

BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF COMMERCE

DEPARTMENT OF ECONOMICS

PROGRAMMES: BSc HONOURS DEGREE IN ECONOMICS

EC 203: QUANTITATIVE METHODS

DURATION: 3 HOURS

INSTRUCTIONS:

1. Attempt all questions.
 2. Each question carries 25 marks.
 3. NO CELLPHONES ALLOWED IN THE EXAMINATION ROOM.
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Question 1

- a. Consider the following linear model in matrix notation: $Y = a + \beta X + u$. Prove that the OLS estimate for β is unbiased. **(8 marks)**
- b. A joint log-linear model is given as

$$\log L = -n \log \sigma_u^2 - \frac{n}{2} \log 2\pi - \frac{1}{2\sigma_u^2} \sum (Y - a - \beta X)^2$$

- i. Derive the normal equations under the maximum likelihood estimation. **(6 marks)**
- ii. Derive the variance of the residuals under MLE and show that it is biased for small samples. **(11 marks)**

Question 2

- a. Explain the conventional methodology of econometrics highlighting the importance of each of stages and also the challenges that a researcher might face at each of the stages.

(10 marks)

- b. A labor economist seeking to establish the effect of education (*edu*) on earnings (*Pay*) and specified a simple earnings as:

$$Pay = a + \beta edu + \epsilon$$

Where ϵ is the stochastic error term.

- i. What does a show in the model? (2 marks)
- ii. State any two more variables that can be included in this model. (3 marks)
- iii. Suppose you decide to use gender as one of the regressors, briefly explain how this variable could be incorporated in these model and the major precautions that the researcher should take. (10 marks)

Question 3

To find out if there is any relationship between fertilizer applied and soya bean yield for farmers in Bindura district the following model was suggested:

$$Y = \beta_0 + \beta_1 F + e$$

Where Y is soya bean yield, F if fertliser application in kilograms per hectare, the β s are parameters.

plot	1	2	3	4	5	6	7	8	9	10	11	12
yield	199	167	166	210	111	234	241	200	133	102	134	144
fert	55	41	48	88	43	77	81	14	45	67	47	70

- a. Draw a scatter plot and superimpose a regression line for the data. (4 marks)
- b. Regress the above model and obtain estimates for the parameters. (8 marks)
- c. Find estimates of the standard errors for the parameters. (8 marks)
- d. How would you test the assumption of the normality of the error term? Show the test. (5 marks)

Question 4

Consider the standard simple regression model; $y = a + b x + u$, satisfying the Classical Linear Regression Model Assumptions.

- a. Show that OLS estimator for b is efficient. (9 marks)
- b. Prove that the OLS estimate of a is unbiased. (5 marks)
- c. Prove that the mean-square error equals the variance plus the square of the bias of the estimator. (6 marks)
- d. Explain using a diagram what you understand by the efficiency of an estimator. (3 marks)

END OF PAPER