

Name \_\_\_\_\_

For Internal Students of  
Royal Holloway

**DO NOT TURN OVER UNTIL TOLD TO  
BEGIN**

**EC5040 : ECONOMETRICS**

Mid-Term Examination No. 2

Time Allowed: **55 minutes**

**Answer All 4 questions**

**STATISTICAL TABLES ARE PROVIDED**

*Silent non-programmable calculators may be used*

**PRINT YOUR NAME ON THE FRONT OF THIS TEST PAPER WHERE  
INDICATED**

**WRITE ALL YOUR ANSWERS (INCLUDING ROUGH WORKING) ON  
THIS TEST PAPER. THERE ARE EXTRA BLANK SHEETS TOWARD THE  
BACK OF THE PAPER**

1. Given the general linear model

$$y = XB + u \quad \text{where } E(u) = 0 \quad E(uu') = \sigma^2 \Omega$$

$\Omega ? I$

a) Show that the estimate of B is unbiased but inefficient if the model is estimated by OLS

(10 marks)

b) Show how a suitable transformation of the model can produce a GLS estimator that is unbiased and efficient

(9 marks)

c) Outline the form of a test for the presence of heteroskedasticity in the model

(6 marks)

2. Given the following model, (in mean deviation form), you suspect that the variable,  $x_1$ , is measured with error.

$$y_i = b x_1 + u_i \quad (1)$$

Outline the consequences for OLS estimation of the coefficient b in (1)  
(7 marks)

Given a possible instrument  $x_2$ , let  $W = [y : x_1 : x_2]$  and

$$W'W = \begin{bmatrix} 66 & 8 & 3 \\ 8 & 4 & 1 \\ 3 & 1 & 3 \end{bmatrix}$$

the sample size is 100

b) Find the OLS and IV estimates of the coefficient on  $x_1$

(4 marks)

c) The estimated residual variance from the IV estimation and hence the standard error of the IV estimate of b

(8 marks)

d) Outline a possible test for endogeneity of  $x_1$  in (1)

(6 marks)

Turn over

3. Determine the rank and order conditions for identification of each of the equations in the following model:

$$\begin{aligned} Y_1 + b_{12}Y_2 + g_{11}X_1 &= u_1 \\ b_{21}Y_1 + Y_2 + g_{21}X_1 + g_{22}X_2 + g_{23}X_3 &= u_2 \end{aligned}$$

where  $Y_1$  and  $Y_2$  are the endogenous variables in the system and  $X_1$ ,  $X_2$  and  $X_3$  are the exogenous variables

(20 marks)

Does this mean you can estimate either equation of the model using

a) OLS?

b) Instrumental variables? If so what instruments would you use?

(5 marks)

4. You are given a set of observations on the same set of individual agents over repeated time periods

$$y_{it} = b_0 + b x_{it} + a_i + u_{it} \quad \begin{aligned} i &= 1, \dots, N \\ t &= 1, \dots, T \end{aligned}$$

You decide to use fixed effects estimation to account for the unobservable individual-specific effect  $a_i$

a) What is the key assumption that distinguishes fixed from random effects estimation?

(3 marks)

b) Given the requirement for a consistent estimator in the case of within-

group estimation,  $E(x_{it} u_{it}) = \sum_{i=1}^N \sum_{t=1}^T x_{it} u_{it} = 0$

where  $x_{it} = X_{it} - \bar{X}_i$  and  $u_{it} = (Y_{it} - \bar{Y}_i) - (X_{it} - \bar{X}_i) \mathbf{b}^{within}$

Show that the within-group estimator and the 1<sup>st</sup> differenced (fixed effects) estimator are identical when  $T=2$

(8 marks)

b) Would you prefer within-group or first differenced estimation? Give reasons.

(6 marks)

c) Outline a test for whether to use fixed or random effects estimation in panel data

(6 marks)