

KATHMANDU UNIVERSITY  
End Semester Examination  
January/February 2024

Marks Scored:

Level : B.E./B.Sc./B.Tech.  
Year : II

09 FEB 2024

Course : MATH 208  
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date :

SECTION "A"  
[10Q.  $\times$  1 = 10 marks]

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

1. The mean of the sum of the deviation taken from the arithmetic mean is \_\_\_\_\_.
2. In calculation of coefficient of quartile deviation, the difference between the first and the third quartile is divided by \_\_\_\_\_.
3. The probability that the last digit of the phone number that will be received next on your cell phone will be 5 is \_\_\_\_\_.
4. If  $A$  and  $B$  are \_\_\_\_\_ events, then  $P(A \cup B) = P(A) + P(B)$ .
5. If  $V(X)$  and  $V(Y)$  are variances of are independent random variables,  $X$  and  $Y$  then  $V(X - Y) =$  \_\_\_\_\_.
6. Poisson distribution can be considered as a special case of binomial distribution when (i) number of trials is infinite and (ii) \_\_\_\_\_.
7.  $t$ -distribution is preferred over  $Z$ - distribution to carry inference on mean of a normal population when \_\_\_\_\_.
8. The probability of rejecting the null hypothesis even when it is true is pre-defined in a statistical test procedure and it is called \_\_\_\_\_ of the test and is denoted as  $\alpha$ .
9. An attribute of the manufacturing product that determines its fitness for use is called its \_\_\_\_\_.
10. In regression analysis, the sum of square of deviations of  $n$  observations, i.e.,  $X_1, X_2, \dots, X_n$  from mean,  $\bar{X}$  is given by expression  
 $S_{xx} =$  \_\_\_\_\_.

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. \_\_\_\_\_ of data lie above the first quartile.  
[ 25%;                      50%;                      75%;                      100%]
12. The probability of the occurrence of exactly one of the two events  $A$  and  $B$  is denoted as  
[ $P(A \cap B)$                        $P(A \cap \bar{B})$ ;                       $P(\bar{A} \cap B)$ ;                       $P((A \cap \bar{B}) \cup (\bar{A} \cap B))$ ]
13. The set of all possible outcomes of a random experiment is called its \_\_\_\_\_.  
[event;                      trial;                      sample space;                      probability]
14. If  $V(X) = 2.5$ , then  $V(2X + 3) =$  \_\_\_\_\_.  
[5;                      10;                      8;                      13]
15. The probabilities related to the event of occurrence of accidents at a junction of a road during a year can be described by using \_\_\_\_\_ distribution.  
[binomial;                      Poisson;                      normal;                      chi-square]
16. If  $X \sim N(12, 3^2)$ , and  $Y = X + 4$ , then  $Y \sim$  \_\_\_\_\_.  
[ $N(16,3)$ ;                       $N(16,3^2)$ ;                       $N(12,16)$ ;                       $N(16, 16)$ ]
17. The total number of samples of size 2 that can be drawn from a population containing 8 units by simple random sampling without replacement method is \_\_\_\_\_.  
[64;                      28;                      4;                      16]
18. In test of hypothesis of mean  $\mu$  of a normal population, if alternative hypothesis is specified as  $H_1: \mu < 24$ , then the corresponding test is called \_\_\_\_\_ tailed test.  
[right;                      left;                      two;                      upper]
19. The control chart for number of defectives is called \_\_\_\_\_.  
[R-chart;                      c-chart;                      p-chart;                      d-chart]
20. The objective of regression analysis is not to \_\_\_\_\_.  
[ observe of change in one variable with respect to another;  
develop model describing relation between two or more variables  
predict unknown/ future values  
detect normality of variables]

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SECTION "C"  
[3 Q. × 7 = 21 marks]

1. Mileage of 32 cars of 2016 model in miles per gallon are presented in following table

21.0	21.0	22.8	21.4	18.7	18.1	14.3	24.4
22.8	19.2	17.8	16.4	17.3	15.2	10.4	10.4
14.7	32.4	30.4	33.9	21.5	15.5	15.2	13.3
19.2	27.3	26.0	30.4	15.8	19.7	15.0	21.4

- Create a stem-and-leaf plot of given data. [1]
  - Use stem-and-leaf plot in part (a) to create ordered stem-and-leaf plot and rewrite given values in ascending order. [1]
  - Using the ordered stem-and-leaf plot created in part (b), determine median and quartiles. [3]
  - Calculate quartile deviation and coefficient of quartile deviation. [1]
  - Draw a boxplot of given data and interpret it. [1]
2. A floor cleaning company has been using **Wax 1** to wax floors for a long time. A new floor wax, **Wax 2**, has recently come on the market with the claim that it is longer lasting than **Wax 1**. The company wants to investigate this claim. The company waxed a sample of 9 floors with **Wax 1** and 8 floors with **Wax 2**. The number of months the wax lasted are presented below-
- Wax 1:** 2.73, 2.36, 2.62, 2.65, 2.08, 2.23, 2.94, 2.61, 2.94  
**Wax 2:** 2.93, 2.05, 2.83, 2.72, 2.41, 2.82, 2.12, 3.27
- Assuming that both the samples are drawn from normal populations having nearly equal variances, test if **Wax 2** lasts longer, on average, than **Wax 1** at 5% level of significance. Also obtain 95% confidence interval for difference in actual average lasting times of the two types of products.

OR

In the class of Dr. Sharma, students take two major tests, one early in the semester and one later in the semester. To hear her tell it, she runs a very hard class, one that most students find very challenging; but she argues that by setting hard assessments, students are encouraged to work harder. Her theory is that the first test is a bit of a "wake up call" for students: when they realise how hard her class really is, they'll work harder for the second test and get a better mark. Marks obtained by 8 students in the two tests are tabulated below-

Student ID	1	2	3	4	5	6	7	8
Test 1	41.7	36.5	56.9	30.6	47.3	61.2	58.5	63.1
Test 2	80.3	69.4	83.8	81.2	61.4	77.6	72.0	66.0

Is she right? Use paired t-test, at 5% level of significance. Also obtain 95% confidence interval for actual difference in marks in the two tests.

3. The speed of cars, in miles per hour and the distances covered to stop, in feet are given in table below-

Speed	8	10	12	14	16
Distance	20	26	28	32	36

- Draw a scatterplot to show that there is nearly linear relationship between speed of cars and stopping distance. [1]
- Develop a linear regression model describing relationship between speed of cars and stopping distance. [4]
- Use the model developed in part (b) to estimate stopping time of a car when it is moving with speed of 15 miles per hour. [1]
- Find Pearson's correlation coefficient between speed and stopping distance. [1]

SECTION "D"

[6 Q. × 4 = 24 marks]

4. Three factories produce light bulbs to supply a market. Factory A produces 20%, 50% of the tools are produced in factories B and 30% in factory C. 2% of the bulbs produced in factory A, 1% of the bulbs produced in factory B and 3% of the bulbs produced in factory C are defective. A bulb is selected at random in the market, find probability of this bulb to be defective. What is the probability that this defective bulb was produced by factory B?

5. The probability density function of a continuous random variable X is given by

$$f(x) = \frac{1}{2}; -1 \leq x \leq 1$$

Consider a function of X given by  $g(X) = Y = X^2$ . Find (i) cumulative distribution function of Y, i.e.,  $F(y)$  (ii) probability density function of Y, i.e.,  $f(y)$ . Also state the domain of both the results.

6. Each of five questions on a multiple-choice examination has four choices, only one of which is correct. A student is attempting to guess the answers. The random variable X is the number of questions answered correctly. What is the probability that the student will get a) exactly three correct answers? b) at the most three correct answers? c) at least one correct answer.

7. In a call center, the number of phone calls received each day by each of the 12 receptionists is normally distributed with 63 calls on average on each day. If probability of daily phone calls numbering between 60 and 66 is found to be 0.6827, find the standard deviation and then find the probability that on a particular day the number of phone calls received by the receptionists is more than 70.

8. A coffee shop claims that their large cup contains 16 ounces of coffee. A skeptical customer takes a random sample of 10 large cups of coffee and measures their contents in ounces with results-

**20.0, 17.9, 20.6, 15.3, 16.8, 16.6, 18.2, 14.2, 19.2, 15.8**

Obtain 95% confidence interval for true average content of coffee and carry t-test to determine if the actual mean volume differs from the claimed 16 ounces.

9. Data on 30 days for number of late flights out of 240 takeoffs daily are presented below-

26	19	26	22	24	19	19	20	18	18
17	9	13	10	12	14	14	13	9	10
12	15	14	15	16	18	17	16	18	17

Construct p-chart for proportions of late flights and interpret the chart.

OR

The times, in seconds, required for packing manufactured products by two machines, namely, Machine-1 and Machine-2 for 10 units each are recorded as follows-

42.1	41	41.3	41.8	42.4	42.8	43.2	42.3	41.8	42.7
42.7	43.6	43.8	43.3	42.5	43.5	43.1	41.7	44	44.1

If standard deviations of the packing times are calculated to be 0.683 for Machine-1 and 0.750 for Machine-2, carry F-test to observe whether packing time of Machine-2 is more varied at 5% level of significance.

SECTION "E"

[5Q. × 2 = 10 marks]

10. Following information are obtained from the study of 120 observations, mean = 47.5, standard deviation = 12.2, median = 52.1. Calculate coefficient of variation of observations.
11. Suppose through a medical data we know that flu causes fever in 80% of cases and approximately every 1 in 10,000 have flu at a given time and approximately every 1 out of 50 people are suffering from fever. Given that a patient has fever, find the probability that she has flu?
12. Given  $X \sim \text{Poisson}(2.4)$ , find  $P(2X \geq 2)$ .
13. If  $E(X_1) = 2.5$  and  $E(X_2) = 7$  then find  $E(2X_1 + X_2 - 3)$
14. Write short note on
- Control chart of attributes
  - Parameters

