Part III

Answers to the Study Guide Even-Numbered Items

This section of the Instructor's Manuel and Test Bank has the answers to the even-numbered items in the *Study Guide for Basic Statistics* by Hakala and Spatz. The answers to the odd-numbered items are in the *Study Guide* itself.

CHAPTER 1

Multiple-Choice Questions

2. 3	4. 1	6. 2
8. 4	10. 2	12. 3
14. 1	16. 3	18. 4
20. 3		

Short-Answer Questions

2. The levels of qualitative variables are distinct from one another; there can be no intermediate values. The levels may or may not be ordered. Often, the levels of a qualitative variable are words. Quantitative variables have a continuous nature; intermediate values are possible.

Problems

2A. a. instructions to participants
- b. 2 levels: scores are averaged and scores count independently
- c. number of words circled
- d. everyone worked with two others; all had same time to work; (other answers are possible)
- e. encouragement of social loafing (little = individual scoring; much = averaging)
- f. ratio scale: number of words circled
- g. this study demonstrates that participants are better able to search and find words when scored individually than when contributing to the group score. This result supports the notion of social loafing.

2B. a. spiciness of the dips
- b. 3 levels: mild, medium and hot
- c. risk survey scores
- d. participants hadn't eaten for at least 3 hours
- e. spiciness of the dip
- f. score on the risk survey: certainly an ordinal scale and perhaps an interval scale
- g. Women's preference for mild, medium, or hot spicy dip was not associated with scores on a survey that measured desire to engage in risky activities.

4. The following pairs represent the lower and upper limits of what numbers?
- a. 5
- b. 6.4
- c. 0.82
- d. 1
- e. 652.4

6. Identify the scale of measurement for the items that follow.
   a. interval
   b. nominal
   c. nominal
   d. ordinal
   e. ratio
   f. ordinal
   g. ratio

8. Identify the quantitative variables below by writing in lower and upper limits on their blank lines. Write qualitative beside the variables that deserve such a name.
   a. Qualitative
   b. Quantitative: 2.5 – 3.5
   c. Qualitative
   d. Quantitative: 4.95 - 5.05
   e. Quantitative: 6.045-6.055
   f. Quantitative: 7.945 - 7.955
   g. Quantitative: 99.5 – 100.5
   h. Qualitative
   i. Qualitative

10. independent variable: experience of early psychic trauma
    dependent variable: cancer (or percent of those with cancer)
    extraneous variables: age, residence, gender of participants. (Other answers can be correct here.)

Chapter 2

Multiple Choice

2. 2	4. 2	6. 1
8. 4	10. 1	12. 3
14. 2		

Short-Answer Questions

2. a. Bar graph with TV shows on the abscissa. TV shows are values on a qualitative variable.

   b. Histogram or frequency polygon with income on the abscissa. Income is a quantitative variable.

   c. Line graph. This problem gives a description of two different variables, hospital admissions and day of the week.

   d. Histogram or frequency polygon with number of friends on the abscissa. Number of friends is a quantitative variable.

   e. Histogram or frequency polygon with number of correct answers on the abscissa. Number of correct answers is a quantitative variable.

   f. Histogram or frequency polygon with income on the abscissa. Income is a quantitative variable.

g. Bar graph with different activities on the abscissa. The activities described are values on a qualitative variable.

h. Line graph with calories on the ordinate and weeks or days on the abscissa. Neither of the two variables are frequency counts.

i. Histogram or frequency polygon with hours on the abscissa. Hours are measured on an interval scale in this case.

j. Bar graph with the four different pizza shops on the abscissa. The different pizza shops are levels of a qualitative variable.

Problems

2. a.

X	*f*
12	4
11	3
10	2
9	1
8	1
Σ	11

This distribution is negatively skewed.

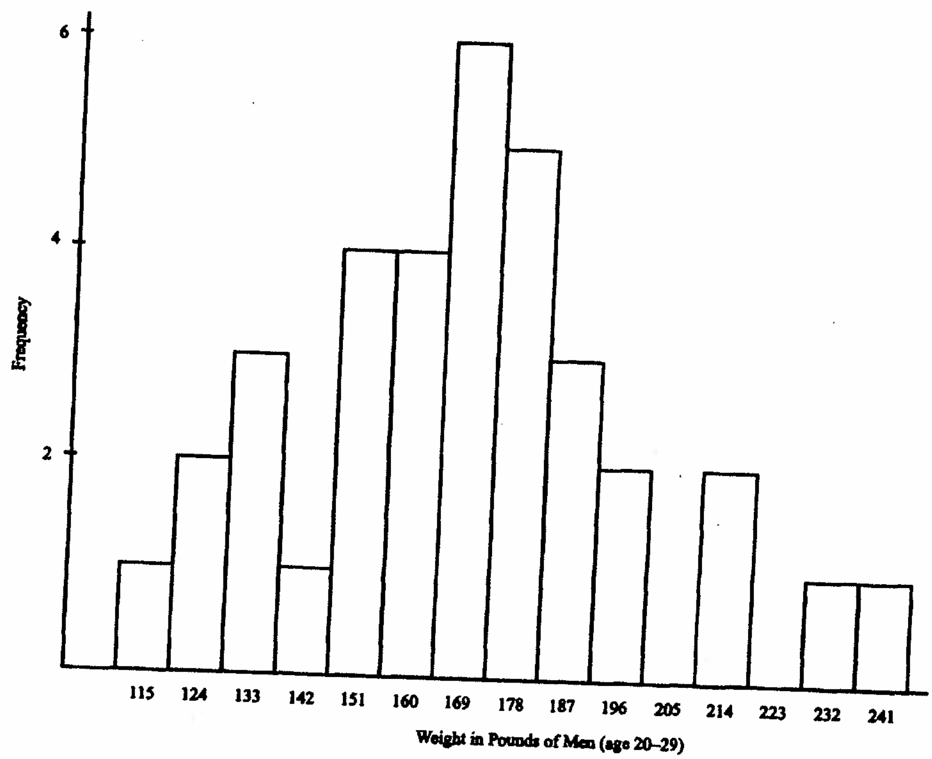
X	*f*
9	1
8	2
7	6
6	2
5	1
Σ	12

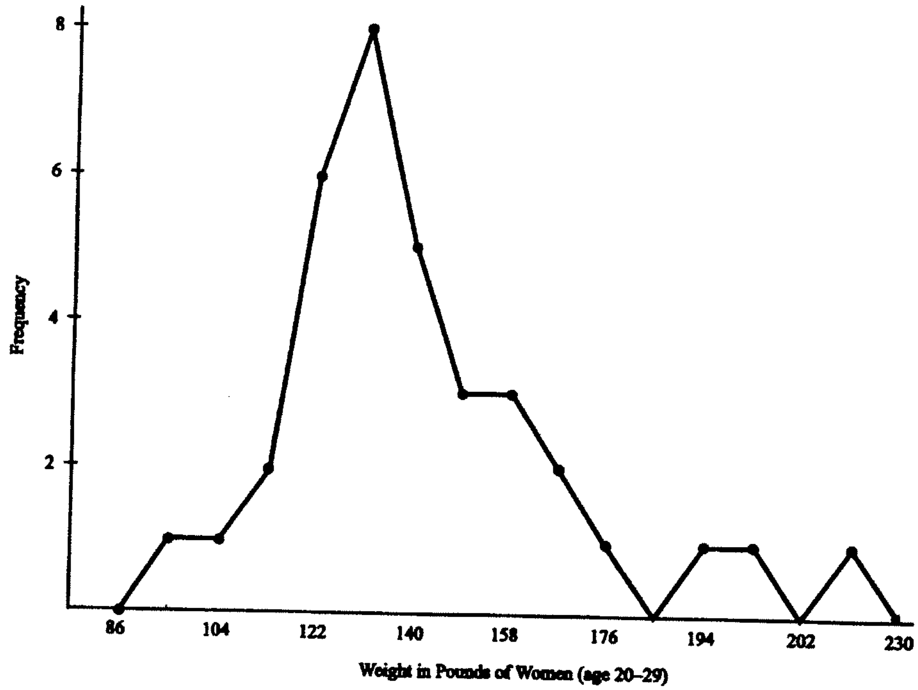
This distribution is symmetrical.

4.

Men Class Interval	f
237-245	1
228-236	1
219-227	0
210-218	2
201-209	0
192-200	2
183-191	3
174-182	5
165-173	6
156-164	4
147-155	4
138-146	1
129-137	3
120-128	2
111-119	1
	Σ = 35

Women Class Interval	f
217-225	1
208-216	0
199-207	1
190-198	1
181-189	0
172-180	1
163-171	2
154-162	3
145-153	3
136-144	5
127-135	8
118-126	6
109-117	2
100-108	1
91-99	1
	Σ = 35





Chapter 3

Multiple-Choice Questions

2. 1	4. 2	6. 4	8. 4	10. 1
12. 2	14. 4	16.4	18. 3	20. 2

Short-Answer Questions

2. The conclusion is correct only if the number of dollars invested in each of the three divisions is the same – which is highly unlikely.

4. Buy all three items at the store that has the lowest price on apples. Because milk and cereal have small standard deviations, the price will be about the same at all four stores. The large standard deviation for apples means that prices vary for apples. The lowest price on apples produces a much larger savings than the lowest price on milk.

Problems

2. A. mean = 9.5, median = 9, mode = 9
   B. mean = 3.53, median = 4, modes = 2, 5
   C. mean = 10.73, median = 11, mode = 12
   D. mean = 7.00, median = 7, mode = 7

4. 1984: mean = 7.13, median = 7, mode = 7
2004: mean = 7.57, median = 7.5 mode = 7

6. The typical child is able to stand without support at approximately 11.7 months (mean). The standard deviation of this distribution is 1.7 months, suggesting that a large majority of children will be standing sometime between the 10th month and 13th month.

8.

College students

Rating		f	fX	fX^2
5		4	20	100
4		4	16	64
3		2	6	18
2		1	2	4
1		1	1	1
	Σ	12	45	187

Older adults

Rating		f	fX	FX^2
5		2	10	50
4		1	4	16
3		2	6	18
2		4	8	16
1		6	6	6
	Σ	15	34	106

College students:

Range = 5 − 1 = 4.
IQR = 5 − 3 = 2.

$$\hat{s} = \sqrt{\frac{187 - \frac{45^2}{12}}{11}} = 1.29$$

Not asked for: $\overline{X} = 3.75$

Older adults:

Range = 5 − 1 = 4.
IQR = 3 − 1 = 2.

$$\hat{s} = \sqrt{\frac{106 - \frac{34^2}{15}}{14}} = 1.44$$

Not asked for: $\overline{X} = 2.27$

10. Estimate: Range = 26. Dividing by 3 gives an estimate of approximately 8.

	X	X^2
	38	144 4
	29	841
	25	625
	21	441
	12	144
Σ =	125	349 5

$\bar{X} = 25.00$

$$\hat{s} = \sqrt{\frac{3495 - \frac{125^2}{5}}{4}} = 9.62.$$

$\hat{s}^2 = 92.50$

Although it isn't surprising that vigilance is worse late in a session compared to early (a mean of 25 percent errors vs. 12 percent errors), it may be surprising that the standard deviations were so different (9.62 vs. 3.54). The much larger standard deviation means that sustained vigilance affects people differently. For some, the number of misses is greatly increased but for others the increase is small.

Chapter 4

Multiple choice

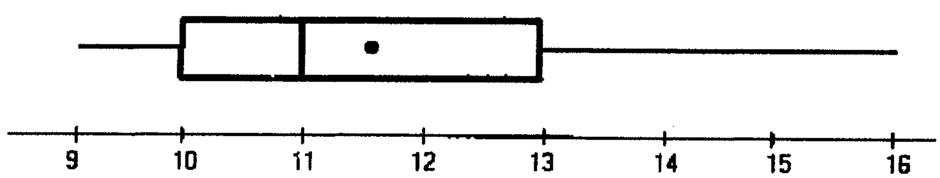
2. 2	4. 3	6. 4
8. 1	10. 4	12. 3
14. 4	16. 2	18. 4
20. 3		

Short-Answer Questions

2. Small = 0.20; Medium = 0.50; Large = 0.80

Problems

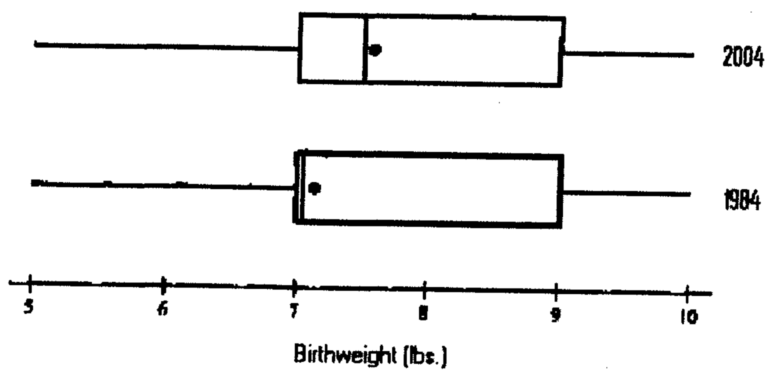
2.



Age (Months)
Baby stands alone

As you can see from the boxplot, the median age at which babies stand alone is 11 months. Of course, children vary; some can stand at 9 months and others don't stand until they are 16 months old. Half the babies are between age 10 and 13 months when they first stand. The mean age for standing alone is 11.7 months. Look at the relationship between the median and the mean and the fact that the right-hand whiskers are longer than the left-hand ones. This is a positively skewed distribution.

4.



In the year 2004, newborn babies weighed more than they did in 1984. The mean weight in 2004 was 7.57 pounds; in 1984 and the mean was 7.13 pounds. The median was 7.5 pounds for 2004 but only 7 pounds for 1984. The effect size index was 0.35, a value intermediate between small and medium. Babies were a little more variable in 2004; the standard deviation was 1.40 pounds compared to 1.25 pounds in 1984. In both years the distributions appear to be fairly symmetrical.

6. a. IQ = 115; $z = 1.00$ b. IQ = 124; $z = 1.60$ c. IQ = 97; $z = -0.20$
d. IQ = 101; $z = 0.08$ e. IQ = 87; $z = -0.87$

Chapter 5

Multiple-Choice Questions

2. 4 4. 3 6. 2 8. 4 10. 4
12. 1 14. 1 16. 4 18. 2 20. 3

Short-Answer Questions

2. The regression procedure is a method of fitting a straight line to a bivariate relationship. It can be used to predict scores on one variable given scores on the other variable. It can be used only with quantitative data that are linearly related. The degree of confidence you have in your prediction is directly related to the size of the absolute value of r.

4. This correlation shows that there is a relationship between SAT and GPA, but the relationship is moderate. Because the correlation is positive, GPA increases go with increases in SAT scores, in general. Correlations alone are not sufficient to infer a cause and effect relationship.

Problems

2.

$$\bar{X} = \frac{252}{12} = 21.00$$

$$\bar{Y} = \frac{204}{12} = 17.00$$

$$S_x = \sqrt{\frac{7644 - \frac{252^2}{12}}{12}} = 14.00$$

$$S_y = \sqrt{\frac{3607 - \frac{204^2}{12}}{12}} = 3.40$$

a. $r = \dfrac{\frac{4787}{12} - (21)(17)}{(14)(3.40)} = .88$

$$r = \frac{(12)(4787) - (252)(204)}{\sqrt{[12(7644) - 252^2][(12)(3607) - 204^2]}} = .88$$

b. $b = (.88)\frac{3.40}{14.00} = 0.214$

$a = 17.00 - 0.214(21.00) = 12.51$

$\hat{Y} = 12.51 + 0.214X$

c. $\hat{Y} = 12.51 + 0.214(50) = 23.21$

d. Because the correlation coefficient is so large (.88), you can be confident that children with reading times of 50 minutes will have vocabulary scores fairly close to 23 (rounded from 23.21).

e. Data such as these are not conclusive evidence that reading improves vocabulary. It might be just the opposite; that is, children with good vocabularies find reading attractive. Perhaps both variables are the result of some third variable such as intelligence or home influences.

4.

Participant	X	Y	X^2	Y^2	XY
1	8	1	64	1	8
2	4	2	16	4	8
3	7	0	49	0	0
4	9	3	81	9	27
5	3	1	9	1	3
6	0	2	0	4	0
7	4	0	16	0	0
Sum:	35	9	235	19	46

$\bar{X} = \frac{35}{7} = 5.00$ $\bar{Y} = \frac{9}{7} = 1.286$

$S_x = \sqrt{\frac{235 - \frac{35^2}{7}}{7}} = 2.928$ $S_y = \sqrt{\frac{19 - \frac{9^2}{7}}{7}} = 1.030$

$r = \frac{\frac{46}{7} - (5)(1.286)}{(2.928)(1.03)} = .047$

$b = (0.047)\frac{1.03}{2.928} = 0.017$

$a = 1.286 - (.017)(5.00) = 1.203$

$\frac{7 - 6.9}{.34}$

Chapter 6

Multiple-Choice Questions

2. 1	4. 4	6. 2	8. 4	10. 4
12. 2	14. 4	16. 3	18. 4	20. 3

Short-Answer Questions

2. [Here are elements that might be included in the paragraph.] The normal curve is a bell-shaped symmetrical distribution. The mean, median and mode are all the same number. The points of inflection in the curve are at plus one and minus one standard deviation. The curve is asymptotic to the *X* axis.

4. The mean will be reduced one inch to 35 inches. The standard deviation will be the same, 2 inches.

Problems

2. a. The easiest way to work these problems is to convert all measurements to inches.
$z = \frac{48-51}{2} = -1.50$, proportion = .5000 + .4332 = .9332

b. $z = \frac{50-51}{2} = -0.50$, $p = .3085$
$z = \frac{54-51}{2} = 1.50$, $p = .0668$
.3085 + .0668 = .3754, the proportion who are left out.

c. $\frac{15}{80} = .19$, the probability of choosing one from the subgroup led by Cephu.

4. All measurements must be converted to the same scale. For our answers, we used pounds.
   a. The z score that corresponds to a proportion of .0025 is 2.81.

$$2.81 = \frac{X-40}{.25}$$

$$.7025 = X - 40$$
$$X = 40.7025 \text{ pounds}$$

Adding the eight ounces (1/2 pound) lost in transit:
$40.7025 + 0.5 = 41.2025$ pounds

   b. (.0025)(5,000,000)=12,500 boxes arrive with less than 40 pounds of bananas.

6.
   a. $z = \frac{7-6.9}{.34} = 0.29$, proportion = .3859
   b. $z = \frac{6-6.9}{.34} = -2.65$, proportion = .004
   c. $z = \frac{6.5-6.9}{.34} = 1.18$, proportion = .3810
      $z = \frac{7.2-6.9}{.34} = 0.88$, proportion = .3106;   .3810 + .3106 = .6916
   d. $z = \frac{7.5-6.9}{.34} = 1.76$, proportion = .0392
      (.0392)(3000) = 117.8 = 118 women
   e. $1.28 = \frac{X-6.9}{.34}$
      $.4353 = X - 6.9$
      $X = 7.34$ inches

8. To win, a person must match 6 numbers drawn from a rotating drum of 36 numbers. The probability of matching the first number is 6/36. If that number matches, the probability of matching the second number is 5/35. The next probability is 4/34, and so forth until all six numbers are drawn.

$$\text{P(winning)} = \frac{6}{36} \times \frac{5}{35} \times \frac{4}{34} \times \frac{3}{33} \times \frac{2}{32} \times \frac{1}{31} = \frac{720}{1{,}402{,}410{,}240} = .000000513$$

which is about one chance in two million. If more than 6 numbers must be matched, the chances of winning decrease dramatically.

Chapter 7

Multiple-Choice Questions

2. 4	4. 2	6. 2	8. 4	10. 4
12. 4	14. 2	16. 3	18. 4	20. 4

Short-Answer Questions

2. A sampling distribution is the result of drawing many random samples from a population and then calculating the same statistic for each sample. If the statistic calculated is the mean, the resulting sample means constitute a sampling distribution of the mean.

4. To improve the study described in MC question 20, 1) ensure that the sample is random, and 2) increase the sample size.

Problems

2. $\overline{X} = \frac{3616}{49} = 73.80$ kilograms

   $\sigma_{\overline{X}} = \frac{\sigma}{\sqrt{N}} = \frac{10}{\sqrt{49}} = 1.43$ kilograms

   For sample means of 73.80 kgs or smaller,

   $z = \frac{73.80 - 75.4}{\frac{10}{\sqrt{49}}} = \frac{-1.6}{1.43} = -1.12$; probability = .1314

   About 13 times in 100 you would expect by chance alone to get a mean of 73.8 from a population with a mean of 75.4 using a sample of 49. The evidence is not strong that male vegetarians weigh less than the national average.

4. $\overline{X} = \frac{1275}{75} = 17.00$ $\hat{s} = 5.00$; $s_{\overline{X}} = \frac{5}{\sqrt{75}} = 0.577$

   $df = 74$

   $t_{95}(60\ df) = 2.00$

   $LL = 17.00 - 2.00(0.577) = 15.85$

   $UL = 17.00 + 2.00(0.577) = 18.15$

   The teacher can be 95 percent confident that in her state, the mean mathematics ability on the test is between 15.85 and 18.15. Thus, the state mean on this exam is between 50 percent and 57 percent correct for the 32 items.

6. $\overline{X} = 52$; $\hat{s} = 10$; $s_{\overline{X}} = \frac{10}{\sqrt{49}} = 1.429$

   $t_{99}(40\ df) = 2.704$

   $LL = 52 - 2.704(1.429) = 48.14$

   $UL = 52 + 2.704(1.429) = 55.86$

   You are 99 percent confident that the mean socialization score for Greeks is between 48.14 and 55.86. Because the general population mean, 50, is within this interval, you do not have strong evidence that Greeks are more sociable than average.

8. To find the standard error of the mean for your sample, divide its standard deviation (calculated with N-1 in the denominator) by $\sqrt{6}$. The standard error of the mean provides information about the reliability of the sample mean as an estimate of the population mean. Small standard errors indicate that the sample mean is a more reliable estimate than do larger standard errors.

Chapter 8

Multiple-Choice Questions

2. 2	4. 4	6. 2	8. 3	10. 2
12. 2	14. 1	16. 3	18. 3	20. 2

Short-Answer Questions

2. Alpha (α) is a probability value chosen by the researcher. If $\alpha = .05$ and the p produced by the data is less than .05 ($p < .05$), reject the null hypothesis. If $p > .05$, retain the null hypothesis. p is the probability of the data obtained, if the null hypothesis is true.

4. a. H_0: $\mu_0 = 50$. $t_{.05}$ (7 *df*) = 2.365. Retain the null hypothesis. There isn't a statistically significant difference between the mean of released hostages and the published mean for the population on the D_0 scale. Because the effect size index, 0.80, is large and the sample size is small, you probably should be suspicious that the t test *may* have resulted in a Type II error.
   b. $r_{.05}$ (13 *df*) = .5139. (From Table A, Appendix B.) A correlation coefficient of .62 is statistically different from .00. The teacher ratings and the test overlap in what they are measuring (which is presumably honesty).

6. Check your answer against the concepts in the section, "The Logic of Null Hypothesis Statistical Testing (NHST)" in Chapter 8 (pp. 169-172).

Problems

2. H_0: $\mu_0 = 896$. The best choice of an alternative hypothesis is the two-tailed alternative because it allows you to detect that the school is better or worse than the national average. Thus, H_1: $\mu_0 \neq 896$.

   $\Sigma X = 24{,}206$ $\quad$ $\Sigma X^2 = 22{,}716{,}411$

   $\bar{X} = 931$; $\hat{s} = 85.00$; $\quad$ $s_{\bar{X}} = 16.67$

   $t = \frac{931-896}{16.67} = 2.10$; $\quad$ $df = 25$ $\quad$ $d = \frac{931-896}{85} = 0.41$

   $t_{.05}$ (25 *df*) = 2.060. There is a significant difference between the small high school and the national average. The students at the small high school scored significantly higher than the national average. An effect size index of $d = 0.41$ means that the size of the high school has a medium effect on SAT scores.

4. $\Sigma X = 234$ $\quad$ $\Sigma X^2 = 8892$

   $\bar{X} = 26.00$; $\quad$ $\hat{s} = 18.735$; $\quad$ $s_{\bar{X}} = 6.245$

   $t = \frac{26-11}{6.245} = 2.40$ $\quad$ $df = 8$ $\quad$ $d = \frac{26-11}{18.73} = 0.80$

   $t_{.05}$ (8 *df*) = 2.306. There is a significant difference between the students who took the assertiveness training course and the population mean. Students who took the course scored significantly higher on the assertiveness training scale than the population mean. The effect size, $d = 0.80$, indicates that the assertiveness training course has a large effect on assertiveness scores.

Chapter 9

Multiple-Choice Questions

2. 2	4. 1	6. 1	8. 3	10. 3
12. 2	14. 3	16. 4	18.1	20. 1

Short-Answer Questions

2. a. Paired samples; $df = 49$
   b. Paired samples; $df = 20$
   c. Independent samples; $df = 22$
   d. Independent samples; $df = 48$
   e. Paired samples; $df = 7$

4. The probability is .01 of obtaining a difference as large as the one observed if there is really no difference between the two populations.

6. This is an independent samples design. $t_{.05}$ (22 df)=2.074. Because the obtained t value is less than the critical value, the null hypothesis is retained. This suggests that the difference detected was due to measurement error or chance, rather than to the independent variable (culture). Looking at the broader question, beginning to walk does not appear to depend on lots of practice.

8. A powerful statistical test is one that is likely to detect an actual difference. The power of a statistical test can be increased by increasing sample size or by selecting an independent variable that has a stronger influence on the participants.

10. 1. A paired-samples t test is more powerful than an independent-samples t test.
    2. Fewer participants are necessary for a paired-samples t test.

Problems

2.

	Detached	Involved
ΣX	114	140
ΣX^2	1996	3432
N	7	6
$\bar{X}$	16.29	23.33
$\hat{s}$	4.82	5.75

$s_{\bar{X}_1} = \frac{4.82}{\sqrt{7}} = 1.82$ $\qquad$ $s_{\bar{X}_2} = \frac{5.72}{\sqrt{6}} = 2.35$

$$s_{\bar{X}_1 - \bar{X}2} = \sqrt{\left(\frac{1}{7}\right)\left(\frac{1}{6}\right)\left(\frac{\left[1996 - \frac{114^2}{7}\right] \Big| \left[3432 - \frac{140^2}{6}\right]}{7+6-2}\right)}$$

$$s_{\bar{X}_1-\bar{X}2} = \sqrt{(0.310)\left(\frac{[1996-1856.57][3432-3266.67]}{11}\right)}$$

$$s_{\bar{X}_1-\bar{X}2} = \sqrt{(0.310)(27.71)} = 2.93$$

$$t = \frac{16.29-23.33}{2.93} = -2.40\,; p<.01$$

$$df = N_1+N_2\text{-}2 = 7 + 6 - 2 = 11$$

$$t_{(.05)}(11\ df) = 2.201$$

$$\hat{s} = \sqrt{\frac{\hat{s}_1^2(df_1)+\hat{s}_2^2(df_2)}{df_1+df_2}} = \sqrt{\frac{4.82^2(6)+5.75^2(5)}{6+5}} = \sqrt{\frac{139.39+165.31}{11}}$$

$$\hat{s} = 5.264;\ d = \frac{16.29-23.33}{5.264} = -1.34$$

Because the calculated t for this problem is larger than the tabled value, the null hypothesis is rejected. Heart rate increased more in the group instructed to become involved in the movie.

Another reasonable interpretation is that those instructed to remain detached suppressed their heart rate. Regardless of interpretation, the instructions produced a large effect ($d = 1.34$). Thus, with instructions, people are able to direct their emotions.

4.

	No Neurosis	Experimental Neurosis
$\sum X$	353	523
$\sum X^2$	18,250	40,125
N	7	7
$\bar{X}$	50.43	74.71

Litter number	No experimental neurosis	Experimental neurosis	D	D^2
1	63	88	-25	625
2	59	90	-31	961
3	52	74	-22	484
4	51	78	-27	729
5	46	78	-32	1024
6	44	61	-17	289
7	38	54	-16	256
	$\sum = 353$	523	-170	4368

$$\hat{s}_D = \sqrt{\frac{4368-\frac{-170^2}{7}}{6}} = 6.3170$$

$$s_{\bar{D}} = \frac{6.3170}{\sqrt{7}} = 2.3876$$

$$t_{.99}(6\ df) = 3.707$$

$$LL = \bar{X} - \bar{Y} - t_\alpha(s_{\bar{D}}) = (74.71 - 50.43) - 3.707(2.3876) = 15.43 \text{ milliliters}$$

$$UL = \bar{X} - \bar{Y} + t_\alpha(s_{\bar{D}}) = (74.71 - 50.43) + 3.707(2.3876) = 33.13 \text{ milliliters}$$

The data allow 99 percent confidence that inducing a temporary neurosis in cats produces an increase in the consumption of alcohol-spiked milk by 15.43 to 33.13 milliliters. There appears to be a relationship; neurosis increases alcohol consumption. [Note that because 0 is not in the 99 percent confidence interval, the null hypothesis can be rejected at the .01 level.]

Chapter 10

Multiple-Choice Questions

2. 3	4. 2	6. 1	8. 1	10. 2
12. 4	14. 2	16. 3	18. *	20. 4

* None of the alternatives are correct in the first printing of the *Study Guide*; the correct answer is 3, 28 *df*. In the second printing of the Study Guide, alternative 3 is correct.

Interpretation

2. The independent variable is activity (exercising, watching a comedy video, or working on problems. The dependent variable is the number of problems worked by each group. The F value produced by the ratio of the two mean squares is 8.94. Because $F_{.01}(2,18, df) = 6.01$, you can conclude that there are significant differences among the means in number of problems worked.

   The f value is 0.50, which is large. The effect of prior activity has a large effect on number of problems worked.

   The Tukey tests indicated that there are significant differences between exercise and comedy. There were no other pairs that differed significantly from each other.

4. Use ANOVA to determine if there are significant differences among the means. Then use Tukey *HSD*s to detect differences between the pairs. (If the analysis was planned prior to gathering data, use an *a priori* test, which would require consultation with an intermediate level textbook.)

Problems

2.

	Friends	Romans	Countrymen
	7	8	10
	9	7	12
	3	4	16
	5	7	14
ΣX	24	26	52
ΣX^2	164	178	696
$\bar{X}$	6.00	6.50	13.00

$\Sigma X_{tot} = 24 + 26 + 52 = 102$

$\Sigma X^2_{tot} = 164 + 178 + 696 = 1038$

$SS_{tot} = 1038 - \frac{102^2}{12} = 171.00$

$SS_{treat} = \frac{24^2}{4} + \frac{26^2}{4} + \frac{52^2}{4} - \frac{102^2}{12} = 122.00$

$SS_{error} = [164 - \frac{24^2}{4}] + [178 - \frac{26^2}{4}] + [696 - \frac{52^2}{4}]$
$= 20 + 9 + 20 = 49.00$

CHECK: 122.00 + 49.00 = 171.00

Source	*SS*	*df*	*MS*	*F*	*p*
	122.00	2	61.00	11.21	< .01
Error	49.00	9	5.44		
Total	171.00	11			

$F_{.01}$ (2,9 *df*) = 8.02. Thus, $p < .01$.

$$f = \frac{\sqrt{\frac{2}{12}(61.00 - 5.44)}}{\sqrt{5.44}} = 1.304$$

An $f = 1.304$ indicates that the effect of being a Friend, Roman or Countryman is large.

HSD tests

$s_{\bar{X}} = \sqrt{\frac{5.44}{4}} = 1.116 \quad HSD_{.01} = 5.43$

HSD (Friends vs. Romans) = 0.43 NS

HSD (Friends vs. Countrymen) = 6.00 $p < .01$

HSD (Romans vs. Countrymen) = 5.57 $p < .01$

Countrymen lent more ears of corn than did Friends or Romans, who did not differ from each other.

4. In this study, the independent variable is the city and the dependent variable is the number of miles walked.

	Gotham	Middletown	Grovers Corners
ΣX	16	24	32
ΣX^2	70	60	140
N	4	12	8
$\bar{X}$	4.00	2.00	4.00

$SS_{tot} = 270 - \frac{72^2}{24} = 54.00$

$SS_{treat} = \frac{16^2}{4} + \frac{24^2}{12} + \frac{32^2}{8} - \frac{72^2}{24} = 24.00$

$SS_{error} = [70 - \frac{16^2}{4}] + [60 - \frac{24^2}{12}] + [140 - \frac{32^2}{8}] = 30.00$

CHECK: 24.00 + 30.00 = 54.00

Source	*SS*	*df*	*MS*	*F*	*p*
City	24.00	2	12.00	8.39	< .01
Error	30.00	21	1.43		
Total	54.00	23			

$F_{.01}$ (2,21 *df*) = 5.78. The three cities produced significantly different amounts of walking behavior. Tukey *HSD* tests:

$HSD_{.05} = 3.58$; $HSD_{.01} = 4.64$

HSD (Gotham vs. Middletown) = 4.10; $p < .05$

HSD (Gotham vs. Grovers Corner) = 0

HSD (Middletown vs. Grovers Corner) = 5.18; $p < .01$

Those who live in middle-sized places walk less than those who live in large places or small places, which do not differ from each other.

Chapter 11

Multiple-Choice Questions

2. 4	4. 3	6. 4	8. 3	10. 4
12. 1	14. 3	16. 2	18. 1	20. 3

Interpretation

2. X AB Interaction: Probably significant
   A Main Effect: NS
   B Main Effect: NS

   Y AB Interaction: NS
   A Main Effect: NS
   B Main Effect: Probably significant

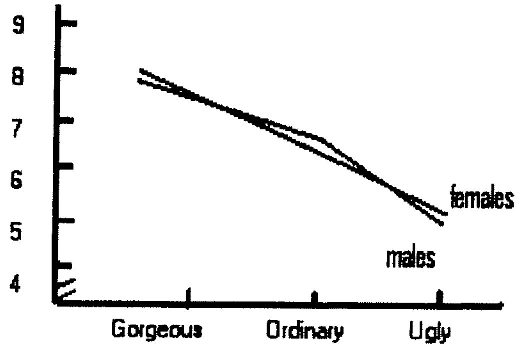
   Z AB Interaction: Probably significant
   A Main Effect: Probably significant
   B Main Effect: Probably significant

4. X AB Interaction: NS
   A Main Effect: Probably significant
   B Main Effect: Probably significant

   Y AB Interaction: Probably significant
   A Main Effect: NS
   B Main Effect: Probably significant

   Z AB Interaction: Probably significant
   A Main Effect: NS
   B Main Effect: NS

6. The description of the physical attractiveness of the telephone personality did affect the rating given the person. This effect did not depend on the gender of the subject; it was found for both genders. This lack of interaction can be seen in the graph of cell means where the lines for both genders drop as attractiveness decreases.



HSD tests: $HSD_{.05} = 3.44$; $HSD_{.01} = 4.37$
HSD (Gorgeous vs. Ordinary) = 4.42 $p < .01$
HSD (Gorgeous vs. Ugly) = 8.95 $p < .01$
HSD (Ordinary vs. Ugly) = 4.17 $p < .05$

Being described as "gorgeous" resulted in significantly higher ratings than either "ordinary" or "ugly". Being described as "ordinary" resulted in significantly higher ratings than being described as "ugly."

Problems

2.

	A_1B_1	A_1B_2	A_2B_1	A_2B_2
ΣX	25	46	18	17
ΣX^2	161	558	86	87
$\bar{X}$	6.25	11.50	4.50	4.25

$$SS_{tot} = 892 - \frac{106^2}{16} = 892 - 702.25 = 189.75$$

$$SS_{\text{cells}} = \frac{25^2}{4} + \frac{46^2}{4} + \frac{18^2}{4} + \frac{17}{4} - \frac{106^2}{16} = 838.50 - 702.25 = 136.25$$

$$SS_{imagery} = \frac{71^2}{8} + \frac{35^2}{8} - \frac{106^2}{16} = 783.25 - 702.25 = 81.00$$

$$SS_{\text{strategy}} = \frac{43^2}{8} + \frac{63^2}{8} - \frac{106^2}{16}$$
$$= 727.25 - 702.25$$
$$= 25.00$$

$$SS_{AB} = 4\begin{bmatrix}(25-35.5-21.5+26.5)^2+(46-35.5-31.5+26.5)^2+ \\ (18-17.5-21.5+26.5)^2+(17-17.5-31.5+26.5)^2\end{bmatrix} = 30.25$$

$$SS_{\text{error}} = \left(161 - \frac{25^2}{4}\right) + \left(558 - \frac{46^2}{4}\right) + \left(86 - \frac{18^2}{4}\right) + \left(87 - \frac{17^2}{4}\right)$$
$$= 53.50$$

CHECK

$53.50 + 30.25 + 25.00 + 81.00 = 189.75$

Source	*df*	*SS*	*MS*	*F*	*p*
Imagery	1	81.00	81.00	18.17	<.01
Strategy	1	25.00	25.00	5.61	<.05
AB	1	30.25	30.25	6.79	<.05
Error	12	53.50	4.458		
Total	15	189.75			

$F_{.05}(1, 12\ df) = 4.75$ $\quad F_{.01}(1, 12\ df) = 9.33$

Interpretation. The interaction is significant ($p < .05$). For low imagery words, the difference between using an elaborative strategy and a rote strategy is almost zero. However, for high imagery words, an elaborative strategy produces much better recall than a rote strategy.

Chapter 12

Multiple-Choice Questions

2. 2 4. 4 (7.00) 6. 4 8. 1 10. 1
12. 3 14. 2 16. 4 18. 2 20. 4

Short-answer questions

2. Your experiment should involve participants who contribute data to every level of the independent variable or participants who are matched into groups with the same number of participants as there are levels of the independent variable.

Problems

2.

	Pretest	Posttest	Follow-up
ΣX	72	138	126
ΣX^2	932	3206	2732
$\bar{X}$	12.00	23.00	21.00

$SS_{tot} = 6870.00 - \frac{336^2}{18} = 6870.00 - 6272.00 = 598.00$

$SS_{time} = \frac{72^2}{6} + \frac{138^2}{6} + \frac{126^2}{6} - \frac{336^2}{18} = 6684.00 - 6272.00 = 412.00$

$SS_{subjects} = \frac{45^2}{3} + \frac{52^2}{3} + \frac{57^2}{3} + \frac{50^2}{3} + \frac{63^2}{3} + \frac{69^2}{3} - \frac{336^2}{18} =$
$6402.67 - 6272.00 = 130.67$

$SS_{error} = 598.00 - 412.00 - 130.67 = 55.33$

Source	*SS*	*df*	*MS*	*F*	*p*
Time	412	2	206.00	37.23	< .01
Subjects	130.67	5			
Error	55.33	10	5.533		
Total	512.00	17			

$F_{.01}(2, 10\ df) = 7.56$

$s_{\bar{X}} = \sqrt{\frac{5.533}{6}} = 0.960$ $\quad HSD_{.05} = 5.27$ $\quad HSD_{.01} = 3.88$

HSD (pre vs. post) = 11.45; $p < .01$
HSD (pre vs. follow-up) = 9.37; $p < .01$
HSD (post vs. follow-up) = 2.08; NS

Interpretation. The workshop is successful; participants know significantly more after the workshop than before ($p < .01$). The amount remembered three months later is not significantly different from what was remembered right after the workshop, but is significantly greater than the pretest scores.

Chapter 13

Multiple-Choice Questions

2. 3	4. 1	6. 2	8. 3	10. 4
12. 1	14. 2	16. 1	18. 2	20. 3

Interpretation

2. Because $\chi^2_{.05}$ (2 *df*) = 5.99, the null hypothesis can be rejected; the two variables are not independent. Among those with low GPAs, males are more likely to skip class (62 % of the low GPA skippers were males). However, among those with high GPAs, females are more likely to skip class (69 % of the high GPA skippers were female).

Problems

2. Goodness of fit.
   The expected frequencies are:

   $\frac{9}{16}(186) = 104.63$; $\quad \frac{3}{16}(186) = 34.88$; $\quad \frac{1}{16}(186) = 11.63$

O	*E*	*O* – *E*	$(O-E)^2$	$\frac{(O-E)^2}{E}$
90	104.63	-14.63	214.04	2.05
39	34.88	4.12	16.97	.49
39	34.88	4.12	16.97	.49
18	11.36	6.38	40.64	3.50
				$\chi^2 = 6.53$

$\chi^2_{.05}$ (3 *df*) = 7.82. Thus, retain the null hypothesis and conclude that 9:3:3:1 model is an adequate fit for these data.

4.

	College Educated	High School Dropouts	Σ
S.A.	2	4	6
M.A.	7	10	17
S.A.	15	24	39
N.	19	21	40
S.D.	23	18	41
M.D.	12	9	21
S.D.	6	3	9
Σ	84	89	173

Expected Frequencies:

$\frac{(6)(84)}{173} = 2.9133$ $\frac{(6)(89)}{173} = 3.0867$

$\frac{(17)(84)}{173} = 8.2543$ $\frac{(17)(89)}{173} = 8.7457$

$\frac{(39)(84)}{173} = 18.9364$ $\frac{(39)(89)}{173} = 20.0636$

$\frac{(40)(84)}{173} = 19.4220$ $\frac{(40)(89)}{173} = 20.5780$

$\frac{(41)(84)}{173} = 19.9075$ $\frac{(41)(89)}{173} = 21.0925$

$\frac{(21)(84)}{173} = 10.1965$ $\frac{(21)(89)}{173} = 10.8035$

$\frac{(9)(84)}{173} = 4.3699$ $\frac{(9)(89)}{173} = 4.6301$

Because the four extreme categories have expected frequencies less than 5, it is advisable to combine the "strong" and "moderate" categories and recomputed frequencies for them. The revised table is:

	College Educated	High School Dropouts	Σ
Strong and moderate agreement	9	14	23
Slight agreement	15	24	39
Neutral	19	21	40
Slight disagreement	23	18	41
Moderate and strong disagreement	18	12	30
Σ	84	89	173

The new expected frequencies are:

$\frac{(23)(84)}{173} = 11.1676$ $\frac{(23)(89)}{173} = 11.8324$

$\frac{(30)(84)}{173} = 14.5665$ $\frac{(30)(89)}{173} = 15.4335$

The other expected frequencies are unchanged.

O	E	$O - E$	$(O\text{-}E)^2$	$\frac{(O-E)^2}{E}$
9	11.1676	-2.1676	4.6985	0.4207
15	18.9364	3.9364	15.4952	0.8183
19	19.4220	0.4220	0.1781	0.0092
23	19.9075	3.0925	9.5636	0.4804
18	14.5665	3.4335	11.7890	0.8093
14	11.8324	2.1676	4.6985	0.3971
24	20.0636	3.9364	15.4950	0.7723
21	20.5780	0.4220	0.1781	0.0087
18	21.0925	3.0925	9.5363	0.4534
12	15.4335	3.4335	11.7890	0.7639
				$\chi^2 = 4.9333$

The *df* for this problem is (*R*-1)(*C-1*). With categories combined, (5-1)(2-1) = 5. The required χ^2 for the .05 level is 11.07. A χ^2 of 4.93 does not permit you to say that there is any relationship between education and degree of agreement or disagreement with the statement.

Chapter 14

Multiple-Choice Questions

2. 1 4. 2 6. 4 8. 1 10. 2

12. 2 14. 1 16. 2 18. 3

Interpretation

2. A. Mann-Whitney *U* test
   B. Spearman r_s
   C. Wilcoxon matched-pairs signed-ranks *T* test

4. The second page of Table H (boldfaced type; $\alpha = .05$, two-tailed test, For $N_1 = 14$, $N_2 = 9$) shows

that a U value of 31 or less is required for significance. Thus, those who had a sex education course were significantly less sexually active than those who did not have such a course.

6. Pilot competency is more highly correlated with general knowledge than it is with a task that has components similar to those used by pilots. Two comments are in order. Flying an airplane well has a heavy cognitive component, and the correlations among any two motor skills are uniformly low.

Problems

2.

Matched Pairs	Untrained	Trained	D	Signed Ranks
	Attitude Scores.			
1	21	23	-2	-3
2	12	18	-6	-6
3	17	22	-5	-5
4	23	23	0	elim.
5	16	17	-1	-1.5
6	21	24	-3	-4
7	19	27	-8	-7
8	14	13	1	1.5

$\Sigma_{positive} = 1.5$
$\Sigma_{negative} = -26.5$
$T = 1.5$
$N = 7$

For a two-tailed test, Table J shows that a T of 2.0 or less is required for significance at $\alpha = .05$. Because $1.5 < 2.0$, the hypothesis of no difference between trained and untrained nurses may be rejected. Scores of those trained are higher, so attitudes are more positive after the training. The program appears to be effective in improving attitudes toward patients with psychological problems.

4.

Chain A

X	Rank
38	12
26	1
44	18
35	9
37	11
46	20
Σ	71

Chain B

X	Rank
29	4
31	5
34	8
40	14
27	2
28	3
Σ	36

Chain C

X	Rank
41	15
47	21
39	13
43	17
36	10
42	16
Σ	92

Chain D

X	Rank
50	24
45	19
33	7
48	22
32	6
49	23
Σ	101

	A(71)	B(36)	C(92)
B(36)	35		
C(92)	21	56	
D(101)	30	65*	9

From Table K for $N = 6$ and $K = 4$, the critical difference at the .05 level is 62.9. The only difference this great is the difference between Chain B and Chain D. You can say that Chain D has cleaner supermarkets than Chain B. The next question is, "Should you?" This question refers back to the material in Chapter 8 on significance and importance. Notice that scores could range from 1 to 50, but the lowest score was 26. How dirty must a supermarket be to affect the food? Will a little dust on the floor or on the shelf affect the contents of a can of peas or a box of cereal? Again, statistical significance and importance are not synonymous.

Appendix A – Arithmetic and Algebra Review

Problems

2. 205.535

4. 26.94

6. 0.612

8. 0.038

10. 64.763

12. 9.701

14. 10.909

16. 0.496

18. $0.6667 + 0.75 = 1.417$

20. $0.8 + 0.2222 = 1.022$

22. $0.6957 - 0.8462 = -0.151$

24. $0.6667 - 0.8889 = -0.222$

26. $0.8 \times 0.3333 = 0.267$

28. $0.75 \times 0.3333 \times 0.375 = 0.094$

30. $0.75 \div 0.5 = 1.5$

32. $25 \div 0.5 = 50$

34. -40

36. 22

38. 28

40. 421

42. -24

44. -147

46. –2.667

48. 0.714

50. $\frac{10}{27} x100 = 37.037\%$

52. 10 - 6 = 4

54. 4

56. 40

58. 45.5, 58.5

60. -0.03, 0.67

62. 5.664

64. .0000081 This is a case where good judgment suggests you carry more decimal places than the instructions indicate.

Complex Problems

66. $\frac{1^2+3^2}{4(8)} = \frac{1+9}{32} = \frac{10}{32} = 0.313$

68. $\frac{100-90}{\sqrt{(190-150)(110-93)}} = \frac{10}{\sqrt{(40)(17)}} = \frac{10}{\sqrt{680}} = \frac{10}{26.0768}$

$= 0.3835$

70. $36 - 1.96\left(\frac{2}{10}\right) = 36 - 1.96(0.2) = 36 - 0.392 = 35.608$

72. $\sqrt{\frac{21-10.6667}{6}} = \sqrt{\frac{10.3333}{6}} = \sqrt{1.7222} = 1.312$

74. $\frac{\left(14-\frac{157}{16}\right)^2}{1.6575+.8288} = \frac{(14-9.8125)^2}{2.4863} = \frac{(4.1875)^2}{2.4863} = \frac{17.5352}{2.4863} = 7.053$

76. $24 - 8 = 6.42x$

$\frac{16}{6.42} = x$

$2.492 = x$

78.

$3 = \frac{3x+5}{2}$

$2(3) = 3x + 5$

$6 - 5 = 3x$

$x = 0.333$

APPENDIX B – Grouped Frequency Distributions and Central Tendency

Problems

2.

Class Interval	f	fX
45-47	3	138
42-44	1	43
39-41	4	160
36-38	3	111
33-35	3	102
30-32	2	62
27-29	6	168
24-26	9	225
21-23	5	95
18-20	5	95
15-17	4	64
12-14	3	39
9-11	2	20
Σ	50	1337

$\bar{X} = \frac{1337}{50} = 26.74$
Median = 25
Mode = 25

Median location = $\frac{N+1}{2} = \frac{50+1}{2} = 25.5$. Counting from the bottom of the distribution, the are 19 scores below 24-26 so the median is located among the 9 scores in that interval. The median IQ is the midpoint of the interval, which is 24.

The mode is the midpoint of the interval 24-26 because the 9 scores in that interval are more than any other; mode = 25.

4.

Class Interval	f	fX
39-41	2	80
36-38	10	370
33-35	8	272
30-32	7	217
27-29	4	112
24-26	3	75
21-23	2	44
18-20	2	38
15-17	1	16
12-14	1	14
Σ	40	1237

$\bar{X} = \frac{1237}{40} = 30.93$
Median = 32.5
Mode = 37