# Formula Sheet: Anderson, Sweeny, and Williams 9th Edition

$$\bar{x} = \frac{\sum x_i}{n} \quad (3.1) \qquad \mu = \frac{\sum x_i}{N} \quad (3.2)$$

$$IQR = Q_3 - Q_1 \quad (3.3) \qquad \sigma^2 = \frac{\sum (x_i - \mu)^2}{N} \quad (3.4)$$

$$s^2 = \frac{\sum (x_i - \bar{x})^2}{n-1} \quad (3.5) \qquad s = \sqrt{s^2} \quad (3.6)$$

$$\sigma = \sqrt{\sigma^2} \quad (3.7) \qquad \left(\frac{\text{standard deviation}}{\text{Mean}} \times 100\right)\% \quad (3.8)$$

$$z_i = \frac{x_i - \bar{x}}{s} \quad (3.9) \qquad s_{xy} = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{n-1} \quad (3.10)$$

$$\sigma_{xy} = \frac{\sum (x_i - \mu_x)(y_i - \mu_y)}{N} \quad (3.11) \qquad r_{xy} = \frac{s_{xy}}{s_x s_y} \quad (3.12)$$

$$\rho_{xy} = \frac{\sigma_{xy}}{\sigma_x \sigma_y} \quad (3.13) \qquad \bar{x} = \frac{\sum w_i x_i}{\sum w_i} \quad (3.15)$$

$$\bar{x} = \frac{\sum f_i M_i}{n} \quad (3.16) \qquad s^2 = \frac{\sum f_i (M_i - \bar{x})^2}{n-1} \quad (3.17)$$

$$\mu = \frac{\sum f_i M_i}{N} \quad (3.18) \qquad \sigma^2 = \frac{\sum f_i (M_i - \mu)^2}{N} \quad (3.19)$$

If $Y = a + bX$, then $\begin{matrix} \mu_y = a + b\mu_x \\ \sigma_Y = |b|\sigma_x \end{matrix}$, or if a sample, $\begin{matrix} \bar{Y} = a + b\bar{X} \\ s_Y = |b| s_x \end{matrix}$ (formula given in class)

$$C_n^N = \binom{N}{n} = \frac{N!}{n!(N-n)!} \quad (4.1) \qquad P_n^N = n!\binom{N}{n} = \frac{N!}{(N-n)!} \quad (4.2)$$

$$P(A) = 1 - P(A^c) \quad (4.5) \qquad P(A \cup B) = P(A) + P(B) - P(A \cap B) \quad (4.6)$$

$$P(A|B) = \frac{P(A \cap B)}{P(B)} \quad (4.7) \qquad P(B|A) = \frac{P(A \cap B)}{P(A)} \quad (4.8)$$

$$P(A \cap B) = P(B)P(A|B) \quad (4.11) \qquad P(A \cap B) = P(A)P(B|A) \quad (4.12)$$

$$P(A \cap B) = P(A)P(B) \quad (4.13)$$

$$P(A_i | B) = \frac{P(A_i)P(B|A_i)}{P(A_1)P(B|A_1) + P(A_2)P(B|A_2) + \cdots + P(A_n)P(B|A_n)} \quad (4.19)$$

$$f(x) = 1/n \quad (5.3) \qquad E(x) = \mu = \sum x f(x) \quad (5.4)$$

$$Var(x) = \sigma^2 = \sum (x - \mu)^2 f(x) \quad (5.5) \qquad \binom{n}{x} = \frac{n!}{x!(n-x)!} \quad (5.6)$$

$$f(x) = \binom{n}{x} p^x (1-p)^{n-x} \quad (5.8)$$

$$E(x) = \mu = np \quad (5.9)$$

$$Var(x) = \sigma^2 = np(1-p) \quad (5.10)$$

$$f(x) = \frac{\mu^x e^{-\mu}}{x!} \quad (5.11)$$

$$f(x) = \frac{\binom{r}{x}\binom{N-r}{n-x}}{\binom{N}{n}} \quad 0 \le x \le r \quad (5.12)$$

$$E(x) = \mu = n\left(\frac{r}{N}\right) \quad (5.13)$$

$$Var(x) = \sigma^2 = n\left(\frac{r}{N}\right)\left(1-\frac{r}{n}\right)\left(\frac{N-n}{N-1}\right) \quad (5.14)$$

$$E(g(x)) = \sum g(x) f(x) \qquad \sigma^2 = E(x^2) - \mu^2$$

$$\sigma_{xy} = \sum\sum (x-\mu_x)(y-\mu_y) f(x,y) \qquad \rho_{xy} = \frac{\sigma_{xy}}{\sigma_x \sigma_y}$$

If $Z = aX + bY$,

$$E(Z) = aE(X) + bE(Y)$$

$$\sigma_z^2 = a^2\sigma_x^2 + b^2\sigma_y^2 + 2ab\sigma_{xy}$$

$$f(x) = \begin{cases} \frac{1}{b-a} & for\ a \le x \le b \\ 0 & elsewhere \end{cases} \quad (6.1)$$

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-(x-\mu)^2/2\sigma^2} \quad (6.2)$$

$$z = \frac{x-\mu}{\sigma} \quad (6.3)$$

$$f(x) = \frac{1}{\mu} e^{-x/\mu} \quad \text{for } x \ge 0, \mu > 0 \quad (6.4)$$

$$P(x \le x_0) = 1 - e^{-x_0/\mu} \quad (6.5)$$

$$E(\bar{x}) = \mu \quad (7.1)$$

$$\sigma_{\bar{x}} = \sqrt{\frac{N-n}{N-1}}\left(\frac{\sigma}{\sqrt{n}}\right) \quad \sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} \quad (7.2)$$

$$E(\bar{p}) = p \quad (7.4)$$

$$\sigma_{\bar{p}} = \sqrt{\frac{N-n}{N-1}}\sqrt{\frac{p(1-p)}{n}} \quad \sigma_{\bar{p}} = \sqrt{\frac{p(1-p)}{n}} \quad (7.5)$$

$$MSE = E(\hat{\theta} - \theta)^2 = (\text{variance of } \hat{\theta}) + (\text{bias})^2$$

$$\text{bias} = E(\hat{\theta}) - \theta$$

$$\bar{x} \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}} \quad (8.1)$$

$$\bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}} \quad (8.2)$$

$$n = \frac{(z_{\alpha/2})^2 \sigma^2}{E^2} \quad (8.3)$$

$$\bar{p} \pm z_{\alpha/2}\sqrt{\frac{\bar{p}(1-\bar{p})}{n}} \quad (8.6)$$

$$n = \frac{(z_{\alpha/2})^2 p^*(1-p^*)}{E^2} \quad (8.7)$$

$$z = \frac{\bar{x} - \mu_0}{\sigma/\sqrt{n}} \quad (9.1)$$

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} \quad (9.4)$$

$$z = \frac{\bar{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} \quad (9.6)$$

$$n = \frac{(z_\alpha + z_\beta)^2 \sigma^2}{(\mu_0 - \mu_A)^2} \quad (9.9)$$

In two – tailed test, replace $z_\alpha$ with $z_{\alpha/2}$

$$\bar{x}_1 - \bar{x}_2 \quad (10.1)$$

$$\sigma_{\bar{x}_1 - \bar{x}_2} = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}} \quad (10.2)$$

$$\bar{x}_1 - \bar{x}_2 \pm z_{\frac{\alpha}{2}} \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}} \quad (10.4)$$

$$z = \frac{(\bar{x}_1 - \bar{x}_2) - D_0}{\sqrt{\sigma_1^2/n_1 + \sigma_2^2/n_2}} \quad (10.5)$$

$$\bar{x}_1 - \bar{x}_2 \pm t_{\frac{\alpha}{2}} \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} \quad (10.6)$$

$$df = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{1}{n_1 - 1}\left(\frac{s_1^2}{n_1}\right)^2 + \frac{1}{n_2 - 1}\left(\frac{s_2^2}{n_2}\right)^2} \quad (10.7)$$

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - D_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \quad (10.8)$$

$$t = \frac{\bar{d} - \mu_d}{s_d/\sqrt{n}} \quad (10.9)$$

$$\bar{p}_1 - \bar{p}_2 \quad (10.10)$$

$$\sigma_{\bar{p}_1 - \bar{p}_2} = \sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}} \quad (10.11)$$

$$\bar{p}_1 - \bar{p}_2 \pm z_{\alpha/2} \sqrt{\frac{\bar{p}_1(1-\bar{p}_1)}{n_1} + \frac{\bar{p}_2(1-\bar{p}_2)}{n_2}} \quad (10.13)$$

$$\sigma_{\bar{p}_1 - \bar{p}_2} = \sqrt{p(1-p)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)} \quad (10.14)$$

$$\bar{p} = \frac{n_1 \bar{p}_1 + n_2 \bar{p}_2}{n_1 + n_2} \quad (10.15)$$

$$z = \frac{\bar{p}_1 - \bar{p}_2}{\sqrt{\bar{p}(1-\bar{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \quad (10.16)$$

$$\frac{(n-1)s^2}{\chi^2_{\alpha/2}} \le \sigma^2 \le \frac{(n-1)s^2}{\chi^2_{(1-\alpha/2)}} \quad (11.7)$$

$$\chi^2 = \frac{(n-1)s^2}{\sigma_0^2} \quad (11.8)$$

$$F = \frac{s_1^2}{s_2^2} \quad (11.10)$$

$$y = \beta_0 + \beta_1 x + \varepsilon \quad (14.1)$$

$$E(y) = \beta_0 + \beta_1 x \quad (14.2)$$

$$\hat{y} = b_0 + b_1 x \quad (14.3)$$

$$\min \sum (y_i - \hat{y}_i)^2 \quad (14.5)$$

$$b_1 = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2} \quad (14.6)$$

$$b_0 = \bar{y} - b_1 \bar{x} \quad (14.7)$$

$$SSE = \sum (y_i - \hat{y}_i)^2 \quad (14.8)$$

$$SST = \sum (y_i - \bar{y})^2 \quad (14.9)$$

$$SSR = \sum(\hat{y}_i - \bar{y})^2 \quad (14.10)$$

$$SST = SSR + SSE \quad (14.11)$$

$$r^2 = \frac{SSR}{SST} \quad (14.12)$$

$$r_{xy} = (\text{sign of } b_1)\sqrt{\text{Coefficient of determination}} = (\text{sign of } b_1)\sqrt{r^2} \quad (14.13)$$

$$s^2 = MSE = \frac{SSE}{N-2} \quad (14.15)$$

$$s = \sqrt{MSE} = \sqrt{\frac{SSE}{N-2}} \quad (14.16)$$

$$\sigma_{b_1} = \frac{\sigma}{\sqrt{\sum(x_i - \bar{x})^2}} \quad (14.17)$$

$$s_{b_1} = \frac{s}{\sqrt{\sum(x_i - \bar{x})^2}} \quad (14.18)$$

$$t = \frac{b_1}{s_{b_1}} \quad (14.19)$$

$$MSR = \frac{SSR}{\text{Number of independent variables}} \quad (14.20)$$

$$F = \frac{MSR}{MSE} \quad (14.21)$$

$$s_{\hat{y}_p} = s\sqrt{\frac{1}{n} + \frac{(x_p - \bar{x})^2}{\sum(x_i - \bar{x})^2}} \quad (14.23)$$

$$\hat{y}_p \pm t_{\alpha/2} s_{\hat{y}_p} \quad (14.24)$$

$$s_{ind} = s\sqrt{1 + \frac{1}{n} + \frac{(x_p - \bar{x})^2}{\sum(x_i - \bar{x})^2}} \quad (14.26)$$

$$\hat{y}_p \pm t_{\alpha/2} s_{ind} \quad (14.27)$$

$$y_i - \hat{y}_i \quad (14.28)$$

$$s_{y_i - \hat{y}_i} = s\sqrt{1 - h_i} \quad (14.30)$$

$$\frac{(y_i - \hat{y}_i)}{s_{y_i - \hat{y}_i}} \quad (14.32)$$

$$h_i = \frac{1}{n} + \frac{(x_i - \bar{x})^2}{\sum(x_i - \bar{x})^2} \quad (14.33)$$

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p + \varepsilon \quad (15.1)$$

$$E(y) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p \quad (15.2)$$

$$\hat{y} = b_0 + b_1 x_1 + b_2 x_2 + \cdots + b_p x_p \quad (15.3)$$

$$\min \sum(y_i - \hat{y}_i)^2 \quad (15.4)$$

$$SST = SSR + SSE \quad (15.7)$$

$$R^2 = \frac{SSR}{SST} \quad (15.8)$$

$$R_a^2 = 1 - (1 - R^2)\frac{n-1}{n-p-1} \quad (15.9)$$

$$MSR = \frac{SSR}{p} \quad (15.12)$$

$$MSE = \frac{SSE}{n-p-1} \quad (15.13)$$

$$F = \frac{MSR}{MSE} \quad (15.14)$$

$$t = \frac{b_i}{s_{b_i}} \quad (15.15)$$

$$\frac{y_i - \hat{y}_i}{s_{y_i - \hat{y}_i}} \quad (15.23)$$

$$s_{y_i - \hat{y}_i} = s\sqrt{1 - h_i} \quad (15.24)$$

$$D_i = \frac{(y_i - \hat{y}_i)^2}{(p-1)s^2}\left[\frac{h_i}{(1-h_i)^2}\right] \quad (15.25)$$

$$E(y) = \frac{e^{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p}}{1 + e^{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p}} \quad (15.27)$$

$$\hat{y} = estimate\ of\ P\left(y=1 \middle| x_1, x_2, \cdots, x_p\right) = \frac{e^{b_0+b_1x_1+b_2x_2+\cdots+b_px_p}}{1+e^{b_0+b_1x_1+b_2x_2+\cdots+b_px_p}} \quad (15.30)$$

$$Odds\ ratio = \frac{odds_1}{odds_2} \quad (15.34) \qquad g\left(x_1, x_2, \cdots, x_p\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p \quad (15.35)$$

$$\hat{g}\left(x_1, x_2, \cdots, x_p\right) = b_0 + b_1 x_1 + b_2 x_2 + \cdots + b_p x_p \quad (15.37)$$

$$\beta_i = b_i \pm t_{\alpha/2} s_{b_i} \qquad \text{(Given in Class)}$$

$$y = \beta_0 + \beta_1 z_1 + \beta_2 z_2 + \cdots + \beta_p z_p + \varepsilon \quad (16.1)$$

$$F = \frac{\dfrac{SSE\left(x_1, x_2, \ldots, x_q\right) - SSE\left(x_1, x_2, \ldots, x_q, x_{q+1}, \ldots, x_p\right)}{p-q}}{\dfrac{SSE\left(x_1, x_2, \ldots, x_q, x_{q+1}, \ldots, x_p\right)}{n-p-1}} \quad (16.13)$$