Formula Sheet

$s^2 = \frac{\sum (x_i - \bar{x})^2}{n-1}$, $Z = \frac{X-\mu}{\sigma}$. $r = \frac{1}{n-1}\sum\left(\frac{x_i - \bar{x}}{s_x}\right)\left(\frac{y_i - \bar{y}}{s_y}\right)$. $b_1 = r\frac{s_y}{s_x}$,

$b_0 = \bar{y} - b_1\bar{x}$. $\mu_X = \sum x_i p_i$, $\sigma^2 = \sum (x_i - \mu)^2 p_i$,

$\sigma^2_{a+bX} = b^2\sigma^2_X$, $\sigma^2_{X+Y} = \sigma^2_X + \sigma^2_Y + 2\rho\sigma_X\sigma_Y$, $\sigma^2_{X-Y} = \sigma^2_X + \sigma^2_Y - 2\rho\sigma_X\sigma_Y$.

P(B|A) = P(A and B)/P(A). If A is independent of B $\Leftrightarrow$ P(A and B) = P(A)$\cdot$$P$(B).

If the events $A_1, A_2, \cdots, A_k$ that are disjoint and their probabilities are not zero and add to exactly one. Then if C is another event whose probability is not 0 or 1,

$P(A_i/C) = \frac{P(C/A_i)P(A_i)}{\sum_{i=1}^{k} P(C/A_i)P(A_i)}$. $\mu_{\bar{X}} = \mu, \sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$. $\mu_X = np, \sigma_X = \sqrt{np(1-p)}$.

$\mu_{\hat{p}} = p, \sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}$. $Z = \frac{\bar{X}-\mu}{\sigma_{\bar{X}}} = \frac{\bar{X}-\mu}{\frac{\sigma}{\sqrt{n}}}$. $P\{X = k\} = \frac{n!}{k!(n-k)!}p^k(1-p)^{n-k}$

$\binom{n}{k} = \frac{n!}{k!(n-k)!}$. $P^n_k = \frac{n!}{(n-k)!}$. $\bar{x} \pm z^* \frac{\sigma}{\sqrt{n}}$; $SE_{\bar{x}} = \frac{s}{\sqrt{n}}$. $t = \frac{\bar{x}-\mu}{\frac{s}{\sqrt{n}}}$, df $= n-1$.

$\bar{x} \pm t^* \frac{s}{\sqrt{n}}$, $z = \frac{\bar{x}_1 - \bar{x}_2 - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$, $t = \frac{\bar{x}_1 - \bar{x}_2 - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$, $\bar{x}_1 - \bar{x}_2 \pm t^*\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$, df =

smaller of $n_1 - 1, n_2 - 1$. df = $\frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{(s_1^2/n_1)^2}{n_1 - 1} + \frac{(s_2^2/n_2)^2}{n_2 - 1}}$. $s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$

$\bar{x}_1 - \bar{x}_2 \pm t^* s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$, $t = \frac{\bar{x}_1 - \bar{x}_2 - (\mu_1 - \mu_2)}{s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$, df = $n_1 + n_2 - 2$.

$F = \frac{s_1^2}{s_2^2}$, has F distribution with $\mathrm{df}_1 = n_1 - 1$, $\mathrm{df}_2 = n_2 - 1$, when $H_0 : \sigma_1 = \sigma_2$ is true.

$SE_{\hat{p}} = \sqrt{\frac{\hat{p}\,(1-\hat{p})}{n}}$ $\hat{p} \pm z^* SE_{\hat{p}}$, $z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$; $SE_{\hat{p}_1 - \hat{p}_2} = \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$

$(\hat{p}_1 - \hat{p}_2) \pm z^* \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$; $z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$, $\hat{p} = \frac{x_1 + x_2}{n_1 + n_2}$.

Independence test df = (r-1)(c-1). $\chi^2 = \Sigma \frac{(O - E)^2}{E}$, df = k-1.

$$\mu_y = \beta_0 + \beta_1 x, \quad \hat{y} = b_0 + b_1 x, \quad s^2 = \frac{\sum_{i=1}^{n} e_i^2}{n-2} = \frac{\sum_{i=1}^{n} \left(y_i - \hat{y}_i\right)^2}{n-2}. \; b_0 \pm t^* \mathrm{SE}_{b_0}; \; b_1 \pm t^* \mathrm{SE}_{b_1};$$

$$t = \frac{b_1}{\mathrm{SE}_{b_1}}; \; \hat{\mu}_y \pm t^* \mathrm{SE}_{\hat{\mu}}, \quad \hat{y} \pm t^* \mathrm{SE}_{\hat{y}}, \quad e_i = y_i - \hat{y}_i. \; r^2 = \frac{\mathrm{SSM}}{\mathrm{SST}} = \frac{\sum_{i=1}^{n} (\hat{y}_i - \bar{y})^2}{\sum_{i=1}^{n} (y_i - \bar{y})^2}.$$

Source	**Degrees of freedom**	**Sum of squares**	**Mean Square**	***F***
Model	1	$\sum_{i=1}^{n} (\hat{y}_i - \bar{y})^2$	SSM/DFM	MSM/MSE
Error	n-2	$\sum_{i=1}^{n} \left(y_i - \hat{y}_i\right)^2$	SSE/DFE	
Total	n-1	$\sum_{i=1}^{n} (y_i - \bar{y})^2$		

$$\mathrm{SE}_{b_1} = \frac{s}{\sqrt{\sum_{i=1}^{n} (x_i - \bar{x})^2}}, \mathrm{SE}_{b_0} = s\sqrt{\frac{1}{n} + \frac{\bar{x}^2}{\sum_{i=1}^{n} (x_i - \bar{x})^2}}, \; \mathrm{SE}_{\hat{\mu}} = s\sqrt{\frac{1}{n} + \frac{\left(x^* - \bar{x}\right)^2}{\sum_{i=1}^{n} (x_i - \bar{x})^2}},$$

$$\mathrm{SE}_{\hat{y}} = s\sqrt{1 + \frac{1}{n} + \frac{\left(x^* - \bar{x}\right)^2}{\sum_{i=1}^{n} (x_i - \bar{x})^2}}. \; t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}.$$