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B.COM. PART 1

CORE CONCEPT OF BUSINESS MATHMATICS & STATISTICS

Inverse Probability or Bayes' Theorem

Probability is calculated before occurrence of an event, while in inverse probability, it is calculated for the cause of the event after its occurrence. The concept of calculation of inverse probability was propounded by British mathematician Thomas Bayes. It is also known as 'a-Posteriori Probability'. According to this theorem "If the occurrence of an event can be influenced by various but mutually exclusive reasons, then the calculation of probability of its occurrence due to particular reasons is called as 'inverse probability'."

Mathematically, if an event can be influenced by any one reason out of n mutually exclusive reasons the probabilities of influence of these reasons are $P_1, P_2, P_3 \ldots\ldots P_n$ and the probability of happening the event by each of these reasons are $p_1, p_2, p_3 \ldots . p_n$, then the probability of happening the event due to m^{th} reason can be calculated as follows:

$$P = \frac{P_m p_m}{P_1 p_1 + P_2 p_2 + P_3 p_3 \ldots\ldots + P_n p_n}$$

Example-32: In a factory manufacturing transistor, machines x, y and z manufacture 30, 30 and 40 percent of the total production of transistors. Of their output 4, 5, and 10 percent of the transistors are defective. If one transistor is selected at random, and if it is found to be defective, what is the probability that it is manufactured by machine z?

Solution- 32: Ratio (Probability) of production by three machines:

$$P_x = \frac{30}{100}, P_y = \frac{30}{100}, P_z = \frac{40}{100},$$

Probability of defective production by three machines:

$$p_x = \frac{4}{100}, p_y = \frac{5}{100}, p_z = \frac{10}{100}$$

Probability that the selected transistor found defective was manufactured by machine z:

$$P\,(P_z p_z) = \frac{Pzpz}{Pxpx + Pypy + Pzpz}$$

$$P\,(P_z p_z) = \frac{\frac{40}{100} * \frac{10}{100}}{\frac{30}{100} * \frac{4}{100} + \frac{30}{100} * \frac{5}{100} + \frac{40}{100} * \frac{10}{100}}$$

$$P\,(P_z p_z) = \frac{\frac{4}{100}}{\frac{67}{100}} = \frac{4}{100} * \frac{67}{100} = \frac{40}{67} \text{ or } 0.597$$

PROBABILITY THEORETICAL DISTRIBUTION
BERNOULLI THEOREM OR BINOMIAL DISTRIBUTION

This theorem was propounded by the famous statistician James Bernoulli. According to him if the probability of occurring an event in one trial or experiment is known, then it can be calculated that what will be the probability of happening of that event exactly r times out of n trials. The formula based on this theorem is as follows:

$P_{(r)} = {}^{n}C_{r}\,(p)^{r}\,(q)^{n-r}$

Whereas:

$P_{(r)}$ = Probability of an event happening exactly r times

n = No. of total trials

r = Desired number of success or happening the event in one trial

p = Probability of success or happening the event in one trial

q = Probability of failure or not happening the event in one trial (1-p)

Characteristics or Properties of Binomial Distribution-

1) Theoretical Frequency Distribution- It is based on Bernoulli theorem of algebra.
2) Discrete Probability Distribution- In this distribution the numbers are in whole no. or not in fraction.
3) Main Parameters- p and q are two main parameters of binomial distribution.
4) Mean, S.D. and variance- Mean($\bar{x}$) = n*p, S.D.(σ) = $\sqrt{npq}$, Variance .(σ^2) = npq

Example-33: Five coins are tossed simultaneously. What is the probability that there will be exactly two heads?

Solution- 33: $P_{(r)} = {}^{n}C_{r}\,(p)^{r}\,(q)^{n-r}$

Whereas, n =5, r=2, p = (probability of head in throw of one coin) = ½

$P(r=2) = {}^{5}C_{2}\,(\frac{1}{2})^{2}\,(\frac{1}{2})^{5-2}$

$P(r=2) = \frac{5!}{(5-3)!*3!}(\frac{1}{2})^{2}\,(\frac{1}{2})^{5-2}$

$P(r=2) = \frac{5!}{2!*3!}(\frac{1}{2})^{2}\,(\frac{1}{2})^{3}$

$P(r=2) = \frac{5*4*3*2*1}{2*1*3*2*1}(\frac{1}{4})\,(\frac{1}{8})$

$P(r=2) = \frac{5*4}{2*1}(\frac{1}{4})\,(\frac{1}{8})$

$P(r=2) = \frac{20}{2}(\frac{1}{4})\,(\frac{1}{8})$

$P(r=2) = \frac{20}{64} = \frac{5}{16}$