A. Data Files in MINITAB

(a) $\chi^2 = \boxed{135.592}$

(b) P-value $= \boxed{0.000}$

(c) Reject H_0 since P-value $= 0 < .05 = \alpha$

B. Chi-Square

- 9.16

  (a) $df = 2$

  (b) Reject H_0 if $\chi^2 > 5.99$

  (c)

  1. H_A: Model dress is related to magazine readership
     H_0: Model dress is not related to magazine readership
  2. Using hand calculations, $\chi^2 = \boxed{80.874}$
  3. Reject H_0 since $\chi^2 = 80.874 > 5.99$
  4. There is enough evidence to show that model dress is related to magazine readership.

  (d) From MINITAB, $\chi^2 = 80.874$, P-value$= 0.000$

  (e) Reject H_0 since P-value $= 0 < .05 = \alpha$

  (f) p_1 = proportion of general interest ads which are not sexual
  p_2 = proportion of men's ads which are not sexual

  $$\widehat{p}_1 = \frac{248}{314} = .7898 \qquad \widehat{p}_2 = \frac{514}{619} = .8304$$

  From MINITAB: $\boxed{(-0.0944616, 0.0133363)}$

  Interpret: With 95% confidence,

  Between 9.44% fewer and 1.33% more general interest ads than men's ads are not sexual.

  (g) The comparison in (f) does not reinforce the χ^2 test.

  The χ^2 test shows that model dress is related to readership *generally* but the CI doesn't affirm any *specific* difference between general interest ads and men's ads.

(continued)

(h) p_1 = proportion of women's ads which are sexual
p_2 = proportion of men's ads which are sexual

$$\widehat{p}_1 = \frac{225}{576} = .3906 \qquad \widehat{p}_2 = \frac{105}{619} = .1696$$

From MINITAB: (0.171382, 0.270612)

Interpret: With 95% confidence,

Between 17.14% and 27.06% more women's ads than men's ads are sexual.

(i) The comparison in (h) does reinforce the χ^2 test.

The χ^2 test shows that model dress is related to readership *generally* and the CI shows where a *specific* difference is.

(j) Here is the Table of χ^2 Contributions from MINITAB:

Model Dress	**Women**	**Men**	**General Interest**
Not sexual	12.835	7.227	1.162
Sexual	36.074	20.312	3.265

1. The General Interest/Not Sexual cell contributes the smallest χ^2 value 1.162.

   Also Men/Not Sexual contributes a relatively small 7.227.

   So it's not surprising that there are not significant differences between those two categories.

2. The Women/Sexual cell contributes the largest χ^2 value 36.074.

   Also Men/Sexual contributes the second-largest value 20.312.

   So it's not surprising to find significant differences between those two categories.

- 9.24

(a)

Percent of over 40 laid off = 41/806 = .0508 = 5.08%

Percent of under 40 laid off = 7/511 = .0137 = 1.37%

(b) 1. H_A: Age is related to being laid off
H_0: Age is not related to being laid off

2. Using hand calculations, $\chi^2 =$ 12.303
3. Reject H_0 since $\chi^2 = 12.303 > 3.84$
4. There is enough evidence to show that age is related to being laid off.

- 9.25

  (a)

  1. H_A: Age is related to Performance
     H_0: Age is not related to Performance

  2. Using hand calculations, $\chi^2 = \boxed{50.812}$

  3. <u>Reject H_0</u> since $\chi^2 = 50.812 > 5.99$

  4. There is enough evidence to show that age is related to performance.

  (b) Older employees do appear to perform less well: $230/758 = 30.3\%$ of them are in the lowest category, compared to $82/496 = 16.5\%$ of younger employees.

- 9.29

  (a)

  1. H_A: City and Income are related
     H_0: City and Income are not related

  2. From MINITAB, $\chi^2 = \boxed{3.955}$, P-value $= \boxed{0.412}$

  3. <u>Fail to Reject H_0</u> since P-value $= 0.412 > .05 = \alpha$

  4. There is not enough evidence to show that income is related to city.

  (b) There are <u>several</u> pairs of proportions which support the χ^2 test.
  Here is the pair of categories which have the smallest χ^2 contributions (0.007 and 0.008):

  (i) p_1 = proportion of City 1 customers with income under \$10,000
  p_2 = proportion of City 2 customers with income under \$10,000

  $$\widehat{p}_1 = \frac{70}{241} = .2905 \qquad \widehat{p}_2 = \frac{62}{218} = .2844$$

  (ii) From MINITAB: $\boxed{(-0.0768405, 0.0889461)}$

  <u>Interpret:</u>

  We are 95% confident that between 7.68% fewer and 8.89% more City 1 customers than City 2 customers have incomes less than \$10,000.

  (iii) The χ^2 test does not show any differences in income distributions between City 1 and City 2 customers. The CI confirms this in particular for the lowest income bracket.

C. Two Means

- 7.58

  (b) The two samples are *independent*.
  μ_1 = mean satisfaction score for employees with new monitors
  μ_2 = mean satisfaction score for employees with standard monitors

  From MINITAB, a 95% CI for $(\mu_1 - \mu_2)$ is

  $$(0.060,\ 2.340)$$

  Interpret:

  We are 95% confident that employees using new monitors average between 0.06 and 2.34 points higher satisfaction than employees using standard monitors.

  (c) Yes, since 0 is not contained in the confidence interval.

- 7.84

  1. μ_1 = mean spatial-reasoning score of children who took piano lessons
     μ_2 = mean spatial-reasoning score of children who did not take piano lessons

     $$H_A\colon\ \mu_1 > \mu_2$$
     $$H_0\colon\ \mu_1 \le \mu_2$$

  2. $t = \boxed{5.06}$ P-value $= \boxed{0.000}$
  3. Reject H_0 since

     $$P\text{-value} = 0 < .05 = \alpha$$

  4. There is conclusive evidence that piano lessons increase children's scores, on average.

- 7.85
  95% CI for $(\mu_2 - \mu_1)$: $(-4.508, -1.954)$

  Interpret:

  We are 95% confident that piano lessons improve children's scores by between 1.95 and 4.51 points, on average.

- 7.10
  The two samples are *paired* by household.

  1. μ_1 = mean Vitamin C before cooking, in milligrams/100 grams of blend
     μ_2 = mean Vitamin C after cooking, in mg/100 grams of blend

     $$H_A\colon\ \mu_1 > \mu_2$$
     $$H_0\colon\ \mu_1 \le \mu_2$$

  2. $t = \boxed{31.24}$ P-value $= \boxed{0.000}$
  3. Reject H_0 since

     $$P\text{-value} = 0 < .05 = \alpha$$

  4. There is conclusive evidence that Vitamin C is lost during cooking, on average.

- 7.11
  95% CI for $(\mu_1 - \mu_2)$: (50.11, 59.89)

  Interpret:

  > We are 95% confident that between 50.11 and 59.89 mg of Vitamin C per 100 grams of blend are lost through cooking, on average.

- 7.43

  (a) and (b)

  1. μ_1 = mean Vitamin C in bags at factory, in mg per 100 grams blend
     μ_2 = mean Vitamin C in bags in Haiti, in mg per 100 grams blend

     $$H_A\colon\ \mu_1 > \mu_2$$
     $$H_0\colon\ \mu_1 \le \mu_2$$

  2. $t = \boxed{4.96}$ $\quad P\text{-value} = \boxed{0.000}$
  3. Reject H_0 since
     $$P\text{-value} = 0 < .05 = \alpha$$
  4. There is conclusive evidence that Vitamin C is lost during shipment from the factory to Haiti, on average.

  (c) 95% CI's:

  * Factory: (40.956, 44.748)
  * Haiti: (36.553, 38.484)
  * Difference: (3.12, 7.54)

- 7.47

  1. μ_1 = mean yield of Variety A tomatoes, in pounds
     μ_2 = mean yield of Variety B tomatoes, in pounds

     $$H_A\colon\ \mu_1 > \mu_2$$
     $$H_0\colon\ \mu_1 \le \mu_2$$

  2. $t = \boxed{1.29}$ $\quad P\text{-value} = \boxed{0.115}$
  3. Fail to Reject H_0 since
     $$P\text{-value} = 0.115 > .05 = \alpha$$
  4. There is not conclusive evidence that Variety A has a higher mean yield than Variety B.

- 7.87

  (a) 1. μ_1 = mean ego strength of high-fitness professors
  μ_2 = mean ego strength of low-fitness professors

  $$H_A\colon\ \mu_1 \neq \mu_2$$
  $$H_0\colon\ \mu_1 = \mu_2$$

  2. $t = \boxed{8.23}$ P-value $= \boxed{0.000}$
  3. <u>Reject H_0</u> since
  $$P\text{-value} = 0 < .01 = \alpha$$
  4. There is overwhelming evidence to show that high-fitness professors and low-fitness professors differ in mean ego strength.

  (b) 99% CI: (1.174, 2.405)

  (c) The study shows that ego strength generally depends on the fitness level of college faculty. In fact, the mean ego strength of high-fitness professors exceeds that for low-fitness professors by between 1.17 and 2.41 points.

- 7.46

  (a) and (c)

  1. μ_1 = mean pre-test score on Spanish test for executives
  μ_2 = mean post-test score on Spanish test for executives

  $$H_A\colon\ \mu_1 < \mu_2$$
  $$H_0\colon\ \mu_1 \geq \mu_2$$

  2. $t = \boxed{-2.02}$ P-value $= \boxed{0.029}$
  3. - For $\alpha = .05$, <u>Reject H_0</u> since
  $$P\text{-value} = 0.029 < .05 = \alpha$$
     - For $\alpha = .01$, <u>Fail to Reject H_0</u> since
  $$P\text{-value} = 0.029 > .01 = \alpha$$
  4. There is <u>sufficient</u> evidence to show that intensive training improves average Spanish scores for executives at a 5% significance level but <u>insufficient</u> evidence at a 1% level.

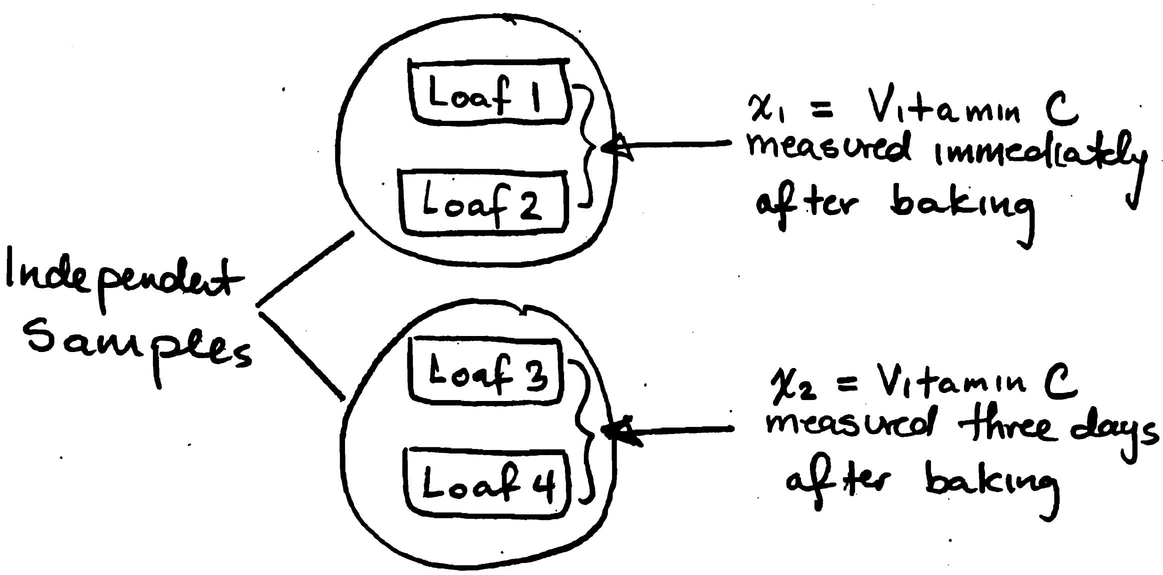
  (c) 90% CI: $(-2.689,\ -0.211)$

  <u>Interpret:</u>

  We are 90% confident that intensive training improves Spanish scores for executives by between 0.21 and 2.69 points, on average.

- 7.79

If the loaves of bread are measured as described in this exercise, the samples are *independent* since each measurement is made on a different loaf.



(a)

1. μ_1 = avg. amount of Vitamin C in loaves of bread immediately after baking, in milligrams/100 grams

   μ_2 = avg. amount of Vitamin C in loaves of bread three days after baking, in milligrams/100 grams

$$H_A\colon\ \mu_1 > \mu_2$$
$$H_0\colon\ \mu_1 \le \mu_2$$

2. $t = \boxed{22.16}$ $P\text{-value} = \boxed{0.014}$
3. Reject H_0 since P-value $= 0.014 < .05 = \alpha$.
4. There is sufficient evidence to show that bread loses Vitamin C over three days after baking, on average.

(b) A 90% confidence interval for $(\mu_1 - \mu_2)$ is

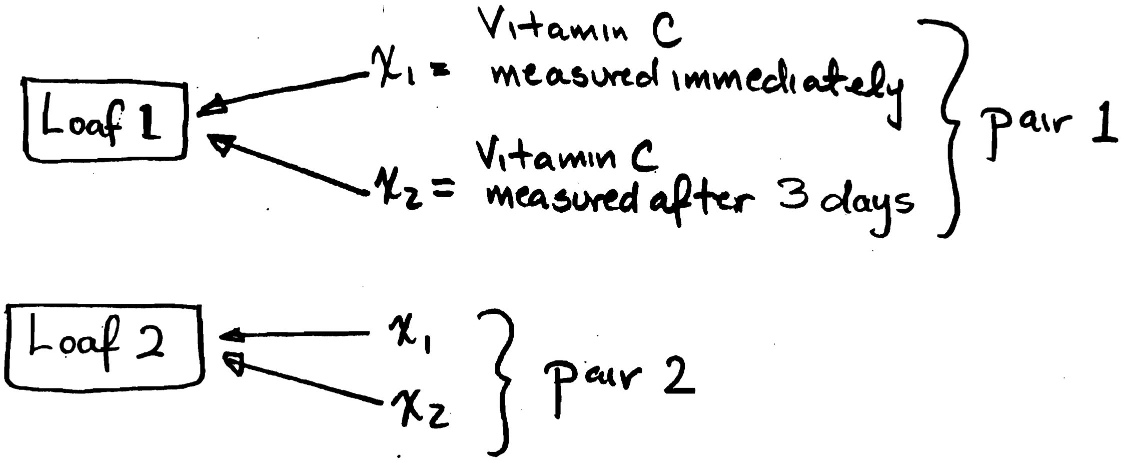
$$(19.24,\ 34.58)$$

Interpret:

We are 90% confident that loaves of bread lose between 19.24 and 34.58 mg/100g of Vitamin C on average over three days after baking.

- 7.80

If the loaves of bread are measured as described in this exercise, the samples are *paired* by the loaves of bread, each of which is measured twice.



(a)

1. μ_1 = avg. amount of Vitamin C in loaves of bread immediately after baking, in milligrams/100 grams

   μ_2 = avg. amount of Vitamin C in loaves of bread three days after baking, in milligrams/100 grams

$$H_A\colon\ \mu_1 > \mu_2$$
$$H_0\colon\ \mu_1 \le \mu_2$$

2. $t = \boxed{49.83}$ P-value $= \boxed{0.006}$
3. Reject H_0 since P-value $= 0.006 < .05 = \alpha$.
4. There is sufficient evidence to show that bread loses Vitamin C over three days after baking, on average.

(b) A 90% confidence interval for $(\mu_1 - \mu_2)$ is

$$(23.501,\ 30.319)$$

Interpret:

We are 90% confident that loaves of bread lose between 23.5 and 30.3 mg/100g of Vitamin C on average over three days after baking.

D. Additional

(1)

(a) The answer is (B)

(b) Reject H_0 since P-value $= 0.034 < 0.05 = \alpha$

(c) There is enough evidence to show that the average price of diesel exceeds the average price of regular gas at Iowa service stations on Sept. 30, 2012.