MIND MAP
PROBABILITY

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- **Two Broad Division**
  - Subjective
  - Objective
    - Classical ⇒ $P(A) = \frac{\text{favourable}}{\text{Total}}$
    - Statistical ⇒ $P(A) = \lim_{n \to \infty} \frac{f_A}{n}$
    - Modern ⇒ $0 \le P(A) \le 1$, $P(S) = 1$, $P(A_1 \cup A_2 \dots \cup) = P(A_1) + \dots$
      - Addition Theorem
        - Mutually Exclusive ⇒ $P(A \cup B) = P(A) + P(B)$
        - Non-Mutually Exclusive ⇒ $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
      - Multiplication Theorem
        - Dependent ⇒ $P(A \cap B) = P(A)\,P(B/A)$ or $P(A \cap B) = P(B)\,P(A|B)$
        - Independent ⇒ $P(A \cap B) = P(A) \cdot P(B)$

- Odds in favour ⇒ $m:n$, $P(A) = \frac{m}{m+n}$
- Odds Against ⇒ $m:n$, $P(A) = \frac{n}{m+n}$
- Atleast one → 1 − No

- **Three Prob**
  - Conditional ⇒ $P(A|B) = \frac{P(A \cap B)}{P(B)}$ or $P(B/A) = \frac{P(A \cap B)}{P(A)}$
    - Given, observe, Notice, known, if, found
  - Total Prob ⇒ $P(A) = P(E_1)P(A|E_1) + P(E_2)(P(A|E_2) \vdots P(E_n)\,P(A|E_n)$
  - Baye's theo. ⇒ $P(E_i/A) = \frac{P(E_i)\,P(A|E_i)}{P(A)}$

- **Probability Distribution**
  - Mean ⇒ $\Sigma P_i x_i$
  - Standard Deviation ⇒ $\sqrt{P_i x_i^2 - (\Sigma P_i x_i)^2}$
  - Variance ⇒ $P_i x_i^2 - (\Sigma P_i x_i)^2$

Some Useful formulae

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

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

$P(A-B) = P(A \cap B^c)$

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

$P(B-A) = P(B \cap A^c)$

$P(A \cup B)^c = 1 - P(A \cup B)$

$P(A^c \cap B^c) = P(A \cup B)^c$

$P(A \cap B)^c = 1 - P(A \cap B)$

$P(A^c \cup B^c) = P(A \cap B)^c$

Important Points

Nothing mention → Consider without replacement.

With replacement → Independent

Without replacement → Dependent

(If order not given without replacement → Combination

Independent $\not\Leftrightarrow$ Mutually Exclusive

$P(A) = 1$ Sure event

$P(A) = 0$ Impossible event.

$0 \le P(A) \le 1$; $P(A) + P(A') = 1$

Properties of Expected Values:

$E(x+y) = E(x) + E(y)$

$E(kx) = k\,E(x)$

$E(ax+b) = a\,E(x) + b$

$E(x \cdot y) = E(x) \cdot E(y)$

$E(x-y) = E(x) - E(y)$

$E(k) = k.$

whenever x and y are Independent