

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

THIRD YEAR EXAMINATION FOR THE AWARD OF BACHELOR OF SCIENCE  
(ECONOMICS AND STATISTICS)

MATH 343: APPLIED STATISTICS

STREAMS: BSC (ECON & STATS)

TIME: 2 HOURS

DAY/DATE: WEDNESDAY 19/04/2023

11.30 A.M. – 1.30 P.M.

**INSTRUCTIONS: Answer Question ONE and any other TWO Questions**

QUESTION ONE (30 MARKS)

(a) An Auto company decided to introduce a new six cylinder car whose mean petrol consumption is claimed to be lower than that of the existing auto engine. It was found that the mean petrol consumption for the 50 cars was 10km per litre with standard deviation of 3.5km per litre. Test for the company at 5% significance level, whether the claims that the new car petrol as assumption is 9.5km per litre on the average is acceptable.

[6 marks]

(b) The efficacy of a treatment for hypertension (high blood pressure) is to be studied using a small clinical trial. 38 patients were randomly allocated to either Group 0 (placebo control) or group 1(treatment) and a three-month follow-up study was carried out. At the end of the study, the difference in blood pressure was measured for patients in each group and recorded. A summary of the results is presented below;

Group	Sample size	Mean	Standard deviation
0	21	-0.208	4.101
1	17	3.953	4.630

Is there evidence of significant improvement in the treatment group at 5% significance level?

[6 marks]

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- (c) The number of yeast cells counted in a haemocytometer is compared to the theoretical value is given below.

No. of Yeast cells in the square	0	1	2	3	4	5
Frequency	103	143	98	42	8	6

Does the experimental result support the theory at 5% significance level? [6 marks]

- (d) The advisor of Statistics club of a large college believes that the group consists of 10% freshmen, 20% sophomores, 40% juniors and 30% seniors. The membership for the club this year consisted of 14 freshmen, 19 sophomores, 51 juniors and 16 seniors. At  $\alpha = 10\%$  test the advisors conjecture. [6 marks]

- (e) The weight for a sample of 18 cans of vegetables was obtained, to test the claim that the mean is 17 grammes. The sample weight was obtained as shown below.

21	11	10	14	13	15	20	22	12
20	18	18	24	19	17	30	23	26

**Required:**

Determine if there is enough evidence to reject the claim at 5% significance level.

[6 marks]

**QUESTION TWO (20 MARKS)**

- (a) The contingency table below summarizes the results obtained in a study conducted by a research organization with respect to the performance of four competing brands of toothpaste among the users:

	BRAND				Total
	A	B	C	D	
No	9	13	17	11	50
1-5 Cavities	63	70	85	82	300
>Cavities	28	37	48	37	150
Total	100	120	150	130	500

Test the hypothesis that incidence of cavities is independence of the brand of the toothpaste used (Take  $\alpha=0.05$ ) [10 marks]

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- (b) The table of unit of fertilizer used and the units of yield in a science laboratory experience is as shown below.

Fertilizer	23	27	28	29	30	31	33	35	36	39
Yield	18	22	23	24	25	26	28	29	30	32

**Required:**

- (i) Determine the Pearson correlation coefficient between fertilizer(X) and Yield (Y) [4 marks]
- (ii) Using the results in b(i), test for the significance of the correlation coefficients at 5% significance level [6 marks]

#### QUESTION THREE (20 MARKS)

- (a) Let X be the IQ scores for a certain population, and that  $X \sim N(\mu, 100)$ . To test  $H_0 : \mu = 110$  vs  $H_1 : \mu > 110$ , a random sample of size  $n = 16$  from this population was taken. If a mean  $\bar{x} = 113.5$  was observed, test the null hypothesis at 5% significance level [8 marks]
- (b) Two random samples taken from two normal populations are as follows:
- |           |    |    |    |    |    |    |    |    |    |    |    |    |
|-----------|----|----|----|----|----|----|----|----|----|----|----|----|
| Sample I  | 20 | 16 | 26 | 27 | 23 | 22 | 18 | 24 | 25 | 19 |    |    |
| Sample II | 17 | 23 | 32 | 25 | 22 | 24 | 28 | 18 | 31 | 33 | 20 | 27 |

Estimate the variances of the populations and test whether the two populations have equal variances at  $\alpha = 5\%$  [12 marks]

#### QUESTIO FOUR (20MARKS)

- (a) An owner of a big \_rm agrees to purchase the products of a factory if the produced items do not have variance of 0.5mm<sup>2</sup> in their length. To be sure of the specifications, the buyer selects a sample of 18 items from his lot. The length of each item was measured as follows:
- 18:57 18:10 18:61 18:32 18:33 18:46  
18:12 18:34 18:57 18:22 18:63 18:43  
18:37 18:64 18:58 18:34 18:43 18:63
- On the basis of the sample data, should the buyer purchase the lot at 5% level of significance? [10 marks]

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- (b) The following data is a sample of 13 loan applicants in a certain bank in Kenya. The applied loan is either approved or declined (status) against three risk variables namely amount of loan applied ( $X_1$ ), applicant's salary ( $X_2$ ) and proposed repayment period ( $X_3$ ) as shown below.

<i>Coefficients:</i>				
	<i>Estimate</i>	<i>Std. Error</i>	<i>t value</i>	<i>Pr(&gt; t )</i>
<i>(Intercept)</i>	24.025	1.222	19.654	1.71e-10
$X_1$	-7.925	1.729	-4.584	0.000628
$X_2$	16.250	1.729	9.400	6.96e-07
$X_3$	-17.425	2.445	-7.127	1.20e-05

*Residual standard error: 2.445 on 12 degrees of freedom*  
*Multiple R-squared: 0.9581, Adjusted R-squared: 0.9476*  
*F-statistic: 91.36 on 3 and 12 DF, p-value: 1.569e-08*

#### Required

Write a report on Multiple regression function and interpret the results

[10 marks]

#### QUESTIO FIVE (20MARKS)

The following data represent the age( $X_1$ ) and nutrition score( $X_2$ ) on health assessment( $Y$ ).

Y	$X_1$	$X_2$
20	23	3
18	40	4
30	50	3
25	30	1

#### Required

- Fit a multiple linear regression model ( $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + e$ )
- Determine variance of  $\beta_0$ ,  $\beta_1$  and  $\beta_2$
- Test hypothesis that ( $X_1$ ) has no effect on  $Y$  (Take alpha=5%)
- Test hypothesis that ( $X_2$ ) has no effect on  $Y$  (Take alpha=5%)

[20 marks]