

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)**

**CLASS: BTECH
BRANCH: AIML**

**SEMESTER: IV
SESSION: SP/2025**

SUBJECT: AI201 PROBABILITY AND STATISTICAL ANALYSIS

TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
 2. Attempt all questions.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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| | | CO | BL |
| Q.1(a) Discuss the various ways of describing a dataset. | [5] | CO1 | BL1BL2 |
| Q.1(b) The sample mean of the annual salaries of a group of 100 accountants who work at a large accounting firm is \$130,000 with a sample standard deviation of \$20,000. If a member of this group is randomly chosen, what can we say about
a) the probability that his or her salary is between \$90,000 and \$170,000?
b) the probability that his or her salary exceeds \$150,000? | [5] | CO1 | BL3BL4 |
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| Q.2(a) A doctor is called to see a sick child. The doctor has prior information that 90% of sick children in that neighborhood have the FLU, while the other 10% are sick with MEASLES. Let F stand for an event of a child being sick with FLU and M stand for an event of a child being sick with MEASLES. Assume for simplicity that $F \cup M = \emptyset$, i.e., that there are no other maladies in that neighbourhood. A well-known symptom of MEASLES is a rash (the event of having which we denote R). Assume that the probability of having a rash if one has MEASLES is $P(R M) = 0.95$. However, occasionally children with FLU also develop rash, and the probability of having a rash if one has FLU is $P(R F) = 0.08$. Upon examining the child, the doctor finds a rash. What is the probability that the child has MEASLES? | [5] | CO2 | BL3BL4 |
| Q.2(b) A construction firm has recently sent in bids for 3 jobs worth (in profits) 10, 20, and 40 (thousand) dollars. If its probabilities of winning the jobs are respectively 0.2, 0.8, and 0.3, what is the firm's expected total profit? | [5] | CO2 | BL3BL4 |
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| Q.3(a) The lifespan of a particular brand of batteries is uniformly distributed between 1 year and 3 years. What is the probability that a randomly selected battery will last between 1.5 years and 2.5 years? | [5] | CO3 | BL2BL3 |
| Q.3(b) The number of times that an individual contracts a cold in a given year is a Poisson random variable with parameter $\lambda = 3$. Suppose a new wonder drug (based on large quantities of vitamin C) has just been marketed that reduces the Poisson parameter to $\lambda = 2$ for 75 percent of the population. For the other 25 percent of the population, the drug has no appreciable effect on colds. If an individual tries the drug for a year and has 0 colds in that time, how likely is it that the drug is beneficial for him or her? | [5] | CO3 | BL4BL5 |
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| Q.4(a) What do you mean by Maximum Likelihood Estimators. Explain its significance. | [5] | CO4 | BL1BL2 |
| Q.4(b) Explain the following terms with relevant examples:
a) Degree of Freedom
b) Level of Significance
c) Confidence Interval | [5] | CO4 | BL1BL2 |

PTO

- Q.5(a) A psychologist is observing eating behavior in 131 children aged 3 years old from India. He presents each child 20 new foods which they have never eaten before. He then records the number of foods they actually try. The results are shown in the table below. Previous research with thousands of British children from across the country has shown that we expect 40% of young children to try 0 to 5 new foods, 30% to try 6 to 10 new foods, 20% to try 11 to 15 new foods and 10% to try 16 to 20 new foods. Perform a Chi Square Test to see if the children from India follow the same distribution that the research on British children has found. (Note: Chi Square Tabulated at 5% Level of Significance = 7.815). [5] C05 BL4BL5

No. of New Foods Tried	Frequency
0 - 5	45
6 - 10	34
11 - 15	31
16 - 20	21

- Q.5(b) A researcher reads a paper introducing a new test of executive function. The authors of the paper had tested 30 healthy volunteers and found that on average they score 51 on the new test. The researcher believes that patients with schizophrenia will score less than the normal average on this test of executive function. They test 22 patients with schizophrenia. The average score for the patients is 39 with a standard deviation of 4.3. Is there significant evidence at the 5 % level of significance to support the researcher's claim? (Note: T - Tabulated at 5% Level of Significance = 1.721). [5] C05 BL4BL5

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