



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**  
**SCHOOL OF AGRICULTURAL AND FOOD SCIENCES**  
**THIRD YEAR FIRST SEMESTER UNIVERSITY EXAMINATION FOR THE DEGREE**  
**OF BACHELOR OF SCIENCE IN FOOD SECURITY**  
**2019/2020 ACADEMIC YEAR**  
**SPECIAL/RESIT**

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**COURSE CODE: AFB 3324**

**COURSE TITLE: Basic Quantitative Methods In Food Security**

**VENUE: STREAM: BSc. (Food Security)**

**DATE: EXAM SESSION:**

**TIME: 2 HOURS**

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**Instructions:**

- 1. Answer ALL questions in section A and ANY other 2 Questions in section B.**
- 2. Candidates are advised not to write on the question paper.**
- 3. Candidates must hand in their answer booklets to the invigilator while in the examination room.**

**SECTION A [30 MARKS]**

**[COMPULSORY]**

**QUESTION ONE [30 MARKS]**

1. Define the following terms as used in design of experiments

- a. Response and predictor variables [2 marks]
- b. Simple and multiple regression [2marks]
- c. Coefficient of determination and Correlation coefficient [2 marks]

2. A data set with one independent variable and an intercept gave the following  $(\mathbf{X}^T\mathbf{X})^{-1}$

$$(\mathbf{X}^T\mathbf{X})^{-1} = \begin{bmatrix} \frac{31}{177} & \frac{-3}{177} \\ \frac{-3}{177} & \frac{177}{6} \end{bmatrix}$$

- i. How many observations were there in the data set? [3 marks]
- ii. Find  $\sum X_i^2$  [3 marks]

3. The time taken to prepare a cup of tea is thought to be related to size of jiko used and can be modeled as  $Y = \beta_0 + \beta_1 X$ . Data on time (Y) and size of jiko (X) are given below:

X	1.0	1.2	1.3	1.4	1.5
Y	12	18	14	16	21

- a. Write the information in matrix form [3 marks]
- b. Using matrix method fit the regression of Y on X [4 marks]
- c. Write down the model [2 marks]

4. The quantity of a meat from a zebu bull is supposed to average 800 kg in a county. A random sample of 16 abattoirs in the county is visited, and the average mass is found to be 812. Suppose we know that the standard deviation of viscosity is  $\sigma = 25$  kg.

- a. Define the term p-value [3 marks]
- b. Determine p-value for the test [3 marks]
- c. Test these hypotheses based on p-values at  $\alpha = 0.05$  [3 marks]

**SECTION B: [40 MARKS]**

**ANSWER ANY TWO QUESTIONS**

**QUESTION FIVE [20 MARKS]**

a. Given that  $A = \begin{pmatrix} 1 & 5 \\ 3 & 7 \end{pmatrix}$ ,  $B = \begin{pmatrix} 7 & 3 \\ -4 & -2 \end{pmatrix}$  and  $C = AB$ , Find  $C^{-1}$  [4marks]

b. Find the matrix B such that  $AB = I$  [3 marks]

c. . In a study to predict weight of a person from the height, a sample of 10 18 year girls yielded the following.

$$\bar{x} = 165.52 \quad \bar{y} = 59.47, \quad S_{XX} = 472.076, \quad S_{YY} = 731.961, \quad S_{XY} = 274.786$$

Using the information:

Compute estimates of

i. the slope [4 marks]

ii. Intercept [5 marks]

iii. Obtain estimate of  $\sigma^2$  [4 marks]

iv. Compute t-test for  $\beta_1$  [4 marks]

v. Test the hypothesis  $\beta_1 = 0$  ( $\alpha = 0.01$ ) [4 marks]

**QUESTION SIX [20 MARKS]**

A farmer believes that a certain plant fed to cows has the effect of causing increase or reduction of weight on the cows. She chooses 36 cows and monitors their weight for some time. Previous research indicates mean change in weight is 1.5 kg. She finds that the mean change in weight for the sampled cows is 1.8 kg with standard deviation of 0.6 kg. She goes ahead to test her results at  $\alpha = 0.01$ .

a. i. Write the hypotheses for the farmer [2 marks]

ii. State whether it is one or two sided test [1 mark]

iii. Calculate the test statistic [3 marks]

b. i. Determine the critical value and sketch the rejection region [4 marks]

ii. Test the hypothesis and make your conclusions [3 marks]

c. A sample of 40 sales receipts from a grocery store has  $\bar{x} = \$137$  and  $\sigma^2 = \$ 25$ . It is also thought that the population mean may be different from \$135. Use the information to:

- i. Determine the p-value for the test [4 marks]
- ii. Use the p-value to draw a conclusion at  $\alpha = 0.01$  [3 marks]

**QUESTION SEVEN [20 MARKS]**

The data in the accompanying table relate heart rate at rest Y to kilograms body weight X.

X	Y
90	62
86	45
67	40
89	55
81	64
75	53

$$\sum X = 488, \sum Y = 319, \sum X^2 = 40092, \sum Y^2 = 17399, \sum XY = 26184$$

- a. i. Draw a scatter plot for the data. [4 marks]
- ii. Does it appear that there is a linear relationship between body weight and heart rate at rest [1 mark]
- b. i. Compute  $\beta_0$  and  $\beta_1$  and write the regression equation for these data. [6 marks]
- ii. Interpret the estimated regression coefficients [3 marks]
- c. i. Obtain the point estimate of the mean of Y when X = 88 [2 marks]
- ii. Obtain a 95% confidence interval estimate of the mean of Y when X = 88. Interpret this interval statement [5 marks].

**QUESTION EIGHT [20 MARKS]**

A study at Rongo University claimed that the mean commuting time for all employees to work exceeds 40 minutes. This figure is higher than what has been assumed in the past. The plan is to test this claim using a significance level equal to 0.05 and 100 of the commuters. The sample of commuters showed a mean time of 43.5 minutes. Based on previous studies, suppose that the population standard deviation is known to be  $\sigma = 15$  minutes.

- a. i. State the appropriate hypotheses [2 marks]

- ii. Determine the Test statistic [3 marks]  
iii. Determine P-value for the test [2 marks]

b. An educator wants to see how the number of absences for a student in her class affects the final grade. The data obtained from a sample are shown.

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No. of absences, x	10	12	2	0	8	5
Final grade, y	<u>70</u>	<u>65</u>	<u>96</u>	<u>94</u>	<u>75</u>	<u>82</u>

- i. State the hypothesis for testing the significance of the relationship [2 marks]

Determine:

- i. Total variation [3 marks]  
ii. Explained variation [3 marks]  
c. Construct the anova table for the regression [5 marks]