Module 1

A. A normal distribution is perfectly symmetrical. The scores closer to the middle are more frequent than the scores farther from the middle. This relationship is manifested in the bell shape of the graph.

B. A population standard deviation of 1.23 inches means that 68.3% of the population is symmetrically disposed about the mean. In other words, 68.3% of all Australian striped squirrels have a tail length between $6.3 - 1.23 = 5.07$ and $6.3 + 1.23 = 7.53$ inches.

C. (1) The z-score of a population is defined to be $\frac{x-\mu}{\sigma}$. We use $x = 2$ inches for the value Dr. Ipkus measured and calculate $z = \frac{2-6.3}{1.23} = -3.5$.

   (2) The z-score of -3.5 indicates that the value of 2 inches Dr. Ipkus found is 3.5 standard deviations shorter than the mean tail length of Australian striped squirrels.

   (3) From a table of z-scores, 99.89% of the population has a tail longer than 2 inches.

D. (1) We seek the proportion of the poulation for which $\frac{6-6.3}{1.23} = -.244 < z$. 59.5% of the population has a tail longer than 6 inches.

   (2) .37% of the population has a tail shorter than 3 inches.

   (3) 98.2% of the population has a tail-length between 3 and 9 inches.

Module 2

A. A sampling distributeion of a particular statistic is a theoretical distribution which graphs all possible values of the particular statistic in a population. In particular, the sampling distribution of the mean graphs all possible sample means in a population.

B. $S_{\bar{x}} = \frac{s}{\sqrt{n}} = \frac{.78}{\sqrt{65}} \approx .097$ This is an estimate of the standard error.

C. (a) $\bar{x} \pm t_{q,n-1} S_{\bar{x}}$ We use this formula because the population mean is not known.

   (b) $3.6 \pm .162$

   (c) The average is not greater than 4.5 hours, therefore Buff should not introduce his new workout-plan.

Module 3

a. H_0: $\mu = 4$

   H_a: $\mu \neq 4$

b. $t = \frac{\bar{x}-\mu_0}{s/\sqrt{n}} = \frac{6.1-4}{.6/\sqrt{100}} = 35$

c. The test is two tailed

d. The critical value is ± 1.96.

e. In this case, we reject the null hypothesis when the calculated statistic is less than -1.96 or greater than 1.96.

f. Lucy would reject the null hypothesis.

Module 4

a. H_0: no association between hunger levels and results of cognitive testing.

H_a: association between hunger levels and cognitive testing.

b.

$$E_{11} = \frac{144 \times 113}{242} = 67.24, E_{11} = \frac{144 \times 129}{242} = 76.76,$$
$$E_{11} = \frac{98 \times 113}{242} = 45.76, E_{11} = \frac{98 \times 129}{242} = 52.24.$$

The chi-squared test statistic value is

$$\sum_{1 \leq i,j \leq 2} \frac{(O_{ij} - E_{ij})^2}{E_{ij}} = \frac{(68 - 67.24)^2}{67.24} + \frac{(76 - 76.76)^2}{76.76} + \frac{(45 - 45.76)^2}{45.76} + \frac{(53 - 52.24)^2}{52.24} = .0398$$

c. The level of significance is .05, the number of degrees of freedom is $(r-1)(c-1) = 1$, thus the critical value is 3.841.

d. To reject H_0, the test statistic must be higher than the critical value.

e. Because the test statistic is lower than the critical value, Ip and Nadi should accept the null hypothesis that no significant association between hunger-level and cognition exists.

Module 5

A. (a) H_0: $\mu_1 = \mu_2$
H_a: $\mu_1 \neq \mu_2$
because Mack wants to discover a difference in attitudes.

(b) $\bar{x}_d = \bar{x}_2 - \bar{x}_1 = 62 - 50 = 12$
$\mu_{d_0} = 0$, $n = 60$, and $s = 6.54$, thus
$t = \frac{\bar{x}_d - \mu_{d_0}}{s/\sqrt{n}} = \frac{(62-50)-0}{6.54/\sqrt{60}} = 14.2$

(c) The test is two tailed.

(d) If we suppose a level of significance of 95%, the critical values of t are ± 2.001.

(e) We reject the null hypothesis when $t < -2.001$ or $t > 2.001$.

(f) Mack should reject H_0 because 14 is greater than 2.001. Thus, a difference in attitude-levels exists with a confidence of 95%.

B. (a) H_0: $\mu_1 = \mu_2$

H_a: $\mu_1 \neq \mu_2$

because Mack wants to discover a difference in attitudes.

(b) $t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{(s_1)^2}{n_1} + \frac{(s_2)^2}{n_2}}} = \frac{(56-76)-0}{\sqrt{\frac{7^2}{60} + \frac{4.5^2}{76}}} = -19.2$

(c) The test is two tailed.

(d) $df = \frac{(n_1-1)+(n_2-1)}{2} = \frac{(60-1)+(76-1)}{2} = 67.$

assuming a level of significance of 95%, the critical value of t is ± 1.996

(e) $t < -1.996$ or $t > 1.996$ is the rejection region.

(f) Mack should reject H_0 because $-19.2 < -1.99$. Thus, evidence is not sufficiently strong to suggest equvalence of means.