Determinants of shared electric scooter use in Washington D.C.

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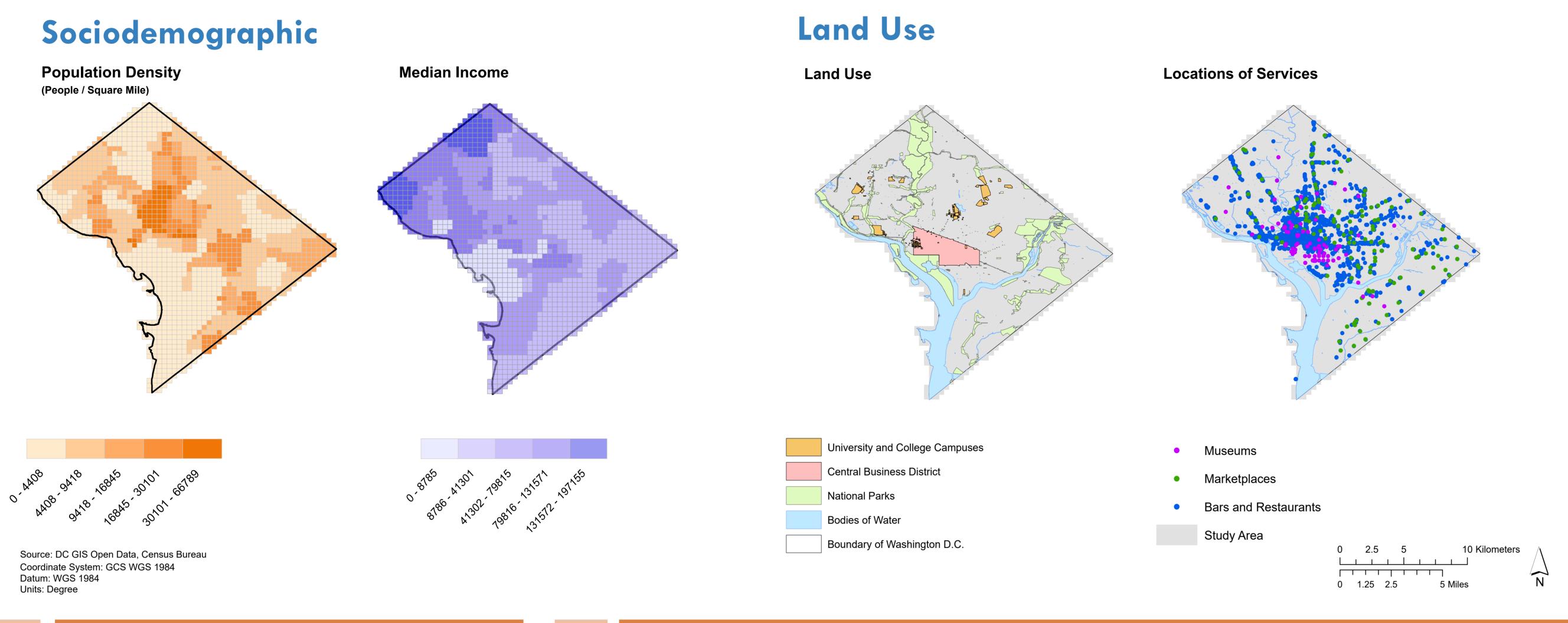




INTRODUCTION

- Our study examines the factors that determine the presence of e-scooters, as well as those that cause variation in e-scooter presence between each consecutive hour and throughout the day.
- Data on the location of e-scooters in the Washington D.C. area over six full days was collected.
- Then, multi-level mixed effects linear regression models were generated to investigate the impact of time, land use characteristics, and transportation infrstructure while controlling for weather conditions.

COVARIATES



MODEL DESIGN

Multi-level mixed effects regression modelling

	Model 1 Presence of e-scooters	Model 2 Average number of e-scooters	Model 3 Hourly change in average number of e-scooters	Model 4 Coefficient of variation	
Model type	Logit	Linear	Linear	Linear	
Dependent variable		12	Δ Σ	Coefficient of $\frac{SD}{\mu}$	
Omission	None		$\Delta_i = \Delta_{i-1} = 0$, 12AM - 1AM	$CV = SD = \mu = 0,$ 12AM - 6AM	
Temporal unit	Hour (144)	Hour (144)	Hour (138)	Day (6)	
Spatial unit	Fishnet (1,671)	Fishnet (1,308)	Fishnet (1,306)	Fishnet (1,297)	
No. observations	240,624	78,260	75,044	5,539	
Bootstrapping	Yes	Yes	Yes	No	

DISCUSSION

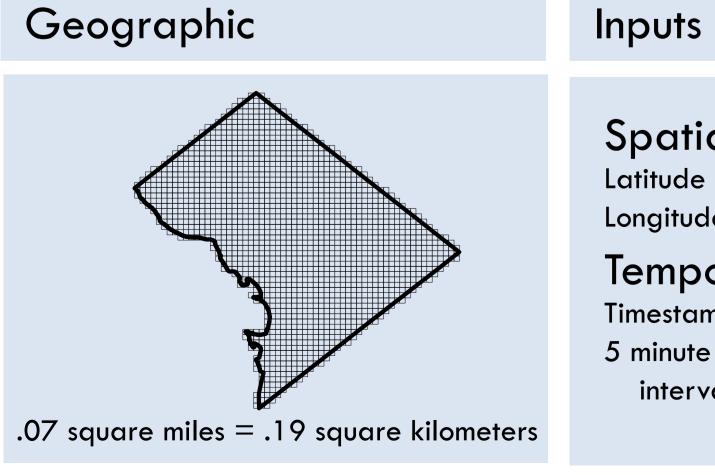
- Weekends & late nights: fewer e-scooters & less variation in hourly e-scooter presence.
- Higher population density & being located in the CBD: more e-scooters, contributed to more change in the hour-to-hour numbers of e-scooters, but less variation throughout the day.
- Bikeshare stations & bicycle lanes: positively impacted the presence & hourly change in e-scooters, low variation throughout the day.
- Metro stations: positively impacted the average number of e-scooters in an area, and hourly movement to & from an area, not a significant indication of presence.

DATA

APIs - publicly accessible via DDOT

Six Full Days in 2019	Sources
Sunday May 12th Monday May 13th Tuesday May 14th Thursday May 16th Saturday June 1st Friday June 14th	Bird Jump Lime Lyft Skip Spin

Unit of Analysis

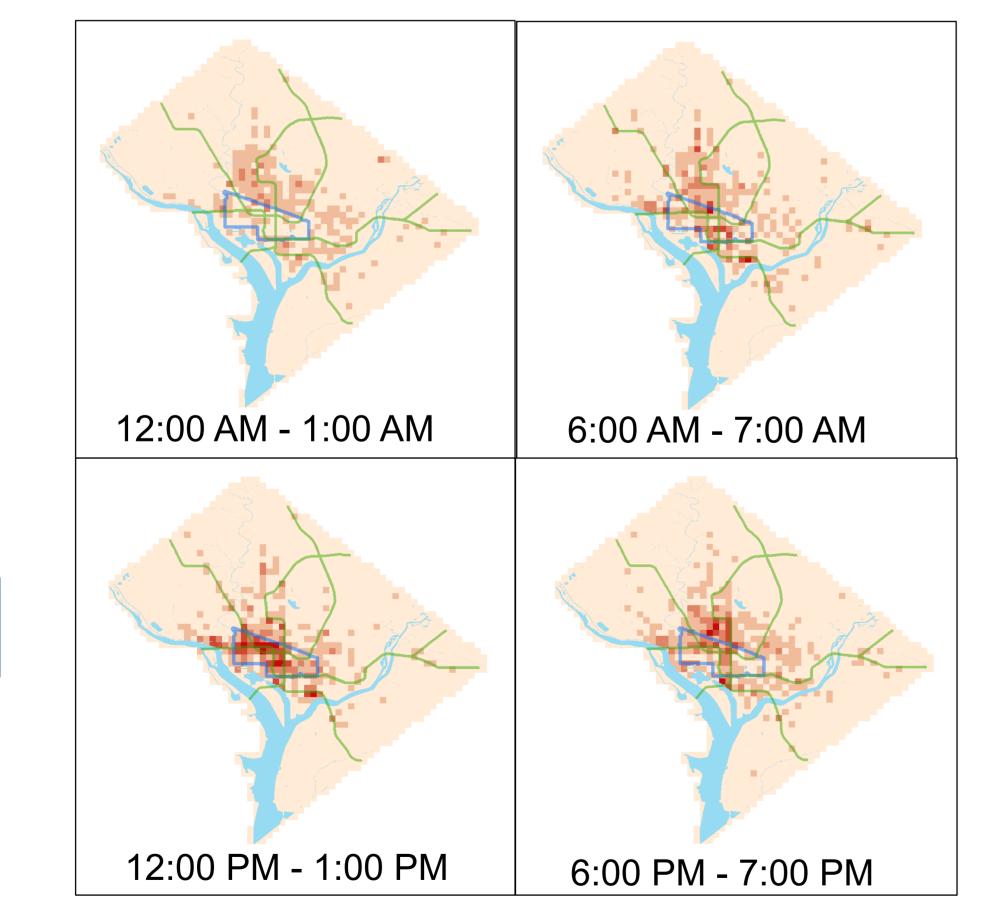




240,624

STUDY AREA

Distribution of e-scooters at selected periods of the day



E-Scooters per Fishnet	Metro Lines
	Central Business District
0,2 3,8 9,7 1,26 1,28	Bodies of Water
Coordinate System: GCS WGS 1984 Datum: WGS 1984 Units: Degree Sources: District Department of Transportation	0 2.5 5 10 Kilometers

REGRESSION RESULTS

		Model 1		Model 2		Model 3		Model 4	
ord		O.R.	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
00	Weekend Day	0.79	*	-0.26	*	-0.16	***	-0.31	**
3	12AM – 6AM	0.58	***	-0.82	***	-0.41	***	N/A	N/A
<u>⊕</u>	6AM – 12PM	0.65	***	0.21		-0.03		N/A	N/A
	12PM – 6PM	0.88		0.68	***	0.04		N/A	N/A

		Model 1		del 1 Model 2		Model	Model 3		4
		O.R.	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
	Census Tract Population Density (1000s)	1.13	***	0.02	***	0.00	**	-0.02	***
	Low Income Area	9.58	***	0.27		0.05		-0.39	*
()	Low–Medium Income Area	11.22	***	0.35	*	0.09		-0.39	*
Use	High–Medium Income Area	17.33	***	0.05		0.04		-0.25	
Land	Number of Museums	1.44		0.64	***	0.22	***	-0.14	
	Number of Marketplaces	2.15	***	-0.31	***	-0.07	**	-0.16	*
	Number of Bars & Restaurants	1.16	***	0.23	***	0.05	***	-0.03	***
	Part of the CBD	25.36	***	3.57	***	1.00	***	-0.63	***
	Part of a College Campus	2.28	***	-0.13		-0.01		-0.10	
	Part of a National Park	1.12		0.14	**	0.06	**	0.06	

Inf		Model 1		Model	Model 2		Model 3		4	
	ב ב		O.R.	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
	ILOCI	Number of Bus Stops	1.26	***	0.06	***	0.00		-0.02	*
,	Tras	Number of Metro Stations	1.94		2.01	***	0.51	***	-0.20	
		Number of Parking Meter Spaces	0.96	**	-0.02	**	0.00		0.01	
	sportar	Number of Capital Bikeshare Stations	3.16	***	0.83	***	0.19	***	-0.30	***
-	Irdns	Fishnet Contains a Bicycle Lane	2.73	***	0.02		0.08	***	-0.21	**

	Model 1		Model 2		Model 3		Model 4	
	O.R.	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Temperature(°C)	1.02		-0.04	***	0.01	*	0.02	*
Precipitation Intensity (mm/hr)	0.85		0.05		-0.14	**	1.76	***
Humidity (0-1)	2.60	*	2.36	***	0.18		-1.44	***
Wind Speed (km/hr)	0.99		0.03	**	0.01		0.03	***

Statistical Significance *p<0.05, **p<0.01, ***p<0.001

CONCLUSION

- This study contributes to a more comprehensive understanding of the factors that impact the presence as well as variations in the presence of e-scooters using data obtained for e-scooters operating in Washington D.C.
- The models suggest that e-scooters were available near bike lanes.
- Dataset cannot address if an e-scooter was placed as part of rebalancing or by a user.
- There is a relationship between public transport & e-scooters, it is not clear if they serve as a first-mile last-mile solution.
- Utilization patterns can help city planners & officials understand how shared e-scooters are used and how they interact with existing systems.

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