STATISTICS FOR ENGINEERS

MAT2001

LAB TASK – 4

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Binomial Distribution -

The binomial distribution is a discrete probability distribution. It describes the outcome of n independent trials in an experiment. Each trial is assumed to have only two outcomes, either success or failure. If the probability of a successful trial is p, then the probability of having x successful outcomes in an experiment.

Binomial Distribution Formula

$$P(x) = \binom{n}{x} p^x q^{n-x} = \frac{n!}{(n-x)!\,x!} p^x q^{n-x}$$

where
n = the number of trials (or the number being sampled)
x = the number of successes desired
p = probability of getting a success in one trial
$q = 1 - p$ = the probability of getting a failure in one trial

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

dbinom() *- This function gives the probability density distribution at each point.*

pbinom() *- This function gives the cumulative probability of an event. It is a single value representing the probability.*

qbinom() *- This function takes the probability value and gives a number whose cumulative value matches the probability value.*

rbinom() *- This function generates required number of random values of given probability from a given sample.*

```
> # Example for dbinom()
> dbinom(27,100,0.25)
[1] 0.08064075
>
> # Example for pbinom()
> # What is P(X <= 1) when X has the Bin(25, 0.005) distrubution ?
> pbinom(1,25,0.005)
[1] 0.9930519
>
> # Example for qbinom()
> # What are the 10th, 20th, and so forth quantiles of the Bin(10, 1/3) distribution ?
> qbinom(0.1,10,1/3)
[1] 1
> qbinom(0.2,10,1/3)
[1] 2
>
> # Example for rbinom()
> # Find 8 random values from sample size of 150 with probability of 0.4
> rbinom(8,150,0.4)
[1] 54 63 59 66 66 68 53 55
>
```

Normal Distribution -

Normal distribution, also known as the Gaussian distribution, is a probability distribution that is symmetric about the mean, showing that data near the mean are more frequent in occurrence than data far from the mean. In graph form, normal distribution will appear as a bell curve.

$$y = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

$$\begin{aligned} \mu &= \text{Mean} \\ \sigma &= \text{Standard Deviation} \\ \pi &\approx 3.14159\cdots \\ e &\approx 2.71828\cdots \end{aligned}$$

R has four in-built functions to generate normal distribution. They are described below.

dnorm() - *This function gives height of the probability distribution at each point for a given mean and standard deviation.*

pnorm() - *This function gives the probability of a normally distributed random number to be less that the value of a given number. It is also called "Cumulative Distribution Function".*

qnorm() - *This function takes the probability value and gives a number whose cumulative value matches the probability value.*

rnorm() - *This function is used to generate random numbers whose distribution is normal. It takes the sample size as input and generates that many random numbers. We draw a histogram to show the distribution of the generated numbers.*

```
> # Example for dnorm()
> x=seq(-10,10,0.1)
> y=dnorm(x,2.5,0.5)
> plot(x,y)
>
> # Example for pnorm()
> x=seq(-20,20,0.5)
> y=pnorm(x,2.5,2)
> plot(x,y)
>
> # Example for qnorm()
> x=seq(0,1,0.005)
> y=qnorm(x,2,1)
> plot(x,y)
>
> # Example for rnorm()
> # Create a sample of 1000 numbers which are normally distributed
> y=rnorm(1000)
> hist(y)
```

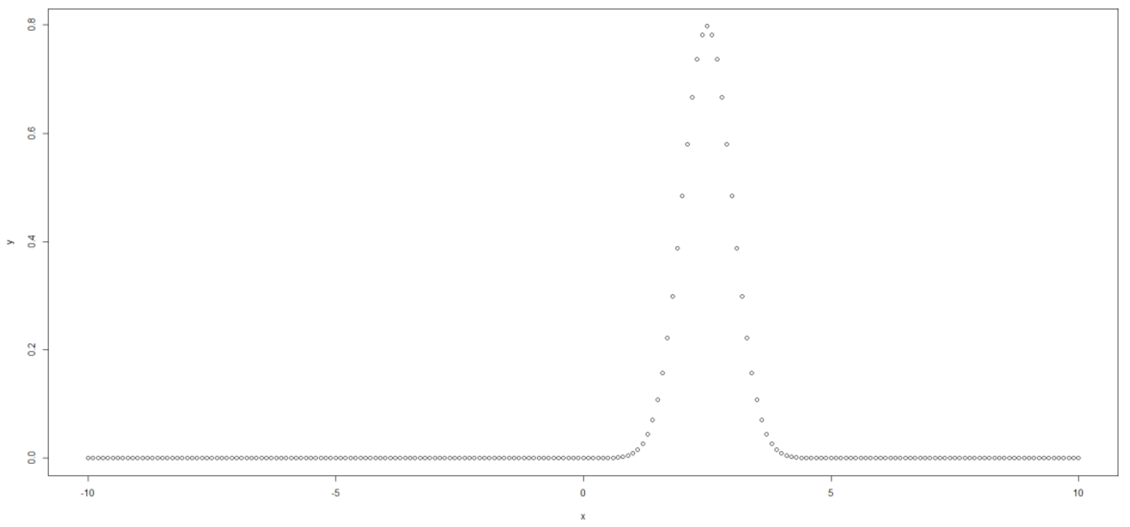

Figure for dnorm()

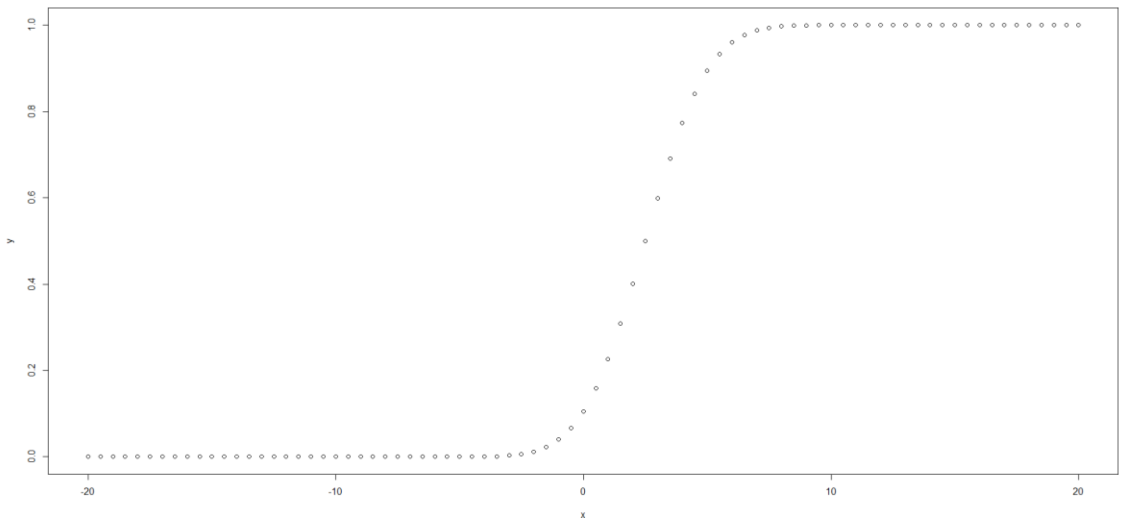

Figure for pnorm()

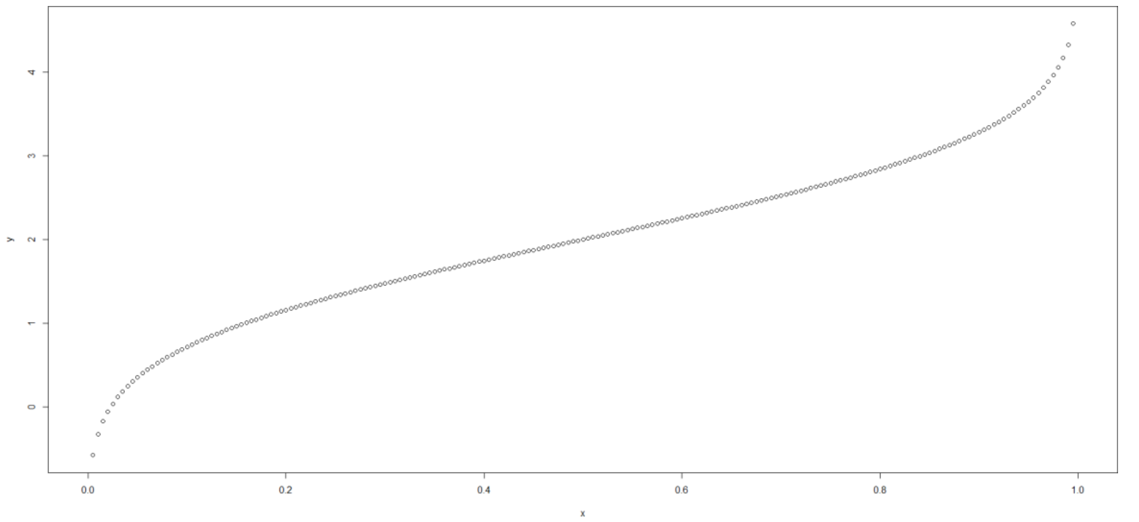

Figure for qnorm()

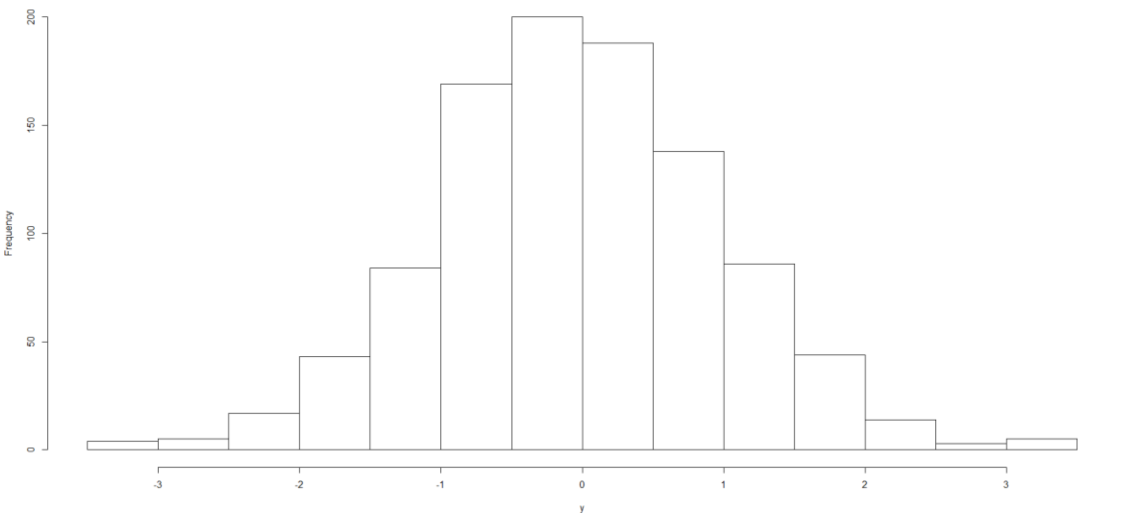

Figure for rnorm()