                TollDist)/5))/20).toFixed(2);
        }
        if (Design == 2)
        {
                if (ValOTimePrev == 0)
```

```
                {
                        var Toll = randtoll(TimODay, 2);
                        if (Toll == -1)
                        {
                                var TotToll1 = " None";
                        }
                        else
                        {
                                var TotToll1 = (Math.round(((Toll *
                                TollDist)/5))/20).toFixed(2);
                        }
                }
                else
                {
                        var TotToll1 = (Math.round(TollFact *
                        ValOTimePrev * (TrvTmGPL2 - TrvTmML1)*
                        20) * 0.05).toFixed(2);
                }
        }
document.getElementById('answer43912X215X160314').value =
TotToll1;

document.getElementById('answer43912X215X160316').value =
'Carpool with 3 or more people';
document.getElementById('answer43912X215X160317').value = 'Toll
lanes' ;
        var randomnumber=randnum(11,0);
        var speedT = Math.round(60 + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmML2 = Math.round((TollDist * 60/speedT) + (FreeDist
        * 60/speedF));
document.getElementById('answer43912X215X160318').value =
TrvTmML2;
        if (Design == 1)
        {
                var Toll = 8/TimODay + randnum(5,0)/TimODay;
                var TotToll2 = (Math.round(((Toll *
                TollDist)/5))/20).toFixed(2);
        }
        if (Design == 2)
        {
                if (ValOTimePrev == 0)
                {
                        var Toll = randtoll(TimODay, 3);
```

```
                                        if (Toll == -1)
                                        {
                                                var TotToll2 = " None";
                                        }
                                        else
                                        {
                                                var TotToll2 = (Math.round(((Toll *
                                                TollDist)/5))/20).toFixed(2);
                                        }
                                }
                                else
                                {
                                        var TotToll2 = (Math.round(TollFact *
                                        ValOTimePrev * (TrvTmGPL2 - TrvTmML2)*
                                        20) * 0.05).toFixed(2);
                                }
                        }
                 document.getElementById('answer43912X215X160319').value =
                TotToll2;
                if (TotToll1 > 0 || (((TrvTmGPL1 + TrvTmGPL2)/2) - ((TrvTmML1 +
                TrvTmML2)/2)) <= 0)
                {
                        var ValOTime = (TotToll1/(((TrvTmGPL1 + TrvTmGPL2)/2) -
                        ((TrvTmML1 + TrvTmML2)/2)));
                }
                else if (TotToll2 > 0 || (((TrvTmGPL1 + TrvTmGPL2)/2) - ((TrvTmML1
                + TrvTmML2)/2)) <= 0)
                {
                        var ValOTime = (TotToll2/(((TrvTmGPL1 + TrvTmGPL2)/2) -
                        ((TrvTmML1 + TrvTmML2)/2)));
                }
                else
                {
                        var ValOTime = 0;
                }

        break;

        case 8:
                document.getElementById('answer43912X215X16031').value = 'Drive
                by myself';
                document.getElementById('answer43912X215X16032').value = 'Main
                freeway lanes' ;
                        var randomnumber=randnum(11,0);
```

```
        var speedT = Math.round(20*TimODay + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmGPL = Math.round((TollDist * 60/speedT) + (FreeDist
        * 60/speedF));
document.getElementById('answer43912X215X16033').value =
TrvTmGPL;
document.getElementById('answer43912X215X16034').value = ' None' ;

document.getElementById('answer43912X215X16036').value ='Drive by
myself';
document.getElementById('answer43912X215X16037').value = 'Toll
lanes';
        var randomnumber=randnum(11,0);
        var speedT = Math.round(60 + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmML1 = Math.round((TollDist * 60/speedT) + (FreeDist
        * 60/speedF));
document.getElementById('answer43912X215X16038').value =
TrvTmML1 ;
        if (Design == 1)
        {
                var Toll = 16/TimODay + randnum(9,0)/TimODay;
                var TotToll1 = (Math.round(((Toll *
                TollDist)/5))/20).toFixed(2);
        }
        if (Design == 2)
        {
                if (ValOTimePrev == 0)
                {
                        var Toll = randtoll(TimODay, 1);
                        if (Toll == -1)
                        {
                                var TotToll1 = " None";
                        }
                        else
                        {
                                var TotToll1 = (Math.round(((Toll *
                                TollDist)/5))/20).toFixed(2);
                        }
                }
                else
                {
```

```
                    var TotToll1 = (Math.round(TollFact *
                    ValOTimePrev * (TrvTmGPL - TrvTmML1)* 20)
                    * 0.05).toFixed(2);
                }
            }
document.getElementById('answer43912X215X16039').value = TotToll1;

document.getElementById('answer43912X215X160311').value = 'Carpool with
one other person';
document.getElementById('answer43912X215X160312').value = 'Toll lanes' ;
    var randomnumber=randnum(11,0);
    var speedT = Math.round(55 + randomnumber) ;
    var speedF = Math.round(60 + randomnumber/10) ;
    var TrvTmML2 = Math.round((TollDist * 60/speedT) + (FreeDist *
    60/speedF));
document.getElementById('answer43912X215X160313').value = TrvTmML2;
    if (Design == 1)
    {
        var Toll = 16/TimODay + randnum(9,0)/TimODay;
        var TotToll2 = (Math.round(((Toll * TollDist)/5))/20).toFixed(2);
    }
    if (Design == 2)
    {
        if (ValOTimePrev == 0)
        {
            var Toll = randtoll(TimODay, 2);
            if (Toll == -1)
            {
                var TotToll2 = " None";
            }
            else
            {
                var TotToll2 = (Math.round(((Toll *
                TollDist)/5))/20).toFixed(2);
            }
        }
        else
        {
            var TotToll2 = (Math.round(TollFact * ValOTimePrev *
            (TrvTmGPL - TrvTmML2)* 20) * 0.05).toFixed(2);
        }
    }
    document.getElementById('answer43912X215X160314').value =
    TotToll2;
```

```
document.getElementById('answer43912X215X160316').value =
'Carpool with 3 or more people';
document.getElementById('answer43912X215X160317').value = 'Toll
lanes' ;
        var randomnumber=randnum(11,0);
        var speedT = Math.round(60 + randomnumber) ;
        var speedF = Math.round(60 + randomnumber/10) ;
        var TrvTmML3 = Math.round((TollDist * 60/speedT) + (FreeDist
        * 60/speedF));
document.getElementById('answer43912X215X160318').value =
TrvTmML3;
        if (Design == 1)
        {
                var Toll = 8/TimODay + randnum(5,0)/TimODay;
                var TotToll2 = (Math.round(((Toll *
                TollDist)/5))/20).toFixed(2);
        }
        if (Design == 2)
        {
                if (ValOTimePrev == 0)
                {
                        var Toll = randtoll(TimODay, 3);
                        if (Toll == -1)
                        {
                                var TotToll2 = " None";
                        }
                        else
                        {
                                var TotToll2 = (Math.round(((Toll *
                                TollDist)/5))/20).toFixed(2);
                        }
                }
                else
                {
                        var TotToll2 = (Math.round(TollFact *
                        ValOTimePrev * (TrvTmGPL - TrvTmML3)* 20)
                        * 0.05).toFixed(2);
                }
        }
document.getElementById('answer43912X215X160319').value =
TotToll2;
if (TotToll1 == " None" || (TrvTmGPL - ((TrvTmML1 + TrvTmML2 +
TrvTmML3)/3)) <= 0)
```

```
                {
                        var ValOTime = 0;
                }
                else
                {
                        var ValOTime = TotToll1/(TrvTmGPL - ((TrvTmML1 +
                        TrvTmML2 + TrvTmML3)/3));
                }

        break;

        default:
                alert ("Default block");
        }
}
else // Random SP questions
{
        //MODE 1 will be the respondent's current mode
        var TrvTmML = 0;
        usedmodes[1]=1;
        document.getElementById('answer43912X215X16031').value = 'Drive by
        myself' ;
        document.getElementById('answer43912X215X16032').value = 'Main freeway
        lanes' ;
                var randomnumber=randnum(26,0);
                var speedT = Math.round(20*TimODay + randomnumber) ;
                var speedF = Math.round(60 + randomnumber/10) ;
                var TrvTmGPL = Math.round((TollDist * 60/speedT) + (FreeDist *
                60/speedF));
        document.getElementById('answer43912X215X16033').value = TrvTmGPL ;
        document.getElementById('answer43912X215X16034').value = ' None';

        if ("{INSERTANS:43912X208X958}" == "2" ||
        "{INSERTANS:43912X208X1508}" == "3" ||
        "{INSERTANS:43912X208X1508}" == "4" ||
        "{INSERTANS:43912X208X1508}" == "5 or more")
        {
                document.getElementById('answer43912X215X16031').value = 'Carpool
                with others';
                usedmodes[3]=1;
                usedmodes[1]=0;
        }

        // MODES 2 thru 4, 1 of the 5 modes already selected, randomly select the final 3
```

```
var totmodes = usedmodes[5] + usedmodes[4] + usedmodes[3] + usedmodes[2]
+ usedmodes[1];
do
{
	var trymode = Math.round(randnum(5,1)); // Random integer from 1 to 5
	if ( usedmodes[trymode] == 0)
	{
		usedmodes[trymode] = 1;
		var totmodes = usedmodes[5] + usedmodes[4] + usedmodes[3] +
		usedmodes[2] + usedmodes[1];
		switch (trymode)
		{
		case 1:		// Add Mode 1 - SOV on GPL
			var randomnumber=randnum(26,0);
			var speedT = Math.round(20*TimODay +
			randomnumber);
			var speedF = Math.round(60 + randomnumber/10);
			var TrvTmGPL = Math.round((TollDist * 60/speedT) +
			(FreeDist * 60/speedF));
			if (TrvTmGPL < TrvTmML)
			{
				var TrvTmGPL = TrvTmML + 3;
			}
			if (totmodes == 2)
			{
				document.getElementById('answer43912X215X16
				036').value = 'Drive by myself';
				document.getElementById('answer43912X215X16
				037').value = 'Main freeway lanes' ;
				document.getElementById('answer43912X215X16
				038').value = TrvTmGPL;
				document.getElementById('answer43912X215X16
				039').value = ' None';
			}
			if (totmodes == 3)
			{
				document.getElementById('answer43912X215X16
				0311').value = 'Drive by myself' ;
				document.getElementById('answer43912X215X16
				0312').value = 'Main freeway lanes';
				document.getElementById('answer43912X215X16
				0313').value = TrvTmGPL;
				document.getElementById('answer43912X215X16
				0314').value = ' None';
```

```
        }
        if (totmoodes == 4)
        {
                document.getElementById('answer43912X215X16
                0316').value = 'Drive by myself' ;
                document.getElementById('answer43912X215X16
                0317').value = 'Main freeway lanes';
                document.getElementById('answer43912X215X16
                0318').value = TrvTmGPL;
                document.getElementById('answer43912X215X16
                0319').value = ' None';
        }
        break;

case 2:         // Add Mode 2 - SOV on ML
        var randomnumber=randnum(21,0);
        var speedT = Math.round(50 + randomnumber);
        var speedF = Math.round(60 + randomnumber/6);
        var TrvTmML = Math.round((TollDist * 60/speedT) +
        (FreeDist * 60/speedF));
        if (TrvTmML > TrvTmGPL && TrvTmGPL > 6)
        {
                var TrvTmML = TrvTmGPL - 3;
        }
        var Toll = randtoll(TimODay,1);
        var TotToll1 = (Math.round(((Toll *
        TollDist)/5))/20).toFixed(2);
        if (totmodes == 2)
        {
                document.getElementById('answer43912X215X16
                036').value = 'Drive by myself' ;
                document.getElementById('answer43912X215X16
                037').value = 'Toll lanes' ;
                document.getElementById('answer43912X215X16
                038').value = TrvTmML;
                document.getElementById('answer43912X215X16
                039').value = TotToll1;
        }
        if (totmodes == 3)
        {
                document.getElementById('answer43912X215X16
                0311').value = 'Drive by myself' ;
                document.getElementById('answer43912X215X16
                0312').value = 'Toll lanes' ;
```

```
                document.getElementById('answer43912X215X16
                0313').value = TrvTmML;
                document.getElementById('answer43912X215X16
                0314').value = TotToll1;
        }
        if (totmodes == 4)
        {
                document.getElementById('answer43912X215X16
                0316').value = 'Drive by myself' ;
                document.getElementById('answer43912X215X16
                0317').value = 'Toll lanes' ;
                document.getElementById('answer43912X215X16
                0318').value = TrvTmML;
                document.getElementById('answer43912X215X16
                0319').value = TotToll1;
                }
break;

case 3:         // Add Mode 3 - HOV on GPL
        var randomnumber=randnum(26,0);
        var speedT = Math.round(20*TimODay +
        randomnumber);
        var speedF = Math.round(60 + randomnumber/10);
        var TrvTmGPL = Math.round((TollDist * 60/speedT) +
        (FreeDist * 60/speedF));
        if (TrvTmGPL < TrvTmML)
        {
                var TrvTmGPL = TrvTmML + 3;
        }
        if (totmodes == 2)
        {
                document.getElementById('answer43912X215X16
                036').value = 'Carpool with others' ;
                document.getElementById('answer43912X215X16
                037').value = 'Main freeway lanes' ;
                document.getElementById('answer43912X215X16
                038').value = TrvTmGPL;
                document.getElementById('answer43912X215X16
                039').value = ' None';
        }
        if (totmodes == 3)
        {
                document.getElementById('answer43912X215X16
                0311').value = 'Carpool with others';
```

```
                document.getElementById('answer43912X215X16
                0312').value = 'Main freeway lanes';
                document.getElementById('answer43912X215X16
                0313').value = TrvTmGPL;
                document.getElementById('answer43912X215X16
                0314').value = ' None';
        }
        if (totmodes == 4)
        {
                document.getElementById('answer43912X215X16
                0316').value = 'Carpool with others';
                document.getElementById('answer43912X215X16
                0317').value = 'Main freeway lanes';
                document.getElementById('answer43912X215X16
                0318').value = TrvTmGPL ;
                document.getElementById('answer43912X215X16
                0319').value = ' None';
        }
break;

case 4:         // Add Mode 4 - HOV2 on ML
        var randomnumber=randnum(21,0);
        var speedT = Math.round(50 + randomnumber);
        var speedF = Math.round(60 + randomnumber/6);
        var TrvTmML = Math.round((TollDist * 60/speedT) +
        (FreeDist * 60/speedF));
        if (TrvTmML > TrvTmGPL && TrvTmGPL > 6)
        {
                var TrvTmML = TrvTmGPL - 3;
        }
        var Toll = randtoll(TimODay,2);
        if (Toll == -1)
        {
                var TotToll1 = ' None';
        }
        else
        {
                var TotToll1 = (Math.round(((Toll *
                TollDist)/5))/20).toFixed(2);
        }
        if (totmodes == 2)
        {
                document.getElementById('answer43912X215X16
                036').value = 'Carpool with one other person' ;
```

```
                document.getElementById('answer43912X215X16
                037').value = 'Toll lanes' ;
                document.getElementById('answer43912X215X16
                038').value = TrvTmML;
                document.getElementById('answer43912X215X16
                039').value = TotToll1;
        }
        if (totmodes == 3)
        {
                document.getElementById('answer43912X215X16
                0311').value = 'Carpool with one other person' ;
                document.getElementById('answer43912X215X16
                0312').value = 'Toll lanes' ;
                document.getElementById('answer43912X215X16
                0313').value = TrvTmML;
                document.getElementById('answer43912X215X16
                0314').value = TotToll1;
        }
        if (totmodes == 4)
        {
                document.getElementById('answer43912X215X16
                0316').value = 'Carpool with one other person' ;
                document.getElementById('answer43912X215X16
                0317').value = 'Toll lanes' ;
                document.getElementById('answer43912X215X16
                0318').value = TrvTmML;
                document.getElementById('answer43912X215X16
                0319').value = TotToll1;
        }
break;

case 5:         // Add Mode 5 - HOV3+ on ML
        var randomnumber=randnum(21,0);
        var speedT = Math.round(50 + randomnumber);
        var speedF = Math.round(60 + randomnumber/6);
        var TrvTmML = Math.round((TollDist * 60/speedT) +
        (FreeDist * 60/speedF));
        if (TrvTmML > TrvTmGPL && TrvTmGPL > 6)
        {
                var TrvTmML = TrvTmGPL - 3;
        }
        var Toll = randtoll(TimODay,3);
        if (Toll == -1)
        {
```

```
            var TotToll1 = ' None';
        }
        else
        {
            var TotToll1 = (Math.round(((Toll *
            TollDist)/5))/20).toFixed(2);
        }
        if (totmodes == 2)
        {
            document.getElementById('answer43912X215X16
            036').value = 'Carpool with 3 or more people' ;
            document.getElementById('answer43912X215X16
            037').value = 'Toll lanes' ;
            document.getElementById('answer43912X215X16
            038').value = TrvTmML;
            document.getElementById('answer43912X215X16
            039').value = TotToll1;
        }
        if (totmodes == 3)
        {
            document.getElementById('answer43912X215X16
            0311').value = 'Carpool with 3 or more people' ;
            document.getElementById('answer43912X215X16
            0312').value = 'Toll lanes' ;
            document.getElementById('answer43912X215X16
            0313').value = TrvTmML;
            document.getElementById('answer43912X215X16
            0314').value = TotToll1;
        }
        if (totmodes == 4)
        {
            document.getElementById('answer43912X215X16
            0316').value = 'Carpool with 3 or more people' ;
            document.getElementById('answer43912X215X16
            0317').value = 'Toll lanes' ;
            document.getElementById('answer43912X215X16
            0318').value = TrvTmML;
            document.getElementById('answer43912X215X16
            0319').value = TotToll1;
        }
    break;
    }
    }
}
```

```
            while (totmodes < 4)
        }

        document.getElementById('answer43912X215X160328').value = ValOTime;

        document.getElementById('answer43912X215X16031').style.display='none';
        document.getElementById('answer43912X215X16032').style.display='none';
        document.getElementById('answer43912X215X16033').style.display='none';
        document.getElementById('answer43912X215X16034').style.display='none';
        document.getElementById('answer43912X215X16035').style.display='none';
        document.getElementById('answer43912X215X16036').style.display='none';
        document.getElementById('answer43912X215X16037').style.display='none';
        document.getElementById('answer43912X215X16038').style.display='none';
        document.getElementById('answer43912X215X16039').style.display='none';
        document.getElementById('answer43912X215X160310').style.display='none';
        document.getElementById('answer43912X215X160311').style.display='none';
        document.getElementById('answer43912X215X160312').style.display='none';
        document.getElementById('answer43912X215X160313').style.display='none';
        document.getElementById('answer43912X215X160314').style.display='none';
        document.getElementById('answer43912X215X160315').style.display='none';
        document.getElementById('answer43912X215X160316').style.display='none';
        document.getElementById('answer43912X215X160317').style.display='none';
        document.getElementById('answer43912X215X160318').style.display='none';
        document.getElementById('answer43912X215X160319').style.display='none';
        document.getElementById('answer43912X215X160320').style.display='none';
        document.getElementById('answer43912X215X160321').style.display='none';
        document.getElementById('answer43912X215X160322').style.display='none';
        document.getElementById('answer43912X215X160323').style.display='none';
        document.getElementById('answer43912X215X160324').style.display='none';
        document.getElementById('answer43912X215X160325').style.display='none';
        document.getElementById('answer43912X215X160326').style.display='none';
        document.getElementById('answer43912X215X160327').style.display='none';
        document.getElementById('answer43912X215X160328').style.display='none';
        document.getElementById('answer43912X215X160329').style.display='none';

        function validation()
        {
        document.limesurvey.move.value = 'movenext';
        document.limesurvey.submit();
        }
        setTimeout( 'validation()', 250);

</script>
```

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