NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF COMMERCE, HUMAN SCIENCES AND EDUCATION

DEPARTMENT OF ECONOMICS, ACCOUNTING AND FINANCE

QUALIFICATION : BACHELOR OF ECONOMICS HONOURS	
QUALIFICATION CODE: 08BECH	**LEVEL:** 8
COURSE CODE: AEM810S	**COURSE NAME:** APPLIED ECONOMETRICS
SESSION: JUNE/JULY 2025	**PAPER:** PAPER 2
DURATION: 3 HOURS	**MARKS:** 100

SECOND OPPORTUNITY EXAMINATION QUESTION PAPER	
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INSTRUCTIONS
1. Read the questions carefully and answer ALL questions 2. Unless specified, all final answers must be round to 2 decimal places 3. Use 5% Significance level 4. Appendixes are attached 5. The use of a calculator is allowed

THIS QUESTION PAPER CONSISTS OF _7_ PAGES (Including this front page)

QUESTION 1 **[25 marks]**

a) Consider the following non-linear model: $y = \beta_0 x_t^{\beta_1} e^{\varepsilon_t}$.
Transform the above model into a linear model which can be estimated by means of an ordinary least square (OLS). (4)

b) Briefly differentiate between the Moving Average (MA) process, the Autoregressive (AR) process, and the Autoregressive Moving Average (ARMA) process. (9)

c) Comment on the meaning of the following terms: (12)

i) Stochastic process
ii) Spurius regression
iii) Cointegration
iv) Stationarity

QUESTION 2 [25 marks]

Refer to the EViews outputs of the DF-GLS and KPSS unit root test results for economic growth (ECG) and money supply (M2) presented in panel A and B and answer the questions that follows.

Null Hypothesis: D(ECG,2) has a unit root **(A)**
Exogenous: Constant, Linear Trend
Lag Length: 11 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-4.028235
Test critical values:	1% level	-3.663600
	5% level	-3.100400
	10% level	-2.806000

*Elliott-Rothenberg-Stock (1996, Table 1)

Null Hypothesis: M2 is stationary **(B)**
Exogenous: Constant
Bandwidth: 7 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		1.223068
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

a) Conduct a unit root hypothesis test of the variables in panel (B). (7)

b) Based on the unit root test results, state the likely order of integration for each series? (4)

c) Why is it important to test for stationarity in time series data? (4)

d) In what way is the Clemente, Montanes, and Reyes (CMR) unit root test advantageous over the DF-GLS and KPSS tests? (4)

e) A researcher has estimated $\Delta y_t = \rho\, y_{t-1} + e_t$. Where $\rho = 0.8$ with a standard error= 0.25. Use the Augmented Dickey-Fuller (ADF) test to for unit root. (NB: Outline both the null and alternative hypothesis. Assume that the critical value of t-statistics = 2.95. (6)

QUESTION 3 **[25 marks]**

Refer to Appendix 2 showing the EViews output for the ARDL model examining the relationship between log of trade openness (lnOPEN), log of current account balance (lnCA), and log of imports (lnIMP).

a) Formulate a generic ARDL model framework to capture both the short-run and long-run relationships among these variables. (4)

b) Using the Bounds test results, conduct a hypothesis test to determine whether a long-run relationship exists between the variables. (6)

c) Interpret the long-run coefficient estimates. (Discuss the magnitude, sign, statistical significance and economic meaning of each explanatory variable.) (6)

d) Look at the error correction model (ECM) results. Report the error correction term (ECT) coefficient and explain its purpose. (4)

e) Using the diagnostic test results in the appendix, say whether the model meets the basic assumptions of a good regression model (like no serial correlation, constant variance, normal errors). Explain what this means for how reliable the results are. (5)

QUESTION 4 **[25 marks]**

Consider the following multiple regression model specified as:

$$M2_t = \alpha_0 + \alpha_1 NFA_t + \alpha_2 REPO_t + \alpha_3 GE_t + u_t$$

Where, M2 represents money supply, NFA is net foreign assets, REPO is repo rate and GE is government expenditure. To answer the questions that follow refer to Appendix 1 consisting of output obtained using the EViews software.

a) Refer to the output used to test for the hypothesis of multicolinearity in the model and interpret it results. (4)

b) How would you interpret the output of the omitted variable test. (Hint: Conduct the hypothesis that the variables OIL and PSCE have jointly omitted from the original model). (4)

c) How would you interpret the output for the Ramsey RESET test. (Hint: Conduct an hypothesis test that the model is correctly specified). (4)

d) Does the original model satisfy the normality assumption? Justify. (4)

e) Are the residuals serially correlation? (4)

f) Do you suspect any an issues regarding heteroskedasticity? (5)

Appendix 1

Dependent Variable: M2
Method: Least Squares
Date: 04/08/24 Time: 11:24
Sample: 1996Q1 2021Q4
Included observations: 104

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-141432.7	21895.47	-6.459449	0.0000
NFA	3.150181	0.093114	33.83158	0.0000
REPO	984.9969	315.7151	3.119892	0.0024
GE	1965.119	348.2819	5.642321	0.0000

R-squared	0.958582	Mean dependent var	48023.28
Adjusted R-squared	0.957340	S.D. dependent var	38847.77
S.E. of regression	8023.742	Akaike info criterion	20.85590
Sum squared resid	6.44E+09	Schwarz criterion	20.95761
Log likelihood	-1080.507	Hannan-Quinn criter.	20.89710
F-statistic	771.4784	Durbin-Watson stat	0.124355
Prob(F-statistic)	0.000000		

(a)

Omitted Variables Test
Null hypothesis: OIL PSCE are jointly significant
Equation: UNTITLED
Specification: M2 C NFA REPO GE
Omitted Variables: OIL PSCE

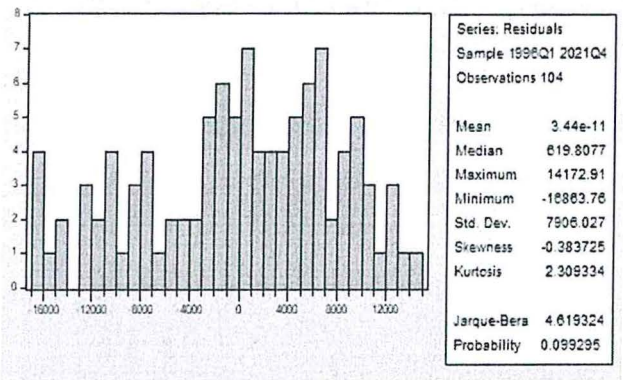
	Value	df	Probability
F-statistic	66.31106	(2, 98)	0.0000
Likelihood ratio	89.00456	2	0.0000

(b)

Ramsey RESET Test
Equation: UNTITLED
Specification: M2 C NFA REPO GE
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.695286	99	0.4885
F-statistic	0.483422	(1, 99)	0.4885
Likelihood ratio	0.506602	1	0.4766

(c)



(d)

Variance Inflation Factors
Date: 04/08/24 Time: 12:08
Sample: 1996Q1 2021Q4
Included observations: 104

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	4.79E+08	774.4408	NA
NFA	0.008670	7.801192	2.605680
REPO	99676.02	14.76889	2.443333
GE	121300.3	734.0333	1.345747

(e)

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	564.6333	Prob. F(2,98)	0.0000
Obs*R-squared	95.69537	Prob. Chi-Square(2)	0.0000

(f)

Heteroskedasticity Test: White

F-statistic	5.977410	Prob. F(3,100)	0.0009
Obs*R-squared	15.81376	Prob. Chi-Square(3)	0.0012
Scaled explained SS	9.571697	Prob. Chi-Square(3)	0.0226

(g)

Appendix 2

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNOPEN)
Selected Model: ARDL(1, 2, 1)
Case 3: Unrestricted Constant and No Trend
Date: 04/12/25 Time: 23:20
Sample: 1996Q1 2021Q4 **(1)**
Included observations: 102

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.103662	0.052256	1.983749	0.0502
LNOPEN(-1)*	0.069310	0.021237	3.263589	0.0015
LNCA(-1)	-0.000568	0.001124	-0.505756	0.6142
LNIMP(-1)	-0.009994	0.004810	-2.077867	0.0404
D(LNCA)	0.014803	0.003818	3.876934	0.0002
D(LNCA(-1))	0.006842	0.003415	2.003708	0.0479
D(LNIMP)	0.612592	0.046703	13.11690	0.0000

* p-value incompatible with t-Bounds distribution.

(2)

Levels Equation
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNCA	0.008202	0.016631	0.493159	0.623(
LNIMP	0.144192	0.066745	2.160347	0.033

EC = LNOPEN - (0.0082*LNCA + 0.1442*LNIMP)

(3)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
		Asymptotic: n=1000		
F-statistic	3.836443	10%	3.17	4.14
k	2	5%	3.79	4.85
		2.5%	4.41	5.52
		1%	5.15	6.36
Actual Sample Size	102	Finite Sample: n=80		
		10%	3.26	4.247
		5%	3.94	5.043
		1%	5.407	6.783

(4)

Heteroskedasticity Test: White

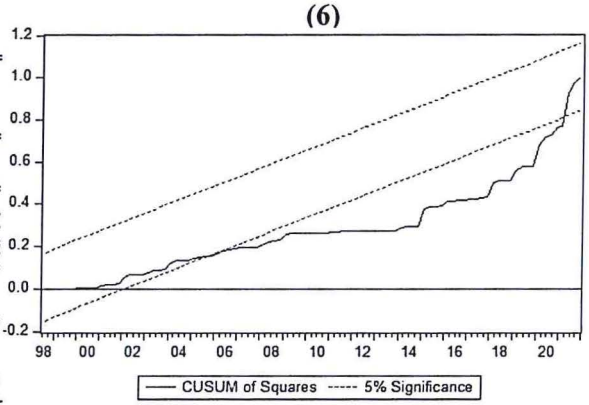
F-statistic	4.204623	Prob. F(6,94)	0.0009
Obs*R-squared	21.37088	Prob. Chi-Square(6)	0.0016
Scaled explained SS	31.10320	Prob. Chi-Square(6)	0.0000

Dependent Variable: D(LNOPEN)
Method: ARDL
Date: 04/12/25 Time: 23:30
Sample (adjusted): 1996Q4 2021Q4
Included observations: 101 after adjustments
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (2 lags, automatic): D(LNCA) D(LNIMP) ECT(-1)
Fixed regressors: C
Number of models evalulated: 27
Selected Model: ARDL(1, 1, 1, 0) **(5)**
Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
D(LNOPEN(-1))	1.083886	0.227765	4.758794	0.0000
D(LNCA)	0.015952	0.003176	5.022146	0.0000
D(LNCA(-1))	-0.014624	0.005214	-2.804820	0.0061
D(LNIMP)	0.683029	0.049443	13.81440	0.0000
D(LNIMP(-1))	-0.725602	0.150387	-4.824910	0.0000
ECT(-1)	-0.380238	0.232099	-1.638256	0.1047
C	0.000283	0.002225	0.127348	0.8989

R-squared	0.794857	Mean dependent var	-0.001359
Adjusted R-squared	0.781763	S.D. dependent var	0.022615
S.E. of regression	0.010565	Akaike info criterion	-6.195817
Sum squared resid	0.010492	Schwarz criterion	-6.014571
Log likelihood	319.8887	Hannan-Quinn criter.	-6.122443
F-statistic	60.70292	Durbin-Watson stat	2.057620
Prob(F-statistic)	0.000000		

(6)

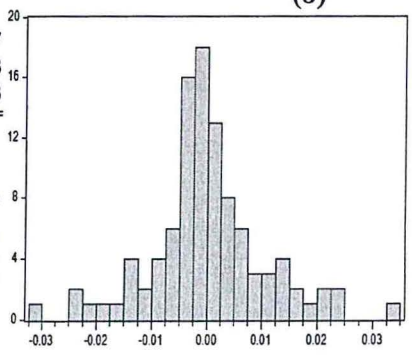


(7)

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.376532	Prob. F(2,92)	0.6873
Obs*R-squared	0.820021	Prob. Chi-Square(2)	0.6636

(8)



Series: Residuals
Sample 1996Q4 2021Q4
Observations 101

Mean	-8.93e-19
Median	-0.000854
Maximum	0.033202
Minimum	-0.030195
Std. Dev.	0.010243
Skewness	0.179275
Kurtosis	4.360468
Jarque-Bera	8.330107
Probability	0.015529