Statistics Formulas - Probability, Discrete and Continuous Distributions:

(Evolution to: Last Update: Sunday, December 29, 2003)

General Probability – Joint and the Addition Rules

Probability of mutually exclusive $P(A \text{ or } B) = P(A) + P(B) \qquad P(A \text{ and } B) = 0$

Probability not mutually exclusive $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

Probability of Independent events $P(A \text{ and } B) = P(A)P(B)$

Probability of Dependent events $P(A \text{ and } B) = P(A)P(B \mid A)$

Conditional probability $P(A \mid B) = \dfrac{P(A \text{ and } B)}{P(B)}$

Test for Independence $P(A \text{ and } B) = P(A)P(B)$ or $P(A \mid B) = P(A)$

Complements $P(A) + P(\bar{A}) = 1,\ P(A) = 1 - P(\bar{A}),\ P(\bar{A}) = 1 - P(A)$

General form of Bayes' Theorem $P(A \mid B) = \dfrac{P(B \mid A)P(A)}{P(B \mid A)P(A) + P(B \mid \bar{A})P(\bar{A})}$

Probability Distributions of Discrete Random Variables

Discrete Random Variable $m = \sum X_i \cdot P(X_i)$, $s^2 = \sum X_i^2 P(X_i) - m^2$ *or* $s^2 = \sum [X_i - E(X)]^2 P(X_i)$

Expectation $E(X) = \sum X_i \cdot P(X_i)$

Binomial $P(X) = \dfrac{n!}{X!(n-X)!} p^X q^{n-X}$ or $P(X) = {}_nC_X\, p^X q^{n-X}$, $m = np$, $s = \sqrt{npq}$, $q = 1 - p$

Multinomial $P(X; X_1, X_2, X_3, \ldots, X_k) = \dfrac{n!}{X_1! \cdot X_2! \cdot X_3! \cdot \ldots \cdot X_k!} p_1^{X_1} \cdot p_2^{X_2} \cdot p_3^{X_3} \cdot \ldots \cdot p_k^{X_k}$

Poisson $P(X; l) = \dfrac{e^{-l} l^X}{X!} \qquad l = m = np \qquad s = \sqrt{l} \qquad s^2 = l$

Hypergeometric $P(X; a, b) = \dfrac{{}_aC_X \cdot {}_bC_{n-X}}{{}_{(a+b)}C_n} \qquad a + b = \text{population size} = N$

Normal Distribution

Formula for the normal distribution (we use the normal distribution table for the values) $f(X) = \dfrac{e^{-\frac{1}{2}\left[\frac{(x-m)^2}{s}\right]}}{s\sqrt{2p}}$

Formula for the z-value (or standard score) $z = \dfrac{X - m}{s}$

Formula for finding a specific data value $X = zs + m$

Formula for the mean and standard deviation (error) of the sample means $m_{\bar{X}} = m$ ***and*** $s_{\bar{X}} = \dfrac{s}{\sqrt{n}}$

Formula for the z-value for the central limit theorem $z = \dfrac{\bar{X} - m}{s / \sqrt{n}}$ ***; when n/N > .05*** $z = \dfrac{\bar{X} - m}{\dfrac{s}{\sqrt{n}} \sqrt{\dfrac{N-n}{N-1}}}$

Sampling Error $SE = \bar{X} - m$

Exponential Distribution

Formula for the (negative) exponential distribution $f(X) = me^{-mX}$ ***where***

X = random variable (service times)
m = average number of units the service facility can handle in a specific period of time
e = 2.718 the base of the natural logarithm