The Logarithmic Function:

$L = \log_b N$

The inverse function is: $N = b^L$

For example:

$\log_2 8 = 3$ since $8 = 2^3$

$\log_{10} 0.01 = -2$ since $0.01 = 10^{-2}$

$\log_5 5 = 1$ since $5 = 5^1$

$\log_b 1 = 0$ since $1 = b^0$

Selected Algebra Topics

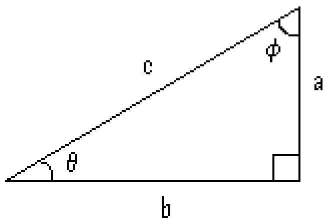
Basic Laws of Exponents

Law	Example
$a^m a^n = a^{m+n}$	$x^5 x^{-2} = x^3$
$\dfrac{a^m}{a^n} = a^{m-n}, a \neq 0$	$\dfrac{x^5}{x^3} = x^2$
$(a^m)^n = a^{mn}$	$(x^{-2})^3 = x^{-6}$
$(ab)^m = a^m b^m$	$(xy)^2 = x^2 y^2$
$\left(\dfrac{a}{b}\right)^m = \dfrac{a^m}{b^m}, b \neq 0$	$\left(\dfrac{x}{y}\right)^2 = \dfrac{x^2}{y^2}$
$a^{-m} = \dfrac{1}{a^m}, a \neq 0$	$x^{-3} = \dfrac{1}{x^3}$
$a^0 = 1, a \neq 0$	$2(3x)^0 = 2(1) = 2$
$a^1 = a$	$(3x^2)^1 = 3x^2$

Laws for fractional exponents

Law	Example
$a^{m/n} = \sqrt[n]{a^m}$	$x^{2/3} = \sqrt[3]{x^2}$
$\dfrac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\dfrac{a}{b}}, b \neq 0$	$\dfrac{\sqrt[3]{16}}{\sqrt[3]{2}} = \sqrt[3]{8} = 2$
$a^{1/2} = \sqrt[2]{a^1} = \sqrt{a}, a \geq 0$	$\sqrt{25} = 5, (not \pm 5)$

Trigonometric Identities



$\sin(\theta)=\frac{a}{c}$	$\csc(\theta)=\frac{1}{\sin(\theta)}=\frac{c}{a}$
$\cos(\theta)=\frac{b}{c}$	$\sec(\theta)=\frac{1}{\cos(\theta)}=\frac{c}{b}$
$\tan(\theta)=\frac{\sin(\theta)}{\cos(\theta)}=\frac{a}{b}$	$\cot(\theta)=\frac{\cos(\theta)}{\sin(\theta)}=\frac{b}{a}$

$$\sin(-x)=-\sin(x)$$
$$\csc(-x)=-\csc(x)$$
$$\cos(-x)=\cos(x)$$
$$\sec(-x)=\sec(x)$$
$$\tan(-x)=-\tan(x)$$
$$\cot(-x)=-\cot(x)$$

$$\sin^2(x)+\cos^2(x)=1$$
$$\tan^2(x)+1=\sec^2(x)$$
$$\cot^2(x)+1=\csc^2(x)$$
$$\sin(x\pm y)=\sin(x)\cos(y)\pm\cos(x)\sin(y)$$
$$\cos(x\pm y)=\cos(x)\cos(y)\pm\sin(x)\sin(y)$$
$$\tan(x\pm y)=\frac{\tan(x)\pm\tan(y)}{1\pm\tan(x)\tan(y)}$$
$$\sin(2x)=2\sin(x)\cos(x)$$
$$\cos(2x)=\cos^2(x)-\sin^2(x)=2\cos^2(x)-1=1-2\sin^2(x)$$
$$\tan(2x)=\frac{2\tan(x)}{(1-\tan^2(x))}$$
$$\sin^2(x)=\frac{1}{2}-\frac{1}{2}\cos(2x)$$

$$\cos^2(x) = \frac{1}{2} + \frac{1}{2}\cos(2x)$$

$$\sin(x) - \sin(y) = 2\sin\left(\frac{(x-y)}{2}\right)\cos\left(\frac{(x+y)}{2}\right)$$

$$\cos(x) - \cos(y) = -2\sin\left(\frac{(x-y)}{2}\right)\sin\left(\frac{(x+y)}{2}\right)$$

Given Triangle abc, with angles A,B,C; a is opposite to A, b is opposite to B, and c is opposite to C:

Law of Sines: $\frac{a}{\sin(A)} = \frac{b}{\sin(B)} = \frac{c}{\sin(C)}$

Law of Cosines:

$$c^2 = a^2 + b^2 - 2ab\cos(C)$$

$$b^2 = a^2 + c^2 - 2ac\cos(B)$$

$$a^2 = b^2 + c^2 - 2bc\cos(A)$$

Law of Tangents: $\frac{(a-b)}{(a+b)} = \frac{\tan\left(\frac{1}{2}(A-B)\right)}{\tan\left(\frac{1}{2}(A+B)\right)}$

Important Statistics Formulas:

Parameters:

Population mean: $\mu = \frac{(\Sigma X_i)}{N}$

Population Standard Deviation: $\sigma = \sqrt{\frac{\Sigma(X_i - \mu)^2}{N}}$

Population Variance: $\sigma^2 = \frac{\Sigma(X_i - \mu)^2}{N}$

Standardized Score: $Z = \frac{(X - \mu)}{\sigma}$

Population Correlation Coefficient: $\rho = \left[\frac{1}{N}\right] * \Sigma\left\{\left[\frac{(X_i - \mu_x)}{\sigma_x}\right] * \left[\frac{(Y_i - \mu_y)}{\sigma_y}\right]\right\}$

Statistics:

Sample mean: $\bar{x} = \frac{(\Sigma x_i)}{n}$

Sample standard deviation: $s = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{(n-1)}}$

Sample variance: $s^2 = \dfrac{\Sigma(x_i - \bar{x})^2}{(n-1)}$

Sample Correlation coefficient: $r = \left[\dfrac{1}{(n-1)}\right] * \Sigma\left\{\left[\dfrac{(x_i - \bar{x})}{s_x}\right] * \left[\dfrac{(y_i - \bar{y})}{s_y}\right]\right\}$

Normal Distribution Formula: $\dfrac{1}{\sigma\sqrt{2\pi}} \exp\left(-\dfrac{(x-\mu)^2}{2\sigma^2}\right)$

Or $\dfrac{1}{\sigma\sqrt{2\pi}} \exp\left(-\dfrac{z^2}{2}\right)$

Simple Linear Regression:

Simple linear regression line: $\hat{y} = b_0 + b_1 x$

Regression coefficient: $b_1 = \dfrac{\Sigma\left[\left(x_i - \bar{x}\right)\left(y_i - \bar{y}\right)\right]}{\Sigma\left(x_i - \bar{x}\right)^2}$

Regression slope intercept: $b_0 = \bar{y} - b_1 * \bar{x}$

Standard error of regression slope: $s_{b_1} = \dfrac{\sqrt{\dfrac{\Sigma\left(y_i - \hat{y}_i\right)^2}{(n-2)}}}{\sqrt{\Sigma\left(x_i - \bar{x}\right)^2}}$

Random Variables:

Expected value of X: $E(X) = \mu_x = \Sigma[x_i * P(x_i)]$

Variance of X: $Var(X) = \sigma^2 = \Sigma[x_i - E(x)]^2 * P(x_i) = \Sigma[x_i - \mu_x]^2 * P(x_i)$

Normal Random Variable: $z - score = z = \dfrac{(x-\mu)}{\sigma}$

Expected value of sum of random variables: $E(X+Y) = E(X) + E(Y)$

Expected value of difference between random variables: $E(X-Y) = E(X) - E(Y)$

Variance of the sum of *independent* random variables:

$$Var(X+Y) = Var(X) + Var(Y)$$

Variance of the difference between *independent* random variables:

$$Var(X-Y) = Var(X) - Var(Y)$$

Sampling Distributions:

Standard deviation of the mean: $\sigma_{\bar{x}} = \dfrac{\sigma}{\sqrt{n}}$

Standard Error:

Standard error of the mean: $SE_{\bar{x}} = s_{\bar{x}} = \dfrac{s}{\sqrt{n}}$

Taylor series expansion:

$$f(x+\Delta x)=\sum_{n=0}^{\infty}\frac{f^{(n)}(x)\Delta x^n}{n!}= f(x)+ f'(x)\Delta x+\frac{f''(x)\Delta x^2}{2!}+\frac{f'''(x)\Delta x^3}{3!}+\cdots$$

Maclaurin series expansion: $f(x)=\sum_{n=0}^{\infty}\frac{f^{(n)}(0)x^n}{n!}$

$$e^x =1+x+\frac{x^2}{2!}+\frac{x^3}{3!}+\frac{x^4}{4!}+\frac{x^5}{5!}+\cdots$$

$$\sin x = x-\frac{x^3}{3!}+\frac{x^5}{5!}-\frac{x^7}{7!}+\frac{x^9}{9!}+\cdots$$

$$\cos x =1-\frac{x^2}{2!}+\frac{x^4}{4!}-\frac{x^6}{6!}+\frac{x^8}{8!}+\cdots$$