Basic Statistics Formula sheet

📘 1. Measures of Central Tendency

Mean (Average)

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

- $\bar{x}$: Sample mean

- x_i: Data points

- n: Number of observations

Median

- Middle value in ordered data

- If even number of values: $\text{Median} = \frac{x_{(n/2)} + x_{(n/2+1)}}{2}$

Mode

- Value that occurs most frequently

📙 2. Measures of Dispersion

Variance

- Population:

$$\sigma^2 = \frac{1}{N} \sum_{i=1}^{N} (x_i - \mu)^2$$

- Sample:

$$s^2 = \frac{1}{n-1} \sum_{i=1}^{n} (x_i - \bar{x})^2$$

Standard Deviation

$$\sigma = \sqrt{\sigma^2}, \quad s = \sqrt{s^2}$$

Range

$$\text{Range} = x_{\max} - x_{\min}$$

Interquartile Range (IQR)

$$\text{IQR} = Q_3 - Q_1$$

📗 3. Probability

Probability of Event

$$P(E) = \frac{\text{Number of favorable outcomes}}{\text{Total number of outcomes}}$$

Addition Rule

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

Multiplication Rule (Independent Events)

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

Conditional Probability

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$

Bayes' Theorem

$$P(A \mid B) = \frac{P(B \mid A) \cdot P(A)}{P(B)}$$

📒 4. Combinatorics

Permutations (n objects, r at a time)

$$P(n,r) = \frac{n!}{(n-r)!}$$

Combinations

$$C(n,r) = \binom{n}{r} = \frac{n!}{r!(n-r)!}$$

📕 5. Distributions

Binomial Distribution

$$P(X = k) = \binom{n}{k} p^k (1-p)^{n-k}$$

Normal Distribution (PDF)

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$$

t-Distribution (PDF)

$$f(t) = \frac{\Gamma\left(\frac{\nu+1}{2}\right)}{\sqrt{\nu\pi}\,\Gamma\left(\frac{\nu}{2}\right)} \left(1 + \frac{t^2}{\nu}\right)^{-\frac{\nu+1}{2}}$$

Poisson Distribution

$$P(X = k) = \frac{\lambda^k e^{-\lambda}}{k!}$$

📓 6. Correlation and Regression

Covariance

$$\text{Cov}(X, Y) = \frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})$$

Pearson Correlation Coefficient

$$r = \frac{\text{Cov}(X, Y)}{s_X s_Y}$$

Linear Regression (Simple)

$$y = a + bx$$

Where:

$$b = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2}, \quad a = \bar{y} - b\bar{x}$$