KATHMANDU UNIVERSITY
End Semester Examination
June/July, 2023

Marks Scored:

Level : B.E./B.Sc./B.Tech.
Year : II
Course : MATH 208
Semester : I & II

Exam Roll No. :
Time: 30 mins.
F. M. : 20

Registration No.:
Date : 14 JUL 2023

SECTION "A"
[10 Q × 1 = 10 marks]

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

1. The sum of deviation taken from arithmetic mean or average is _____

2. The formula for calculation of Karl Pearson's coefficient of skewness is S_k = _____.

3. In a perfectly symmetrical distribution, 50% items are above 60 and 75% items are below 75. Therefore Q_1 = _____.

4. "The chances of catching cold by workers working in an ice factory during winter are 25%. What is the probability that out of 5 workers 4 or more will catch cold?" This problem can be solved by using _____ distribution.

5. If $X_1 \sim N(40, 25)$, $X_2 \sim N(60, 36)$, then $E(2X_1 + 3X_2)$ = _____.

6. The standard deviation of B(12, 0.4) distribution is _____.

7. In test of hypothesis procedure, the level of type-I error is explicitly specified and this level is called _____ of the test.

8. The error that is committed in accepting the null hypothesis when, in fact, it is wrong is called _____ error.

9. Control charts are used to detect the presence of variation produced due to _____ _____ cause.

10. The formula for calculation of sum of cross-products of X and Y is, i.e., S_{xy} = _____ _____.

SECTION "B"
[10 Q × 1 = 10 marks]

11. The _____ moment of a distribution is related to the kurtosis.
a. first b. second c. third d. fourth

12. The probability of occurrence of exactly one of the two events A and B is denoted as _____ _____
a. $P(A \cup B)$ b. $P(A \cap B)$ c. $P(A \cap \bar{B})$ d. $P\big((A \cap \bar{B}) \cup (\bar{A} \cap B)\big)$

13. If X_1 and X_2 are two independent random variables, then $V(2X_1 - 3X_2) =$ _____

a. $2V(X_1) - 3V(X_2)$
b. $4V(X_1) - 9V(X_2)$
c. $4V(X_1) + 9V(X_2)$
d. $4E(X_1^2) - 9E(X_2^2)$

14. A person wants to study the number of accidents occurring in a city over a year. The statistical distribution he/she needs to apply is _____ distribution.

a. binomial b. Poisson c. normal d. hypergeometric

15. An observation divides a group of data into four subgroups _____.

a. Quartiles b. Median c. Deciles d. Percentiles

16. The expression $\left(\frac{\sigma Z_{\frac{\alpha}{2}}}{E_{Max}}\right)^2$ gives _____

a. error in estimation
b. sample size required
c. confidence interval of population mean
d. confidence interval of population variance

17. _____ distribution is formed by combination of two chi-square distributions.

a. normal b. c. F d. Poisson

18. The major purpose of a test of hypothesis is to _____

a. make a decision about the sample, using the statistic
b. make a decision about the observed statistic
c. make a decision about the population, using the statistic
d. make a decision about the population, using parameters

19. _____ chart does not belong to '**control chart for attributes**'.

a. p – chart b. d – chart c. c – chart d. R – chart

20. The correct expression for finding Pearson's correlation coefficient is _____

a. $\frac{\Sigma xy - \frac{1}{n}\Sigma x \Sigma y}{\left(\Sigma x^2 - \frac{1}{n}(\Sigma x)^2\right)\left(\Sigma y^2 - \frac{1}{n}(\Sigma y)^2\right)}$

b. $\frac{\Sigma xy - \frac{1}{n}\Sigma x \Sigma y}{\sqrt{\Sigma x^2 - \frac{1}{n}(\Sigma x)^2}\sqrt{\Sigma y^2 - \frac{1}{n}(\Sigma y)^2}}$

c. $\frac{\Sigma xy - \frac{1}{n}\Sigma x \Sigma y}{\sqrt{\Sigma x^2 - \frac{1}{n}(\Sigma x)^2}}$

d. $\frac{\Sigma xy - \frac{1}{n}\Sigma x \Sigma y}{\sqrt{\Sigma y^2 - \frac{1}{n}(\Sigma y)^2}}$

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Semester : I & II
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SECTION "C"
[3Q. × 7 = 21 marks]

1. The following data represent the length of life, in seconds, of 50 fruit flies subject to a new spray in a controlled laboratory experiment: [1+1+3+1+1]

17	20	10	9	23	13	12	19	18	24
12	14	6	9	13	6	7	10	13	7
16	18	8	13	3	32	9	7	10	11
13	7	18	7	10	4	27	19	16	8
7	10	5	14	15	10	9	6	7	15

a. Create a branched stem-and-leaf plot with digits 0, 1, 2, 3, 4 in leaf indicated by symbol '+' and digits 5, 6, 7, 8, 9 in leaf indicated by symbol '*'.
b. Use stem-and-leaf plot in part (a) to create ordered stem-and-leaf plot and rewrite given values in ascending order.
c. Using the ordered stem-and-leaf plot created in part (b) determine median and quartiles.
d. Calculate quartile deviation and coefficient of quartile deviation.
e. Draw a boxplot of given data and interpret it.

2. The scores achieved by 10 males and 8 females in an IQ test are given below:

Score of Males: 95 78 68 95 98 79 98 78 89 89
Score of Females: 100 100 95 90 95 98 92 97

Assuming that the actual scores of male and female candidates are both normally distributed with unknown means and variances but variances are equal, is there any evidence to consider that the actual mean score of females is significantly greater than that of males at 0.05 level of significance. Also construct 95% confidence interval for difference in means of scores of males and females.

3. In a survey, the question, "Do you smoke?" was asked to 100 people. Results are shown in the following table:

	Yes (A)	No ($\bar{A}$)	Total
Male (B)	19	41	60
Female ($\bar{B}$)	12	28	40
Total	31	69	100

An individual is chosen from them at random. Find: a) What is the probability that the selected individual smokes? b) What is the probability that the selected individual is a male and smokes? c) What is the probability that the selected individual is a male? d) What is the probability of selected individual being a smoker if he was found to be a male?

OR

Explain what are the probability of Dependent and Independent events. Write down the multiplication theorem of dependent and independent probability for two events.
Explain what are $\bar{X}$ – chart and R – chart used for? During summer season the machine at an ice cream factory is operated for 20 hours on a day. It is suspected that the weights of ice creams produced are uniform. The weights of 4 ice creams are observed as sample each hour. The results for 20 hours on a day, in pounds, are given below-

Hour	Weight			
	1	2	3	4
1	7	9	12	14
2	9	5	5	12
3	7	10	11	7
4	8	9	5	14
5	7	8	11	12
6	12	11	9	10
7	16	9	10	7
8	6	5	11	3
9	8	7	10	14
10	15	17	9	14

Hour	Weight			
	1	2	3	4
11	7	12	13	17
12	5	11	8	12
13	16	10	13	14
14	8	13	9	13
15	11	8	11	16
16	15	11	10	14
17	10	9	11	10
18	16	8	11	12
19	8	7	10	13
20	15	17	10	15

Construct (i) $\bar{X}$ – chart and (ii) R – chart using given data and interpret the charts.

SECTION "D"
[6Q. × 4 = 24 marks]

4. In certain food experiment to test the effectiveness of a baby food, 8 children were observed. Their weights, in pounds, before taking the food and after 2 weeks of experiment are as follows-

Children ID	1	2	3	4	5	6	7	8
Before	49	53	51	52	47	50	52	53
After	52	55	52	53	50	54	54	53

Carry paired t-test to examine whether the baby food has been effective in increasing weight at 0.05 level of significance.

5. A researcher is interested in studying average weight of obese children in a province. Previous literature gives an estimated standard deviation of weight of obese children in the province to be 1.24. What is the sample size required for him/her to observe if 95% confidence level is required and that maximum tolerable error is 1.5?

OR

Write down any two characteristics of Poisson distribution. The number of customers arriving at a grocery store is a Poisson random variable. On average 10 customers arrive per hour. Let X be the number of customers arriving from 10 am to 12 noon. Find $P(12 < X \leq 15)$.

6. The average number of acres burned by forest and range fires in a county is 4,300 acres per year, with a standard deviation of 750 acres. The distribution of the number of acres burned is normal. What is the probability that between 2,500 and 4,200 acres will be burned in any given year? Find 'c' such that probability is 0.38 that at the most 'c' acres will be burned in a year.

7. A manufacturer of tyres claim that average life of its product is more than 50000 kms. A sample of 250 tyres is observed and it is found that the average life of the tyres is 50500 kms with a standard deviation of 3500 kms. Test the claim of the manufacturer at 5% level of significance. Also establish the 99% confidence interval within which the mean life of tyres of the company can be expected to lie.

8. A random sample of 10 workers is taken from a factory. The wages (in hundreds) per months of these workers are given below: 48, 50, 62, 75, 80, 60, 70, 56, 52, 77. Obtain 95% confidence interval for the variance of wages of all the workers of the factory.

9. In a sample of 15 patients at Clinic 1, the standard deviation for the wait time to see a doctor was 45 minutes. In a sample of 12 patients at Clinic 2, the standard deviation for the wait time to see a doctor was 27 minutes. Assume the population of wait times at the two clinics are independent and normally distributed. Is the variability of waiting time in clinic 1 is significantly greater than that in clinic 2? Test at 5% level of significance.

SECTION "E"

[5Q. × 2 = 10 marks]

10. Find the coefficient of correlation, if the coefficient of determination is 0.81.

11. Write down the two-regression equation of Y on X and X on Y.

12. The probability that it is Friday and that a student is absent is 0.03. There are 6 school days in a week. What is the probability that a student is absent given that today is Friday?

13. A bag contains 5 white balls, and 4 black balls. Two balls are drawn from the bag randomly, one by one, without replacement. Find the probability that the first ball is black, and second is white.

14. Write short notes on (i) type-I error (ii) continuous random variable.

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SECTION "A"
[20Q. × 1 = 20 marks]

Mark [X] in the most appropriate option.

1. Which statistical parameter is used to quantify the precision of a set of measurements?
   [ ] Standard deviation [ ] Confidence interval
   [ ] Detection limit [ ] Mode

2. In a laboratory, a pH meter is wrongly calibrated by the lab staff. _____type of error is likely to happen.
   [ ] Random error [ ] Relative error
   [ ] Gross error [ ] Systematic error

3. Which of the following conditions *does not* promote the formation of salts of weak acids like ZnS?
   [ ] Precipitation in elevated temperature
   [ ] Decreasing (Q-S)/S
   [ ] Precipitation at high pH
   [ ] Slow mixing of dilute solution

4. Gravimetric factor of Fe in Fe_2O_3 is_____.
   [ ] 0.699 [ ] 0.344 [ ] 159.69 [ ] 55.85

5. The mean activity coefficient (calculated using Davies equation) for a solution of Na_2SO_4, having ionic strength 0.9, is_____.
   [ ] 0.101 [ ] 0.394 [ ] 0.485 [ ] 0.457

6. What will be the molarity (mol/ltr.) of a solution which contains 119.0gm of $KMnO_4$ (MW 158) in 3 liters of solution?
   [ ] 0.250 [ ] 0.750 [ ] 12.06 [ ] 0.126

7. Dichlorofluorescein is an example of _____ indicator.
   [ ] Acid base [ ] Metallochromic
   [ ] Specific [ ] Adsorption

8. When 50 ml of 0.04M NaCl is mixed with 50ml of 0.2M $AgNO_3$ the ion strongly adsorbed on primary layer of the precipitate is_____.
   [ ] Cl^- [ ] Ag^+ [ ] NO_3^- [ ] Na^+

9. The potential, at equivalence point, for the following titration reaction is_____.
   $A^{2+} + 2B^{4+} \leftrightarrows A^{4+} + 2B^{3+}$ (E^0_A= 0.10V and E^0_B=1.40V)
   [ ] 0.53V [ ] 0.58V [ ] 1.06V [ ] 0.76V

10. How can the concentration of an unknown acid solution be determined using acid-base titration?
    [ ] By measuring the volume of the titrant solution added
    [ ] By measuring the initial pH of the acid solution
    [ ] By determining the color change of the indicator
    [ ] By calculating the volume of indicator used

Fill in the blank by the most appropriate VALUE or WORD.

11. In redox titration, an example of specific indicator is _____.

12. For a weak base B and its conjugate acid BH^+, the Henderson-Hasselbalch equation can be written as _____.

13. _____ error arises when a glass electrode is employed to measure the pH of solution having pH values in the 10 to 12 range or greater.

14. The process by which an impurity is deposited after precipitation of the desired substance is termed as _____.

15. A pure metal which is in direct equilibrium with its own cation in the electrolyte solution forms _____.

16. The half-cell representation for saturated silver/silver chloride electrode is_____.

17. An _____ is an occasional result in a replicate measurement, that obviously differs significantly from the rest of the results.

18. The resistance (reciprocal of conductance) of a cell can be measured using a device called as_____.

19. The result of determination of molarity of a solution is 19.4, 19.6, 19.5, 20.1, 19.8, and 20.3. The true value for this experiment is 20.0. The relative error (in %) for the mean of the data is _____.

20. The equation which gives the relation between the potential of a cell and the activities of reactants is called _____.