Homework3

Min-kyeong (Min) Cha

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1 Python

(a)

The underlying non-linear relationship of electricity usage and other variables is $y_i = e^{\alpha}\delta^{d_i} z_i^{\gamma} e^{\eta_i}$. If we take natural log both side, then it becomes $ln(y_i) = \alpha + \ln(\delta)d_i + \gamma \ln(z_i) + \eta_i$.

(b)

δ is the average effect of retrofitting on electricity consumption. If other variables are being fixed, a house with retrofitting increases or decreases electricity consumption by δ compared to a house without retrofitting.

(c)

$$\frac{\Delta y_i}{\Delta x_i} = \frac{y_i(d_i = 1) - y_i(d_i = 0)}{(d_i = 1) - (d_i = 0)} \tag{1}$$

$$= e^{\alpha} z_i^{\gamma} e^{\eta_i}(\delta - 1) \tag{2}$$

$$= (\delta - 1)\frac{y_i}{\delta^{d_i}} \tag{3}$$

$\frac{\Delta y_i}{\Delta x_i}$ is about the marginal effect of retrofitting on electricity consumption. It accounts for the change in electricity consumption with respect to retrofitting for the same household. In other words, it shows how much change will occur once the house chooses to retrofit. The result $(\delta - 1)\frac{y_i}{\delta^{d_i}}$ shows that the marginal effect depends on the average effect and the electricity consumption of household i.

(d)

$$\frac{\partial y_i}{\partial z_i} = \gamma e^{\alpha} \delta^{d_i} z_i^{\gamma - 1} e^{\eta_i} \tag{4}$$

$$= y_i z_i \tag{5}$$

When z_i is house size (in square feet), $\frac{\partial y_i}{\partial z_i}$ indicates the marginal effect of one unit increase in household size on electricity consumption. The result shows that it depends on current electricity consumption and house size.

(e)

Table 1 shows OLS and average marginal effect estimates with bootstrapped confidence intervals in parenthesis. I report one additional column with the average marginal effect computed via bootstrapping. For some unknown reason, estimates from bootstrapping (Marginal effect (2) column) are different from estimates from the OLS estimator with original data (Marginal effect (1) column). I checked OLS, but I got the same coefficients regardless of bootstrapping. I am still figuring out where the problem occurs...

	Regression estimates	Margin effect(1)	Margin effect(2)
retrofit	-0.1	-0.7	-0.66
	(-0.11, -0.09)	(-0.74, -0.59)	(-0.74, -0.59)
ln(temp)	0.28	0.85	0.84
	(0.04, 0.52)	(0.81, 0.87)	(0.81, 0.87)
ln(sqft)	0.89	0.45	0.8
	(0.88, 0.91)	(0.73, 0.87)	(0.73, 0.87)
alpha	-0.77		
	(-1.81, 0.3)		
Observations	1000	1000	1000

Table 1: Results of OLS and average marginal effect estimate

(f)

Because of the discrepancy of estimates of average marginal effect, in Figure 1, I present bootstrapped estimates and confidence intervals. The average marginal effect is larger in 'sqft' variable but insignificant, indicating that the marginal impact of home size is not significantly different from the outdoor temperature on average.

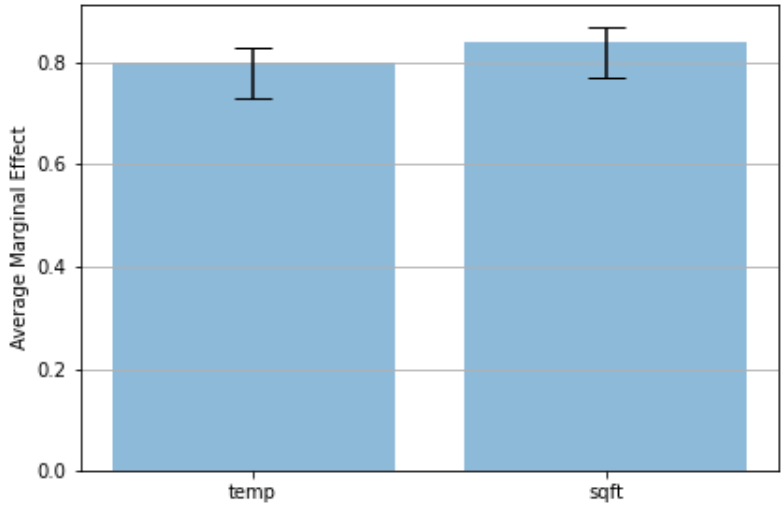

Figure 1: Average Marginal Effect.