

Assignment 3

Malothu Avinash
AI21BTECH11018

May 27, 2022

Outline

1 Question

2 Answer

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 represent the number of prizes winning in 50 lotteries and the trials are Bernoulli trials.

Here, We have a binomial distribution where $n=50$ $p=1/100$ then

$$q = 1 - p \quad (1)$$

$$q = 1 - 1/100 \quad (2)$$

$$q = 99/100 \quad (3)$$

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

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

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

$$= P(X \geq 1) \quad (6)$$

$$= 1 - P(X < 1) \quad (7)$$

$$= 1 - P(X = 0) \quad (8)$$

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

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

$$(11)$$

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

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

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

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

$$(16)$$

$$(17)$$

$$(c) \text{The probability of winning lottery at least twice is} \quad (18)$$

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

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

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

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

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

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

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

Code Output:

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

