

CHUKA



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**EXAMINATION FOR THE AWARD OF DEGREE OF MASTER OF SCIENCE IN
APPLIED STATISTICS**

MATH 843: PARAMETRIC REGRESSION ANALYSIS**STREAMS: MSC (APPLIED STATISTICS)****TIME: 3 HOURS****DAY/DATE: MONDAY 08/04/2024****11.30 A.M – 2.30 P.M.****INSTRUCTIONS:**

- Answer ANY four questions.

QUESTION ONE (15 MARKS)

An experiment was conducted to determine the effect of ozone pollution on soybean over the growing season. Four dose levels of ozone and the resulting mean seed yield of soybeans are given;

Ozone (ppm) X levels	Yield (gm/pit) Y
0.02	242
0.07	237
0.11	231
0.15	201

A simple linear model was slated to the data in table above with the following results

$$\beta_0 = 253.4$$

$$S_0^2 = 115.9$$

$$\beta_1 = -293.5$$

$$S_1^2 = 116.3$$

Required:

- i. Predict the yield of soybeans exposed to ozone of 0.12ppm [4marks]
- ii. Test the null hypothesis that the ozone pollution has no effect on yield of soybeans at 5% [6marks]
- iii. Compute the Analysis of Variance (ANOVA) [5marks]

QUESTION TWO (15 MARKS)

- a) State four assumptions made in fitting the simple linear model [5marks]
- b) Write an R-program code that fits a simple linear regression model to problem in QUESTION ONE Above [5marks]
- c) Outline any three methods that can be used to estimate the parameters in a non-linear regression model [5marks]

QUESTION THREE (15 MARKS)

- a) Outline the uses of Regression analysis in a scientific study [3marks]
- b) The data in the accompanying table relate income and alcohol consumption in Kenya

Income (X)	26.8	27.1	29.5	28.4	30.8	36.4	30.4	29.8	35.1	32.5
Alcohol consumption(Y)	8.7	8.4	8.8	7.6	8.9	10.0	9.7	8.9	11.1	10.9

Required

- i. Fit a regression equation of Alcohol consumption on Income [6marks]
- ii. Test the null hypothesis that Income has no effect on Alcohol consumption at 5% [7marks]

QUESTION FOUR (15 MARKS)

Let $Y_i = \beta x_i + e_i (i = 1, 2)$ where $e_1 \sim N(0, \delta^2)$ and $e_2 \sim N(0, 2\delta^2)$ and e_1 and e_2 are statistically independent. If $x_1 = \pm 1$ and $x_2 = -1$

Required

- i. Obtain the weighted least square estimates at β
- ii. Find the variance of the estimate obtained [15marks]

QUESTION FIVE (15 MARKS)

- (a) Let β be uniquely identified in the model $Y = X\beta + e$ where $e \sim N(0, \delta^2)$. Prove that with probability 1, one has $\hat{\beta} \rightarrow \beta$ [10marks]
- (b) List any five assumptions that are necessary to ensure asymptotic normality of the quasi-maximum likelihood estimator (QMLE) [5marks]
