BINOMIAL DISTRIBUTION:

Yes/no (binomial) outcomes lie at a heart of analytics since they are often the culmination of a decision or a other process; buy/don't buy, click/don't click, survive/die, and so on. Central to understanding the binomial distribution is the idea of a set of trials, each trial having two possible outcomes with definite probabilities.

The key terms are as follows:

Trial → An event with a discrete outcomes.
Success → The outcome of interest for a trial.
Binomial → Having two outcomes.
Binomial Distribution → Distribution of number of successes in x trials.

Example:-

Consider we have 2 flavours of fanta. We want know which flavour reigns supreme? Or are they both equally loved?

Orange Fanta Vs Grape Fanta

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Assume that I asked 3 people if they liked orange fanta more than Grape fanta.
2 people say they like and one person says that he/she like grape fanta. What is the probability that any 2 out of 3 people would randomly say that they prefer orange fanta.

Let's calculate manually.

$\boxed{0.125 + 0.125 + 0.125 = 0.375}$

probability that person likes GF

$0.5 \times 0.5 \times 0.5$			+	$0.5 \times 0.5 \times 0.5$			+	$0.5 \times 0.5 \times 0.5$		
Grape Fanta	Orange Fanta	Orange Fanta	+	Orange Fanta	Grape Fanta	Orange Fanta	+	Orange Fanta	Orange Fanta	Grape Fanta
1	2	3		1	2	3		1	2	3.

Case 1
Person 1 likes GF
" 2 " OF
" 3 " OF

Case 2
Person 1 likes OF
" 2 " GF
" 3 " OF

Case 3.
Person 1 likes OF
Person 2 likes OF
Person 3 likes GF.

~~0.375~~ The probability that any 2 out of 3 people would randomly say that they prefer Orange Fanta is 0.375.

This is manual calculation. The same can be calculated using binomial distribution formula:

Formula:

$$\boxed{p(x|n,p) = \frac{n!}{x!(n-x)!} p^{x}(1-p)^{n-x}}$$

$x \rightarrow$ no. of people who preferred orange fantā, ~~n=2~~ $x=2$

$n \rightarrow$ Total no. of people we asked, $n=3$

$(n-x) \rightarrow$ No. of people who preferred grape fantā

$P \rightarrow$ Probability that someone will pick up orange fantā $(p=0.5)$.

$(1-p) \rightarrow$ Probability that someone will pick up grape fanta $(1-0.5=0.5)$

$p^{(x)} \rightarrow$ probability that orange fantā is picked up 2 (twice).

$(1-p)^{n-x} \rightarrow$ Someone preferred grape fantā.

$(1-0.5)^{3-2} = 0.5$

$$P(x=2|3,p=0.5) = \frac{3!}{2!(1!)}(0.5)^2(1-0.5)^{3-2}$$

$$= 3 \times (0.5)^3 = 3 \times 0.125 \; \boxed{= 0.375}$$

0.375 is the same value received through manual calculation.

What is the probability that all will pick orange fantā?

$n=3, x=3.$ $\quad p(3|3,p=0.5) = \frac{3!}{3!(3-3)!} \times (0.5)^3(1-0.5)^{3-3}.$

$= 0.5 \times 0.5 \times 0.5$ $\boxed{= 0.125}$

Example:

If 4 people say that they like orange fanta and 3 people say they like grape fanta, can you conclude that people in general prefer orange fanta?

Solution:

$n = 7, x = 4, (n-x) = 3.$

$$p(x=4 \mid n=7, p=0.5) = \frac{7!}{4!(7-4)!} \times (0.5)^4 \cdot (0.5)^{7-4}$$

$$= \frac{7!}{4! \times 3!} (0.5)^7$$

$$= 5 \times 7 \times (0.5)^7$$

$$= 35 \times (0.5)^7.$$

$$\boxed{= 0.273}$$

0.273 is the probability that people in general prefer orange fanta.

POISSON DISTRIBUTION:-

* It is a discrete probability distribution of a discrete random variable X, which has no upper bound.
* It is defined for non-negative values of x.
* It is suitable for rare events for which the probability of occurence p is very small and the trials of n is very large.