MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR
FOURTH YEAR SECOND SEMESTER

SCHOOL OF BUSINESS & ECONOMICS
BACHELOR OF SCIENCE IN ECONOMICS & STATISTICS

COURSE CODE: ECO 4203/ECS 3203
COURSE TITLE: ECONOMETRICS II

DATE: 15TH OCTOBER, 2021 TIME: 0830 – 1030HRS

INSTRUCTIONS TO CANDIDATES

Answer Question **ONE** and any other **THREE** questions

*This paper consists of **SEVEN** printed pages. Please turn over.*

QUESTION ONE (25 MARKS)

a) The assumptions underlying the classical linear regression model are:

A.1 Linearity
A.2 Full rank: $rank(X) = k$
A.3 Errors have zero mean: $E(\varepsilon) = 0$
A.4 Spherical errors
A.5 The process that generates X is unrelated to the process that generates
A.6 Normality of errors

Under these assumptions, estimation of the linear model by OLS is sensible. Estimation of the variance of **b** by $s^2(X'X)^{-1}$ is also sensible. For each of the assumptions listed above, explain:

(i) how the assumption might be violated [3 Marks]

(ii) The implications for estimating the model by OLS [3 Marks]

(iii) How the problem might be corrected, or how an alternative estimator might be used to correct the problem (if possible). [4 Marks]

b) A researcher is considering two regression specifications to estimate the relationship between a variable X and Y,

$$\log Y = \beta_1 + \beta_2 log\, X + U \qquad \text{(Equation 1)}$$

$$\log \frac{X}{Y} = \alpha_1 + \alpha_2 log\, X + V \qquad \text{(Equation 2)}$$

Where the Greek letters refer to parameters and X and Y are two random, variables, which we have a random sample of, size n.

i. Determine whether (Equation2) can be represented as a restricted version of (Equation1) [3 Marks]

ii. Using the same n observations of variable X and Y, the researcher fits two specifications using ordinary least squares (OLS). The fits are:

$$\widehat{\log Y} = \hat{\beta}_1 + \hat{\beta}_2 \log X \qquad \text{(Equation 3)}$$

$$\widehat{\log \frac{X}{Y}} = \hat{\alpha}_1 + \hat{\alpha}_2 \log X \qquad \text{(Equation 4)}$$

Using the expressions for the estimates write $\hat{\beta}_2$ in terms of $\hat{\alpha}_2$, Write $\hat{\beta}_1$ in terms of $\hat{\alpha}_1$ [2 Marks]

iii. Demonstrate that $\widehat{\log Y} - \log X = \widehat{\log \frac{X}{Y}}$ [3 Marks]

iv. Demonstrate that the residuals in (Equation 3) are identical to those in (Equation 4) [2 Marks]

v. Determine the relationship between the t statistic using $\hat{\beta}_2$ and the t statistic using $\hat{\alpha}_2$ [3 Marks]

vi. Explain with detailed arguments whether R^2 would be the same in the two regressions. [3 Marks]

QUESTION TWO (15 MARKS)

a) Consider the following model:

$$\hat{Y}_i = -0.261 - 2.306D_{2i} - 1.7327D_{3i} + 2.1289D_2D_{3i} + 0.8028X_i$$

t = (-0.2357) (-5.4873)* (-2.1803)* (9.9094)*

R^2 = 0.2032, n = 528, α = 0.05
*→ indicate P value is less than 0.05

Where Y_i → hourly wage in dollar
X→ education (Years if schooling)
D_2 = 1 if female, 0 if male
D_3 = 1 if non-white and non-Hispanic
=0 if otherwise

Interpret these results [5 Marks]

b) The following are the daily stock prices of a company listed at the Nairobi Stock Exchange during the month of September 2017

12,16,14,17,19,15,11,19,23,15,16,18,16,24,10,20,15,24,15,15,16

i. Compute the sample mean, variance, skewness, excess kurtosis, and minimum and maximum of the daily simple returns [3 Marks]

ii. Compute the daily log returns rt [2 Marks]

iii. Compute the sample mean, variance, skewness, excess kurtosis, and minimum and maximum of the daily log returns [3 Marks]

iv. Perform the Jarque and Bera test on the normality of rt [2 Marks]

QUESTION THREE (15 MARKS)

a) Write the functional form of $E(y_i / x_i, \beta)$, the conditional mean function, that is used in each of the following

i. Probit model [2 Marks]

ii. Logit model [2 Marks]

b) For the logit model, derive the marginal effect, or partial derivative $\partial E(y_i / x_i, \beta) / \partial x_{ij}$, where x_{ij},is the j^{th} element of the x_i vector[4 Marks]

c) Suppose logit model estimation produces the following table

Variable Name	Estimated Coefficient	Standard Error	Asymptotic T-Ratio
X1	3.8	1.7	2.2
X2	-1.6	0.54	-3.0
Constant	-4.2	2.3	-1.8

i. What is the predicted probability that $y = 1$ when $x_1 = 2$ and $x_2 = 0.5$? [2 Marks]

ii. Compute the change in the predicted probability when x_2 increases by one unit from $x_2 = 0.5$ to $x_2 = 1.5$, holding x_1 at $x_1 = 2$ [2 Marks]

iii. Using the derivative result from part (a) and the estimates of the above table, compute the partial derivative $\partial E(y/x_1, x_2, \beta) / \partial x_2$, at the x value given in part (i) [3 Marks]

iv. Comment on the difference between the answers to (ii) and (iii) [2 Marks]

QUESTION FOUR (15 MARKS)

The following model has been developed for studying the relationship of the GDP with interest rate, inflation and exchange rate.

$$GDP_i = a_0 + a_{INT}\, INT + a_{INF}\, INF + a_{EXR}\, EXR + e_i$$

In the above model GDP has been taken as a dependent variable whereas, interest rate, inflation and exchange rate has been included as an independent variables.

- GDP is the Gross Domestic Product of Pakistan which has been converted into real form by using financial year 1976 as a base period and log of it has been taken.
- INT is the nominal discount rate. It is used into real form after adjusting it for inflation.
- INF is the inflation rate of Pakistan which is shows the annual percentage change in consumer price index
- EXR is the nominal exchange rate of Pakistan rupee against US dollar.

Table. 1.1: Regressions Results

Dependent Variable : GDP
Method : Least Squares
Sample : 1973-2008

Variable	Coefficient	t-stat	prob.
EX	2.04* (0.32)	6.25	0.00
IF	1.89* (0.53)	3.56	0.00
R	0.11* (0.04)	3.08	0.01
C	4.50* (1.75)	2.57	0.01

R2	0.67	Akaik Info Criterion	2.66
Adjusted R2	0.64	Schwarz Criterion	2.84
F-Stat	21.56	Durbin Watson Stat	0.78
Prob (F-Stat)	0.00		

1. “*” shows 5 % level of significance
2. A rise in exchange rate means devaluation
3. Figures in parenthesis shows SE of the estimates

a) Comment on the use and meaning of the following statistics from the table above
   i. R-squared [2 Marks]
   ii. The Akaike information and Schwarz criteria [3 Marks]
   iii. The F statistics and Durbin Watson [3 Marks]

b) For examining the serial correlation in data, and confirmation of the above results Correlogram, Q-Statistics, Correlogram squared Residuals and Breusch- Godfrey Serial Correlation LM test are used given in figures 1.2, and 1.3 respectively.

Figure 1.2: Correlogram test results

<table>
<tr><th>obs</th><th>Actual</th><th>Fitted</th><th>Residual</th><th>Residual Plot</th></tr>
<tr><td>1973</td><td>11.0767</td><td>12.3973</td><td>-1.32060</td><td>| * . | . |</td></tr>
<tr><td>1974</td><td>11.3432</td><td>11.2464</td><td>0.09679</td><td>| . |* . |</td></tr>
<tr><td>1975</td><td>11.5759</td><td>11.2424</td><td>0.33349</td><td>| . | * . |</td></tr>
<tr><td>1976</td><td>11.7350</td><td>12.0948</td><td>-0.35975</td><td>| . * | . |</td></tr>
<tr><td>1977</td><td>11.8736</td><td>12.5834</td><td>-0.70976</td><td>| .* | . |</td></tr>
<tr><td>1978</td><td>12.0371</td><td>13.1197</td><td>-1.08262</td><td>| *. | . |</td></tr>
<tr><td>1979</td><td>12.1373</td><td>14.3830</td><td>-2.24576</td><td>|* . | . |</td></tr>
<tr><td>1980</td><td>12.3208</td><td>14.1044</td><td>-1.78366</td><td>| . | . |</td></tr>
<tr><td>1981</td><td>12.4930</td><td>13.5113</td><td>-1.01825</td><td>| * | . |</td></tr>
<tr><td>1982</td><td>12.6459</td><td>12.9506</td><td>-0.30465</td><td>| . * | . |</td></tr>
<tr><td>1983</td><td>12.7629</td><td>12.4378</td><td>0.32516</td><td>| . | * . |</td></tr>
<tr><td>1984</td><td>12.9045</td><td>13.0820</td><td>-0.17747</td><td>| . *| . |</td></tr>
<tr><td>1985</td><td>13.0220</td><td>12.9870</td><td>0.03498</td><td>| . * . |</td></tr>
<tr><td>1986</td><td>13.1080</td><td>12.0021</td><td>1.10588</td><td>| . | .* |</td></tr>
<tr><td>1987</td><td>13.2147</td><td>13.5667</td><td>-0.35205</td><td>| . * | . |</td></tr>
<tr><td>1988</td><td>13.3800</td><td>13.4600</td><td>-0.08003</td><td>| . * . |</td></tr>
<tr><td>1989</td><td>13.5108</td><td>13.5909</td><td>-0.08019</td><td>| . * .</td></tr>
<tr><td>1990</td><td>13.6169</td><td>14.4305</td><td>-0.81361</td><td>| .* | .</td></tr>
<tr><td>1991</td><td>13.7928</td><td>13.3300</td><td>0.46284</td><td>| . |* .</td></tr>
<tr><td>1992</td><td>13.9642</td><td>12.9864</td><td>0.97783</td><td>| . | *</td></tr>
<tr><td>1993</td><td>14.0663</td><td>13.3507</td><td>0.71566</td><td>| . | *.</td></tr>
<tr><td>1994</td><td>14.2255</td><td>13.5224</td><td>0.70305</td><td>| . | *.</td></tr>
<tr><td>1995</td><td>14.4048</td><td>13.8966</td><td>0.50826</td><td>| . | *.</td></tr>
<tr><td>1996</td><td>14.5341</td><td>14.9232</td><td>-0.38907</td><td>| . * | .</td></tr>
<tr><td>1997</td><td>14.6715</td><td>14.2990</td><td>0.37251</td><td>| . |* .</td></tr>
<tr><td>1998</td><td>14.7574</td><td>13.8803</td><td>0.87707</td><td>| . | *</td></tr>
<tr><td>1999</td><td>14.8503</td><td>14.7203</td><td>0.13005</td><td>| . |* .</td></tr>
<tr><td>2000</td><td>15.1143</td><td>16.1517</td><td>-1.03737</td><td>| *. | .</td></tr>
<tr><td>2001</td><td>15.2099</td><td>15.4278</td><td>-0.21788</td><td>| . *| .</td></tr>
<tr><td>2002</td><td>15.2660</td><td>14.0209</td><td>1.24506</td><td>| . | . *</td></tr>
<tr><td>2003</td><td>15.3567</td><td>14.7712</td><td>0.58546</td><td>| . | *.</td></tr>
<tr><td>2004</td><td>15.5024</td><td>14.9553</td><td>0.54716</td><td>| . | *.</td></tr>
<tr><td>2005</td><td>15.6442</td><td>14.9959</td><td>0.64830</td><td>| . | *.</td></tr>
<tr><td>2006</td><td>15.8036</td><td>15.1651</td><td>0.63851</td><td>| . | *.</td></tr>
<tr><td>2007</td><td>15.9327</td><td>14.9947</td><td>0.93796</td><td>| . | *</td></tr>
<tr><td>2008</td><td>16.1031</td><td>15.3764</td><td>0.72672</td><td>| . | *.</td></tr>
</table>

Figure. 1.3: Correlogram Q-Statistics Results

<table>
<tr><th>Autocorrelation</th><th>Partial Correlation</th><th></th><th>AC</th><th>PAC</th><th>Q-Stat</th><th>Prob</th></tr>
<tr><td>. |**** |</td><td>. |**** |</td><td>1</td><td>0.561</td><td>0.561</td><td>12.315</td><td>0.000</td></tr>
<tr><td>. |** |</td><td>.*| . |</td><td>2</td><td>0.242</td><td>-0.107</td><td>14.665</td><td>0.001</td></tr>
<tr><td>. |** |</td><td>. |*. |</td><td>3</td><td>0.233</td><td>0.210</td><td>16.908</td><td>0.001</td></tr>
<tr><td>. |*.</td><td>.*| . |</td><td>4</td><td>0.101</td><td>-0.169</td><td>17.343</td><td>0.002</td></tr>
<tr><td>. |*. |</td><td>. |*. |</td><td>5</td><td>0.085</td><td>0.157</td><td>17.660</td><td>0.003</td></tr>
<tr><td>. |*.</td><td>. | .</td><td>6</td><td>0.110</td><td>-0.038</td><td>18.208</td><td>0.006</td></tr>
<tr><td>. | . |</td><td>.*| . |</td><td>7</td><td>0.003</td><td>-0.067</td><td>18.209</td><td>0.011</td></tr>
<tr><td>. | .</td><td>. |*. |</td><td>8</td><td>0.059</td><td>0.143</td><td>18.380</td><td>0.019</td></tr>
<tr><td>. |*. |</td><td>. | . |</td><td>9</td><td>0.143</td><td>0.033</td><td>19.416</td><td>0.022</td></tr>
<tr><td>. |*.</td><td>. |*. |</td><td>10</td><td>0.152</td><td>0.113</td><td>20.629</td><td>0.024</td></tr>
<tr><td>. |*. |</td><td>. | . |</td><td>11</td><td>0.139</td><td>-0.046</td><td>21.685</td><td>0.027</td></tr>
<tr><td>. | .</td><td>.*| . |</td><td>12</td><td>-0.027</td><td>-0.195</td><td>21.726</td><td>0.041</td></tr>
<tr><td>.*| . |</td><td>. | . |</td><td>13</td><td>-0.148</td><td>-0.063</td><td>23.035</td><td>0.041</td></tr>
<tr><td>.*| .</td><td>.*| . |</td><td>14</td><td>-0.145</td><td>-0.090</td><td>24.338</td><td>0.042</td></tr>
<tr><td>.*| . |</td><td>. | . |</td><td>15</td><td>-0.138</td><td>0.023</td><td>25.582</td><td>0.043</td></tr>
<tr><td>. | .</td><td>. |*. |</td><td>16</td><td>-0.025</td><td>0.144</td><td>25.626</td><td>0.060</td></tr>
</table>

Figure. 1.4: Correlogram Squared Residuals

<table>
<tr><th>Autocorrelation</th><th>Partial Correlation</th><th></th><th>AC</th><th>PAC</th><th>Q-Stat</th><th>Prob</th></tr>
<tr><td>. |*** |</td><td>. |*** |</td><td>1</td><td>0.415</td><td>0.415</td><td>6.7443</td><td>0.009</td></tr>
<tr><td>. |*.</td><td>.*| .</td><td>2</td><td>0.077</td><td>-0.115</td><td>6.9858</td><td>0.030</td></tr>
<tr><td>**| . |</td><td>**| . |</td><td>3</td><td>-0.216</td><td>-0.250</td><td>8.9171</td><td>0.030</td></tr>
<tr><td>**| .</td><td>. | .</td><td>4</td><td>-0.216</td><td>-0.024</td><td>10.913</td><td>0.028</td></tr>
<tr><td>**| . |</td><td>.*| . |</td><td>5</td><td>-0.207</td><td>-0.112</td><td>12.807</td><td>0.025</td></tr>
<tr><td>. |*.</td><td>. |*.</td><td>6</td><td>0.085</td><td>0.213</td><td>13.138</td><td>0.041</td></tr>
<tr><td>. |*. |</td><td>. | . |</td><td>7</td><td>0.144</td><td>-0.011</td><td>14.110</td><td>0.049</td></tr>
<tr><td>. | .</td><td>**| . |</td><td>8</td><td>-0.025</td><td>-0.244</td><td>14.140</td><td>0.078</td></tr>
<tr><td>.*| . |</td><td>. | .</td><td>9</td><td>-0.107</td><td>0.019</td><td>14.725</td><td>0.099</td></tr>
<tr><td>. | .</td><td>. |*.</td><td>10</td><td>-0.058</td><td>0.074</td><td>14.900</td><td>0.136</td></tr>
<tr><td>. | .</td><td>. | .</td><td>11</td><td>-0.036</td><td>-0.017</td><td>14.971</td><td>0.184</td></tr>
<tr><td>. | .</td><td>. | .</td><td>12</td><td>0.001</td><td>-0.038</td><td>14.971</td><td>0.243</td></tr>
<tr><td>. | .</td><td>. | .</td><td>13</td><td>0.072</td><td>-0.016</td><td>15.279</td><td>0.290</td></tr>
<tr><td>. | .</td><td>. | .</td><td>14</td><td>0.011</td><td>-0.031</td><td>15.286</td><td>0.359</td></tr>
<tr><td>. | .</td><td>. | .</td><td>15</td><td>-0.055</td><td>0.016</td><td>15.486</td><td>0.417</td></tr>
<tr><td>.*| . |</td><td>. | .</td><td>16</td><td>-0.074</td><td>-0.052</td><td>15.865</td><td>0.462</td></tr>
</table>

Comment on the following:

i. The presence or absence of autocorrelation between the variables using the Q-statistics [3 Marks]

ii. Correlogram of the squared residuals for test hetroscedasticity from Figure 1.4.[4 Marks]

QUESTION FIVE (15 MARKS)

Suppose the following equations were set up as a simple macroeconomic model of USA. Altogether 2 mutually dependent Y variables were simultaneously determined by 3 predetermined X variables.

$$Y_1 = \gamma_2 Y_2 + \beta_1 X_1 + \beta_2 X_2 + \epsilon$$
$$Y_2 = \gamma_1 Y_1 + \beta_3 X_3 + \epsilon$$

a) Outline how you would estimate:

i. The first equation (2 marks)

ii. The second equation (2 marks)

b) Now consider a smaller simultaneous system than the one in (a) with two mutually dependent Y variables and just 1 predetermine X variable.

$$Y_1 = \gamma_2 Y_2 + \epsilon$$
$$Y_2 = \gamma_1 Y_1 + \beta_1 X_1 + \epsilon$$

	Y_1	Y_2	X_1
	38	8	21
	27	15	17
	31	10	20
	21	18	14
	20	15	12
	43	6	24
Average	**30**	**12**	**18**

i. Using the above data, derive the 2SLS estimate of the coefficient γ_2 in the first equation. (4 marks)

ii. Using 2SLS on the second equation set up the appropriate estimating equations for γ_1 and β_1 in symbols and numbers. (4 marks)

iii. Give reason why you couldn't solve for γ_1 and β_1? (3 marks)

END//