



Semester



Subject Statistics for AIDS

Academic Year: 20 23 20 24

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?



vs





Semester I

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Academic Year: 2023-2024

Assume that I asked 3 people if they liked orange fanta more than Grape fanta.

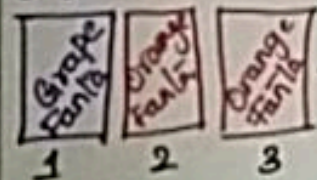
2 people say they like and one person says that he/she like grape fanta. What is the probability that any 2 out of 3 people would randomly say that they prefer orange fanta.

Let's calculate manually.

$$0.125 + 0.125 + 0.125 = 0.375$$

Probability that person likes GF.

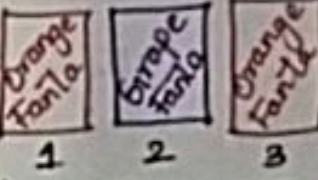
$$0.5 \times 0.5 \times 0.5$$



Case 1

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

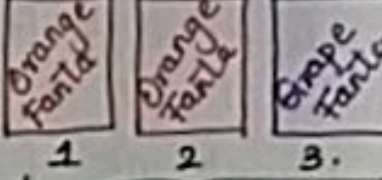
$$0.5 \times 0.5 \times 0.5$$



Case 2

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

$$0.5 \times 0.5 \times 0.5$$



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!



Semester



Subject Statistics for AI&DS Academic Year 2023-2024.

Formula:

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

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

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

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

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

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

$P^x \rightarrow$ probability that orange fanta is picked up 2 (twice).

$(1-p)^{n-x} \rightarrow$ someone preferred grape fanta.
 $(1-0.5)^{3-2} = 0.5$

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

$$= 3 \times (0.5)^3 = 3 \times 0.125 = 0.375$$

0.375 is the same value received through manual calculation.

What is the probability that all will pick orange fanta?

$n=3, x=3.$

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



Semester: IV

Subject: Statistics for AIDS

Academic Year: 2023-24

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

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:

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

$$\begin{aligned} p(x=4|n=7, p=0.5) &= \frac{7!}{4!(7-4)!} \times (0.5)^4 \times (0.5)^{7-4} \\ &= \frac{7!}{4! \times 3!} (0.5)^7 \\ &= \frac{5 \times 7 \times (0.5)^7}{1} \\ &= 35 \times (0.5)^7 \\ &= \boxed{0.273} \end{aligned}$$

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 occurrence p is very small and the trials of n is very large.