Basics of Probability

1) **What is probability?**
   A number that represents the likelihood that a particular event will occur for a random variable.
2) **What is Random Variable?**
   A variable whose numerical values represent the event of an experiment.
3) **What is Event?**
   An outcome of Experiment or Survey.
4) **What is sample Space?**
   A sample space is a collection or a set of possible outcomes of a random experiment.
5) **What is Sample point?**
   A sample point is one of the possible outcomes of the experiment.
6) **What is an equally likely events?**
   Equally likely events are those events which have an equal probability of occurring.
7) **What is probability line?**
   Probability line is a line from 0 to 1 which represents the probability of difference events. The events closer to zero are more unlikely to happen than the event closer to one.
8) **What is Independent Event?**
   An independent event is an event that has no connection to another event's chances of happening (or not happening).
9) **What is Mutually Exclusive Events?**
   Mutually Exclusive events are completely independent of all other events and have no impact on the outcome.
10) **What is Intersection?**
    The intersection is the set of elements that are common to both X and Y.
11) **What is Union?**
    The Union of two sets contains all the elements contained in either set (or both sets)
12) **What is Complement?**
    The complement of a set A contains everything that is not in the set A.

Probability Distributions

13) What is Probability Distribution?

The possible values that a variable can take and how frequently they occur.

- Mean
- Variance
- Standard deviation
- M.G.F

1) Bernoulli Distribution

The Bernoulli distribution is the discrete probability distribution of a random variable which takes a binary, Boolean output 1 and 0.

2) 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 of n independent trials is as follows.

Pre-requisites:

- There are two potential outcomes per trial
- The probability of success (p) is the same across all trials
- The number of trials (n) is fixed
- Each trial is independent

$$\frac{n!}{k!(n-k)!}p^x(1-p)^{n-x}$$

μ=np

$$\sigma = \sqrt{np(1-p)}$$

dbinom(x,size,prob,log=False)

${}^{n}c_{x}\, p^{x}(1\text{-}p)^{n\text{-}x}$

3) Poisson Distribution:

- The Poisson distribution is the discrete probability distribution.
- It describes the number of events occurring in a fixed time interval.
- It requires only one parameter which the expected number of events per time interval i.e. λ

For example: Poisson distribution (λ=3) means 3 customer every hour or 3 mistakes on a page. Or 3 accidents in a day it can be anything.
In these examples: fix time is one hour, one page, and one day

• Bounded by 0 and ∞.

Poisson distribution Assumptions:

• The rate at which events occur is constant.

• The occurrence of one event does not affect the occurrence of a subsequent event. (I.e. events are independent)

Ppois(q,lambda,lower.tail=TRUE,log.p=FALSE)

$$\mathrm{P(X)} = \frac{\gamma^X e^{-\gamma}}{X!}$$

P.M.F is used for Poisson distribution

C.D.F is used when you calculate distribution at ∞.

Expected value: E(X) = λ

Variance: V(X) = λ

Standard Deviation = sqrt(V(X)= λ)

4) **Normal Distribution/Gaussian Distribution (** Continuous)

The normal distribution is a continuous probability distribution that is symmetrical on both sides of the mean, so the right side of the center is a mirror image of the left side.

pnorm(q,mean,sd,lower.tail,log.p)[2]

$$z = \frac{X - \mu}{\sigma}$$

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