Assignment 4

Suryaansh Jain

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Outline

Problem Statement

13.5 Q12 [NCERT 12]

Find the probability of throwing at most 2 sixes in 6 throws of a single die.

Random Variable Definition

In this experiment, there are six consecutive Bernoulli trials. Let us define a Binomial Random Variable $X = \{0, 1, 2, 3, 4, 5, 6\}$ where the value of X is the number of sixes obtained

Probability Mass Function

The probability of success (assuming a fair die) is $p = \frac{1}{6}$.

Therefore, the probability that X maps to i is given by:

$$\Pr(X = i) = \binom{6}{i}(1-p)^{6-i}p^i, \ 0 \le i \le 6 \tag{1}$$

The values for i can be substituted in the above formula, and the graph of the PMF can be obtained.

Cumulative Distribution Function

The cumulative probability $\Pr\left(X \leq i\right)$ can be defined as under:

$$\Pr\left(X \leq i\right) = \sum_{k=0}^{i} \binom{6}{k}(1-p)^{6-k}p^{k}, \; 0 \leq i \leq 6 \tag{2}$$

The values of i can be substituted in the above equation, and the obtained values can be used to plot the CDF graph.
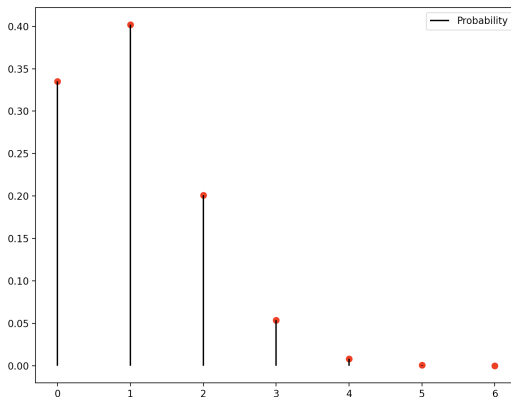
Solution

The probability to be found corresponds to the case $\Pr(X \le 2)$.
Substituting i in Equation 1 and summing, we get

$$\Pr(X=2) + \Pr(X=1) + \Pr(X=0) = \frac{5^4}{3^3 \times 2^6} \approx 0.36 \qquad (3)$$

PMF Graph

The PMF graph is:

CDF Graph

The CDF graph is: