

## Formula Sheet

$$\bar{x} \equiv \frac{1}{n} \sum x; \quad s_{xx} \equiv \sum (x - \bar{x})^2 = \sum x^2 - \frac{1}{n} (\sum x)^2; \quad s^2 \equiv \frac{s_{xx}}{n-1}.$$

$$P(A \cup B) = P(AB') + P(A'B) + P(AB).$$

$$P(A \cup B) = P(A) + P(B) - P(AB).$$

$$P(A \cup B) = 1 - P(A \cup B)' = 1 - P(A'B'). \text{ De Morgan's Law}$$

$$P(AB)' = P(A' \cup B'). \text{ De Morgan's Law}$$

$$P(A|B) = \frac{P(AB)}{P(B)}, \quad P(B) \neq 0; \quad P(AB) = P(A)P(B|A) = P(B)P(A|B)$$

$$\text{Independence: } P(AB) = P(A)P(B). \quad .$$

$$\mu \equiv E(X) = \sum_x x f(x).$$

$$E(X^2) = \sum x^2 f(x), \quad \sigma^2 \equiv E(X - \mu)^2 = E(X^2) - \mu^2.$$

$$\text{The Binomial Distribution: } f(x) = \binom{n}{x} p^x (1-p)^{n-x}, \quad x = 0, 1, \dots, n; \quad 0 < p < 1; \quad \mu = np, \quad \sigma^2 = npq.$$

$$\text{The Geometric Distribution: } f(x) = q^x p, \quad x = 0, 1, 2, \dots; \quad q = 1 - p; \quad \mu = 1/p, \quad \sigma^2 = q/p^2.$$

The Hypergeometric Distribution

$$f(x) = \binom{K}{x} \binom{N-K}{n-x} \div \binom{N}{n}, \quad \mu = np, \quad \sigma^2 = (1-c) npq, \quad (N-1)c = n-1, \quad p = (K/N), \quad q = 1-p.$$

$$\text{The Poisson Distribution: } f(x) = \frac{(\lambda t)^x}{x!} e^{-\lambda t}; \quad x = 0, 1, \dots; \quad \mu = \lambda t, \quad \sigma^2 = \lambda t.$$

$$P(a < X < b) = \int_a^b f(x) dx; \quad P(X \leq k) = \int_{-\infty}^k f(x) dx \text{ where } k \text{ is a particular value of } x.$$

$$\mu \equiv E(X) = \int_{-\infty}^{\infty} x f(x) dx, \quad E(X^2) = \int_{-\infty}^{\infty} x^2 f(x) dx, \quad \sigma^2 \equiv V(X) = E(X^2) - \mu^2.$$

$$\text{The Normal Distribution } X \sim N(\mu, \sigma^2), \quad Z = \frac{X - \mu}{\sigma} \sim N(0, 1)$$

$$\text{The Exponential Distribution: } f(x) = \frac{1}{\beta} e^{-x/\beta}, \quad 0 \leq x; \quad \mu = \beta, \quad \sigma^2 = \beta^2.$$

Confidence Interval	Test Statistic
$\bar{x} \mp z_{\alpha/2} \left( \frac{\sigma}{\sqrt{n}} \right), \quad n = \frac{z_{\alpha/2}^2 \sigma^2}{e^2}$	$z = \frac{\bar{x} - \mu_0}{\frac{\sigma}{\sqrt{n}}}$
$\bar{x} \mp t_{\alpha/2} \left( \frac{s}{\sqrt{n}} \right)$	$t = \frac{\bar{x} - \mu_0}{\sqrt{s^2/n}}, \quad df = n - 1.$
$(\bar{x}_1 - \bar{x}_2) \mp z_{\alpha/2} \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$	$z = \frac{\bar{x}_1 - \bar{x}_2 - \delta_0}{\sqrt{(\sigma_1^2/n_1) + (\sigma_2^2/n_2)}}$
$(\bar{x}_1 - \bar{x}_2) \pm t_{\alpha/2} \cdot s_p \cdot \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}, \quad df = n_1 + n_2 - 2$	$t = \frac{(\bar{x}_1 - \bar{x}_2) - \delta_0}{s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}, \quad S_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$
$(\bar{x}_1 - \bar{x}_2) \pm t_{\alpha/2} \cdot \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$	$t = \frac{(\bar{x}_1 - \bar{x}_2) - \delta_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$
$\bar{d} \pm t \frac{s_d}{\sqrt{n}}$	$t = \frac{\bar{d}}{s_d/\sqrt{n}}$
$\hat{p} \pm z \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}, \quad n = \frac{z_{\alpha/2}^2 \hat{p}\hat{q}}{e^2}$	$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$
$(\hat{p}_1 - \hat{p}_2) \pm z \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$	$z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}(1-\hat{p}) \left( \frac{1}{n_1} + \frac{1}{n_2} \right)}}, \quad \hat{p} = \frac{x_1 + x_2}{n_1 + n_2}$

$$y = \beta_0 + \beta_1 x + \varepsilon, \quad \hat{y} = \hat{\mu}(x) = \hat{\beta}_0 + \hat{\beta}_1 x, \quad \hat{y} = \hat{\mu}(x), \quad e = y - \hat{\mu}(x).$$

$$s_{yy} = \sum y^2 - \frac{1}{n} (\sum y)^2, \quad s_{xy} = \sum xy - \frac{1}{n} (\sum x)(\sum y), \quad s_{xx} = \sum x^2 - \frac{1}{n} (\sum x)^2$$

$$\hat{\beta}_1 = b_1 = \frac{s_{xy}}{s_{xx}}, \quad \hat{\beta}_0 = b_0 = \bar{y} - \hat{\beta}_1 \bar{x}.$$

$$SSR = \hat{\beta}_1 s_{xy}, \quad SSE = s_{yy} - SSR = SST - SSR.$$

$$r = \frac{s_{xy}}{\sqrt{s_{xx} s_{yy}}}, \quad (r \sqrt{s_{yy}} = \hat{\beta}_1 \sqrt{s_{xx}})$$

$$MSE = s^2 = \frac{SSE}{n - 2}$$

$$R^2 = \frac{\text{Explained variation}}{\text{Total variation}} = \frac{SSR}{s_{yy}}.$$

$\hat{\beta}_0 \mp t_{\alpha/2} \sqrt{\left( \frac{1}{n} + \frac{\bar{x}^2}{s_{xx}} \right) MSE}, \quad df = n - 2$	$H_0: \beta_0 = c, \quad t = \frac{b_0 - c}{\sqrt{s^2 \left( \frac{1}{n} + \frac{\bar{x}^2}{s_{xx}} \right)}}$
$\hat{\beta}_1 \mp t_{\alpha/2} \sqrt{\frac{MSE}{s_{xx}}}$	$H_0: \beta_1 = c, \quad t = \frac{\hat{\beta}_1 - c}{\sqrt{MSE / s_{xx}}}$
	$H_0: \rho = 0, \quad t = \frac{r \sqrt{n - 2}}{\sqrt{1 - r^2}}, \quad (\rho \sigma_y = \beta_1 \sigma_x)$
$\hat{\mu}(x) \pm t_{\alpha/2} \sqrt{\left( \frac{1}{n} + \frac{(x - \bar{x})^2}{s_{xx}} \right) MSE}$	$\hat{\mu}(x) \pm t_{\alpha/2} \sqrt{\left( 1 + \frac{1}{n} + \frac{(x - \bar{x})^2}{s_{xx}} \right) MSE}$