



## GENERAL SIR JOHN KOTELAWALA DEFENCE UNIVERSITY

Faculty of Engineering

Department of Mathematics

✓  
06/05/2022

BSc Engineering Degree  
Semester 5<sup>th</sup> Examination – May 2022  
(Intake 37 – All streams)

### MA 3102 – APPLIED STATISTICS

Time allowed: 2 (Two) hours

20<sup>th</sup> May, 2022

#### ADDITIONAL MATERIAL PROVIDED

Statistical tables are provided

#### INSTRUCTIONS TO CANDIDATES

This paper contains 4 questions on 6 pages

Answer **all** questions

This is a closed book examination

This examination accounts for 70% of the module assessment. A total maximum mark obtainable is 100. The marks assigned for each question and parts thereof are indicated in square brackets

If you have any doubt as to the interpretation of the wordings of a question, make your own decision, but clearly state it on the script

Assume reasonable values for any data not given in or provided with the question paper, clearly make such assumptions made in the script

All examinations are conducted under the rules and regulations of the KDU

### Question 1

(a) Define the term "sample statistic".

[4 marks]

(b) The weights of 2000 packages in a brand of serial are normally distributed with mean of 32 grams and standard deviation of 1.3 grams.

(i) What is the probability that the weight of a package is between 30 grams and 34 grams?  $0.499$

(ii) Find the expected number of packages of weight between 30 grams and 34 grams.  $n = 418$

(iii) Find the expected number of packages of weight more than 34 grams. [3x3 marks]

(c) Suppose an independent testing agency has been contracted to determine whether the contracting company should use a gasoline additive to increase gasoline mileage of its vehicles. The current gasoline mileage for it vehicles is 18.5 mpg. A random sample of 29 vehicles from the company's fleet produced a sample average of 19.34 mpg and a sample standard deviation of 5.2 mpg.

(i) Construct a 95% two-sided confidence interval for the population average of the gasoline mileage with gasoline additive.  $12.36 \leq \mu \leq 21.17$  [6 marks]

(ii) What sample size should be taken if the agency wants 95% confidence when the margin of error is 1.5? [6 marks]

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## Question 2

(a) The average length of time for students to register for first semester class modules at a certain college has been 50 minutes with a standard deviation of 10 minutes. A new registration procedure using modern computing machines is being tried. A random sample of 12 students had an average registration time of 42 minutes with a standard deviation of 11.9 minutes under the new system. It is claimed that the population mean is now less than 50. Assume the population of times to be normal.

(i) Write the appropriate null and alternative hypothesis based on the claim.

$H_0: \mu = 50$        $H_a: \mu < 50$  [3 marks]

(ii) Select the appropriate test statistic and calculate the test value.

$Z = -2.328$  [3 marks]

(iii) Test the hypothesis for 0.05 significance level.

$|Z| > 1.96$  [3 marks]

(iv) Interpret the conclusion.

[3 marks]

(b) The observed frequencies of tossing of a die 120 times given in the Table 1.

	Faces					
	1	2	3	4	5	6
Observed frequencies	20	22	17	18	19	24

By comparing the observed frequencies with the expected frequencies, decide whether the die is fair die or not. Use 0.05 significance level.

[13 marks]

### Question 3

- (a) A financial company wants to find whether the interest rate (X) has significant influence on the number of customers opened fixed deposit (Y) in their company. The data obtained for the nine weeks are shown in the Table 2.

(r)	X	30 ✓	30 ✓	40	20 ✓	20 ✓	45 ✓	30 ✓	45 ✓	50
(x)	Y	190	180	180	200	195	170	185	175	165

Table 2

- (i) Plot the data on a scatter diagram. Discuss the behaviors.

[3 marks]

- (ii) Calculate the correlation coefficient.  $r = -0.958$

[3 marks]

- (iii) Find an equation of the simple linear regression line.

$$\hat{y} = 212.37 - 0.9916x$$

[3 marks]

- (iv) What is the expected number of fixed deposit accounts open when the interest rate will be increased to 38?

$$\hat{y} = 8.698$$

[3 marks]

(b)

The Mozart effect refers to a boost of average performance on tests for elementary school students if the students listen to Mozart's chamber music for a period of time immediately before the test. In order to attempt to test whether the Mozart effect actually exists, an elementary school teacher conducted an experiment by dividing her third-grade class of 15 students into three groups of 5. The first group was given an end-of-grade test without music; the second group listened to Mozart's chamber music for 10 minutes; and the third group listened to Mozart's chamber music for 20 minutes before the test. The scores of the 15 students are given below in Table 3.

Group 1	Group 2	Group 3
80	79	73
63	73	82
74	74	79
71	77	82
70	81	84

$$T_1 = 358$$

$$T_2 = 384$$

$$T_3 = 400$$

$$T_{\text{total}} = 1142$$

At the 10% level of significance, test whether the data provide sufficient evidence to conclude that the Mozart effect exists.  $\rightarrow \text{H}_0$  ✓

[13 marks]

Question 4

The Table 4 presents the weights, in ounces, for a sequence of 15 rational subgroup samples of potato chips, with  $n=4$  for each sample.

Sample number	Package weights (oz)			
	$x_1$	$x_2$	$x_3$	$x_4$
1	15.01	14.98	15.16	14.80
2	15.09	15.14	15.08	15.03
3	15.04	15.10	14.93	15.03
4	14.90	15.03	14.94	14.92
5	15.04	15.05	15.08	14.98
6	14.96	14.81	14.96	14.91
7	15.01	15.10	14.90	15.03
8	14.71	14.92	14.77	14.95
9	14.81	14.80	14.64	14.95
10	15.03	14.89	14.99	15.03
11	15.16	14.91	14.95	14.83
12	14.92	15.05	15.01	15.02
13	15.06	15.03	14.95	15.02
14	14.99	15.14	15.04	15.11
15	14.94	15.08	14.90	15.17

Table 4

(a) Using these parameter values, determine the **central line** and **control limits (UCL and LCL)** for  $R$  charts.

[6 marks]

(b) Plot  $R$  chart.

[4 marks]

(c) Identify out of control points from  $R$  chart.

[2 marks]

(d) Determine the **centerline** and the **lower and upper** control limits for the

$\bar{X}$  chart.

[6 marks]

(e) Plot  $\bar{X}$  chart.

[4 marks]

(f) Identify out of control points from  $\bar{X}$  chart.

[3 marks]

-----End of the question paper-----