Engineering Mathematics II (ED 121)

Homework 2

Release Date: 15.01.2024
Due Date: 20.01.2021

1. From a lot of 12 items containing 3 defective items, a sample of 4 items are drawn at random without replacement. Let a random variable X denote the number of defective items in the sample. Find the probability distribution of X.

2. A random variable X has the following probability distribution function

X	0	1	2	3	4
$P(X)$	c	$2c$	$2c$	c^2	$5c^2$

   Find the value of c. Evaluate $P(X < 3)$, $P(0 < X < 4)$. Determine the distribution function of X. Find the mean and Variance of X.

3. The guidance system for a rocket operates correctly with probability p when called upon. Independent but identical backup systems are installed in the rocket so that the probability that at least one system will operate correctly when called upon is no less than 0.99. Let n denote the number of guidance systems in the rocket. How large must n be to achieve the specified probability of at least one guidance system operating if

   a) $p = 0.9$ b) $p = 0.8$.

4. One engineering firm enjoys 40% success rate in getting state government construction contracts. This month they have submitted bids on eight construction projects to be funded by the state government. The bids for different projects are assessed independently of each other.
   a) Find the probability that the firm will get none of those contracts?
   b) Find the probability that the firm will get five out of eight contracts?
   c) Find the probability that the firm will get all eight contracts? .

5. A recruiting firm finds that 30% of the applicants for a certain industrial job have advanced training in computer programming. Applicants are selected at random from the pool and are interviewed sequentially.
   a) Find the probability that the first applicant having advanced training is found on the fifth interview.
   b) Suppose the first applicant with the advanced training is offered the position, and the applicant accepts. If each interview costs \$300, find the expected value and variance of the total cost of interviewing incurred before the job is filled. Within what interval would this cost be expected to fall?

6. The quality of computer disks is measured by sending the disks through a certifier that counts the number of missing pulses. A certain brand of computer disk has averaged 0.1 missing pulse

per disk.
a) Find the probability that the next inspected disk will have no missing pulse.
b) Find the probability that the next inspected disk will have more than one missing pulse.
c) Find the probability that neither of the next two inspected disks will contain any missing pulse.

7. The number of bacteria colonies of a certain type in samples of polluted water has a Poisson distribution with a mean of two per cubic centimeter.
a) If four 1-cubic-centimeter samples are independently selected from this water, find the probability that at least one sample will contain one or more bacteria colonies.
b) How many 1-cubic-centimeter samples should be selected to have a probability of approximately 0.95 of seeing at least one bacteria colony?

8. Suppose there are 3 defective items in a lot of 50 items. A sample of size 10 is taken at random and without replacement. Let X denote the number of defective items in the sample. What is the probability that the sample contains at most one defective item?

9. What is the probability that the fifth head is observed on the 10^{th} independent flip of a coin?

10. The following problems involve being dealt, at random and without replacement, a bridge hand (i.e., 13 cards) from a standard deck of 52 cards. Find the probability of being dealt a bridge hand that:

    (a) does not contain a spade?

    (b) contains exactly 5 hearts?

    (c) contains at most one ace?