ISBE 8.1 multiple choice:

a) $\bar{X}$ ... μ
b) $\sigma/\sqrt{n}$ ... standard error SE
c) 2 ... μ
d) about 50 times ... would NOT
e) wider

ISBE 8.6 $\bar{X}$ = 148,000 and s = 62,000

a) n=25, so use t percentage point in interval (24 degrees of freedom). The formula:

$$\mu = \bar{X} \pm t_{0.025} * s/\sqrt{n}$$

$t_{0.025,df=24} = 2.06$, so

$$\mu = 148,000 \pm 2.06 * 62,000/5,$$

and the interval is $[122456, 173544]$.

b) The confidence interval in part a) gives a range of plausible values for the *mean* of the distribution of home sale prices. Look, instead, at the distribution of sample sale prices: sample mean is $148,000 and sample standard deviation is $62,000. The friend paid $206,000 for a home, this is less than one standard deviation above the sample mean ($210,000), not unusual at all.

ISBE 8.11 Confidence interval for a difference in population means using unmatched data.

a) sample mean for women, $\bar{X}_W$, is 11; sample mean for men, $\bar{X}_M$, is 16. sample variance for women, s_W^2=10; sample variance for men, s_M^2=21.5. This is an unmatched problem, and the 2 population variances are unknown, use formula 8-20. Degrees of freedom for the t value are, using 8-22, 10-2=8. For a 95% confidence interval $t_{0.025,df=8} = 2.31$. Using 8-21,

$$s_p^2 = \frac{4 * s_W^2 + 4 * s_M^2}{4+4} = 15.75.$$

The confidence interval for the difference in women's and men's salaries, $\mu_W - \mu_M$, is

$$\mu_W - \mu_M = \bar{X}_W - \bar{X}_M \pm t_{0.025} * s_p * \sqrt{\frac{1}{n_W} + \frac{1}{n_M}}$$

where $n_W = n_M = 5$, so

$$\mu_W - \mu_M = -5 \pm 2.31 * 3.97 * 0.632,$$

hence

$$\mu_W - \mu_M = -5 \pm 5.8.$$

b) This only provides very weak evidence that, on average, women earn less than men. Indeed, the confidence interval contains 0 and hence is consistent with no discrimination. Furthermore, this analysis does not take into account possible explanations for this difference (e.g. experience, training, etc.) and so, while a policy of discrimination would likely result in a difference, a difference is not, in itself, proof of discrimination.

ISBE 8.15 Confidence interval for a difference in population means using matched data. The data is matched by litter.

a) Use formula 8-12. Start by forming the differences between treatment and control, $D =$ Treatment $-$ Control. The sample mean difference, $\bar{D}$, is 3 and the sample variance, s_D^2, of D is 3.56. $n = 10$, so d.f. $=$ 9 and $t_{0.025,df=9} = 2.26$.

$$\Delta = \bar{D} \pm t_{0.025,df=9} * s_d/\sqrt{10},$$

$$\Delta = 3 \pm 2.26 * 0.596,$$

$$\Delta = 3 \pm 1.35.$$

b) The experiment provides evidence that an interesting environment leads to greater brain development,as measured by brain weight.

ISBE 8.17 Confidence interval for a proportion. In a sample of size n tires, a proportion, $P = 0.10$, failed to meet standards.

a) (n=10) Expected number of 'successes' is $0.10 * 10 = 1 < 5$, so need to use the graphical method. Find $P = 0.10$ on the horizontal axis and read off the 95% interval from the vertical axis (n=10):

$$0 \leq \pi \leq 0.45.$$

b) (n=25) Expected number of 'successes' is $0.10 * 25 = 2.5 < 5$, so need to use the graphical method. Find $P = 0.10$ on the horizontal axis and read off the 95% interval from the vertical axis (half way between n=20 and n=30):

$$0.01 \leq \pi \leq 0.30.$$

c) (n=50) Expected number of 'successes' is $0.10 * 50 = 5$, so can use either method. Using the graphical method, find $P = 0.10$ on the horizontal axis and read off the 95% interval from the vertical axis (n=50):

$$0.04 \leq \pi \leq 0.22.$$

Using formula 8.27,

$$\pi = P \pm 1.96 * \sqrt{\frac{P(1-P)}{n}},$$

$$\pi = 0.1 \pm 1.96 * \sqrt{\frac{0.1(0.9)}{50}},$$
$$\pi = 0.1 \pm 0.08.$$

d) (n=200) Use formula 8.27,

$$\pi = P \pm 1.96 * \sqrt{\frac{P(1-P)}{n}},$$

$$\pi = 0.1 \pm 1.96 * \sqrt{\frac{0.1(0.9)}{200}},$$
$$\pi = 0.1 \pm 0.04.$$

ISBE 8.19 Confidence intervals for differences in proportions. Use formula 8-29 for parts a and b:

a) $n_{us} = n_{japan} = 300$. $P_{us} = 0.40$ and $P_{japan} = 0.33$

$$\pi_{us} - \pi_{japan} = P_{us} - P_{japan} \pm 1.96 * \sqrt{\frac{P_{us}(1-P_{us})}{n_{us}} + \frac{P_{japan}(1-P_{japan})}{n_{japan}}},$$

$$\pi_{us} - \pi_{japan} = 0.07 \pm 1.96 * 0.039,$$
$$\pi_{us} - \pi_{japan} = 0.07 \pm 0.077,$$

b) $n_{us} = n_{la} = 300$. $P_{us} = 0.40$ and $P_{la} = 0.57$

$$\pi_{us} - \pi_{la} = P_{us} - P_{la} \pm 1.96 * \sqrt{\frac{P_{us}(1-P_{us})}{n_{us}} + \frac{P_{la}(1-P_{la})}{n_{la}}},$$

$$\pi_{us} - \pi_{la} = -0.17 \pm 0.079,$$