INDIAN INSTITUTE OF TECHNOLOGY DELHI,
Department of Humanities and Social Sciences

II Semester, 2016-17

HUL315: ECONOMETRIC METHODS

Major Exam: 2.5.2017

Duration: 120 mins, Total Points: 35

Name [redacted] SID [redacted]

NOTE: This is a closed book exam. Unauthorized use of any electronic device, talking during exams or leaving the classroom without permission, showing (whether unintentional or not) answer to others, possession of notes or books are considered as academic dishonesty. Good luck!

1. **(10 points)** Consider a simple unobserved effects model for city crime rates for 1982 and 1987

$$crmrte_{it} = \beta_0 + \delta_0 d87_t + \beta_1 unem_{it} + a_i + u_{it} \qquad (1)$$

where d87 is a dummy variable for 1987. a_i is an unobserved city effect or city fixed effect.

(i) How will you estimate the parameter β_1, given two years of panel data ?

(ii) If we think that β_1 is positive and that Δu_i and $\Delta unem_i$ are negatively correlated, what is the bias in the OLS estimator of β_1 in the first-differenced equation?

2. **(10 points)** With a single explanatory variable, the equation used to obtain the between estimator is

$$\bar{y}_i = \beta_0 + \beta_1 \bar{x}_i + a_i + \bar{u}_i \qquad (2)$$

where overbar represents the average over time. We can assume that $E(a_i) = 0$ because we have included an intercept in the equation. Suppose that $\bar{u}_i$ is uncorrelated with $\bar{x}_i$, but $Cov(x_{it}, a_i)$ $= \sigma_{xa}$ for all t and i.

(i) Letting $\tilde{\beta}_1$ be the between estimator, that is, the OLS estimator using the time averages, show that

$$plim \tilde{\beta}_1 = \beta_1 + \frac{\sigma_{xa}}{Var(\bar{x}_i)} \qquad (3)$$

(ii) Assume further that the x_{it}, for all t = 1,2,...T, are uncorrelated with constant variance $\sigma_x{}^2$. Show that $plim \tilde{\beta}_1 = \beta_1 + \frac{T\sigma_{xa}}{\sigma_x^2}$

(iii) If the explanatory variables are not very highly correlated across time, what does part(ii) suggest about whether the inconsistency in the between estimator is smaller when there are more time periods ?

3. **(5 points)** Let (e_t : t= -1,0,1...) be a sequence of independent, identically distributed random variables with mean zero and variance one. Define a stochastic process by

$$x_t = e_t - (1/2)e_{t-1} + (1/2)e_{t-2}, t = 1, 2, \ldots \qquad (4)$$

(i) Find $E(x_t)$ and $\text{Var}(x_t)$. Do either of these depend on t ?

(ii) Find $Corr(x_t, x_{t+1})$ and $Corr(x_t, x_{t+2})$

(iii) What is $Corr(x_t, x_{t+h})$ for h > 2 ?

(iv) Is x_t an asymptotically uncorrelated process ?

4. **(5 points)** Briefly describe two test for serial correlation in error term in multiple regression model. Are these test valid when explanatory variable are not strictly exogenous ?

5. **(5 points)** Consider the model

$$Y_i = \beta_1 + \beta_2 X_i^* + u_i \tag{6}$$

In practice we measure X_i^* by X_i such that

(a) $X_i = X_i^* + 5$

(b) $X_i = 3X_i^*$

(c) $X_i = (X_i^* + \epsilon_i)$ where ϵ_i is white noise term.

What will be the effect of these measurement errors on estimates of true β_1 and β_2 ?

END OF EXAM