

# Supplementary Material

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## I. OLS ESTIMATION FOR 116 INTERIOR WARDS AND 49 EXTERIOR WARDS

The spatial extent of Bangalore city has expanded considerably from  $69 \text{ km}^2$  in 1949 to  $741 \text{ km}^2$  in 2017 [1]. This has necessitated the division of the city into eight different zones for administrative convenience, as shown in Figure 1. While the interior group comprises of the older parts of the city, the exterior group comprises of the recently developed parts of the city. In Figure 1, it can be seen that the interior groups are numbered (1,2,3) and exterior groups are numbered (4,5,6,7,8). The OLS estimates of interior and exterior group of municipal wards are compared in this section to see the relative influence of the demand determinants.

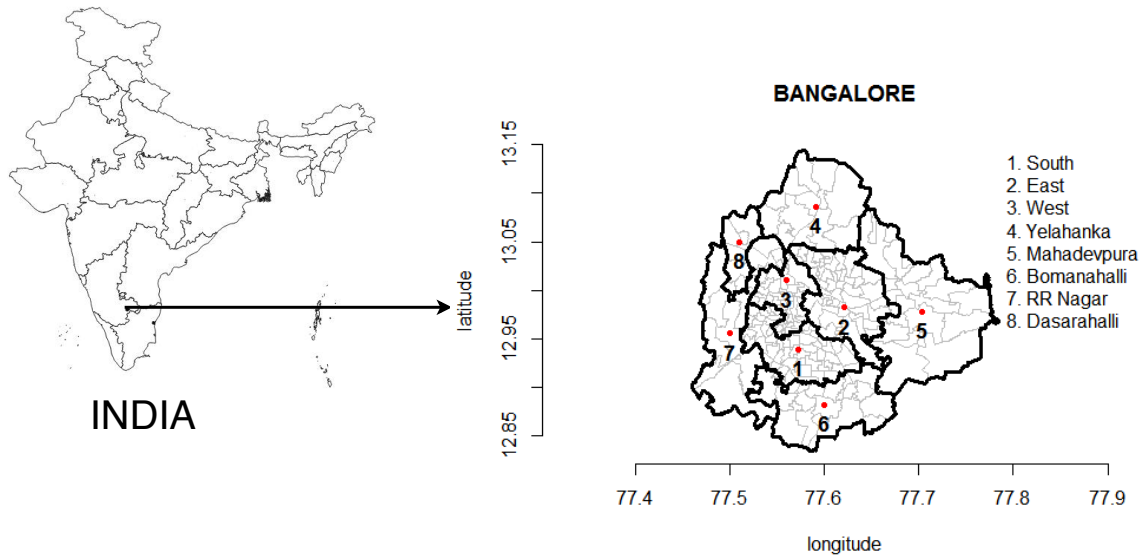


Figure 1: Study Area - Bangalore, India

8 groups of municipal wards

Before doing the comparison between the demand models of interior and exterior wards, difference of means test is done between the interior and exterior wards. Results of two-sample Welch t-test shown in Table I clearly suggests that interior wards have significantly higher population density, household density, property density, road density and average built-up area than exterior wards. In Table I,  $\mu_{s1}$  and  $\mu_{s1}$  indicate the sample mean of interior and exterior wards.

Table I: Comparison of means between interior and exterior wards

Variable	$\mu_{s1}$	$\mu_{s2}$	p-value	Confidence Interval
Population density ( $x_1$ )	34119	14594	8.5e-13	14602-24449
Household density ( $x_2$ )	8117	3781	3.24e-11	3156-5515
Built-up area per property ( $x_7$ )	7.15e-05	4.0e-05	5.5e-08	2.0e-05-4.1e-05
Property density ( $x_8$ )	3959.0	2339.7	3.744e-10	1145.8-2092.7
Road density ( $x_9$ )	30.11	21.34	1.32e-10	6.32-11.22
Street light density ( $x_{10}$ )	1405.1	701.7	1.5e-12	527-879
Bus stop density ( $x_{11}$ )	10.08	4.72	2.2e-16	4.27-6.42
Per capita park area ( $x_{12}$ )	1.840	1.260	.2035	-.31-1.47

A comparison of OLS estimates of log-linear demand models is done between interior and exterior wards, as shown in Table II. The findings are summarized below.

- 1) The significant demand determinants of log demand model are different in the case of interior and exterior municipal wards. For the interior municipal wards, the significant factors that influence consumption are proportion of high income households  $x_3$ , proportion of middle income households  $x_4$ , average built-up area  $x_7$ , street light density  $x_{10}$  and per capita park area  $x_{12}$ . The exterior wards have significant factors such as proportion of high income households  $x_3$ , average built-up area  $x_7$ , property density  $x_8$ , road density  $x_9$  and streetlight density  $x_{10}$ .
- 2) The influence of average built-up area  $x_7$  on average demand levels is higher for the exterior municipal wards when compared to the interior wards. The strength of the factor  $x_7$  is 3653 for interior municipal wards and 4853 for exterior municipal wards. Hence, this shows that the impact of the built-up area on average water consumption is more pronounced in the exterior municipal wards when compared to the interior municipal wards.
- 3) Although the proportion of high income households positively influence the average water consumption in the interior and exterior wards, the strength of the factor is higher for exterior wards (.857) when compared to interior wards (.261). This observation is possibly due to the fact that high income households that includes the number of apartments are more prevalent in the exterior municipal wards when compared to the interior municipal wards of Bangalore.
- 4) For the interior wards, the per capita park area positively influences the average consumption. This is possibly due to the presence of households with higher consumption in the interior wards with significant number of parks.

Table II: OLS estimate comparison - Interior and Exterior wards

	<i>Dependent variable: log</i>	
	(Interior wards)	(Exterior wards)
population density x1	−0.00001 $p = 0.173$	−0.00004 $p = 0.566$
household density x2	0.00003 $p = 0.420$	0.0003 $p = 0.312$
proportion of high income households in ward x3	<b>0.261*</b> $p = 0.094$	<b>0.857*</b> $p = 0.051$
proportion of middle income households in ward x4	<b>0.411*</b> $p = 0.092$	0.178 $p = 0.743$
water meters per ward area x6	0.00001 $p = 0.718$	0.00001 $p = 0.952$
average built-up area x7	<b>3,653.821***</b> $p = 0.005$	<b>4,853.670**</b> $p = 0.023$
property density x8	0.00000 $p = 0.961$	<b>-0.001***</b> $p = 0.003$
road density x9	−0.011 $p = 0.291$	<b>0.053*</b> $p = 0.052$
street light density x10	<b>0.0002***</b> $p = 0.006$	<b>0.001*</b> $p = 0.069$
bus stop density x11	−0.0001 $p = 0.991$	−0.037 $p = 0.299$
per capita park area x12	<b>0.020***</b> $p = 0.008$	0.059 $p = 0.146$
Constant	2.761*** $p = 0.000$	2.513*** $p = 0.00001$
Observations	116	49
R <sup>2</sup>	0.503	0.486
Adjusted R <sup>2</sup>	0.450	0.334
Residual Std. Error	0.289 (df = 104)	0.350 (df = 37)
F Statistic	9.550*** (df = 11; 104)	3.185*** (df = 11; 37)

Note:

\*p&lt;0.1; \*\*p&lt;0.05; \*\*\*p&lt;0.01

## REFERENCES

- [1] BDA. <http://wgbis.ces.iisc.ernet.in/energy/lake2006/programme/programme/proceedings/Presentations/Lake%202006%20-%20Presentations/30%20Dec%202006/Session%20XI/Sudhira/Urbanisation%20in%20Bangalore.pdf>.