NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

SORS4104

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF STATISTICS AND OPERATIONS RESEARCH

SORS4104: ECONOMETRICS

BSc. Operations Research and Statistics: Part IV

MARCH 2025 SPECIAL EXAMINATION

Time : 3 hours

Candidates should attempt **ALL** questions from Section A and **ANY THREE** questions from Section B. Each question should start on a fresh page

SECTION A: Answer all questions in this section (40 marks).

A1. State the assumptions of the classical linear regression model. [6]

A2. Distinguish between the following:

(a) Economic and econometric models, [4]

(b) Autoregressive and distributed lag models. [4]

A3. Explain the meaning of each of the following terms:

(a) Autocorrelation. [2]

(b) Heteroscedasticity. [2]

(c) Multicollinearity. [2]

(d) Instrumental variable. [2]

A4. Write short notes on the following, stating the null and alternative hypotheses in each case:

(a) White's test for heteroscedasticity, [3]

(b) Breusch-Godfrey test for serial correlation, [3]

(c) Jacque-Bera test. [2]

A5. Given the following multiple regression model in matrix form,

$$Y = X\beta + u$$

Derive the best linear unbiased estimators of β using the ordinary least squares estimation criterion. [10]

SECTION B: Answer any THREE questions in this section (60 marks).

B6. The following version of the standard reserve flow equation was used by some researchers to check whether or not the monetary approach to the balance of payments holds for Barbados:

$$\frac{\Delta\ \hat{R}_t}{(R+D)_t} = \gamma_1 + \gamma_2\frac{\Delta\ P_t}{P_t} + \gamma_3\frac{\Delta\ Y_t}{Y_t} + \gamma_4\frac{\Delta\ i_t}{i_t} + \gamma_5\frac{\Delta\ m_t}{m_t} + \gamma_6\frac{\Delta\ D_t}{D_t}$$

Where
R_t= international reserves in Barbados \$millions; i_t = nominal interest rate in %; P_t = consumer price index; Y_t = real income in Barbados \$million; m_t = money multiplier; D_t = domestic credit in Barbados \$millions;Δ= first difference operator; ϵ_t = error term; t = time index.

Using annual data for Barbados in the period 1973-1998 and OLS, they obtained the following results:

$$\frac{\Delta\ \hat{R}_t}{(R+D)_t} = 0.058 + 0.158\frac{\Delta\ P_t}{P_t} + 1.097\frac{\Delta\ Y_t}{Y_t} - 0,152\frac{\Delta\ i_t}{i_t} - 0.685\frac{\Delta\ m_t}{m_t} - 1.007\frac{\Delta\ D_t}{D_t}$$

RSS = 0.181067

$$\begin{pmatrix} 0.000657 & -0.001967 & -0.00742 & 0.000552 & -0.000954 & -0.000535 \\ & 0.026738 & 0.022712 & 0.001820 & 0.009637 & 0.002804 \\ & & 0.350372 & -0.015812 & -0.001509 & 0.006453 \\ & & & 0.008131 & 0.005216 & 0.0000655 \\ & & & & 0.048476 & 0.011609 \\ & & & & & 0.012637 \end{pmatrix}$$

Where RSS = residual sum of squares and [...] = variance-covariance matrix of estimates. Use $\alpha = 0.05$ to attempt the following questions:

(a) Test the significance of each parameter except the constant term. [10]

(b) The monetary approach predicts that $\gamma_6 = -1$. Test the latter hypothesis. [4]

(c) Write a concise report on the results of the exercise. [6]

B7. An aggregate model of the economy has been given as follows:

$$C_t = \beta_{10} + \beta_{11} Y_t + u_{1t} (\text{consumption})$$

$$I_t = \beta_{20} + \beta_{21} Y_t + \beta_{22} Y_{t-1} + u_{2t} (\text{investment})$$

$$Y_t = C_t + I_t + G_t (\text{income identity})$$

where C=consumption, I=investment expenditure, Y=income, and G=government expenditure. Y_{t-1} and G_t are assumed to be predetermined.

(a) Determine which of the preceding equations in the model are identified (just or over-identified) [6]

(b) Obtain the reduced-form equations for the model. [9]

(c) Which method would you use to estimate the parameters of the over-identified equation and of the exactly identified equation? Justify your answer. [5]

B8. (a) Outline the theory underpinning the application of the following lagged variable models:

(i) Adaptive expectations model. [3]

(ii) Partial adjustment model. [3]

(iii) Koyck lag model. [2]

(b) In studying the farm demand for tractors, the following equation was used:

$$T_t^* = \alpha \; X_{1,t-1}^{\beta_1} X_{2,t-1}^{\beta_2} + u_t$$

where T^*= desired stock of tractors, X_1= relative price of tractors and X_2= interest rate. Using the partial adjustment model, the following results were obtained:

$$\log \; T_t = constant - 0.218 \log \; X_{1,t1} - 0.855 \log \; X_{2,t1} + 0.864 \log \; T_{t1}$$

(i) What is the estimated coefficient of adjustment? [3]

(ii) What are the short- and long-run price elasticities? [5]

(iii) What are the corresponding interest elasticities. [4]

B9. The table below gives the data on fixed private investment in information processing and equipment (Y, in billions of dollars), sales in total manufacturing and trade (X_1, in millions of dollars) and interest rate, X_2, Moody's triple A corporate bond rate, %.

Year	Y	X_1	X_2
1990	155.9	497 157	9.71
1991	173.0	527 039	9.26
1992	176.1	545 909	9.32
1993	181.4	542 815	8.77
1994	197.5	567 176	8.14
1995	215.0	595 628	7.22
1996	233.7	639 163	7.96
1997	262.0	684 982	7.59

Test for unilateral causality between Y and X_2 at lags 1 and 2. Comment on the results. [20]

END OF QUESTION PAPER