

# THE AUSTRALIAN NATIONAL UNIVERSITY

*Second Semester Midterm Examination – September, 2015*

## **Econometrics II: Econometric Modelling**

**(EMET 3004/6008)**

*Reading Time: 5 Minutes*

*Writing Time: 90 Minutes*

*Permitted Materials: None*

### Instructions:

- This handout of exam questions contains 3 pages (including cover page) with 4 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 arithmetic is required! You do not need to work out solutions to problems such as, for example,  $(0.247 \cdot 0.253)$  or  $\sqrt{0.804}$ . Just write as is.
- 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. [ 25 marks ]

Consider the following *response function*:  $Y_i = f(X_i, u_i)$  where  $Y_i$  is a dependent variable,  $X_i$  is an independent variable and  $u_i$  is a random error term.

- (a) Why does  $u_i$  need to be included in  $f(\cdot)$ ?
- (b) Mathematically define the *individual causal effect* of  $X$  on  $Y$ .
- (c) Intuitively, what does the *individual causal effect* capture?
- (d) In the linear model, what is the *individual causal effect* equal to?  
How does it differ from the *average causal effect*?
- (e) Suppose  $f(a, b) := \beta \cdot g(a) + b$ . An oracle tells you what the function  $g(\cdot)$  is. Define an OLS estimator for  $\beta$ .

2. [ 25 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 biased estimator will also be inconsistent.
- (b) If  $E[u_i | X_i] = 0$  then the OLS estimator is not internally valid.
- (c) When studying the effect of cardiac catheterization (a particular heart surgery) on patients' longevity (subsequent survival outcomes), OLS estimates likely suffer from sample selection bias.
- (d) In TSLS estimation, instead of following the two-stage procedure, one could simply regress  $Y_i$  on  $X_i$  and  $Z_i$  to get consistent estimates for all coefficients.
- (e) Whenever  $u_i$  is uncorrelated with  $X_i$  it is preferable to use OLS estimation rather than TSLS estimation.

3. [ 25 marks ]

Korrt and Leigh, in their paper “Does Size Matter in Australia”, published in the *Economic Record* (2010), conduct OLS and TSLS estimations using Australian data.

Answer the following questions briefly.

- (a) What is the main research question?
- (b) What are their main dependent and independent variables?
- (c) What is the main endogeneity problem? What IV do they propose?
- (d) What is their main finding?
- (e) What problems/shortcomings do you see in their research?

4. [ 25 marks ]

Consider the simple linear model with endogenous  $X_i$ :

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

with the first stage equation

$$X_i = \pi_0 + \pi_1 Z_i + v_i, \tag{2}$$

where  $E[u_i|X_i] \neq E[u_i]$ .

- (a) [ 5 marks ] State the conditions that need to be satisfied for  $Z_i$  to be an IV.

For the rest of this exercise, assume that  $Z_i$  is indeed an IV.

- (b) [ 15 marks ] Suppose you run a regression of  $Y_i$  on a constant term and  $Z_i$ . Unsurprisingly, the resulting OLS estimator of the slope is equal to  $s_{ZY}/s_Z^2$ . What is this estimator equal to, asymptotically? (Hint: The result should depend on some (or all) of the coefficients from equations (1) and (2).)
  - (c) [ 5 marks ] An oracle tells you the value of  $\pi_1$ . Given your estimator  $s_{ZY}/s_Z^2$  from part (b), propose an estimator for  $\beta_1$ .
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