Chapter 8 —

1. (a) $H_0 : \mu = 24.6$ years (claim) $H_1 : \mu \neq 24.6$ years

   (b) $H_0 : \mu \leq 25.4$ years $H_1 : \mu > 25.4$ years (claim)

   (c) $H_0 : \mu \geq 88$ points $H_1 : \mu < 88$ points (claim)

   (d) $H_0 : \mu \geq 70$ bpm $H_1 : \mu < 70$ bpm (claim)

   (e) $H_0 : \mu = 8.2$ lb (claim) $H_1 : \mu \neq 8.2$ lb

2. $H_0 : \mu \leq \$19{,}410$
   $H_1 : \mu > \$19{,}410$

All hypothesis test calculated values (critical values, test statistics, and p-values) are approximate.

Claim: H_1

Test statistic:

Critical value: 2.33

$$z = \frac{\overline{X} - \mu}{\sigma / \sqrt{n}} = \frac{22098 - 19410}{6050 / \sqrt{40}} \approx 2.81$$

Decision: Reject H_0.

Conclusion: There is strong evidence (p-value ≈ 0.0025) in favor of the claim that the cost has increased.

3. $H_0 : \mu \geq 11.52$ in.
   $H_1 : \mu < 11.52$ in

Claim: H_1

Test statistic:

Critical value:: –1.833

$$t = \frac{\overline{X} - \mu}{s / \sqrt{n}} = \frac{7.42 - 11.52}{1.3 / \sqrt{10}} \approx -9.97$$

Decision: Reject H_0.

Conclusion: There is extremely strong evidence (p-value ≈ 0.0000018) in favor of the claim that the rainfall is below average.

4. $H_0: p = 64.7\%$
$H_1: p \neq 64.7\%$ Claim: H_1

$p = 0.647$, $q = 0.353$, $\hat{p} = \frac{92}{150} = 0.61\bar{3}$

Test statistic: Critical value(s): ± 2.575

$$z = \frac{\hat{p} - p}{\sqrt{pq/n}} = \frac{92/150 - 0.647}{\sqrt{0.647 \cdot 0.353/150}} \approx -0.863$$

Decision: Do not reject H_0.

Conclusion: There is very little evidence (p-value = 0.3883) in favor of the claim that there is a difference from the national population on the proportion who own their home..

5. $H_0: \sigma \leq 20$ calories
$H_1: \sigma > 20$ calories Claim: H_1

Test statistic: Critical value: 36.191

$$\chi^2 = \frac{(n-1)s^2}{\sigma^2} = \frac{19 \cdot 35.109^2}{20^2} \approx 58.550$$

Decision: Reject H_0.

Conclusion: There is very strong evidence (p-value < 0.005, p ≈ 0.00000655) in favor of the claim that the standard deviation is greater than 20 calories.

Chapter 9 —

6. $$\left(\overline{X}_1 - \overline{X}_2\right) - z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}} < \mu_1 - \mu_2 < \left(\overline{X}_1 - \overline{X}_2\right) + z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

$$(9.2 - 8.8) - 1.96\sqrt{\frac{0.3^2}{27} + \frac{0.1^2}{30}} < \mu_1 - \mu_2 < (9.2 - 8.8) + 1.96\sqrt{\frac{0.3^2}{27} + \frac{0.1^2}{30}}$$

$0.28\text{ v} < \mu_1 - \mu_2 < 0.52\text{ v}$ Since the 95% confidence interval for the difference in means does not contain 0, if we set up a hypothesis test for these batteries' mean voltage performance with $H_0: \mu_1 = \mu_2$, we would reject the null at $\alpha = 0.05$.

7. $H_0: \mu_1 = \mu_2$

$H_1: \mu_1 \neq \mu_2$ (Claim)

Test statistic: Critical value(s):: ± 2.33

$$z = \frac{(\overline{X}_1 - \overline{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} = \frac{(9.2 - 8.8) - (0)}{\sqrt{\frac{0.3^2}{27} + \frac{0.7^2}{30}}} \approx 6.61$$

Decision: Reject H_0.

Conclusion: There is extremely strong evidence (p-value<0.0001, p-value ≈ 0.0000000000397) to support the claim that there is a significant difference in the voltage output of the two battery brands.

8. Step 1— $H_0: \sigma_1^2 = \sigma_2^2$

$H_1: \sigma_1^2 \neq \sigma_2^2$ (Claim)

Because of the F Test, we are using subscript 1 for IRS tax preparers, and we are using subscript 2 for the volunteer tax preparers.

Test statistic: $F = \frac{s_1^2}{s_2^2} = \frac{5.6^2}{4.3^2} = 1.70$ Critical value: 4.19

Decision: Do not reject H_0. Assume that the variances are equal.

Step 2 — $H_0: \mu_1 = \mu_2$

$H_1: \mu_1 \neq \mu_2$ (Claim)

Test statistic: Critical value(s):: ± 2.508
[df = 10 + 14 – 2 = 22]

$$t = \frac{(\overline{X}_1 - \overline{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} = \frac{(21 - 27) - (0)}{\sqrt{\frac{9 \cdot 5.6^2 + 13 \cdot 4.3^2}{22}}\sqrt{\frac{1}{10} + \frac{1}{14}}} \approx -2.973$$

Decision: Reject H_0.

Conclusion: There is strong evidence (p-value < 0.005) in favor of the claim that there is a significant difference in the average times of the two types of tax return preparers.

The 98% confidence interval is $-11.1 < \mu_1 - \mu_2 < -0.93$.

9.

Twin A (X_1)	87	92	78	83	88	90	84	93
Twin B (X_2)	83	95	79	83	86	93	80	86
D = $X_1 - X_2$	4	–3	–1	0	2	–3	4	7
D^2	16	9	1	0	4	9	16	49

$\sum D = 10$ $\sum D^2 = 104$ $\overline{D} = \frac{10}{8} = 1.25$ $s_D = \sqrt{\frac{104 - 10^2/8}{7}} \approx 3.615$

$H_0 : \mu_D = 0$
$H_1 : \mu_D \neq 0$ (Claim)

Test statistic: Critical value(s):: ± 3.499 [df = 7]

$$t = \frac{\overline{D} - \mu_D}{s_D / \sqrt{n}} = \frac{1.25 - 0}{3.615 / \sqrt{8}} \approx 0.978$$

Decision: Do not reject H_0.

Conclusion: There very little evidence (p-value > 0.10, p-value ≈ 0.361) to support the claim that there is a significant difference in the pulse rates between identical twins.

The 99% confidence interval is -3.23 < μ_D < 5.73. Notice that this interval includes 0.

10. $\hat{p}_1 = \frac{80}{150} = \frac{8}{15} = 0.5\overline{3}$ $\hat{p}_2 = \frac{30}{100} = 0.3$ $\overline{p} = \frac{80+30}{150+100} = \frac{11}{25} = 0.44$ $\overline{q} = 0.56$

$H_0 : p_1 = p_2$
$H_1 : p_1 \neq p_2$ Claim: H_1

Test statistic: Critical value(s):: ± 1.96

$$z = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{\overline{p} \cdot \overline{q} \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}} = \frac{\left(\frac{8}{15} - 0.3 \right) - 0}{\sqrt{0.44 \cdot 0.56 \cdot \left(\frac{1}{150} + \frac{1}{100} \right)}} \approx 3.64$$

Decision: Reject H_0.

Conclusion: There is very strong evidence (p-value < 0.0001, p-value ≈ 0.00027) to support the claim that there is a significant difference between the proportion of people who suffer from lung disease in the two communities.

Chapter 10

11. 0.5238; 42.5146

12. (a) There is no relationship between the two variables.

    (b) There is a perfect positive relationship between the two variables; a linear function with positive slope characterizes the relationship. All of the points would be on the line.

    (c) There is a perfect negative relationship between the two variables; a linear function with negative slope characterizes the relationship. All of the points would be on the line.

13. ±0.514; Reject $H_0: \rho = 0$.

14. (a) -0.9776 (b) $y' = 57.6425 - 0.0093x$

    (c) 24.7 mpg (d) 21.7 mpg

15. (a) $H_0: \rho = 0$
    $H_1: \rho \neq 0$ (Claim)

    Test Statistic: $r \approx 0.9808$

    Critical Value: ±0.444

    Decision: Reject H_0

    Conclusion: There is an extremely strong positive correlation (p-value $\approx 1.14 \times 10^{-15}$) between ad costs and years.

    (b) $y' = -276{,}549{,}517.2 + 139{,}144.5511x$

    (c)

Year	Cost
2015	$3,800,000
2016	$4,000,000
2020	$4,500,000
2025	$5,200,000

    (d) 96.19

    (e) 139,144; an average increase of $139,144 per year for the 30-second ad

Do your best! Rise to the challenge! Live and learn!