BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF COMMERCE

DEPARTMENT OF BANKING AND FINANCE

FINANCIAL ECONOMETRICS (BS450)

DURATION: THREE HOURS

JUN 2025

INSTRUCTIONS TO CANDIDATES:

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

2) Candidates will need non-programmable calculators.

3) Each question carries equal marks.

4) Electronic data saving devices are not allowed into the examination halls.

ADDITIONAL MATERIAL

Standard Normal Distribution Tables

QUESTION ONE (Compulsory)

a) A clinical trial is run to compare weight loss programs and participants are randomly assigned to one of the comparison programs and are counselled on the details of the assigned program. Participants follow the assigned program for 8 weeks. The outcome of interest is weight loss, defined as the difference in weight measured at the start of the study (baseline) and weight measured at the end of the study (8 weeks), and measured in kilograms.

Three popular weight loss programs are considered. The first **is a low starch diet**. The second is a **low fat diet** and the third is **a low carbohydrate diet**. For comparison purposes, a fourth group is considered as **a control group**. Participants in the fourth group are told that they are participating in a study of healthy behaviours with weight loss only one component of interest. The control group is included here to assess the placebo effect (i.e., weight loss due to simply participating in the study). A total of twenty patients agree to participate in the study and are randomly assigned to one of the four diet groups. Weights are measured at baseline and patients are counselled on the proper implementation of the assigned diet (with the exception of the control group as shown in the Table below:

Low Starch	Low Fat	Low Carbohydrate	Control Group
8	2	3	2
9	4	5	2
6	3	4	1-
7	5	2	0
3	1	3	3

Required:

Use ANOVA (Analysis of Variance) to determine if there is a statistically significant difference in the mean weight loss among the four diets.

[25 Marks]

QUESTION TWO

(a) Discuss any four (4) assumptions of the Ordinary Least Squares OLS regression approach and explain the importance of testing these assumptions. (12)

(b) Paul Sixpence, vice president of Dulibadzimu Water Power, is worried about the possibility of a takeover attempt and the fact that the number of common shareholders have been decreasing since 1983. He instructed you to study the number of common shareholders from 1983 to 2023 and come up with a forecast for 2024. You decided to investigate the most potential predictor variables namely earnings per share, dividends per share and pay-out ratio.

Required:

Critically analyse the steps you would take to formulate the best model to investigate the most potential predictor. (13)

[25 Marks]

QUESTION THREE

(a) Explain in detail any three (3) sources of errors in a regression model. (6)

(b) A realtor in a local area is interested in being able to predict the selling price for a newly listed home or for someone considering listing their home. This realtor would like to attempt to predict the selling price by using the size of the home (in square feet), the number of rooms, the age of the home (in years) and if the home has an attached garage. Study the excel output below and answer the questions that follow.

Summary measures

Multiple R	0.9439
R-Square	0.8910
Adj. R-Square	0.8474
St Err of Estimate	22.241

Regression coefficients

	Coefficient	*Std Err*	*t-value*	*p-value*
Constant	-19.026	54.769	-0.3474	0.7355
Size	7.494	1.529	4.9010	0.0006
Number of Rooms	7.153	9.211	0.7767	0.4553
Age	-0.673	0.992	-0.6789	0.5126
Attached Garage	0.453	20.192	0.0224	0.9826

Required:

i. Use the information above to estimate the linear regression model. (4)

ii. Identify variables that can be regarded as dummies. (3)

iii. Identify and interpret the coefficient of determination (R^2) and the standard error of the estimate (s_e) for the model. (6)

iv. Discuss whether this model is adequate to predict the selling price of a home. (6)

[25 Marks]

QUESTION FOUR

a) Explain any three (3) types of economic data used in econometrics for empirical analysis. (9)

b) A manufacturer claims that its rechargeable batteries are good for an average of more than 1,000 charges. A random sample of 100 batteries has a mean life of 1002 charges and a standard deviation of 14. Is there enough evidence to support this claim at $\alpha = 0.01$? (6)

c) A tyre manufacturer wishes to investigate the tread life of its tyres. Samples of 10 tyres driven 50,000 miles revealed a sample mean of 0.32 inch of tread remaining with a standard deviation of 0.09 inch. Construct a 95 percent confidence interval for the population mean. Would it be reasonable for the manufacturer to conclude that after 50,000 miles the population mean amount of tread remaining is 0.30 inches? (10)

[25 Marks]

QUESTION FIVE

Suppose Mr Maida observes the selling price and sales volume of milk for 10 randomly selected weeks. The data he has collected are presented in the Table below:

Week	Weekly Sales (1000s of gallons)	Selling Price ($)

1	10	1.30
2	6	2.00
3	5	1.70
4	12	1.50
5	10	1.60
6	15	1.20
7	5	1.60
8	12	1.40
9	17	1.00
10	20	1.10

Required:

Calculate the following

i. β and interpret its meaning (4)

ii. α and interpret its meaning (2)

iii. SST (5)

iv. SSR (4)

v. SSE (5)

vi. Standard Error of Estimate and interpret its meaning (2)

vii. Coefficient of Determination and comment on the goodness of fit. (3)

[25 Marks]

QUESTION SIX

The table below shows results of regression assumptions tested using EViews 10.

Null Hypothesis: GDP has a unit root

Exogenous: None

Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.339168	0.0001
Test critical values:	1% level	-2.621185	
	5% level	-1.948886	
	10% level	-1.611932	

Null Hypothesis: D(RMT) has a unit root

Exogenous: None

Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.154405	0.0000
Test critical values:	1% level	-2.624057	
	5% level	-1.949319	
	10% level	-1.611711	

F-Bounds Test			Null Hypothesis: No levels relationship	
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	6.617348	10%	2.63	3.35

K	2	5%	3.1	3.87
		2.5%	3.55	4.38
		1%	4.13	5

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.754185	Prob. F(2,29)	0.4741
Obs*R-squared	1.878766	Prob. Chi-Square(2)	0.3429

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.235907	Prob. F(6,31)	0.0124
Obs*R-squared	1.659295	Prob. Chi-Square(6)	0.0152
Scaled explained SS	4.029729	Prob. Chi-Square(6)	0.0147

Ramsey RESET Test

Equation: UNTITLED

Specification: DINV DINV(-1) DINV(-2) DINV(-3) DINV(-4) DRMT GDP C

Omitted Variables: Squares of fitted values

	Value	Df	Probability
t-statistic	0.346914	30	0.7111
F-statistic	0.120349	(1, 30)	0.7111

Required:

Comment on the implications of these assumption results at 5% level of significance.

[25 Marks]

END OF EXAMINATION

Formula Sheet (2024)

Hypothesis Test Statistics and Confidence Intervals

1 - α Confidence Interval Point Estimate $\pm$ Maximum Error E		Hypothesis Test Value (Statistic) NULL Hypothesis: Use the statement containing the condition of equality either directly or implied, as the Null Hypothesis H_0.
(TI-84)	**Single Population**	(TI-84)
	One Sample for mean μ (σ is known)	
(ZInterval) $\bar{x} \pm z_{\alpha/2} \dfrac{\sigma}{\sqrt{n}}$	Use the *Normal* z -Table for the critical value z	(Z-Test) $z = \dfrac{\bar{x} - \mu}{\sigma / \sqrt{n}}$
	One Sample for mean μ (σ is unknown)	
(TInterval) $\bar{x} \pm t_{\alpha/2} \dfrac{s}{\sqrt{n}}$	$df = n - 1$ Use the t-distribution Table for the critical value t	(T-Test) $t = \dfrac{\bar{x} - \mu}{s / \sqrt{n}}$
	One Sample for Proportion p	
(1-PropZInt) $\hat{p} \pm z_{\alpha/2} \sqrt{\dfrac{\hat{p}\hat{q}}{n}}$	Use the *Normal* z -Table for the critical value z	(1-PropZTest) $z = \dfrac{\hat{p} - p}{\sqrt{pq / n}}$

Linear Regression Formulas

$$b = \frac{n \sum XY - \sum X \sum Y}{n \sum X^2 - (\sum X)^2}$$

$$r = \frac{\sum xy - \dfrac{\sum x \sum y}{n}}{\sqrt{\left(\sum x^2 - \dfrac{(\sum x)^2}{n} \right) \cdot \left(\sum y^2 - \dfrac{(\sum y)^2}{n} \right)}}$$

Multiple Regression Formulas

$$\hat{b}_1 = \frac{(\sum x_1 y)(\sum x_2{}^2) - (\sum x_2 y)(\sum x_1 x_2)}{(\sum x_1{}^2)(\sum x_2{}^2) - (\sum x_1 x_2)^2}$$

$$\hat{b}_2 = \frac{(\sum x_2 y)(\sum x_1{}^2) - (\sum x_1 y)(\sum x_1 x_2)}{(\sum x_1{}^2)(\sum x_2{}^2) - (\sum x_1 x_2)^2}$$

$$\hat{b}_0 = \bar{Y} - \hat{b}_1 \bar{X}_1 - \hat{b}_2 \bar{X}_2$$

The Formula for R

$$R = \sqrt{\frac{\left[\left(r_{y,x1}\right)^2 + \left(r_{y,x2}\right)^2\right] - \left(2 r_{y,x1} r_{y,x2} r_{x1,x2}\right)}{1 - \left(r_{x1,x2}\right)^2}}$$

ANOVA (Analysis of Variance) Formula – F Statistic

Sum of squares Due to Error: $SSE = \sum(y_i - \hat{y}_i)^2$
Total sum of squares: $SST = \sum(y_i - \bar{y})^2$
Sum of Squares Due to Regression: $SSR = \sum(\hat{y}_i - \bar{y})^2$
Relationship Among SST,SSR,and SSE: $SST = SSR + SSE$
Coefficient of determination: $r^2 = \frac{SSR}{SST}$

Source of Variation	Sums of Squares (SS)	Degrees of Freedom (df)	Mean Squares (MS)	F
Between Treatments	$\text{SSB} = \Sigma n_j\left(\bar{X}_j - \bar{X}\right)^2$	k-1	$\text{MSB} = \frac{SSB}{k-1}$	$F = \frac{\text{MSB}}{\text{MSE}}$
Error (or Residual)	$\text{SSE} = \Sigma\Sigma\left(X - \bar{X}_j\right)^2$	N-k	$\text{MSE} = \frac{\text{MSE}}{N-k}$	
Total	$\text{SST} = \Sigma\Sigma\left(X - \bar{X}\right)^2$	N-1		

Autocorrelation Coefficient (r_k)

$$r_k = \frac{\sum_{t=k+1}^{n}(Y_t - \bar{Y})(Y_{t-k} - \bar{Y})}{\sum_{t=1}^{n}(Y_t - \bar{Y})^2}$$