# 244 Hw 2 Answer key

7. a. $\mu_1$ = Population mean 2002

   $\mu_2$ = Population mean 2003

   $H_0$: $\mu_1 - \mu_2 \leq 0$

   $H_a$: $\mu_1 - \mu_2 > 0$

   b. With time in minutes, $\bar{x}_1 - \bar{x}_2$ = 172 - 166 = 6 minutes

   c. $$z = \frac{(\bar{x}_1 - \bar{x}_2) - D_0}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} = \frac{(172 - 166) - 0}{\sqrt{\frac{12^2}{60} + \frac{12^2}{50}}} = 2.61$$

   *p*-value = 1.0000 - .9955 = .0045

   *p*-value $\leq$ .05; reject $H_0$. The population mean duration of games in 2003 is less than the population mean in 2002.

   d. $$\bar{x}_1 - \bar{x}_2 \pm z_{.025}\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

   $$(172 - 166) \pm 1.96\sqrt{\frac{12^2}{60} + \frac{12^2}{50}}$$

   6 $\pm$ 4.5 (1.5 to 10.5)

   e. Percentage reduction: 6/172 = 3.5%. Management should be encouraged by the fact that steps taken in 2003 reduced the population mean duration of baseball games. However, the statistical analysis shows that the reduction in the mean duration is only 3.5%. The interval estimate shows the reduction in the population mean is 1.5 minutes (.9%) to 10.5 minutes (6.1%). Additional data collected by the end of the 2003 season would provide a more precise estimate. In any case, most likely the issue will continue in future years. It is expected that major league baseball would prefer that additional steps be taken to further reduce the mean duration of games.

17.a. $H_0$: $\mu_1 - \mu_2 \le 0$

$H_a$: $\mu_1 - \mu_2 > 0$

b. $$t = \frac{(\bar{x}_1 - \bar{x}_2) - D_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{(6.82 - 6.25) - 0}{\sqrt{\frac{.64^2}{16} + \frac{.75^2}{10}}} = 1.99$$

c. $$df = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{1}{n_1 - 1}\left(\frac{s_1^2}{n_1}\right)^2 + \frac{1}{n_2 - 1}\left(\frac{s_2^2}{n_2}\right)^2} = \frac{\left(\frac{.64^2}{16} + \frac{.75^2}{10}\right)^2}{\frac{1}{15}\left(\frac{.64^2}{16}\right)^2 + \frac{1}{9}\left(\frac{.75^2}{10}\right)^2} = 16.9$$

Use $df$ = 16

Using $t$ table, $p$-value is between .025 and .05

Exact $p$-value corresponding to $t$ = 1.99 is .0320

d. $p$-value $\le$ .05, reject $H_0$. The consultant with more experience has a higher population mean rating.

23.a. $_1$ = population mean grocery expenditures

$_2$ = population mean dining-out expenditures

$H_0$: $\mu_d = 0$

$H_a$: $\mu_d \ne 0$

b. $$t = \frac{\bar{d} - \mu_d}{s_d / \sqrt{n}} = \frac{850 - 0}{1123/\sqrt{42}} = 4.91$$

$df = n - 1 = 41$

$p$-value $\approx 0$

Conclude that there is a difference between the annual population mean expenditures for groceries and for dining-out.

c. Groceries has the higher mean annual expenditure by an estimated \$850.

$$\bar{d} \pm t_{.025} \frac{s_d}{\sqrt{n}}$$

$$850 \pm 2.020 \frac{1123}{\sqrt{42}}$$

$850 \pm 350$ (500 to 1200)

31.a. $\bar{p}_1$ = 150/250 = .46 Republicans

$\bar{p}_2$ = 98/350 = .28 Democrats

b. $\bar{p}_1 - \bar{p}_2$ = .46 - .28 = .18

Republicans have a .18, 18%, higher participation rate than Democrats.

c. $z_{.025}\sqrt{\frac{\bar{p}_1(1-\bar{p}_2)}{n_1}+\frac{\bar{p}_2(1-\bar{p}_2)}{n_2}}$

$$1.96\sqrt{\frac{.46(1-.46)}{250}+\frac{.28(1-.28)}{350}} = .0777$$

d. Yes, .18 $\pm$ .0777 (.1023 to .2577)

Republicans have a 10% to 26% higher participation rate in online surveys than Democrats. Biased survey results of online political surveys are very likely.

35.a. $H_0$: $p_1 - p_2 = 0$

$H_a$: $p_1 - p_2 \neq 0$

$\bar{p}_1$ = 63/150 = .42

$\bar{p}_2$ = 60/200 = .30

$$\bar{p} = \frac{n_1\bar{p}_1 + n_2\bar{p}_2}{n_1 + n_2} = \frac{63 + 60}{150 + 200} = .3514$$

$$z = \frac{\bar{p}_1 - \bar{p}_2}{\sqrt{\bar{p}(1 - \bar{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} = \frac{.42 - .30}{\sqrt{.3514(1 - .3514)\left(\frac{1}{150} + \frac{1}{200}\right)}} = 2.33$$

*p*-value = 2(1.0000 - .9901) = .0198

*p*-value $\leq$ .05, reject $H_0$. There is a difference between the recall rates for the two commercials.

b. $\bar{p}_1 - \bar{p}_2 \pm z_{.025}\sqrt{\frac{\bar{p}_1(1 - \bar{p}_1)}{n_1} + \frac{\bar{p}_2(1 - \bar{p}_2)}{n_2}}$

$$.42 - .30 \pm 1.96\sqrt{\frac{.42(1 - .42)}{150} + \frac{.30(1 - .30)}{200}}$$

.12 $\pm$ .1014 (.0186 to .2214)

Commercial A has the better recall rate.