# Probability

→ $P(A/B) = \dfrac{P(A\cap B)}{P(B)} = \dfrac{n(A\cap B)}{n(B)}$

→ $P((A\cup B)/F) = P(A/F) + P(B/F) - P((A\cap B)/F)$

→ Independent events

$$P(A\cap B) = P(A)\,P(B)$$

- If A & B are independent then
  - → A & B'
  - → A' & B
  - → A' & B' are also independent

→ Total probability theorem

[If $A_1, A_2 \ldots A_n$ are mutually exclusive and exhaustive events of a random experiment such that $P(A_i) > 0$ for $i = 1, 2, \ldots n$ and E is any event] then

$$P(E) = P(A_1)P(E/A_1) + P(A_2)P(E/A_2) \ldots\ldots + P(A_n)P(E/A_n)$$

→ Baye's theorem [ ] & $P(E) > 0$

then

$$P(A_k/E) = \frac{P(A_k)\,P(E/A_k)}{P(E)}$$

$$= \frac{P(A_k)\,P(E/A_k)}{P(A_1)P(E/A_1) + P(A_2)P(EA_2) + \ldots + P(A_n)P(E/A_n)}$$

→ Random variables and probability distribution

| variable | $x_1$ | $x_2$ | .... | $x_n$ |
|---|---|---|---|---|
| probab | $p_1$ | $p_2$ | ... | $p_n$ |

$$p_1 + p_2 + \dots + p_n = 1$$

$$\text{mean} = \mu = \sum_{i=1}^{n} x_i p_i$$

$$\text{Variance} = \sigma^2 = \sum_{i=1}^{n} (x_i - \mu)^2 p_i$$

$$= \sum_{i=1}^{n} \left(x_i^2 + \mu^2 - 2x_i\mu\right) p_i$$

$$\cancel{\neq p_i\left(\sum_{i=1}^{n} x_i^2\right)+}$$

$$= \sum_{i=1}^{n} x_i^2 p_i + \mu^2 \underbrace{\sum_{i=1}^{n} p_i}_{1} - 2\mu \underbrace{\sum_{i=1}^{n} p_i x_i}_{\mu}$$

$$= \sum_{i=1}^{n} x_i^2 p_i + \mu^2 - 2\mu^2$$

$$= \sum x_i^2 p_i - \mu^2$$

Standard deviation $= \sigma$

→ Bernoulli's trials

$n$ → no. of trials
$r$ → no. of times event happens
$p$ → probab. of " happening success
$q$ → " " " not " failure

$${}^nC_0 p^n q^0 + {}^nC_1 p^{n-1} q^1 + {}^nC_2 p^{n-2} q^2 + \dots + {}^nC_n p^0 q^n = 1$$

. If a particular event has to happen exactly r times in n trials then

the probability is

$$\boxed{{}^nC_r p^r q^{n-r}}$$

~~If a particular~~ $\cancel{{}^nC_1 p^1 q^{n-1} + {}^nC_2 p^1 q^{n-2} + \dots + {}^nC_n p^n q}$

Note:-

$$\boxed{\begin{aligned} \text{mean} &= np \\ \text{variance} &= npq \end{aligned}}$$

*Formula

$${}^mC_0 \, {}^nC_0 + {}^mC_1 \, {}^nC_1 + {}^mC_2 \, {}^nC_2 + \dots \; {}^mC_m \, {}^nC_m$$

$$= {}^{m+n}C_m \quad (m<n)$$

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Without replacement / or together:- Order not imp

With / replacement // one by one:- Order imp (default)

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