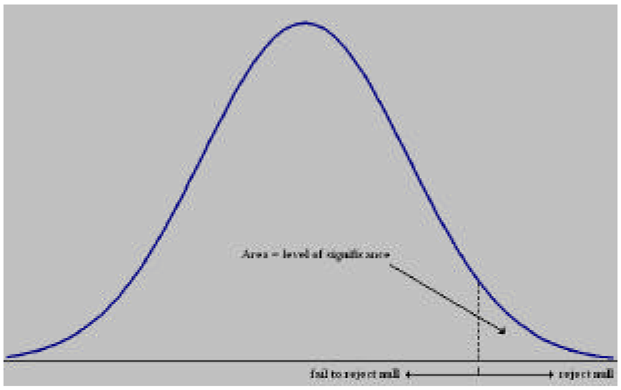
Statistical Equations (QAII)

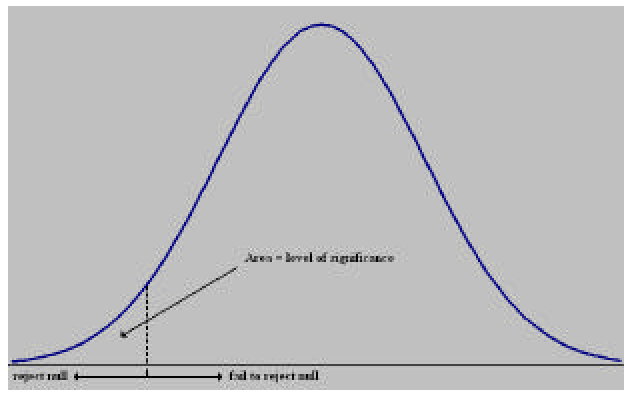
You are permitted to use the information in this handbook during your exams. This handbook is <u>not</u> guaranteed to contain all the information you will need. If you find information which you believe should be included in the handbook, you may request that the information be added. All changes in the handbook must be made prior to the last class before the final exam.

<u>Hypothesis Testing</u>

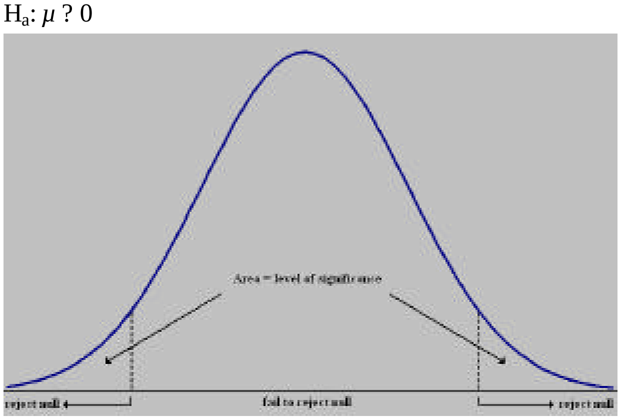
H_o: $\mu = 0$
H_a: $\mu > 0$



H_o: $\mu = 0$
H_a: $\mu < 0$



H_o: $\mu = 0$
H_a: μ ? 0



<u>One tailed tests</u>
In the case of a one-tailed test, the null hypothesis represents the <u>assumed outcome</u>; the alternative hypothesis represents the researchers <u>hoped-for outcome</u>.

<u>Two tailed tests</u>
In the case of a two-tailed test, the null hypothesis is always that the sample statistic <u>equals</u> some value. The alternative hypothesis is always that the sample statistic <u>does not equal</u> that value.

<u>Critical value and tail(s)</u>
Select the critical value (positive or negative value) so that the tail satisfies the following conditions:

1. The area of the tail is the significance level of the test.
2. The range of the tail corresponds to the alternative hypothesis.

<u>p-Value</u>
For one-tailed hypotheses, the p-value is the area from the test statistic toward and including the tail. For two-tailed hypotheses, the p-value is <u>two times</u> the area from the test statistic toward and including the closer tail.

Sample Statistics and Population Parameters

Sample Mean	$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$
Population Mean	m
Sample Variance	$s_x^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2$
Population Variance	$s_x^2 = \frac{1}{n}\sum_{i=1}^{n}(x_i - m)^2$
Variance of Sample Mean	$s_{\bar{x}}^2 = \frac{s_x^2}{n}$
Sample Proportion	p
Population Proportion	p
Sample Variance of a Proportion	$s_p^2 = \frac{p(1-p)}{n}$
Population Variance of a Proportion	$s_p^2 = \frac{p(1-p)}{n}$
Standard Deviation	$\sqrt{\text{Variance}}$

Finite Population Correction Factor

$$\text{correction factor} = \frac{N-n}{N-1}$$

Multiply variance by this factor when $n / N \geq 0.05$

Constructing a *t* or standard normal test statistic

$$\text{Test Statistic} = \frac{\text{Estimate} - \text{Expected value of estimate}}{\text{Standard deviation of estimate}}$$

Confidence Interval

Confidence interval for Estimate: $\text{Estimate} \pm (\text{Critical Value})(\text{Standard deviation of estimate})$

Table of Test Statistics

Test statistic for…	Small Sample: Test Statistic	Small Sample: Distribution	Large Sample: Test Statistic	Large Sample: Distribution	Large Sample Criteria
Single observation	$\frac{x-m}{\sqrt{s_x^2}}$	t_{n-1}	$\frac{x-m}{\sqrt{s_x^2}}$	Standard normal	$n = 30$
Mean	$\frac{\overline{x}-m}{\sqrt{s_{\overline{x}}^2}}$	t_{n-1}	$\frac{\overline{x}-m}{\sqrt{s_{\overline{x}}^2}}$	Standard normal	$n = 30$
Variance	$\frac{(n-1)s^2}{s^2}$	c_{n-1}^2	$\frac{(n-1)s^2}{s^2}$	c_{n-1}^2	
Proportion			$\frac{p-p}{\sqrt{s_p^2}}$	Standard normal	$np > 5$ $n(1-p) > 5$
Difference in means	$\frac{\overline{x}_1-\overline{x}_2-(m_1-m_2)}{\sqrt{s_{\overline{x}_1}^2+s_{\overline{x}_2}^2}}$	t_{df} where $df = \frac{\left(s_{\overline{x}_1}^2+s_{\overline{x}_2}^2\right)^2}{\frac{\left(s_{\overline{x}_1}^2\right)^2}{n_1-1}+\frac{\left(s_{\overline{x}_2}^2\right)^2}{n_2-1}}$	$\frac{\overline{x}_1-\overline{x}_2-(m_1-m_2)}{\sqrt{s_{\overline{x}_1}^2+s_{\overline{x}_2}^2}}$	Standard normal	$n_1 \geq 30$ $n_2 \geq 30$
Difference in proportions			$\frac{p_1-p_2-(p_1-p_2)}{\sqrt{s_{p_1}^2+s_{p_2}^2}}$	Standard normal	$np_1 \geq 5$ $n(1-p_1) \geq 5$ $np_2 \geq 5$ $n(1-p_2) \geq 5$
Difference in variances	$\frac{s_1^2}{s_2^2}$	F_{n_1-1,n_2-1}	$\frac{s_1^2}{s_2^2}$	F_{n_1-1,n_2-1}	
Regression parameter estimates	$\frac{\hat{b}-b}{\sqrt{s_{\hat{b}}^2}}$	t_{n-k}	$\frac{\hat{b}-b}{\sqrt{s_{\hat{b}}^2}}$	Standard normal	$n-k = 30$

Note: For critical values on the F distribution, $F_{n_1,n_2} = \frac{1}{F_{n_2,n_1}}$.