Rajiv Gandhi Institute of Petroleum Technology, Jais

B. Tech. (CSE+CSDE+IT+MnC+EE+EV+3rd PE) and IDD Even Semester

Mid-Semester Examination, A.Y. 2024-2025

Subject: MA 231 Statistical Methods and Data Analysis

Time : 2 hours | Full Marks : 30

Instructions:

a) Answer all the questions.
b) Answer all parts of a question together.
c) Use of calculator is allowed.
d) See overleaf for standard normal table.

1. IOCL selects students through campus interview independently from MBA, M.Tech and B.Tech of RGIPT. Let the chances of selecting an MBA, M.Tech and B.Tech student are 50%, 25% and 75%, respectively. What is the probability that a student will be placed in IOCL? [3]

2. An item is produced by a machine in large numbers. The machine is known to produce 10 per cent defectives. A quality control engineer tests the item on a random basis. What is the probability that at least 3 items are examined in order to get 2 defectives? Also find the expected number of items required for testing to get 5 defective items. [3 + 1]

3. 95% of laboratory mice that have been treated with a new drug are resistant to a strain of diphtheria, which is a bacterial infection. Suppose a sample of 70 mice are reated with the drug. Then find [4]

   (a) the probability that exactly 67 mice are resistant to the bacterium.

   (b) the probability that at least 67 mice are resistant to the bacterium.

4. Obtain the moment-generating function (MGF) of a Binomially distributed random variable with n independent trials and success probability p per trial. Using the MGF, determine the mean and variance of the distribution. [6]

5. A soft-drink machine is regulated so that it discharges an average of 200 millimeters per cup. If the amount of drink is normally distributed with a standard deviation equal to 15 millimeters, then [6]

   (a) what percentage of the cups will contain more than 224 millimeters?

   (b) what is the probability that a cup contains between 191 and 209 millimeters?

   (c) how many cups will probably overflow if 230 millimeter cups are used for the next 1000 drinks?

6. Suppose that the lifetime (in hours) of a machine component follows a lognormal distribution with parameters $\mu = 4$ and $\sigma = 0.6$. [2 + 2 + 3]

   (a) What is the probability that a component lasts more than 100 hours?

   (b) If a component is replaced every 200 hours, what fraction of components will fail before replacement?

   (c) A manufacturer wants to set a warranty period such that no more than 5% of components fail before that time. What should the warranty period be?