Poison and Binomial Distribution

Poison Distribution

Poison distribution describes the distribution of binary data from an infinite sample. Thus it gives the probability of getting r events in a population.

Binomial Distribution

- Binomial Distribution describes the distribution of binary data from a finite sample. Thus it gives the probability of getting r events out of n trials.

Basis for Comparison	Binomial Distribution	Poisson Distribution
meaning	Binomial Distribution is one in which the probability of repeated number of trials are studied.	Poisson Distribution gives the count of independent events occur randomly with a given period of time.
Nature	Biparametric	Uniparametric
Number of trials	Fixed	Infinite

Basis for Comparison	Binomial Distribution	Poisson Distribution
Success	Constant Probability	Infinitesimal chance of Success
Outcomes	Only two possible outcomes, i.e. success or failure	Unlimited number of possible Outcomes.
Mean and Variance	mean > Variance	Mean = Variance
Example	Coin Tossing Experiment	Printing mistakes/ page of a large book.

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 occurence than data from the mean. In graph form, normal distribution will appear as a bell curve.

- Normal Distributions are Symmetrical, but not all symmeterical distributions are normal.
- In reality, most pricing distributions are not perfectly normal.

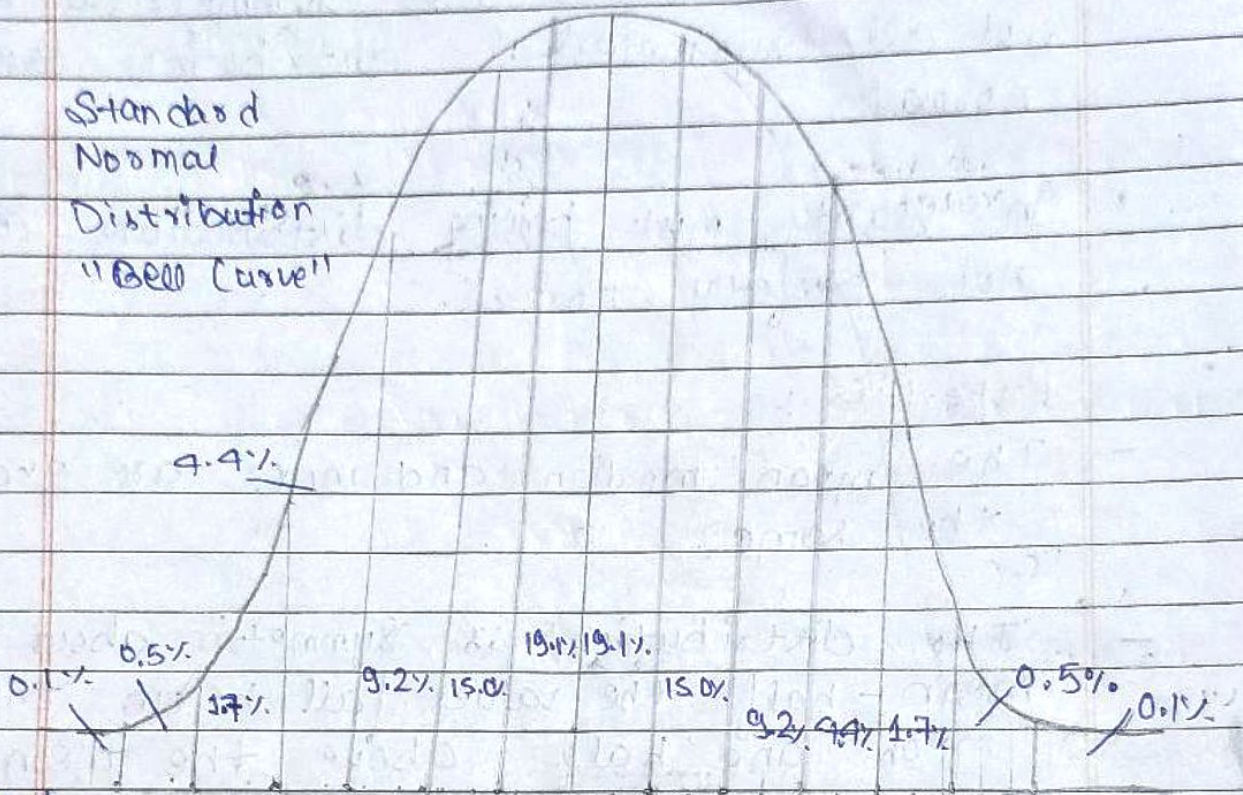
Properties :-

- The mean, median and mode are exactly the same.
- The distribution is Symmetric about the mean - half the values fall below the mean and half above the mean.
- The distribution can be described by two values: the mean and the standard deviation.

Standard Normal Distribution :-

- The standard normal distribution, also called the z-distribution, is a special normal distribution where the mean is 0 and the standard deviation is 1.
- Any normal distribution can be converted into the standard normal distribution by tuning the individual values into z-scores.
- In a z-distribution, z-scores tell you how many standard deviation away from the mean each value lies.

Standard Normal Distribution "Bell Curve"



Standard deviation	-3	-2.5	-2.0	-1.5	-1.0	-0.5	0	0.5	1.0	1.5	2.0	2.5	3
Z score	-3	-2.5	-2.0	-1.5	-1.0	-0.5	0	0.5	1.0	1.5	2.0	2.5	3.
Cumulative Percent	0.1%	2.3%	15.9%	50%	84.1%	97.7%	99.9%						

Marginal, Joint and Conditional Probabilities

Scenario

A survey was carried out with 500 strangers in London's West End to determine people's favorite sports. The options were Football, Rugby, and the rest was grouped together in Other; The result of the test are displayed in figure. 1

	male	Female	Total
Football	120	75	195
Rugby	100	25	125
Other	50	130	180
	270	230	500

After Probability Distribution

To get Probability Distribution, we divide each number by no. of Observation.

	male	female	Total
Football	0.24	0.15	0.39
Rugby	0.2	0.05	0.25
Other	0.1	0.26	0.36
	0.54	0.46	1

Joint Probability

The joint probability is a statistical measure that is used to calculate the probability of two events occuring together at the same - P(A and B) or P(A, B).

~~For example~~ Using figure we can see that the joint probability of someone being a male and a living a football is 0.24.

	Male	Female	Total
Football	0.24	0.15	0.39
Rugby	0.2	0.05	0.25
Other	0.1	0.26	0.36
	0.54	0.46	1

Note:-
The cells highlighted is the Joint Probability Distribution must sum to 1, because everyone in the distribution must be in one of the cells.

The Joint probability is symmetrical meaning that P(male and Football) = P(Football and male) and we can also use it to find other types of distributions. the marginal distribution and the conditional distribution.

Marginal Distribution:

- In probability theory and statistics, the marginal distributional of a subset of a collection of random variables is the probability distribution of the variables contained in the subset.

- It gives the ~~probability~~ probabilities of various values of the variables in the subset without reference to the values of the other variables.

- Marginal Probability is the probability of an event irrespective of the outcome of another variable.

	Male	Female	Total
Football	0.24	0.15	0.39
Rugby	0.2	0.05	0.25
Other	0.1	0.26	0.36
	0.54	0.46	1

Note:-

Whether we ignore the gender or the sport our marginal Distributions must sum to 1.

A fun fact of marginal probability is that all the marginal ~~probability~~ probability appear in the margins. Hence the P(Female) = 0.46 which completely ignores the sport the Female prefers, and the P(rugby) = 0.25 completely ignores the gender.

Conditional Probability

It defines the Probability of one event occuring given that another event has occured (by ausumption, presumption, assertion or evidence).

$$P(A|B) = P(A,B) / P(B)$$

If we want to calculate the probability that a person would like Rugby given that they are female, we must take the joint probability that the Person is

female and likes rugby (P(Female and Rugby)) and divide it by the probability of the condition.

$$P(\text{Female, Rugby}) = 0.05$$

$$P(\text{Female}) = 0.46$$

$$P(\text{Rugby} \mid \text{Female}) = \frac{0.05}{0.46}$$

$$= 0.11$$