# Stats Digital Assignment

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Q1) A die is thrown 4 times. Getting a number greater than 2 is a success. Find probability of getting:

(i) Exactly 1 success
(ii) Less than 3 successes

## Solution:

Die is thrown 4 times.
$\therefore$ no. of trials, $n = 4$

Numbers of die that will be regarded as success are 3, 4, 5, 6

$$\therefore p = \frac{4}{6} = \frac{2}{3}$$

$$q = 1 - p = 1 - \frac{2}{3} = \frac{1}{3}$$

X is getting success

(i) $P(X=1) = {}^nC_1 p^1 q^{n-1} = {}^4C_1 \times \frac{2}{3} \times \left(\frac{1}{3}\right)^3$

$= \frac{8}{81}$ (Answer)

(ii) $P(X<3) = P(x=0) + P(x=1) + P(x=2)$

$= {}^nC_0 p^0 q^n + {}^nC_1 p^1 q^{n-1} + {}^nC_2 p^2 q^{n-2}$

$= {}^4C_0 \times \left(\frac{2}{3}\right)^0 \times \left(\frac{1}{3}\right)^4 + {}^4C_1 \times \left(\frac{2}{3}\right)^1 \times \left(\frac{1}{3}\right)^3 + {}^4C_2 \left(\frac{2}{3}\right)^2 \left(\frac{1}{3}\right)$

$= \frac{1}{81} + \frac{8}{81} + \frac{24}{81} = \frac{33}{81} = \frac{11}{27}$ (Answer)

2) If the chance that any of 5 telephone lines is busy at any instant is 0.01, what is the probability that all the lines are busy? What is the probability that more ~~that~~ than 3 lines are busy?

Solution:

Probability of a line being busy :-

$p = 0.01$

$q = 1 - p = 1 - 0.01 = 0.99$

no. of telephones, $n = 5$

Let X be no of lines that are busy.

So, the probability of all lines being busy,

$P(X=5) = {}^5C_5 (0.01)^5 (0.99)^0$

$= \frac{1}{100^5} = 10^{-10}$ (Answer)

Now, Probability of more than 3 lines being busy :

$P(X>3) = P(X=4) + P(X=5)$

$= {}^5C_4 (0.01)^4 (0.99)^1 + {}^5C_5 (0.01)^5 (0.9$

$= 5 \times 10^{-8} \times 0.99 + 10^{-10}$

$= 496 \times 10^{-10}$ (Answer)

3) Probability of getting no misprint in a page of book is $e^{-4}$. What is the probability that a page contains more than 2 misprints?

Solution:

We will use poisson distribution:

$$P(0, \mu) = e^{-4}$$

$$\Rightarrow \frac{e^{-\mu}\mu^0}{0!} = e^{-4}$$

$$\Rightarrow e^{-\mu} = e^{-4}$$

$$\therefore \mu = 4$$

So, $P(X > 2) = 1 - P(X=0) - P(X=1) - P(X=2)$

$$= 1 - P(0,\mu) - P(1,\mu) - P(2,\mu)$$

$$= 1 - e^{-4} - \frac{e^{-\mu}\mu^1}{1!} - \frac{e^{-\mu}\mu^2}{2!}$$

$$= 1 - e^{-4} - \frac{e^{-4}(4)^1}{1!} - \frac{e^{-4}(4)^2}{2!}$$

$$= 1 - e^{-4} - 4e^{-4} - 8e^{-4}$$

$$= 1 - 13e^{-4} \text{ (Answer)}$$

4) Six coins are tossed 6400 times using Poisson distribution what is the approximate probabity of getting six heads 10 times.

Solution:

Getting 6 heads ~~conseq~~ consecutively is considered success,

$$P = \left(\frac{1}{2}\right)^6 = \frac{1}{64}$$

Now the coins are tossed 6400 times.

So, mean probability, $\mu = 6400 \times \frac{1}{64} = 100$

Now, we use Poisson distribution for this,

$$P(10, \mu) = \frac{e^{-\mu} \mu^{10}}{10!}$$

$$= \frac{e^{-100} \, 100^{10}}{10!}$$

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5) Fit a poisson distribution to the following data and compare the expected frequencies with the observed frequencies.

~~Fitting~~

Solution:

The Question asks for Poisson distribution, but it is ~~approximett~~ approximetely poisson.

Solution for (5) continue...

To find PMF:

$$P\{X = \mu\} = \frac{e^{-\mu} \mu^{n}}{\mu!}, \quad \mu = 0, 1, 2, 3, \ldots, \infty$$

| $x$ | 0 | 1 | 2 | 3 | 4 | |
|---|---|---|---|---|---|---|
| $f$ | 122 | 60 | 15 | 2 | 1 | 200 |
| $fx$ | 0 | 60 | 30 | 6 | 4 | 100 |

$$\bar{X} = \frac{\Sigma fx}{\Sigma f} = \frac{100}{200} = 0.5 = \mu$$

Theoritical frequencies:

$$N \frac{e^{-\mu} \mu^{n}}{\mu!}$$

$$= 200 \frac{e^{-0.5} (\frac{1}{2})^{n}}{\mu!}$$

| $x$ | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Theoritical f | 121.30 | 60.65 | 15.16 | 2.52 | 0.31 |

The theoritical frequencies for $x = 5, 6, 7\ldots$ are small so we neglect.

Following Poisson distribution fits the given distribution.

| $x$ | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Theoritical f | 121 | 61 | 15 | 3 | 0 |