

KATHMANDU UNIVERSITY
End Semester Examination [C]
April/May, 2023

Marks Scored:

Level : B.Sc.

Year : II

Exam Roll No.:

Time: 30 mins.

Course : MATH 206

Semester : I

F. M. : 20

Date

27 APR 2023

Registration No.:

SECTION "A"

[10Q. × 1 = 10 marks]

Fill in the blank space(s) by the most appropriate word(s) or symbol(s).

1. The proportion of defective items is not allowed to be over 15%. A buyer wants to test whether the proportion of defectives exceeds the allowable limit. The buyer takes a random sample of 100 items and finds that 19 are defective. State the null and alternative hypotheses for this test _____.
2. The _____ is very popular for the goodness-of-fit test.
3. A machine puts out 16 imperfect articles in a sample of 500. After machine is overhauled, it puts out 3 imperfect articles in batch of 100. Has the machine improved? The null hypothesis to this problem is _____.
4. The ratio of two sample variances, S_1^2/S_2^2 , taken from two samples is termed as the _____ and follows _____.
5. The mathematical model $y = a + bx + cx^2$ is called _____ model.
6. A regression analysis with two or more independent variables is refereed as _____.
7. In the completely randomized design, variance between the samples can be attributed to treatment effects and variance within group can be attributed to _____.
8. When we want check whether the variability in the products is within the tolerance limits or not we use _____.
9. The study of number of defects per unit is _____.
10. _____ chart studies the size of the variable.

SECTION "B"

[10Q. × 1 = 10 marks]

Fill in the blank space(s), **DO NOT TICK**, by selecting the most appropriate answers from among the given ones.

11. Conduct a test to determine whether or not the population proportion of voters in favor of proposal A is greater than 50%. In a random sample of 200 voters, 140 said that they were in favor of this proposal. The test statistic is _____.
a. $z = 6.17$ b. $z = 19.80$ c. $z = 5.66$ d. $z = 7.07$

12. _____ symbol represents the test statistic for the Mann–Whitney test.
a. W b. t c. U d. H

13. It is suspected from theoretical considerations that the rate of flow from a firehouse is proportional to some power of the nozzle pressure. Assume pressure data is more accurate. You are linearizing the data.

Flow rate, F (gallons/min)	96	129	135	145	168	235
Pressure, p (psi)	11	17	20	25	40	55

The exponent of the power of the nozzle pressure in the regression model, $F=ap^b$ most nearly is _____.
a. 0.497 b. 0.556 c. 0.578 d. 0.678

14. Sampling distribution of R(run) can be approximated by _____, with defined mean and standard deviation.
a. binomial distribution b. normal distribution
c. uniform distribution d. poisson distribution

15. When observations are classified on the basis of two variables and arranged in a table, the resulting table is referred to as a _____.
a. frequency table b. cumulative frequency table
c. contingency table d. normal table

16. The F distribution is _____.
a. Symmetric b. V shaped c. U shaped d. Not Symmetric

17. _____ is especially used when a researcher wants to compare two or more regression models that have the same dependent variable but have different number of independent variables.
a. R^2 b. Variance c. R d. Standard Error

18. If a process is said to be in control, what can we say about the variation?
_____.
a. Random b. Normal c. Attribute d. Assignable

19. The non-parametric alternative to the repeated measures one-way ANOVA is the _____.
a. Kruskal Wallis H test b. Mann Whitney U test
c. Run test d. Sign test

20. _____ test(s) is an example of non-parametric test.
a. t – test b. z – test c. sign test d. all of these

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Level : B.Sc.
Year : II
Time : 2 hrs. 30 mins.

Course : MATH 206
Semester : I
F. M. : 55

SECTION "C"
[3Q. × 9 = 27 marks]

1. Define multiple linear regression. The following table presents measured weights (in g), thickness (in mm), and loads (in kg) required to crack the specimen for a collection of specimens dated between AD 1100 and 1300. [2+3+2+2]

Weight (x_1)	12.7	12.9	17.8	18.5	13.4	15.2	13.2	18.3	16.2
Thickness (x_2)	5.69	5.05	6.53	6.51	5.92	5.88	4.09	6.14	5.73
Load(y)	20	16	20	36	27	35	15	18	24

- a. Fit the model $y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \epsilon$
 - b. Compute the R^2
 - c. Plot the residuals versus the fitted values for the model
2. What is Chi square test? Four machines manufacture cylindrical steel pins. The pins are subject to a diameter specification. A pin may meet the specification, or it may be too thin or too thick. Pins are sampled from each machine, and the number of pins in each category is counted. Test the null hypothesis that the proportions of pins that are too thin, OK, or too thick are the same for all the machines. [2+7]

Machine	Too Thin	OK	Too Thick
Machine 1	10	102	8
Machine 2	34	161	5
Machine 3	12	79	9
Machine 4	10	60	10

3. What principles have to be kept in mind while designing an experiment? Explain with respect to the following problem. A professor wants to determine which subject engineering students find most difficult among statistics, physics, and chemistry. She obtains the final exam grades for four students who took all three courses last semester and who were in the same sections of each class. The results are presented in the following table. [3+5+1]

Course	Student			
	1	2	3	4
Statistics	82	94	78	70
Physics	75	70	81	83
Chemistry	93	82	80	70

- a. Conduct a two-way ANOVA
- b. The professor proposes a randomized block design, with students as blocks. Give the reason that this is likely not to be appropriate.

SECTION "D"

[4Q. × 7 = 28 marks]

4. a. Two quantities x and y are measured and corresponding values are given in the following table.

x	20	40	60	80	100	120
y	5.5	9.1	14.9	22.8	33.3	46

Find a second-degree parabola Y on X to the data. Find the R^2 . [1.5+2]

- b. Two quantities x and y are measured and corresponding values are given in the following table.

x	1	5	7	9	12
y	10	15	12	15	21

Fit the curve $y = ae^{bx}$. Find the R^2 [1.5+2]

5. What are non-parametric tests? Apply the Mann Whitney U test to the following problem; from the pig blood loss experiment: [2+5]

Pig Blood Loss Data (ml)

Control Group Pigs	Treatment Group Pigs
786	743
375	766
3446	655
1886	923
478	1916
587	897
434	3028
3764	1351
2281	902
2837	1378
Sample mean = 1687.40	Sample mean = 1255.90

6. The following table presents the results for entropies of transfer (in J/K. mol) from water to water + methanol of NaCl(table salt) over a range of concentration of methanol: [2+2+3]

Concentration (%)	5	10	20	30	40	50	60	70	80	90	100
Entropy	1	-1	-7	-17	-28	-39	-52	-65	-80	-98	-121

- a. Fit a polynomial model of degree 1 and 2 to predict the entropy (y) from the concentration (x)
 b. Which degree polynomial is the most appropriate? Explain.

7. a. The quality – control plan for a certain production process involves taking samples of size 4. The results from the last 30 samples can be summarized as follows: [1.5+1.5]

$$\sum_{i=1}^{30} \bar{X}_i = 712.5, \sum_{i=1}^{30} R_i = 143.7, \sum_{i=1}^{30} s_i = 62.5$$

- i. Compute the 3σ control limits for the R chart.
 ii. Using the sample ranges, compute the 3σ control limits for the \bar{X} chart.
 b. To set up a p chart to monitor a process that produces computer chips, samples of 300 chips are taken daily, and the number of defective chips in each sample is counted. The number of defective chips for each of last 20 days are as follows: [2+1+1]
 12, 13, 11, 10, 15, 9, 1, 10, 9, 15, 8, 13, 11, 9, 16, 12, 19, 20, 18, 9
 i. Compute the upper and lower 3σ limits for the p chart.
 ii. At which sample is the process first detected to be out of control?
 iii. Suppose that the special cause that resulted in the out-of-control condition is determined, should this cause be remedied? Explain.