Chapter 9
Hypothesis Tests

Solutions:

6. a. H_0: $\mu \leq 1$ The label claim or assumption.

   H_a: $\mu > 1$

   b. Claiming $\mu > 1$ when it is not. This is the error of rejecting the product's claim when the claim is true.

   c. Concluding $\mu \leq 1$ when it is not. In this case, we miss the fact that the product is not meeting its label specification.

7. a. H_0: $\mu \leq 8000$

   H_a: $\mu > 8000$ Research hypothesis to see if the plan increases average sales.

   b. Claiming $\mu > 8000$ when the plan does not increase sales. A mistake could be implementing the plan when it does not help.

   c. Concluding $\mu \leq 8000$ when the plan really would increase sales. This could lead to not implementing a plan that would increase sales.

10. a. $z = \dfrac{\bar{x} - \mu_0}{\sigma / \sqrt{n}} = \dfrac{26.4 - 25}{6 / \sqrt{40}} = 1.48$

   b. Upper tail p-value is the area to the right of the test statistic

   Using normal table with $z = 1.48$: p-value = 1.0000 - .9306 = .0694

   Using Excel: p-value = 1 - NORMSDIST(1.48) = .0694

   c. p-value > .01, do not reject H_0

   d. Reject H_0 if $z \geq 2.33$

   1.48 < 2.33, do not reject H_0

11. a. $z = \dfrac{\bar{x} - \mu_0}{\sigma / \sqrt{n}} = \dfrac{14.15 - 15}{3 / \sqrt{50}} = -2.00$

   b. Because $z < 0$, p-value is two times the lower tail area

   Using normal table with $z = -2.00$: p-value = 2(.0228) = .0456

Using Excel: *p*-value = 2*NORMSDIST(-2.00) = .0456

c. *p*-value ≤ .05, reject H_0

d. Reject H_0 if $z \leq -1.96$ or $z \geq 1.96$

-2.00 ≤ -1.96, reject H_0

15. a. H_0: $\mu \geq 1056$

H_a: $\mu < 1056$

b. $$z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}} = \frac{910 - 1056}{1600 / \sqrt{400}} = -1.83$$

Lower tail *p*-value is the area to the left of the test statistic

Using normal table with $z = -1.83$: *p*-value =.0336

Using Excel: *p*-value = NORMSDIST(-1.83) = .0336

c. *p*-value ≤ .05, reject H_0. Conclude the mean refund of “last minute” filers is less than $1056.

d. Reject H_0 if $z \leq -1.645$

-1.83 ≤ -1.645, reject H_0

23. a. $$t = \frac{\bar{x} - \mu_0}{s / \sqrt{n}} = \frac{14 - 12}{4.32 / \sqrt{25}} = 2.31$$

b. Degrees of freedom = $n - 1 = 24$

Upper tail *p*-value is the area to the right of the test statistic

Using *t* table: *p*-value is between .01 and .025

Using Excel: *p*-value = TDIST(2.31,24,1) = .0149

c. *p*-value ≤ .05, reject H_0.

c. With $df = 24$, $t_{.05} = 1.711$

Reject H_0 if $t \geq 1.711$

2.31 > 1.711, reject H_0.

24. a. $$t = \frac{\bar{x} - \mu_0}{s / \sqrt{n}} = \frac{17 - 18}{4.5 / \sqrt{48}} = -1.54$$

b. Degrees of freedom = $n - 1 = 47$

Because $t < 0$, *p*-value is two times the lower tail area

Using t table: area in lower tail is between .05 and .10; therefore, p-value is between .10 and .20.

Using Excel: p-value = TDIST(1.54,47,2) = .1303

c. p-value > .05, do not reject H_0.

d. With $df = 47$, $t_{.025} = 2.012$

Reject H_0 if $t \leq -2.012$ or $t \geq 2.012$

$t = -1.54$; do not reject H_0

36. a. $$z = \frac{\bar{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} = \frac{.68 - .75}{\sqrt{\frac{.75(1-.75)}{300}}} = -2.80$$

Lower tail p-value is the area to the left of the test statistic

Using normal table with $z = -2.80$: p-value =.0026

Using Excel: p-value = NORMSDIST(-2.80) = .0026

b. $$z = \frac{.72 - .75}{\sqrt{\frac{.75(1-.75)}{300}}} = -1.20$$

Lower tail p-value is the area to the left of the test statistic

Using normal table with $z = -1.20$: p-value =.1151

Using Excel: p-value = NORMSDIST(-1.20) = .1151

c. $$z = \frac{.70 - .75}{\sqrt{\frac{.75(1-.75)}{300}}} = -2.00$$

Lower tail p-value is the area to the left of the test statistic

Using normal table with $z = -2.00$: p-value =.0028

Using Excel: p-value = NORMSDIST(-2.00) = . 0028

d. $$z = \frac{.77 - .75}{\sqrt{\frac{.75(1-.75)}{300}}} = .80$$

Lower tail p-value is the area to the left of the test statistic

Using normal table with $z = .80$: p-value =.7881

Using Excel: p-value = NORMSDIST(.80) = . 7881

38. a. H_0: $p = .64$

H_a: $p \neq .64$

b. $\bar{p} = \frac{52}{100} = .52$

$$z = \frac{\bar{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} = \frac{.52 - .64}{\sqrt{\frac{.64(1-.64)}{100}}} = -2.50$$

Because $z < 0$, p-value is two times the lower tail area

Using normal table with $z = -2.50$: p-value = 2(.0062) = .0124

Using Excel: p-value = 2*NORMSDIST(-2.50) = . 0124

c. p-value ≤ .05; reject H_0. Proportion differs from the reported .64.

d. Yes. Since $\bar{p} = .52$, it indicates that fewer than 64% of the shoppers believe the supermarket brand is as good as the name brand.