Formulae Sheet

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$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{n(\sum x^2) - (\sum x)^2}\sqrt{n(\sum y^2) - (\sum y)^2}}$	$r^2 = \frac{\sum(\hat{y} - \bar{y})^2}{\sum(y - \bar{y})^2}$
$r = \frac{\sum Z_x Z_y}{n-1}$	Adjusted $R^2 = 1 - \frac{(n-1)}{[n-(k+1)]}(1 - R^2)$
$Z_x = \frac{x - \bar{x}}{s_x}$	$(X'X)b = X'y$
$Z_y = \frac{y - \bar{y}}{s_y}$	$X'X = \begin{bmatrix} n & \sum_{i=1}^{n} x_{1i} & \sum_{i=1}^{n} x_{2i} & \cdots & \sum_{i=1}^{n} x_{ki} \\ \sum_{i=1}^{n} x_{1i} & \sum_{i=1}^{n} x_{1i}^2 & \sum_{i=1}^{n} x_{1i}\, x_{2i} & \cdots & \sum_{i=1}^{n} x_{1i}\, x_{ki} \\ \vdots & \vdots & \vdots & & \\ \sum_{i=1}^{n} x_{ki} & \sum_{i=1}^{n} x_{ki}\, x_{1i} & \sum_{i=1}^{n} x_{ki}\, x_{2i} & \cdots & \sum_{i=1}^{n} x_{ki}^2 \end{bmatrix}$
$s_x = \sqrt{\frac{\sum(x - \bar{x})^2}{n-1}}$	$X'y = \begin{bmatrix} \sum_{i=1}^{n} y_i \\ \sum_{i=1}^{n} x_{1i}\, y_i \\ \vdots \\ \sum_{i=1}^{n} x_{ki}\, y_i \end{bmatrix}$
$s_x = \sqrt{\frac{1}{n(n-1)}\{n\sum_{i=1}^{n} x^2{}_i - (\sum_{i=1}^{n} x_i)^2\}}$	$b = (X'X)^{-1}X'y$
$s_y = \sqrt{\frac{\sum(y - \bar{y})^2}{n-1}}$	If $n \leq 25$: Test statistic is x = the number of times the less frequent sign occurs. If $n > 25$: Test statistic is $Z = \frac{(x + 0.5) - \frac{n}{2}}{\frac{\sqrt{n}}{2}}$ 1. If $n \leq 25$, critical x values are found in Table A-7. 2. If $n > 25$, critical z values are found in Table A-2.
$s_y = \sqrt{\frac{1}{n(n-1)}\{n\sum_{i=1}^{n} y^2{}_i - (\sum_{i=1}^{n} y_i)^2\}}$	If $n \leq 30$: Test statistic is x = the number of times the less frequent sign occurs. If $n > 30$, the test statistic is $Z = \frac{T - \frac{n(n+1)}{4}}{\sqrt{\frac{n(n+1)(2n+1)}{24}}}$ 1. If $n \leq 30$, the critical T value is found in Table A-8. 2. If $n > 30$, the critical z values are found in Table A-2.
$t_{cal} = \frac{r}{\sqrt{\frac{1 - r^2}{n-2}}}$	$z = \frac{R - \mu_R}{\sigma_R}$ *Where* $\mu_R = \frac{n_1(n_1 + n_2 + 1)}{2}$ *and* $\sigma_R = \sqrt{\frac{n_1\, n_2(n_1 + n_2 + 1)}{12}}$ Critical values can be found in Table A-2
$b_1 = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$	$H = \frac{12}{N(N+1)}\left(\frac{R_1^2}{n_1} + \frac{R_2^2}{n_2} + \ldots + \frac{R_k^2}{n_k}\right) - 3(N+1)$

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	The test is *right-tailed* and critical values can be found from the chi-square distribution in Table A-4.
$b_1 = r\frac{s_y}{s_x}$	$r_s = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{n(\sum x^2) - (\sum x)^2}\sqrt{n(\sum y^2) - (\sum y)^2}}$ $r_s = 1 - \frac{6\sum d^2}{n(n^2 - 1)}$ 1. If $n \leq 30$, critical values are found in Table A-9. 2. If $n > 30$, critical values of r_s are found using the formula: $r_s = \frac{\pm z}{\sqrt{n-1}}$ (critical values for $n > 30$)
$b_0 = \bar{y} - b_1\bar{x}$	*For Large Samples or $\alpha \neq 0.05$: If $n_1 > 20$ or $n_2 > 20$ or a 0.05, the test statistic, critical values, and decision criteria are as follows:* *Where* $z = \frac{G - \mu_G}{\sigma_G}$ $\mu_G = \frac{2n_1 n_2}{n_1 + n_2} + 1$ $\sigma_G = \sqrt{\frac{(2n_1 n_2)(2n_1 n_2 - n_1 - n_2)}{(n_1 + n_2)^2(n_1 + n_2 - 1)}}$ *Critical values of z: Use Table A-2.*
$b_0 = \frac{(\sum y)(\sum x^2) - (\sum x)(\sum xy)}{n(\sum x^2) - (\sum x)^2}$	For Small Samples and $\alpha = 0.05$: If $n_1 \leq 20$ and $n_2 \leq 20$ and the significance level is $\alpha = 0.05$, the test statistic, critical values, and decision criteria are as follows: Test statistic: number of runs *G* Critical values of G: Use Table A-10.
$\hat{y} = b_0 + b_1 x$	
$\hat{y} - E < y < \hat{y} + E$	
$E = t_{\alpha/2} s_e \sqrt{1 + \frac{1}{n} + \frac{n(x_0 - \bar{x})^2}{n(\sum x^2) - (\sum x)^2}}$	
$s_e = \sqrt{\frac{\sum (y - \hat{y})^2}{n-2}}$	
$s_e = \sqrt{\frac{\sum y^2 - b_0 \sum y - b_1 \sum xy}{n-2}}$	
$\sum (y - \bar{y})^2 = \sum (\hat{y} - \bar{y})^2 + \sum (y - \hat{y})^2$	