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Stats Formula Sheet

Mean: $\overline{y} = \frac{1}{n}\sum_{i=1}^{n} y_i$

Variance: $s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(y_i - \overline{y})^2$

Standard Deviation: $s = \sqrt{s^2}$

Permutation Equation: $P_r^n = \frac{n!}{(n-r)!}$

Combination Equation: $\binom{n}{r} = C_r^n = \frac{P_r^n}{r!} = \frac{n!}{r!(n-r)!}$

Conditional Probability: $P(A|B) = \frac{P(A \cap B)}{P(B)}$

Independent and Dependent:

Events A and B are independent if:

$P(A|B) = P(A), P(B|A) = P(B),$

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

Otherwise, events are dependent

If events are dependent,

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

If events are independent,

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

If events are mutually exclusive,

$P(A \cap B) = 0$ AND

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

Otherwise,

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

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Complement: $P(A) = 1 - P(\overline{A})$

Theorem of Total Probability: $P(A) = \sum_{i=1}^{n} P(A|B_i)P(B_i)$

Bayes' Rule: $P\left(B_j\middle|A\right) = \frac{P(A\cap B_j)}{P(A)} = \frac{P\left(A\middle|B_j\right)P(B_j)}{\sum_{i=1}^{k} P(A|B_i)P(B_i)}$

When Y is a discrete random variable,

Expected Value: $E(Y) = \sum_{y} yp(y)$

Variance: $V(Y) = E[\left(y - E(Y)\right)^2]$

Standard Deviation: $S(Y) = \sqrt{V(Y)}$

Binomial Distributions: $p(y) = \binom{n}{y} p^y q^{n-y}$

Expected Value: $E(Y) = np$

Variance: $V(Y) = npq.$

Standard Deviation: $\sqrt{npq}$

Geometric Distributions: $p(y) = q^{y-1}p$

Expected Value: $E(Y) = 1/p$

Variance: $V(Y) = \frac{1-p}{p^2}$

Standard Deviation: $\sqrt{\frac{1-p}{p^2}}$

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Hypergeometric Distributions: $p(y) = \frac{\binom{r}{y}\times\binom{N-r}{n-y}}{\binom{N}{n}}$

Expected Value: $E(Y) = \frac{nr}{N}$

Variance: $V(Y) = n(\frac{r}{n})(\frac{N-r}{N})(\frac{N-n}{N-1})$

Standard Deviation: $S(Y) = \sqrt{n(\frac{r}{n})(\frac{N-r}{N})(\frac{N-n}{N-1})}$

Poisson Distributions: $p(y) = (\frac{\lambda^y}{y!}) \times e^{-\lambda}$

Expected Value: $E(Y) = \lambda$

Variance: $V(Y) = \lambda$

Standard Deviation: $S(Y) = \sqrt{\lambda}$

Chebyshev's Theorem

$P(|Y - \mu| < k\sigma) \geq 1 - \frac{1}{k^2}$ OR $P(|Y - \mu| \geq k\sigma) \leq \frac{1}{k^2}$

- Lower Interval Bound = $\mu - k\sigma$
- Upper Interval Bound = $\mu + k\sigma$