Assignment 2

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Outline

Question

A person buys a lottery ticket in 50 lotteries ,in each of which his chance of winning a prize is 1/100.What is the probability that he will win a prize
(a)at least once
(b)exactly once
(c)at least twice

Answer

(a)Let X represents the number of prizes winning in 50 lotteries and the trials are Bernoulli trails.
Here,We have a binomial distribution where n=50 p=1/100 then

$$q = 1 - p \tag{1}$$
$$q = 1 - 1/100 \tag{2}$$
$$q = 99/100 \tag{3}$$

As we know $P(X{=}x) = {}^{n}C_{x} \cdot q^{n-x} \cdot p^{x}$

$$= {}^{50}C_x \cdot \left(\frac{99}{100}\right)^{n-x} \cdot \left(\frac{1}{100}\right)^{x} \tag{4}$$

Hence the probability of winning lottery at least once is (5)

$$= P(X \geq 1) \tag{6}$$

$$= 1 - P(X < 1) \tag{7}$$

$$= 1 - P(X = 0) \tag{8}$$

$$= 1 - {}^{50}C_0 \cdot \left(\frac{99}{100}\right)^{50} \tag{9}$$

We get final probability as $= 1 - \left(\frac{99}{100}\right)^{50}$ (10)

(11)

(b) The probability of winning lottery exactly once is (12)

$= P(X = 1)$ (13)

$= {}^{50}C_1 \cdot (\frac{99}{100})^{49} \cdot (\frac{1}{100})^1$ (14)

We get final probability as $= \frac{1}{2} \cdot (\frac{99}{100})^{49}$ (15)

(16)

(17)

(c)The probability of winning lottery at least twice is (18)

$= P(X < 2)$ (19)

$= 1 - P(X \leq 1)$ (20)

$= 1 - [P(X = 0) + P(X = 1)]$ (21)

$= [1 - P(X = 0)] - P(X = 1)$ (22)

$= 1 - (\frac{99}{100})^{50} - \frac{1}{2} \cdot (\frac{99}{100})^{49}$ (23)

$= 1 - (\frac{99}{100})^{49} \cdot [\frac{99}{100} + \frac{1}{2}]$ (24)

We get final probability as $= 1 - (\frac{149}{100}) \cdot (\frac{99}{100})^{49}$ (25)

Code Output:

The following is a result of python code plotting pmf of given cases