BINOMIAL, POISSON AND NORMAL DISTRIBUTION

Experiment 3

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Exp-3 Binomial, Poissons and Normal Distributions.

Using R software, obtain the binomial probabilities, poisson probability and normal probability and also express it diagramatically.

⇒ R has four in-built functions to generate binomial distribution. They are described below:-

dbinom(x, size, prob).
pbinom(x, size, prob).
qbinom(p, size, prob).
rbinom(n, size, prob).

Following is the description of the parameters used.

x is the vector of numbers.
p is the vector of probabilities.
n is the number of observations.
size is the number of trials.
prob is the probability of success of each trial.

pbinom()

Example 1:- The probability of getting 26 or less heads from 51 tosses of a coin.

R-code:-

```
> x <- pbinom(26, 51, 0.5)
> print(x)
[1] 0.610116
```

dbinom()

This function gives the probability distribution at each point.

```
> x <- seq(0, 50, by=1)            # creates a sample of 50 numbers incremented by 1.
> y <- dbinom(x, 50, 0.5)          # Creates binomial distribution.
> png(file="dbinom.png")           # Gives the chart a filename.
> plot(x, y)                       # plots the graph of sample.
> dev.off()                        # Saves the file.
```

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* qbinom()

This function takes probability value and gives a number whose cumulative value matches probability value.

Eg:- How many heads will have a probability of 0.25 will come out when a coin is tossed 51 times.

R-code:-

```
X <- qbinom(0.25, 51, 1/2)
print(x).
[1] 23
```

* rbinom()

This function ~~takes the probability value and gives a nun~~ generates required number of random values of a given probability from the given sample.

Eg:- Find 8 random values from a sample of 150 with probability of 0.4.

R-code:-

```
x <- rbinom(8, 150, .4)
print (x)
[1] 58 61  59 66  55  60 61 67
```

Poisson's Distribution in R:

R-codes:-

- dpois(x, lambda) # the probability of x success in a period when expected number of events is lambda.
- ppois(q, lambda) # the cumulative probability of less than or equal to q successes.
- qpois(p, lambda) # returns the value (quantile) at specified cumulative propability (percentile) p.
- rpois(n, lambda) # returns n random numbers from the Poisson distribution:-

Eg:-

1). What is P(X=4) with lambda 2.6?

```
>dpois (4, lambda= 2.6)
[1] 0.1414218
```

2). What is P(X>_2) with lambda 3?

```
> 1- ppois(2,3)
[1] 0.5768099
```

Normal-distribution

A random Variable X is said to possess normal distribution with mean μ and variance σ^2, if its probability density function can be expressed of the form,

$$f(x) = \frac{e^{-\frac{(x-\mu)^2}{2\sigma^2}}}{\sigma\sqrt{2\pi}} \quad , \quad -\infty < x < \infty$$

It's standard notation is:- $X \sim N(\mu, \sigma^2)$.

Standard Normal Distribution

If a random Variable X follows normal distribution with mean μ and variance σ^2, it's transformation $Z = \frac{X-\mu}{\sigma}$ follows standard normal distribution (mean 0 and unit variance).

$$f(z) = \frac{1}{\sqrt{2\pi}} e^{-z^2/2} \quad , \quad -\infty < z < +\infty .$$

The distribution function of standard normal distribution is:-

$$F(z) = \int_{-\infty}^{z} \frac{1}{2\pi} e^{-z^2/2} dx$$

R has four built in functions to generate normal distributions. They are:-

1. dnorm(x, mean, sd) # Calculates the height of probability distribution at each point for given mean and standard deviation.

pnorm(x, mean, sd) # Gives the probability of a randomly distributed random number to be less than the value of given number. It is also called "Cumulative Distribution Function".

qnorm(p, mean, sd) # It takes the probability value and gives a number whose cumulative value matches the probability value.

rnorm(n, mean, sd) # It generates random numbers whose distribution is normal. It takes sample size as input and generates that many random numbers.

Problems:-

1). If a committee has 7 members, find the probability of having more female members than male members given that the probability of having a male or female member is equal.

Sol

The probability of having female member = 0.5

The probability of having male member = 0.5.

To have more female members, the number of females should be greater than or equal to 4.

R-code:-

```
> 1-pbinom(3,7,0.5)
[1] 0.5
```

```
> #probability of having a female member is : 0.5
> #probability of having a male member is : 0.5
>
> #probability of having more female than male is same as having 4 or more females.
>
> 1-pbinom(3,7,0.5)
[1] 0.5
>
> #Hence the probability of having more women than
  men is 0.5
```

2). The weekly wages of 1000 workman are normally distributed around a mean of Rs 70 with SD of Rs 5. Estimate the number of workers whose weekly wages will be:.

(i) Between Rs 69 and Rs 72. (ii) Less than Rs 69 (iii) More than Rs 72.

R-codes:-

```
>#(i) Between Rs 69 and Rs 72.
>(pnorm (72, mean=70, sd=5) - pnorm(69, mean=70, sd=5)) * 1000
[1] 234.6815.
># (i) Hence, the number of workers whose wage lie between 69 and 72 234
># (ii) Less than Rs 69.
>pnorm (69, mean= 70, sd=5) )* 1000.
[1] 420.7403
># Hence, the number of workers whose wave is less than Rs 69 is 421.
># (iii) More than Rs 72.
>(1- pnorm( 72, mean= 70, sd=5)) * 1000
[1] 344.5783.
```

```
> #(i)between Rs 69 and Rs 72
> (pnorm(72, mean=70,sd=5) - pnorm(69, mean=70, sd=5))*1000
[1] 234.6815
> #(ii)Less than Rs69.
> (pnorm(69, mean=70, sd=5))*1000
[1] 420.7403
>
> #The number of Workers whose wages is less than Rs 69 is 421.
>
>
> #(iii) More than 72
> (1-pnorm(72, mean=70, sd=5))*1000
[1] 344.5783
> #The number of workers whose wages is More than Rs. 72 is 345
> |
```