

Indian Statistical Institute, Bangalore Centre

Documentation Research and Training Centre
M.S. (Library and Information Science)
2nd Semester Final Examination (2022-2024)

Paper 09: Elements of Mathematics and Statistics

Time: 10.00 AM - 1:00 PM

Max. Marks: 80

Date: 02-05-2023

[INSTRUCTION: (i) Read the question before you attempt.

(ii) Section A of 11 marks, Section B of 19 marks, and Section C of 50 marks]

Section A

[1x6 = 6]

- 1) The alpha critical region, to determine if a new pen lasts longer, would be placed in:
 - a) in the upper tail
 - b) in the lower tail
 - c. in the upper and lower tail
 - d. in the nether tail
- 2) The value of correlation coefficient lies between
 - a) ± 1
 - b. ± 3
 - c. $\pm \infty$
 - d. ± 2
- 3) If any regression coefficient's value is zero, the two variables are:
 - a) Independent
 - b) Qualitative
 - c. Dependent
 - d. None of the preceding.
- 4) Regression modelling is a statistical tool for building a mathematical equation depicting how
 - a) One explanatory and one or above response variables are related
 - b) There is a link between one response variable and one or many explanatory variables
 - c) Several explanatory and response variables are related
 - d) All of the above are correct.
- 5) Two events A and B are independent if and only if
 - a) $P(A \cap B) = P(A) \cdot P(B)$
 - b) $P(A|B) = P(A)$
 - c) $P(B|A) = P(B)$
 - d) All of the above

- 6) The variable y is income in 1000's of rupee and x is years of experience. Suppose a relationship between x and y is represented by the function $y = 10 + 18x$. Which statement is correct?
- For each additional year of experience, income is expected to increase by Rs.1800.
 - For every Rs. 18,000 increase in income, experience is expected to rise by one year.
 - For each additional year of experience, income is expected to increase by Rs. 18,000.
- 7) Which measurement scale can measure the following phenomena [5]
- Military ranks
 - Zip code
 - Number of passengers in a bus
 - Temperature measured on the Kelvin scale
 - Employee identity number

Section B

- 8) An urn contains 10 black and 5 white balls. Two balls are drawn from the urn one after the other without replacement. What is the probability that both drawn balls are black? [2]
- 9) Three cards are drawn successively without replacement from a pack of 52 well shuffled cards. What is the probability that the first two cards are kings and the third card drawn is an ace? [2]
- 10) The heights of young Indian women, X , follows the normal distribution with mean 65.5 inches and standard deviation 2.5 inches. [2+2+2]
- What is the chance that a randomly selected female is at least 67 inches tall?
 - $P(X < 62)$
 - $P(X \leq 65.5)$
- 11) Suppose an experiment was performed to compare the reliability of two brands of golf balls (Nike and Callaway). Six golf balls of each brand were struck by a mechanical golf club with exactly the same force. Balls from a perfectly reliable brand would travel the same distance with every strike. Below is the number of feet travelled by the six golf balls from each of the two brands. [2+2+2]

Number of feet travelled by Callaway (in ft)	229	265	220	280	245	250
Number of feet travelled by Nike (in ft)	240	265	215	270	250	249

- Do the numbers above represent a sample or a population? Calculate the mean distance travelled by the two types of balls. Compare the two means you just calculated. What does the comparison imply?
- Calculate the variance and standard deviation of distance travelled by the two types of golf balls. Compare the two standard deviations and indicate which brand is the more reliable golf ball. Defend your answer.
- From the criterion we are using for reliability can you say with 100% certainty that, based on this experiment, one golf ball brand is more reliable than the other

12) A tyre manufacturing company kept a record of the distance covered before a tyre needed to be replaced. The table shows the results of 1000 cases.

Distance [d] (in km)	$d < 4000$	$4000 < d < 9000$	$9000 < d < 14000$	$d > 14000$
Frequency	20	210	325	445

what is the probability that:

[3]

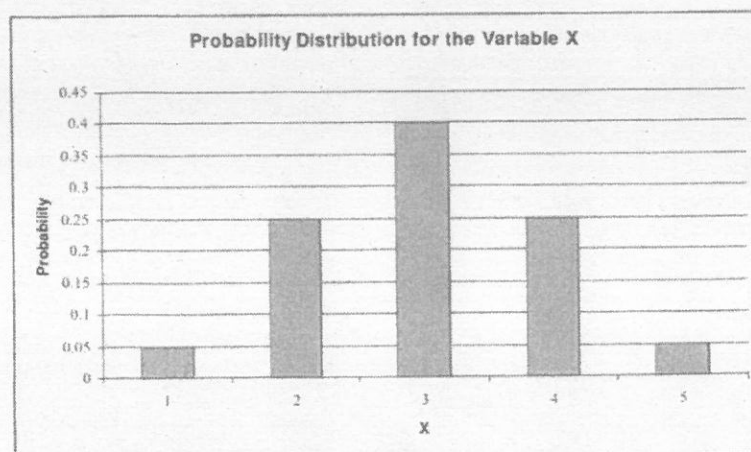
- it will need to be replaced before it has covered 4000 km?
- it will last more than 9000 km?
- it will need to be replaced after it has covered somewhere between 4000 km and 14000 km?

Section C

(Attempt any 5 questions from this section)

13) Refer the following figure to answer the following questions:

[10]



- Is this a symmetric probability distribution? Explain?
- What is the median value of X?
- What is the mean value of X?
- What is $P(2 \leq X \leq 4)$?
- What is $P(X > 4)$?

f. Calculate the variance and standard deviation of X

- 14) Calculate the correlation coefficient between the years of schooling of farmers and the annual yield per acre. [10]

No. of years of schooling of farmers	0	2	4	6	8	10	12
Annual yield per acre in 1000 (Rs)	4	4	6	10	10	8	7

- 15) A fertilizer mixing machine is set to give 12 Kg of nitrate for every 100 kg of fertilizer. Ten bags of 100 kg each are examined. The percentage of nitrate per bag are as follows: 11, 14, 13, 12, 13, 12, 13, 14, 11 and 12. Is there any reason to believe that the machine is defective, given that the population from where the sample has been drawn assumes normality? (Test the hypothesis at 5% level of significance. The value of t for 9 degrees of freedom is either ± 2.685 (two tailed) or 2.262 (one tailed).) [10]

- 16) An instructor has a question bank consisting of 300 easy True / False questions, 200 difficult True / False questions, 500 easy multiple choice questions and 400 difficult multiple choice questions. If a question is selected at random from the question bank, what is the probability that it will be an easy question given that it is a multiple choice question? [10]

- 17) Consider the experiment of throwing a die, if a multiple of 3 comes up, throw the die again and if any other number comes, toss a coin. Find the conditional probability of the event 'the coin shows a tail', given that 'at least one die shows a 3'. [10]

- 18) Short answers questions: (attempt any 5)

[5x2=10]

- Level of significance
- Confidence Interval
- Difference between null hypothesis and alternative hypothesis
- Difference between z-test vs t-test
- Regression
- Conditional Probability