Charter Font Sample
Probability Cheatsheet Content

1 Fundamental Definitions

Random Variable A function $X : \Omega \to \mathbb{R}$ that assigns a real number to each outcome in the sample space Ω.

Independence Events A and B are independent if:

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

2 Key Probability Rules

Bayes' Theorem: $P(A|B) = \frac{P(B|A)P(A)}{P(B)}$
Law of Total Probability: For partition $\{B_i\}$: $P(A) = \sum_i P(A|B_i)P(B_i)$

3 Expected Value

The average value of a random variable:

$$E(X) = \sum_x x \cdot P(X = x) \text{ (discrete)}$$

$$E(X) = \int_{-\infty}^{\infty} x f(x) dx \text{ (continuous)}$$

Linearity: $E(aX + bY + c) = aE(X) + bE(Y) + c$
Variance: $\text{Var}(X) = E(X^2) - [E(X)]^2$

4 Common Distributions

Binomial: $X \sim \text{Bin}(n, p)$ has PMF $P(X = k) = \binom{n}{k} p^k (1-p)^{n-k}$
Properties: $E(X) = np$, $\text{Var}(X) = np(1-p)$
Poisson: $X \sim \text{Pois}(\lambda)$ has PMF $P(X = k) = \frac{\lambda^k e^{-\lambda}}{k!}$
Properties: $E(X) = \lambda$, $\text{Var}(X) = \lambda$
Normal: $X \sim \mathcal{N}(\mu, \sigma^2)$ has PDF:

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

Properties: $E(X) = \mu$, $\text{Var}(X) = \sigma^2$

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