Multiplicative Law of Probability or (Theorem of Compound Probability)

Statement → The probability of simultaneous occurrence of two events A & B is the product of probability of A and the Conditional Probability of B, when A has already occurred or vice versa

i.e. $P(A \cap B) = P(A) . P(B/A)$ if $P(A) \neq 0$

$P(A \cap B) = P(B) . P(A/B)$ if $P(B) \neq 0$

Proof → let m_1 be the number of cases favourable to the event A out of n possible cases

so $P(A) = \frac{m_1}{n}$ Event n is exhaustive, mutually exclusive and equally likely

out of these m_1, let m_2 be the number of cases favourable to the event B, when A has occurred

∴ Conditional Probability $P\left(\frac{B}{A}\right) = \frac{m_2}{m_1}$

of B, given that A has happened

Now out of n exhaustive, mutually exclusive and Equally likely outcomes, m_2 are favourable to the happening of 'A and B'

The multiplication theorem is not applicable in case of dependent events.

Two events A and B are said to be dependent when B can occur only when A is known to have occurred (or vice versa)

CONDITIONAL PROBABILITY →

The Probability of occurrence of an event A, given that the event B has already occurred, is called the Conditional probability of occurrence of A on the condition that B has already occurred.

It is denoted by $P(A/B)$

and is read as 'Probability of A, given that B has already occurred.'

Mutually Independent events → An event A is said to be independent of an event B

if $P(A/B) = P(A)$

i.e. if the probability of happening of A is independent of the happening of B