THE AUSTRALIAN NATIONAL UNIVERSITY

Second Semester Midterm Examination – September, 2014

Econometrics II: Econometric Modelling

(EMET 2008/6008)

Reading Time: 0 Minutes
Writing Time: 90 Minutes
Permitted Materials: None

Instructions:

- This handout of exam questions contains 3 pages (including cover page) with 5 exam questions. Make sure you are not missing any pages!
- Answer **ALL** questions of this handout in the script book provided to you.
- Always provide comprehensive and exhaustive answers. Show your work!
- No partial credit will be given for merely stating results (unless I explicitly ask you to 'state' a result).
- Cheat sheets are not permitted.
- Total marks: 100.
- Good luck!

1. [20 marks]

   Consider the following simple linear model: $Y_i = \beta_0 + u_i$ with $E[u_i] = 0$.

   (a) [2.5 marks] Show that β_0 is the population mean of Y_i.

   (b) [2.5 marks] Define the sample average of Y_i.

   (c) [5 marks] Mathematically define and derive the OLS estimator of β_0.

   (d) [5 marks] Mathematically define the standard error of the OLS estimator from part (c).

   (e) [5 marks] Prove that the OLS estimator from part (c) is an unbiased estimator for β_0.

2. [15 marks]

   Are the following statements true or false? Provide a short explanation.
   (Note: you will not receive any credit without providing a correct explanation.)

   (a) A consistent estimator is also unbiased.

   (b) In OLS estimation, if you do not omit any explanatory variables then you can interpret your estimates as estimates of the causal effect.

   (c) In randomized control trials, non-compliance of subjects in the treatment group is not a threat to internal validity as long as it is random.

3. [20 marks]

   You are interested in the causal effect of body size on earnings. To that effect you are considering the following linear model:

$$\text{logWages}_i = \beta_0 + \beta_1 \text{BMI}_i + u_i,$$

   where the dependent variable is the log wage of person i and the explanatory variable that captures the notion of body size is BMI_i, the body mass index of person i.

   (a) [15 marks] Can you interpret the OLS estimate $\hat{\beta}_1$ for β_1 as an estimate of the causal effect of body size on earnings? (Provide a short but comprehensive discussion of potential endogeneity problems in the above regression.)

   (b) [5 marks] Suggest an instrumental variable for BMI_i. Justify!

4. [20 marks]

   Burde and Linden, in their paper published in the *American Economic Journal: Applied Economics* (2013), describe a randomized control trial conducted in Afghanistan. Summarize that paper!

   In your summary, address the following points:

   - What is the main research question?
   - What is the main endogeneity problem?
   - What econometric method do they use to address the endogeneity problem?
   - Does their econometric method 'solve' the endogeneity problem?
     (What evidence do they provide in the paper?)
   - What are their main outcome variables?
   - What is their main finding?
     (You do not need to mention specific numbers, just argue qualitatively.)
   - What problems/shortcomings do you see in their research?

5. [25 marks]

   Consider the simple linear model

$$Y_i = \beta_0 + \beta_1 X_i + u_i, \tag{1}$$

   where X_i and u_i are uncorrelated with each other. Note that $\beta_1 \neq 0$.

   Instead of X_i you observe a noisy measurement $\tilde{X}_i := X_i + w_i$, where w_i is a random error uncorrelated with both X_i and Y_i. (This is the case of so-called classical measurement error.) Now you are interested in estimating the linear model

$$Y_i = \beta_0 + \beta_1 \tilde{X}_i + r_i, \tag{2}$$

   where r_i is the error term in that model.

   (a) [5 marks] What does r_i need to be equal to in order for equations (1) and (2) to be equivalent with each other?

   (b) [10 marks] Show that $\tilde{X}_i$ and r_i are correlated with each other.
   (Hint: Study the following expected value: $E[\tilde{X}_i r_i]$.)

   (c) [10 marks] Use your knowledge of omitted variables bias to derive the bias that results from classical measurement error.