Long-Distance Overnight Values of Travel Time Across Modes and Tour Characteristics

by

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ABSTRACT

The value of travel time (VoTT) quantifies the willingness of individuals to pay money in order to save a unit of travel time. It is a critical metric for the transportation industry that underlies many policy decisions and processes, including cost-benefit analyses, project evaluations, travel demand forecasting, and economic investments. However, despite the continuous growth of long-distance intercity travel in terms of the number of miles traveled and dollars spent on local/regional economies, existing metro area-based VoTT metrics are inadequate for long-distance trips. Therefore, this study completes three objectives: 1) examine the trade-offs between travel times and costs in the mode choices in representative observed long-distance trips, 2) model mode choice to quantify the VoTT for air and personal vehicles across multiple tour types in the Alabama and Vermont regions, and 3) develop a framework for characterizing individuals' unique relationship with costs and travel times for long-distance travel. Specifically, this research combines detailed out-of-state long-distance tour records from the 2013 Longitudinal Survey of Overnight Travel (LSOT) with mode choice alternative data generated from the Bureau of Transport Statistics (BTS) and Google Maps to calculate VoTT for a variety of relevant individuals and tour factors using a multinomial logistic regression function. To represent as broad a definition as possible, long-distance trip in this study was defined as an overnight and out-of-state trip with at least 50 mi (one-way) distance between origin and destination.

Trade-offs between travel cost and travel time in long-distance trips are examined to find that (1) minimizing travel costs was most important to long-distance overnight travelers, when the trip distance is less than 500 miles one-way and (2) minimizing travel time was most important to long-distance overnight travelers, when the trip distance is greater than 500 miles one-way. Values of travel time, calculated as a ratio of time and cost estimates from logistic regression, are found to have a negative sign more commonly in long-distance travel. This study identified different ways of interpreting negative VoTTs depending on the coefficients contributing to the negative sign. It further identified six different types of long-distance travel behaviors based on travelers' attitudes towards saving time and/or money while taking their tour, annual travel and annual household characteristics into consideration. The results from this study are intended to assist transportation planners and analysts in the policy-making and decision-making processes related to transportation infrastructure.

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One-way trip	: A trip with its origin and destination in different locations.
Out-of-state trip	: A trip originating in one state and ending in another state.
Overnight trip	: A trip in which traveler(s) stay at their destination at least for a night.

1. INTRODUCTION

1.1 Value of Travel Time and Its Importance

Value of Travel Time (VoTT) quantifies individuals' willingness to pay to reduce their travel time (*1*). For example, a value of 4$/hr indicates an individual is willing to pay $4 to save an hour of travel time. VoTT is critical for transportation planning as it underlies many policy decisions and processes like cost-benefit analyses, project evaluations, travel demand forecasting, and economic investments *(2)*. In fact, U.S. Department of Transportation (USDOT) provides VoTT in their "Departmental Guidance for Valuation of Travel Time in Economic Analysis" to assist transportation analysts and planners in consistent evaluation of infrastructure projects and decision-making (*3*). This report recommended VoTT for different categories of travel by purpose, mode and distance and used a percentage of hourly income to specify VoTTs in dollars per hour. VoTT metrics are practically used to a) quantify roadway congestion metrics, b) evaluate work zone project installations, and c) predict travel behaviors.

First, travel time delay is one of the largest costs of transportation *(1)* and hence, one of the most important metrics to measure the efficiency of a transportation system. The cost of time spent in traffic includes fuel costs, maintenance and operational costs of vehicles, financial losses to employers and employees from lack of productivity, and costs to individuals due to loss of personal time. Travel time delay also influences mode-choice and route-choice decisions since travelers typically prefer modes and routes that take them to their destinations faster. Hence, lower travel time is one of the indications of a higher efficiency of transportation systems.

Second, as per the Urban Congestion Report of the Federal Highway Administration, traffic congestion is becoming worse over the years (*4*). Travel times become longer due to traffic delays caused by congestion. The usual strategy employed to combat congestion is addition of capacity of highway networks. It is estimated the capacity of highway system in the US increased by only 5.3% between 2000 and 2013, while the number of licensed drivers increased by 11% and miles traveled on highways increased by 8.8% during the same period (*5*). This disparate growth suggests the inability of system capacity to meet the traffic demand, which, leads to increasing congestion. Unfortunately, most of the attempts to reduce long-term congestion involve construction, expansion or rehabilitation of infrastructure. All such activities create work zones across the transportation network, which temporarily cause additional delays. For instance, it is estimated that more than 20% of the National Highway System (NHS) is under construction with more than 3000 active work zones during the season of peak construction (*6*). Albeit temporarily, work zones prompt more delays and exacerbate the congestion problem. Therefore, reduction of delays is one of the most prominent goals of transportation investments. Availability of VoTTs in such cases gives an idea to what extent travelers are willing to save travel time in project-specific circumstances. This helps in evaluating possible alternatives in terms of their costs and benefits and prioritizing the projects with maximum benefits. Thus, VoTT plays a crucial role in project evaluations, benefit-cost analysis, and economic investments related to transportation infrastructure.

Third, value of travel time highlights the travel behavioral aspects of individuals and is an important component in travel demand models. A travel demand model predicts travel behavior and forecasts travel demand for a specific timeframe in the future. To simplify, it predicts the travel decisions of individuals based on the travel costs and travel times of available alternatives. It helps us interpret individuals' emphasis on travel time-savings and the influence of these savings in making decisions. For example, the Four-Step travel demand model uses travel time as a factor to determine the route choice of individuals. VoTTs are also important in studying the activity patterns and scheduling decisions of individuals. When the underlying trends in the values of time are analyzed, they can help in unravelling several behavioral puzzles. To summarize, VoTT plays a crucial role in the travel behavioral analysis of individuals.

1.2 Long Distance Travel

Long distance travel is found to make a significant contribution to the nation's economy. People travelling long distances domestically were reported to spend $836.6 billion, comprising 84% of the total travel expenditure (*7*). In 1995, US residents made 1 billion domestic long-distance trips while the number raised to 2.2 billion trips in 2016 (*7*). The American Travel Survey (ATS) estimated that 25% of all person-miles were due to long-distance travel (*8*). The 2001 NHTS estimated that 90% of the long-distance trips were by personal vehicle (*9*). Given the numbers, it is evident that long-distance travel has a significant share in individuals' travel and it is highly likely to cause congestion issues due to the auto-dependence.

As a result, long-distance travel might lead to several losses both personally and in business due to wasted time in traffic, thereby affecting the regional economy. Travel occurs from induced demand and people prefer lower travel times. It is therefore, important to curb traffic delays and save travel time. Calculating VoTT for individuals travelling long distances in specific, is essential to assist transportation planners and analysts in making decisions on investments and policy-making due to its growing impact on transportation. It helps to meet the rising demand of long-distance travelers efficiently. Surprisingly, no complete set of long-distance VoTT currently exists for researchers or practitioners to use in their transportation analyses.

1.3 Research Objectives

Even though there is a significant growth in long-distance travel in the past decade, it is still understudied compared to daily travel. The VoTT metrics for long-distance travel are yet to be completed, and within the next decade the US will need these values to guide decisions related to megaregion planning, interstate highway construction, and high-speed rail development. Therefore, this research presents a comprehensive examination of long-distance VoTT across modes and tour characteristics in the US using the 2013 Longitudinal Survey of Overnight Travel. Specifically, this research combines detailed out-of-state long-distance tour records from Alabama and Vermont with mode choice alternative data to calculate VoTT for a variety of relevant individuals and tour factors. Trade-offs between cost and travel time in long-distance trips are also examined. VoTTs are modelled with Multinomial Logistic Regression. The results are intended to assist in economic investments, evaluate transportation projects and make transportation policies. They further help in understanding the long-distance travel behavior of different individuals based on their trip and household characteristics. The objectives of this research shown in Figure 1 could be described in the following statements:

1. *To calculate values of travel time for different categories of individuals*

   Individuals are categorized by different tour, annual travel and household characteristics. VoTTs are then calculated and compared for each category of individuals based on two mode-alternatives: personal vehicle and air travel. These values are also used to further identify different behaviors exhibited by long-distance travelers depending on their attitudes towards saving travel time and/or travel costs.

2. *To identify the dedicated influence of travel cost and travel time on the mode choices of long-distance travelers*

   All the trips in the final dataset are divided into five categories based on the distance travelled. Costs and travel time differences between air options and personal vehicle options are then considered. These trips are then examined to identify the influence of travel cost and travel time exclusively in the mode-choice decisions of travelers.

3. *To identify a framework for discussing and characterizing long-distance travelers' values of travel time.*

   Individuals exhibit a markedly different relationship with travel times and costs for their long-distance trips, compared to daily travel, mainly due to its non-recurring nature.

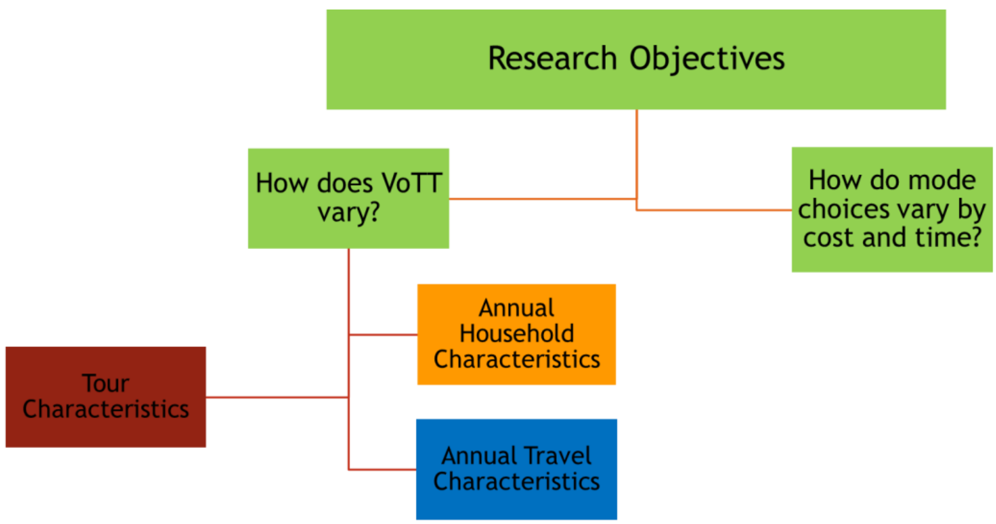


Figure 1: Research Objectives

1.4 Organization of the Report

This thesis is organized into five sections: *Section 1: Introduction*, introduces and explains the concepts of value of travel time (VoTT), long-distance travel and their importance in transportation planning. It further explains the necessity of evaluating the values of travel time for long-distance travel and states the objectives of this research. *Section 2: Literature Review*, reports past research and findings on calculation of VoTT and challenges faced in the estimation of VoTT for long-distance travel. It specifically presents existing studies on VoTTs for long-distance travel. *Section 3: Data*, describes the data source, method of data collection and data cleaning. It provides summary statistics of the final dataset and mentions the limitations, if there are any. *Section 4: Methodology*, describes in detail the statistical models and any tools or software used for the evaluation of VoTT. *Section 5: Results*, reports the final VoTT values obtained from this research and identifies the underlying trends in travel behavior and explains the reasons behind such behavior. *Section 6: Conclusions*, summarizes the need for this research, data used, analysis methods followed, and significant results found. It discusses the need for future research and makes recommendations.

2. LITERATURE REVIEW

2.1 Calculating Value of Time

Discrete choice models are the most common method of quantifying travel time. A utility function of travel cost, time, alternative- and individual-specific variables is used to estimate value of time. VoTT expressed as $/min, is calculated as a ratio of the coefficients of travel time (utilities/min) and travel cost (utilities/$) (*10*). The data used for the evaluation is typically collected from travel behavioral surveys on stated preferences (SP) or revealed preferences (RP) (*10*). The basic theory behind VoTT assumes no constraints on time allocated for various activities by an individual namely, work, leisure and travel but, imposes constraint only on the final sum of work and leisure times. It assumes time can be freely transferred between work and leisure and proposed that an increased time allocation in work would offset the effects of decreased time in leisure and vice-versa (*11*). This theory was later elaborated by imposing time constraints on different activities of an individual. For instance, modelling of utility was modified as a log function of predictor variables (*12*). Discrete choice models predict travelers' choice among a set of alternatives and quantify the trade-off between travel cost and time. Therefore, logit models were extensively used to evaluate VoTT. The logit models used in literature include Binary logit model (*13,14*), Multinomial logit model (*15*), Ordered logit model and Mixed effects model (*16*) depending on the number of alternatives and desired outcome (continuous or ordered).

2.2 Challenges of Long-Distance Travel VoTT

Growth of long-distance or interregional travel over the decades has made it an important component for consideration in the analysis and improvement of existing transportation networks and infrastructure. Intraregional daily VoTT has been widely documented by practitioners and researchers under a variety of different roadway conditions, trip purposes, highway types, etc. Unfortunately, VoTT metrics for long-distance trips still remain incomplete despite the increasing number of miles travelled and dollars spent in local/regional economies (*7*). Issues like poor data sources and wide variation in long-distance trip-making patterns are cited as reasons for the lack of existing VoTT for long-distance travel.

Data Sources

Limited data sources is one of the primary reasons hindering the study of long-distance travel (*17*). For example, Census Bureau of the United States conducted National Travel Surveys (NTS) in 1972 and 1977 to collect data on non-local travel (*18*). Two other national surveys, the ATS and NHTS were conducted in 1995 and 2001 respectively to collect data on long-distance travel of US residents (*19,20*). However, even these datasets did not collect enough data to effectively calculate VoTT for individuals. Ever since the 2001 NHTS, no efforts were made by the federal government to collect long-distance travel data at national level. Such a lack of contemporary data reduces the ability of long-distance travel studies to replicate reality. However, this thesis uses the most recent dataset on long-distance travel, 2013 LSOT (year-long survey conducted by a group of researchers at University of Vermont and Auburn University).

Inconsistent definitions, recall problems and fatigue effects are cited as prominent issues in the collection of long-distance travel data (*21*). The definition of a long-distance trip is not yet harmonized across different surveys but, most commonly defined by travel distance. Examples include surveys defining long-distance trips as 50 mi or 100 mi (one-way) trips, overnight trips and trips by activity durations and mode-choices (*22*). One reason for non-uniformity is the complexity involved in explaining the respondents how to differentiate their relevant movements (to be reported) from others in a multi-day trip. The other is the application of the data collected in surveys. For instance, tourism-related applications require duration-based definitions while transportation planning related applications require distance-based definitions. The rarity of long-distance travel relative to daily travel requires longer duration of reporting periods. This makes it difficult for respondents to recall the trips taken some days/weeks ago. Moreover, a longer reporting period for a rare event creates fatigue effects since respondents would be asked to report numerous details imposing response burden (*21*). In addition to the issues mentioned above, the Federal Highway Administration (FHWA) identified insufficient geographic and temporal detail and coverage as a potential issue (*23*).

To overcome the limitations of data, a uniform (although complex) definition of long-distance travel incorporating non-distance based thresholds is deemed necessary (*22*). In order to ensure consistency and comprehensiveness in data collection, Aultman-Hall et. al, recommended inclusion of all the relevant attributes in the travel surveys (like distance, duration and mode-choice) and leave the grouping of long-distance trips (for study) to users' discretion (*24*). FHWA supported this definition by recommending conducting a national long-distance travel survey with the help of smart phones (*23*). To ease the data collection procedure, it recommended tracking the survey respondents retrospectively for a year and asking questions on trip purpose, mode choice etc., whenever they record a long-distance trip on their phones. Thus, it suggests surveying all kinds of populations and gathering sufficient geographic and temporal detail to be representative of the American long-distance travel.

Uniqueness of Long-Distance Travel

As already mentioned, numerous studies focused on evaluation of VoTT for intraregional daily travel. However, long-distance travel is significantly different from intraregional daily travel and requires specific VoTT metrics. This thesis presents literature on certain travel behavior and traveler characteristics, relevant to this study, that differentiate long-distance travel from daily travel.

- **Distance** - Trip distance is one of the most significant factors affecting VoTT and a positive relation exists between VoTT and trip distance *(25).* This is because time constraints are more binding in longer trips than in shorter trips *(25)* and travelers cannot afford delays. Hence, VoTT increases with trip distance. The distances travelled are typically higher in long-distance travel compared to daily travel; travelers assign a higher value to their travel time in long-distance trips. This makes the VoTT of long-distance trips higher than that of daily travel.
- **Travel Party Composition** - More than half of the long-distance trips are for pleasure/leisure *(26,27)* while majority of daily trips are utilitarian (*28*). Therefore, individuals typically travel with other children and/or adults i.e., family or friends in long-distance journeys (*29*). Presence of family and/or friends in a trip is associated with additional responsibilities and influences the mode-choice decisions of individuals. For example, individuals travelling with children are more worried about children's comfort and prefer a personal vehicle. Moreover, people have to spend money out of their pockets

for all the leisure trips and hence, they typically try to minimize travel costs by choosing a cheaper mode (*30*).

- **Trip Duration** - The duration of long-distance trips is typically longer than daily trips. Moreover, individuals might make multiple destinations in long-distance trips. Both the factors play a key role in dictating the mode choice decisions of individuals *(31).* For instance, an individual might prefer public transit to avoid fatigue from driving for multiple days or for longer distances. On the other hand, he/she might prefer a car for comfort and convenience while making multiple stops.
- **Mode Choice** - Daily travel is often characterized by shorter trip distances and durations. Therefore, individuals have a variety of mode-choices ranging from motorized modes (like car, bus) to non-motorized modes (like walking, bicycling). In long-distance travel, these choices are mostly restricted to faster modes due to longer trip distances and durations *(32)*. Socio-demographic factors also have a major role in the mode-choice decisions of individuals in long-distance travel. People from higher income groups choose a faster mode of travel like air albeit expensive, while people from lower income groups depend on cheaper modes like public transit (*33*). In addition to the income, household composition is also found to heavily influence long-distance travel. People from households with children are more likely to travel by car for children's comfort. On the other hand, people from single households are reported to prefer other modes due to the high acquirement and maintenance costs (*34*).
- **Enjoyment of Travel** - Travelling is often perceived as a derived demand since people travel in order to pursue other activities of their interest. Interestingly, there is literature proving that the paradigm of derived demand is not always applicable (*35*). Individuals are

reported to seek pleasure in travel for various reasons like status, escape from tensions, attitudes seeking adventures or variety etc. (*36*). Whatever the reason might be, individuals show a stronger liking for overall long-distance travel compared to short-distance travel (daily travel). It is possible that this liking for travel might not be due to its inherent joy but because of the liking for activities at destination. Either way, it still has travel implications and individuals show a positive affinity towards long-distance travel *(16)*. Moreover, the ability to multitask while travelling makes individuals more travel-affine (*37*) and multi-tasking is more probable and convenient in long-distance travel. All the above-mentioned studies point out that long-distance travel is perceived more enjoyable than daily travel.

- **Income** - Income is a major determinant of long distance travel. People with higher incomes travel farther and often compared to people with lower income *(38)*. Car-ownership generally increases with income and improves the mobility of higher income groups. Individuals' mode-choice reflects their earnings. Higher income increases affordability and individuals choose a mode of their comfort and convenience which, is not possible all the time for individuals with lower income. Therefore, they prefer faster modes even though they are expensive. Past research shows that higher income groups make air travel to a greater extent (*29*). Hence, improved mobility, accessibility and affordability allows higher income groups to travel farther and often.
- **Household Composition** - People from single-adult households or 2-adult households were found to travel longer distances more frequently than others. This is because larger households impose additional familial and financial responsibilities hindering frequent and long-distance travel. Travel distances and frequency of long-distance travel decline as the number of children in household increases due to similar reasons (*38*). Household

composition additionally influences the purpose and modes of long-distance travel. Single-adults are likely to make more business trips and prefer faster modes (*38*) while individuals from households with adults and/or children are more likely to make leisure trips and prefer cheaper modes (*39*).

- **Season** - Season of the year plays an important role in determining the frequency of long distance trips (*40*). Most of the trips are made in summer followed by winter and other seasons. This is because there are more number of holidays in summer and winter.

Frequency of overnight work tours and leisure tours are also important in long-distance travel and are explained in the remaining sections of the study. Many of these factors are greatly tied to travel costs and times, indicating a greater influence on long-distance travel rather than daily travel.

2.3 Existing Intraregional Daily and Interregional Long-Distance Values of Travel Time

Past VoTT research has focused on intraregional daily trips. This resulted in VoTT metrics for daily trips, which are usually over short distances. These values typically vary with trip purpose, mode choice, route choice, time of travel (peak and off-peak hours) and various individual characteristics. However, a few studies extended their work to consider a limited scope of long-distance travel. Representative work of each method can be seen in Table 1 and are discussed below.

Oregon estimated statewide average VoTT of trips made by automobile/light, medium and heavy trucks. Weighted average values of vehicle occupancy, freight inventory values and number of miles travelled for both personal and business trips were used to arrive at a final VoTT for each type of vehicle. This gave a VoTT of $25.41/hr for automobile trips irrespective of the trip purpose (*41*).

A study conducted by Texas Transportation Institute(TTI) to analyze the impact of toll roads on time savings reported a VoTT of $1.96-$8.06 for users of a freeway with both general-purpose lanes and toll lanes. This was found to be far less than $21.73 used by TxDOT in general. The reason behind this low VoTT on toll roads was not clear. However, the possible reason behind this was assumed to be the uneconomic trips by freeway travelers due to trip-distance and safety issues (*42*). This behavior and VoTT cannot be generalized on all toll roads and is expected to change based on various factors. A study on two different toll roads in California yielded a VoTT of $10-$40 during morning commute hours. This higher value was attributed to the tendency of travelers to reach their work destinations faster during morning peak hours (*45*).

A meta-analysis of 389 European studies on VoTT showed travelers have highest willingness to pay to reduce travel time for business trips. Their next preference for such reductions is for other personal trips. Factors considered in the valuation of commute trips were unclear leading to an unexpected lower VoTT (*43*). This trend was also reported in other studies evaluating business and personal trips in local and intercity travel (*3*) or urban and interurban travel (*46*). Many studies reported a higher VoTT for faster modes (*3,46,25*). Similarly, VoTT increased with both income (*13*) and distance travelled (*13, 46*).

A Swedish study calculated in-vehicle values of time for short trips(<31mi) and longer trips(>31mi). Longer trips were to have higher VoTT due to the greater distances travelled than short trips. Short trips were further segmented into commute and other trips where commute trips have a higher VoTT than other trips. Faster modes were reported a higher VoTT across any category of trips (*46*).

VoTT for leisure trips are expected to be lower than other trips according to literature. Younger individuals making trips for any purpose were found to report a lower VoTT than others making leisure trips. This behavior was attributed to fewer obligations and lower income of young people (*44*).

To summarize, computing VoTT for long distance travel is a challenging task. First, it is difficult to craft and deploy surveys that efficiently capture long-distance travel data due to many reasons, including travel variety, fatigue and accuracy issues, and others. Second, it is difficult to generate complete detailed accounts of each mode choice cost and travel time one travel survey data is calculated. However, numerous research groups have explored the concept of estimating VoTT for a variety of trips. The findings of such studies are summarized earlier in Table 1. Discrete choice models such as logit models are best suited to evaluate VoTT. In this thesis, multinomial logit model was used for the same purpose.

TABLE 1: Previous Values of Travel Time

Type of trips	Individual/Tour Characteristics	Mode Choice	VoT	Source	Year
All trips	-	Personal Vehicle	25.41$/hr	41	2016
All trips	Toll roads	Motorists with transponders	1.96$/hr-8.06$/hr	42	2016
Commute trips	-	All modes	11.4$/hr	43	2016
Other trips	-	All modes	19.15$/hr		
Business trips	-	All modes	34.17$/hr		
All trips	-	All modes	24.42$/hr		
Worktrips (5-10km)	Income<10,000Rs/month	8 alternatives on a scale of increasing cost and time	0.77$/hr	13	2014
	Income-10,000Rs/monthto20,000Rs/month		0.88$/hr		
	Income-20,000Rs/monthto30,000Rs/month		0.99$/hr		
Worktrips(10-20km)	Income<10,000Rs/month	8 alternatives on a scale of increasing cost and time	0.89$/hr		
	Income-10,000Rs/monthto20,000Rs/month		0.97$/hr		
	Income-20,000Rs/monthto30,000Rs/month		1.2$/hr		
Worktrips(20-30km)	Income<10,000Rs/month	8 alternatives on a scale of increasing cost and time	0.99$/hr		
	Income-10,000Rs/monthto20,000Rs/month		1.24$/hr		
	Income-20,000Rs/monthto30,000Rs/month		1.77$/hr		
Personal trips	Local Travel	Surface modes	12$/hr	3	2009
Business trips			22.9$/hr		
All purposes			12.5$/hr		
Personal trips	Intercity travel	Surface modes	16.7$/hr		
Business trips			22.9$/hr		
All purposes			18$/hr		
Personal trips		Air	31.9$/hr		
Business trips			57.2$/hr		
All trips	Young travelers	-	5.6$/hr	43	2007
Leisure trips	All travelers	-	7.5$/hr		
Commute trips	Morning hours	Personal Vehicle	10$/hr-40$/hr	44	2005
Commute trips	Urban	Personal Vehicle	5.37$/hr	45	2004
		Bus	3.76$/hr		
		Rail	6.45$/hr		
		Underground	8.24$/hr		
Leisure trips	Urban	Personal Vehicle	5.82$/hr		

		Bus	2.33$/hr		
		Rail	5.82$/hr		
		Underground	6.53$/hr		
		Personal Vehicle	11.82$/hr		
Business trips	Urban	Bus	2.87$/hr		
		Rail & Underground	17.19$/hr		
		Personal Vehicle	9.4$/hr		
Commute trips	Inter Urban	Bus	-		
		Rail	11.3$/hr		
		Underground	-		
		Personal Vehicle	8.24$/hr		
Leisure trips	Inter Urban	Bus	-		
		Rail	11.91$/hr		
		Underground	-		
		Personal Vehicle	16.39$/hr		
Business trips	Inter Urban	Bus	-		
		Rail & Underground	28.84$/hr		
		Personal Vehicle	5.07$/hr		
Commute trips	<50km(31miles)	Regional Train	8.06$/hr		
		Long Distance Bus	7.01$/hr		
		Regional Bus	6.42$/hr		
		Personal Vehicle	4.03$/hr		
Other trips	<50km(31miles)	Regional Train	6.42$/hr		
		Long Distance Bus	5.67$/hr		
		Regional Bus	4.18$/hr	46	1996
		Personal Vehicle	12.09$/hr		
		Regional Train	10.45$/hr		
		Long Distance Bus	9.7$/hr		
All trips	>50km(31miles)	Regional Bus	7.46$/hr		
		Air	13.13$/hr		
		Long Distance Train	11.04$/hr		

3. DATA

3.1 Longitudinal Survey of Overnight Travel

The data used for this study was obtained from the online survey, Longitudinal Survey of Overnight Travel (LSOT), conducted by the researchers at University of Vermont and Auburn University from February 2013 to February 2014. The researchers collaborated with Resource Systems Group (RSG) to administer the survey to a large number of respondents in US and Canada. These respondents were recruited by sending mass emails to large corporate, university and personal groups; postings to social media and email newsletters; word of mouth. A recruitment survey was conducted prior to the survey period to gather key demographic information of potential respondents. In the first month of the survey period, the survey collected demographic information of respondents and their households. It also collected the information of their future overnight trips which were currently being planned. In the following months, the respondents were emailed once every month over the entire year and were asked to record the information on their planned and completed overnight tours. Respondents that missed the surveys of previous two months were eliminated from the survey. A map-based and user-friendly interface was used to facilitate the accurate mapping of trip origins and destinations. Along with locations of origins and destinations, the monthly surveys recorded information of several tour characteristics like departure and return dates, trip purpose and travel party. Respondents were also allowed to update the status of their trips planned in previous months and trips that were completed but not planned. The final survey in February 2014 marked the end of the survey period which, made the total number of surveys the respondents participated as 12. Each of the respondents were enrolled in a drawing every month to provide incentives for their participation. The incentive structure coupled with the online method were proved to be effective by retaining more than 50% of the respondents to participate for the entire year-long duration.

LSOT represents the first year-long survey to collect data on long-distance travel in US since the 1995 American Travel Survey (ATS) (*47*). It is also the most recent survey on long-distance travel in US since the 2001 National Household Travel Survey (NHTS), which only collected 3-weeks of long-distance travel data (*48*). Previous long-distance travel surveys used distance thresholds to define a long-distance trip; for example, ATS defined a long-distance trip as a 100mi (one-way) trip and NHTS defined it as a 50mi (one-way) trip; but the LSOT defined a long-distance trip as an overnight trip regardless of the distance travelled (*24*).

The entire LSOT dataset contains 1220 individuals with 8367 long-distance tours. Of these individuals making long-distance tours, 62.2% were women while only 37.8% were men. 89% of the individuals had higher education (college degree) while 11% had only high school education or college education without a degree. 80.2% of the individuals were full-time employees and the remaining 9.8% constituted from retirees and homemakers to students and part-time employees. Only 0.9% of the survey respondents were unemployed. Approximately 76% of the respondents earned more than $75,000 per year. The dataset emphasizes individuals with higher income and education levels due to sample recruitment. However, these people tend to make most of the long-distance travel and are most represented in long-distance analyses (*10,14*).

3.2 Generating Mode Choice Alternatives

Alternative mode choice information is essential to quantify VoTT. This information comprises the travel time, distance and cost of a trip based on the mode utilized for travel. Since, the information was not collected directly in the survey, it had to be collected manually from the trip origins and destinations, mode choice of respondents. In order to simplify this data processing task, trips originating in Alabama and Vermont were only analyzed as they constitute a major portion of the LSOT dataset. Different mode alternatives available in Alabama and Vermont namely, personal vehicle, air, bus and train were examined. The number of trips either made by bus or train or were feasible by these modes were both negligible. As such, personal vehicle and airline were concluded as the feasible modes of travel common to both the states and were considered for the study.

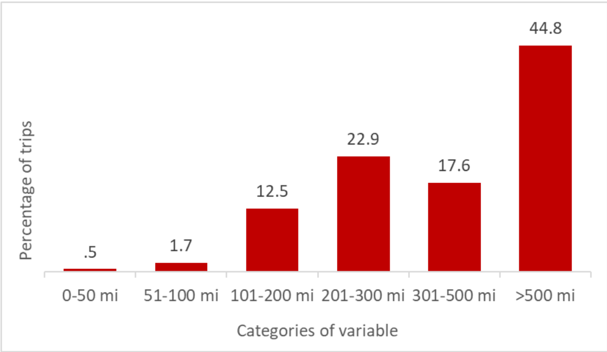
This study used only overnight and out-of-state tours to make the dataset consistent since, air travel for in-state tours is relatively uncommon. Similarly, trips from Alabama to Georgia were also deleted as most of the trips have a common airport for origin and destination i.e., the Atlanta international airport. All the trips with their destinations out of the country were removed as personal vehicles are not feasible for the majority of these trips. The final dataset consists of 3019 long-distance trips originating from both Alabama and Vermont.

Distances, travel times and costs were calculated for personal vehicle and air for every recorded overnight and out-of-state tour originating in Alabama and Vermont. Google Earth was used to estimate the distance and time taken to travel from an origin city to a destination city by personal vehicle (*49*). It was assumed that people choose routes with least travel time. Travel costs (fuel cost) of a trip made by personal vehicle were calculated using average gas cost, average mileage and the on-road trip distance. The operating costs of personal vehicles were not included as travelers generally do not consider such costs while making decisions regarding long-distance trips. National average gas price by month and home state were provided by US Energy Information Administration for 2013 calendar year (*49*). The MPG (miles per gallon) value was assumed to be 21.6, based on the 2013 BTS average for US light duty 27 vehicles (*50*). The travel cost for a trip was calculated as

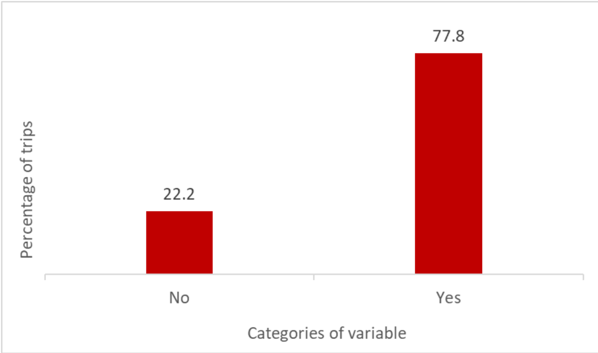
$$Cost = (Distance_{motor\ vehicle} / MPG_{avg}) \times (Gas\ Price_{avg}) \quad (1)$$

Data from the survey did not specify the mode used to access or egress from an airport. Therefore, individuals in the dataset were assumed to use personal vehicles as it is the most feasible option. The same procedure (for personal vehicles) was followed to calculate access and egress travel times, distances and costs to an airport. Google Earth was used to calculate travel times and distances while national average gas price and MPG were used to calculate fuel costs. Bureau of Transportation Statistics (BTS) provided the average air fares and travel time to reach a destination based on the month in which a trip took place (*51*). LSOT does not provide information on the airports used by long-distance travelers at their origins and destinations. Hence, airports closest to the origin city and destination city were assumed to be used by the travelers. However, BTS provided air fares and travel times only if considerable number of trips took place between origin and destination airports. Therefore, if the travel characteristics were not reported between two airports closest to the origin and destination cities respectively, it is assumed that the travelers do not choose one or both of the airports depending on the data. In that case, the next-closest airports were checked for data on air fares and travel times. This process continued until the airports which were commonly used by the passengers were found.

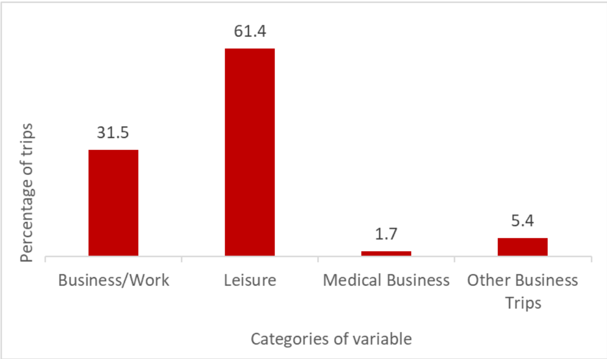
Several tour characteristics, annual travel characteristics and annual household characteristics were included in the original dataset and kept for the VoTT analysis. They were divided into several sub-categories and coded accordingly. This made all the variables (characteristics) in the analysis categorical. For example, trip purpose is a variable with four sub-categories. Figure 2 to Figure 4 shows all the ten variables along with their sub-categories analyzed in this study. Each graph in the figures shows the categories of a variable on X-axis and percentage of trips made by individuals belonging to each category on Y-axis. It should be noticed that the percentages for overnight work and leisure tours do not add up to 100%. This is because the respondents who did not travel overnight either for leisure or work during the survey period were not reported. These travelers made their trips for medical and other purposes. Similarly, 8% of the respondents that did not prefer to mention their annual household income were not considered for the study.



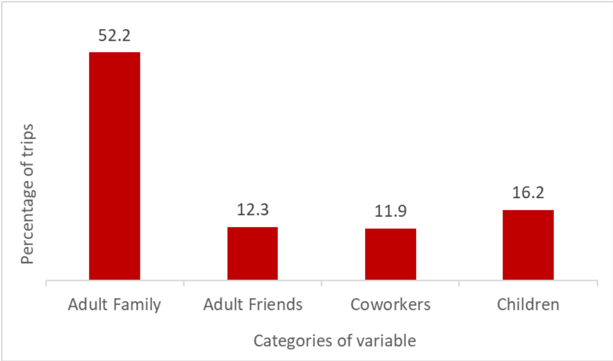
Distance Travelled



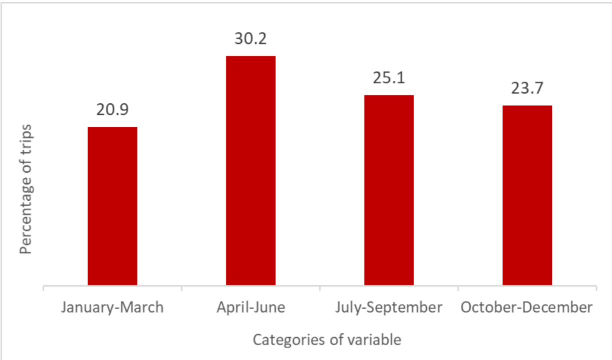
Planned



Trip Purpose

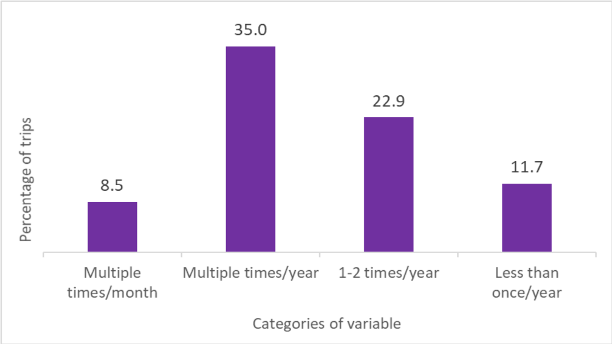


Travel Party Composition

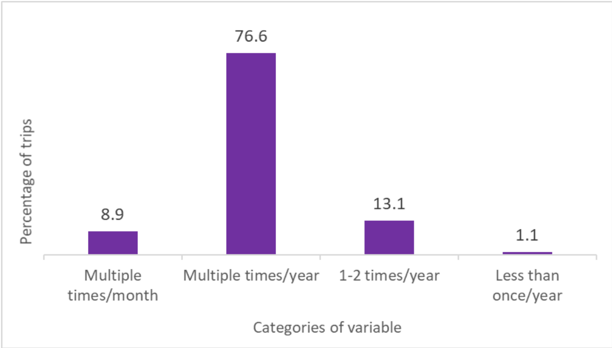


Season of Travel

Figure 2: Trip Characteristics

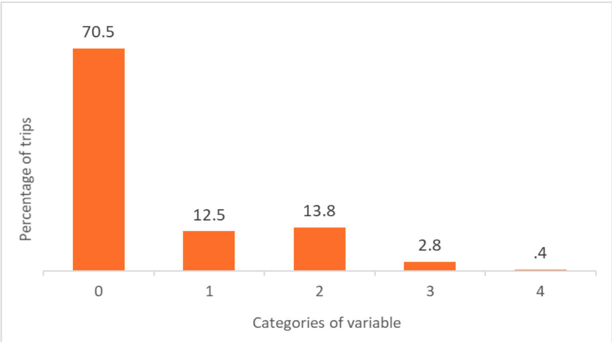


Overnight Work Tour Frequency

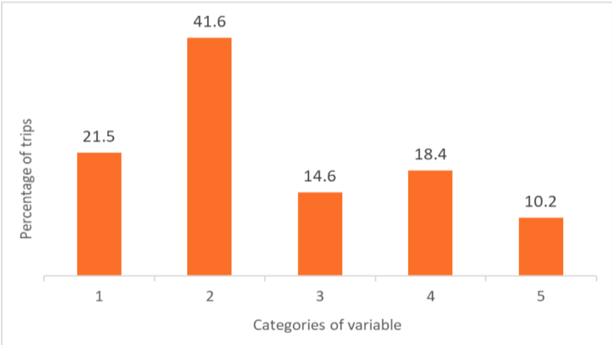


Overnight Leisure Tour Frequency

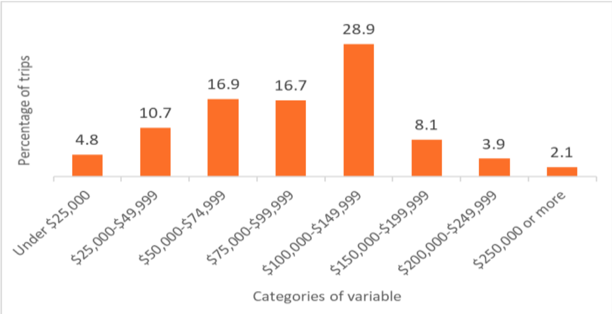
Figure 3: Annual Travel Characteristics



Number of Children in the Household



Household Size



Annual Household Income

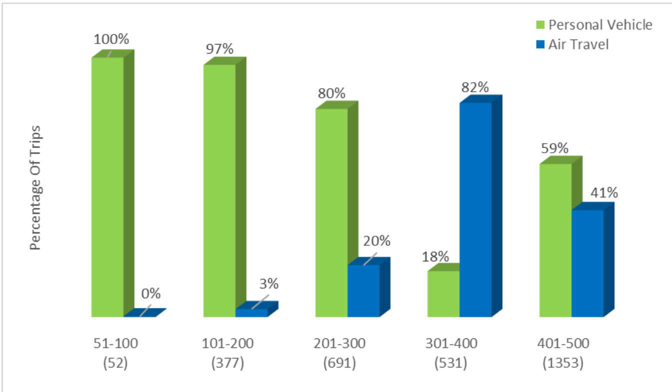
Figure 4: Annual Household Characteristics

3.3 Variation in Mode Choices

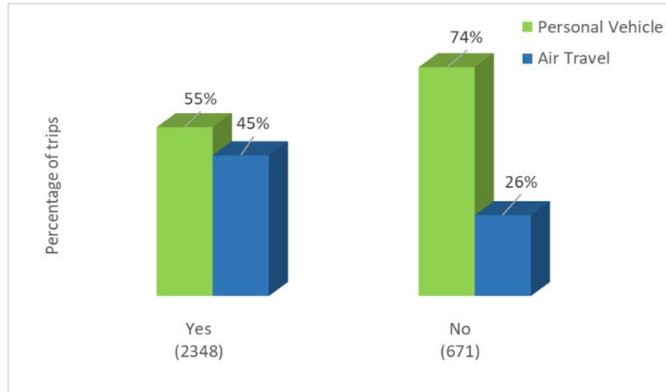
The choice of transportation mode is one of the most important considerations in transportation planning. It plays a key role in policy-making as planners aim at improving the efficiency of transportation system by facilitating travel to meet travelers' demand and choices (*52*). Therefore, this section examines the mode-choices of individuals and the influence of trip characteristics, annual travel and household characteristics in making the choices. Figures 5, 6 and 7 depict the mode-choice of individuals based on these characteristics according to the data gathered from LSOT. X-axes in the figures are the characteristics that are expected to impact the mode choices of individuals. The numbers in the parenthesis under each category are respective sample sizes. Y-axes are the percentage of trips made by personal vehicle and air by individuals with the corresponding characteristics. Each figure has multiple graphs each of which shows the mode-choice of individuals with different characteristics. For example, the *Trip Purpose* graph in Figure 5 shows the mode-choice of individuals travelling for work, leisure, medical and other purposes.

By Tour Characteristics

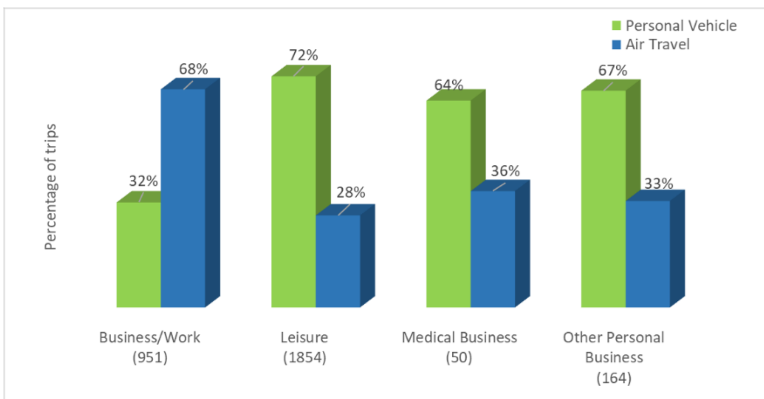
Figure 5 shows the variation in mode choices of individuals based on tour characteristics. A huge difference can be spotted in the planning of trips. Individuals planning their trips ahead predominantly travelled by air but, individuals making spontaneous or sudden tours predominantly travelled by personal vehicle. This might be because travel distance, time or costs of a personal vehicle do not necessarily change with planning when compared to trips by air. Hence, people generally focus on planning their air travel. Most of the work trips were made by air and majority of leisure trips were made by personal vehicle. This is due to the tendency to travel faster for work and cheaper for leisure. Similarly, trips with family, friends or children imply leisure travel while trips with coworkers imply work/business travel. Therefore, a greater percentage of trips with family, friends or children were by personal vehicle while a greater percentage of trips with coworkers were by air travel. Even though trip purpose and travel party composition seem to be correlated, it did not affect the model because each variable was modeled separately.



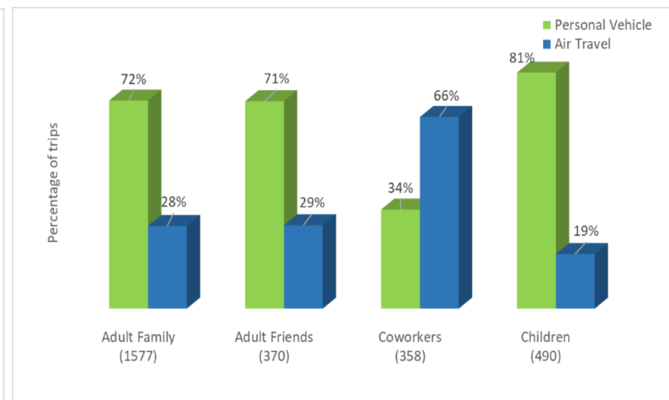
Trip Distance (in miles)



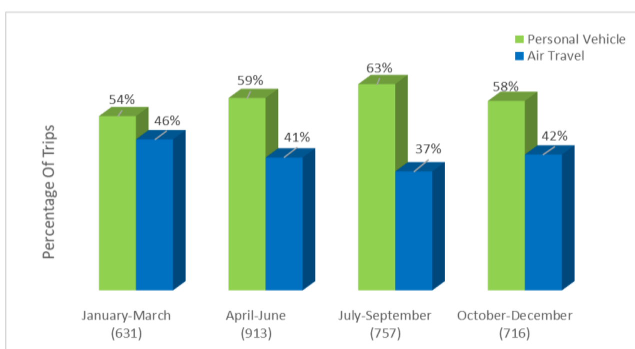
Planning of Trips



Trip Purpose



Travel Party Composition

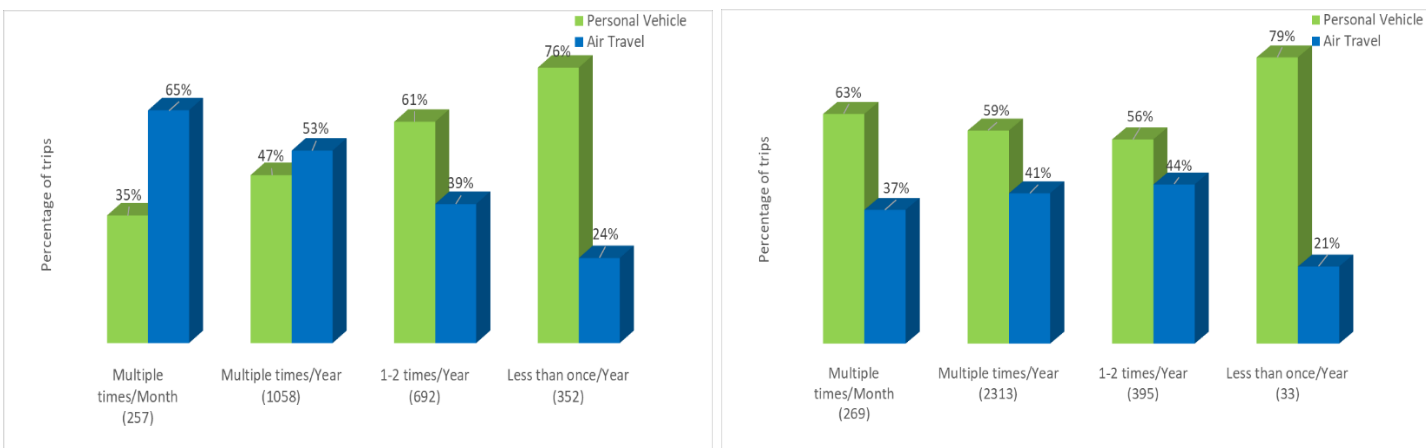


Season of Travel

Figure 5 Tour Characteristics Affecting Mode Choices

By Annual Travel Characteristics

Figure 6 shows the variation in mode choices of individuals based on their annual long-distance travel characteristics. Respondents who answered that they do not travel for work/leisure or who answered they were unemployed for overnight work tour frequency are not reported in the graphs. Individuals travelling multiple times per month/year for work travelled frequently by air compared to personal vehicle. This can be attributed to the tendency to optimize productivity at destinations. In all other cases of overnight work tours, they travelled more by personal vehicle. However, percentage of trips made by personal vehicle is higher for any frequency of overnight leisure travel. This is because travelers are more concerned about money in leisure tours and they prefer personal vehicle to save travel costs.

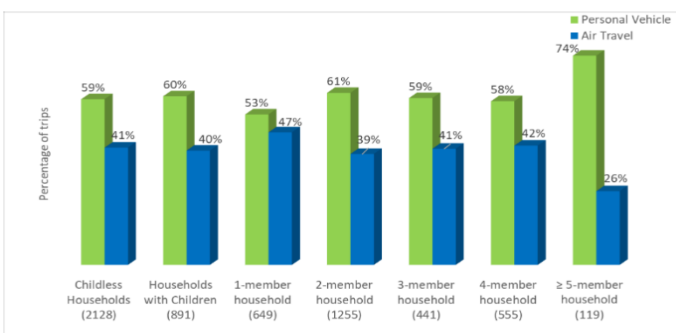


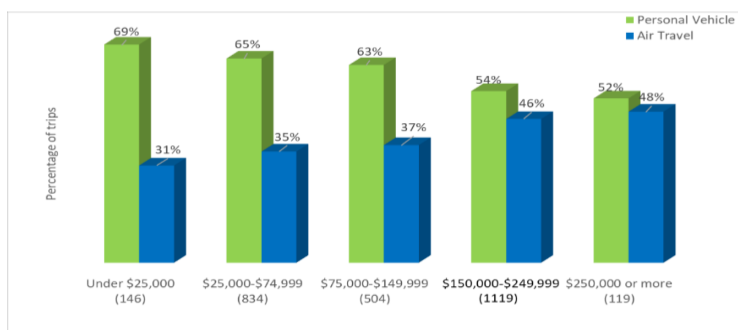
Overnight Work Tour Frequency *Overnight Leisure Tour Frequency*

Figure 6: Annual Travel Characteristics Affecting Mode Choices

By Annual Household Characteristics

Figure 7 shows the variation in mode choices of individuals based on their household characteristics. Trips made by travelers from households with or without children and trips made by travelers from households of different sizes were merged and shown in a single graph. Survey respondents that were unemployed or did not prefer to mention their income were excluded from the graphs. It is interesting to notice that personal vehicle has a relatively higher use for individuals regardless of their household size, composition, and income. Presence of children in household did not have a greater influence on the mode-choice of individuals as percentage of trips by personal vehicle and air remained similar. However, individuals from 1-member households traveling by personal vehicle were only 6% higher than those travelling by air while majority of individuals from 5-member households travelled by personal vehicle. For any other household size, distribution of trips between personal vehicle and air remained similar. This is because the household responsibilities raise with the number of household members and restrain individuals from spending more money on travel. As the annual household income increased, travel by personal vehicle reduced and air travel increased since, higher income groups could afford higher costs to travel faster.





Household Size *Annual Household Income*

Figure 7: Annual Household Characteristics Affecting Mode Choices

3.4 Trade-off Between Travel Cost and Travel Time

Individuals usually compromise between travel costs and time while choosing their mode of long-distance travel. This is evident from the graphs (Figure 9) plotted with the LSOT trips. The X-axes of these graphs are a difference in travel costs (in US dollars) between personal vehicle and air for a trip. The Y-axes are a difference in travel times (in minutes) between personal vehicle and air for a trip. The trade-off between time and cost for a trip is construed from the quadrant in which a trip lies. Figure 8 clearly explains the interpretation of trade-offs based on the quadrant in which a trip lies. The quadrants are numbered as Q1, Q2, Q3 and Q4 for easy understanding. For example, if a trip made by air lies in second quadrant, it implies individuals typically chose air for that trip since it is a faster mode. On the other hand, if a trip made by a personal vehicle lies in second quadrant, it implies individuals typically chose personal vehicle for that trip as it is a cheaper mode. In the former case, their decisions were based on travel times while in the latter case, their decisions were based on travel costs.. While researchers recognize that many factors influence mode choices in general, and many unobserved factors are likely affecting the choices seen here, other factors possibly influencing the mode-choice decisions are not considered since they are beyond the scope of this study.

Once the dataset is finalized, all the 3019 trips are divided into two categories based on the modes (personal vehicle and air) utilized for travel and then plotted into graphs (Figure 9). The numbers highlighted in red are the percentage of individuals belonging to the corresponding quadrant. This shows the differences in travelers' concern for saving money and time while using different modes. The trips are further grouped into 5 categories based on the distances travelled. According to Figure 9, trips by personal vehicle are expected to be ideal if they lie in the third quadrant while trips by air travel are expected to be ideal if they lie in first quadrant.

It is evident from Figure 9, more trips are significantly made by personal vehicle until trip distances reach 500mi. Most of the trips by personal vehicle between 50 to 200 mi long lie in third quadrant since these are cheaper and faster compared to air travel. They shift to second quadrant once the trip lengths exceed 200mi. This is because people using personal vehicle for these distances are more willing to save money instead of time. On the other hand, trips made by air always lie in second quadrant for these distances meaning air travelers are always willing to save time by choosing a faster mode of travel i.e., air.

More trips are made by air once the trip distances exceed 500 mi and they predominantly lie in second quadrant. Similarly, trips (>500 mi) by personal vehicles predominantly lie in second quadrant. This indicates people usually prefer air travel for *longer* long-distance trips if they consider time savings are more important than cost. On the other hand, they prefer personal vehicle if cost savings are more important.

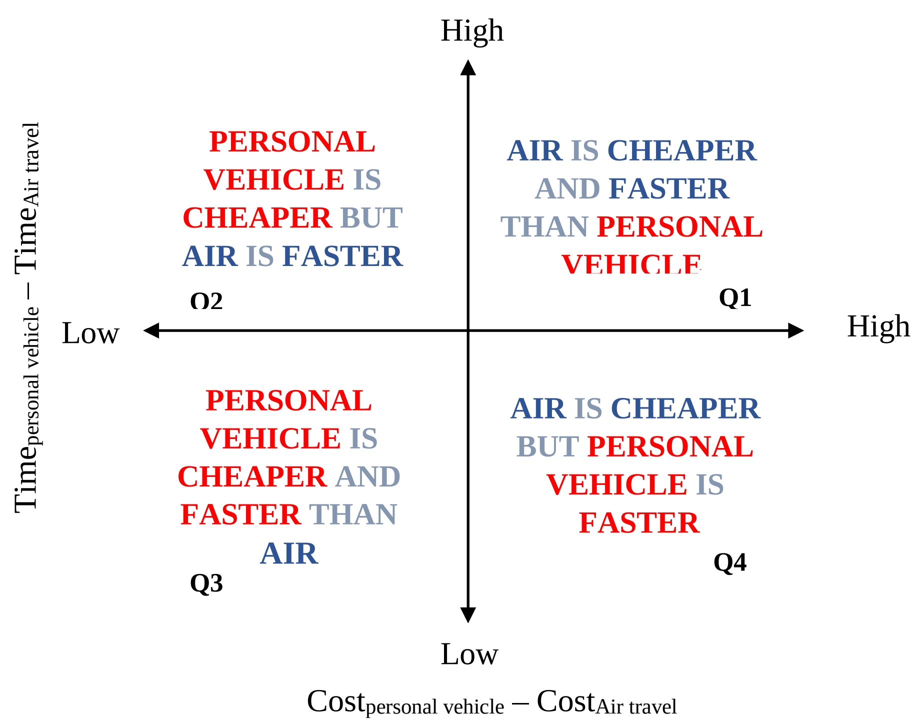


Figure 8: Interpretation of Trade-off

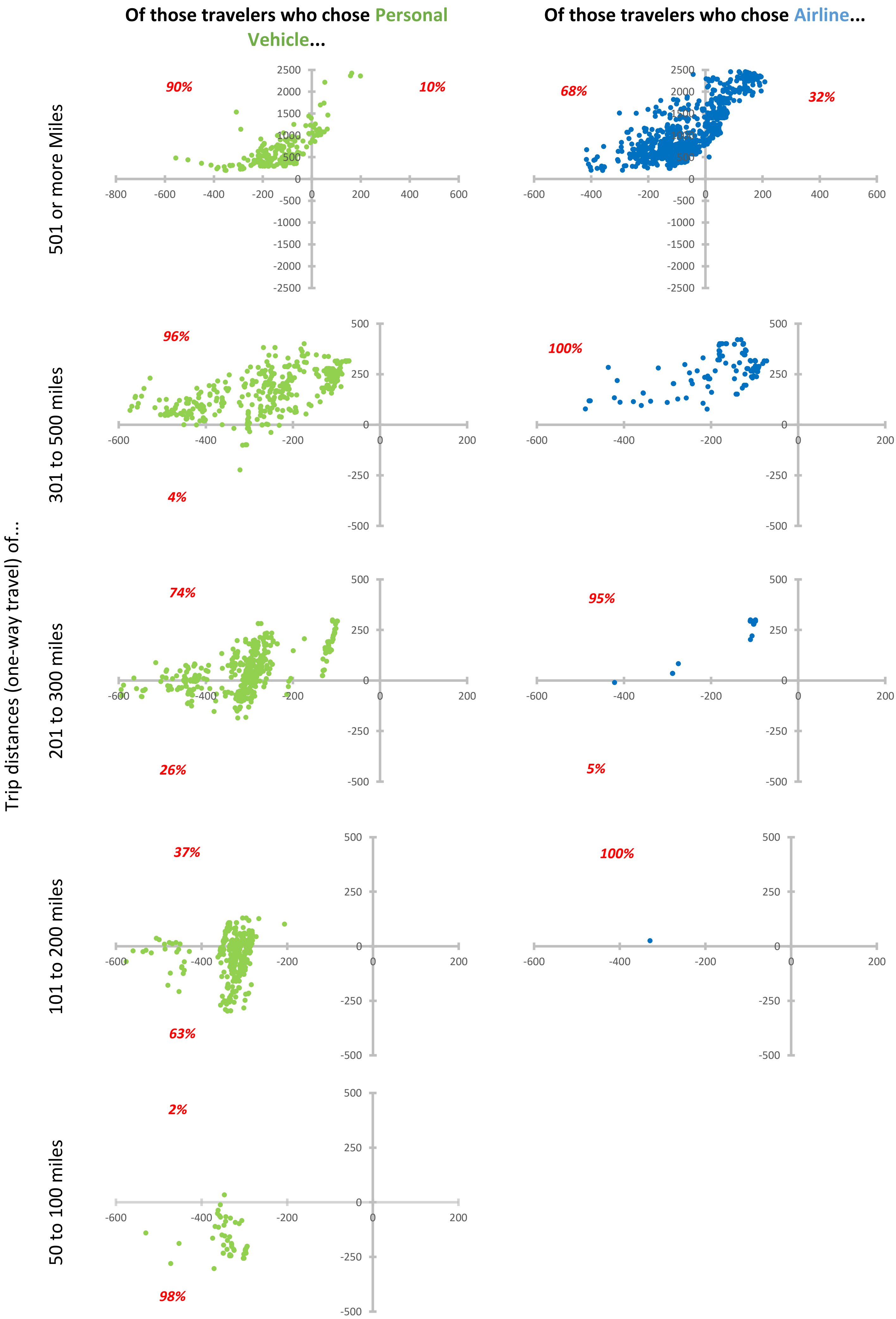


Figure 9: Characterizing Tours by Modes, Costs, Travel Time and Distances

Characteristics of Travelers Categorized by Modes, Costs, Travel Time and Distances

Table 2 summarizes the characteristics of travelers in each quadrant. Travelers choosing a personal vehicle in Q1 and travelers choosing air in Q3 are too few to summarize, and are not included in the table. Similarly, travelers who (i) never make overnight long-distance trips for leisure or work (ii) were unemployed and (iii) did not prefer to mention their annual household income were disregarded in the analysis. Individuals travelling with family, friends, coworkers or children were divided into four dummy variables respectively and hence, the percentage of trips was calculated separately for each of them based on their presence and absence while travelling. However, the statistics in Table 2 were reported only if either of them was present in the trips.

Figure 9 demonstrated that, for tours less than 500mi, personal vehicles were predominantly selected based on costs. When individuals are categorized based on whether they sought to *solely* minimize costs (Q2) versus if they also considered travel time (Q3), differences emerge. Considering the percentages and sample sizes from Table 2, it is clear that individuals desiring to save money make more number of overnight work tours per year than those desiring to save both money and time. They exhibit a similar behavior in overnight leisure tours but on a smaller scale. Travelers preferring cheaper trips travel significantly more for work trips than those considering cheaper and faster trips. This behavior is vice-versa in leisure trips. Regardless of their tendency to solely minimize costs or both costs and time, individuals travel similarly with family, friends and children. But, those preferring to minimize costs travel more with coworkers. Individuals that desire to save travel costs further plan their trips in advance, travel more in winter and belong to both lower-income and higher-income households.

Similarly, travelers that chose airlines can be categorized as those who were *solely* focused on minimizing travel time (Q2) versus if they also considered costs (Q1). Compared to individuals considering both cost and time, individuals that selected air travel because it got them to their destinations fastest, make more overnight work trips per month/year and hence, travel more with coworkers. However, they travel less for overnight leisure tours. Similarly, they travel more for work/business compared to others and belong to higher income households. Individuals desiring to reach their destinations faster even though the trips are expensive make a larger number of unplanned tours than those desiring both cheaper and faster trips. At times, unavoidable circumstances prompt individuals to make unplanned trips. This might have contributed to the expensive nature of trips apart from increasing their willingness to travel faster due to the importance involved.

To summarize, individuals travelling frequently either for work or leisure choose a personal vehicle if they wish to minimize costs. On the other hand, they choose air travel if they wish to minimize travel time. The major difference is that a higher percentage of individuals using airlines travel for work while a higher percentage of individuals using personal vehicle travel for leisure. This difference also extends to the frequency of overnight trips. For instance, individuals using air travel to make multiple work trips per month/year are more in number. The demographics are consistent with literature (29) according to which, income plays a key role in making travel decisions. Many travelers using airlines belong to higher income groups relative to those using personal vehicle. This is because it is easier for them to afford higher prices and need not compromise with time.

Table 2: Summary Statistics of Travelers

Variable	Category	% of Tours Using a Personal Vehicle in...		% of Tours Using san Airline in…	
		Q2 (Sample Size) | Personal vehicle cheaper but slower	Q3 (Sample Size) | Personal vehicle cheaper and faster	Q1 (Sample Size) | Air cheaper and faster	Q2 (Sample Size) | Air costlier but faster
Work Tour Frequency Overnight	Multiple times/month	5% (62)	6% (29)	11% (38)	14% (128)
	Multiple times/year	30% (382)	21% (106)	38% (134)	49% (431)
	1-2 times/year	24% (302)	24% (118)	24% (84)	21% (183)
	Less than once/year	15% (190)	15% (75)	8% (30)	6% (53)
Leisure Tour Frequency Overnight	Multiple times/month	9% (111)	11% (57)	8% (29)	8% (70)
	Multiple times/year	77% (967)	74% (371)	79% (279)	76% (677)
	1-2 times/year	13% (167)	10% (52)	12% (44)	15% (129)
	Less than once/year	1% (9)	3% (17)	0.2% (1)	1% (6)
Travel Party Compositio n Includes...	Adult Family Members	62% (781)	67% (332)	45% (158)	33% (290)
	Adults Friends	15% (185)	16% (78)	10% (34)	8% (72)
	Coworkers	8% (100)	4% (22)	16% (58)	20% (178)
	Children	22% (280)	22% (112)	8% (29)	7% (63)
Purpose	Work/Business	20% (251)	11% (55)	47% (167)	54% (475)
	Leisure	73% (913)	80% (396)	50% (178)	39% (349)
	Medical business	1% (20)	2% (12)	0.2% (1)	2% (17)
	Other personal business	6% (72)	7% (35)	2% (8)	5% (46)
Planned	-	74% (929)	66% (331)	90% (319)	84% (747)
Quarter	January-March	19% (241)	19% (93)	30% (105)	21% (187)
	April-June	29% (365)	33% (164)	28% (100)	31% (273)
	July-September	26% (331)	29% (142)	21% (73)	23% (204)
	October-December	25% (317)	20% (99)	21% (76)	25% (223)
Children Count	0	70% (873)	71% (354)	73% (258)	70% (623)
	1	12% (159)	11% (53)	11% (40)	14% (126)
	2	15% (185)	12% (60)	13% (45)	14% (123)
	3	3% (33)	6% (31)	2% (8)	1% (13)
	4+	0.4% (6)	0% (0)	1% (3)	0.2% (2)
Household Total Count	1	20% (254)	17% (85)	23% (82)	25% (221)
	2	43% (534)	43% (216)	43% (153)	38% (339)
	3	14% (175)	17% (85)	12% (42)	16% (139)
	4	19% (239)	16% (79)	19% (67)	19% (167)
	5+	4% (54)	7% (33)	3% (10)	2% (21)
Household Income	Under $25,000	6% (79)	4% (21)	5% (17)	3% (28)
	$25,000 - $49,999	12% (150)	14% (70)	10% (37)	7% (62)
	$50,000 - $74,999	17% (216)	19% (95)	11% (39)	17% (155)
	$75,000 - $99,999	17% (216)	18% (92)	16% (57)	15% (131)
	$100,000 - $149,999	27% (342)	31% (154)	27% (94)	32% (280)
	$150,000 - $199,999	7% (84)	5% (25)	12% (44)	10% (92)
	$200,000 - $249,999	4% (50)	2% (12)	6% (20)	4% (37)
	$250,000 or more	1% (18)	1% (6)	3% (9)	3% (31)

4. METHODOLOGY

4.1 Multinomial Logit Regression

Value of Travel Time is a ratio of estimate for time over estimate for cost. Modelling of VoTT is based on utility theory in which, travelers are assumed to choose an alternative with maximum utility (level of satisfaction). Therefore, higher the utility of a mode-choice alternative, higher is the probability of travelers choosing that mode. In this case, utility is a linear function of travel cost and time and is most commonly computed by logistic regression models (*53*). Logistic regression models predict a categorical outcome dependent variable based on one or more explanatory independent variables. VoTT estimation involves calculation of utility for different alternatives to determine the probability of individuals choosing an alternative and logistic regression serves the purpose.

Multinomial logistic regression (MNL) model was used in this study since the dependent variable i.e., mode alternatives is nominal. MNL regression assumes a linear function to calculate the utilities of alternatives based on predictor variables. Since, we are trying to find the influence of travel cost and time on mode-choices of different individuals, cost and time are independent variables while utility of each mode is a dependent variable. The dependent alternative-choice in the linear utility equation is binary: individuals may select between airline or personal vehicle. The cost and time estimates obtained from the model which are used for the calculation of VoTT were computed by Maximum likelihood estimation (MLE) in R studio (*54*). MLE is a method of estimating parameters by finding the parameter values, which maximize the likelihood of predicting the known observations, given the parameters. It uses the likelihood function to calculate the parameter values that makes the observations most probable. For instance, if θ is a parameter and X_i are independent and identically distributed observations, the likelihood function is given as:

$$\text{lik}(\theta) = \prod_{i=1}^{n} f(x_i|\theta) \tag{2}$$

Maximizing this product is often tedious and hence, log-likelihood function is employed in the estimation of MLE. Logarithm is an increasing function so it will be equivalent to maximizing the log-likelihood. The log-likelihood function is:

$$\text{l}(\theta) = \sum_{i=1}^{n} \log(f(x_i|\theta))$$

(3)The utility function used in this analysis is of the form

$$U_n = \beta_{cost,air} Cost + \beta_{time,air}\, Time + \beta_{cost,pers.veh.} Cost + \beta_{time,pers.veh.}\, Time \tag{4}$$

where U_n is the utility of a mode, $\beta_{cost,air}$ and $\beta_{cost,pers.veh.}$ are the estimates of the cost variable of air and personal vehicle respectively. $\beta_{time,air}$ and $\beta_{time,pers.veh.}$ are the estimates of the time variable of air and personal vehicle respectively. In a multinomial logit model, the choice probability of an individual i.e., the probability of an individual choosing from a set of alternatives is calculated by using probability equations as follows:

$$P(Ui) = \frac{e^{U_i}}{e^{U_1} + e^{U_2} + \cdots + e^{U_n}} \tag{5}$$

Where, P($U1$) is the probability of choosing an option 'i' from 'n' available alternatives and $U_1, U_2, \ldots..U_n$ are the utilities of each alternative.

For instance, the probability of choosing air travel in this study is:

$$P(Air) = \frac{e^{U_{air}}}{e^{U_{pers.veh}} + e^{U_{air}}} \tag{6}$$

MNL has a closed-form of equation which, gives finite results for easy interpretation. It assumes:

1. Independent and identically distributed (IID) random components with a Gumbel distribution - This does not allow the same unobserved factors across alternatives but treats their effects identically across the alternatives.
2. Response homogeneity - This does not allow sensitivity variations to an attribute due to error terms.
3. Error-variance or covariance homogeneity across individuals.

Value of Travel Time (VoTT), calculated as a ratio of time and cost estimates is multiplied by 60 to change its units from \$/min to \$/hr:

$$VoTT\ \left(in\,\frac{\$}{hr}\right) = \frac{\beta_{time}}{\beta_{cost}} * 60 \tag{7}$$

One model was estimated with all the 3019 trips in the dataset to give a general value of travel time for all individuals for both modes. Its significance is explained in the following section. Forty-seven models were estimated separately to give specific values of travel time for individuals based on their characteristics. The data used for each model is a subset of a larger dataset. For instance, purpose of the trip which, is a larger dataset has four subsets. Individuals assign different VoTT by a mode based on the purpose of trip (subset in this case). The results are explained in detail in the following sections.

5. RESULTS

Multinomial logit (MNL) model was used for the estimation of cost and time coefficients of individuals across various trip, travel, and household characteristics. The average log-likelihood ratio of all the estimations is -148.316. It is greater than critical value and makes the MNL model statistically better than a constants-only model. Results are presented in Table 3, which include the significance of estimates and values of travel time for both air and personal vehicle. The VoTT columns specify the amount of money travelers are willing to pay to save travel time. These values are calculated as a ratio of time and cost estimates and multiplied by 60 to change the units from \$/min to \$/hr:

$$VoTT\ \left(in\,\frac{\$}{hr}\right) = \frac{\beta_{time}}{\beta_{cost}} * 60 \tag{7}$$

Since, VoTT is a ratio, it cannot be calculated when one or both the coefficients are statistically insignificant. In such cases, these values are represented as NA (not applicable). VoTTs are expected to be positive since travel is deemed to have a negative utility which, means travelers do not like higher travel times and they are willing to pay money to reduce them. This is different in long-distance travel as negative VoTTs are reported in our results. The negative values of time imply the individuals are fine with travelling regardless of the time spent in it and they are least willing to pay to reduce travel times. However, a detailed examination of negative VoTTs revealed this is not true all the time.

Since VoTT is a ratio of time and cost coefficients from the equation of utility, the negative sign might result from either a positive cost coefficient or a positive time coefficient. If the negative sign is due to the positive cost coefficient, it indicates a traveler is willing to prefer a mode even though it is expensive because it would be faster (time coefficient is negative in this case). On the other hand, if the negative sign is due to the positive time coefficient, it indicates a traveler is willing to prefer a mode even though it is slower because it would be cheaper (cost coefficient is negative in this case). This proves a traveler is likely to pay money in order to save travel time in spite of a negative VoTT. Therefore, it is crucial to scrutinize the cause for a negative VoTT before making conclusions.

Based on the cost and time coefficients, travelers' relationships with long distance travel mode costs and travel times are categorized into six groups. Each group exhibits distinct travel behavior than others in terms of their attitude towards travel time and cost. The 'Behavior' columns in Table 3 demonstrate individuals' inclination to save travel time, money or both for either mode based on the significance and signs on cost and time coefficients.

- *Time Conscious Behavior*

  In many situations, travelers wish to travel faster to reach their destinations and spend time on activities of their interest. In other situations, they are required to reach their destinations sooner owing to time constraints. Either way, travelers remain conscious of their travel time and try to minimize it. This behavior is recognized from a negative time coefficient and an insignificant cost coefficient. Travelers exhibiting this behavior are only worried about travel time and remain indifferent to travel costs. This can be observed in both the personal vehicle and air travel modes indicating the importance of time while travelling regardless of the mode chosen.

- *Budget Conscious Behavior*

  Travelers who are financially constrained or whose preference is to save money are conscious of their budget and exhibit this kind of behavior. A negative cost coefficient and an insignificant time coefficient are indicative of the budget conscious behavior. It means travelers are indifferent to travel time but prefer cheaper trips. Such a conduct may also arise from their wanting to travel for longer durations in certain circumstances. Whatever the reason might be, budget consciousness is equally seen in personal vehicle and air travel.

- *Efficiency Maximizing Behavior*

  In many situations, travelers do not like travelling for longer durations nor do they like travelling at higher costs. They prefer to strike a balance between saving time and money instead of compromising over one. To summarize, such travelers try to maximize the efficiency of their long-distance trips at lower travel costs and times. This attitude is seen only in air travel and it is more prevalent than any others. It is identified by a negative cost coefficient and negative time coefficient. It is the anticipated form of behavior expected in travelers.

- *Exorbitant behavior*

  Individuals with exorbitant behavior prefer shorter but expensive long-distance trips. Sometimes, travelers might choose an expensive travel mode for personal comfort, display of status and other such factors, which are subjective and vary from one person to another. As a result, the travel costs increase. Individuals exhibit this behavior only in personal vehicles as such people like to travel shorter distances for which, personal vehicle is the most common and feasible choice. These travelers can be identified from trips with a positive cost coefficient and a negative time coefficient.

- *Vagary Behavior*

  In certain circumstances, individuals like to spend more time travelling but, they remain unwilling to spend money on it. In such cases, they prefer longer but cheaper trips. Per the results, this behavior is seen only in individuals from a household of 3 adults while considering personal vehicles. This suggests that individuals who are driven by a desire to spend time with family but bound by financial responsibilities exhibit vagary behavior. They are identified by VoTT with a negative cost coefficient and a positive time coefficient.

- *Individualistic Behavior*

  In some situations, individuals remain unaffected by travel costs and time while making travel decisions. They are influenced by other factors. Interestingly, this behavior is only reflected in personal vehicle modes. This behavior is identified when the coefficients for travel time and costs in the model are insignificant. Since both variables are insignificant, they do not have any influence over an individual's travel. A traveler within this category is more indifferent to saving travel time and money. This highlights the complexity of perceiving long-distance travel and the fact that individuals truly perceive this travel uniquely.

Table 3: Values of Travel Time for Different Trip, Annual Travel and Household Characteristics

Characteristics	Sample size	$Cost_{Air}$	$Cost_{PV}$	$Time_{Air}$	$Time_{PV}$	$VoTT_{Air}$	$Behavior_{Air}$	% of Trips by Air	$VoTT_{PV}$	$Behavior_{POV}$	% of Trips by Personal Vehicle
Generalized	3019	-0.0013^{-}	-0.018^{-}	-3.9783***	-0.0002^{-}	NA	Time Conscious	41.1	NA	Individualistic	58.9
							Trip Characteristics				
Distance Travelled											
0-50mi	15	-0.0600^{-}	-0.8505^{-}	0.0029^{-}	0.0449^{-}	NA	Individualistic	0	NA	Individualistic	100
51-100mi	52	-0.0410^{-}	-0.0411^{-}	-0.0094^{-}	0.0285^{-}	NA	Individualistic	0	NA	Individualistic	100
101-200mi	377	-0.0378^{-}	0.1042^{-}	-0.0029^{-}	0.0349^{-}	NA	Individualistic	0.3	NA	Individualistic	99.7
201-300mi	691	-5.2179^{-}	5.7789^{-}	3.2492^{-}	-2.5772^{-}	NA	Individualistic	3	NA	Individualistic	97
301-500mi	531	-0.0011^{-}	0.0411**	-0.0080***	-0.0083**	NA	Time Conscious	20	-12.14	Exorbitant	80
>500mi	1353	0.0007^{-}	-0.0062^{-}	-0.0049***	-0.0013^{-}	NA	Time Conscious	82.3	NA	Individualistic	17.7
Planned											
Yes	2348	-0.0024***	-0.0154**	-0.0071***	-0.0008^{-}	175.84	Efficiency Maximizing	45.4	NA	Budget Conscious	54.6
No	671	-0.0031*	0.0049^{-}	-0.0100***	-0.0057*	194.91	Efficiency Maximizing	26.1	NA	Time Conscious	73.9
Purpose											
Work/business	951	-0.0020^{-}	0.0398**	-0.0078***	-0.0124***	NA	Time Conscious	67.5	-18.66	Exorbitant	32.5
Leisure/relaxation/visit family or friends	1854	-0.0045***	-0.0110^{-}	-0.0069***	-0.0015^{-}	92.12	Efficiency Maximizing	28.5	NA	Individualistic	71.5
Medical business	50	-0.0026^{-}	-0.0125^{-}	-0.0025^{-}	-0.0022^{-}	NA	Individualistic	36	NA	Individualistic	64
Other personal business	164	-0.0035^{-}	-0.0104^{-}	-0.0052^{-}	-0.0012^{-}	NA	Individualistic	32.9	NA	Individualistic	67.1

Significance

'*'- 90% confidence level; '**'-95% confidence level; '***'-99% confidence level; '-'Insignificant

NA – Not Applicable due to insignificant coefficients

Table 3 Continued…….

Characteristics	Sample size	$Cost_{Air}$	$Cost_{PV}$	$Time_{Air}$	$Time_{PV}$	$VoTT_{Air}$	$Behavior_{Air}$	% of Trips by Air	$VoTT_{PV}$	$Behavior_{PV}$	% of Trips by Personal Vehicle
Travel Party											
Adult Family	1577	-0.0041^{***}	-0.0142^{*}	-0.0061^{***}	-0.0005^{-}	89.02	Efficiency Maximizing	28.4	NA	Budget Conscious	71.6
Adult Friends	370	-0.0059^{***}	-0.0152^{-}	-0.0060^{**}	-0.0011^{-}	60.78	Efficiency Maximizing	28.6	NA	Individualistic	71.4
Coworkers	358	-0.0049^{**}	0.0164^{-}	-0.0046^{-}	-0.0085^{*}	NA	Budget Conscious	65.9	NA	Time Conscious	34.1
Children	490	-0.0013^{-}	-0.0180^{-}	-0.0138^{***}	-0.0002^{-}	NA	Time Conscious	18.8	NA	Individualistic	81.2
Season of Travel											
January-March	631	-0.0021^{-}	0.0051^{-}	-0.0083^{***}	-0.0049^{-}	NA	Time Conscious	46.4	NA	Individualistic	53.6
April-June	913	-0.0020^{-}	-0.0120^{-}	-0.0071^{***}	-0.0011^{-}	NA	Time Conscious	40.9	NA	Individualistic	59.1
July-September	757	-0.0030^{**}	-0.0308^{**}	-0.0064^{***}	0.0020^{-}	126.21	Efficiency Maximizing	36.6	NA	Budget Conscious	63.4
October-December	716	-0.0021^{-}	-0.0434^{**}	-0.0109^{***}	0.0027^{-}	NA	Time Conscious	41.8	NA	Budget Conscious	58.2
Annual Travel Characteristics											
Overnight Work Tour Frequency											
Multiple times/month	257	-0.0050^{-}	0.1183^{***}	-0.0112^{**}	-0.0287^{***}	NA	Time Conscious	64.6	-14.56	Exorbitant	35.4
Multiple times/year	1058	-0.0034^{***}	-0.0101^{-}	-0.0063^{***}	-0.0025^{-}	112.11	Efficiency Maximizing	53.4	NA	Individualistic	46.6
1-2 times/year	692	-0.0030^{**}	-0.0198^{-}	-0.0085^{***}	-0.0006^{-}	169.83	Efficiency Maximizing	38.6	NA	Individualistic	61.4
Less than once/year	352	0.0006^{-}	-0.0309^{-}	-0.0099^{***}	0.0029^{-}	NA	Time Conscious	23.6	NA	Individualistic	76.4

Significance

'*'- 90% confidence level; '**'-95% confidence level; '***'-99% confidence level; '-'Insignificant

NA – Not Applicable due to insignificant coefficients

Table [illegible] Continued

Characteristics	Sample size	$Cost_{Air}$	$Cost_{PV}$	$Time_{Air}$	$Time_{PV}$	$VoTT_{Air}$	$Behavior_{Air}$	% of Trips by Air	$VoTT_{PV}$	$Behavior_{PV}$	% of Trips by Personal Vehicle
Overnight Leisure Tour Frequency											
Multiple times/month	269	-0.0071**	-0.0151^{-}	-0.0079*	-0.0028^{-}	67.11	Efficiency Maximizing	36.8	NA	Individualistic	63.2
Multiple times/year	2313	-0.0021***	-0.0122^{-}	-0.0078***	-0.0014^{-}	224.31	Efficiency Maximizing	41.4	NA	Individualistic	58.6
1-2 times/year	395	-0.0023^{-}	-0.0063^{-}	-0.0063***	-0.0022^{-}	NA	Time Conscious	43.8	NA	Individualistic	56.2
Less than	33	-0.0855^{-}	-0.7479^{-}	0.0001^{-}	0.0557^{-}	NA	Individualistic	21.1	NA	Individualistic	78.8
						Household Characteristics					
Children in Household											
0	2128	-0.0020***	-0.0059^{-}	-0.0075***	-0.0024*	220.55	Efficiency Maximizing	41.4	NA	Time Conscious	58.6
1	378	-0.0034^{-}	-0.0733***	-0.0117***	0.0068^{-}	NA	Time Conscious	43.9	NA	Budget Consciousness	56.1
2	416	-0.0037**	-0.0250^{-}	-0.0072**	0.0001^{-}	117.05	Efficiency Maximizing	40.4	NA	Individualistic	59.6
3	85	-0.0301**	-0.0815^{-}	0.0022^{-}	0.0053^{-}	NA	Budget Conscious	24.7	NA	Individualistic	75.3
4	12	0.0056^{-}	0.4092^{-}	-0.0295^{-}	-0.0821^{-}	NA	Individualistic	41.7	NA	Individualistic	58.3
Household Size											
1	649	-0.0040**	0.0238^{-}	-0.0087***	-0.0089***	131.51	Efficiency Maximizing	46.8	NA	Time Conscious	53.2
2	1255	-0.0014^{-}	-0.0139^{-}	-0.0073***	-0.0005^{-}	NA	Time Conscious	39.2	NA	Individualistic	60.8
3	441	-0.0040*	-0.0883***	-0.0101***	0.0092**	153.06	Efficiency Maximizing	41	-6.24	Vagary	59
4	555	-0.0046***	-0.0133^{-}	-0.0060**	-0.0022^{-}	78.33	Efficiency Maximizing	42.2	NA	Individualistic	57.8
5	98	-0.0081^{-}	0.0266^{-}	-0.0072^{-}	-0.0091^{-}	NA	Individualistic	29.6	NA	Individualistic	70.4
6	21	-0.0274^{-}	-1.4581^{-}	-0.0184^{-}	0.2337^{-}	NA	Individualistic	9.5	NA	Individualistic	90.5

Significance

‘*’- 90% confidence level; ‘**’-95% confidence level; ‘***’-99% confidence level; ‘-‘Insignificant

NA – Not Applicable due to insignificant coefficients

Table 3 Continued…….

Characteristics	Sample size	$Cost_{Air}$	$Cost_{PV}$	$Time_{Air}$	$Time_{PV}$	$VoTT_{Air}$	$Behavior_{Air}$	% of Trips by Air	$VoTT_{PV}$	$Behavior_{POV}$	% of Trips by Personal Vehicle
HH Income											
Under $25,000	146	-0.0097^{**}	0.1017^{**}	-0.0172^{**}	-0.0246^{***}	106.29	Efficiency Maximizing	30.8	-14.49	Exorbitant	69.2
$25,000 - $49,999	323	-0.0008^{-}	-0.0431^{**}	-0.0096^{***}	0.0044^{-}	NA	Time Conscious	31	NA	Budget Conscious	69
$50,000 - $74,999	511	-0.0026^{-}	-0.0258^{-}	-0.0072^{***}	0.0011^{-}	NA	Time Conscious	38	NA	Individualistic	62
$75,000 - $99,999	504	-0.0043^{**}	0.0161^{-}	-0.0042^{*}	-0.0059^{*}	58.92	Efficiency Maximizing	37.3	NA	Time Conscious	62.7
$100,000 - $149,999	873	-0.0025^{**}	-0.0027^{-}	-0.0085^{***}	-0.0040^{-}	201.5	Efficiency Maximizing	42.8	NA	Individualistic	57.2
$150,000 - $199,999	246	-0.0023^{-}	-0.0164^{-}	-0.0082^{*}	-0.0018^{-}	NA	Time Conscious	55.3	NA	Individualistic	44.7
$200,000 - $249,999	119	-0.0184^{***}	0.0079^{-}	-0.0023^{-}	-0.0111^{-}	NA	Budget Conscious	47.9	NA	Individualistic	52.1
$250,000 or more	54	0.0031^{-}	0.0154^{-}	-0.0112^{-}	-0.0067^{-}	NA	Individualistic	62.5	NA	Individualistic	37.5

Significance
'*'- 90% confidence level; '**'-95% confidence level; '***'-99% confidence level; '-'Insignificant
NA – Not Applicable due to insignificant coefficients

Generalized Model

The first model considers all the long-distance tours in the dataset and sets a generalized baseline for all long-distance VoTTs. In general, long-distance travelers are willing to travel faster in order to reach their destination quickly by air. However, they are influenced by other factors like comfort and convenience when making travel decisions regardless of the travel time and costs while considering personal vehicle. The exact reasons behind this behavior are not yet identified and should be studied in future research.

5.1 Trip Characteristics

Distance Travelled

The tendency of individuals to travel faster increased with trip distance especially after 300 mi. The data shows a transition in the mode-choice of individuals as soon as their trip distances exceed 300mi. The percentage of trips made by air travel reached a maximum for trips longer than 500mi. This is because air is the fastest and most feasible option available for *longer* long-distance trips. Their preference for air at these distances explains the time conscious behavior of individuals at longer trip lengths. We can conclude individuals prefer to save travel time once the trip lengths exceed 500 mi even though VoTT is not applicable. For distances <300mi, travelers exhibit an individualistic behavior. This is because the distances are too small to travel by air considering the money, time and effort put into the pre-travel and post-travel arrangements. The percentage of trips made by air support the statement.

Travelers, in general, exhibit individualistic behavior while considering personal vehicle to travel any distances except 301-500mi. This suggests that people like to travel by personal vehicle at these distances regardless of the time and money involved. This is clear from the fact that more than 97% of the trips less than 300mi were made by personal vehicle. The liking can be attributed to its feasibility at shorter distances while problems like driving stress and fatigue are associated with driving longer distances (>500mi).

Planned Trips

Whether planned or spontaneous, individuals typically try to maximize efficiency by preferring shorter and cheaper trips while considering air travel. This is because air is a faster mode and people expect to reach their destinations faster. It has relatively higher fares making people dislike any further raise in costs. However, they apply a higher VoTT (approximately $20 more) for spontaneous tours compared to planned tours. As the name suggests, spontaneous tours are sudden, and individuals focus more on minimization of travel times due to the importance and necessity involved in such sudden tours.

While considering personal vehicle, travelers exhibit a time-conscious behavior meaning they are more concerned for time due to the additional importance attached to spontaneous tours. On the other hand, travelers trying to minimize costs plan their trips in advance exhibiting a budget-conscious behavior.

Purpose

While considering air travel, individuals are more conscious of their travel time in business trips compared to other trips. This can be attributed to the importance of travel time savings on business trips demanding productivity at destinations. LSOT shows that 67.5% of the long-distance trips were made by air owing to its speed. Moreover, many employees are usually reimbursed for business trips and hence, they try to minimize travel time regardless of costs. On the other hand, people spend money out of their pockets on leisure trips. They are also flexible with travel times since they do not have any fixed schedules unlike business trips. Therefore, they try to strike balance between both travel time and costs. Travelers exhibit individualistic behavior while travelling on purposes other than business and leisure. This might be attributed to the lower sample sizes.

The cost and time coefficients show that people display an exorbitant attitude in business trips while considering personal vehicle. Saving travel time is more important for them and they choose a comfortable mode over a cheaper mode if reimbursed. Individuals travelling for any purpose other than work are individualistic in travel behavior. Personal vehicle was used for 71.5% of the leisure travel suggesting accessibility at destinations and comfort are more important in these trips. Moreover, leisure trips comprise family, friends or children in many circumstances during which, individuals like to spend time with fellow travelers and choose personal vehicle to serve the purpose.

Travel Party Composition

While considering air travel, it is not surprising to see that the travel decisions of individuals are influenced by travel time alone regardless of the costs if children are involved. Their time consciousness in air travel may arise from the comfort and health related issues associated with children. They are willing to spend $89.02 and $60.78 to save an hour while travelling with family and friends respectively. In either case, individuals try to maximize efficiency by preferring cheaper and shorter trips as they are most likely to be on leisure trips.

While considering personal vehicle, travelers with children demonstrate individualistic tendencies in their decision-making. Here, neither cost nor time coefficients are significant, highlighting that travelers with children are not guided by these factors when selecting a mode.

Instead, factors such as convenience, flexibility, ease, and comfort may guide their decision. Individuals behave similarly while travelling with friends as they would be on leisure trips and might find inherent joy (in travel) in the company of friends. However, their budget consciousness in the presence of family is probably due to the associated financial responsibilities. As trips with coworkers are most likely for business/work, individuals tend to reach their destinations faster.

Season of Travel

People exhibit different behaviors depending on the months they travel. When individuals travel during the winter holidays and spring travel, they are influenced exclusively by the efficiency of air modes. Traditionally, these are not dedicated 'vacation' times of the year, so when people travel during this time they are either guided by how fast they can get there by air or by the comfort/flexibility of a personal vehicle. Interestingly, during the summer season (which is traditionally a vacation period), travelers evaluate air modes in terms of minimizing costs *and* time and personal vehicle modes in terms of cost. This is expected as larger groups may be traveling together and increased group costs becoming a driving force in the decision-making process. Finally, the fall period, which has some family holidays such as Thanksgiving, sees travelers choose between the speed of air and the cost of a personal vehicle. Again, this is indicative of having time constraints for travel within a work schedule and budgeting costs for a larger familial travel party.

5.2 Annual Travel Characteristics

Overnight Work Tour Frequency

Regardless of the number of times they travel overnight for work, travelers most likely need to minimize travel times or prefer to minimize travel times either due to high productivity or inexperience in case of air travel. They also try to minimize costs along with time while travelling multiple times or 1-2 times/year. Whatever the frequency of their overnight work tours might be, individuals typically tend to save travel time.

While considering personal vehicle to make multiple overnight work tours in a month, travelers behave exorbitantly preferring shorter trips owing to the time constraints and demand for productivity. For any other frequency of work trips, travelers exhibit individualistic behavior. According to the percentage of trips made by personal vehicle, this behavior might be attributed to their liking to travel. However, the reasons are not yet clear and should be examined carefully.

Overnight Leisure Tour Frequency

While considering air travel, individuals' willingness to pay for travel time savings on leisure trips is high (224.31$/hr) when they travel multiple times/year. Their frequent travel proves their strong interest to travel for enjoying their leisure time at destinations. VoTT reduces considerably if the travel frequency increases to multiple times/month owing to the travel expenses incurred. In either case, they prefer cheaper and shorter trips. When the travel frequency drops to only 1-2 times/year, individuals exhibit a time conscious behavior. The sample size of individuals travelling less than once/year might have contributed to their individualistic behavior while considering air travel.

Majority of long-distance leisure trips in LSOT were made by personal vehicle which, is evident from the percentage of trips made. All the individuals exhibit individualistic behavior while considering personal vehicle regardless of how often they travel for leisure. It implies that individuals probably like to travel for longer durations for leisure and they are influenced by factors other than time and costs while making travel decisions.

5.3 Annual Household Characteristics

Number of Children in Household

While considering air travel, individuals from childless households are the most willing group to pay money for travel time reductions as they have fewer responsibilities compared to others. Their willingness declined as the number of children in the households increased. The familial and financial responsibilities associated with children contribute to this behavior. The individualistic behavior of individuals from 4-child households result from smaller sample sizes.

While considering personal vehicle, individuals belonging to childless households are the only people conscious of their time and prefer to travel faster regardless of travel costs. Individuals from single-child households are budget conscious and most willing to save money instead of time. All the others are individualistic in making travel decisions regarding personal vehicle. The factors leading to this behavior shall be explored.

Household Size

While considering air travel, individuals from 2-member households are time conscious and seek to minimize travel times. Individuals from 3-member and 4-member households assign certain value to their travel time which, declined with increasing household size. This can be attributed to a rise in responsibilities with additional household members. Individuals from single households however, have a lower VoTT as they tend to save both time and money.

While considering personal vehicle, individuals only from single households are time conscious and prefer to travel faster. Individuals from 3-member households exhibit a vagary behavior and like to travel for longer durations. Therefore, they are more willing to save money than time. All the others exhibit individualistic behavior meaning they are not worried about money or time but other factors while making travel decisions.

Annual Household Income

Travelers within the lowest income group (under $25k) demonstrated the most concern for costs and travel time, seeking flights that minimized times and costs but showing a bias towards personal vehicles, even when costs for this mode are increased if the travel time is kept low. Interestingly, all households with income between $25k and $200k all consider efficiency of air in their mode choices. Most important, the income group with the most respondents ($100k to $150k) would choose air modes only if they were both cheaper and faster, but did not impose the same constraints on personal vehicles. This implies that personal vehicles are a go-to mode choice for long-distance travel, unless the traveler can find a fast and efficient flight to their destination. Household with income between 200k to $250k perceive the cost of air as exclusively important, and those with income above $250k, admittedly a small sample size, sought convenience and comfort as more important than costs and travel times for either mode. This highlights that the higher an individual’s income, the less constrained they are in their mode choices and select between air and personal vehicles more on the trip purpose or needs of the travel than costs or time.

6. SUMMARY AND CONCLUSIONS

This study presents a comprehensive examination of values of travel time (VoTT), a quantification of individuals' willingness to pay to save travel time, in long-distance travel. A long-distance trip was defined as an overnight trip according to the data source, Longitudinal Survey of Overnight Travel that collected data on long-distance travel of US residents from 2013-2014. VoTTs were examined for a variety of individuals across modes, tour and household characteristics which, helped in a better understanding of how travelers perceive long-distance travel. Additionally, trade-offs between travel costs and times were analyzed for different trip lengths to examine the changes in travel behavior of individuals with trip distance. VoTT was calculated as a trade-off ratio between travel time and travel cost coefficients. Multinomial Logistic Regression was used to estimate the coefficients from a utility equation.

Analysis of the trade-offs between travel costs and times yielded two significant results: First, minimizing costs were most important to long-distance overnight travelers, especially when the trip is less than 500 miles one-way. This results in personal vehicles being preferred even when air travel would have been a faster mode. Second, minimizing times were important to long-distance overnight travelers when the trip distances exceed 500 miles one-way. As a result, they prefer to travel by air even though personal vehicle would have been a cheaper mode. In other words, travelers prefer personal vehicle to save money while they prefer air travel to save time.

This study found that negative values of travel time are more common in long-distance travel making it unique from short-distance/daily travel. Since, VoTT is a ratio of time and cost coefficients, the negative values result when one of the coefficients is positive and the other is negative. A combination of positive cost and negative time coefficients indicate travelers are willing to spend money in order to save time despite the negative VoTT. On the other hand, a combination of negative cost and positive time coefficients indicate a traveler is least willing/unwilling to spend money for travel time savings. Therefore, a negative VoTT does not always imply unwillingness to reduce travel time. A careful examination of coefficients is required before making conclusions on negative values of travel time.

Based on these coefficients and their signs, travelers were found to exhibit six different behaviors: *Time conscious behavior*, seeking to solely minimize travel times; *Budget conscious behavior*, seeking to solely minimize travel costs; *Efficiency maximizing behavior*, seeking to minimize both travel time and costs; *Exorbitant behavior*, preferring expensive trips but seeking to minimize time; *Vagary behavior*, preferring longer trips but seeking to minimize costs and *Individualistic behavior*, whose decisions are influenced by factors other than travel time and costs.

A number of characteristics like travel distances, planning, trip purpose, travel party composition, season of travel, frequency of trip-making, household size and composition and annual household income were found to influence the VoTTs of individuals while considering personal vehicle and air travel. Most of the individuals exhibited either efficiency maximizing behavior or time conscious behavior while considering air travel. On the other hand, individualistic behavior was found to be more pronounced while considering personal vehicle. Almost all the individuals assigned a higher VoTT for air travel than personal vehicle since air is the fastest mode of travel. Regardless of the mode, individuals are willing to pay in order to save travel time while travelling for work/business. They are also willing to pay if they are from childless households or 1-member households.

The willingness to pay of travelers with certain characteristics varies by mode. For example, people travelling with children have a higher tendency to save travel time by air but are less concerned with personal vehicle travel times. Similarly, people tend to save both money and time while considering air travel, but they tend to reduce travel times on spontaneous tours and costs associated with planned tours related to personal vehicles. The influence of travel costs and time is different for different frequencies of overnight leisure travel while considering air travel. However, factors other than cost and time are found to influence travelers while making overnight leisure tours.

Limitations of the study

Many efforts within the data collection and analyses were taken to ensure that results are transferrable across at least some geographic and demographic ranges. Specifically, conclusions drawn from this study can most likely be transferred or applied to certain states or regions which share demographic and geographic characteristics with either Alabama or Vermont. However, in geographically larger states, it is possible to make overnight trips of 50 miles or longer while staying within the state. According to the assumptions made in this study, such trips cannot be considered as long-distance trips. Moreover, this study considered only the influence of travel costs and travel times in its model (eg., mode choice) due to the limited data. Even though these are the main factors affecting travelers' decisions, there is a need to incorporate other relevant factors to accurately understand the decision-making process of long-distance travelers.

6.1 Potential Applications

The results from this study are intended to assist transportation planners and analysts in making decisions related to economic investments, evaluate transportation projects and make transportation policies. The VoTTs give a general idea of the importance long-distance travelers assign to their time in various circumstances. In the coming decades, several large metropolitan areas in the U.S. are anticipated to transform into mega regions, housing millions of people and encompassing thousands of square miles with many daily long-distance trips. Many experts believe it is becoming increasingly important to plan for sustainable transportation infrastructure within these regions to accommodate the increased travel demand that is likely to originate from them. Urbanization at such massive scale is likely to push more people out of city centers towards the suburbia. As a result, long-distance travel will increase since people living far away from central business districts will have to travel several miles between their homes and work places. In that scenario, having a robust estimate of the value people place on travel times will help transportation planners in envisioning various projects that can reduce travel times for long distance commuters. For example, if a transportation agency is considering the development of a short-haul air service, they would likely need to quantify the cost savings for an average long-distance commuter by using these flights instead of their personal vehicle. In other words, the agency would benefit from knowing the VoTT for such travelers. The total amount money that is likely to be collectively saved by the entire population of that region can be compared to the cost of the project before deciding to build it. Simply put, VoTT will act as an excellent tool to conduct cost-benefit analysis on megaregion transportation projects of the future.

On the other hand, emergence of megaregions and the associated population expansion might lead to unprecedented levels of congestion. One way to alleviate congestion is creation of toll lanes. In order to decide toll prices, transportation planners need to understand how much value does a traveler place on his time lost in travel. Estimating the VoTT for people that are likely to use toll lanes will help planners in this decision-making process.

Finally, a major contribution of this study is the identification and interpretation of different categories of how individuals' respond to long distance travel times and costs for different trip types (including in relation to other unobserved variables)These categories provide insight into how travelers with different tour and household characteristics behave while making long-distance trips. For instance, this information is very useful while considering the impacts of automated vehicle technology on long-distance travel since it is likely to influence the mode-choice and travel patterns of individuals in many ways due to a change in travel times and costs.

6.2 Future Research

This thesis can be expanded to consider the following additional study areas:

- Incorporate more variation in geographies

  As stated earlier, the scope of this study is limited to Alabama and Vermont regions. However, the geographic characteristics of the United States are much diverse than these two states. In that context, future studies will find it useful to expand their study areas to encompass more regions within USA. A good starting point will be to pick at least one state to study from each of the four regions (Northeast, Midwest, South and West—as defined by the US census bureau). Whether to study these states independently or collectively is left to the researcher's discretion.

- Incorporate more variation in demographics

  There exists a huge cultural and demographic diversity in this country. The demographic category of a traveler directly influences certain aspects of their travel behavior such as mode choice. Therefore, future efforts directed at exploring VoTT of long distance travel will benefit from incorporating this demographic variation into their studies. While collecting data for future studies in this discipline, care should be taken to acquire information regarding long distance travelers who come from different walks of life and belonging to various social backgrounds. This can be achieved by ensuring that the surveys distributed for data collection purposes are accessible to people from as many demographic categories as possible. It is also important to provide different kind of incentives to survey respondents belonging to different categories to enhance the response rate. A more nuanced approach would be to tie the demographic and geographic characteristics of the study area and to explore how these two facets interact with each other to influence long distance travel behavior in the study area. The actual study methodology to achieve this objective will have to be developed by the future researchers.

- Incorporate more variation in mode choices, such as buses or rail

  Future studies to be conducted in the field of long distance travel must consider the fact that the modes of travel available to travelers depend on the region where they reside. It is necessary account for this fact while studying long distance travel. To be more specific, not all Origin-Destination (O-D) pairs have the same kind of mode choices available. Therefore, it is not advisable to treat O-D pairs with different possible mode choices in an equal manner. Wherever more mode choices such as buses or railroads are available, it is advised that data regarding their travel costs and times also be gathered and included in the analyses.

- Quantify how other unobserved factors affect mode choices and interact with cost and travel time perceptions

  The concept of long distance travel is ingrained into the American culture in the form of road-trips and long-drives. Obviously, these types of trips are different from conventional long-distance trips where travelling is only a derived demand. Travelers who make long distance trips for the sake of enjoyment ought to be studied separately from the rest of the long-distance travelers. Future studies will find it interesting to make a comparison between the values of travel time for these two types of travelers. But, to make such a comparison, it is necessary to quantify intangible factors such as enjoyment of travel. Researchers will have to device a methodology that can achieve this objective. (A possible way to quantify such factors will be to craft surveys that ask respondents to rate their satisfaction or happiness related to their road-trips) The results of such studies may be beneficial for transportation agencies that wish to expand tourism related infrastructure in their jurisdictions.

- Evaluate the relationship between destination and mode choices

  It is commonly perceived that different individuals starting their trips from the same city choose their modes from a set of alternatives commonly available to all of them. However, in reality, their mode-choice also depends on the destination they like to reach. In several circumstances, travelers will have to choose from a limited set of mode-alternatives in spite of the availability of multiple modes. For instance, individuals travelling to a certain destination will be restricted to choose a personal vehicle if their destination doesn't have public transit facilities. However, other individuals travelling from the same city could choose from a variety of modes if their trips end in other destinations. Therefore, there is a need to understand if travelers consider multiple modes or if there is a reduced choice set for a selected destination and incorporate the effects in a mode-choice model. One of the ways to achieve this could be to include questions regarding the role of destination while making a mode-choice. This facilitates the study of relationship between destination and mode-choice in future. The results from such studies could be used by transportation planners and analysts in policy-making initiatives.

- Understand the implications of these cost and travel time categories on automated vehicle adoption for long distance travel

  Automated vehicles are soon going to become commonplace. While the main promise of this revolutionizing concept is enhancement of highway safety there is one other important benefit. That is, travelers will no longer have to dedicate a portion of their day exclusively for travel. Automated vehicles will allow travelers to use their travel time for other purposes such as working on their jobs, running errands via the internet and other similar tasks. As a result of this newfound flexibility in travelling, people are likely to place less value on their travel time since they are now free to work on other tasks while travelling. This applies to long distance trips as well. Future studies should explore the effects of automated vehicles on values of travel time concerning long distance travel. Such a study will have to consider the level of comfort and flexibility offered by automated vehicles to the passengers so that they can utilize their travel time for other purposes without any discomfort. Information on this aspect of automated vehicles can be obtained by interacting with car manufacturers and experts in the area. A study such as this can be extremely useful for transportation agencies in making decisions related to investments on infrastructure that facilitates free operation of automated vehicles.

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