**MASTER OF ARTS EXAMINATION, 2025**

**(2nd Year, 1st Semester)**

**ECONOMICS**

**Advanced Econometrics I**

**Course : PG/ECO 302**

*Time* : *Two Hours* *Full Marks* : 30

Answer *any* **three** questions.

**1.** Suppose there is a dynamic panel model as,

$$y_{it} = \delta y_{it-1} + \varepsilon_{it}$$
$$\varepsilon_{it} = \alpha_i + u_{it}$$

Where $i = 1, 2, \ldots 3$ and $t = 1, 2, \ldots 5$ with $\alpha_i$ follows iid$(0, \sigma_\alpha^2)$ and $u_{it}$ follows iid$(0, \sigma_u^2)$

*(a)* Derive the matrix of all possible valid instruments for $i^{th}$ cross-section.

*(b)* How many numbers of orthogonality conditions are there for each cross-section? (Write in an matrix form). How many number of general moment condition are available for all cross-sections?

*(c)* Derive Two-step Arellano and Bond (1991) estimator for the above model. Why do we apply GSL in the One-step Arellano and Bond estimation? Why Two-step Arellano and Bond (1991) estimator is an improvement over the One-step Arellano and Bond estimator?

2+4+4=10

**2.** Suppose we have a system of equations,

$$Y_{1t} = a_1 + a_2 Y_{2t} + b_1 X_{1t} + b_2 X_{3t} + U_{1t}$$
$$Y_{2t} = c_1 + c_2 Y_{3t} + d_1 X_{1t} + d_2 X_{2t} + U_{2t}$$
$$Y_{3t} = e_1 + e_2 Y_{1t} + f_1 X_{2t} + f_2 X_{3t} + U_{3t}$$
$$t = 1, 2, ..., n; U_1, U_2, U_3 \text{ follow IID } (0, \Sigma)$$

Derive the log likelihood function of Full Information Maximum Likelihood method of estimation. Discuss the FIML method of estimation in detail in case of above example. Briefly mention the difference between FIML and LIML methods of estimation. 5+3+2=10

**3.** A household level decision of a child to send school depends on mother's income, father's income, mother's years of education, father's education, number of children, child age, gender of the child and cohabiting practice of the parent. If the household decides to send the child to the school then his/her educational performance depends on mother's years of education, father's education, mother's income, father's income, number of children, child age. The disturbance errors in both the equations are correlated to each other and individually follow the normal distribution with zero mean and





constant variances. Frame the suitable econometric model in detail. Derive the log likelihood function for the model. What are the problems that we have expected to face during the maximization of log likelihood function in this case?

4+4+2=10

**4.** *(a)* Show that the GMM criterion function is $(y - x\beta)^T W (W^T \Omega W)^{-1} W^T (y - x\beta)$ when the original model is $y = x\beta + u$, $E(uu^T) = \Omega$ and $W$ = matrix of instrument.

*(b)* Under what choice of matrix of instruments GMM estimator becomes GIV estimator? (Show full derivation).

*(c)* Discuss the test of over-identifying restriction under GMM. Compare this with the similar test under IV estimation method. 3+3+2+2=10

**5.** Write short notes on the following : 5+5=10

*(a)* HAC Covariance matrix estimation

*(b)* Probabilistic choice model

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