LAIKIPIA UNIVERSITY

UNIVERSITY EXAMINATIONS

FIRST SEMESTER 2025/2026 ACADEMIC YEAR

SECOND YEAR EXAMINATION FOR THE DEGREES OF BACHELOR OF SCIENCE (STATISTICS) AND BACHELOR OF (ECON & STAT)

STAT 213: PRINCIPLES OF STATISTICAL INFERENCES

STREAM: R ***TIME: 2 HRS***

DAY: TUESDAY [8.30 – 10.30 A.M] ***DATE: 03/02/2026***

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

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INSTRUCTIONS: ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS

QUESTION ONE (30 MARKS)

a) Briefly explain the difference between the following terms

i) Null and alternative hypotheses

ii) One-tailed and two tailed tests

iii) Type I and Type II errors **(6 Marks)**

b) The amount of time that customer spends at an airport check-in counter is a normal random variable with mean 8.2 minutes and standard deviation 1.5 minutes. Suppose that a random sample of size $n = 49$ customers is observed. Find the probability that the average time waiting in line for these customers is between 7.5 and 9.1 minutes. **(5 Marks)**

c) If S_1^2 and S_2^2 represent the variances of independent random samples of size $n_1 = 6$ and $n_2 = 9$, taken from normal populations with variances $\sigma_1^2 = 15$ and $\sigma_2^2 = 10$ respectively.

Find $P\left(4.095 < \frac{S_1^2}{S_2^2} < 12.45\right)$ **(4 Marks)**

d) A group of 10 college students were asked to report the number of hours that they slept on the previous night with the following results: 7.0, 6.5, 7.25, 8.5, 5.0, 8.0, 7.0, 6.75, 5.75, 7.15. Find a 99% confidence interval for the average number of hours that college students sleep. **(5 Marks)**

e) The records of a hospital show that 52 men in sample of 1000 men versus 23 women in a sample of 1000 women were admitted because of heart disease. Do these data present sufficient evidence to indicate a higher rate of heart disease among men admitted to the hospital? Use $\alpha = 0.05$

(5 Marks)

f) Suppose that a random sample of 10 pairs of observations on (X, Y) yielded the following summary quantities: $S_{XX} = 60.4,\ S_{XY} = 328$ *and* $S_{YY} = 2610.$ Find a 99% confidence interval for the population correlation coefficient ρ_{XY} between X and Y. **(5 Marks)**

QUESTION TWO (20 MARKS)

a) A random sample of size $n_1 = 16$ is selected from a normal population with a mean of 75 and a standard deviation of 8. A second sample of size $n_2 = 9$ is taken from another normal population with mean 70 and standard deviation 12. What is the probability that the difference in mean lies between 3.5 and 5.3?

(5 Marks)

b) Find the probability that a random sample of 21 observations, from a normal population with variance $\sigma^2 = 8$ will have a variance S^2 between 3.304 and 7.736 **(5 Marks)**

c) The mean number of travel days per year for outside sales people is to be estimated. Past studies indicate that the travel days are approximately normal with a standard deviation of 10 days. What sample size would have to be taken so that a person is 95% confident that the sample mean will be within 2 days of the true mean travel days of all outside sales people **(4 Marks)**

d) A particular brand of diet margarine was analyzed to determine the level of polyunsaturated fatty acid (in percentages). A sample of 8 packages resulted in the following data: 16.8, 17.2, 17.4, 16.2, 16.9,17.1, 18.2, 16.5. Find a 95% prediction interval for the polyunsaturated fatty acid in the next package of margarine that is tested. **(6 Marks)**

QUESTION THREE (20 MARKS)

The wearing qualities of two types of automobile tyres were compared by road testing samples of $n_1 = n_2 = 10$ tires for each type. The number of miles until wear out was defined as specific amount of tires wear. The means and variance are $\bar{x}_1 = 26,400$, $s_1^2 = 1,440,000$, $\bar{x}_2 = 25,100$ and $s_2^2 = 1,960,000$.

a) Find a 99% confidence interval for the difference in mean wearing quality for the two types of tires **(8 Marks)**

b) Use the above confidence interval to determine whether there was a significant difference in mean wearing quality for the two types of tires **(4 Marks)**

c) Construct the 95% interval for the ratio of the two population variances and interpret it **(5 Marks)**

d) What assumptions must be made in order that the confidence intervals obtained in parts

(a) and (c) be valid? **(3 Marks)**

QUESTION FOUR (20 MARKS)

A study was made by a retail merchant to determine the relation between weekly advertising expenditures (x) and sales (y). The data obtained from a sample of 12 were summarized as follows: $\sum x_i = 410,\ \sum x_i^2 = 15650,\ \sum y_i = 5345,\ \sum y_i^2 = 2,417,925$ and $\sum x_i y_i = 187,325$.

a) Find the equation of the regression line to predict weekly sales from advertising expenditures. **(6 Marks)**

b) Compute 99% prediction interval for a single predicted value of sales when the weekly advertising expenditures are \$35 **(6 Marks)**

c) Do the data provide sufficient evidence to indicate that weekly advertising expenditures *x* provide information for prediction of sales y. Use $\alpha = 0.01$ **(5 Marks)**

d) Calculate the coefficient of determination R^2 and interpret it. **(3 Marks)**

QUESTION FIVE (20 MARKS)

The personnel director for A-Z Electronics used multiple regression to relate an employee's score (y) on job satisfaction test to his or her length of service (x_1) and wage rate (x_2). A sample of 10 data points provided the following information: $\hat{\beta}_0 = 14.448,\ s(\hat{\beta}_0) = 8.191,$ $\hat{\beta}_1 = -8.69,\ s(\hat{\beta}_1) = 1.555,\ \hat{\beta}_2 = 13.517,\ s(\hat{\beta}_2) = 2.085$ and $R^2 = 0.92$.

a) Interpret R^2 **(3 Marks)**

b) Give the least squares prediction equation **(3 Marks)**

c) Find an estimate of the job satisfaction test score for employee who has seven years of service and makes $6.50 per hour. **(3 Marks)**

d) Would you consider deleting the independent variable x_2 from the regression equation?. Use $\alpha = 0.05$ **(5 Marks)**

e) Do the data provide sufficient evidence to indicate that the model contributes information for the prediction an employee's job satisfaction test score? **(6 Marks)**