In this worksheet you will learn to apply discrete probability distributions to solve practical problems in various fields. You are expected to use concepts from discrete probability distributions and the binomial distribution to answer these questions.

Easy Questions

1. Write a real-life scenario where a discrete probability distribution might be used. For example, consider the number of defective items in a production batch.

2. A coin is tossed twice. Using the binomial model with probability $\frac{1}{2}$ for heads, calculate the probability of obtaining exactly one head.

3. A standard six-sided die is rolled once. Determine the probability of rolling an even number.

4. In a quality control test, the probability that an item is defective is 0.1. For a sample of three items, calculate the probability that none are defective.

5. A batch of twenty items is produced where each has a 0.05 probability of being defective. Using the binomial distribution, compute the probability that all items are non-defective.

Intermediate Questions

6. A machine produces items with a 0.02 probability of being defective. In a production run of twenty-five items, calculate the probability that exactly one item is defective.

7. For a process with $n = 10$ trials and a success probability 0.3, use the binomial distribution to calculate the probability of obtaining at most two successes.

8. In a marketing survey, 40% of people prefer Brand A. If eight people are chosen at random, determine the probability that exactly four prefer Brand A.

9. In a game, a player wins each play with a probability of 0.2. If the player plays five times, calculate the probability of winning at least once.

10. A multiple-choice question has four options. If a student answers by guessing, calculate the probability of selecting the correct answer.

11. A salesperson makes twelve phone calls, with a 0.15 probability of success on each call. Determine the probability that exactly three calls are successful.

12. A six-sided die is rolled four times. Assuming the probability of rolling an even number is 0.5 on each roll, calculate the probability of obtaining an even number exactly two times.

13. In a survey, 60% of respondents are expected to favour a proposal. For a sample of fifteen respondents, determine the expected number who favour the proposal.

14. In a lottery, the probability of winning with a single ticket is 0.01. If you purchase ten tickets (assuming independence), calculate the probability of winning at least once.

15. A discrete random variable follows a binomial distribution with $n = 8$ and an unknown success probability p. If the mean is 4, find the value of p.

16. A quality control inspector examines twelve items with a 0.1 probability that each item is defective. Calculate the variance in the number of defective items.

17. In a class of thirty students, each student has a 0.7 probability of passing an exam independently. Determine the probability that exactly twenty-five students pass.

18. In a hospital, each of twenty patients has a 0.1 probability of requiring urgent care. Using the binomial distribution, compute the probability that exactly three patients require urgent care.

19. A retailer has a product with a 0.2 probability of being purchased by a customer. If fifty customers enter the store, calculate the probability that more than twelve customers make a purchase.

20. A quiz consists of five multiple-choice questions, each with four options. Assuming a student guesses every answer, determine the probability of getting exactly two correct responses.

Hard Questions

21. A company produces 1000 batteries with a defect rate of 0.03. Using the binomial distribution, approximate the probability that at most twenty-five batteries are defective.

22. In a pharmaceutical trial, each patient responds favourably with a probability of 0.8. For thirty patients, calculate the probability that fewer than twenty-five respond favourably.

23. An election poll indicates that 55% of voters prefer Candidate A. In a random sample of one hundred voters, determine the probability that at most sixty voters prefer Candidate A.

24. A shooter has a probability of 0.75 of hitting a target with each shot. If the shooter takes twenty shots, calculate the probability of hitting the target exactly fifteen times.

25. A website experiences a cyber-attack with a probability of 0.05 on any given day. Calculate the probability that the website is attacked on exactly four days during a thirty-day month.

26. A factory machine produces parts with a 0.02 probability of being defective. In a batch of two hundred parts, determine the probability that at least three parts are defective.

27. A new product is offered in a store and each of fifteen customers independently makes a purchase with a probability of 0.3. Calculate the probability that at least seven customers make a purchase.

28. A research team determines that a type of cell reproduces successfully with probability 0.45. For a sample of twenty cells, compute the expected number of reproducing cells and the variance of that number.

29. An insurance company observes that the probability of a claim on a policy is 0.01. For a sample of five hundred policies, determine the probability that exactly five claims are made.

30. An online advertisement has a click-through rate of 0.1. If one thousand people view the advertisement, calculate the probability that more than 120 people click on it.