**Some Useful Formulas**

$$P(E_1 \, or \, E_2) = P(E_1) + P(E_2) - P(E_1 \, and \, E_2)$$

**Conditional Probability** $P(E_1 | E_2) = \dfrac{P(E_1 \, and \, E_2)}{P(E_2)}$

**Bayes' Theorem** $$P(E_i | B) = \frac{P(E_i)P(B | E_i)}{\sum_{c=1}^{k} P(E_c)P(B | E_c)}$$

**Covariance** $$\sigma xy = \sum [x_i - E(x)][y_j - E(y)] P(x_i y_j)$$

**Correlation Coefficient** $$\rho = \frac{\sigma xy}{\sigma x \, \sigma y}$$

**Binomial** $$P(x) = \frac{n!}{x!(n-x)!} p^x q^{n-x}, \ \mu = E(x) = np, \ \sigma = \sqrt{npq}$$

**Poisson** $$P(x) = \frac{(\lambda t)^x e^{-\lambda t}}{x!}, \ \mu = \lambda t, \sigma = \sqrt{\lambda t}$$

**Hypergeometric** $$P(x) = \frac{C_{n-x}^{N-X} \, C_x^X}{C_n^N}$$

**Uniform** $$f(x) = \begin{cases} \dfrac{1}{b-a} & if \ a \le x \le b \\ 0 & otherwise \end{cases}$$

**Exponential** $$P(0 \le x \le a) = 1 - e^{-\lambda a}$$

**Sampling Error** = Statistic Value – Parameter Value

$$\mu_{\bar{x}} = \mu, \qquad \sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} \qquad \mu_{\bar{p}} = p, \qquad \sigma_{\bar{p}} = \sqrt{\frac{p(1-p)}{n}}$$

**Finite Population Correction**: $\dfrac{N-n}{N-1}$

**Confidence Interval for μ (σ Known)** $\bar{x} \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$

**Confidence Interval for μ (σ Unknown):** $\bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$

**Required Sample Size** $n = \frac{z_{\alpha/2}^2 \sigma^2}{e^2} = \left(\frac{z_{\alpha/2}\,\sigma}{e}\right)^2$

**Estimating the Difference between Two Means, independent Samples:**

**$\sigma_1$ and $\sigma_2$ known** $\left(\bar{x}_1 - \bar{x}_2\right) \pm z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$

**$\sigma_1$ and $\sigma_2$ unknown, and large samples**

$$\left(\bar{x}_1 - \bar{x}_2\right) \pm z_{\alpha/2}\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

**$\sigma_1$ and $\sigma_2$ unknown and equal, and small samples,**

$$\left(\bar{x}_1 - \bar{x}_2\right) \pm t_{\alpha/2}\, s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}} \quad \text{where } s_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

**$\sigma_1 \neq \sigma_2$ unknown and small samples**

$\left(\bar{x}_1 - \bar{x}_2\right) \mp t_{\alpha/2} \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$ where $t$ has the following degrees of freedom

$$d.f = \frac{\left(s_1^2/n_1 + s_2^2/n_2\right)^2}{\frac{\left(s_1^2/n_1\right)^2}{n_1 - 1} + \frac{\left(s_2^2/n_2\right)^2}{n_2 - 1}}$$

**Paired Samples** $\bar{d} \pm t_{\alpha/2} \frac{s_d}{\sqrt{n}}$ where $d_i = x_{1i} - x_{2i}$

**Difference between two population proportions**

$$\left(\bar{p}_1 - \bar{p}_2\right) \pm z_{\alpha/2}\sqrt{\frac{\bar{p}_1(1-\bar{p}_1)}{n_1} + \frac{\bar{p}_2(1-\bar{p}_2)}{n_2}}$$