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STATE
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UNIVERSITY OF HAWAI'I AT MĀNOA
SHIDLER COLLEGE
OF BUSINESS
SCHOOL OF TRAVEL
INDUSTRY MANAGEMENT



Visitors and Public Transit: A Data-Driven Analysis of Oahu Island

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Date: Sep 22nd, 2025

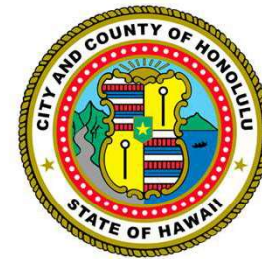


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Acknowledgement

- City and County of Honolulu – Chris Clark, Greg Tsugawa, Daniel Alexander, Ian Crittenden
- OahuMPO – Dallas Ige, Mark Garrity
- HTA – Jennifer Chun; HDOT; HSEO
- ETC Institute, Stantec, Caliper



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Outline

- Background and Data Collection
- Descriptive Analysis
- Data Processing
- Methodology
- Results



Background

HSEO priorities (energy use and decarbonization):

- Understand visitor travel mode choices (to reduce VMT and support electrification)

OahuMPO priorities (transportation planning):

- Assess visitor impacts on the transportation network
- Update the travel demand forecasting model with visitor travel data



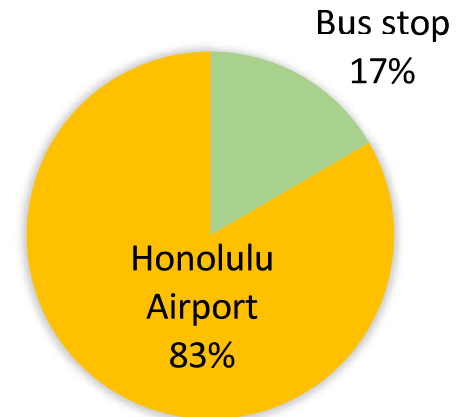
Data Collection

O'ahu visitor travel survey

- 2024
- Non-Oahu residents
- 3,219 responses include:
 - **Demographic factors**
 - **Travel diary**
 - 24-hour period on a weekday
(12,439 trips in total)



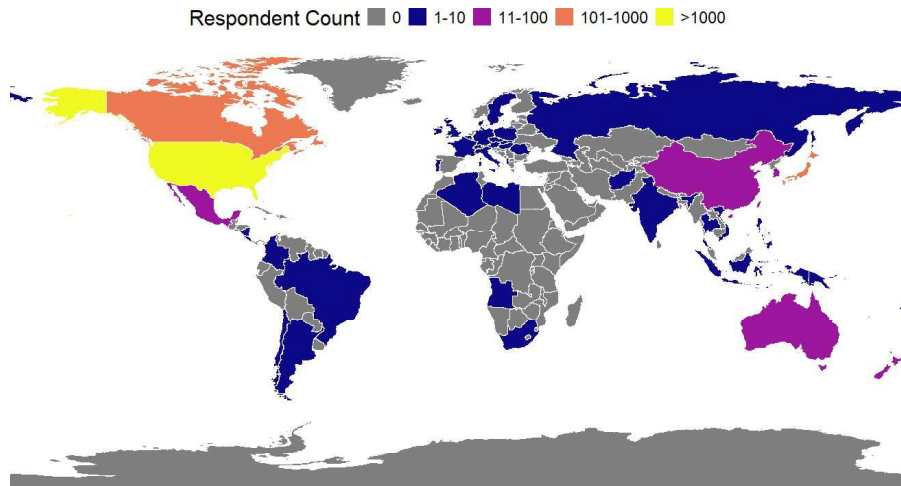
Survey Location



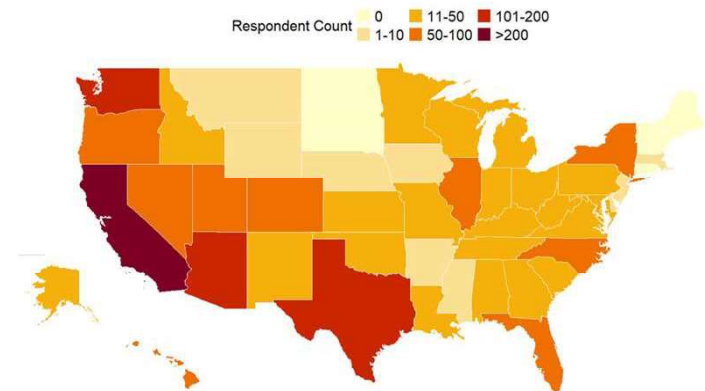
Respondent Distribution

Respondents' Country of Origin

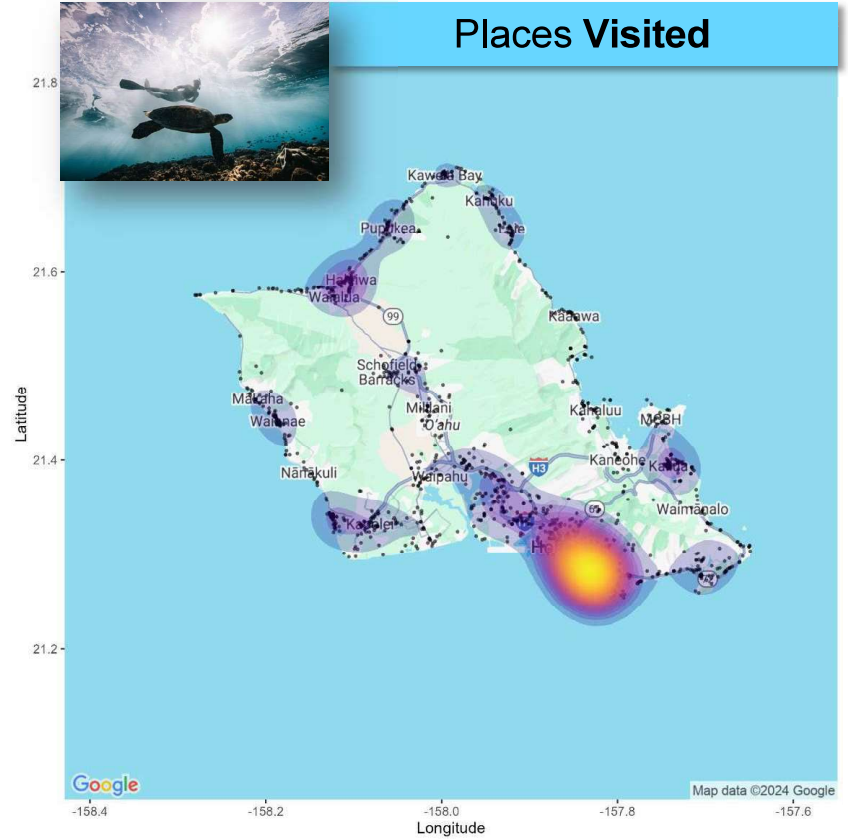
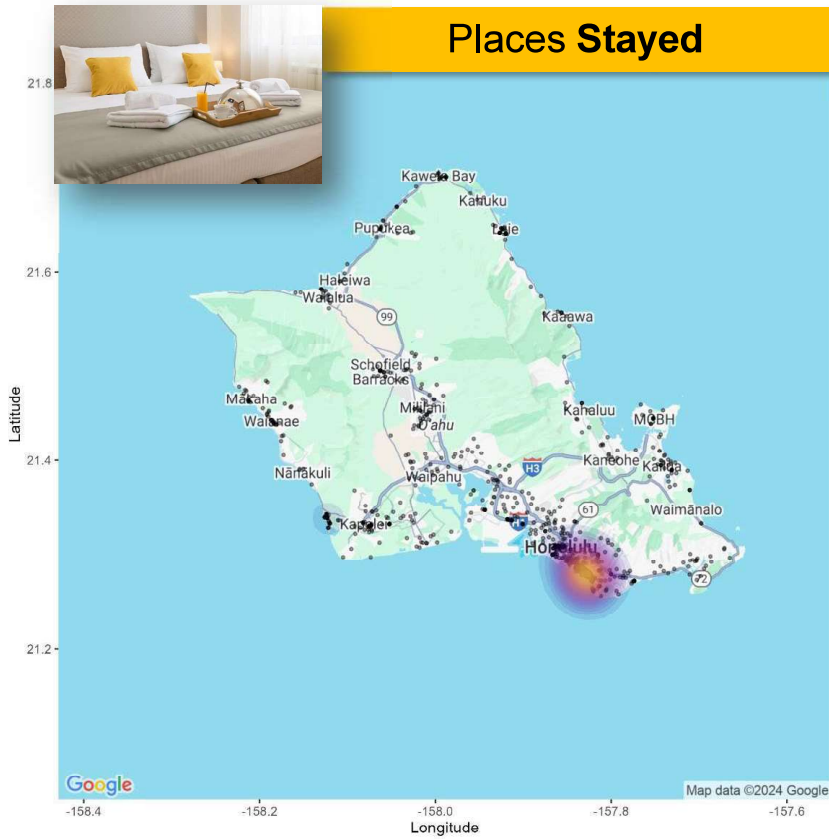
- 3,219 respondents
- mostly from the U.S. mainland, Canada, and Japan



- most domestic respondents from the West Coast



Where visitors **stayed** and where they **visited**

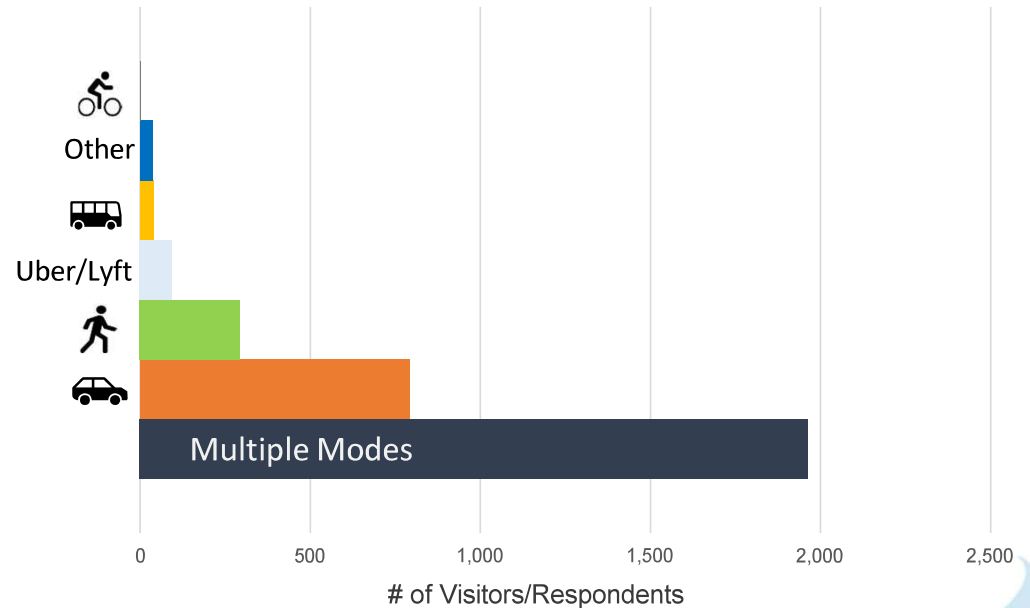


Mode use questions

Reason not using public transit

Rank	Reason (Ranked by Most Selected)
1	Convenience of other transportation options
2	I have never really considered it
3	Lack of familiarity with public transit system
4	The bus rides take too long
5	Other (please specify)
6	Understanding how to use the bus seemed too complicated
7	Lack of convenient bus routes
8	Concerns about safety/security
9	I prefer not to be in close proximity to strangers
10	Too many transfers
11	Had trouble getting a HOLO card (bus card)

Primary Mode of travel while on Oahu

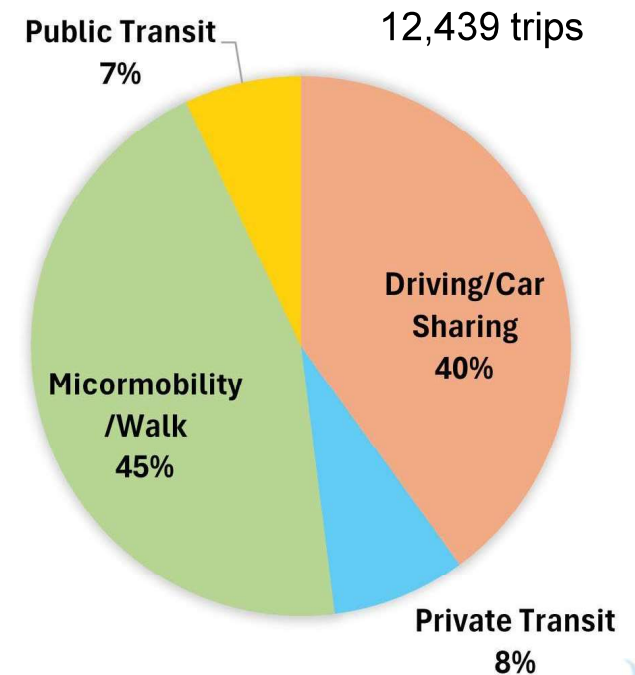


Travel Diary Data

Travel diary MODES → grouped into 4 categories:

Driving/Car Sharing 	Public Transit 	Private Transit 	Micromobility/Walking 
• Rental car/vehicle; • Personal auto, motorcycle, van or truck; • Hired car, taxi, limo, Uber, or Lyft; • Commercial Vehicle or Truck Driver	• Public Transit/ The Bus/ Rail	• Private shuttle • Other Private Transit	• E-Scooter • Wheelchair or Mobility Scooter • Personal E-Scooter or One-wheel • Walk • Bike

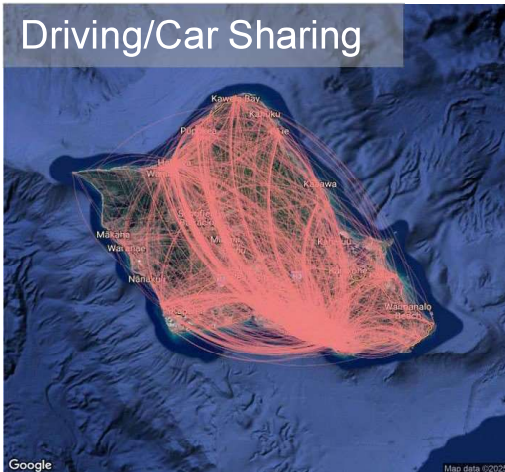
Trips by mode



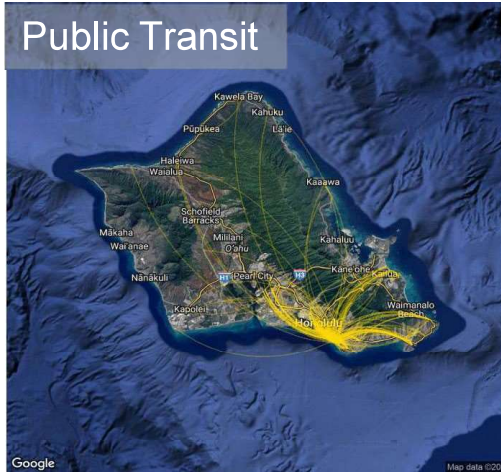
Travel Origin/Destination Distribution

- Travel mode choice is related to trip distance

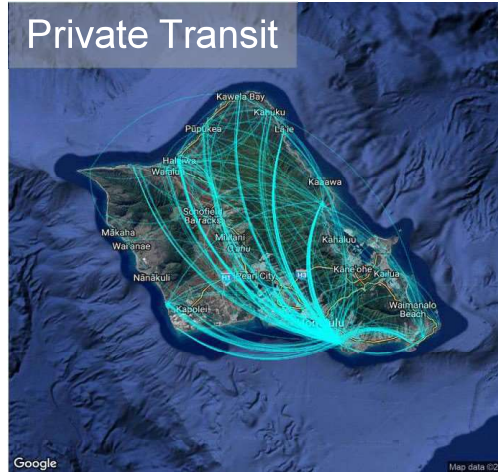
Driving/Car Sharing



Public Transit



Private Transit



Micromobility/Walk



Variable Selection

- Numerical Variables
 - Bikesharing stations and bus stops next to OD
 - Travel distance (km)
 - Using Google Maps API

Variable	Mean	SD
Number of Travelers	2.2	2.8
Age	42.6	14.4
Visiting Frequency	3.2	3.0
Nights	6.8	5.9
Number of people	2.9	2.7
Household members	2.3	1.4
Under 18	0.5	0.9
Origin BS count	3.7	3.3
Des BS count	3.7	3.3
Origin Bus count	5.3	4.2
Des Bus count	5.3	4.2
Distance (KM)	11.8	17.7



Variable Selection

- Half of the explanatory variables are categorical.

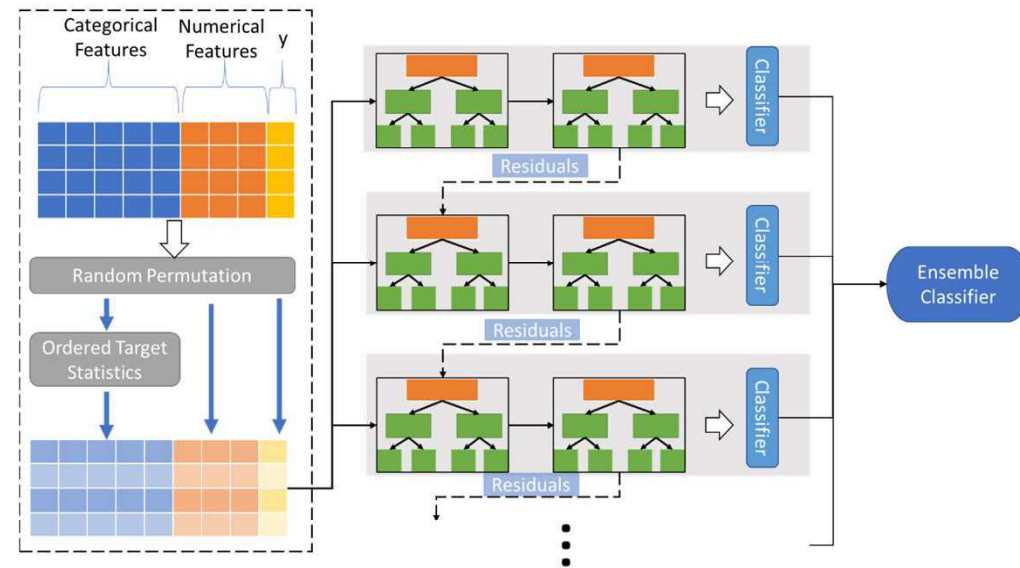
Variable	Category	Percentage
Trip Purpose	Business	2.0%
	Leisure/Activity	46.6%
	Medical or health services	0.2%
	Other	0.9%
	Return to Home/Lodging	39.6%
	School	0.1%
	Shopping	9.1%
	Transportation-related	1.1%
	Visiting friends/relatives	0.5%
County Origin Group	Canada	4.3%
	Hawaii Not Oahu	2.6%
	Japan	11.9%
	Oceania	4.7%
	Other	3.0%
	Other Asia	3.1%
	USA-Eastern	29.4%
	USA-Pacific	41.0%
Arrival Time to Oahu	Afternoon	44.4%
	Evening	9.0%
	Morning	40.8%
	Night	5.8%
Accommodation	Condo	6.6%
	Friends/Relatives	10.0%
	Hotel	68.9%
	Other	3.5%
	Rental Home/Room/Air B&B	6.6%
	Time Share	4.4%

Variable	Category	Percentage
Airport to Stay Location	Driving or Car Sharing	87.5%
	Micromobility/Walk	0.0%
	Other	0.2%
	Private Transit	9.5%
	Public Transit	2.8%
Household Income	<\$10k	0.5%
	\$10k-\$50k	9.3%
	\$50k-\$100k	31.5%
	\$100k-\$200k	20.8%
	>\$200k	7.0%
	Refused	22.6%
Employment Status	Don't Know	8.3%
	Full-time	78.1%
	Part-time	9.2%
	Not Employed	12.7%
Gender	Female	45.3%
	Male	54.5%
	Other	0.1%
Public transport use	Never	51.4%
	Occasionally	27.3%
	Often	21.3%
Prepay for transport	No	83.2%
	Yes	16.8%
Trip Start Time	Afternoon	33.4%
	Evening	25.4%
	Morning	33.9%
	Night	7.4%
Organized	No	97.9%



Methodology

- CatBoost
 - Powerful model for handling categorical variables and small datasets
 - Capturing non-linear relationship
- SHAP
 - Interpreting the ML method



Proposed Method Framework



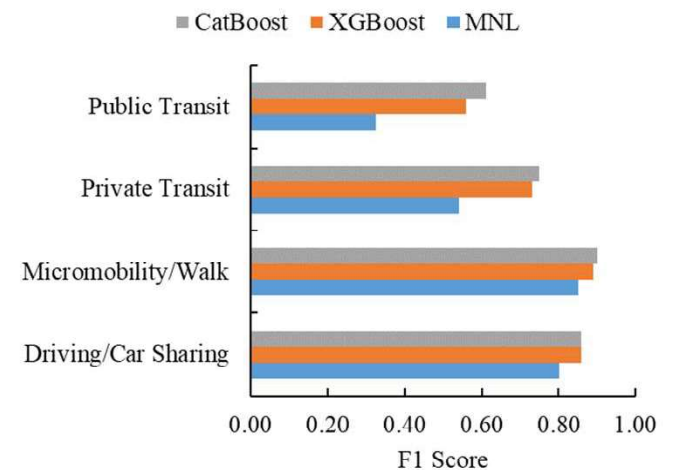
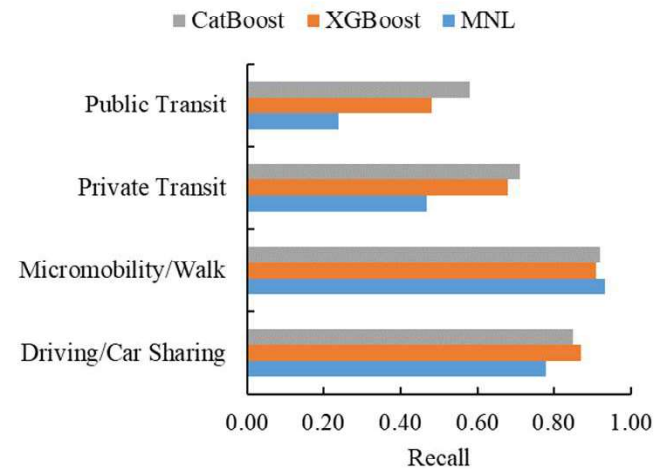
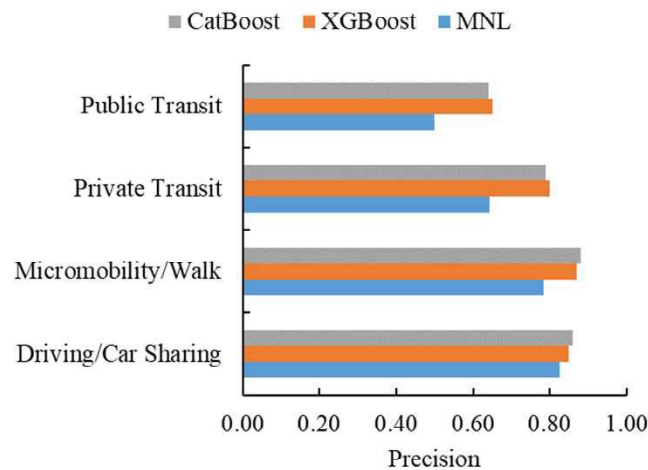
Model Performance

- Model comparison using the test dataset
 - MNL vs. XGBoost vs. CatBoost

$$\text{Precision}_{mm} = \frac{TP_{mm}}{TP_{mm} + FP_{mm}}$$

$$\text{Recall}_{mm} = \frac{TP_{mm}}{TP_{mm} + FN_{mm}}$$

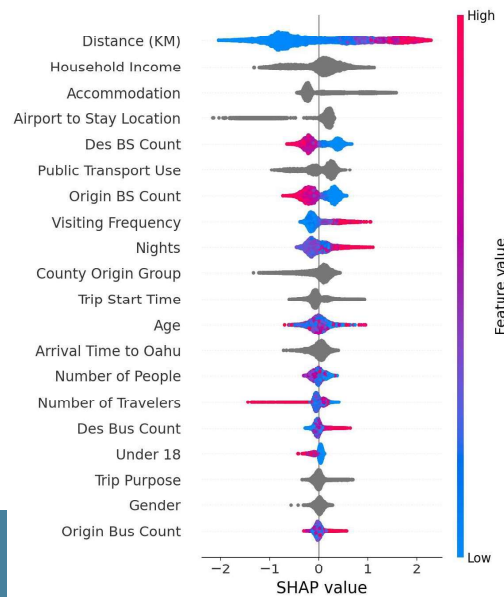
$$F1_{mm} = 2 \times \frac{\text{Precision}_{mm} \times \text{Recall}_{mm}}{\text{Precision}_{mm} + \text{Recall}_{mm}}$$



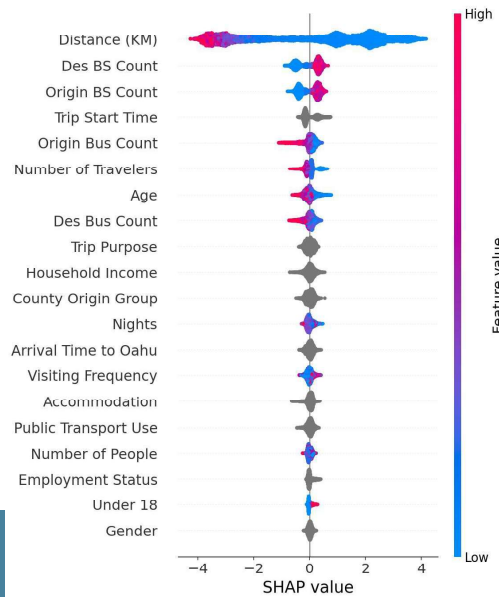
Model Interpretation

- Using SHAP to interpret the ML model

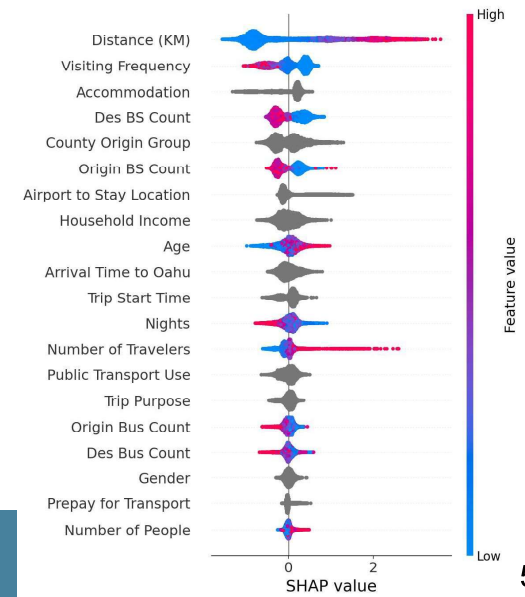
Driving/Car Sharing



Micromobility/Walk

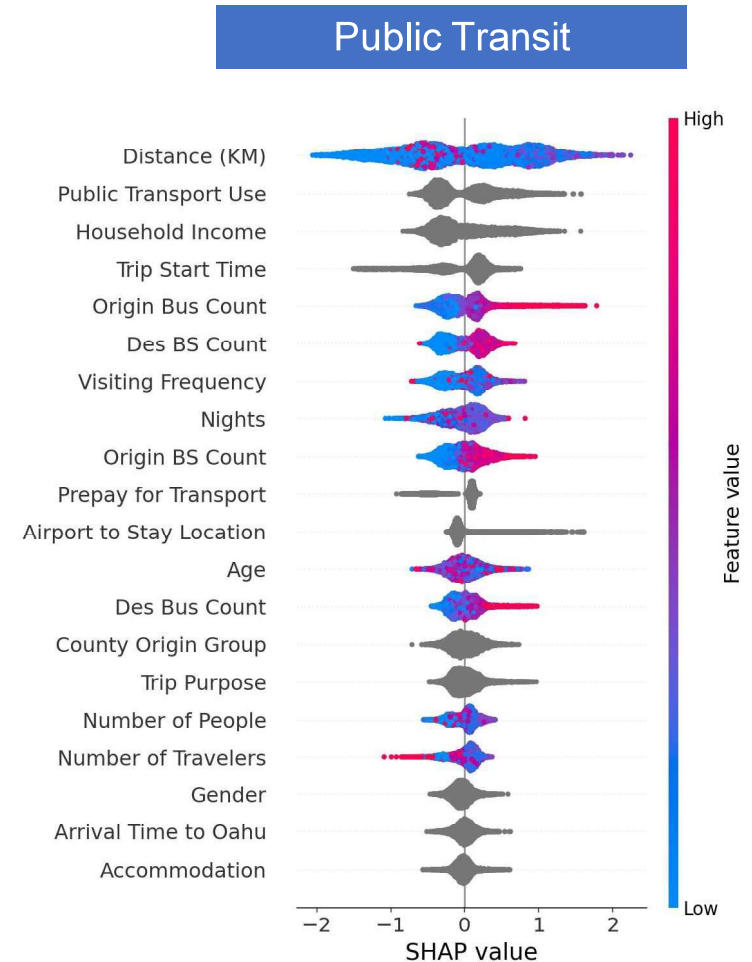


Private Transit



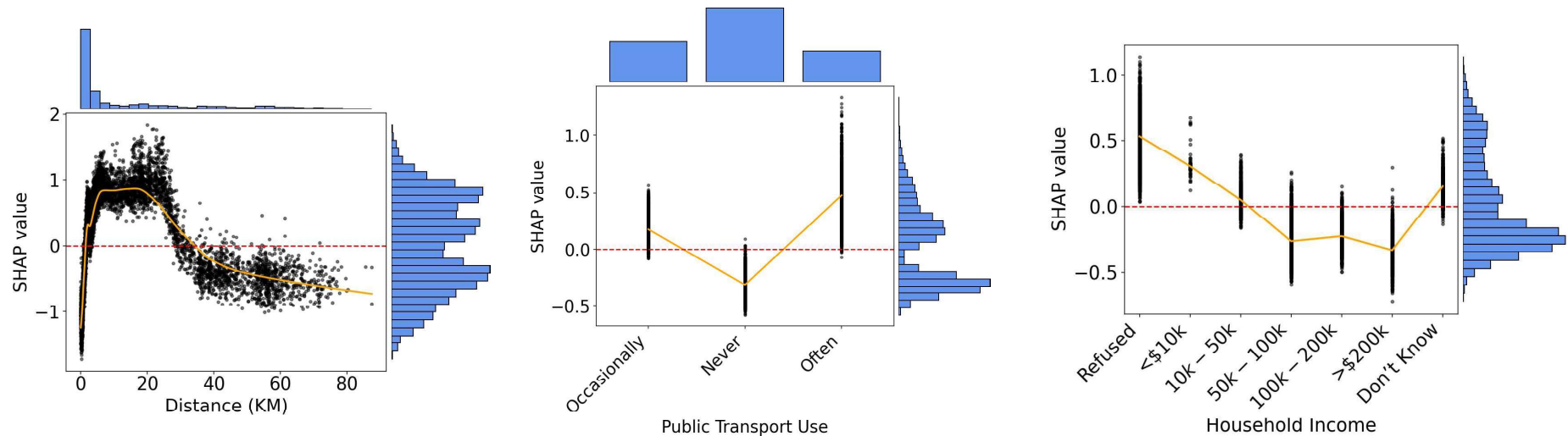
Model Interpretation

- Positive impact on selecting public transit
 - Bus stops, bikesharing stations
- Negative impact on selecting public transit
 - Number of travelers



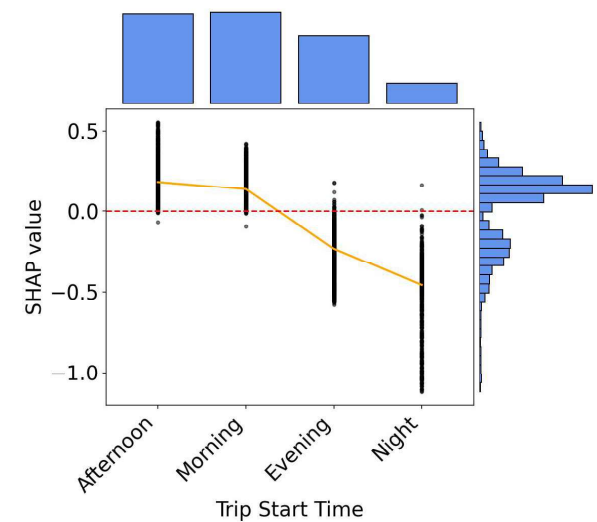
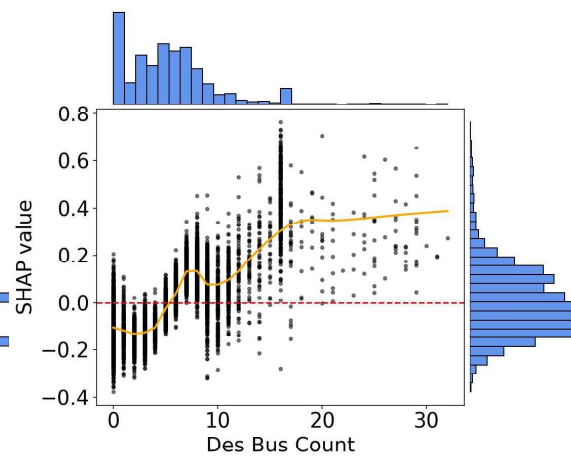
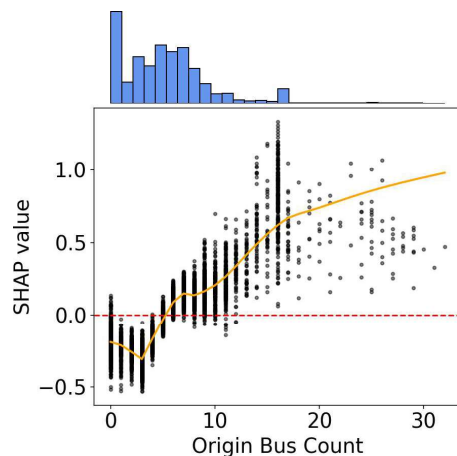
Model Interpretation

- Variables impact the likelihood of selecting buses
 - Trip distance, bus use at home, income



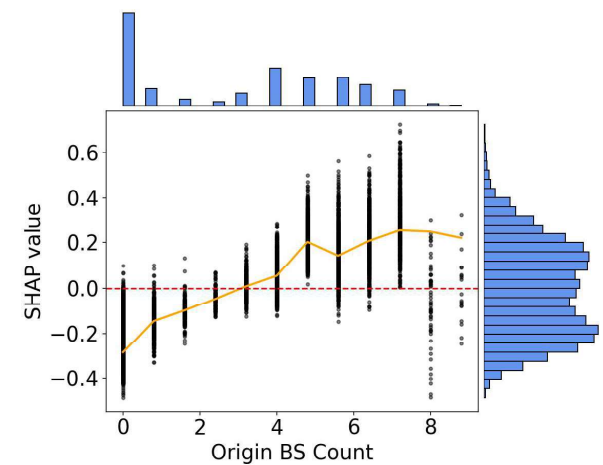
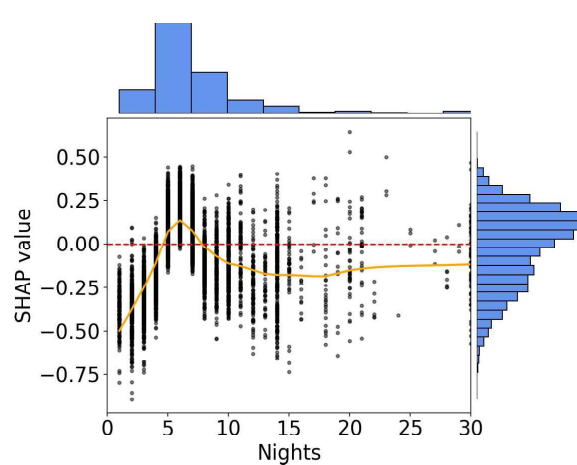
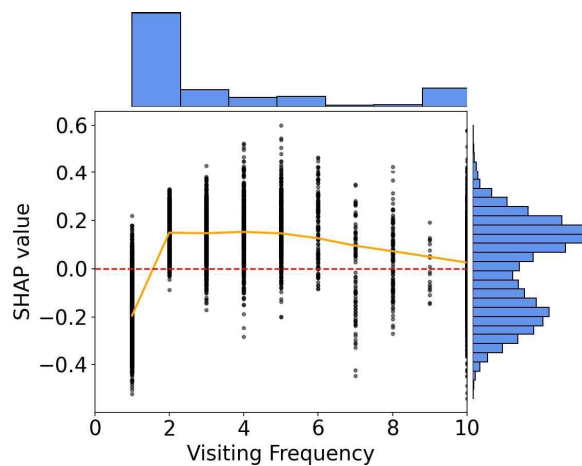
Model Interpretation

- Variables impact the likelihood of selecting buses
 - Bus stop count, trip start time



Model Interpretation

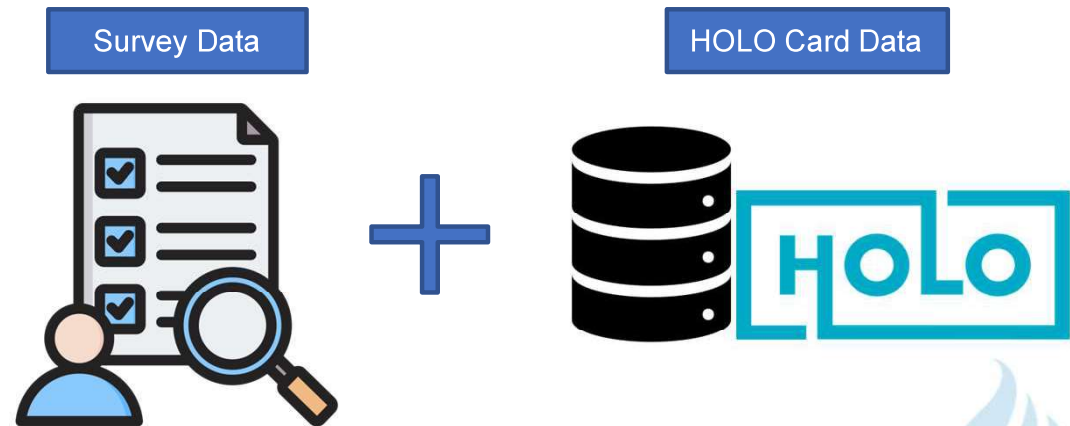
- Variables impact the likelihood of selecting buses
 - Visiting frequency, Number of nights, bikesharing stations





Transit Data: Data Integration

- Small Data and Big Data Integration
- 2021-2022 Transit Rider Survey Data
 - Bus user demographic info
 - HOLO card last five digits
- HOLO Card Data
 - HOLO card ID
 - Transaction events
 - Boarding events



Transit Data: Data Integration





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Mahalo!