# Homework 2

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ECON 7920- Econometrics II

Due on Feb 15, 2022

## 1   Problem 1

**Solution:**

a. For identification, from (Wooldridge (2010)) Assumption NLS.2: $E\{[m(x,\theta)-m(x,\theta_0)]^2\} > 0$ for all $\theta \in \Theta$, $\theta \neq \theta_0$.

b. For this question, we should have following function:

$$\min \frac{1}{N}\sum_i^N (\exp(\theta_{01}+\theta_{02}rooms_i+\theta_{03}baths_i)-\exp(\theta_1+\theta_2rooms_i+\theta_3baths_i))^2 \quad (1)$$

Under above min optimization problem, we assume there are N numbers of data in the dataset, and our goal is to minimize the regression errors. Based on (a.), we assume $\theta_0 \neq \theta$ and the sum of square is strictly larger than 0.

c. Since we want to get the score of objective function: $s(w_i, \theta)$, we take the F.O.C wrt $\theta$ on 1:

$$s(w_i,\theta) = [\exp(\cdot), \exp(\cdot)rooms_i, \exp(\cdot)baths_i] \quad (2)$$

d. The expected Hessian matrix is the second order derivate of our min problem, like in the lecture notes, we denote the min problem as minimizing $q(w_i,\theta)$. Thus:

$$\ddot{H}_i = \frac{\partial^2 q(w_i,\theta)}{\partial \theta^2} \quad (3)$$
$$= [\exp(\cdot), \exp(\cdot)rooms_i^2, \exp(\cdot)baths_i^2]$$

If we take the expected value of each hessian matrix $\ddot{H}_i$, it will be:

$$\frac{1}{N}\sum_i^N \ddot{H}_i \to^p E[H(w_j,\theta_0)]$$
$$= A_0(\text{Nonsingular})$$
$$= O_p(1)$$

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The first limit uses the (Wooldridge (2010)) Lemma 12.1, The second is used by assumption, and the third is by the Definition 3.2.

e. From the NLS regression, $b0 = 10.29226, b1 = 0.04148, b2 = 0.36908$, both b0 and b2 are significant, but b1 is not. So the estimation model should be:

$$price = m(x, \theta_0) = \exp(10.29226 + 0.36908 baths) \tag{4}$$

f. From an online lecture slides[1], we first can use gradient methods, to estimate whether the partial effect is zero, the codes are similar like what we did in class. The second method, is to use Newton-Raphson method to upate infomation consistently to estimate the partial effect. Check this question later!!!

## Bibliography

Wooldridge, Jeffrey M (2010) *Econometric analysis of cross section and panel data*: MIT press.

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[1]See here: `http://cameron.econ.ucdavis.edu/bgpe2011/bgpev2_nonlinear.pdf`