# All Required Formulas for SOC3811/5811

1. **Mean**

$$\bar{x} = \frac{\sum x_i}{n}$$

2. **Variance**

$$s^2 = \frac{\sum (x - \bar{x})^2}{n - 1}$$

3. **Standard Deviation**

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$$

4. **Conservative Margin of Error**

$$Margin\ of\ error = \frac{1}{\sqrt{n}}$$

5. ***z*-Score**

$$z = \frac{x - \bar{x}}{s_x}$$

6. **Index of Qualitative Variation (IQV)**

$$\mathrm{IQV} = \frac{\mathrm{K}}{\mathrm{K}-1}(\mathrm{D}) \quad \text{where} \quad \mathrm{D} = 1 - \sum_{\mathrm{i}=1}^{\mathrm{K}} \mathrm{p}_\mathrm{i}^2$$

7. **Expected Value of a Discrete Random Variable**

$$E(X) = \mu = \sum x_k p_k$$

8. **Standard Deviation of a Discrete Random Variable**

$$\sqrt{V(X)} = \sigma = \sqrt{\sum (x_i - \mu)^2 p_i}$$

9. **Probabilities for Binomial Random Variables**

$$P(X = k) = \frac{n!}{k!\,(n - k)!} p^k (1 - p)^{n-k}$$

10. **Expected Value of a Binomial Random Variable**

$$E(X) = \mu = np$$

11. **Standard Deviation of a Binomial Random Variable**

$$\sigma = \sqrt{\sigma^2} = \sqrt{np(1 - p)}$$

**12. Standard Error for the Sampling Distribution of *p*-Hat**

$$s.e.(\hat{p}) = \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

**13. Standard Error for the Sampling Distribution of *x*-Bar**

$$s.e.(\overline{x}) = \frac{s}{\sqrt{n}}$$

**14. Standard Error for the Sampling Distribution of $p$-Hat$_1$ - $p$-Hat$_2$**

$$s.e.(\hat{p}_1 - \hat{p}_2) = \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$$

**15. Standard Error for the Sampling Distribution of $x$-Bar$_1$ - $x$-Bar$_2$**

$$s.e.(\bar{x}_1 - \bar{x}_2) = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

**16. Confidence Interval for Proportions**

$$\hat{p} \pm z^* \times \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

**17. Confidence Interval for Means**

$$\bar{x} \pm t^* \frac{s}{\sqrt{n}}$$

**18. Confidence Interval for Differences in Proportions**

$$\hat{p}_1 - \hat{p}_2 \pm z^* \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$$

**19. Confidence Interval for Differences in Means**

$$\bar{x}_1 - \bar{x}_2 \pm t^* \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

**20. Test Statistic for Hypothesis Tests about Proportions**

$$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$$

**21. Test Statistic for Hypothesis Tests about Means**

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$$

**22. Test Statistic for Hypothesis Tests about Differences In Proportions**

$$z = \frac{\hat{p}_1 - \hat{p}_2 - 0}{\sqrt{\frac{\hat{p}(1-\hat{p})}{n_1} + \frac{\hat{p}(1-\hat{p})}{n_2}}}$$

where…

$$\hat{p} = \frac{n_1\hat{p}_1 + n_2\hat{p}_2}{n_1 + n_2}$$

**23. Test Statistic for Hypothesis Tests about Differences in Means**

$$t = \frac{\bar{x}_1 - \bar{x}_2 - 0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

**24. Test Statistic for Hypothesis Tests about Multiple Group Means**

$$F = \frac{MS\ Groups}{MSE}$$

where…

$$MS\ Groups = \frac{SS\ Groups}{k\text{ - }1} \quad (\text{and } \mathrm{SS\ Groups} = \mathrm{n}_1(\bar{\mathrm{y}}_1 - \bar{\mathrm{y}})^2 + \mathrm{n}_2(\bar{\mathrm{y}}_2 - \bar{\mathrm{y}})^2 + \ldots + \mathrm{n}_\mathrm{k}(\bar{\mathrm{y}}_\mathrm{k} - \bar{\mathrm{y}})^2)$$

and…

$$MSE = \frac{SS\ Error}{N\text{ - }k} \quad (\text{and } \mathrm{SS\ Error} = (\mathrm{n}_1 - 1)\mathrm{s}_1^2 + (\mathrm{n}_2 - 1)\mathrm{s}_2^2 + \ldots + (\mathrm{n}_\mathrm{k} - 1)\mathrm{s}_\mathrm{k}^2)$$

**25. Chi-Squared ($\chi^2$)**

$$\chi^2 = \sum \frac{(observed - expected)^2}{expected}$$

$$Expected\ Value = \frac{row\ total \times column\ total}{total\ number\ of\ cases\ in\ table}$$

**26. Correlation**

$$r = \frac{1}{n-1}\sum_i \left(\frac{x_i - \bar{x}}{s_x}\right)\left(\frac{y_i - \bar{y}}{s_y}\right)$$

**27. Regression**

$$Regression\ Line: \hat{y} = b_0 + b_1 x$$

$$b_1 = r\left(\frac{s_y}{s_x}\right)$$

$$b_0 = \bar{y} - b_1\bar{x}$$

**28. Standard Deviation for Regression**

$$s = \sqrt{\frac{SSE}{n-2}} = \sqrt{\frac{\sum (y_i - \hat{y}_i)^2}{n-2}}$$

**29. Standard Error for Regression Slope**

$$s.e.(b_1) = \frac{s}{\sqrt{\sum (x_i - \bar{x})^2}}$$

**30. Confidence Interval for Regression Slope**

$$b_1 \pm t^* s.e.(b_1)$$

**31. Test Statistic for Hypothesis Tests about Regression Slope**

$$t = \frac{sample\ statistic - null\ value}{standard\ error} = \frac{b_1 - 0}{s.e.(b_1)}$$

**32. Standard Error of Predicted Values**

$$s.e.(fit) = s\sqrt{\frac{1}{n} + \frac{(x - \bar{x})^2}{\sum (x_i - \bar{x})^2}}$$

**33. Confidence Interval for Individual Predicted Values**

$$\hat{y} \pm t^* \sqrt{s^2 + [s.e.(fit)]^2}$$

**34. Confidence Interval for the Mean of *y* at a Given *x***

$$\hat{y} \pm t^* \times s.e.(fit)$$