NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

SORS4104

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF STATISTICS AND OPERATIONS RESEARCH

SORS 4104: ECONOMETRICS

AUGUST 2024: SUPPLEMENTARY EXAMINATION

Time: 3 hours

This paper contains **TWO** sections. Attempt **ALL** questions in Section A and any **THREE** questions in Section B. Each question should start on fresh page.

SECTION A

Attempt **ALL** questions in this section **[40 MARKS]**

A1. Distinguish between the following terms, giving examples where possible:

(a) Variable and parameter, [3]

(b) Economics and econometrics. [3]

A2. With the aid of a diagram explain the steps involved in econometric modelling. [8]

A3. (a) Define an econometric model, [1]

(b) Explain any three goals of econometrics. [6]

A4. Describe and explain any three assumptions of the General Linear Model. [9]

A5. The following data shows a segment of the series on percentage wage change Y, unemployment X_1, and inflation X_2:

Table: 1

Y	$\mathbf{X_1}$	$\mathbf{X_2}$
3	3	5
1	1	4
8	5	6
3	2	4
5	4	6

Given that

$$(X^T X)^{-1} = \begin{pmatrix} 26.7 & 4.5 & -8.0 \\ 4.5 & 1.0 & -1.5 \\ -8.0 & -1.5 & 2.5 \end{pmatrix}$$

(a) Fit a general model to this data using ordinary least squares. Write down the estimated regression model. [5]

(b) Calculate the fitted values $\hat{Y}$, and hence compute the residuals $\hat{u}=Y-\hat{Y}$. [5]

SECTION B

Attempt any **THREE** questions in this section **[60 MARKS]**

B6. Consider the following presented expenditure data:

Table: 2

Income X	**Expenditure Y**
2	2
3	2.5
4	2.6
5	2.9
6	3

(a) Plot expenditure against income and comment the relationship between these two variables. [4]

(b) Estimate correlation between income and expenditure. [5]

(c) Test the hypothesis that there is positive correlation between income and expenditure. Use a 5% significance level [4]

(d) Given that at $\alpha = 0.05$, $dL = 0.6$ and $dU = 1.4$, calculate the Durbin-Watson statistic and comment. [7]

B7. (a) What are the causes of heteroscedasticity? Why is heteroscedasticity a problem? [6]

(b) Suppose we postulate that consumption expenditure is linearly related to income but that heteroscedasticity is present. The following table presents data for 30 families:

Table: 3

	Expenditure	Income		Expenditure	Income
1	55	80	16	115	180
2	65	100	17	140	225
3	70	85	18	120	200
4	80	110	19	145	240
5	79	120	20	130	185
6	84	115	21	152	220
7	98	130	22	144	210
8	95	140	23	175	245
9	90	125	24	180	260
10	75	90	25	135	190
11	74	105	26	140	205
12	110	160	27	178	265
13	113	150	28	191	270
14	125	165	29	137	230
15	108	145	30	189	250

Perform the Goldfeld Quandt test on the hypothetical consumption expenditure data above in relation to income. [14]

B8. (a) Suppose that an econometric model consist of the following equations:

$$\begin{aligned} Y_1 &= 3Y_2 - 2X_1 + X_2 + u_1 \\ Y_2 &= Y_3 + X_3 + u_2 \\ Y_3 &= Y_1 - Y_2 - 2X_3 + u_3 \end{aligned}$$

(b) What could be endogenous and exogenous variables from the above econometric model? [3]

(c) Write down the identification structure matrix. [3]

(d) Establish the identification of each equation, that is whether the equation is under, exactly or over identified using the order and rank condition. [14]

B9. (a) Given the following regression equation:

$$Y_t=\alpha+\beta_0X_t+\beta_1X_{t-1}+\beta_2X_{t-2}+\ldots+u_t$$

Derive the Koyck distributed lag model. [10]

(b) Suppose the model $Y_t = \beta_0 + \beta_1 X_t + u_t$ has heteroscedasticity of the form

$\sigma_{u_t}^2 = \sigma^2 X_t^2$ *where* σ^2 *is a finite constant*

(i) Determine the appropriate transformation of Y, X and u such that the model is homoscedastic, [7]

(ii) Justify your answer. [3]

END OF QUESTION PAPER