RESULTS OF A SURVEY ON TRANSPORTATION SAFETY EQUITY IN HAWAII

FINAL REPORT

by
Flávia Nunes Duque de Medeiros, MSCE
Rafaela De Melo Barros, MSCE
Panos D. Prevedouros, PhD

Department of Civil and Environmental Engineering
University of Hawaii at Manoa

for

Center for Safety Equity in Transportation (CSET)
USDOT Tier 1 University Transportation Center

University of Alaska Fairbanks
ELIF Suite 240, 1764 Tanana Drive
Fairbanks, Alaska 99775-5910

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16. Abstract Five transportation equity questions were developed for this assessment. Question 1 addressed EMS response in urban and rural areas. People with a bachelor's degree or higher thought slightly more that rural response is worse. Rural residents believed it is worse and half of urban residents agreed. CSET minority respondents thought that rural response is slightly worse. These groups have a perception that reflects reality, according to FARS data, but the overall response to the question "Compared to urban areas, in rural areas emergency response is?" is "about the same." Every demographic group did not support the proposal of question 2 for the government to increase gasoline taxes to collect money to invest in EMS response improvements in rural areas of Hawaii. The overall result for question 3 is that respondents were divided when it comes to converting rural roads into high standard roads in Hawaii. No demographic group had a majority response, pro, against or neutral. The response to question 4 was much clearer: all demographic groups disagreed with the proposition that the government should raise gasoline taxes to collect funds for the purpose of making rural roads safer by converting them to high standard roads. Question 5 addressed the urban-rural road funding balance: "Should more money, less money or about the same amount of money be provided to support urban road and highway improvements?" The response was mostly divided between same amount and more money, suggesting that an equal share should be allocated between urban and rural roads. Overall, the results suggest a lack of awareness of conditions on rural roads.			
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APPROXIMATE CONVERSIONS TO SI UNITS				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
		LENGTH		
in	inches	25.4	milimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square milimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milimeters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
		LENGTH		
mm	milimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square milimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yard	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milimeters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
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EXECUTIVE SUMMARY

The Center for Safety Equity in Transportation (CSET) is a University Transportation Center (composed of the Universities of Hawaii, Alaska, Idaho, and Washington) and focuses its research on transportation safety equity for rural, isolated, tribal, and indigenous communities. Many members of the rural, isolated, tribal, and indigenous community in Hawaii live in rural areas, including native Hawaiians, part Hawaiians and Pacific Islanders. The state does not have Indian reservations, but there are a few rural locations where there is a higher percentage of CSET minorities (e.g., Waianae, Waimanalo and 98% of Hawaii County). A significant number of fatal crashes involve minorities in Hawaii, which has the highest proportion of fatal crashes involving minorities among the four CSET states. The CSET survey has many more male respondents, older respondents and educated respondents with a BS degree or higher. The population adjustment based on shares reflecting Hawaii's demography did not change any of the original findings. Five transportation equity questions were developed for this assessment. Question 1 addressed EMS response in urban and rural areas. People with a bachelor's degree or higher thought that rural response is worse. Rural residents believed it is worse and half of urban residents agreed. CSET minority respondents thought that rural response is slightly worse. These groups have a perception that reflects reality, according to FARS data, but the overall response to the question "Compared to urban areas, in rural areas emergency response is?" is "about the same." Every demographic group did not support the proposal of question 2 for the government to increase gasoline taxes to collect money to invest in EMS response improvements in rural areas of Hawaii. The overall result for question 3 is that respondents were divided when it comes to converting rural roads into high standard roads in Hawaii. No demographic group had a majority response, pro, against or neutral. The response to question 4 was much clearer: all demographic groups disagreed with the proposition that the government should raise gasoline taxes to collect funds for the purpose of making rural roads safer by converting them to high standard roads. Question 5 addressed the urban-rural road funding balance: "Should more money, less money or about the same amount of money be provided to support urban road and highway improvements?" The response was mostly divided between same amount and more money, suggesting that an equal share should be allocated between urban and rural roads. Overall, the results suggest a lack of awareness of conditions on rural roads where EMS response tends to be much longer and funding is much lower compared to urban roads. This allows for the continued imbalance in funding for safety and quality of service improvements, and the continuation of high rates of fatal crashes on rural roads.

CHAPTER 1. INTRODUCTION

The University of Hawaii, in collaboration with the universities of Alaska, Idaho and Washington, received funding for a Tier-1 University Transportation Center from the U.S. Department of Transportation, named Center for Safety Equity in Transportation (CSET). Its research focuses on transportation safety equity for rural, isolated, tribal, and indigenous (RITI) communities. CSET's goal is to investigate whether a safe and equitable transportation system is available to RITI communities. We have collected various aggregate of data (i.e., Census type data) in developing an understanding of RITI communities, which in Hawaii include (i) Native Hawaiians, Part Hawaiians and Pacific Islanders[1], and (ii) selected rural communities such as Waianae and Waimanalo on Oahu, and most of the Big Island (Hawaii county). Several aggregate outcomes are available in Prevedouros et al. [1].

The top three reasons for fatal crashes are speeding, non-usage of restraint and impaired driving. In Hawaii, 48% of the fatalities associated with speeding were CSET minorities. There is a significant number of fatal crashes involving minorities in Hawaii. Native Hawaiians and part Hawaiians are considered a minority in the state and many of them live in rural areas. In general, there is not much research or data on rural regions.

Urban and rural areas are different by definition and their differences generate potential transportation equity differences. Urban regions have a higher number of people, vehicles, and roads, and consequently more chances for a crash or traffic accident to occur. Typically, more resources are allocated to urban traffic safety, as it benefits a large number of people and addresses a frequent problem. On the other hand, rural regions receive fewer resources, largely because the number of beneficiaries is much smaller. However, rural areas have a higher proportion of fatal crashes by population size. This is a serious public health and equity issue that is worthy of investigation.

Prevedouros et al. [1] analyzed the crash data provided from the Fatality Analysis Reporting System (FARS) among the four CSET states: Alaska, Hawaii, Idaho, and Washington, from 2007 to 2016. FARS is a national statistical database about fatal injuries due to motor vehicle crashes [2]. Since Hawaii does not have an Indian reservation, the authors considered the areas in Hawaii with highest percentage of native Hawaiians and part Hawaiians as RITI areas. These 10 years of data show that Hawaii had 347 fatalities involving minorities, representing 31% of the state total. Considering all CSET states, Hawaii had the highest proportion of minority fatalities. The percentage of Hawaii's CSET minorities younger than 35 years old involved in fatal crashes was almost 60%.

This report is the final analysis based on all available data. A preliminary study was conducted with eight of the current ten survey deployments (of a largely identical survey questionnaire) [3]. The previous study was based on 813 surveys, and this study is based on 1,376 surveys.

[1] These form a group referred to as CSET minorities.

CHAPTER 2. OBJECTIVES AND METHODOLOGY

The objective of this research is to understand the perceptions of minority groups and others on urban and rural transportation equity, while correlating with demographic characteristics such as gender, age, and education level. The overall methodology is depicted in Figure 1.0. The methodology diagram presents a summary of the research process. It started with literature review on topics such as rural transportation, equity, minorities in Hawaii, and EMS response time. From the literature review findings, a transportation survey was created. After the survey was launched, the data were processed and a statistical analysis was done, leading to lessons and conclusions.

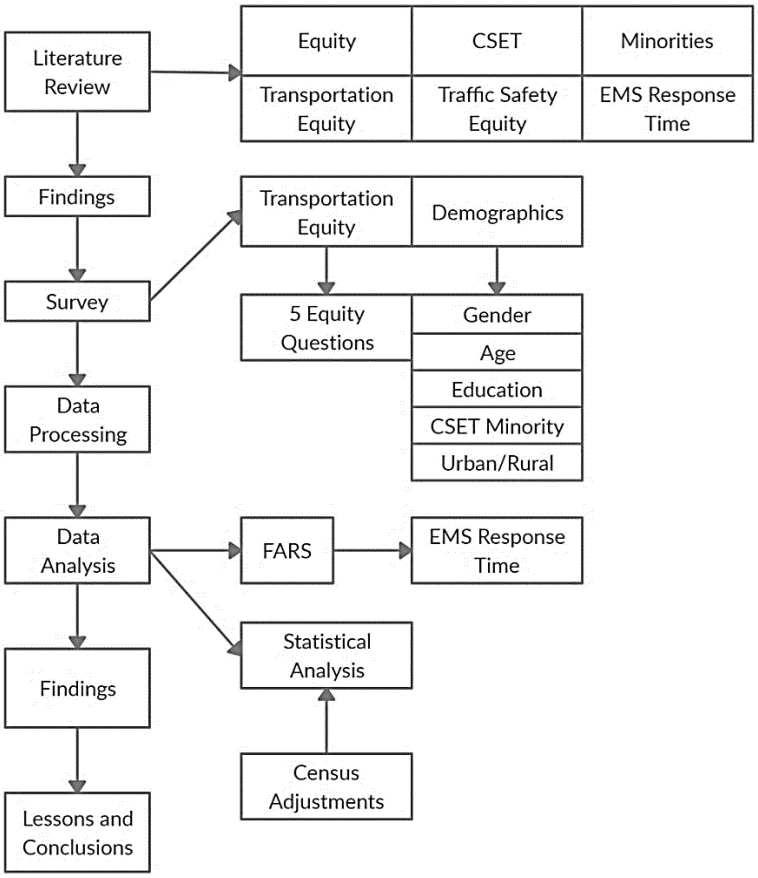

Figure 1.0 – Methodology Diagram

The survey was created to aid with understanding the highway transportation and traffic safety perceptions of various respondents in Hawaii, including those from RITI communities and CSET minorities. A survey is a suitable approach for asking several and complex questions in order to learn about people's opinions and behaviors. Most responses include numerical scales that make it possible to quantify the importance of opinions, comments, and feedback, and to make comparisons. Respondents are more inclined to contribute with honest feedback in a confidential survey.

The survey was divided in three parts: basic transportation characteristics, rural transportation, and demographics. The complete survey is shown in Appendix A. The first part asked the respondents to answer questions such as how long they commute per day, their behavior while driving, their opinion about traffic conditions in Hawaii, and about traffic regulations such as alcohol limit, helmet use, etc. The second part focused on rural roads and asked respondents to rank travel conditions, vehicle use, behaviors, and connectivity. This part also had an empty box for additional comments about risky behaviors or risky conditions on rural roads. The third and last part requested information of the respondent's sociodemographic characteristics.

Five transportation equity questions were developed; they are detailed in Chapter 4. Our analysis compared responses to equity questions with respondent's sociodemographic characteristics. Five demographic characteristics were chosen: gender, age, education, location of residence, and race, some of which were grouped into fewer categories to aid in interpretations of results, as shown in Table 2.0. Races were grouped into "CSET Minority" and "All Others". The CSET group includes the RITI communities of Native Hawaiians and part Hawaiians, Guamanian or Chamorro, Samoan, Other Pacific Islander, and American Indian or Alaska native. All respondents not declaring any of these races were referred to as "All Others".

Table 2.0 - Demographics Chosen for Analysis

Demographics	Original Survey		Grouped for Analysis
Gender	Male		Male
	Female		Female
Age	Under 15	46-55	Under 25
	15-25	56-65	26 to 55
	26-35	66-75	56 or older
	36-45	76 or older	
Education	Less than high school degree	Associate degree	High School or less than high school (HS or less)
	High school degree or equivalent	Bachelor's degree	Associate degree or some college but no degree (AD or some)
	Some college but no degree	Graduate degree	Bachelor or Graduate (BS or grad)
Location of Residence	What's the zip code at your place of residence?		Rural
			Urban
			Suburban
Race	Native Hawaiian or part Hawaiian	Chinese	CSET Minority
	Guamanian or Chamorro	Filipino	All others
	Samoan	Japanese	
	Other Pacific Islander	Korean	
	White	Hispanic/Latino	
	African American or Black	Vietnamese	
	American Indian or Alaska Native	Other Asian	
	Asian Indian	Other	

An important variable in this analysis is the difference between urban and rural areas. The U.S. Census Bureau classifies urban areas according to two definitions. The first type is Urbanized Areas with a population of 50,000 or more, and the second type is Urban Clusters with a population between 2,500 and 50,000 people. Rural areas are characterized as all people, housing, and regions that are not part of an urban area [4].

Hawaii Strategic Development Corporation (HSDC) released a report [5] in 2010 defining urban and rural areas in the state of Hawaii, using the U.S. Census Bureau as its basis. The HSDC states that 63.6% of the total land area in Honolulu County (island of Oahu) is rural and 0.9% of the population lives in rural areas, whereas 97.8% of the total land area in Hawaii County (the Big Island or Hawaii Island) is rural and 38% of its population lives in rural areas.

Maps of the Hawaii Department of Transportation were used to separate ZIP codes into rural, suburban, and urban groups for each island. These groups are shown in Table 2.1.

Table 2.1 - Hawaii Zip Codes

	Rural			Urban			Suburban		
Oahu	96712	96762		96813	96818	96850	96701	96782	96857
	96717	96786		96814	96819	96853	96706	96795	96863
	96730	96789		96815	96822	96859	96707	96797	
	96731	96791		96816	96826	96860	96734	96821	
	96759	96792		96817	96848		96744	96825	
Big Island	96704	96749	96776	96720					
	96710	96750	96777	96725					
	96719	96755	96778	96740					
	96726	96760	96780						
	96727	96764	96781						
	96728	96771	96783						
	96737	96772	96785						
	96738	96773							
	96743	96774							
Kauai	96703	96716	96754				96741	96766	
	96705	96722	96756				96746		
	96714	96747	96769				96751		
	96715	96752	96796				96765		
Maui	96708	96757	96784	96732			96753		
	96713	96763	96788				96761		
	96729	96767	96790						
	96733	96768	96793						
	96742	96770							
	96748	96779							

CHAPTER 3. LITERATURE REVIEW

The literature review includes a summary of studies on the definition of equity, transportation equity and transportation network planning equity. It introduces other equity types such as procedural equity, geographic equity, and social equity. The difference between traffic safety and traffic safety equity is discussed. Crashes and EMS response time on rural roads are also discussed along with a brief FARS-based analysis in Hawaii.

3.1 Equity

The difference between equity and equality is illustrated in Figure 3.0. In an equality scenario, every individual would have the same means and opportunities, with no regard to their specific needs. In an equity scenario, the needs are weighed and dealt with more appropriately (e.g., proportional to their level of need), so that everyone would have their needs met equitably.

Figure 3.0 – Equality vs. Equity (2017 Robert Wood Johnson Foundation)

Shaheen et al. [6] stated: "There is not a universally agreed upon definition of equity and all of its facets; legislative and regulatory definitions narrowly focus on protected classes (inclusive of race, national origin, Americans with Disabilities Act (ADA) etc.) but often exclude unbanked, low-income, and digitally impoverished households. Additionally, there is no consensus about the acceptability of universal design–accessibility (everyone can access all modes) versus universal mobility (everyone has access to a mode of transportation that can provide equivalent level of service)." According to Bills et al. [7], "Transportation equity generally refers to the fair or just distribution of transportation costs and benefits among current (and future) members of society".

Traditional areas of transportation equity analysis are planning, social justice, and policies, such as mileage-based user fees, congestion charge zones, and performance-based parking pricing. Whenever there is a proposal on fare change, urban areas with a population larger than 200,000 are required to provide a fare equity analysis. Karner and Golub [8] discussed whether the proposed changes would have any negative effect on racial minorities and low-income people.

According to Lee at al. [9], sociodemographic characteristics like gender, age, race, and income are typically considered to define social equity in transportation. However, to determine spatial equity,

initially geographic groups are stratified and then each group is analyzed by its demographic characteristics. The goal of the spatial equity is to identify locations where inequities take place. People with low-income rely more on different transportation modes. Among transportation modes, there is an equity gap between safety and access as there are more fatalities of pedestrians and bikers than drivers, by certain metrics such as VMT or specific urbanized location.

The transportation network planning equity has the goal of implementing equal and fair economic and social opportunities for every demographic group and territory. As presented by Sanchez et al. [10], every user should have access to emergency services, medical care, education, employment, food and clothing, recreation, and commercial activities.

In 2012, the Federal Highway Administration (FHWA) defined a few plans of action to focus on environmental justice. Those strategies include decreasing human health impacts on minorities and low-income people, including every single person in the process of transportation planning and providing equity to minorities and low-income people [11]. Metropolitan Planning Organizations (MPOs) have a continuous challenge on attaining transportation equity while simultaneously following the regulations for civil rights and environmental justice aiming at the impartial dissemination of federal transportation funds among locations and demographic groups.

Karner [12] noted the three types of equity in the MPO assessments. The first is procedural equity, meaning the procedures of public meetings including where the meetings occur, the time a meeting is scheduled and the formality of how the information is delivered. The second is geographic equity, referring to the dissemination of funds across the territory such as rural, urban, and suburban areas. The third is social equity and it indicates the distribution of funds and benefits among demographic groups such as minorities vs. all others. To comprehend geographic and social equity, qualitative and quantitative measures are defined. Prevalent indicators include accessibility, average travel times, commute time, transit mode share, amount invested, and air quality [7].

Karner and Marcantonio [13] suggest a new transportation equity planning model where the focus of MPOs is on the demands of minorities and low-income people. However, according to Sanchez [14], “it is difficult to gauge the level of commitment of MPOs to transportation equity principles simply by describing the types of planning activities that they undertake. Moreover, the racial and ethnic composition of voting members is only an indirect measure of adequate public participation and representation, although it may serve as an indicator of the degree to which minorities have a stake in regional policy making.”

The difference between traffic safety and traffic safety equity is the inclusion of the population’s needs. Traffic safety is about increasing the safety of the transportation systems while traffic safety equity is making sure that safety is evenly distributed across users from different demographic groups and regions. In other words, traffic safety only concerns the safety of what is beneficial for all, whereas traffic safety equity refers to the fairness of traffic safety for all population groups.

As Najaf et al. [15] specified, transportation equity refers to the fairness among people of distinct localities, age groups, demographic characteristics, and users of the various transportation modes. In compliance with this framework, traffic safety equity can be connected to these five factors: “public awareness and knowledge about traffic safety and safe driving skills, equal allocation of financial resources to different types of road networks, equal law enforcements for different groups of users, equal safety standards for low- and high-priced vehicles, integrated traffic control rules, signs and devices in all regions.” The authors support the idea of considering traffic safety equity as the central

factor for the development of traffic safety policies built on equity considerations. A substantial goal holds on giving fair economic and social opportunities for everyone. One example would be to provide all transportation users, including the transportation underprivileged people, with basic access. To reinforce a sustainable growth and according to transportation equity, each user should have equal access to "emergency services, medical care, education, employment, food and clothing, recreational activities and commercial activities".

For transportation network planning to be equitable, it would have to allocate traffic safety equally to the entire community. Safe vehicles and safe roads are less common in RITI areas, so they would require better planning to make traffic safety (i.e., fatality proportions) as low as those in urban areas. One example would be ensuring that every single traveler has access to a safe vehicle that meets a certain level of safety. As reported by Beury [16], Congresswoman Smith of Nebraska proposed the Rural Transportation Equity Act in 1989. This legislation had the objective of reaching a balance of transportation funding between rural and urban areas provided by the federal government. At that time, rural communities received less than 3% of the transportation funds and a considerable percentage of the rural population had no vehicles, no nearby bus stops or taxis and they had no alternative but to stay at home.

Frequently, rural roads are not designed as high standard roads such as expressways. Rural roads often come with blind curves, narrow widths, no shoulders, no medians, gravel or dirt surfaces, steep hills, and sharp curves. According to analysis by Russo et al. [17], road characteristics such as AADT (annual average daily traffic), lane width, curvature change rate, length, and vertical grade can have a significant effect on the severity of crashes. Those attributes tend to be problematic on rural roads. Karner and Marcantonio [13] stated that redesigning the roads (e.g., increasing lane width, median width, and inside and outside shoulder width) could be a solution to decrease the number of crashes. They assessed the impact of the geometric design of roads, the environment and the traffic attributes of head-on accidents, and listed the causes of head-on crashes: undivided roadways, speeding, horizontal curve, high heavy-vehicle traffic, undulating terrains, access points and shoulder width; and their potential countermeasures such as installing median barriers, installing advisory speed signs, and widening shoulder width.

3.2 EMS response time

If a motor vehicle crash occurs and the injured person gets definitive care within one hour of their injury, their chances of surviving are increased, and this is considered the "golden hour" [18]. EMS response is critical for crashes located in rural settings where medical or trauma centers are far away. The response time is considered a crucial variable for survival rates and some of the essential factors affecting response include location of EMS station, condition of the road, traffic flow, safe speed and weather conditions.

The location of an EMS station is important to reducing response time for critical situations. Ambulances have a meaningful effect on the survival of patients on prehospital medical care. Most EMS stations located in rural areas are within the densest region, but most severe crashes occur on highways in the least dense regions. EMS stations or ambulances should be placed near regions with the highest rate of crashes, consequently optimizing response time.

According to the National Fire Protection Association (NFPA), the response time of 8 minutes is acknowledged for life-threatening incidents. As claimed by Gonzalez et al. [19] in their research in an area in Alabama, the EMS response time was 10.67 minutes in rural areas and 6.50 minutes in urban

areas. For fatalities incidents, the amount of time from the scene of the incident to an emergency room was 12.5 minutes in rural areas and 7.43 minutes in urban areas.

Data on EMS response in rural areas is very limited, which makes the development of performance measures challenging and the cost-effective improvement of the service difficult.

Barros [3] conducted an analysis using the Fatality Analysis Reporting System data from 2006 to 2017. The goal was to calculate the average EMS response time for urban areas and for rural areas in the counties of Honolulu which is mostly urban and Hawaii which is mostly rural. Specific elements of the FARS database were chosen to make the analysis: time of crash, time of notification, and time of EMS arrival at the scene. The difference from time of arrival at scene and time of notification was calculated and defined as the response time. This does not account for the time to dispatch the first emergency vehicle nor the duration of the 911 call; these are likely to be similar, on average, for urban and rural locations. The files had missing data; therefore, usable cases were the ones that had information for every single element chosen. The total number of fatal crashes for each area of each of the two island counties in Hawaii is presented in Table 3.0 [3].

Table 3.0 – FARS Number of Cases for Honolulu County and Hawaii County

Year	Rural Cases		Urban Cases		Total Cases	
	Honolulu	Hawaii	Honolulu	Hawaii	Honolulu	Hawaii
2007			49	3	49	3
2008	5	19	26	4	31	23
2009	6	13	36	11	42	24
2010	10	18	43	8	53	26
2011	7	16	35	3	42	19
2012	8	25	46	5	54	30
2013	7	12	38	4	45	16
2014	6	10	44	3	50	13
2015	1	7	47	8	48	15
2016	2	9	49	14	51	23

EMS response metrics for Honolulu and Hawaii counties and urban/rural areas are shown in Tables 3.1 and 3.2. [3]

EMS response time for rural Oahu (Honolulu County) was 10 minutes, while for urban Oahu it was 8 minutes (25% higher for rural). EMS response time for Hawaii county was 12 minutes for rural, and 7 minutes for urban (71% higher for rural). These Hawaii based means are in agreement with similar findings in the literature. The findings above covering a decade of cases provide a strong indication that EMS response time for traffic crashes is substantially longer in rural areas compared with urban areas.

Table 3.1 – Honolulu County EMS Response Time in Minutes

HONOLULU COUNTY				
Year	Rural		Urban	
	Average Time to Notify	Response Time	Average Time to Notify	Response Time
2007			7	7
2008	7	8	5	7
2009	5	8	6	7
2010	4	11	4	7
2011	5	8	4	7
2012	5	14	5	9
2013	6	7	6	9
2014	5	11	5	7
2015			5	7
2016	4	14	6	8
AVERAGE	5	10	5	8

Table 3.2 - Hawaii County EMS Response Time in Minutes

HAWAII COUNTY				
Year	Rural		Urban	
	Average Time to Notify	Response Time	Average Time to Notify	Response Time
2007			35	7
2008	4	12	6	10
2009	8	10	5	7
2010	6	14	6	9
2011	6	13	1	4
2012	3	13	3	6
2013	7	14	3	6
2014	2	10	3	7
2015	4	10	2	6
2016	4	11	3	8
AVERAGE	5	12	7	7

CHAPTER 4. ANALYSIS AND RESULTS

The survey was conducted in 2019, by email, in a total of ten stages, with a *Zoho* questionnaire survey link. The entire survey tool is shown in Appendix A. The email invitation is shown in Appendix B.

Zoho is a platform for creating online surveys. It is easily reached by the public through any device with internet access, and results can be graphically visualized in real time. The survey was developed on this platform to easily reach recipients by email. No personal identification was collected on this survey. Every page of the survey had the message "Your privacy is protected; all your answers are anonymous, and all results will be in summary form".

This report summarizes the efforts and results of the final stage that included ten deployments. All questions were optional so not every question had a response from the total number of completed responses. Groups 1 to 3 were deployed in March 2019; these surveys did not contain a transportation equity and rural transportation section. Groups 4 and 5 were deployed in April 2019 followed by groups 6 and 7 in mid-May to mid-June 2019. At that point, a substantial decrease in response rate was noted, likely due to summer vacations. Groups 8 to 10 were conducted from mid-September to mid-October 2019. Only the principal investigator and two graduate research assistants were involved with survey deployment, thus assuring a specific regiment of quality control at each stage.

Table 4.0 shows the number of people who replied to the ten deployments of surveys. We typically sent out 100 to 300 emails, Monday to Thursday, and carefully monitored the number of responses received. Part of the deployment number (7) was done in June when we noticed a substantially lower response rate (likely due to summer time). The deployment was halted and resumed after Labor Day in September.

Once the responses were collected, the first step was to inspect for gross errors and merge the responses into one database file. This task involved some careful coordination of the spreadsheets since the order of questions was changed at various deployments; a few questions were dropped, and others were inserted. A final, clean database had a total of 1,376 completed responses.

Table 4.0 – Sample Size of Survey Deployments

Code	Survey Title	#	Percent
1	Charley's Taxi - The Center for Safety Equity in Transportation Survey for Hawaii	236	17.2%
2	UH Students - The Center for Safety Equity in Transportation Survey for Hawaii	13	0.9%
3	CSET Survey of Native Hawaiians & Part Hawaiians & Pacific Islanders	16	1.2%
4	CSET Survey of Native Hawaiians & Part Hawaiians & Pacific Islanders	44	3.2%
5	University of Hawaii Center for Equity in Transportation Safety Survey for Oahu Transit Services	47	3.4%
6	CSET Survey of Traffic Issues in Hawaii	151	11.0%
7	CSET Survey of Traffic Issues in Hawaii	278	20.2%
8	CSET Survey of Traffic Issues in Hawaii	59	4.3%
9	CSET Survey for Hawaii	417	30.3%
10	CSET Survey for Hawaii via Facebook	115	8.4%
	TOTAL	1,376	100.0%

Requests to fill out the survey were sent to 13,993 email addresses available to principal investigator Prevedouros; 4,196 were returned (30%) as a no longer valid email address. It was surmised that 9,797 emails reached a valid account, although not all valid accounts are monitored by their users. Based on responses shown in Table 4.0, 1,376 complete and partial (but usable) responses were received for an overall response rate of 14%. From a careful inspection of emails used in stages 6 and 7, it was estimated that approximately 25% of valid email addresses belonged to people outside Hawaii and thus unlikely to respond; a handful of recipients sent a reply to this effect, i.e., the survey was not applicable to them. Using this adjustment, the effective response rate is estimated at 18.7%.

The survey collected responses to 31 questions, some of which were used in this portion of the CSET study to understand people's perceptions on transportation urban-rural equity, and to examine possible relationships between the equity responses and demographic characteristics such as gender, age, race, and education and residence location at a rural, urban or suburban location in Hawaii.

Statistical tests were deployed to determine whether the data collected from the survey support or contradict the equity propositions. The analysis was conducted by using SPSS Statistics software by IBM.

4.1 Basic Statistics of Equity Questions

All percentile results greater than 50% were highlighted to represent the tendency of the majority.

Equity question 1 is shown in the tables as **EMS Response**: *Compared to urban areas, in rural areas emergency response is*.

Basic analysis of equity question 1 by gender, age, education, location of residence, and race is shown in Table 4.1. The overall result for this question is that respondents were divided between rural EMS response being either worse or about the same compared to urban EMS response in Hawaii.

Slightly more male respondents thought that rural EMS response compared to urban is about the same. Female respondents were divided. Most respondents below the age of 25 (61%) thought the rural response is about the same. Respondents aged 56 or older also agreed. Respondents between the ages of 26 and 55 believed somewhat more that rural EMS response is worse. Based on FARS analysis in Tables 3.1 and 3.2, the perception of this group reflects reality best. People with a high school degree or less believed that rural EMS response is about the same. One half of the respondents with some sort of advanced degree concurred. People with a bachelor's degree or higher thought slightly more that rural EMS response is worse. This group also has a perception that reflects reality according to FARS data. Rural residents believed that EMS response is worse and half of urban residents (50%) agreed, so they have a perception that reflects reality as well. Most suburban residents (52%) thought it is about the same. Regarding race, CSET minority respondents thought that rural response is slightly worse, also showing a perception that reflects reality; whereas All Others believed that it is about the same.

Table 4.1 – Frequency/Percentage for Equity Question 1

EMS Response by Gender	Worse	About the same	Better
Male	252	270	50
Female	143	143	26
Total	395	413	76

EMS Response by Gender	Worse	About the same	Better
Male	44%	47%	9%
Female	46%	46%	8%
Total	45%	47%	9%

EMS Response by Age	Worse	About the same	Better
Under 25	23	46	6
26 to 55	162	142	24
56 or older	212	227	46
Total	397	415	76

EMS Response by Age	Worse	About the same	Better
Under 25	31%	61%	8%
26 to 55	49%	43%	7%
56 or older	44%	47%	9%
Total	45%	47%	9%

EMS Response by Education	Worse	About the same	Better
HS or less	30	34	7
AD or some	100	125	26
BS or grad	266	256	42
Total	396	415	75

EMS Response by Education	Worse	About the same	Better
HS or less	42%	48%	10%
AD or some	40%	50%	10%
BS or grad	47%	45%	7%
Total	45%	47%	8%

EMS Response by Location	Worse	About the same	Better
Rural	75	65	15
Urban	164	137	24
Suburban	151	201	37
Total	390	403	76

EMS Response by Location	Worse	About the same	Better
Rural	48%	42%	10%
Urban	50%	42%	7%
Suburban	39%	52%	10%
Total	45%	46%	9%

EMS Response by Race	Worse	About the same	Better
CSET	90	87	21
All Others	316	335	56
Total	406	422	77

EMS Response by Race	Worse	About the same	Better
CSET	45%	44%	11%
All Others	45%	47%	8%
Total	45%	47%	9%

Equity question 2 shown in the tables as **Gas Tax EMS**: *Do you agree that the government should increase gasoline taxes in order to improve emergency response for rural roads?*

Basic analysis of equity question 2 by gender, age, education, location of residence, and race is shown in Table 4.2. Overall, every demographic group disagreed with the statement.

They do not support the position that the government should increase gasoline taxes to fund EMS response improvements in rural areas of Hawaii. The rate of disagreement averaged 62% between genders and 61% across age groups, education levels, residence location and race. Respondents with a

high school degree or less had the highest disagreement share of 77%. Regardless of respondent characteristics, they all disagreed with the idea of increasing gasoline taxes even if they think EMS response time is worse in rural areas compared to urban areas.

Table 4.2 – Frequency/Percentage for Equity Question 2

Gas Tax EMS by Gender	Disagree	Neutral	Agree
Male	379	151	75
Female	198	96	39
Total	577	247	114

Gas Tax EMS by Gender	Disagree	Neutral	Agree
Male	63%	25%	12%
Female	59%	29%	12%
Total	62%	26%	12%

Gas Tax EMS by Age	Disagree	Neutral	Agree
Under 25	47	24	4
26 to 55	221	82	37
56 or older	306	145	74
Total	574	251	115

Gas Tax EMS by Age	Disagree	Neutral	Agree
Under 25	63%	32%	5%
26 to 55	65%	24%	11%
56 or older	58%	28%	14%
Total	61%	27%	12%

Gas Tax EMS by Education	Disagree	Neutral	Agree
HS or less	56	15	2
AD or some	177	64	25
BS or grad	340	172	89
Total	573	251	116

Gas Tax EMS by Education	Disagree	Neutral	Agree
HS or less	77%	21%	3%
AD or some	67%	24%	9%
BS or grad	57%	29%	15%
Total	61%	27%	12%

Gas Tax EMS by Location	Disagree	Neutral	Agree
Rural	101	39	16
Urban	201	101	52
Suburban	261	105	46
Total	563	245	114

Gas Tax EMS by Location	Disagree	Neutral	Agree
Rural	65%	25%	10%
Urban	57%	29%	15%
Suburban	63%	25%	11%
Total	61%	27%	12%

Gas Tax EMS by Race	Disagree	Neutral	Agree
CSET	135	50	19
All Others	449	208	100
Total	584	258	119

Gas Tax EMS by Race	Disagree	Neutral	Agree
CSET	66%	25%	9%
All Others	59%	27%	13%
Total	61%	27%	12%

Equity question 3 shown in the tables as **High Std Roads**: *Do you agree that the government should make rural roads safer by converting them to high standard roads given that the costs will be much higher?*

Basic analysis of equity question 3 by gender, age, education, location of residence, and race is shown in Table 4.3. The overall result for this question is that respondents were divided when it comes to converting rural roads into high standard roads in Hawaii.

No demographic group had a majority response, pro, against or neutral. Male disagreement rate was close to agreement rate. Females tended to agree more. Respondents under the age of 25 tended to disagree more; respondents aged 26 to 55 were divided between agree and disagree; and, respondents aged 56 years or older tended to agree more. Respondents with a high school degree or less tended to disagree more, and those with Bachelor's degree or more tended to agree more. Respondents in rural areas tended to disagree, while in urban areas tended to agree. Survey respondents tended to agree with the question. All these tendencies are based on absolute percentages, but in sum the population responded very differently and there was no apparent pattern. When comparing responses across locations, the combined feelings of neutrality and agreement were 59% for rural respondents and 70% for urban respondents, showing that urban residents agreed at a higher rate that rural roads should be converted to high standard roads, even if costs are higher.

Equity question 4 shown in the tables as **Gas Tax High Std**: *Do you agree that the government should raise gasoline taxes to collect funds to make rural roads safer by converting them to high standard roads?*

Basic analysis of equity question 4 by gender, age, education, location of residence, and race is shown in Table 4.4. Overall, all the demographic groups disagreed with the proposition that the government should raise gasoline taxes to collect funds for the purpose of making rural roads safer by converting them to high standard roads.

Regardless of their gender, age, education level, location of residence or race, or if they agreed the government should convert rural roads to high standard roads, the survey respondents disagreed with paying extra taxes. The no-tax mindset is analogous to the one shown in Table 4.2, in which all the demographic groups also disagreed with raising taxes to improve EMS response on rural roads. Notably, 67% of the rural residents that responded to the survey, most likely the ones to benefit the most from the proposed high standard roads, also disagreed with the increase, at a higher rate than urban (55%) and suburban (60%) respondents.

Table 4.3 – Frequency/Percentage for Equity Question 3

High Std Roads by Gender	Disagree	Neutral	Agree
Male	225	166	216
Female	99	113	119
Total	324	279	335

High Std Roads by Gender	Disagree	Neutral	Agree
Male	37%	27%	36%
Female	30%	34%	36%
Total	35%	30%	36%

High Std Roads by Age	Disagree	Neutral	Agree
Under 25	27	25	23
26 to 55	117	104	118
56 or older	181	150	196
Total	325	279	337

High Std Roads by Age	Disagree	Neutral	Agree
Under 25	36%	33%	31%
26 to 55	35%	31%	35%
56 or older	34%	28%	37%
Total	35%	30%	36%

High Std Roads by Education	Disagree	Neutral	Agree
HS or less	27	21	25
AD or some	89	91	86
BS or grad	208	167	226
Total	324	279	337

High Std Roads by Education	Disagree	Neutral	Agree
HS or less	37%	29%	34%
AD or some	33%	34%	32%
BS or grad	35%	28%	38%
Total	34%	30%	36%

High Std Roads by Location	Disagree	Neutral	Agree
Rural	64	43	50
Urban	106	113	134
Suburban	142	120	150
Total	312	276	334

High Std Roads by Location	Disagree	Neutral	Agree
Rural	41%	27%	32%
Urban	30%	32%	38%
Suburban	34%	29%	36%
Total	34%	30%	36%

High Std Roads by Race	Disagree	Neutral	Agree
CSET	62	65	77
All Others	264	221	271
Total	326	286	348

High Std Roads by Race	Disagree	Neutral	Agree
CSET	30%	32%	38%
All Others	35%	29%	36%
Total	34%	30%	36%

Table 4.4 – Frequency/Percentage for Equity Question 4

Gas Tax High Std by Gender	Disagree	Neutral	Agree
Male	368	131	104
Female	196	88	51
Total	564	219	155

Gas Tax High Std by Gender	Disagree	Neutral	Agree
Male	61%	22%	17%
Female	59%	26%	15%
Total	60%	23%	17%

Gas Tax High Std by Age	Disagree	Neutral	Agree
Under 25	43	20	11
26 to 55	212	75	52
56 or older	307	128	92
Total	562	223	155

Gas Tax High Std by Age	Disagree	Neutral	Agree
Under 25	58%	27%	15%
26 to 55	63%	22%	15%
56 or older	58%	24%	17%
Total	60%	24%	16%

Gas Tax High Std by Education	Disagree	Neutral	Agree
HS or less	44	16	12
AD or some	173	59	33
BS or grad	344	148	111
Total	561	223	156

Gas Tax High Std by Education	Disagree	Neutral	Agree
HS or less	61%	22%	17%
AD or some	65%	22%	12%
BS or grad	57%	25%	18%
Total	60%	24%	17%

Gas Tax High Std by Location	Disagree	Neutral	Agree
Rural	105	25	27
Urban	197	96	62
Suburban	248	98	64
Total	550	219	153

Gas Tax High Std by Location	Disagree	Neutral	Agree
Rural	67%	16%	17%
Urban	55%	27%	17%
Suburban	60%	24%	16%
Total	60%	24%	17%

Gas Tax High Std by Race	Disagree	Neutral	Agree
CSET	124	50	30
All Others	444	184	129
Total	568	234	159

Gas Tax High Std by Race	Disagree	Neutral	Agree
CSET	61%	25%	15%
All Others	59%	24%	17%
Total	59%	24%	17%

Equity question 5 shown in the tables as **Money Provided**: *Should more money, less money or about the same amount of money be provided to support urban road and highway improvements?*

Basic analysis of equity question 5 by gender, age, education, location of residence, and race is shown in Table 4.5.a. Overall, all the demographic groups responded “about the same” to this question.

Most males and females believe either the same amount or more money should be provided to support road improvement. Same pattern for respondents of various age groups, education levels, locations of residence, and race. The percentage of people below the age of 25 that believe about the same amount should be invested was 60%, but only 5 respondents fit in that age range. Similarly, 63% of people with high school degree or less also think about the same amount should be invested, but only 17 respondents were in that category.

Table 4.5.b was created to show the results if No opinion responses were ignored. Main differences: Half of male and female respondents believed about the same amount of money should be provided. Between age groups, 51% of respondents aged 56 or more also believed the same amount of money should be provided. Respondents with some sort of advanced degree agreed (56%). Between locations, 54% of suburban residents also chose the same amount. Lastly, 50% of All Other Races agreed.

Table 4.5a – Frequency/Percentage for Equity Question 5

Money Provided by Gender	More Money	Less Money	About the same	No opinion
Male	174	31	210	48
Female	91	19	104	55
Total	265	50	314	103

Money Provided by Gender	More Money	Less Money	About the same	No opinion
Male	38%	7%	45%	10%
Female	34%	7%	39%	20%
Total	36%	7%	43%	14%

Money Provided by Age	More Money	Less Money	About the same	No opinion
Under 25	1	0	3	1
26 to 55	89	16	89	40
56 or older	177	34	220	63
Total	267	50	312	104

Money Provided by Age	More Money	Less Money	About the same	No opinion
Under 25	20%	0%	60%	20%
26 to 55	38%	7%	38%	17%
56 or older	36%	7%	45%	13%
Total	36%	7%	43%	14%

Money Provided by Education	More Money	Less Money	About the same	No opinion
HS or less	7	1	17	2
AD or some	47	15	80	36
BS or grad	214	34	217	66
Total	268	50	314	104

Money Provided by Education	More Money	Less Money	About the same	No opinion
HS or less	26%	4%	63%	7%
AD or some	26%	8%	45%	20%
BS or grad	40%	6%	41%	12%
Total	36%	7%	43%	14%

Money Provided by Location	More Money	Less Money	About the same	No opinion
Rural	47	14	45	23
Urban	105	17	117	30
Suburban	107	17	145	50
Total	259	48	307	103

Money Provided by Location	More Money	Less Money	About the same	No opinion
Rural	36%	11%	35%	18%
Urban	39%	6%	43%	11%
Suburban	34%	5%	45%	16%
Total	36%	7%	43%	14%

Money Provided by Race	More Money	Less Money	About the same	No opinion
CSET	48	12	53	20
All Others	231	38	267	86
Total	279	50	320	106

Money Provided by Race	More Money	Less Money	About the same	No opinion
CSET	36%	9%	40%	15%
All Others	37%	6%	43%	14%
Total	37%	7%	42%	14%

Table 4.5b – Frequency/Percentage for Equity Question 5 without No opinion Responses

Money Provided by Gender	More Money	Less Money	About the same
Male	174	31	210
Female	91	19	104
Total	265	50	314

Money Provided by Gender	More Money	Less Money	About the same
Male	42%	7%	51%
Female	43%	9%	49%
Total	42%	8%	50%

Money Provided by Age	More Money	Less Money	About the same
Under 25	1	0	3
26 to 55	89	16	89
56 or older	177	34	220
Total	267	50	312

Money Provided by Age	More Money	Less Money	About the same
Under 25	25%	0%	75%
26 to 55	46%	8%	46%
56 or older	41%	8%	51%
Total	42%	8%	50%

Money Provided by Education	More Money	Less Money	About the same
HS or less	7	1	17
AD or some	47	15	80
BS or grad	214	34	217
Total	268	50	314

Money Provided by Education	More Money	Less Money	About the same
HS or less	28%	4%	68%
AD or some	33%	11%	56%
BS or grad	46%	7%	47%
Total	42%	8%	50%

Money Provided by Location	More Money	Less Money	About the same
Rural	47	14	45
Urban	105	17	117
Suburban	107	17	145
Total	259	48	307

Money Provided by Location	More Money	Less Money	About the same
Rural	44%	13%	42%
Urban	44%	7%	49%
Suburban	40%	6%	54%
Total	42%	8%	50%

Money Provided by Race	More Money	Less Money	About the same
CSET	48	12	53
All Others	231	38	267
Total	279	50	320

Money Provided by Race	More Money	Less Money	About the same
CSET	42%	11%	47%
All Others	43%	7%	50%
Total	43%	8%	49%

4.2 Descriptive and Correlation Statistics

This section presents the analysis of descriptive statistics, means tests, and correlations. The coding for the five questions on transportation equity between urban and rural areas is presented in Table 4.6.

Table 4.6 – Code for the Answer Options of Each Equity Question

Equity	1	2	3	4	5
Question 1	Far worse	Worse	About the same	Better	Much better
Question 2	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Question 3	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Question 4	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Question 5	Less money	Same amount	More money	-	-

The following abbreviations apply to the tables that follow:

- **N**: the valid number of responses used to generate the statistical indices
- **Mean**: the arithmetic mean of the responses to variable x.
- **Std. Dev**.: the standard deviation of the responses to variable x.
- **t**: statistic test for independent-samples. The T-test determines whether the means for variable x from two groups are significantly different.
- **F**: statistic test for one-way ANOVA. It examines if the means for variable x are significantly different (three groups or more).
- **Sig**: level of statistical significance; less than or equal to 5% (alpha=0.05) denotes a statistically significant difference among the mean values for each group.

Descriptive statistics analysis shows that the mean response ranged from 2.48 to 2.76 for equity question 1, as shown in Table 4.7. Given that 3 represents a neutral response, the range of means indicates a perception that response is somewhat worse in rural areas, consistent with the estimated EMS response times. Age and residence location were the variables with significant mean responses, meaning that the mean estimates for each group are significantly different statistically. Specifically, the mean response for age under 25 (2.76) is significantly different from the other two groups; their means trend further away from neutral. The mean response of suburban location (2.67) is also significantly different from that of the other two groups; their means also trend further away from neutral.

Table 4.7 – Equity Question 1 Descriptive and Test Statistics

Compared to urban areas, in rural areas emergency response is:

		N	Mean	Std. Dev.	t	Sig.
Gender	Male	572	2.58	0.804	0.645	0.519
	Female	312	2.54	0.772		
Race	CSET	198	2.56	0.846	-0.217	0.829
	All others	707	2.57	0.772		
		N	Mean	Std. Dev.	F	Sig.
Age	Under 25	78	2.76	0.612	3.921	0.020
	26 to 55	328	2.49	0.782		
	56 or older	485	2.59	0.820		
Education	HS or less	71	2.63	0.779	2.631	0.073
	AD or some	251	2.65	0.788		
	BS or grad	564	2.52	0.794		
Location	Rural	155	2.48	0.870	5.945	0.003
	Urban	325	2.49	0.748		
	Suburban	389	2.67	0.790		

Descriptive statistics analysis shows that the mean response ranged from 1.82 to 2.31 for equity question 2, as shown in Table 4.8. This indicates a perception that most of the respondents disagreed on paying more for gasoline so the government can collect funds for the improvement of emergency services on rural roads. Race and education level were the variables with significantly different mean responses, meaning that the respondent race and education level influenced on whether they agreed or disagreed with paying more gasoline taxes. There is also the possibility that location mattered for these results due to its level of statistical significance being only slightly bigger than 5%. CSET minority response is significantly different from All Others; CSET minorities disagree more. All three education levels had significantly different responses.

Table 4.8 – Equity Question 2 Descriptive and Test Statistics

Do you agree that the government should increase gasoline taxes in order to improve emergency response for rural roads?

		N	Mean	Std. Dev.	t	Sig.
Gender	Male	605	2.16	1.152	-0.941	0.347
	Female	333	2.23	1.077		
Race	CSET	204	2.03	1.094	-2.414	0.016
	All others	757	2.24	1.137		
		N	Mean	Std. Dev.	F	Sig.
Age	Under 25	75	2.17	0.876	2.240	0.107
	26 to 55	340	2.09	1.125		
	56 or older	525	2.26	1.151		
Education	HS or less	73	1.82	0.855	10.419	0.000
	AD or some	266	2.03	1.095		
	BS or grad	601	2.31	1.153		
Location	Rural	156	2.06	1.154	2.917	0.055
	Urban	354	2.30	1.157		
	Suburban	412	2.16	1.084		

Descriptive statistics analysis shows that the mean response ranged from 2.82 to 3.08 for equity question 3, as shown in Table 4.9. This indicates a perception that is clearly neutral to the idea of converting rural roads into high standard roads. Rural location respondents trend a bit more negative to the proposition (only mean response below 2.9, where 3 is neutral).

Table 4.9 – Equity Question 3 Descriptive and Test Statistics

Do you agree that the government should make rural roads safer by converting them to high standard roads given that the costs will be much higher?

		N	Mean	Std. Dev.	t	Sig.
Gender	Male	607	2.93	1.200	-1.210	0.227
	Female	331	3.02	1.094		
Race	CSET	204	3.08	1.190	1.476	0.141
	All others	756	2.95	1.147		
		N	Mean	Std. Dev.	F	Sig.
Age	Under 25	75	2.91	1.016	0.106	0.899
	26 to 55	339	2.96	1.185		
	56 or older	527	2.97	1.174		
Education	HS or less	73	2.93	1.159	0.051	0.950
	AD or some	266	2.95	1.147		
	BS or grad	601	2.97	1.172		
Location	Rural	157	2.82	1.289	1.970	0.140
	Urban	353	3.04	1.134		
	Suburban	412	2.97	1.131		

Descriptive statistics analysis shows that the mean response ranged from 2.13 to 2.35 for equity question 4, as shown in Table 4.10. This indicates a perception that most of the respondents disagreed on paying more for gasoline so the government can collect funds to invest on making rural roads safer. Education was the only variable with significant mean responses, meaning that each education level has a significantly different mean response; all three are opposing the proposal of raising taxes, but to a different degree, with more educated respondents opposing it the least.

Table 4.10 – Equity Question 4 Descriptive and Test Statistics

Do you agree that the government should raise gasoline taxes to collect funds to make rural roads safer by converting them to high standard roads?

		N	Mean	Std. Dev.	t	Sig.
Gender	Male	603	2.26	1.182	-0.458	0.647
	Female	335	2.30	1.078		
Race	CSET	204	2.22	1.124	-1.093	0.275
	All others	757	2.31	1.149		
		N	Mean	Std. Dev.	F	Sig.
Age	Under 25	74	2.35	1.026	0.762	0.467
	26 to 55	339	2.22	1.161		
	56 or older	527	2.31	1.153		
Education	HS or less	72	2.24	1.120	3.054	0.048
	AD or some	265	2.14	1.081		
	BS or grad	603	2.35	1.176		
Location	Rural	157	2.13	1.199	1.653	0.192
	Urban	355	2.33	1.165		
	Suburban	410	2.30	1.112		

Descriptive statistics analysis shows that the mean response ranged from 2.23 to 2.39 for equity question 5, as shown in Table 4.11. This indicates a perception that most of the respondents believed that the same amount of money or more money should be provided to support road improvements. Education was the only variable with significantly different mean responses, with more educated respondents being willing to allocate more funds to road improvements.

Table 4.11 – Equity Question 5 Descriptive and Test Statistics

Should more money, less money or about the same amount of money be provided to support urban road and highway improvements?

		N	Mean	Std. Dev.	t	Sig.
Gender	Male	415	2.34	0.613	0.154	0.878
	Female	214	2.34	0.635		
Race	CSET	113	2.32	0.658	-0.616	0.539
	All others	536	2.36	0.611		
		N	Mean	Std. Dev.	F	Sig.
Age	Under 25	4	2.25	0.500	0.390	0.677
	26 to 55	194	2.38	0.634		
	56 or older	431	2.33	0.617		
Education	HS or less	25	2.24	0.523	4.110	0.017
	AD or some	142	2.23	0.623		
	BS or grad	465	2.39	0.620		
Location	Rural	106	2.31	0.695	0.361	0.697
	Urban	239	2.37	0.614		
	Suburban	263	2.33	0.592		

4.3 Census Adjustment

Survey responses rarely represent the entire population analyzed. An assessment was performed for several primary demographic indicators such as gender, age and education level. The frequencies in our survey sample were compared to the corresponding frequencies in the population on Hawaii. Then an adjustment based on Hawaii Census distribution was performed to approximate the mean responses of the actual population, as shown in Tables 4.12, 4.13 and 4.14.

Table 4.12 shows the differences between our survey respondent database (columns labelled CSET) and Hawaii Census data (columns labelled HI). Each question had a slightly different response and population percentages, and these are shown for all five questions. Clearly the CSET survey has many more male respondents, older respondents and educated respondents with a Bachelor's degree or higher. These differences did not affect much the mean response estimates, as shown in Table 4.13.

Table 4.12 – Hawaii and CSET Population Distribution and Difference

	HI	15a		15b		15c		15d		15e	
		CSET	Difference	CSET	Difference	CSET	Difference	CSET	Difference	CSET	Difference
M	50.1%	64.7%	14.6%	64.5%	14.4%	64.7%	14.6%	64.3%	14.2%	66.0%	15.9%
F	49.9%	35.3%	-14.6%	35.5%	-14.4%	35.3%	-14.6%	35.7%	-14.2%	34.0%	-15.9%
Under 25	29.9%	8.4%	-21.5%	8.0%	-21.9%	8.0%	-21.9%	7.9%	-22.0%	0.6%	-29.3%
26 to 55	51.7%	36.9%	-14.8%	36.2%	-15.5%	36.0%	-15.7%	36.1%	-15.6%	30.9%	-20.8%
56 or older	18.4%	54.6%	36.2%	55.9%	37.5%	56.0%	37.6%	56.1%	37.7%	68.5%	50.1%
HS or less	36.7%	8.0%	-28.7%	7.8%	-28.9%	7.8%	-28.9%	7.7%	-29.0%	3.9%	-32.8%
AD or some	33.3%	28.3%	-5.0%	28.3%	-5.0%	28.3%	-5.0%	28.2%	-5.1%	22.5%	-10.8%
BS or grad	30.0%	63.7%	33.7%	63.9%	33.9%	63.9%	33.9%	64.1%	34.1%	73.6%	43.6%

Using SPSS, the mean response was compared with the population adjusted mean. The difference was calculated, and the values are shown in Table 4.13. Small differences are those under about ±2%; larger differences are shown in gray cells. They were only two, for the responses to Questions 2 and 5 and for education level only. We surmise that all the interpretations provided in Tables 4.1 to 4.11 are fairly representative of the population groups of Hawaii examined herein.

Table 4.13 – Hawaii and CSET Mean Response and Difference

Equity Question	Mean Response								
	CSET Survey			Population Adjusted			Difference		
	By Gender	By Age	By Education	By Gender	By Age	By Education	By Gender	By Age	By Education
EMS Response	2.57	2.57	2.57	2.56	2.59	2.60	0.2%	-0.8%	-1.5%
Gas Tax EMS	2.18	2.19	2.19	2.19	2.15	2.04	-0.5%	2.2%	7.6%
High Std Roads	2.96	2.96	2.96	2.97	2.95	2.95	-0.4%	0.5%	0.4%
Gas Tax High Std	2.27	2.28	2.28	2.28	2.28	2.24	-0.2%	0.2%	1.9%
Money Provided	2.34	2.34	2.35	2.34	2.33	2.28	0.0%	0.6%	3.0%

Finally, for easier interpretation, the mean values were converted from a scale of 1 to 5 with 3 being neutral, to a scale of -2 to 2 with 0 being neutral. This was done for the first four questions. For the fifth question, the scale of 1 to 3 was converted to a sale of -1 to 1. Large deviations from neutral are highlighted in gray cells. The adjusted means are shown in Table 4.14. The population adjustment did not change any of the original findings and interpretations based on CSET survey responses.

Table 4.14 – Hawaii and CSET Mean Response

Equity Question	Mean Response					
	CSET Survey			Population Adjusted		
	By Gender	**By Age**	**By Education**	By Gender	By Age	By Education
EMS Response	**-0.43**	**-0.43**	**-0.43**	-0.44	-0.41	-0.40
Gas Tax EMS	**-0.82**	**-0.81**	**-0.81**	-0.81	-0.85	-0.96
High Std Roads	**-0.04**	**-0.04**	**-0.04**	-0.03	-0.05	-0.05
Gas Tax High Std	**-0.73**	**-0.72**	**-0.72**	-0.72	-0.72	-0.76
Money Provided	**0.34**	**0.34**	**0.35**	0.34	0.33	0.28

CHAPTER 5. CONCLUSION

Urban and rural areas are different by definition and their differences generate potential transportation equity differences. For example, rural areas have a higher proportion of fatal crashes by population size. This is a serious public health and equity issue that is worthy of investigation. In addition, Hawaii had the highest amount of minority fatalities. Between 2006 and 2017, Hawaii had 347 fatalities involving minorities, representing 31% of the state total. Among the four CSET states of Alaska, Hawaii, Idaho and Washington, Hawaii had the highest proportion of minority fatalities.

The objective of this task of research was to understand the perceptions of minority groups and others on urban and rural transportation equity, while correlating with demographic characteristics such as gender, age, and education level.

A web-based survey was deployed and 9,797 emails reached a valid account. Excluding 25% of email reaching recipients outside Hawaii who did not respond, the effective response rate is estimated at 18.7% as reflected by the database of 1,376 valid responses.

Hawaii does not have Indian reservations, but there are a few rural locations (e.g., Waianae, Waimanalo and 98% of Hawaii County) where there is a higher percentage of CSET minorities including native Hawaiians, part Hawaiians and Pacific Islanders.

Five transportation equity questions were designed to address potential traffic-related safety deficiencies and funding for mitigating the deficiencies. The statement of each question and the overall responses are shown in Table 5.1. (Also recall from Table 4.14 that the direct responses to our survey and the Hawaii Census-adjusted responses are very similar, thus the results are representative of Hawaii's population.)

Table 5.0 – Summarized Responses

Survey Question	Overall Answer
EMS Response - Compared to urban areas, in rural areas emergency response is:	About the same
Gas Tax EMS - Do you agree that the government should increase gasoline taxes in order to improve emergency response for rural roads?	Disagree
High Std Roads - Do you agree that the government should make rural roads safer by converting them to high standard roads given that the costs will be much higher?	Mixed response (neutral average)
Gas Tax High Std - Do you agree that the government should raise gasoline taxes to collect funds to make rural roads safer by converting them to high standard roads?	Disagree
Money Provided - Should more money, less money or about the same amount of money be provided to support urban road and highway improvements?	Mixed response (neutral average)

Respondents perceive that EMS response is about the same when comparing urban and rural areas, but analysis of FARS records over ten years (see Table 3.2.) indicates that EMS response time is substantially longer on rural roads. The respondents disagreed with paying more taxes to improve EMS response in rural areas and paying more taxes so the government can upgrade the standard of rural roads. The responses were mixed when asked about converting rural roads into high standard roads and regarding the amount of money provided to support urban roads and highway improvements. Overall, the results suggest a lack of awareness of conditions on rural roads where EMS response tends to be much longer and funding is much lower compared to urban roads. This allows for the continued imbalance in funding for safety and quality of service improvements, and the continuation of high rates of fatal crashes on rural roads.

Kumfer et al. [20] developed an online tool to educate drivers about rural roads and driver behavior, particularly for teen drivers who typically have poor or undeveloped rural road safety awareness (which results in a high percentage of crashes involving people of young age). Their tool measures before and after perceptions of the participants and assesses whether they learned something. It could be adopted in Hawaii and become a part of the written test for a driver's license on the neighboring islands which are mostly rural.

Finally, regarding the focus on rural residents and CSET minorities, their overall responses to the five transportation equity questions were as follows:

- EMS Response: most urban residents believed the EMS response is worse in rural areas, while most suburban residents believed it is about the same as urban areas; rural residents were divided between both responses. CSET minorities and all others were also divided between being worse or about the same.
- Gas Tax EMS: all groups disagreed with the idea of increasing gas taxes to improve emergency response on rural roads.
- High Std Roads: combined neutral and positive responses show that a larger percentage of urban residents agreed with making rural roads safer, in comparison to rural residents. CSET minorities and all others had similar responses between neutral and agreement.
- Gas Tax High Std: all groups disagreed with the idea of increasing gas taxes to convert rural roads to high standard roads.
- Money Provided: ignoring the responses with no opinion, most suburban residents believed about the same amount of money should be provided; both rural and urban residents were divided between more money or about the same. CSET minorities were also divided, while all others thought it should be about the same.

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APPENDIX A: SURVEY

Part 1: Transportation Survey

1) Do you have a Driver's License?

[ ] Yes, go to Question 2. [ ] No, go to Question 3.

2) How many years of driving experience do you have? _____

3) How many cars, vans, or pickups are available to your household or immediate family?

[ ] 0 [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ] 6 or more

4) How many of these are pickup trucks or large SUV?

[ ] 0 [ ] 1 [ ] 2 [ ] 3 [ ] 4 or more

5) On a typical day, which of these transportation options do you use to commute?

[ ] Car, as a driver [ ] Car, as a passenger [ ] Walk (your main trip is on foot)

[ ] Bicycle [ ] Motorcycle [ ] Bus

[ ] Other (Please Specify): _____

6) On a typical day, how many miles do you commute to work or school? _____

7.a) On a typical day, how many minutes do you commute to work or school? _____

7.b) On a typical day, how many minutes do you commute back to your home? _____

8) Is traffic congestion a problem during busy times of the day?

	1. Not a problem at all	2.	3. Moderate problem	4.	5. Big problem
At the area around your work or school	[ ]	[ ]	[ ]	[ ]	[ ]
At the area around your residence	[ ]	[ ]	[ ]	[ ]	[ ]
On your island	[ ]	[ ]	[ ]	[ ]	[ ]

9) In the last two weeks how many trips did you drive at night?

[ ] Never [ ] 1 – 4 [ ] 5 – 10 [ ] More than 10

10) Hawaii does not have a motorcycle helmet law. Should it have a law?

[ ] Yes [ ] No [ ] Do not know

11) What do you think about those who drink and drive in Hawaii?

[ ] 1. Not a problem at all [ ] 2. [ ] 3. Moderate problem [ ] 4. [ ] 5. Big problem [ ] 6. Do not know

12) What do you think about the blood alcohol level in Hawaii?

[ ] 1. Too low [ ] 2. [ ] 3. About right [ ] 4. [ ] 5. Too high [ ] 6. Do not know

13) How often do you do the following while driving?

	Always	Often	Sometimes	Rarely	Never
Listen to the radio	[ ]	[ ]	[ ]	[ ]	[ ]
Listen to CD, iPod, or Podcasts	[ ]	[ ]	[ ]	[ ]	[ ]
Change CDs, DVDs, or Tapes	[ ]	[ ]	[ ]	[ ]	[ ]
Think about work and things you need to do	[ ]	[ ]	[ ]	[ ]	[ ]
Talk or interact with children in the back seat	[ ]	[ ]	[ ]	[ ]	[ ]
Talk to other passengers in the vehicle	[ ]	[ ]	[ ]	[ ]	[ ]
Travel with an animal companion	[ ]	[ ]	[ ]	[ ]	[ ]
Eat	[ ]	[ ]	[ ]	[ ]	[ ]
Drink (Water, coffee, tea, soda, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]
Make or take phone calls	[ ]	[ ]	[ ]	[ ]	[ ]
Read e-mails or text messages	[ ]	[ ]	[ ]	[ ]	[ ]
Send e-mails or text messages	[ ]	[ ]	[ ]	[ ]	[ ]
Surf the net or social media	[ ]	[ ]	[ ]	[ ]	[ ]
Put on make-up in traffic or at stop lights	[ ]	[ ]	[ ]	[ ]	[ ]
Read a book, newspaper, iPad, or Kindle	[ ]	[ ]	[ ]	[ ]	[ ]
Use GPS or map service	[ ]	[ ]	[ ]	[ ]	[ ]
Multitask two or more of these activities in one trip	[ ]	[ ]	[ ]	[ ]	[ ]

14) During the past 12 months:

	Yes	No
a) Have you been stopped by the Police?	[ ]	[ ]
b) Were you issued a citation?	[ ]	[ ]
c) Have you had a DUI?	[ ]	[ ]
d) Have you been involved in a traffic accident?	[ ]	[ ]
If YES, did any of these accidents involve your cell phone use?	[ ]	[ ]
If YES, did any of these accidents involve someone else's cell phone use?	[ ]	[ ]

15) Please give us your opinion on the five urban-rural road questions below:

15.a) Think about emergency response for traffic accidents such as police, ambulance and fire truck. Compared to urban areas, in rural areas emergency response is:

[ ] 1. Far worse [ ] 2. Worse [ ] 3. About the same [ ] 4. Better [ ] 5. Much better

15.b) Do you agree that the government should increase gasoline taxes in order to improve emergency response for rural roads?

[ ] 1. Strongly disagree [ ] 2. Disagree [ ] 3. Neutral [ ] 4. Agree [ ] 5. Strongly agree

15.c) There are more fatal crashes on rural roads than on urban roads. High standard roads like freeways are the safest. Building high standard rural roads with two lanes per direction, a median, barriers and shoulders is much safer but costs a lot more.

Do you agree that the government should make rural roads safer by converting them to high standard roads given that the costs will be much higher?

[ ] 1. Strongly disagree [ ] 2. Disagree [ ] 3. Neutral [ ] 4. Agree [ ] 5. Strongly agree

15.d) Do you agree that the government should raise gasoline taxes to collect funds to make rural roads safer by converting them to high standard roads?

[ ] 1. Strongly disagree [ ] 2. Disagree [ ] 3. Neutral [ ] 4. Agree [ ] 5. Strongly agree

15.e) Should more money, less money or about the same amount of money be provided to support urban road and highway improvements?

[ ] More money [ ] Less money [ ] About the same [ ] No opinion

Part 2: Rural Transportation Survey

1) Please rate these travel conditions on rural roads:

	1. Not a problem at all	2.	3. Moderate problem	4.	5. Big problem
Ambulance response to emergencies	[ ]	[ ]	[ ]	[ ]	[ ]
Cell phone reception for emergency calls	[ ]	[ ]	[ ]	[ ]	[ ]
Access to public transportation	[ ]	[ ]	[ ]	[ ]	[ ]
Road condition of state highways	[ ]	[ ]	[ ]	[ ]	[ ]
Hidden, missing or defaced traffic signs	[ ]	[ ]	[ ]	[ ]	[ ]
Faded or worn out lane markings	[ ]	[ ]	[ ]	[ ]	[ ]
No traffic lights at rural intersections	[ ]	[ ]	[ ]	[ ]	[ ]
Lighting at night	[ ]	[ ]	[ ]	[ ]	[ ]
Speed limits are low	[ ]	[ ]	[ ]	[ ]	[ ]
Narrow shoulders or no shoulders	[ ]	[ ]	[ ]	[ ]	[ ]
Winding roads	[ ]	[ ]	[ ]	[ ]	[ ]
Stopping to turn left into driveways	[ ]	[ ]	[ ]	[ ]	[ ]
Slowing down to turn right into driveways	[ ]	[ ]	[ ]	[ ]	[ ]
Farm driveways	[ ]	[ ]	[ ]	[ ]	[ ]
Animal crossings	[ ]	[ ]	[ ]	[ ]	[ ]
Driving at night	[ ]	[ ]	[ ]	[ ]	[ ]
Driving when roads are wet	[ ]	[ ]	[ ]	[ ]	[ ]

2) Please rate these vehicles and behaviors on rural roads:

	1. Not a problem at all	2.	3. Moderate problem	4.	5. Big problem
Seatbelt use is low	[ ]	[ ]	[ ]	[ ]	[ ]
Farm vehicles or equipment on the highway	[ ]	[ ]	[ ]	[ ]	[ ]
Large trucks and buses	[ ]	[ ]	[ ]	[ ]	[ ]
Drivers speeding	[ ]	[ ]	[ ]	[ ]	[ ]
Drivers overtaking	[ ]	[ ]	[ ]	[ ]	[ ]
Drivers stopping or blocking lanes	[ ]	[ ]	[ ]	[ ]	[ ]
Impaired drivers (alcohol, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]
Distracted drivers (texting, etc.	[ ]	[ ]	[ ]	[ ]	[ ]
Unlicensed drivers (young teens)	[ ]	[ ]	[ ]	[ ]	[ ]
Single Motorcyclists	[ ]	[ ]	[ ]	[ ]	[ ]
Groups of Motorcyclists	[ ]	[ ]	[ ]	[ ]	[ ]
Single bikers	[ ]	[ ]	[ ]	[ ]	[ ]
Groups of bikers	[ ]	[ ]	[ ]	[ ]	[ ]
Sports events that use rural roads	[ ]	[ ]	[ ]	[ ]	[ ]
Tourists driving erratically	[ ]	[ ]	[ ]	[ ]	[ ]

3) Please add your comments about risky behaviors or risky conditions on rural roads:

_____
_____

4) How do you get information on the condition of rural roads?

[ ] Radio	[ ] TV	[ ] Newspaper, printed
[ ] Email	[ ] Facebook	[ ] Twitter
[ ] Online websites	[ ] Word of mouth	
[ ] Other (Please Specify):	_____	

5) In rural areas, what do you think about connectivity?

5.a) Cell phone:

	1. Very bad	2.	3. Neutral	4.	5. Very Good
Cell phone signal strength for calls	[ ]	[ ]	[ ]	[ ]	[ ]
Data limits by providers	[ ]	[ ]	[ ]	[ ]	[ ]
Internet speed	[ ]	[ ]	[ ]	[ ]	[ ]
Cost of internet service	[ ]	[ ]	[ ]	[ ]	[ ]
Service availability	[ ]	[ ]	[ ]	[ ]	[ ]

5.b) Home:

	1. Very bad	2.	3. Neutral	4.	5. Very Good
Availability of internet	[ ]	[ ]	[ ]	[ ]	[ ]
Internet speed	[ ]	[ ]	[ ]	[ ]	[ ]
Download speed	[ ]	[ ]	[ ]	[ ]	[ ]
Cost of internet service	[ ]	[ ]	[ ]	[ ]	[ ]
Unreliable connection	[ ]	[ ]	[ ]	[ ]	[ ]
Electric power interruptions	[ ]	[ ]	[ ]	[ ]	[ ]

Part 3: Demographic Survey

1) What is your gender? [ ] Male [ ] Female

2) What is your age?

[ ] Under 15 [ ] 15 - 25 [ ] 26 - 35
[ ] 36 - 45 [ ] 46 - 55 [ ] 56 - 65
[ ] 66 - 75 [ ] 76 or older

3) What is your marital status?

[ ] Single [ ] Married [ ] Widowed [ ] Divorced or Separated

4) What is the highest level of school you have completed or the highest degree you have received?

[ ] Less than high school degree [ ] High school degree or equivalent [ ] Some college but no degree
[ ] Associate degree [ ] Bachelor degree [ ] Graduate degree

5) Which of the following categories best describes your main current status?

[ ] Employed full-time [ ] Employed part-time [ ] Not employed
[ ] Retired [ ] Student [ ] Disabled, not able to work

6) If you work full or part-time, your employment is in:

[ ] Public sector – City or County [ ] Public sector – State [ ] Public sector – Federal
[ ] Private sector – Small business with 1 to 99 employees [ ] Private sector – Medium-sized business with 100 to 499 employees [ ] Private sector – Large business with 500 employees or more
[ ] Self-employed

7) What's the zip code at your place of residence? _____

8) Your place of residence is this type of area...

[ ] Rural [ ] Urban [ ] Suburban

9) What's the zip code at your place of work or school? _____

10) Which race best describes you? Please mark one box.

[ ] Native Hawaiian or part Hawaiian [ ] Guamanian or Chamorro [ ] Samoan
[ ] Other Pacific Islander [ ] White [ ] African American or Black
[ ] American Indian or Alaska Native [ ] Asian Indian [ ] Chinese
[ ] Filipino [ ] Japanese [ ] Korean
[ ] Hispanic/Latino [ ] Vietnamese [ ] Other Asian
[ ] Other

11) Are there other races that also describe you? If yes, please add them in the box below.

APPENDIX B: EMAIL STANDARD CONTENT

SENDER: CSET Transportation Research Center at UH <cset@hawaii.edu>

SUBJECT: We need your opinion! How bad is traffic congestion? Do you feel safe driving on rural roads?

How bad is traffic congestion in Hawaii?
Do you feel safe driving on rural roads in Hawaii?
Your opinion to our scientific survey is very important!

Click here to take the survey: https://survey.zohopublic.com/zs/KSBUte

In return, you'll have a chance to receive one of ten $20 Amazon gift cards. Just add your email at the end.

Your email will be removed from your responses. Your responses will be kept anonymous and results will be reported in summary form only.

Please take this survey by October 15, 2019. Thanks for giving us a few minutes of your time!

****** Feel free to share with friends and family. We need help reaching folks on Kauai, Lanai, Maui and the Big Island! ******

Mahalo nui loa,

Dr. Panos Prevedouros and the CSET* Team at the University of Hawaii at Manoa

*CSET is the Center for Safety Equity in Transportation, a U.S. Dept. of Transportation research project at the Universities of Alaska, Hawaii, Idaho and Washington.