APPENDIX 3

ANSWERS TO EXERCISES AND PROBLEMS

Note: We have provided answers to SPSS problems using the format and terminology employed by SPSS. We have noted differences in format and presentation in comparison to the conventions in your textbook.

On the fill-in-the-blank items, it is possible that more than one answer may be correct. We have listed the answer we intended, but if your answer is synonymous with ours, then it is also correct. *Slight* differences in answers to the problems are probably the result of rounding differences and should be ignored.

CHAPTER 1

Fill-in-the-blanks

(1) statistics
(2) statistics
(3) statistics
(4) consumer
(5) behavior
(6) variable
(7) vocabulary
(8) consumer
(9) literature
(10) tools
(11) language
(12) practice
(13) vocabulary
(14) anxiety
(15) uncertainty
(16) practice
(17) pencils
(18) calculator
(19) class attendance

Problems

2. **a.** 344
b. 46.4
c. 2.31
d. 14
e. 142
f. 120.14

CHAPTER 2

Fill-in-the-blanks

(1) variable
(2) independent
(3) dependent
(4) independent
(5) dependent
(6) population
(7) sample
(8) parameter
(9) statistic
(10) biased
(11) random
(12) replacement
(13) stratified
(14) scales
(15) measurement
(16) frequency
(17) nominal
(18) ordinal
(19) interval
(20) ratio
(21) ratio
(22) interval
(23) Descriptive
(24) inferential
(25) descriptive

Problems

1. **a.** independent, kind of drug; dependent, score on IQ test
b. independent, presence (or absence) of others; dependent, performance
c. independent, odd versus even answer; dependent, seconds to solution
d. independent, illumination level; dependent, time to identify the stimulus

2. **a.** ratio
b. nominal
c. ordinal
d. nominal
e. ratio
f. ordinal
g. ordinal
h. interval

3. **a.** parameter, characteristic of the population of all left-handed boys at Fairlawn High School
b. statistic, 15 randomly selected students constitutes a sample
c. parameter, characteristic of the population of all inmates
d. statistic, characteristic of the sample consisting of every 100th name

4. **a.** descriptive
b. inferential
c. inferential
d. descriptive
e. inferential
f. descriptive

CHAPTER 3

Fill-in-the-blanks

(1) highest
(2) lowest
(3) scores
(4) *X*
(5) frequency distribution
(6) frequency
(7) *f*
(8) omitted
(9) continuous
(10) discrete
(11) apparent
(12) half
(13) half
(14) real
(15) percentage
(16) *N*
(17) sum
(18) size
(19) accumulate
(20) lower or previous
(21) Cum *f*

Problems

1.

X	*f*	Cum *f*	Cum %age
15	5	15	100.00
14	1	10	66.67
13	4	9	60.00
12	2	5	33.33
10	1	3	20.00
8	1	2	13.33
6	1	1	6.67
	N = 15		

2.

X	*f*
4	1
3	1
2	4
1	6
0	3
	N = 15

The sample sizes are equivalent.

3. a.

X	*f*
37	1
33	1
31	1
30	1
29	1
28	1
27	1
26	2
25	6
24	2
23	3

X	*f*
22	1
21	4
20	3
19	3
18	3
17	5
16	4
15	5
14	1
12	1
	N = 50

b.

X	*Real Limits*	*f*	*%age f*
37	36.5–37.5	1	2
33	32.5–33.5	1	2
31	30.5–31.5	1	2
30	29.5–30.5	1	2
29	28.5–29.5	1	2
28	27.5–28.5	1	2
27	26.5–27.5	1	2
26	25.5–26.5	2	4
25	24.5–25.5	6	12
24	23.5–24.5	2	4
23	22.5–23.5	3	6
22	21.5–22.5	1	2
21	20.5–21.5	4	8
20	19.5–20.5	3	6
19	18.5–19.5	3	6
18	17.5–18.5	3	6
17	16.5–17.5	5	10
16	15.5–16.5	4	8
15	14.5–15.5	5	10
14	13.5–14.5	1	2
12	11.5–12.5	1	2
		N =50	

4.

Apparent Limit	Real Limits
a. 25	24.5–25.5
b. 11.7	11.65–11.75
c. 12.55	12.545–12.555
d. 7.853	7.8525–7.8535

5.

X	*f*	Cum *f*	%age *f*
45	1	20	5
42	1	19	5
39	1	18	5
37	1	17	5
36	1	16	5
35	2	15	10
34	2	13	10
33	1	11	5
32	3	10	15
31	1	7	5
30	2	6	10
28	1	4	5
26	2	3	10
25	1	1	5
	N = 20		

6.

Distribution A

X	*f*	%age *f*
79	1	1.18
77	1	1.18
76	1	1.18
74	2	2.35
65	2	2.35
64	3	3.53
62	2	2.35
60	2	2.35
57	5	5.88
56	4	4.71
54	6	7.06
53	7	8.24
52	6	7.06
51	7	8.24
50	10	11.76
49	7	8.24
48	6	7.06
47	4	4.71
45	2	2.35
44	1	1.18
42	3	3.53
40	2	2.35
39	1	1.18
	N = 85	

Distribution B

X	*f*	%age *f*
79	1	3.13
78	2	6.25
77	2	6.25
76	2	6.25
75	3	9.38
74	2	6.25
73	2	6.25
71	1	3.13
70	2	6.25
69	3	9.38
68	4	12.50
65	1	3.13
60	1	3.13
58	2	6.25
55	1	3.13
50	1	3.13
44	1	3.13
39	1	3.13
	N = 32	

7.

X	Real Limits	*f*	Cum *f*	Cum %age
49	48.5–49.5	1	169	100.00
48	47.5–48.5	6	168	99.41
47	46.5–47.5	6	162	95.86
46	45.5–46.5	11	156	92.31
45	44.5–45.5	13	145	85.80
44	43.5–44.5	16	132	78.11
43	42.5–43.5	8	116	68.64
42	41.5–42.5	15	108	63.91
41	40.5–41.5	16	93	55.03
40	39.5–40.5	13	77	45.56
39	38.5–39.5	9	64	37.87
38	37.5–38.5	5	55	32.54
37	36.5–37.5	3	50	29.59
36	35.5–36.5	7	47	27.81
35	34.5–35.5	8	40	23.67
34	33.5–34.5	3	32	18.93

X	Real Limits	f	Cum f	Cum %age
33	32.5–33.5	1	29	17.16
32	31.5–32.5	7	28	16.57
31	30.5–31.5	3	21	12.43
30	29.5–30.5	4	18	10.65
29	28.5–29.5	3	14	8.28
28	27.5–28.5	4	11	6.51
27	26.5–27.5	1	7	4.14
26	25.5–26.5	3	6	3.55
25	24.5–25.5	2	3	1.78
23	22.5–23.5	1	1	0.59
		N = 169		

EXERCISE USING SPSS

Follow these steps:

1. Enter data and name variable **test.**
2. *Analyze>Descriptive Statistics>Frequencies*
3. Highlight and move **test** into the Variable(s) box.
4. *Format >Descending values >Continue*
5. *OK*

```
FREQUENCIES
  VARIABLES=test
  /FORMAT=DVALUE
  /ORDER  ANALYSIS .
```

Frequencies

Statistics

TEST

N	Valid	40
	Missing	0

TEST

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	35.00	8	20.0	20.0	20.0
	34.00	3	7.5	7.5	27.5
	33.00	1	2.5	2.5	30.0
	32.00	7	17.5	17.5	47.5
	31.00	3	7.5	7.5	55.0
	30.00	4	10.0	10.0	65.0
	29.00	3	7.5	7.5	72.5
	28.00	4	10.0	10.0	82.5
	27.00	1	2.5	2.5	85.0
	26.00	3	7.5	7.5	92.5
	25.00	2	5.0	5.0	97.5
	23.00	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

SELF-TEST

1. c, j, h, a, i, b, e

2.

X	Real Limits	f	Cum f	Cum %age
93	92.5–93.5	1	42	100.00
81	80.5–81.5	1	41	97.62
75	74.5–75.5	1	40	95.24
71	70.5–71.5	1	39	92.86
65	64.5–65.5	2	38	90.48
61	60.5–61.5	1	36	85.71
52	51.5–52.5	1	35	83.33
37	36.5–37.5	1	34	80.95
32	31.5–32.5	1	33	78.57
22	21.5–22.5	1	32	76.19
21	20.5–21.5	1	31	73.81
17	16.5–17.5	1	30	71.43
15	14.5–15.5	2	29	69.05
13	12.5–13.5	1	27	64.29
12	11.5–12.5	3	26	61.90
10	9.5–10.5	5	23	54.76
9	8.5–9.5	2	18	42.86
8	7.5–8.5	4	16	38.10
7	6.5–7.5	1	12	28.57
6	5.5–6.5	2	11	26.19
5	4.5–5.5	3	9	21.43
3	2.5–3.5	3	6	14.29
2	1.5–2.5	1	3	7.14
0	–0.5–0.5	2	2	4.76
		$N = 42$		

$$\text{Cum \%age} = \frac{\text{Cum } f}{N}(100)$$

$$\text{Cum \%age of Cum } f \text{ of } 2 = \frac{2}{42}(100) = \frac{200}{42} = 4.76$$

CHAPTER 4

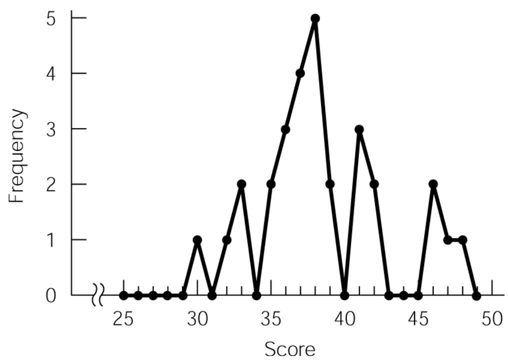
Fill-in-the-blanks

(1) 1,000
(2) graphs
(3) cumulative
(4) histogram
(5) line
(6) *Y*
(7) three-fourths
(8) three-quarters
(9) 0
(10) deviations
(11) scores
(12) frequencies
(13) Score
(14) Frequency
(15) caption
(16) percentages
(17) relative
(18) normal

(19) skewed
(20) positively skewed
(21) negatively skewed
(22) scores
(23) vertical
(24) horizontal
(25) horizontal
(26) bar
(27) frequency
(28) halfway
(29) nominal
(30) arbitrary
(31) stem
(32) leaf
(33) stem
(34) leaf
(35) 13
(36) 3
(37) vertical
(38) leaves
(39) scores
(40) histogram
(41) independent
(42) continuous

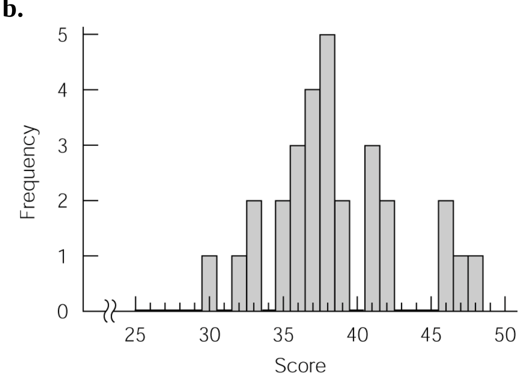
Problems

1. a.



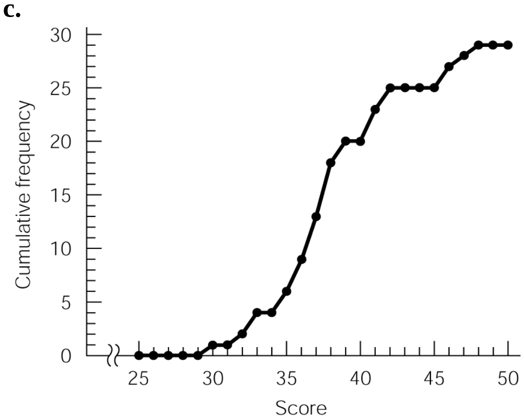
Frequency polygon showing test scores from introductory class.

b.



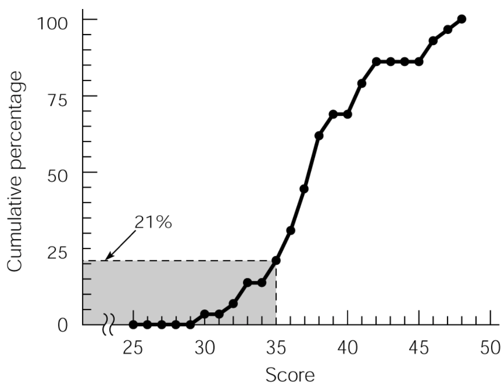
Frequency histogram of introductory class test scores.

c.



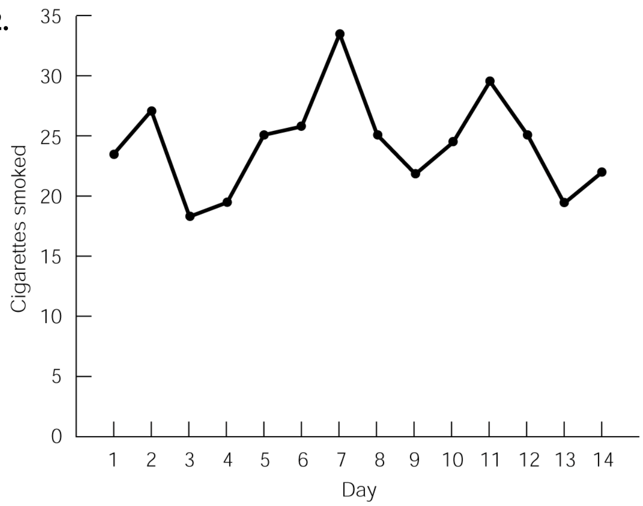
Cumulative frequency polygon of introductory class scores.

d.



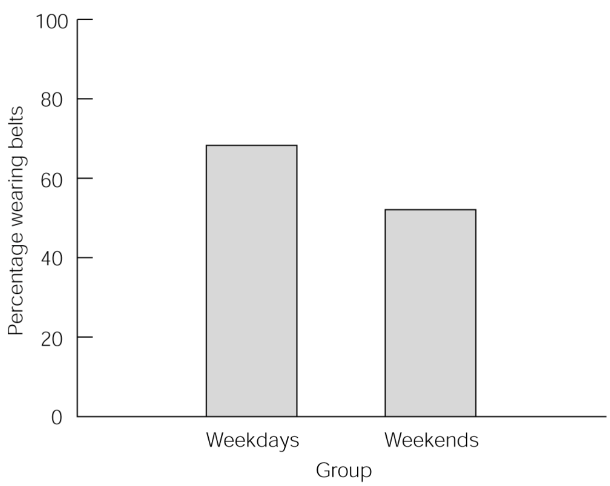
Cumulative percentage polygon of introductory class test scores. Approximately 21% of students made scores of 35 or less.

2.



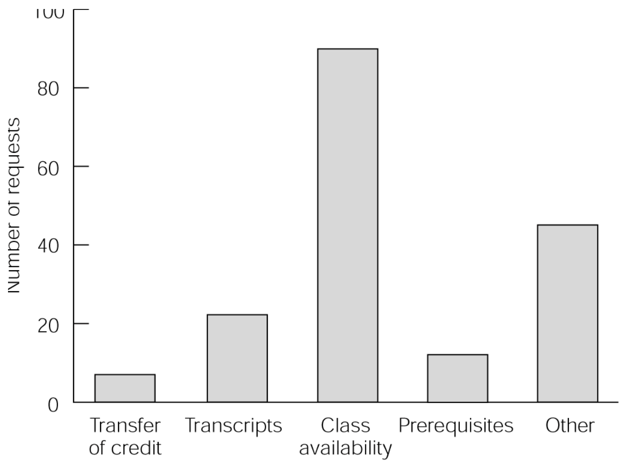
Line graph showing number of cigarettes smoked per day over a 2-week period.

3.



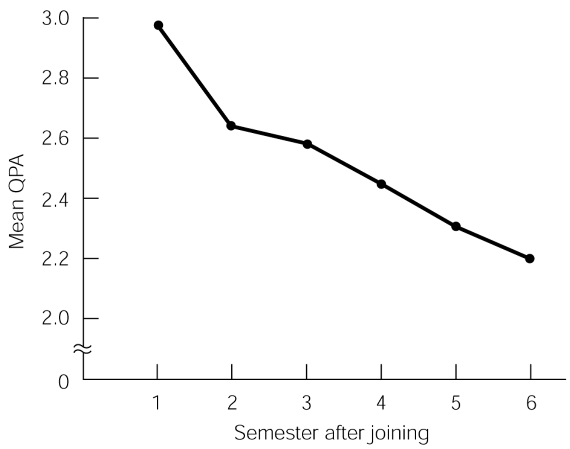
Bar graph showing percentage of people wearing seatbelts stopped for traffic violations on weekdays and weekends.

4.



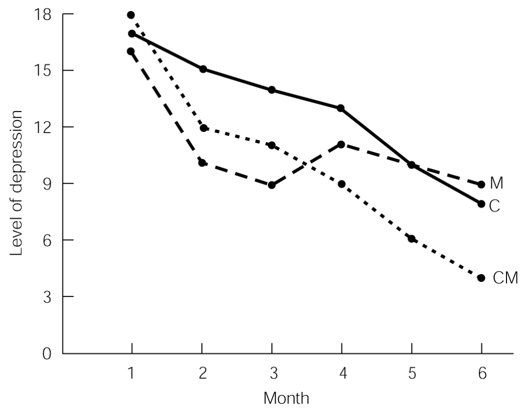
Bar graph showing number of requests for information at the registration office

5.



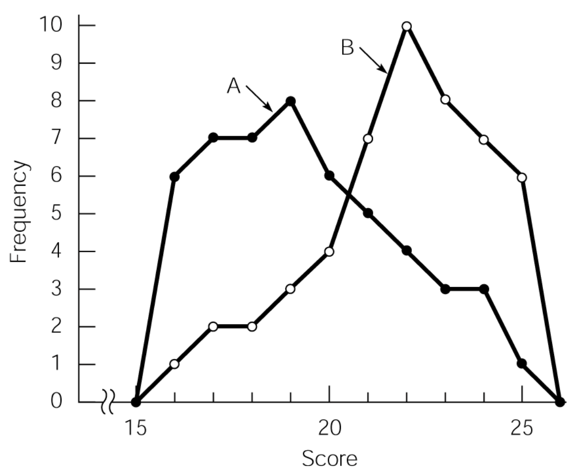
Line graph showing mean QPA by semester after joining a campus organization

6.



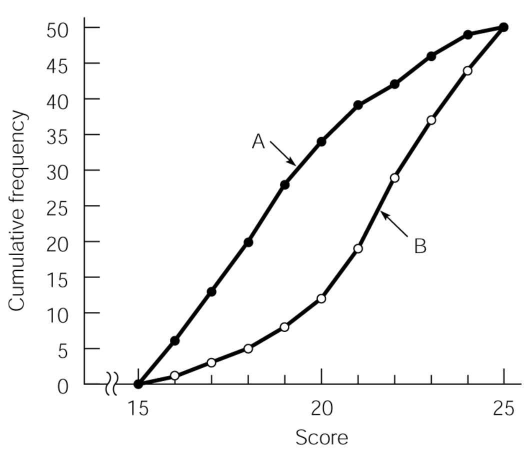
Line graphs showing depression by month of treatment. C = counseling group; M = medication group; CM = counseling and medication group.

7. a.



Frequency polygons showing the shapes of Distributions A (positively skewed) and B (negatively skewed).

b.



Cumulative frequency polygons for Distributions A and B.

8.

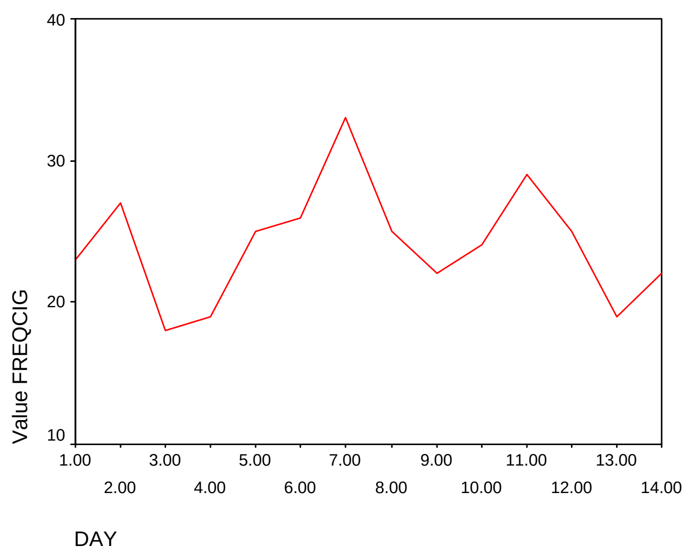
Stems	Leaves										
15	9										
16	6	8	9	7							
17	7	5	7	2							
18	3	8	5	5	5	8	8	8	9		
19	9	7	9	7	2	5	2	9	3	5	8
20	3	7	1	5	4						
21	0										

					8		
					5		
				9	3		
				8	9		
				8	2		
Leaves				8	5		
				5	2	4	
		7	2	5	7	5	
		9	7	5	9	1	
		8	5	8	3	7	
	9	6	7	3	9	3	0
Stems	15	16	17	18	19	20	21

EXERCISES USING SPSS

1.
```
RENAME VARIABLES (fcig=freqcig).
GRAPH
  /LINE(SIMPLE)=VALUE( freqcig ) BY day .
```

Graph



2.

```
EXAMINE
 VARIABLES=speeds
 /PLOT BOXPLOT STEMLEAF
 /COMPARE GROUP
 /STATISTICS NONE
 /CINTERVAL 95
 /MISSING LISTWISE
 /NOTOTAL.
```

Explore

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
SPEEDS	35	100.0%	0	.0%	35	100.0%

SPEEDS

```
SPEEDS Stem-and-Leaf Plot

Frequency    Stem &  Leaf

    1.00       15 .  9
    4.00       16 .  6789
    4.00       17 .  2577
    9.00       18 .  355588889
   11.00       19 .  22335578999
    5.00       20 .  13457
    1.00       21 .  0

Stem width:     10.00
Each leaf:       1 case(s)
```

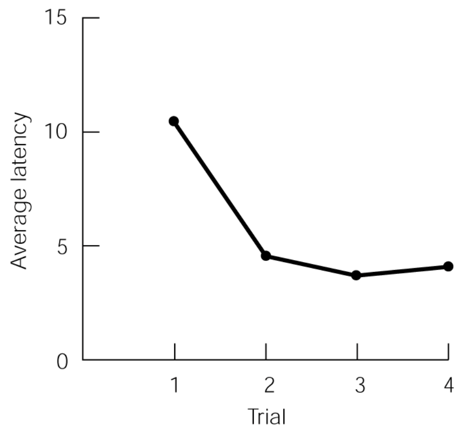
Note that SPSS arranges the leaves in ascending order rather than placing them as they appear in the data set.

SELF-TEST

1. b
2. True
3. c
4.

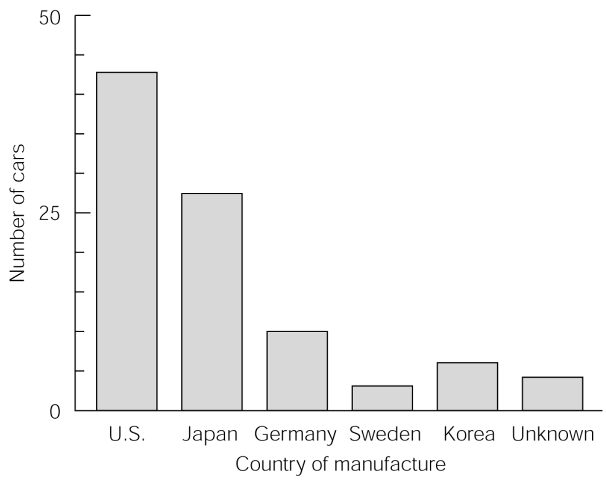
Stems	Leaves
2	9
3	
4	
5	5 4
6	6 5 9
7	6 4 6
8	6 0 6 8 9 9 8 0 4
9	3 1 0 2 2 5

5.



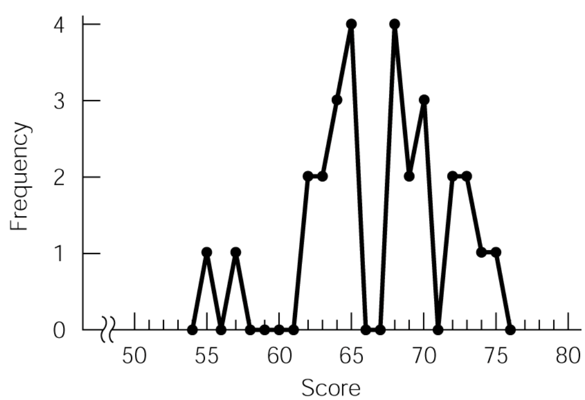
Line graph showing average latency over trials
for rats to leave a platform.

6.



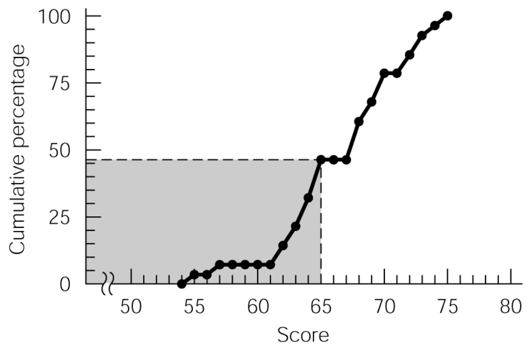
Bar graph showing number of cars made in a particular country
passing through an intersection.

7. a.



Frequency polygon of typing test scores.

b.



Cumulative percentage polygon of typing test scores. Approximately 46% of students typed 65 or fewer words per minute.

CHAPTER 5

Fill-in-the-blanks

(1) middle
(2) mean
(3) median
(4) mode
(5) mode
(6) *Mo*
(7) least
(8) bimodal
(9) 50th
(10) percentile
(11) (*N*/2)th
(12) (*N*/2)th + 1
(13) (*N* + 1)/2th
(14) scores
(15) number
(16) frequencies
(17) $\overline{X}$
(18) μ
(19) hundredths
(20) final
(21) three
(22) drop
(23) up
(24) balancing
(25) 0
(26) mode
(27) median
(28) missing
(29) statistical
(30) stable
(31) unbiased
(32) same
(33) mean
(34) tail
(35) mode
(36) middle or center
(37) frequencies
(38) twice

Problems

1. a. $\overline{X} = 10$
b. $\overline{X} = 8$
c. $\overline{X} = 3$
d. $\overline{X} = 16$

2.

X	f	$X - \bar{X}$	$f(X - \bar{X})$
10	1	4	4
9	2	3	6
8	1	2	2
7	4	1	4
6	6	0	0
5	5	–1	– 5
4	2	–2	– 4
3	1	–3	– 3
2	2	– 4	– 4
	$N = 23$		$\Sigma f(X - \bar{X}) = 0$

$Mo = 6$
$\bar{X} = 6$
Md (counting method) = 6

3. $Mo = 6$, $Md = 6$, $\bar{X} = 5.8$
4. $Mo = 2$, $Md = 3$, $\bar{X} = 2.8$
5. $Mo = 15$, $Md = 14$, $\bar{X} = 12.6$
6. $Mo = 27$, $Md = 27.5$, $\bar{X} = 27.85$
7. with nonresponders: $Md = 35$
omitting nonresponders: $Mo = 33$, $Md = 33$, $\bar{X} = 33.15$
8. **a.** 1.45. If the number in the thousandths place is less than 5, drop it and all the following numbers.
b. 1.56. If the number in the thousandths place is 5 or more, round the preceding digit up.
c. 3.67; same as b
d. 23.33; same as a
e. 7.83; same as b

EXERCISE USING SPSS

1.

```
FREQUENCIES
  VARIABLES=neurot
  /STATISTICS=MEAN MEDIAN MODE
  /ORDER  ANALYSIS .
```

Frequencies

Statistics

NEUROT

N	Valid	50
	Missing	0
Mean		5.8000
Median		6.0000
Mode		6.00

NEUROT

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	2	4.0	4.0	4.0
	2.00	4	8.0	8.0	12.0
	3.00	4	8.0	8.0	20.0
	4.00	5	10.0	10.0	30.0
	5.00	7	14.0	14.0	44.0
	6.00	8	16.0	16.0	60.0
	7.00	7	14.0	14.0	74.0
	8.00	5	10.0	10.0	84.0
	9.00	4	8.0	8.0	92.0
	10.00	4	8.0	8.0	100.0
	Total	50	100.0	100.0	

SELF-TEST

1. a, a, c, a, b, b, c, c
2. *Mo* = –1, *Md* = –0.5, $\bar{X}$ = –1.28
3. *Mo* = 122, *Md* = 127, $\bar{X}$ = 125.46

CHAPTER 6

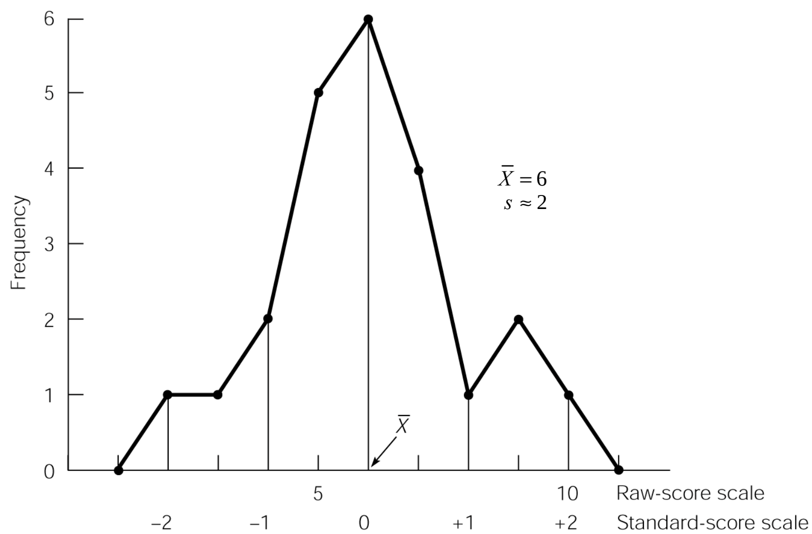
Fill-in-the-blanks

(1) spread or dispersion
(2) variance
(3) standard deviation
(4) range
(5) *AD*
(6) variance
(7) absolute value
(8) variance
(9) standard deviation
(10) biased
(11) underestimate
(12) $N - 1$
(13) square root
(14) computational
(15) computations
(16) baseline
(17) range
(18) 4
(19) sum of squares
(20) mean
(21) *SS*
(22) standard
(23) *z*
(24) *z* score
(25) sign
(26) negative
(27) mean
(28) feel
(29) one-sixth
(30) positive
(31) square root

Problems

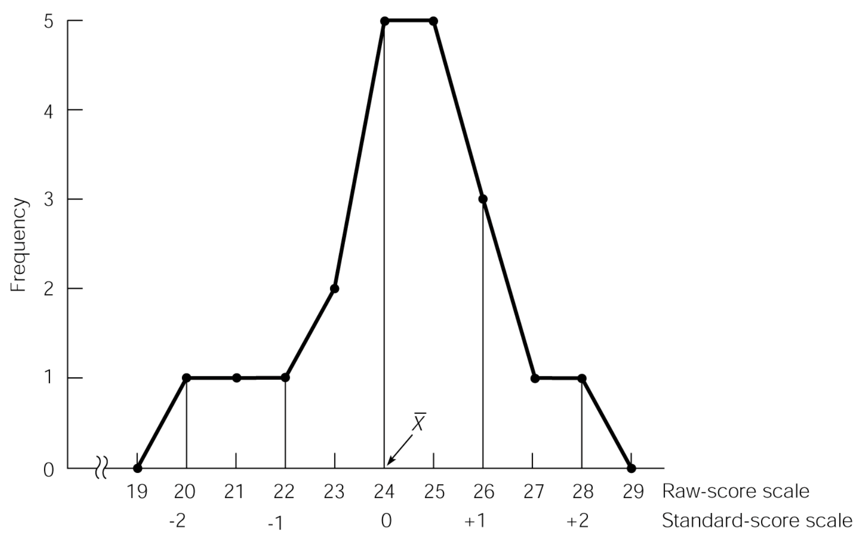
1. *AD* = 1.45, so Karl is correct; $R = 7$; $s_{approx} = 1.75$; $s^2 = 3.61$; $s = 1.90$
2. a. $R = 8$, $s_{approx} = 2$, $s^2 = 3.64$, $s = 1.91$

b.



Frequency polygon of correctly solved analogy problems showing both the raw-score scale and the standard-score scale.

3. $R = 65$, $s_{approx} = 16.25$, $s^2 = 264.75$, $s = 16.27$, $z_{96} = 0.91$. The score 2 standard deviation units below $\overline{X}$ is 48.6.
4. $R = 4$, $s_{approx} = 1$, $s^2 = 1.62$, $s = 1.27$
5. $s_A = 0.16$, $s_B = 0.11$. Applicant B gets the job.
6. $\overline{X} = 74.33$, $s = 13.64$. All employees scoring less than 74.33 – 13.64 = 60.69 are required to take another week of training. Five employees scored less than 60.69.
7. $\overline{X} = 24.35$, $s^2 = 3.71$, $s = 1.93$



Frequency polygon showing both the raw-score scale and the standard-score scale.

8. **a.** $z_{3.75} = 1.42$
b. $z_{2.10} = -0.57$
c. A score of 1.3 is 1.53 standard deviation units below the mean.
d. $X = 4.02$
e. $X = 0.77$

EXERCISES USING SPSS

1.
```
DESCRIPTIVES
  VARIABLES=correct  /SAVE
  /STATISTICS=MEAN STDDEV VARIANCE RANGE MIN MAX .
```

Descriptives

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
CORRECT	23	8.00	2.00	10.00	6.0000	1.9069	3.636
Valid N (listwise)	23						

2.
```
COMPUTE correctz = (correct-6.0)/1.9069 .
EXECUTE .
```

	Correct	Zcorrect	correctz
1	10.00	2.09762	2.10
2	9.00	1.57321	1.57
3	9.00	1.57321	1.57
4	8.00	1.04881	1.05
5	7.00	.52440	.52
6	7.00	.52440	.52
7	7.00	.52440	.52
8	7.00	.52440	.52
9	6.00	.00000	.00
10	6.00	.00000	.00
11	6.00	.00000	.00
12	6.00	.00000	.00
13	6.00	.00000	.00
14	6.00	.00000	.00
15	5.00	−.52440	−.52
16	5.00	−.52440	−.52
17	5.00	−.52440	−.52
18	5.00	−.52440	−.52
19	5.00	−.52440	−.52
20	4.00	−1.04881	−1.05
21	4.00	−1.04881	−1.05
22	3.00	−1.57321	−1.57
23	2.00	−2.09762	−2.10

SELF-TEST

1. c, g, f, d, b, e, h
2. The size of z tells how far the score is from the mean in standard deviation units.
3. The sign of a z score indicates whether the score is above (+) or below (–) the mean.
4. **a.** $s^2 = 3.27$, $s = 1.81$
b. $z_6 = 0.92$, $z_3 = 0.73$
c. 7.05, 0.71

CHAPTER 7

Fill-in-the-blanks

(1)	Statistical hypotheses	(13)	personal	(25)	independent
(2)	probability	(14)	subjective	(26)	Conditional probability
(3)	statistics	(15)	Bayesian	(27)	$p(B \mid A)$
(4)	population	(16)	inference	(28)	$p(A) \times p(B \mid A)$
(5)	gambler's fallacy	(17)	Bayesian	(29)	Conditional
(6)	probability	(18)	wrong or distorted	(30)	A
(7)	any	(19)	conclusions	(31)	B
(8)	patterns or tendencies	(20)	sum	(32)	probability
(9)	guarantees	(21)	addition	(33)	controversial
(10)	Theoretical	(22)	$p(A) + p(B)$	(34)	two
(11)	empirical	(23)	multiplication	(35)	symmetrical
(12)	relative frequency	(24)	$p(A, B) = p(A) \times p(B)$	(36)	normal probability distribution

Problems

1. There's no change in the probability of getting another head on the 10th flip: $p = .5$.
2. **a.** $p = .019$
b. $p = .077$
c. $p = .308$
d. $p = .25$
e. $p = .75$
3. **a.** $p = .20$
b. $p = .40$
c. $p = .00$
d. $p = .87$
e. $p = .40$
f. $p = .33$
4. **a.** $p = .50$
b. $p = .50$
5. **a.** $p = .25$
b. $p = .75$
c. True–false is easier.
6. **a.** $p = .001$
b. $p = .003$

c. $p = .006$
d. $p = .01$

7. **a.** $p = .028$
b. $p = .25$
c. $p = .11$
d. $p = .083$
e. $p = .17$
f. $p = .33$

8. **a.** $p = .00$
b. $p = .13$
c. $p = .20$
d. $p = .40$

9. **a.** $p = .00667$
b. $p = .0134$
c. $p = .0267$
d. $p = .0535$
e. $p = .000268$

10. p(3 heads in 5 flips) = .346
p(4 heads in 5 flips) = .259

11. **a.** $p = .38$
b. $p = .538$
c. Yes, added information about personality type increases the probability of holding office.
d. Extraversion and holding office are related, not independent. Knowing personality type changes the probability of holding office.

SELF-TEST

1. a
2. d
3. **a.** $1/3 = .33$
b. $1/3 \times 1/3 \times 1/3 = .04$
4. **a.** $(1/6)^3 = .0046$
b. $2/6 \times 2/6 \times 3/6 = .056$
c. $(.056)(3) = .168$
5. **a.** $1/6 \times 2/5 \times 3/4 = .05$
b. $2/6 \times 1/5 \times 3/4 = .05$
c. $3/6 \times 2/5 \times 1/4 = .05$
6. **a.** p(held office) = .38
b. p(held office | intuition) = .38
c. No, the added information about personality does not change the probability of holding office.
d. Intuition-sensing personality type and holding office *are* independent. Knowing the personality type does not change the probability of holding office. $p(A|B) = p(A)$ indicates that events A and B are independent.

CHAPTER 8

Fill-in-the-blanks

(1)	Rosetta	(15)	tails	(29)	how many
(2)	Gauss	(16)	standard	(30)	*z* scores
(3)	De Moivre	(17)	6	(31)	added
(4)	empirical	(18)	*z* score	(32)	100
(5)	Empirical	(19)	below	(33)	1
(6)	limiting	(20)	above	(34)	*z* score
(7)	means	(21)	B	(35)	both
(8)	probability	(22)	C	(36)	half
(9)	probability	(23)	Percentile rank	(37)	percentage area
(10)	*z* scores	(24)	draw	(38)	100
(11)	A	(25)	*z* score	(39)	normal curve
(12)	area	(26)	raw score	(40)	reasonable
(13)	symmetrical	(27)	A	(41)	form
(14)	central	(28)	A		

Problems

1. **a.** $z_{89.6} = 1.21$
b. $z_{61.5} = -0.72$
c. 48.8
d. 95.2
e. 50.25 or less, 93.75 or more

2. **a.** 21.57%
b. 21.57%
c. $z = 1.75$; yes
d. $z = 1.28$
e. 7.53%
f. 2.50%
g. 99.02%
h. 10.03%

3. **a.** 92.22
b. 6.68
c. 12
d. 73.69
e. 40.70
f. 8
g. 35.77 or less, 71.23 or more
h. 21.74 or less, 85.26 or more

4. **a.** 9
b. .1949
c. 62
d. 15.28% (*Note*: 47.6 is as deviant from 78.8 as is 110.)
e. 36.09 or less, 121.51 or more

5. **a.** 79.02 mph
b. 637.87 or 638 automobiles

c. 5.82%
d. 83.89%
e. 435.4 or 435 automobiles
f. 51.99 mph or less, 82.61 mph or more

SELF-TEST

1. The standard normal curve has a mean of 0 and a standard deviation of 1.
2. False; areas are always positive, whereas z scores below the mean are negative.
3. **a.** 9.98 or 10 applicants
b. 85.02 or 85 applicants
c. 31.21%
d. .0721
e. 58.5
f. 28.89 or below, 67.11 or above

CHAPTER 9

Fill-in-the-blanks

(1) estimates
(2) population
(3) estimation
(4) estimates
(5) unbiased
(6) *N*
(7) means
(8) frequency
(9) sampling distribution of means
(10) μ
(11) normal
(12) central limit theorem
(13) standard deviation
(14) standard error
(15) $\sigma_{\bar{X}}$
(16) $z = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}}$
(17) raw score
(18) sample
(19) $\bar{X}$
(20) *s*
(21) $N - 1$
(22) underestimate
(23) degrees of freedom
(24) values
(25) restrictions
(26) *z* score
(27) *t*
(28) Gosset
(29) Student
(30) confidence interval
(31) 99%
(32) *z* scores
(33) *t* scores
(34) B
(35) $N - 1$
(36) sample size
(37) interval
(38) null hypothesis
(39) H_0
(40) μ
(41) μ
(42) H_1
(43) nondirectional
(44) directional
(45) null
(46) alpha or α
(47) .05
(48) rejection
(49) test
(50) decision
(51) conclusion
(52) context
(53) same
(54) less
(55) one tail
(56) more
(57) direction
(58) making a decision
(59) I
(60) α
(61) α
(62) decrease
(63) II
(64) β
(65) decreases
(66) power
(67) power = $1 - \beta$
(68) α
(69) size
(70) less
(71) larger
(72) greater
(73) effect size

(74) meta-analysis
(75) effect size
(76) abandon
(77) error rate
(78) power
(79) II or β
(80) power
(81) reasonable
(82) mean
(83) *df*
(84) sign
(85) negative
(86) rejecting

Problems

1. **a.** $s_{\bar{X}}$ = 0.87
b. $s_{\bar{X}}$ = 0.79
c. $s_{\bar{X}}$ = 0.40
d. $s_{\bar{X}}$ = 2.68
e. $s_{\bar{X}}$ = 2.15

2. **a.** t = ±2.2622
b. t = ±2.5758. ±2.58 are the t scores cutting off the deviant 1% of the normal curve.
t = ±1.9600. ±1.96 are the t scores cutting off the deviant 5% of the normal curve.
c. t = ±2.0141, approximately
t = ±2.6896, approximately
d. The sampling distribution of means becomes more compact with larger sample sizes. Thus, deviant scores are closer to the mean as sample size (and *df*) increases.
e. Use the values for the *df* closest to the observed *df.*

3. **a.** With *df* = 120, 95% CI = 20 ± 0.49 = 19.51 to 20.49
99% CI = 20 ± 0.65 = 19.35 to 20.65
b. 95% CI= 10 ± 0.80 = 9.20 to 10.80
99% CI= 10 ± 1.09 = 8.91 to 11.09
c. 95% CI = 10.5 ± 0.83 = 9.67 to 11.33
99% CI = 10.5 ± 1.11 = 9.39 to 11.61

4. **a.** $t(53) = 2.01$, p < .05. Applicants demonstrate significantly higher Conscientiousness scores than the general population.
b. 95% CI = 54.2 ± 4.40 = 49.80 to 58.60
c. 99% CI = 54.2 ± 5.86 = 48.34 to 60.06

5. **a.** 95% CI = 29.6 ± 2.09 = 27.51 to 31.69
b. 99% CI = 29.6 ± 2.78 = 26.82 to 32.38

6. **a.** $\sigma_{\bar{X}}$ = 2.10
b. $s_{\bar{X}}$ = 1.70
c. $t(24) = 0.82$, $p > .05$
d. If you made an error, it was a Type II error (failure to reject a false null hypothesis).

7. $t(25) = –2.55$, $p < .05$. Significantly fewer calculators were assembled in the last hour of the shift.

8. **a.** $s_{\bar{X}}$ = 2.43
b. 95% CI = 77.6 ± 5.35 = 72.25 to 82.95. No, 71.1 is not in the interval.
c. $t(11) = 2.67$, $p < .05$
d. Working with the psychologist significantly improved free-throw shooting.

9. **a.** $s_{\bar{X}}$ = 1.28
b. $\sigma_{\bar{X}}$ = 1.30. This is very similar to $s_{\bar{X}}$.
c. $t(9) = –1.40$, $p > .05$. The sample probably came from the population with μ = 22.5.
d. 95% C1 = 20.85 ± 2.67 = 18.18 to 23.52

EXERCISE USING SPSS

```
T-TEST
  /TESTVAL=9
  /MISSING=ANALYSIS
  /VARIABLES=ncorrect
  /CRITERIA=CIN (.95) .
```

T-Test

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
NCORRECT	20	10.6500	3.0826	.6893

One-Sample Test

	Test Value = 9					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
NCORRECT	2.394	19	.027	1.6500	.2073	3.0927

Verbal skills of females were significantly higher this year than over the last 2 years, $t(19) = 2.39$, $p = .027$.

```
T-TEST
  /TESTVAL=0
  /MISSING=ANALYSIS
  /VARIABLES=ncorrect
  /CRITERIA=CIN (.95) .
```

T-Test

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
NCORRECT	20	10.6500	3.0826	.6893

Only the 95% CI is correct in the following output.

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
NCORRECT	15.451	19	.000	10.6500	9.2073	12.0927

We can be 95% confident that the verbal skills of females, as measured by mean number of correctly unscrambled sentences, was at least 9.21 and at most 12.09 sentences.

SELF-TEST

1. b
2. b

3. c
4. Its mean is equal to μ. The larger the sample sizes, the more nearly the distribution approximates the normal curve; the larger the sample sizes, the smaller the standard error of the mean.
5. **a.** $t(216) = 1.38$, $p > .05$. The program has not improved reading significantly.
   b. 95% CI = 28.2 ± 1.15 = 27.05 to 29.35
6. **a.** $t(12) = -4.50$, $p < .01$. Couples experiencing marital difficulty engaged in significantly fewer nods.
   b. 99% CI = 22.6 ± 6.44 = 16.16 to 29.04
7. **a.** $\bar{X} = 58.42$
   b. $s^2 = 173.36$
   c. $s = 13.17$
   d. $s_{\bar{X}} = 3.80$
   e. 95% CI = 58.42 ± 8.36 = 50.06 to 66.78
   f. $t(11) = 2.43$, $p < .05$. Students seeking counseling exhibit more hypochondriasis than would be expected from test norms.

CHAPTER 10

Fill-in-the-blanks

(1) two
(2) independent
(3) random
(4) randomly
(5) pairs
(6) mean
(7) difference
(8) distribution
(9) polygon
(10) standard error
(11) 0
(12) normal
(13) smaller
(14) $\bar{X}_1 - \bar{X}_2$
(15) $\mu_1 - \mu_2$
(16) $\sigma_{\bar{X}_1 - \bar{X}_2}$
(17) $z_{\bar{X}_1 - \bar{X}_2} = \dfrac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sigma_{\bar{X}_1 - \bar{X}_2}}$
(18) $t_{\bar{X}_1 - \bar{X}_2} = \dfrac{\bar{X}_1 - \bar{X}_2}{s_{\bar{X}_1 - \bar{X}_2}}$
(19) number
(20) variance
(21) same population
(22) 0
(23) $N_1 + N_2 - 2$
(24) two-tailed
(25) predictions
(26) one-tailed
(27) before
(28) one-tailed
(29) easier
(30) normally
(31) variances
(32) large
(33) little
(34) robust
(35) rejection
(36) power
(37) matched pairs
(38) repeated measures
(39) control
(40) within-subjects
(41) reducing
(42) Counterbalancing
(43) double-blind
(44) differences
(45) standard error
(46) algebraic
(47) pairs
(48) $N - 1$
(49) t ratio
(50) independent
(51) dependent
(52) positive
(53) sign
(54) difference
(55) algebraically
(56) reject

Problems

1. **a.** $s_{\bar{X}_1 - \bar{X}_2} = 1.62$
   b. $s_{\bar{X}_1 - \bar{X}_2} = 0.67$
   c. $s_{\bar{X}_1 - \bar{X}_2} = 0.41$
2. $t(33) = -4.41$, $p < .01$. Pilots made fewer errors (failure to respond) than navigators.
3. $t(7) = 2.95$, $p < .05$. The adults with a family history of alcoholism had a higher level of the metabolite of alcohol in their blood 30 minutes after drinking alcohol.

4. $t(30) = -15.89$, $p < .01$. Performance was better on the recognition test; more nouns were recognized than were recalled.
5. a. Yes, this is an attempted replication of an effect in which "stupid" rats perform worse than "intelligent" rats. Group "Stupid" should have a larger mean number of errors than Group "Intelligent."
   b. $t(28) = 5.70$, $p < .005$, one-tailed test. Group "Stupid" rats made more errors.
6. $t(9) = -3.39$, $p < .01$. The average heart rate increased following exposure to the slides of known conservatives.
7. $t(48) = 2.91$, $p < .01$. The final averages were higher in the lecture group.
8. $t(1{,}356) = -2.59$, $p < .01$. The average freshman ACT score at Private University is higher than at State University. Even though there is little difference in the means, the large sample sizes result in a small standard error and a more powerful test.
9. $t(9) = 2.42$, $p < .05$. There was less error in distance estimation when the student used both eyes.
10. $t(26) = 1.50$, $p > .05$. Children and young adults did not differ in ESP ability.

EXERCISES USING SPSS

1.

```
T-TEST
  GROUPS=group(1 2)
  /MISSING=ANALYSIS
  /VARIABLES=wpm
  /CRITERIA=CIN(.95) .
```

T-Test

Group Statistics

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
WPM	1.00	10	410.6000	85.3635	26.9943
	2.00	10	514.2000	75.7889	23.9666

Independent Samples Test

		Levene's Test for Equality of Variances	
		F	Sig.
WPM	Equal variances assumed	.153	.700
	Equal variances not assumed		

Independent Samples Test

		t-test for Equality of Means			
		t	df	Sig. (2-tailed)	Mean Difference
WPM	Equal variances assumed	-2.870	18	.010	-103.6000
	Equal variances not assumed	-2.870	17.751	.010	-103.6000

Independent Samples Test

		t-test for Equality of Means		
			95% Confidence Interval of the Difference	
		Std. Error Difference	Lower	Upper
WPM	Equal variances assumed	36.0983	-179.4398	-27.7602
	Equal variances not assumed	36.0983	-179.5161	-27.6839

Conclusion: Reading speed was significantly greater for the group that attended the speed reading course than for people who did not attend, $t(18) = -2.87$, $p = .01$.

2.
```
T-TEST
  PAIRS= noclass  WITH class (PAIRED)
  /CRITERIA=CIN(.95)
  /MISSING=ANALYSIS.
```

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	NOCLASS	410.6000	10	85.3635	26.9943
	CLASS	514.2000	10	75.7889	23.9666

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	NOCLASS & CLASS	10	.428	.217

Paired Samples Test

		Paired Differences					
					95% Confidence Interval of the Difference		
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t
Pair 1	NOCLASS - CLASS	-103.6000	86.5373	27.3655	-165.5051	-41.6949	-3.786

Paired Samples Test

		df	Sig. (2-tailed)
Pair 1	NOCLASS - CLASS	9	.004

For the between-groups design used in Exercise 1, $t = -2.87$, $p = .010$. For the dependent-groups design used in Exercise 2, $t = -3.79$, $p = .004$. The dependent-groups or paired-samples design is more powerful.

SELF-TEST

1. Properties of the sampling distribution of the mean differences:
  a. Its mean is equal to 0.
  b. The larger the sample sizes, the more closely the distribution approximates the normal curve.
  c. The larger the sample sizes, the smaller the standard error of the mean differences.
2. A *t* test for independent samples is used when data are gathered from unrelated (independent) groups, such as when a control group is compared to a separate experimental group.
3. A *t* test for dependent samples is used when data are gathered from the same, related, or matched samples on two occasions (repeated measures), such as when participants are pretested, receive a treatment, and then are posttested.
4. e (a and b are correct)
5. $t(22) = 0.79$, $p > .05$. Leadership style did not significantly influence worker productivity.
6. $t(9) = -3.79$, $p < .01$. The course significantly improved reading speed.

CHAPTER 11

Fill-in-the-blanks

(1) two
(2) different
(3) analysis of variance
(4) tedious
(5) I
(6) true
(7) between-subjects
(8) repeated measures
(9) population
(10) mean
(11) score
(12) additivity
(13) sum
(14) component parts
(15) between-groups
(16) key deviations
(17) grand mean
(18) between-groups
(19) large
(20) within-groups
(21) between-groups
(22) total
(23) within-groups
(24) individual differences
(25) treatment effect
(26) between
(27) within
(28) 1.00
(29) large
(30) total
(31) within
(32) between
(33) scores
(34) squared scores
(35) total
(36) total
(37) $\sum X^2_g$
(38) $\sum X^2$
(39) subtraction
(40) *df*
(41) mean
(42) *F* ratio
(43) MS_w
(44) groups
(45) $N - K$
(46) C
(47) rejected
(48) positively
(49) 1.00
(50) Post-ANOVA
(51) increasing
(52) post-ANOVA
(53) a priori
(54) means
(55) sample sizes
(56) powerful
(57) protected
(58) *F* ratio
(59) significant
(60) LSD
(61) $\text{LSD}_\alpha = t_\alpha \sqrt{MS_w \left(\frac{1}{N_1} + \frac{1}{N_2} \right)}$
(62) α
(63) β
(64) Table of Differences
(65) pairwise
(66) equal
(67) HSD
(68) $\text{HSD}_\alpha = q_\alpha \sqrt{\frac{MS_w}{N_g}}$
(69) studentized range statistic
(70) D
(71) honestly significant difference
(72) same
(73) two
(74) control
(75) variance
(76) error
(77) subjects
(78) SS_{error}
(79) denominator

(80) SS_{error}
(81) subjects
(82) three parts
(83) subjects
(84) df_{subj}
(85) subjects
(86) MS_{error}
(87) negative
(88) SS_{tot}
(89) df
(90) $N - 1$
(91) $N - 1$
(92) N_g
(93) F
(94) t
(95) q
(96) positive
(97) absolute
(98) large

Problems

1. $\sum X_1 = 66,\ \sum X_2 = 45,\ \sum X_3 = 30,\ \sum X_4 = 70,\ \sum X = 211$

$\sum X_2^1 = 558,\ \sum X_2^2 = 279,\ \sum X_3^2 = 138,\ \sum X_4^2 = 620,\ \sum X^2 = 1{,}595$

$N_1 = 8$, $N_2 = 8$, $N_3 = 8$, $N_4 = 8$, N = 32

$SS_{tot} = 203.72$

$SS_w = 72.38$

$SS_b = 131.34$

ANOVA Summary Table

Source	*SS*	*df*	*MS*	*F*
Between groups	131.34	3	43.78	16.94
Within groups	72.38	28	2.585	
Total	203.72	31		

The computed value of *F is* 16.94. The *df* for the numerator is 3 and the *df* for the denominator is 28. The table values required for rejection of H_0 are 2.95 at the 5% level and 4.57 at the 1% level. What is your decision? Reject H_0 at the 1% level and conclude that the groups differ significantly. The treatments had an effect on how closely a phobic student would approach a live snake.

2. $LSD_{.05} = 1.65$; $LSD_{.01} = 2.22$.

Table of Differences

	Group 3 3.750	Group 2 5.625	Group 1 8.250	Group 4 8.750
Group 3 3.750		1.875*	4.500**	5.000**
Group 2 5.625			2.625**	3.125**
Group 1 8.250				0.500
Group 4 8.750				

Note. *$p < .05$; **$p < .01$.

Conclusion: Group 3, which got both relaxation training and imagery training, had significantly lower behavioral avoidance scores (displayed less fear) than any of the other groups. Group 2 participants, who had imagery training, were significantly less fearful than Groups 1 and 4 participants, who did not differ from each other.

3. $SS_{tot} = 39.28$, $SS_w = 37.92$, $SS_b = 1.36$

ANOVA Summary Table

Source	*SS*	*df*	*MS*	*F*
Between groups	1.36	3	0.453	$F = 0.36$
Within groups	37.92	30	1.264	$F_{crit}(3, 30) = 2.92$ ($p = .05$)
Total	39.28	33		

Thus, $F(3, 30) = 0.36$, $p > .05$. There's no evidence that the sleeping aids affected the speed of sleep onset.

4. $F(2, 21) = 359.54$, $p < .01$. Different levels of preflight illumination had an effect on time to complete dark adaptation.

5. $LSD_{.05} = 2.31$; $LSD_{.01} = 3.14$.

Table of Differences

	Group C 4.50	Group B 9.75	Group A 32.50
Group C 4.50		5.25**	28.00**
Group B 9.75			22.75**
Group A 32.50			

Note. *p < .05; **p < .01.

Conclusion: All comparisons were significant, with Group C pilots who spent 30 minutes wearing red-tinted goggles having the shortest times to dark adaptation, followed by Group B pilots (30 minutes in a dimly lighted room), and Group A pilots (30 minutes in a bright room).

6. $F(3, 24) = 41.15$, $p < .01$. Mathematics anxiety varied over time in the course.

7. $LSD_{.05} = 0.83$; $LSD_{.01} = 1.12$.

Table of Differences

	9 Weeks 6	6 Weeks 7	3 Weeks 9	First Day 10
9 Weeks 6		1*	3**	4**
6 Weeks 7			2**	3**
3 Weeks 9				1*
First Day 10				

Note. *p < .05; **p < .01.

Conclusion: All pairwise comparisons were significant, with students showing progressively less math anxiety with passage of time in the course.

8. $F(2, 18) = 40.95$, $p < .01$. Fatigue affected time to assemble pocket calculators.

9. $HSD_{.05} = 0.74$; $HSD_{.01} = 0.96$.

Table of Differences

		Beginning 22.1	Middle 23.1	End 24.7
Beginning	22.1		1.0**	2.6**
Middle	23.1			1.6**
End	24.7			

Note. *$p < .05$; **$p < .01$.

Conclusion: All pairwise comparisons were significant. The average time to assemble pocket calculators got progressively longer as the shift progressed.

10. $F(2, 14) = 17.06$, $p < .01$. The amount of dark adaptation affected the number of object detections.

11. $LSD_{.05} = 1.32$; $LSD_{.01} = 1.84$.

Table of Differences

		1 Minute 2.5	15 Minutes 5.0	30 Minutes 6.0
1 Minute	2.5		2.5**	3.5**
15 Minutes	5.0			1.0
30 Minutes	6.0			

Note. *$p < .05$; **$p < .01$.

Conclusion: Object identification was significantly better after 15 minutes and after 30 minutes in the dark than after 1 minute. There was no significant difference in identification between 15 and 30 minutes in the dark.

12. $F(3, 32) = 0.88$, $p > .05$. The different diets had no effect on errors to learn the visual discrimination task.

EXERCISES USING SPSS

1.

```
ONEWAY
  colratio BY diet
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC = LSD ALPHA(.05).
```

Oneway

Descriptives

COLRATIO

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean: Lower Bound	95% Confidence Interval for Mean: Upper Bound	Minimum	Maximum
1.00	10	2.2800	.3824	.1209	2.0065	2.5535	1.60	2.80
2.00	10	1.7200	.1619	5.121E-02	1.6042	1.8358	1.50	2.00
3.00	9	2.1222	.3032	.1011	1.8891	2.3553	1.60	2.50
4.00	7	2.3429	.4077	.1541	1.9658	2.7199	1.60	2.80
Total	36	2.0972	.3953	6.589E-02	1.9635	2.2310	1.50	2.80

ANOVA

COLRATIO

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.185	3	.728	7.096	.001
Within Groups	3.285	32	.103		
Total	5.470	35			

Post Hoc Tests

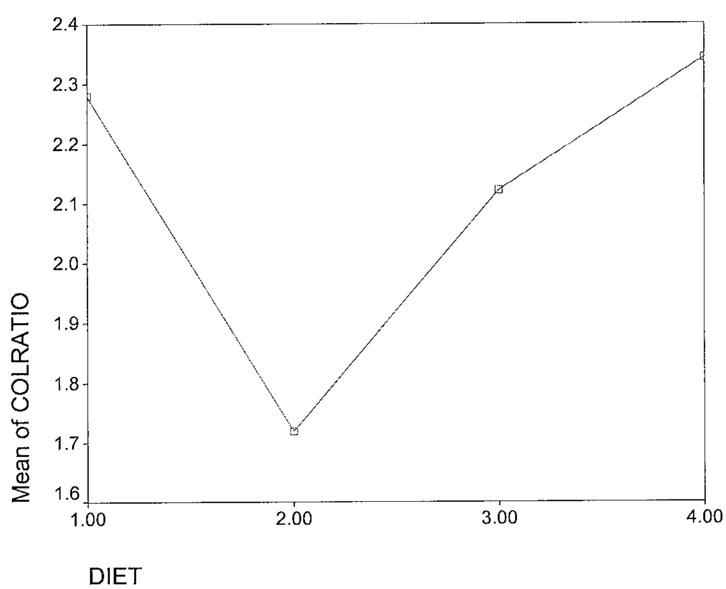
Multiple Comparisons

Dependent Variable: COLRATIO
LSD

(I) DIET	(J) DIET	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
1.00	2.00	.5600*	.143	.000	.2681	.8519
	3.00	.1578	.147	.292	-.1421	.4576
	4.00	-6.2857E-02	.158	.693	-.3845	.2587
2.00	1.00	-.5600*	.143	.000	-.8519	-.2681
	3.00	-.4022*	.147	.010	-.7021	-.1024
	4.00	-.6229*	.158	.000	-.9445	-.3013
3.00	1.00	-.1578	.147	.292	-.4576	.1421
	2.00	.4022*	.147	.010	.1024	.7021
	4.00	-.2206	.161	.181	-.5495	.1082
4.00	1.00	6.286E-02	.158	.693	-.2587	.3845
	2.00	.6229*	.158	.000	.3013	.9445
	3.00	.2206	.161	.181	-.1082	.5495

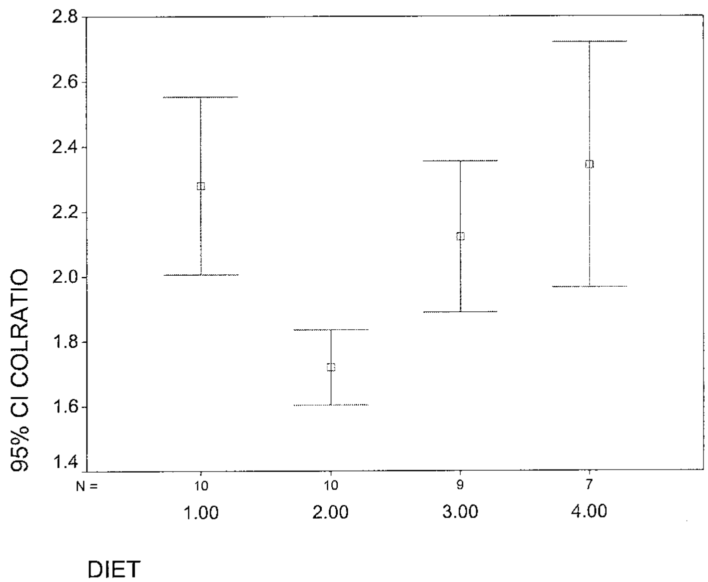
*. The mean difference is significant at the .05 level.

Means Plots



```
GRAPH
  /ERRORBAR( CI 95 )=colratio BY diet
  /MISSING=REPORT.
```

Graph



Conclusion: The ANOVA conducted on the four-diet group indicated there was a significant effect for type of diet on cholesterol ratio—they were not all the same, $F(3, 32) = 7.096$, $p = .001$. Diet 2 had the best (lowest) ratio, significantly lower than Diets 1, 3, and 4, which did not differ by the LSD test, $p < .05$.

2. *Note.* Only the necessary portions of the output are given. Your solution will generate additional output that should be ignored.

```
GLM
  begin middle end
  /WSFACTOR = factor1 3 Polynomial
  /METHOD = SSTYPE(3)
  /PLOT = PROFILE( factor1 )
  /PRINT = DESCRIPTIVE
  /CRITERIA = ALPHA(.05)
  /WSDESIGN = factor1 .
```

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

FACTOR1	Dependent Variable
1	BEGIN
2	MIDDLE
3	END

Descriptive Statistics

	Mean	Std. Deviation	N
BEGIN	22.1000	3.2472	10
MIDDLE	23.1000	3.8137	10
END	24.7000	3.8312	10

Tests of Within-Subjects Effects

Measure: MEASURE_1

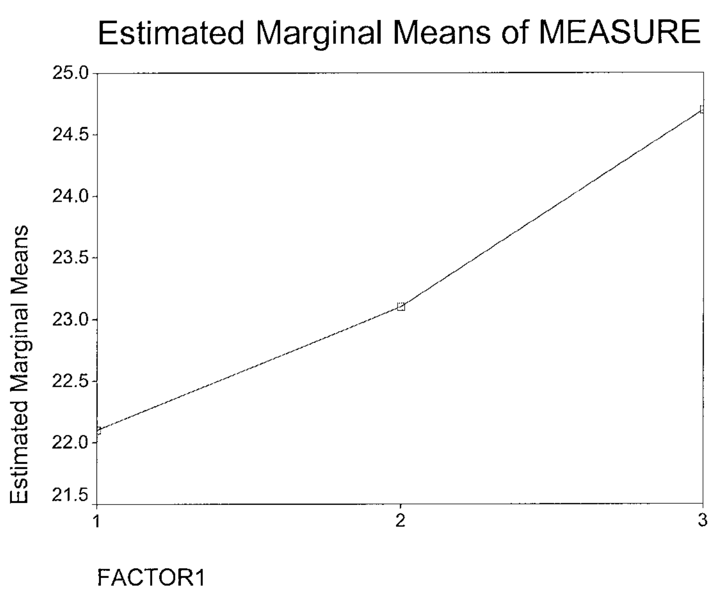
Source		Type III Sum of Squares	df	Mean Square	F	Sig.
FACTOR1	Sphericity Assumed	34.400	2	17.200	40.737	.000
	Greenhouse-Geisser	34.400	1.652	20.821	40.737	.000
	Huynh-Feldt	34.400	1.976	17.406	40.737	.000
	Lower-bound	34.400	1.000	34.400	40.737	.000
Error(FACTOR1)	Sphericity Assumed	7.600	18	.422		
	Greenhouse-Geisser	7.600	14.870	.511		
	Huynh-Feldt	7.600	17.787	.427		
	Lower-bound	7.600	9.000	.844		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	16286.700	1	16286.700	418.442	.000
Error	350.300	9	38.922		

Profile Plots



SELF-TEST

1. b
2. False. Further testing is necessary to determine which groups differ significantly.
3. j, b, l, f, h, c, a, d, k, i
4. $F(3, 32) = 7.12$, $p < .01$. The total cholesterol/HDL ratios were significantly affected by the diets.
5. $F(2, 12) = 16.78$, $p < .01$. There's a significant change in object conservation ability as the children get older.
   $LSD_{.05} = 5.27$; $LSD_{.01} = 7.38$.

Table of Differences

		9 Months 2	12 Months 4	15 Months 15
9 Months	2		2	13**
12 Months	4			11**
15 Months	15			

Note. *$p < .05$; **$p < .01$.

Conclusion: There was significantly greater object conservation at 15 months than at either 9 months or 12 months and no difference in ability at the earlier ages.

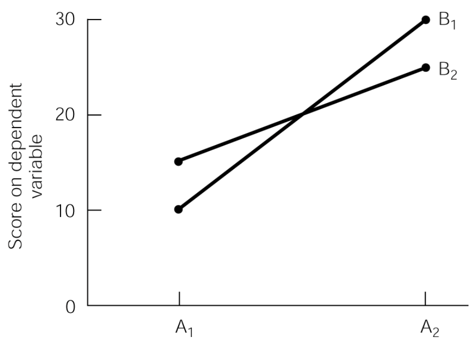
CHAPTER 12

Fill-in-the-blanks

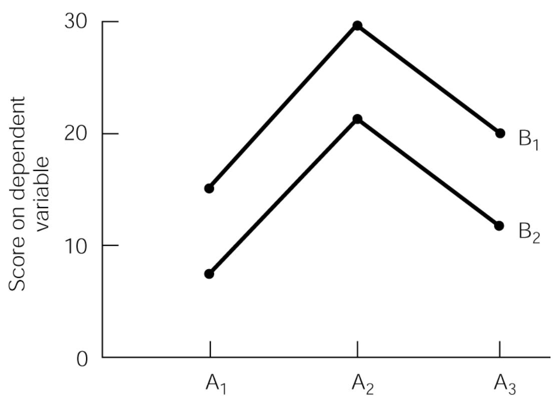
(1) one-way ANOVA
(2) two-way ANOVA
(3) factors
(4) 3×3
(5) main effect
(6) interaction
(7) depends
(8) parallel
(9) converging
(10) crossing
(11) A
(12) lines
(13) interaction
(14) interaction
(15) subjects
(16) powerful
(17) generalization
(18) three
(19) main effects
(20) interaction
(21) MS_w
(22) interaction
(23) post hoc
(24) interaction

Problems

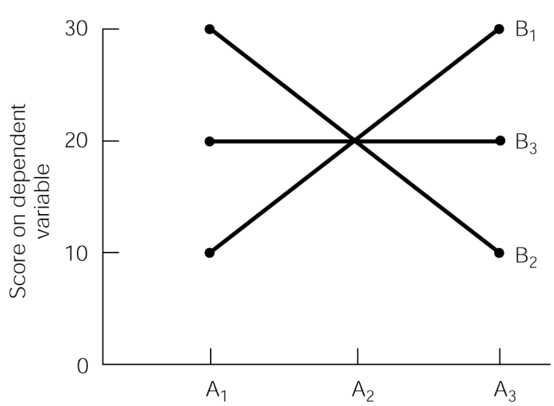
1. **a.** factor A, significant; factor B, nonsignificant; interaction, significant



b. factor A, significant; factor B, significant; interaction, nonsignificant

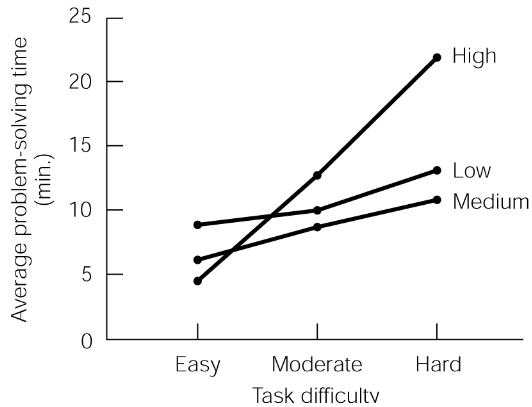


c. factor A, nonsignificant; factor B, nonsignificant; interaction, significant

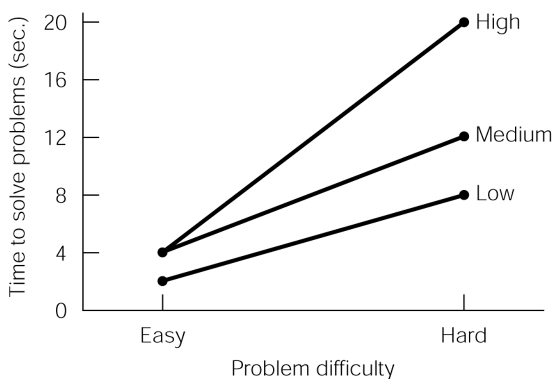


2. **a**. handedness main effect, significant; illumination main effect, significant; interaction, nonsignificant
b. handedness main effect, significant; illumination main effect, nonsignificant; interaction, significant
c. handedness main effect, nonsignificant; illumination main effect, nonsignificant; interaction, significant

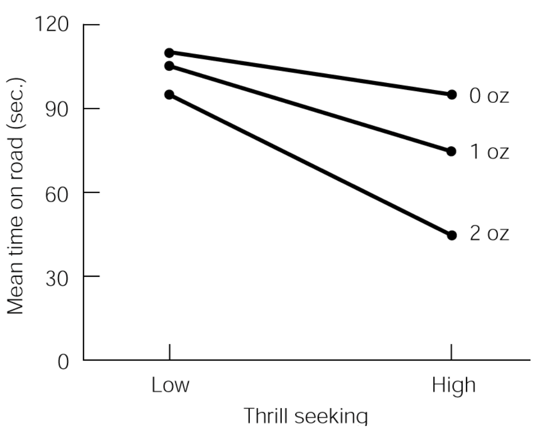
3. task difficulty, significant; anxiety level, significant; interaction, significant



4. anxiety, significant; problem difficulty, significant; interaction, significant



5. thrill seeking, significant; alcohol level, significant; interaction, significant



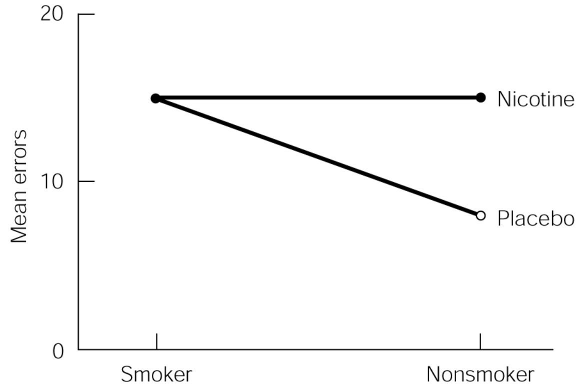
6. **a.** The handedness main effect was significant ($p < .05$); dextrals spent more time on target than sinistrals. The illumination main effect was significant ($p < .05$); performance improved with higher illumination levels. The interaction was not significant.

b. The handedness main effect was significant ($p < .05$); dextrals did better than sinistrals overall. The illumination main effect was not significant ($p > .05$). The handedness/illumination interaction was significant ($p < .01$); dextrals outperformed sinistrals at high and low levels of illumination but did worse at medium levels.

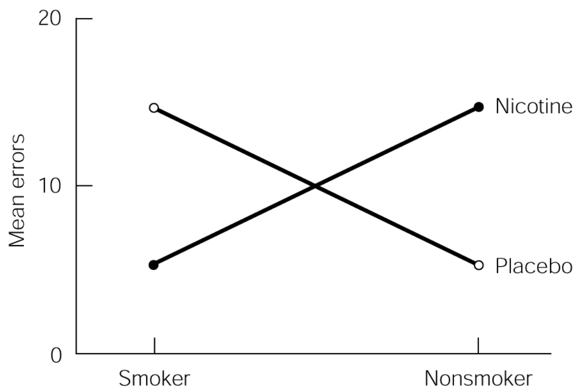
c. Neither main effect was significant ($p > .05$). The interaction effect was significant ($p < .01$); sinistrals improved as light levels increased, whereas dextrals got worse under the same conditions.

SELF-TEST

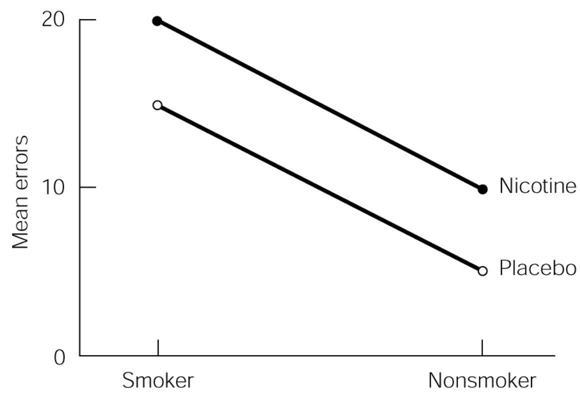
1. c
2. d
3. **a.** main effect (smoking), significant; main effect (nicotine), significant; interaction, significant



b. main effect (smoking), nonsignificant; main effect (nicotine), nonsignificant; interaction, significant



c. main effect (smoking), significant; main effect (nicotine), significant; interaction, nonsignificant



CHAPTER 13

Fill-in-the-blanks

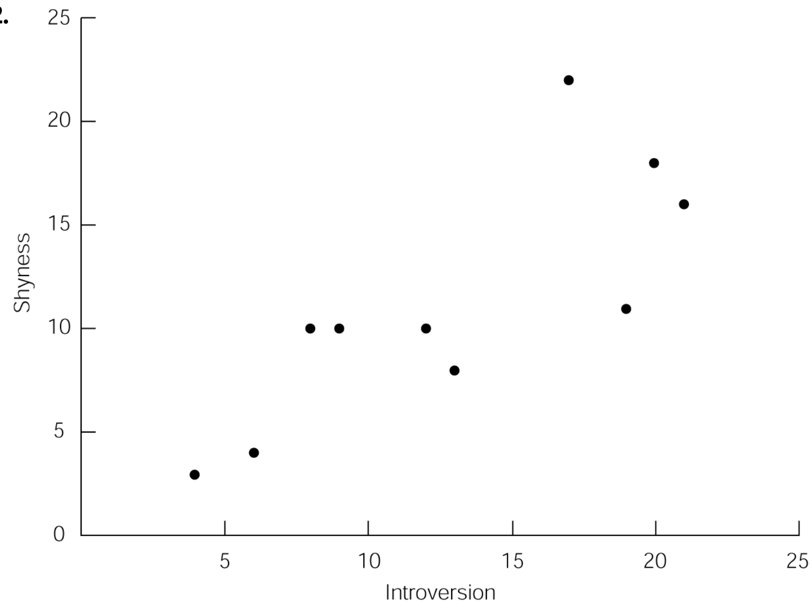
(1) correlation
(2) linear correlation
(3) high
(4) low
(5) positive
(6) scatterplot
(7) negative
(8) downward
(9) zero
(10) absolute value
(11) causes
(12) sufficient
(13) mean
(14) –1 to +1
(15) positive
(16) inverse
(17) zero
(18) covariance
(19) covariance
(20) Pearson correlation
(21) lowers or reduces
(22) no relationship
(23) ρ (rho)
(24) zero
(25) E
(26) *df*
(27) zero
(28) reject
(29) relationship
(30) linear
(31) straight
(32) $Y = bX + a$ or $Y = a + bX$
(33) slope
(34) *Y* axis
(35) deviations
(36) 1.00
(37) multiple regression
(38) coefficient of determination
(39) r^2
(40) large
(41) significance
(42) compute
(43) ordinal
(44) ordinal
(45) rank
(46) ranks
(47) average
(48) point biserial
(49) two
(50) phi coefficient
(51) multiple regression
(52) general linear model
(53) relationships
(54) strength
(55) group
(56) –1 to +1
(57) rank
(58) 1
(59) $\bar{Y} - \left(\frac{rs_y}{s_x}\right)\bar{X}$
(60) algebraically

Problems

1. **a.** negatively correlated
b. positively correlated

c. negatively correlated
d. not correlated
e. negatively correlated
f. not correlated
g. positively correlated

2.



Scatterplot of introversion and shyness.

$r(8) = .81$, $p < .01$; there is a significant positive correlation between introversion and shyness. $r^2 = .66$.

3. $\hat{Y} = 0.79X + 1.01$. If $X = 15$, $\hat{Y} = 12.86$.

4. $r = .92$. $r(15) = .92$, $p < .01$. There is a significant positive correlation between first and last exam scores.
$\hat{Y} = 0.66X + 31.4$
If $X = 95$, $\hat{Y} = 94.1$ or 94. If $X = 55$, $\hat{Y} = 67.7$ or 68.

5. $r_S = .93$, $p < .01$. There is a significant positive relationship between the rankings.

6. $r(6) = .96$, $p < .01$. There is a significant positive relationship between time spent reading the paper and recognition of current events. $r^2 = .92$.

7. $r(7) = -.96$, $p < .01$. The weight of the car is inversely related to its gas mileage.

8. $\hat{Y} = -5.63X + 31.33$. If $X = 4.3$ (4,300 pounds), $\hat{Y} = 7.12$ mpg.

9. $r_S = -.07$, $p > .05$. The correlation between the ratings is not significant.

10. $r_S = .96$, $p < .01$. There is a significant positive correlation between the ratings of the experimenters.

11. $r(8) = .84$, $p < .01$. There is a significant positive relationship for heart rates of subjects viewing different stimuli.

EXERCISES USING SPSS

1.
```
CORRELATIONS
  /VARIABLES=time score
  /PRINT=TWOTAIL NOSIG
  /STATISTICS DESCRIPTIVES
  /MISSING=PAIRWISE .
```

Correlations

Descriptive Statistics

	Mean	Std. Deviation	N
TIME	26.8750	19.0746	8
SCORE	10.5000	5.0427	8

Correlations

		TIME	SCORE
TIME	Pearson Correlation	1.000	.962**
	Sig. (2-tailed)	.	.000
	N	8	8
SCORE	Pearson Correlation	.962**	1.000
	Sig. (2-tailed)	.000	.
	N	8	8

**. Correlation is significant at the 0.01 level (2-tailed).

2.
```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT score
  /METHOD=ENTER time  .
```

Regression

Descriptive Statistics

	Mean	Std. Deviation	N
SCORE	10.5000	5.0427	8
TIME	26.8750	19.0746	8

Correlations

		SCORE	TIME
Pearson Correlation	SCORE	1.000	.962
	TIME	.962	1.000
Sig. (1-tailed)	SCORE	.	.000
	TIME	.000	.
N	SCORE	8	8
	TIME	8	8

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	TIME[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: SCORE

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.962[a]	.925	.912	1.4935

a. Predictors: (Constant), TIME

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	164.616	1	164.616	73.796	.000[a]
	Residual	13.384	6	2.231		
	Total	178.000	7			

a. Predictors: (Constant), TIME

b. Dependent Variable: SCORE

Coefficients[a]

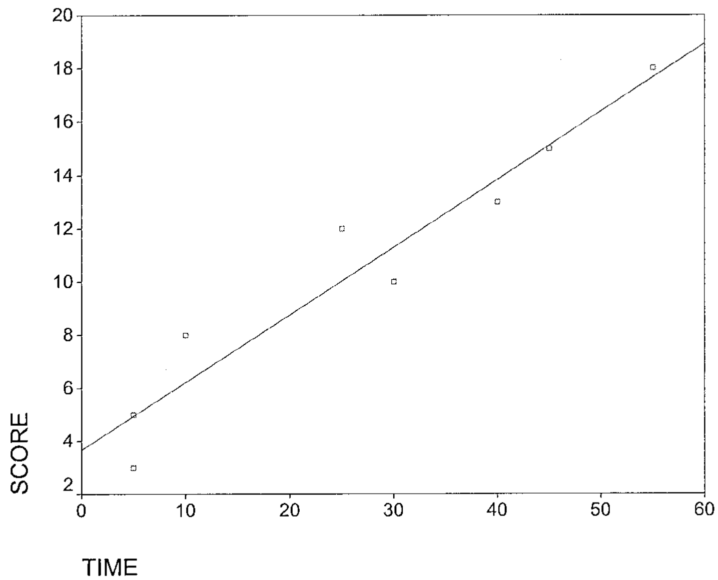
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.667	.955		3.842	.009
	TIME	.254	.030	.962	8.590	.000

a. Dependent Variable: SCORE

$$SCORE = 3.667 + 0.254\,(TIME)$$

```
GRAPH
  /SCATTERPLOT(BIVAR)=time WITH score
  /MISSING=LISTWISE .
```

Graph



3.
```
NONPAR CORR
  /VARIABLES=b a
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE .
```

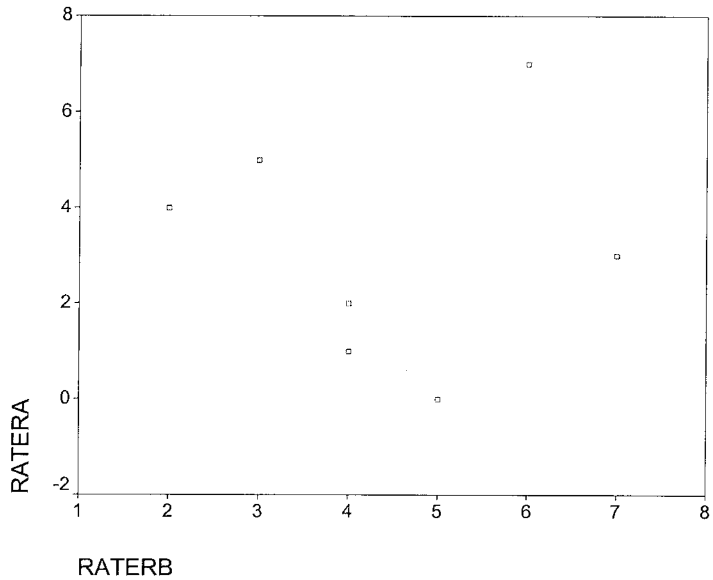
Nonparametric Correlations

Correlations

			B	A
Spearman's rho	B	Correlation Coefficient	1.000	-.098
		Sig. (2-tailed)	.	.817
		N	8	8
	A	Correlation Coefficient	-.098	1.000
		Sig. (2-tailed)	.817	.
		N	8	8

```
GRAPH
  /SCATTERPLOT(BIVAR)=raterb WITH ratera
  /MISSING=LISTWISE .
```

Graph



SELF-TEST

1. e, f, d, g, i, a, h ,b, j, c
2. $r(6) = .89$, $p < .01$. There is a significant positive relationship between math and science ACT scores.
3. $\hat{Y} = 0.93X + 1.50$
science ACT = 32.19 or 32
4. $r_S = .78$, $p < .05$. There is a significant positive relationship between the attractiveness ratings of husbands and wives.

CHAPTER 14

Fill-in-the-blanks

(1) parametric
(2) nonparametric
(3) distribution-free
(4) nominal
(5) frequencies
(6) Chi square
(7) goodness-of-fit
(8) squared
(9) equally distributed
(10) previous research
(11) summed
(12) $K - 1$
(13) levels
(14) research hypothesis
(15) confirmation
(16) power
(17) replication
(18) two
(19) independence
(20) two-sample
(21) independent
(22) contingency
(23) research
(24) marginal

(25)	*N*	(29)	independent	(33)	four
(26)	subtraction	(30)	occurrence	(34)	expected
(27)	(R – 1)(C – 1)	(31)	nonoccurrence	(35)	negative
(28)	frequency	(32)	5		

Problems

1. **a.** 20.77 9.23
   24.23 10.77
   Only one value had to be computed; the remaining three could be found by subtraction.
   b. 23.77 14.85 12.38
   24.23 15.15 12.62
   It was necessary to compute two expected values; four were found by subtraction.
   c. 16.85 33.29 22.86
   9.23 18.24 12.53
   15.92 31.47 21.61
   It was necessary to compute four values; five were found by subtraction.
2. **a.** $\chi^2(1, N = 65) = 13.32, p < .01$.
   b. $\chi^2 (2, N = 103) = 1.60, p > .05$.
   c. $\chi^2 (4, N = 182) = 17.77, p < .01$.
3. $\chi^2 (1, N = 132) = 11.68, p < .01$. Left-handers were less likely to be aphasic than right-handers.
4. $\chi^2 (1, N = 204) = 3.53, p > .05$. Parental alcoholism was not significantly related to alcoholism of the participants in the study.
5. $\chi^2 (1, N = 50) = 25.92, p < .01$. The monkey had generalized its learned response from objects to pictures of objects.
6. $\chi^2 (2, N = 160) = 1.91, p > .05$. Introversion–extroversion did not affect brand preference.
7. $\chi^2 (4, N = 170) = 103.11, p < .01$. The grade assignment significantly departed from a normal distribution.
8. $\chi^2 (1, N = 60) = 3.51, p > .05$. High- and low-self-esteem students did not differ on the test of attitudes toward risk taking.
9. $\chi^2 (1, N = 28) = 11.57, p < .01$. In physiological psychology, the professor scored significantly better than the departmental average.
10. $\chi^2 (1, N = 28) = 2.29, p > .05$. In statistics, the professor did not score better than the departmental average.

EXERCISES USING SPSS

1.

```
NPAR TEST
  /CHISQUARE=item
  /EXPECTED=EQUAL
  /MISSING ANALYSIS.
```

NPar Tests

Chi-Square Test

Frequencies

ITEM

	Observed N	Expected N	Residual
.00	5	14.0	-9.0
1.00	23	14.0	9.0
Total	28		

Test Statistics

	ITEM
Chi-Square[a]	11.571
df	1
Asymp. Sig.	.001

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 14.0.

This result—being above average on 23 of 28 evaluation items—is significantly different from a chance outcome, χ^2 (1, N = 28) = 11.57, p = .001.

2.
```
CROSSTABS
  /TABLES=esteem  BY risk
  /FORMAT= AVALUE TABLES
  /STATISTIC=CHISQ
  /CELLS= COUNT EXPECTED TOTAL
  /BARCHART .
```

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
ESTEEM * RISK	60	100.0%	0	.0%	60	100.0%

ESTEEM * RISK Crosstabulation

			RISK		
			1.00	2.00	Total
ESTEEM	1.00	Count	18	9	27
		Expected Count	14.4	12.6	27.0
		% of Total	30.0%	15.0%	45.0%
	2.00	Count	14	19	33
		Expected Count	17.6	15.4	33.0
		% of Total	23.3%	31.7%	55.0%
Total		Count	32	28	60
		Expected Count	32.0	28.0	60.0
		% of Total	53.3%	46.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.506[b]	1	.061		
Continuity Correction[a]	2.600	1	.107		
Likelihood Ratio	3.552	1	.059		
Fisher's Exact Test				.074	.053
Linear-by-Linear Association	3.448	1	.063		
N of Valid Cases	60				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 12.60.

Students differing in self-esteem do not differ significantly in their risk-taking attitude, χ^2 (1, N = 60) = 3.506, p = .061.

SELF-TEST

1. a, d ,e, h

2. χ^2 (1, N = 201) = 18.49, p < .01. Republicans and Democrats differ in their opinions on increased entitlement spending: Democrats tend to favor it, whereas Republicans tend to oppose it.

3. χ^2 (2, N = 80) = 2.42, p > .05. The diets did not affect problem-solving ability significantly.

CHAPTER 15

Fill-in-the-blanks

(1) nonparametric
(2) distribution free
(3) assumptions
(4) interval
(5) *t* test for independent
(6) independent
(7) ordinal
(8) identical
(9) ranked
(10) *U′*
(11) populations
(12) H
(13) less
(14) *z* score
(15) 1.96
(16) dependent
(17) randomly
(18) ordinal
(19) identical
(20) difference
(21) 0
(22) rank-
(23) sign
(24) less
(25) smaller
(26) normal
(27) *z* score
(28) Mann–Whitney
(29) *F* test or one-way ANOVA
(30) ordinal
(31) ranked
(32) ranks
(33) chi square
(34) $K - 1$
(35) M–W
(36) ranking
(37) *N*
(38) positive
(39) *U′*
(40) 0
(41) absolute
(42) less

Problems

1. **a.** Mann-Whitney test
b. *t* test for dependent samples

c. Kruskal-Wallis test
d. Wilcoxon test
e. Chi-square test of significance

2. $U' = 4$, $p = .02$. Only children were less willing to share toys with other children.

3. $H = 13.42$, $p < .01$. There were significant differences between the diets in their effects on handling scores.
A vs. B: $U' = 12$, $p < .01$. Diet B made rats harder to handle than Diet A.
A vs. C: $U = 47.5$, $p > .05$. Diets A and C did not differ in their effects.
B vs. C: $U = 7$, $p < .01$. Diet B made rats more irritable than Diet C.

4. $U = 36.5$, $p > .05$. There was no difference in the speech patterns of the parents of schizophrenic children.

5. $T = 11$, $p = .05$. Attitudes toward risk taking were more positive after alcohol consumption.

6. $U' = 58.5$, $p > .05$. The groups did not differ in attitudes toward risk taking.

7. $T = 26.5$, $p > .05$. There were no differences in double-blind statements between the parents' letters.

8. $H = 10.20$, $p < .01$. The classes differed significantly.
1 vs. 2: $U = 16$, $p = .01$. Class 1 had higher creativity scores than Class 2.
1 vs. 3: $U = 12$, $p < .01$. Class 1 had higher scores than Class 3.
2 vs. 3: $U = 44$, $p > .05$. Classes 2 and 3 did not differ.

EXERCISES USING SPSS

1.

```
NPAR TESTS
  /M-W= share   BY group(1 2)
  /MISSING ANALYSIS.
```

NPar Tests

Mann-Whitney Test

Ranks

	GROUP	N	Mean Rank	Sum of Ranks
SHARE	1.00	7	4.57	32.00
	2.00	6	9.83	59.00
	Total	13		

Test Statistics[b]

	SHARE
Mann-Whitney U	4.000
Wilcoxon W	32.000
Z	-2.449
Asymp. Sig. (2-tailed)	.014
Exact Sig. [2*(1-tailed Sig.)]	.014[a]

a. Not corrected for ties.

b. Grouping Variable: GROUP

```
EXAMINE
  VARIABLES=share BY group /PLOT=BOXPLOT/STATISTICS=NONE/NOTOTAL
  /MISSING=REPORT.
```

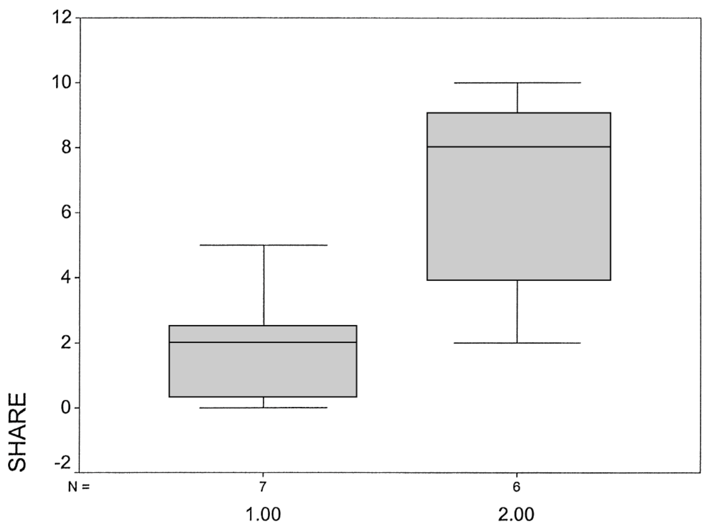
Explore

GROUP

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	GROUP	N	Percent	N	Percent	N	Percent
SHARE	1.00	7	100.0%	0	.0%	7	100.0%
	2.00	6	100.0%	0	.0%	6	100.0%

SHARE



GROUP

The results were that the group of children with siblings indicated more willingness to share toys than the group of only children, $U = 4.0$, $p = .014$.

2.
```
NPAR TEST
  /WILCOXON=schizo  WITH nonschiz (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
NONSCHIZ - SCHIZO	Negative Ranks	5[a]	5.30	26.50
	Positive Ranks	6[b]	6.58	39.50
	Ties	1[c]		
	Total	12		

a. NONSCHIZ < SCHIZO

b. NONSCHIZ > SCHIZO

c. SCHIZO = NONSCHIZ

Test Statistics[b]

	NONSCHIZ - SCHIZO
Z	-.582[a]
Asymp. Sig. (2-tailed)	.560

a. Based on negative ranks.

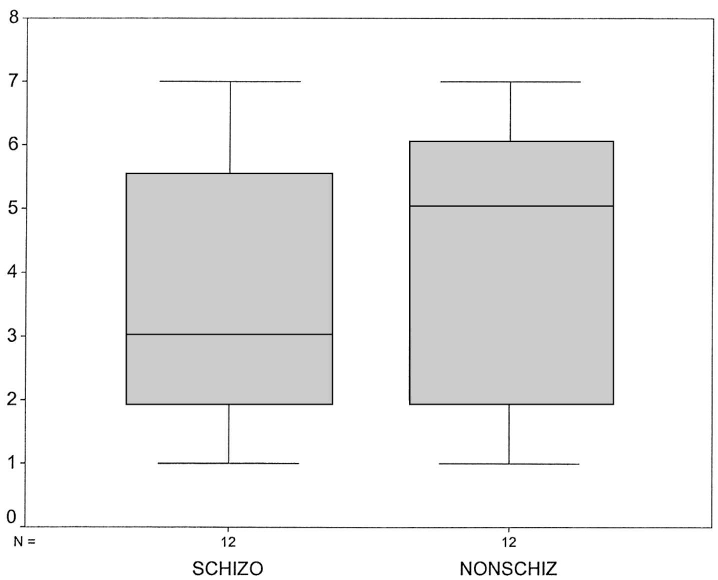
b. Wilcoxon Signed Ranks Test

```
EXAMINE
  VARIABLES=schizo nonschiz /COMPARE VARIABLE/PLOT=BOXPLOT/STATISTICS=NONE
 /NOTOTAL
  /MISSING=LISTWISE .
```

Explore

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
SCHIZO	12	100.0%	0	.0%	12	100.0%
NONSCHIZ	12	100.0%	0	.0%	12	100.0%



The results indicated that there were no differences in ratings of incompatible ideas and feelings in letters from parents of schizophrenic versus nonschizophrenic children by the Wilcoxon test, $T = 26.50$, $p = .56$.

3.
```
NPAR TESTS
  /K-W=creat   BY group(1 3)
  /MISSING ANALYSIS.
```

NPar Tests

Kruskal-Wallis Test

Ranks

	GROUP	N	Mean Rank
CREAT	1.00	10	22.70
	2.00	10	12.70
	3.00	10	11.10
	Total	30	

Test Statistics[a,b]

	CREAT
Chi-Square	10.212
df	2
Asymp. Sig.	.006

a. Kruskal Wallis Test

b. Grouping Variable: GROUP

```
EXAMINE
  VARIABLES=creat BY group /PLOT=BOXPLOT/STATISTICS=NONE/NOTOTAL
  /MISSING=REPORT.
```

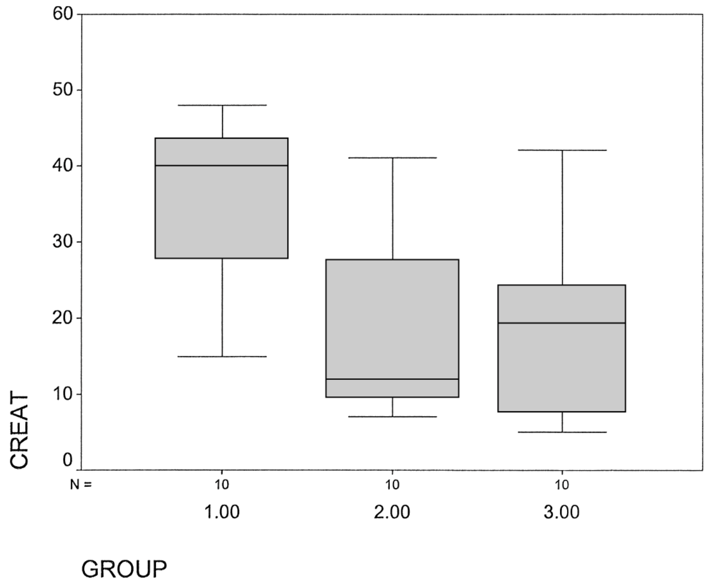
Explore

GROUP

Case Processing Summary

		Cases					
		Valid		Missing		Total	
	GROUP	N	Percent	N	Percent	N	Percent
CREAT	1.00	10	100.0%	0	.0%	10	100.0%
	2.00	10	100.0%	0	.0%	10	100.0%
	3.00	10	100.0%	0	.0%	10	100.0%

CREAT




```
NPAR TESTS
  /M-W= creat   BY group(1 2)
  /MISSING ANALYSIS.
```

NPar Tests

Mann-Whitney Test

Ranks

	GROUP	N	Mean Rank	Sum of Ranks
CREAT	1.00	10	13.90	139.00
	2.00	10	7.10	71.00
	Total	20		

Test Statistics[b]

	CREAT
Mann-Whitney U	16.000
Wilcoxon W	71.000
Z	-2.573
Asymp. Sig. (2-tailed)	.010
Exact Sig. [2*(1-tailed Sig.)]	.009[a]

a. Not corrected for ties.

b. Grouping Variable: GROUP

```
NPAR TESTS
  /M-W= creat   BY group(1 3)
  /MISSING ANALYSIS.
```

NPar Tests

Mann-Whitney Test

Ranks

	GROUP	N	Mean Rank	Sum of Ranks
CREAT	1.00	10	14.30	143.00
	3.00	10	6.70	67.00
	Total	20		

Test Statistics[b]

	CREAT
Mann-Whitney U	12.000
Wilcoxon W	67.000
Z	-2.874
Asymp. Sig. (2-tailed)	.004
Exact Sig. [2*(1-tailed Sig.)]	.003[a]

a. Not corrected for ties.

b. Grouping Variable: GROUP

```
NPAR TESTS
  /M-W= creat   BY group(2 3)
  /MISSING ANALYSIS.
```

NPar Tests

Mann-Whitney Test

Ranks

	GROUP	N	Mean Rank	Sum of Ranks
CREAT	2.00	10	11.10	111.00
	3.00	10	9.90	99.00
	Total	20		

Test Statistics[b]

	CREAT
Mann-Whitney U	44.000
Wilcoxon W	99.000
Z	-.454
Asymp. Sig. (2-tailed)	.650
Exact Sig. [2*(1-tailed Sig.)]	.684[a]

a. Not corrected for ties.

b. Grouping Variable: GROUP

The three classes differed in creativity test scores overall by the Kruskal-Wallis test: χ^2 (2, N = 30) = 10.21, p = .006. Pairwise comparisons using the Mann-Whitney procedure indicated that Class 1 was higher than Class 2, U = 16.0, p = .01; Class 1 was higher than Class 3, U = 12.0, p = .004; and Class 2 and Class 3 were not significantly different, U = 44.0, p = .65. The results can be summarized in terms of creativity scores as follows: Class 3 = Class 2 < Class 1.

SELF-TEST

1. c, a, b

2. H = 9.42, $p < .01$. The diets significantly affected the rats' latencies to leave the lighted platform.
Group 1 vs. Group 2: U' = 16.5, $p > .05$. Groups 1 and 2 do not differ significantly in latency to leave the platform.
Group 1 vs. Group 3: U = 14, $p > .05$. Groups 1 and 3 do not differ significantly in latency to leave the platform.
Group 2 vs. Group 3: U = 2.5, $p < .01$. Group 3 had shorter latencies than Group 2.

3. T = –11, $p < .01$. Assertiveness training decreased the introversion score.