Binomial distribution:

Example 1:

Assume a popular Car brand showroom has a conversion rate of 30%, which means out of 10 customers who walk into the store 3 customers make a purchase. The store manager wants to know if 3 customers come in today what is the probability that all the three will make a purchase.

We can consider 3 customers walking in sequentially as 1 trial for each customer. There are only two outcomes possible which Success/Failure and purchase decisions of 3 customers are going to be independent. Let us determine the number of outcomes with 3 successes = **3!/3!(3-3)! => 1. There is only 1 possible outcome that all three makes a purchase.**

Probability of success (*p*) = 0.3

$$f(3)= (\mathbf{3!/3!(3-3)!)(0.30)}^3 = 0.027$$

Similarly, we can calculate the probability of 2 customers making the purchase, while q = (1-p) i.e 1-0.3 => 0.7

$$f(2)= (\mathbf{3!/2!(3-2)!)(0.30)^2\,(0.70)^1}= 0.19$$

Note: To find probability faster, Refer to Binomial Tables with your ***n** (total trials),* ***x** (outcomes),* ***p** (probability)*

Example 2:

Say you are driving along the famous queen’s necklace road (marine drive) in Mumbai and you want to visit a friend who lives at Nariman Point. There are three traffic lights that you have to go past to get to your friend's apartment. Assume that each traffic light is green for 20 seconds and red for 40 seconds. What is the probability that you will have to stop at none, one, two or all three lights?
Let us first calculate the probability of the light being green.
p = 20 / (20 + 40) = 1/3
The probability of the light not being green is
q = 40 / (20 + 40) = 2/3 or can be also calculated as q = 1 - p = 2/3
Now let us find the probability that you will not encounter any red light i.e. x = 0

$$f(0) = [\,3!\,/\,(0! \times (3-0)!)] \times (1/3)^0 \times (2/3)^{3-0}$$
$$= [\,6/(\,1 \times 6\,)\,] \times (1/3)^0 \times (2/3)^{3-0}$$
$$= (2/3)^3$$
$$= 8/27$$

Similarly, the probabilities that you might have to stop at 1,2 or all three lights are 2/9, 2/9 and 8/27

Poisson Distribution:

Example 1:

Poisson distributions are mostly used for Capacity planning in any business. For eg: One of the key personnel in Stock market trading are the Brokers (Dealers) who sit in the computer and places trades for the clients. Anytime you look at a Broker he will be in a phone receiving the orders from clients, so it is important to understand the probability of him receiving calls from clients at a specific interval, so as to plan number of telephones to assign to him or to appoint more dealers to the desk.

Assume that the dealer on average gets 48 calls per hour let's find out the probability of 3 calls in every 5mins interval.

Expected calls in 5mins = 48(1/12) = 4 :::: (5mins/60mins => 1/12)

$$\mathbf{f(3) = (4^3 e^{-4})/3! \Rightarrow 0.195}$$

Based on the cut off probability that the decision maker has, he can decide if this is low or high probability. If Manager believes if the probability of anything above 0.5 needs action, he would decide not to allot a new connection to the dealer.

Example 2:

A popular food delivery start-up in Delhi had been getting many orders, thanks to its recent coverage in national newspapers and TV. It now gets over 2000 weekly food delivery orders, i.e., about 40 orders per hour. As soon as an order is placed on the system, it assigns the closest available food delivery agent(FA) to reach the restaurant, pick up the order, and deliver it to the customer. It is assumed that the system has been optimized so that as soon as the FA reaches the restaurant, the order is ready to be collected. As soon as the order is delivered, the FA becomes available again to be assigned to another order.

For modelling the incoming orders a process was proposed. According to this process, the number of potential new customers would be independent of the number of customers already waiting in the queue. Such a process used to model the arrival rate of orders in a business such as the food delivery business is the Poisson process. According to this process, the number of new customers who arrive every hour is given by a Poisson distribution. The main input parameter required to define a Poisson distribution is the average arrival rate per hour (λ), which is equal to 40 orders/hour for the example discussed above.

Normal Distribution:

A shoe manufacturing company that specializes in women's shoe production, when trying to set up their manufacturing units, would need to look at the distribution of the sizes of the shoes that need to be manufactured in high quantity. When we look at the distribution of a female show size, it will tend to follow a normal distribution. So accordingly, the senior management at the company can take a call on what shoe sizes are most commonly used by females and what shoe size would be a rare requirement for a particular region, and accordingly can ramp up or down the manufacturing capacity as well as the manpower needed at the manufacturing facility.