Formulas

Confidence Intervals

$$\sigma \text{ Known: } \quad \mu_1 - \mu_2 = \overline{x}_1 - \overline{x}_2 \pm z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

$$\sigma \text{ Unknown: } \quad \mu_1 - \mu_2 = \overline{x}_1 - \overline{x}_2 \pm t_{n_1+n_2-2,\alpha/2}\sqrt{S_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

$$\text{where: } \quad S_p^2 = \frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1+n_2-2}$$

$$\text{Proportions: } \quad p_1 - p_2 = \hat{p}_1 - \hat{p}_2 \pm z_{\alpha/2}\sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$$

Hypothesis Testing

1. Select the correct formula (σ known, σ Unknown, or Proportions).
2. Calculate the Statistic.
3. Find the Critical Value (use α for one tail and $\alpha/2$ for two tails).
4. If $Stat \geq C.V.$ reject the null hypothesis (yes).

   If $Stat < C.V.$ cannot reject the null hypothesis (no).

$$\sigma \text{ Known: } \quad z = \frac{\overline{x}_1 - \overline{x}_2 - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

$$\sigma \text{ Unknown: } \quad t_{n_1+n_2-2} = \frac{\overline{x}_1 - \overline{x}_2 - (\mu_1 - \mu_2)}{\sqrt{S_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$$\text{Proportions: } \quad z = \frac{\hat{p}_1 - \hat{p}_2 - (p_1 - p_2)}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

p-value for z: for one tail $0.5 - F(z)$. For two tails $2[0.5 - F(z)]$.

One-way ANOVA

k columns, $n_1, \ldots, n_k$ rows in each column, x_{ij} value in column i row j, $\overline{x}_i$ mean of column i, $\overline{\overline{x}}$ grand mean, $n = n_1 + \ldots + n_k$.

$$SST = \sum_{i=1}^{k} n_i(\overline{x}_i - \overline{\overline{x}})^2$$

$$SSE = \sum_{i=1}^{k} \sum_{j=1}^{n_i} (x_{ij} - \overline{x}_i)^2$$

$$MST = \frac{SST}{k-1}$$

$$MSE = \frac{SSE}{n-k}$$

$$F_{k-1,n-k} = \frac{MST}{MSE}.$$

Two-way ANOVA

k columns, b rows, x_{ij} value in column i row j, $\overline{x}_i^c$ mean of column i, $\overline{x}_j^r$ mean of row j, $\overline{\overline{x}}$ grand mean .

$$SST = b \sum_{i=1}^{k} (\overline{x}_i^c - \overline{\overline{x}})^2$$

$$SSE = \sum_{i=1}^{k} \sum_{j=1}^{b} (x_{ij} - \overline{x}_i^c - \overline{x}_j^r + \overline{\overline{x}})^2$$

$$MST = \frac{SST}{k-1}$$

$$MSE = \frac{SSE}{kb-k-b+1}$$

$$F_{k-1,kb-k-b+1} = \frac{MST}{MSE}.$$