Table 1.1 Example of the Format of a Data Set From a Survey of 20 College Students

ID Number	Gender	Age	College Year	GPA	Average Month # Drinks	Average Month # Times Drugs Used	Religion
1	Female	19	Sophomore	2.3	45	22	Catholic
2	Male	22	Senior	3.1	30	10	Other
3	Female	22	Senior	3.8	0	0	Protestant
4	Female	18	Freshman	2.9	35	5	Jewish
5	Male	20	Junior	2.5	20	20	Catholic
6	Female	23	Senior	3.0	10	0	Catholic
7	Male	18	Freshman	1.9	45	25	Not religious
8	Female	19	Sophomore	2.8	28	3	Protestant
9	Male	28	Junior	3.3	9	0	Protestant
10	Female	21	Junior	2.7	0	0	Muslim
11	Female	18	Freshman	3.1	19	2	Jewish
12	Male	19	Sophomore	2.5	25	20	Catholic
13	Female	21	Senior	3.5	2	0	Other
14	Male	21	Junior	1.8	19	33	Protestant
15	Female	42	Sophomore	3.9	10	0	Protestant
16	Female	19	Sophomore	2.3	45	0	Catholic
17	Male	21	Junior	2.8	29	10	Not religious
18	Male	25	Sophomore	3.1	14	0	Other
19	Female	21	Junior	3.5	5	0	Catholic
20	Female	17	Freshman	3.5	28	0	Jewish

Table 1.2 Example of the Data Presented in Table 1.1 as They Would Be Stored in a Computer Data File

ID Number	Gender	Age	College Year	GPA	Average Month		Religion
					# Drinks	# Times Drugs Used	
1	1	19	2	2.3	45	22	1
2	2	22	4	3.1	30	10	6
3	1	22	4	3.8	0	0	2
4	1	18	1	2.9	35	5	3
5	2	20	3	2.5	20	20	1
6	1	23	4	3.0	10	0	1
7	2	18	1	1.9	45	25	5
8	1	19	2	2.8	28	3	2
9	2	28	3	3.3	9	0	2
10	1	21	3	2.7	0	0	4
11	1	18	1	3.1	19	2	3
12	2	19	2	2.5	25	20	1
13	1	21	4	3.5	2	0	6
14	2	21	3	1.8	19	33	2
15	1	42	2	3.9	10	0	2
16	1	19	2	2.3	45	0	1
17	2	21	3	2.8	29	10	5
18	2	25	2	3.1	14	0	6
19	1	21	3	3.5	5	0	1
20	1	17	1	3.5	28	0	3

Figure 1.1 Levels of Measurement

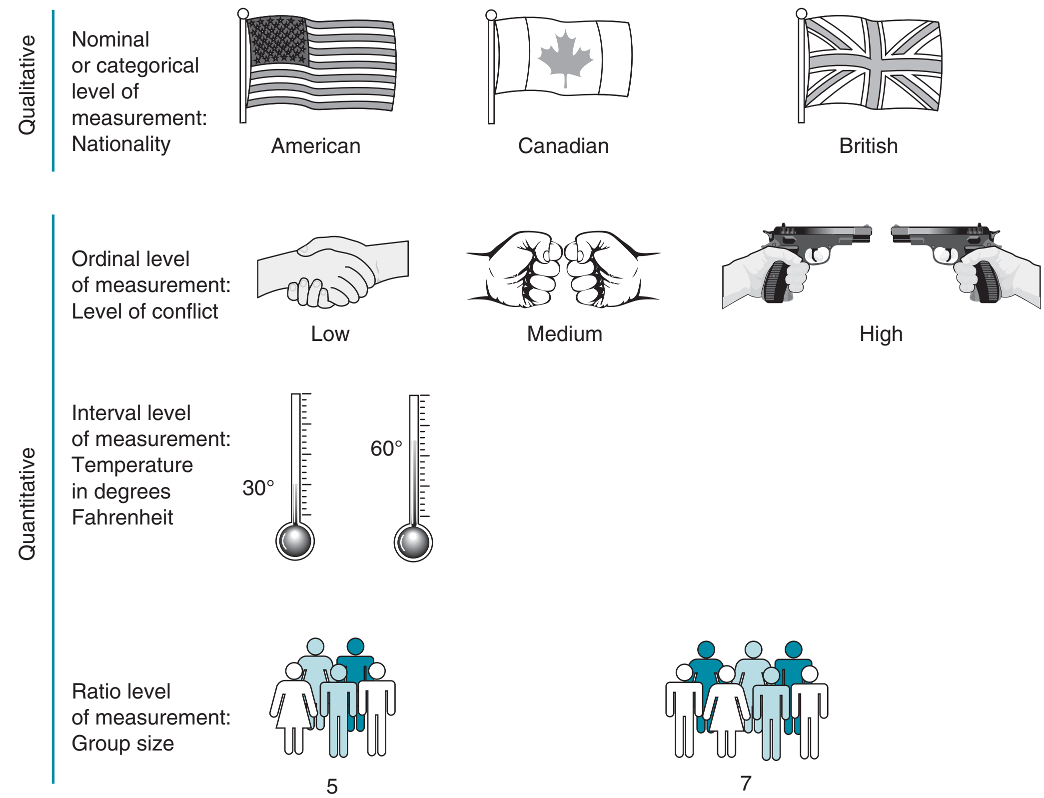


Table 1.3 Ordinal-Level Variables Can Be Added to Create an Index With Interval-Level Properties: Core Alcohol and Drug Survey

How Do You Think Your Close Friends Feel (or Would Feel) About You? (mark one for each line)	*Do Not Disapprove*	*Disapprove*	*Strongly Disapprove*
a. Trying marijuana once or twice			
b. Smoking marijuana occasionally			
c. Smoking marijuana regularly			
d. Trying cocaine once or twice			
e. Taking cocaine regularly			
f. Trying LSD once or twice			
g. Taking LSD regularly			
h. Trying amphetamines once or twice			
i. Taking amphetamines regularly			
j. Taking one or two drinks of an alcoholic beverage (e.g., beer, wine, liquor) nearly every day			
k. Taking four or five drinks nearly every day			
l. Having five or more drinks in one sitting			
m. Taking steroids for bodybuilding or improved athletic performance			

Source: Adapted from *Core Alcohol and Drug Survey: Long Form* © 2015 from the Core Institute.

Table 1.4 Properties of Measurement Levels

Examples of Comparison Statements	*Appropriate Math Operations*	*Relevant Level of Measurement*			
		Nominal	*Ordinal*	*Interval*	*Ratio*
A is equal to (not equal to) B	$=$ ($\neq$)	√	√	√	√
A is greater than (less than) B	$>$ ($<$)		√	√	√
A is three more than (less than) B	$+$ ($-$)			√	√
A is twice (half) as large as B	$\times$ ($\div$)				√

Age Group	*Number of Victims (**f**)*
12–17	545,370
18–24	527,410
24–34	604,500
35–49	684,150
50–64	566,990
65 and older	112,760

Table 1.5 Violent Crime Victims, Total Population, and Violent Crime Rates per 1,000 by Age Group, 2013

Age Group	*Number of Victims*	*Total Population*	*Rate per 1,000*
12–17	545,370	24,633,684	22.1
18–24	527,410	27,143,454	19.4
24–34	604,500	39,891,724	15.2
35–49	684,150	65,240,931	10.5
50–64	566,990	41,860,232	13.5
65 and older	112,760	34,991,753	3.2

Source: Adapted from *Criminal Victimization, 2013* by Truman and Langton, 2014, from the Bureau of Justice Statistics, U.S. Department of Justice.

Table 1.6 Total Number, Number Reported, Proportion, and Percentage of Crimes Reported to Police by Type of Crime (NCVS, 2013)

Type of Crime	*Total Number (n)*	*Number Reported (f)*	*Proportion (f / n)*	*Percent (f / n) × 100*
Violent crime	**3,041,170**	**1,398,938**	**.46**	**46**
Rape/Sexual assault	173,610	60,073	.35	35
Robbery	369,070	250,967	.68	68
Assault	2,600,920	1,118,395	.43	43
Aggravated assault	633,090	405,177	.64	64
Simple assault	2,046,600	777,708	.38	38
Domestic violence	589,140	335,809	.57	57
Intimate partner violence	369,310	210,506	.57	57
Stranger violence	1,244,560	609,834	.49	49
Violence with injury	849,240	305,726	.56	56
Property crime	**11,531,420**	**4,151,311**	**.36**	**36**
Burglary	2,458,360	1,401,265	.57	57
Motor vehicle theft	555,660	422,301	.76	76
Personal theft	9,070,680	2,630,497	.29	29

Source: Adapted from Tables 4 and 6 of *Criminal Victimization, 2013* by Truman and Langton, 2014, from the Bureau of Justice Statistics, U.S. Department of Justice.

Table 1.7 Murder Rates by State per 100,000 Population

Alabama	7.2	Montana	2.2
Alaska	4.6	Nebraska	3.1
Arizona	5.4	Nevada	5.8
Arkansas	5.4	New Hampshire	1.7
California	4.6	New Jersey	4.5
Colorado	3.4	New Mexico	6.0
Connecticut	2.4	New York	3.3
Delaware	4.2	North Carolina	4.8
Florida	5.0	North Dakota	2.2
Georgia	5.6	Ohio	3.9
Hawaii	1.5	Oklahoma	5.1
Idaho	1.7	Oregon	2.0
Illinois	5.5	Pennsylvania	4.7
Indiana	5.4	Rhode Island	2.9
Iowa	1.4	South Carolina	6.2
Kansas	3.9	South Dakota	2.4
Kentucky	3.8	Tennessee	5.0
Louisiana	10.8	Texas	4.3
Maine	1.8	Utah	1.7
Maryland	6.4	Vermont	1.6
Massachusetts	2.0	Virginia	3.8
Michigan	6.4	Washington	2.3
Minnesota	2.1	West Virginia	3.3
Mississippi	6.5	Wisconsin	2.8
Missouri	6.1	Wyoming	2.9

Source: Adapted from Table 4 of *Crime In the United States* from the Federal Bureau of Investigation (2013a).

	f	*Proportion*	%
Less than $10	16		
$10–$49	39		
$50–$99	48		
$100–$249	86		
$250–$999	102		
$1,000 or more	251		
	n = 542		

Figure 2.1 Rate of Firearm-Related Violent Victimization per 1,000 People 12 Years or Older: National Crime Victimization Survey

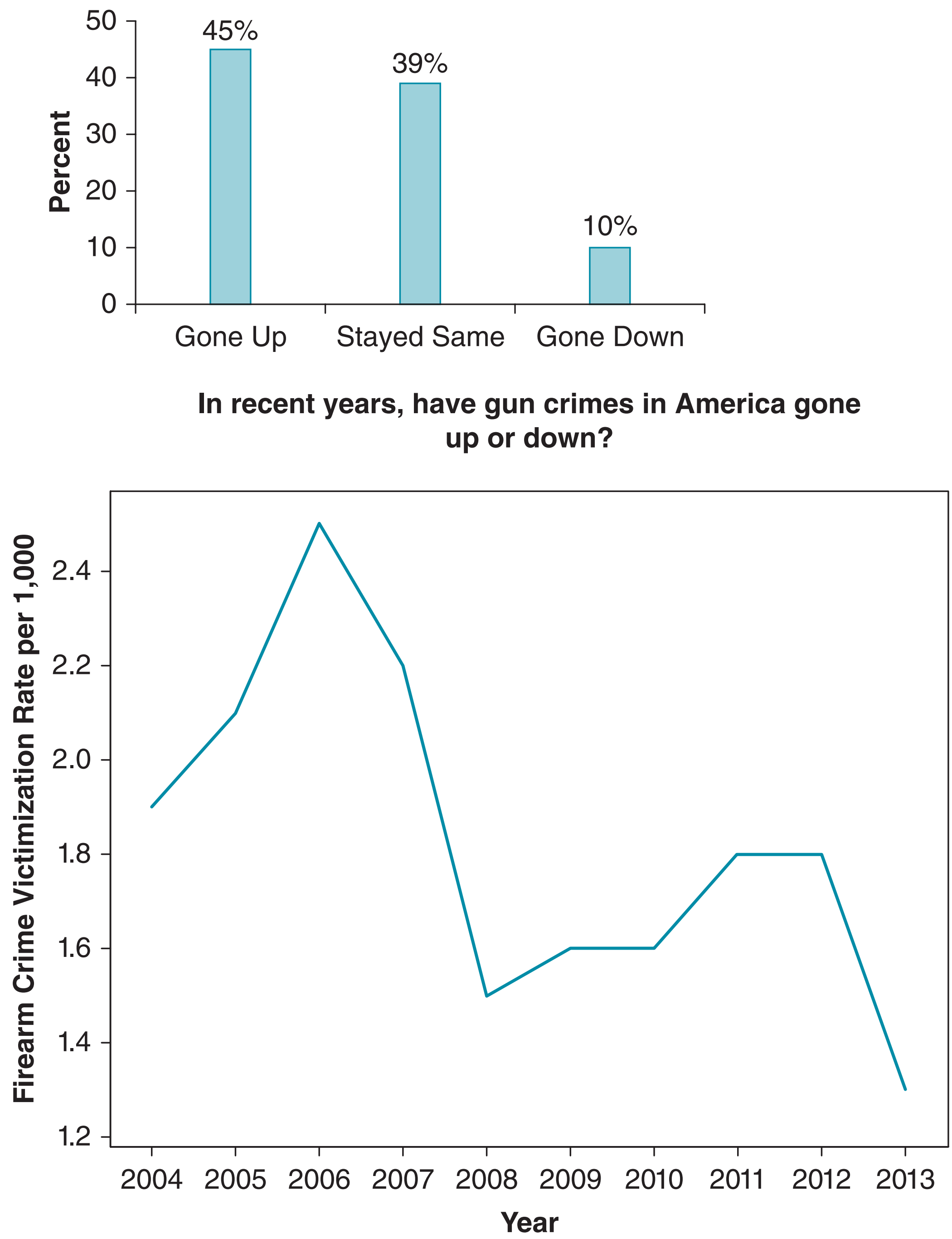


Table 2.1 Types of Hate Crime Incidents Reported to Police in 2013

Basis of Hate	*f*	*Proportion*	*%*
Race	2,871	.485	48.5
Religion	1,031	.174	17.4
Sexual orientation	1,233	.208	20.8
Ethnicity/National origin	655	.111	11.1
Disability	83	.014	1.4
Gender	18	.003	0.3
Gender identity	31	.005	0.5
Total	5,922	1.000	100.0

Source: Adapted from *Hate Crime Statistics—2013* from the Federal Bureau of Investigation (2013b).

Figure 2.2 **Types of Hate Crime Incidents Reported to Police in 2013: Frequency Data**

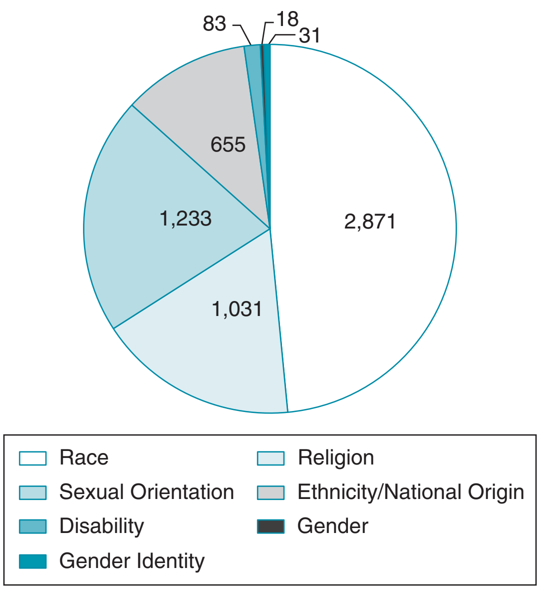


Figure 2.3 Types of Hate Crime Incidents Reported to Police in 2013: Frequency and Percentage Data

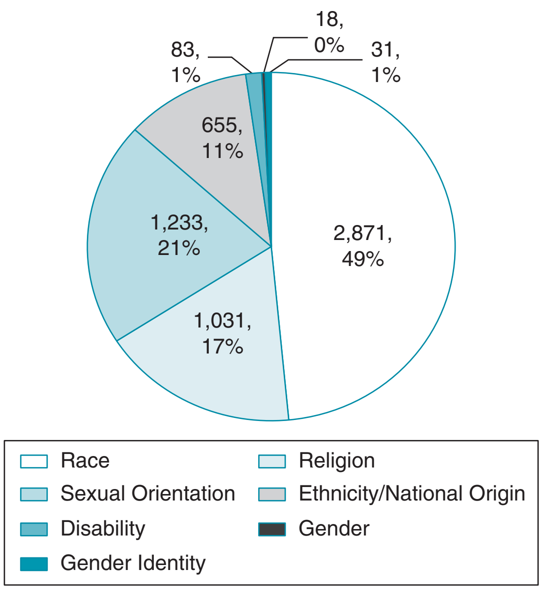


Table 2.2 Hate Crime Incidents Reported to Police in 2013 That Were Motivated by Bias Against the Victim's Religion

Type of Religious Hate	*f*	*Proportion*	*%*
Anti-Jewish	625	.606	60.6
Anti-Catholic	70	.068	6.8
Anti-Protestant	35	.034	3.4
Anti-Islamic	135	.131	13.1
Anti-other religions	117	.113	11.3
Anti-multireligious group	42	.041	4.1
Anti-agnostic/atheist	7	.007	0.7
Total	1,031	1.00	100.0

Source: Adapted from *Hate Crime Statistics—2013* from the Federal Bureau of Investigation (2013b).

Figure 2.4 Pie Chart for Antireligious Hate Crime Incidents Reported to the Police in 2013 by Type of Antireligious Sentiment

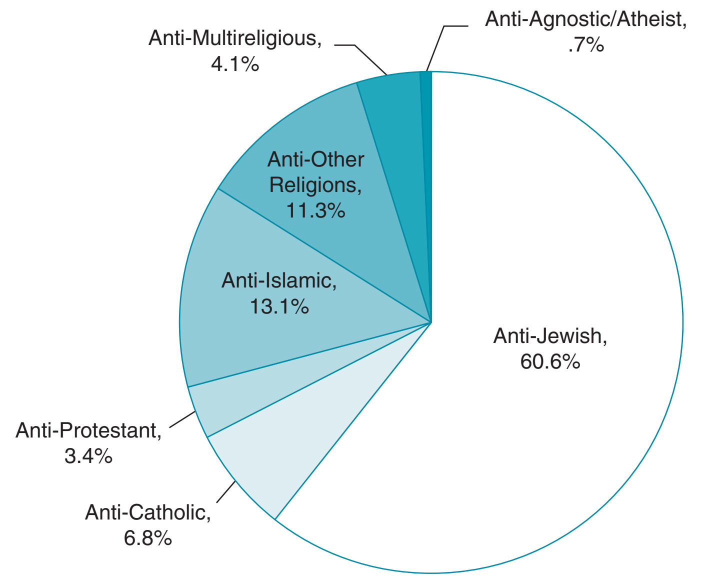


Figure 2.5 Bar Chart for Frequency of Religious Hate Crime Incidents Reported to the Police in 2013

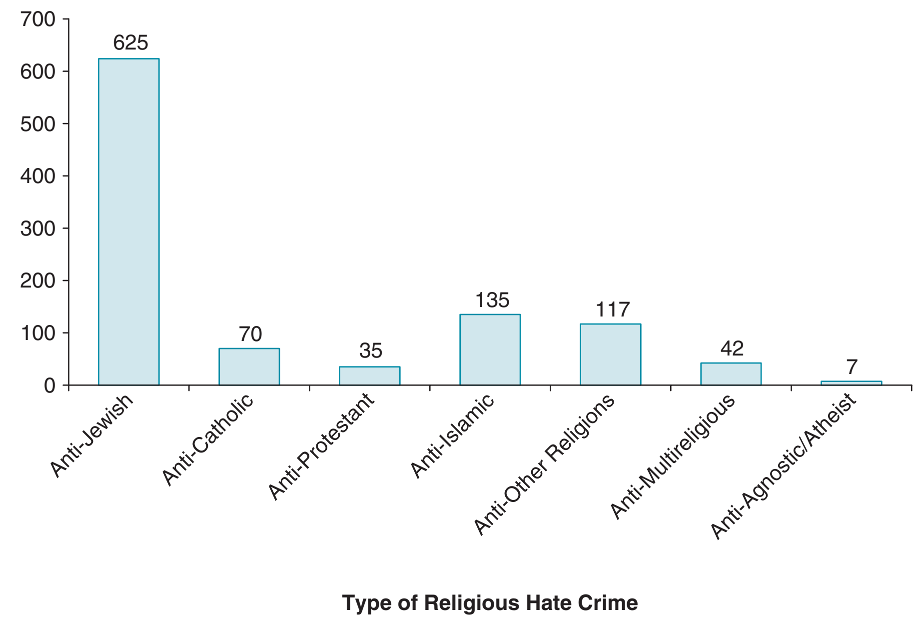


Table 2.3 **Percentage of Arrests for Violent Crimes, Property Crimes, and Total Index Crimes by Gender, 2013**

Crime Type	*% Male*	*% Female*
Violent crimes	79.9	20.1
Property crimes	62.2	37.8
Total index crimes	73.5	26.5

Source: Adapted from table 42 of *Crime In the United States* from the Federal Bureau of Investigation (2013a).

Figure 2.6 **Percentage of Total Arrests for Violent, Property, and Total Index Offenses by Gender, 2013**

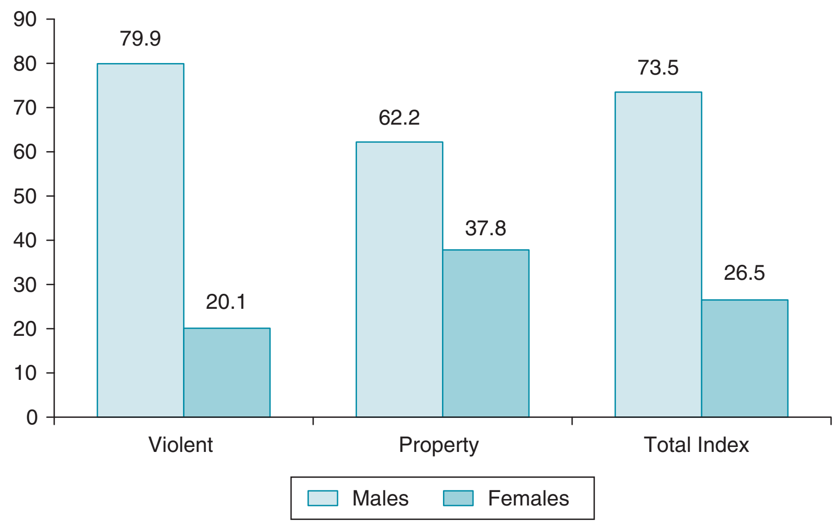


Table 2.4 Hypothetical Response Times of the Police to a 911 Call (in Minutes)

7	4	3	1	3	2	6	10	7	2
5	3	5	9	2	4	9	3	1	4
4	4	6	6	5	6	11	5	3	8
3	2	1	4	8	5	6	3	3	2
1	2	6	7	5	3	1	4	4	6

Table 2.5 Ungrouped Frequency Distribution for 50 Police Response Times to a 911 Call for Service

Minutes	*f*	*cf*	*p*	*cp*	%	*c*%
1	5	5	.10	.10	10	10
2	6	11	.12	.22	12	22
3	9	20	.18	.40	18	40
4	8	28	.16	.56	16	56
5	6	34	.12	.68	12	68
6	7	41	.14	.82	14	82
7	3	44	.06	.88	6	88
8	2	46	.04	.92	4	92
9	2	48	.04	.96	4	96
10	1	49	.02	.98	2	98
11	1	50	.02	1.00	2	100
Total	50		1.00		100	

Figure 2.7 Police Response Times to 911 Calls

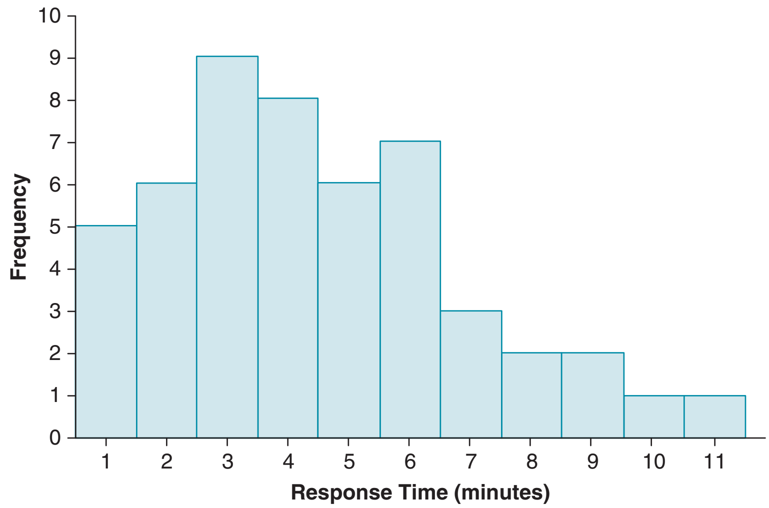


Figure 2.8 Police Response Times to 911 Calls Using Frequencies

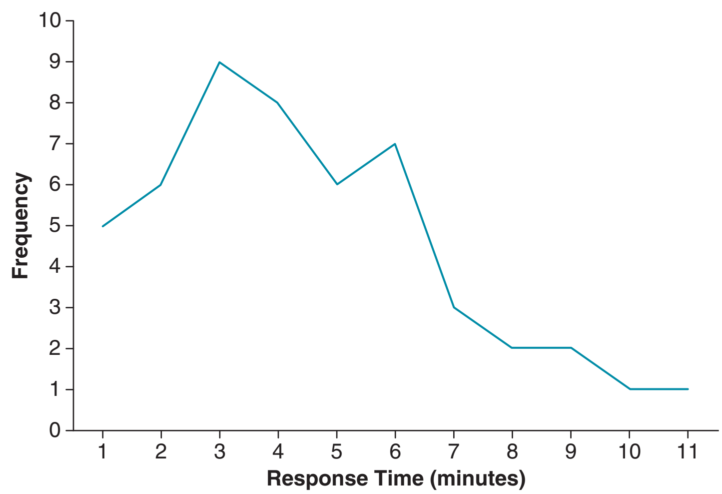


Figure 2.9 Police Response Times to 911 Calls Using Percentages

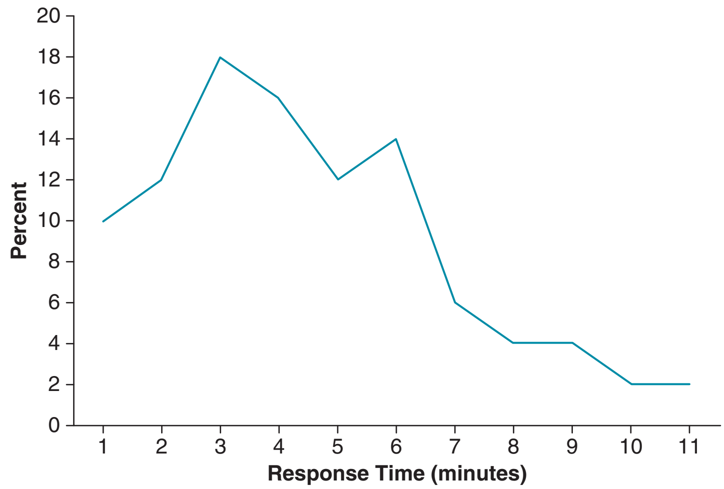


Figure 2.10 Cumulative Percentage of Police Response Times to 911 Calls

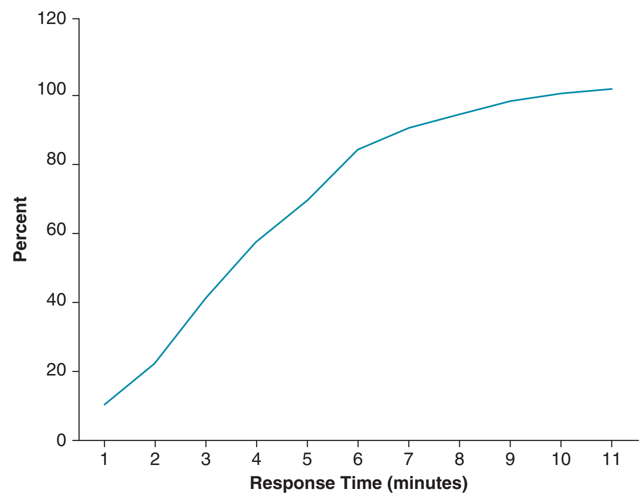


Table 2.6 Number of Days Until Rearrest for Sample of 120 Released Offenders

25	30	31	33	19	36
37	34	39	32	33	37
20	27	38	29	23	36
29	39	30	28	33	35
27	27	25	24	29	38
28	26	34	23	36	17
40	31	29	28	33	38
26	31	32	35	37	32
30	29	37	33	33	25
18	19	33	40	31	29
27	23	40	24	36	38
24	27	35	33	32	32
34	30	31	31	36	36
24	25	25	26	27	28
34	32	28	35	33	29
35	29	35	31	28	27
31	34	37	36	36	35
40	29	31	34	34	33
30	32	30	29	29	30
31	33	33	34	35	34

Table 2.7 Time Until Rearrest: Ungrouped Frequency and Percentage Distribution

Days Until Rearrest	*f*	%	*c*%
17	1	0.8	0.8
18	1	0.8	1.6
19	2	1.7	3.3
20	1	0.8	4.1
21	0	0.0	4.1
22	0	0.0	4.1
23	3	2.5	6.6
24	4	3.3	9.9
25	5	4.2	14.1
26	3	2.5	16.6
27	7	5.8	22.4
28	6	5.0	27.4
29	11	9.2	36.6
30	7	5.8	42.4
31	10	8.3	50.7
32	7	5.8	56.5
33	12	10.0	66.5
34	8	6.7	73.2
35	8	6.7	79.9
36	8	6.7	86.6
37	6	5.0	91.6
38	4	3.3	94.9
39	2	1.7	96.6
40	4	3.3	99.9*
Total	n = 120	99.9*	

*Does not sum to 100% because of rounding.

Figure 2.11 Histogram of Ungrouped Time-Until-Rearrest Data

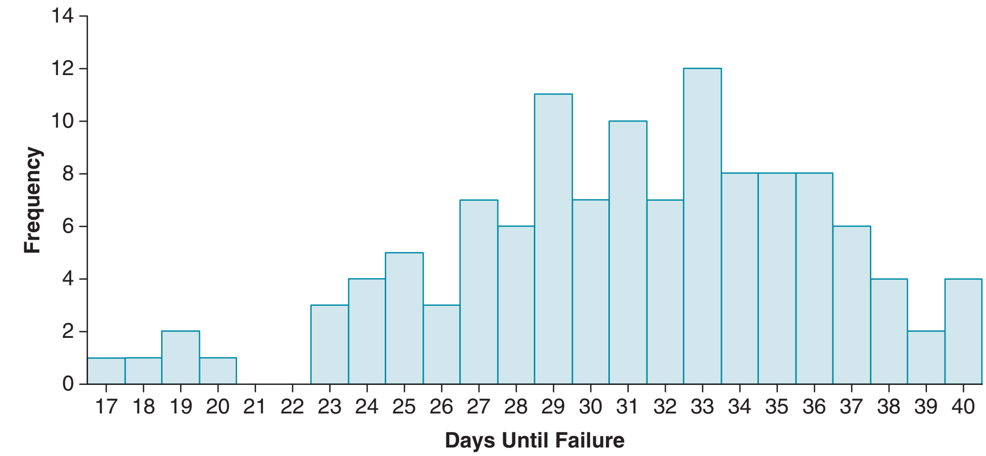


Table 2.8 Grouped Distribution for Time-Until-Rearrest Data

Stated Class Limits (days)	*f*	*cf*	*p*	*cp*	%	*c*%
17–19	4	4	.0333	.0333	3.33	3.33
20–22	1	5	.0083	.0416	0.83	4.16
23–25	12	17	.1000	.1416	10.00	14.16
26–28	16	33	.1333	.2749	13.33	27.49
29–31	28	61	.2333	.5082	23.33	50.82
32–34	28	89	.2333	.7415	23.33	74.15
35–37	21	110	.1750	.9165	17.50	91.65
38–40	10	120	.0833	.9998	8.33	99.98
Total	120		.9998*		99.98*	

*Does not sum to 1.0, or 100%, because of rounding.

Figure 2.12 Histogram of Grouped Frequency Data for Time Until Rearrest

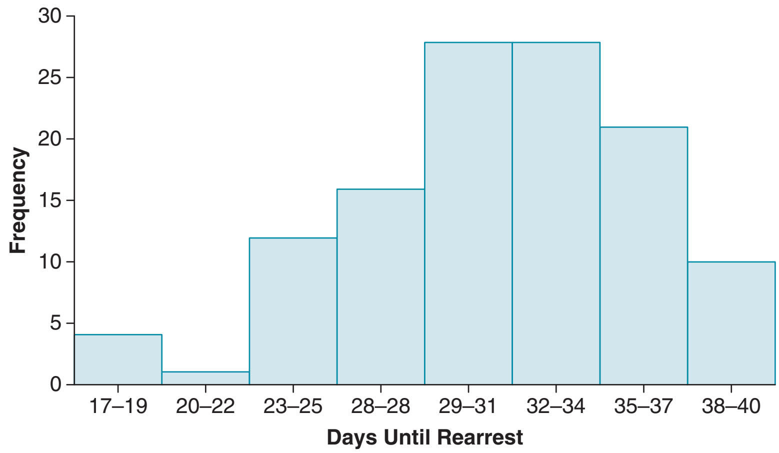


Table 2.9 Grouped Distribution for Time-Until-Rearrest Data Using Interval Width of 2

Stated Class Limits	*f*	%
17–18	2	1.7
19–20	3	2.5
21–22	0	0.0
23–24	7	5.8
25–26	8	6.7
27–28	13	10.8
29–30	18	15.0
31–32	17	14.2
33–34	20	16.7
35–36	16	13.3
37–38	10	8.3
39–40	6	5.0
Total	120	100.0

Figure 2.13 Histogram of Grouped Frequency Data for Time Until Rearrest Using Interval Width of 2

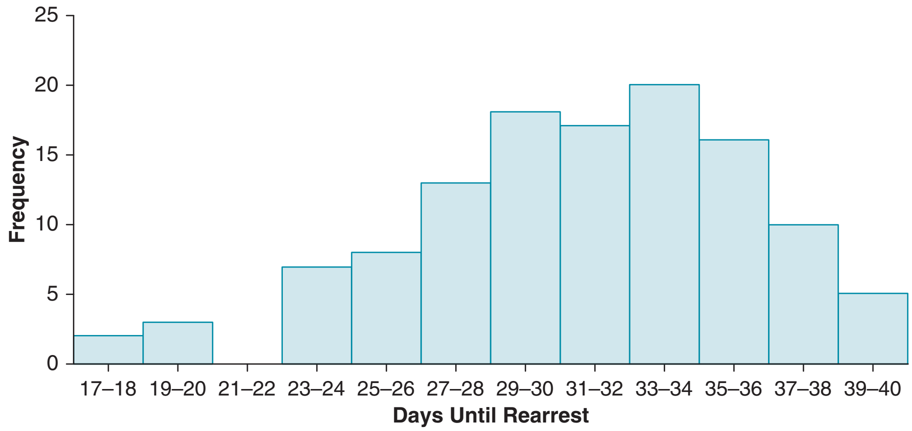


Table 2.10 Stated Class Limits, Real Class Limits, and Midpoints for Grouped Frequency Distribution in Table 2.8

Stated Class Limits	*Real Class Limits*	m_i	f
17–19	16.5–19.5	18	4
20–22	19.5–22.5	21	1
23–25	22.5–25.5	24	12
26–28	25.5–28.5	27	16
29–31	28.5–31.5	30	28
32–34	31.5–34.5	33	28
35–37	34.5–37.5	36	21
38–40	37.5–40.5	39	10
			Total = 120

Figure 2.14 Example of a Normal or Symmetrical Distribution

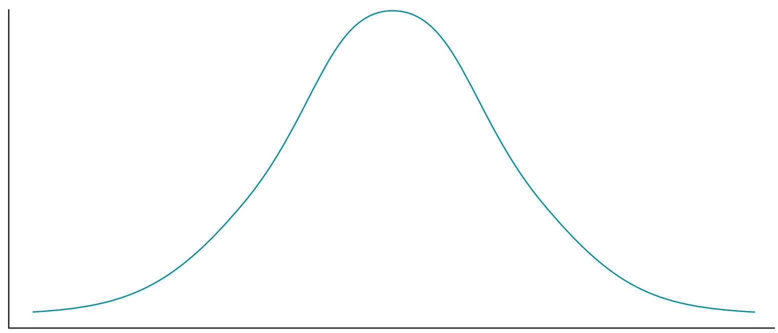


Figure 2.15 Example of a Negatively Skewed Distribution

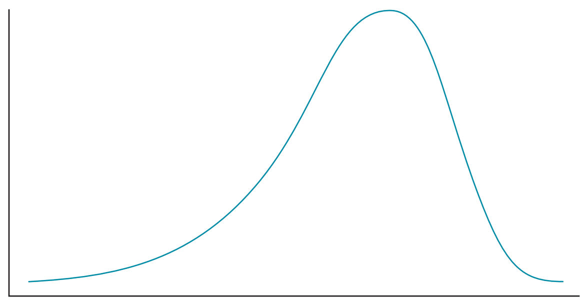


Figure 2.16 Example of a Positively Skewed Distribution

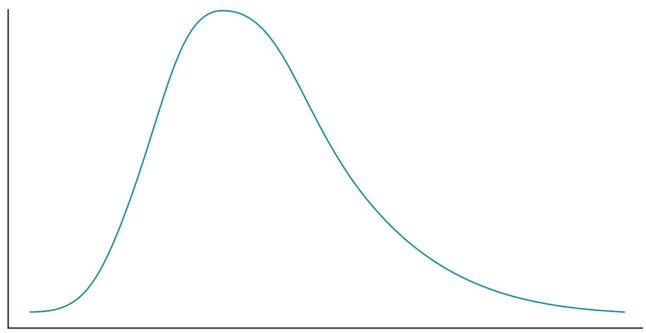


Table 2.11 **Annual Rates (per 100,000) of Rape, Robbery, and Aggravated Assault Known to the Police and Reported to the FBI's Uniform Crime Reports Program, 1972–2013**

Year	*Rape Rate*	*Robbery Rate*	*Aggravated Assault Rate*
1972	22.5	180.7	188.8
1973	24.5	183.1	200.5
1974	26.2	209.3	215.8
1975	26.3	220.8	227.4
1976	26.6	199.3	233.2
1977	29.4	190.7	247.0
1978	31.0	195.8	262.1
1979	34.7	218.4	286.0
1980	36.8	251.1	298.5
1981	36.0	258.7	289.3
1982	34.0	238.9	289.0
1983	33.7	216.5	279.4
1984	35.7	205.4	290.6
1985	37.1	208.5	304.0
1986	37.9	225.1	347.4
1987	37.4	212.7	352.9
1988	37.6	220.9	372.2
1989	38.1	233.0	385.6
1990	41.2	257.0	422.9
1991	42.3	272.7	433.4
1992	42.8	263.7	441.9
1993	41.1	256.0	440.5
1994	39.3	237.8	427.6
1995	37.1	220.9	418.3
1996	36.3	201.9	391.0
1997	35.9	186.2	382.1
1998	34.5	165.5	361.4
1999	32.8	150.1	334.3
2000	32.0	144.9	323.6
2001	31.8	148.5	318.6
2002	33.1	146.1	309.5
2003	32.3	142.5	295.4
2004	32.4	136.7	288.6
2005	31.8	140.8	290.8
2006	30.9	149.4	287.5
2007	30.1	155.7	292.6
2008	29.4	154.0	281.6
2009	28.9	139.6	268.3
2010	27.8	122.7	255.5
2011	26.8	117.1	243.5
2012	26.7	116.3	246.5
2013	23.1	112.9	233.7

Source: Adapted from *Uniform Crime Reports* from the Federal Bureau of Investigation (1990, 1995, 2000, 2005–2013).

Figure 2.17 Time Plot of Forcible Rape, Armed Robbery, and Aggravated Assault Rates Using Both *y* Axes, 1972–2013

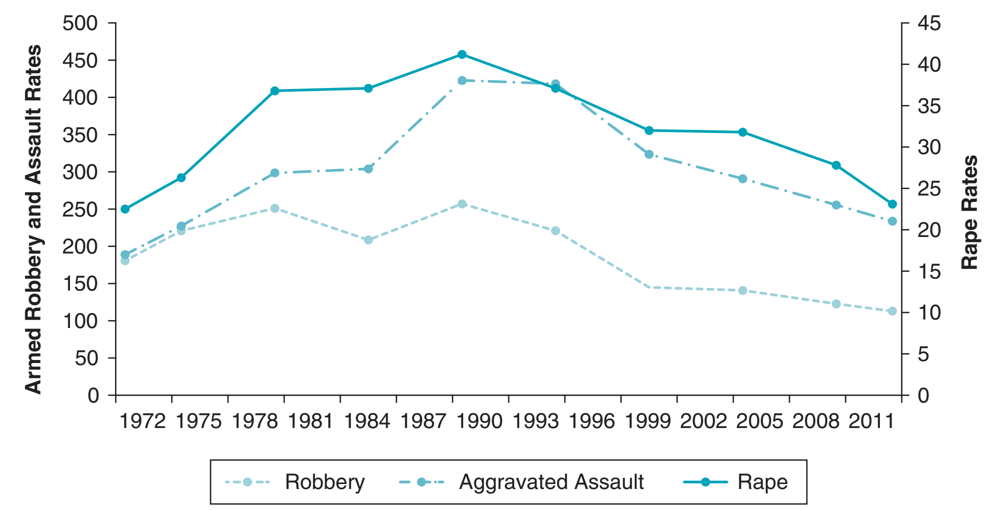
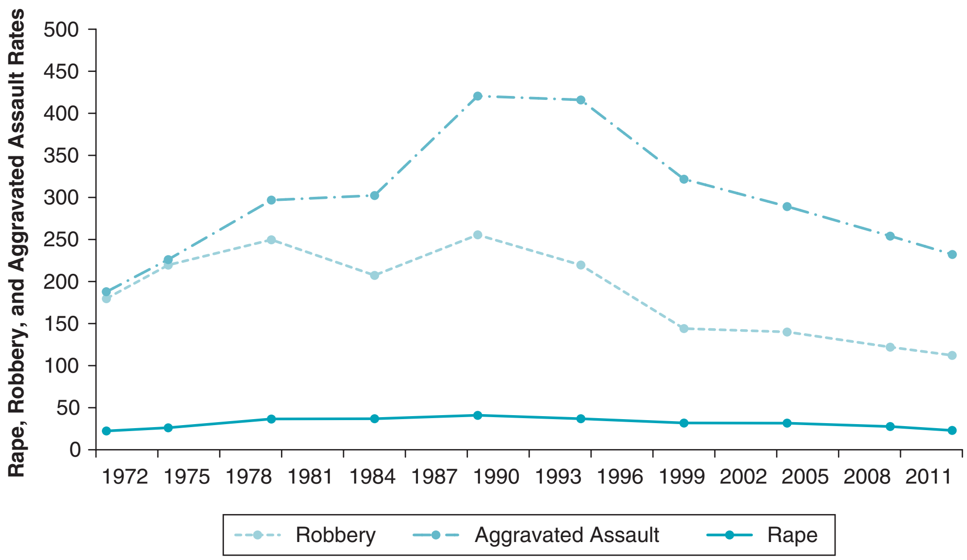


Figure 2.18 Time Plot of Forcible Rape, Armed Robbery, and Aggravated Assault Rates Using Only One *y* Axis, 1972–2013



Stated Class Limits	*f*
0–7	0
7–10	35
10–15	40
16–30	50
Total	125

Stated Class Limits	*f*
7–9	35
10–12	25
13–15	15
16–18	20
19–21	10
22–24	5
25–27	10
28–30	5
Total	125

Number Correct	*Gender*
15	Male
16	Female
11	Male
10	Male
14	Male
15	Male
15	Female
11	Female
10	Male
10	Male
20	Female
15	Female
14	Male
16	Male
15	Male
19	Female
11	Male
13	Male
15	Female
13	Female
10	Male
20	Male
15	Male
16	Female
10	Male

17	22	13	24	15
12	30	17	27	16
21	14	12	13	18
18	27	19	18	25
11	19	11	26	30
28	28	23	14	35
8	13	26	22	21
17	20	15	39	15
26	24	16	30	31
31	25	24	23	6
15	32	29	38	36
34	16	12	34	12
20	12	33	35	34
7	21	11	37	19
11	21	20	43	35

Victimization Year	*Rate per 1,000 Households*	*Victimization Year*	*Rate per 1,000 Households*
1993	351.8	2004	167.5
1994	341.2	2005	159.5
1995	315.5	2006	169.0
1996	289.3	2007	154.9
1997	267.1	2008	142.6
1998	237.1	2009	132.6
1999	210.6	2010	125.4
2000	190.4	2011	138.7
2001	177.7	2012	155.8
2002	168.2	2013	131.4
2003	173.4		

Source: Data taken from the Bureau of Justice Statistics at www.ojp.usdoj.gov/bjs/.

Year	*Number of Arrests*	*Year*	*Number of Arrests*
1994	117,300	2004	83,700
1995	116,200	2005	85,600
1996	106,400	2006	90,800
1997	92,300	2007	92,400
1998	86,900	2008	94,200
1999	79,200	2009	95,000
2000	78,600	2010	85,100
2001	81,900	2011	82,900
2002	81,200	2012	82,200
2003	82,300		

Source: Data taken from Easy Access to FBI Arrest Statistics at www.ojjdp.gov/ojstatbb/ezaucr/asp/ucr_display.asp.

Figure 3.1 Types of Hate Crime Incidents Reported to Police in 2013

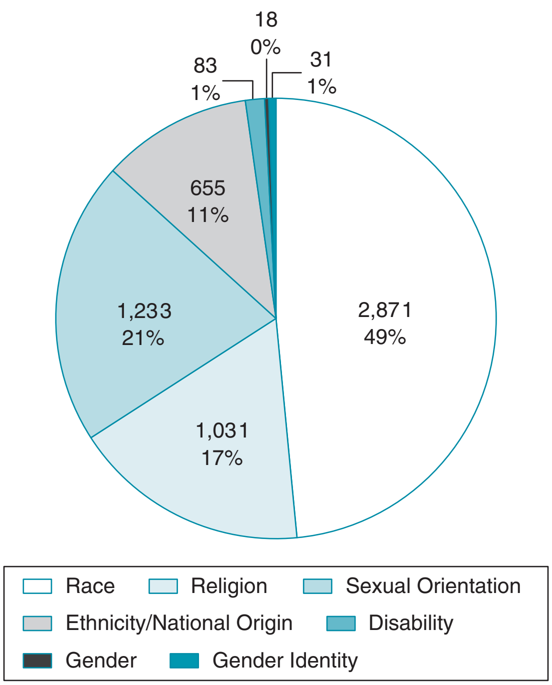


Table 3.1 Types of Hate Crime Incidents Reported to Police in 2013

Basis of Hate	*f*	*Proportion*	*%*
Race	2,871	.485	48.5
Religion	1,031	.174	17.4
Sexual orientation	1,233	.208	20.8
Ethnicity/National origin	655	.111	11.1
Disability	83	.014	1.4
Gender	18	.003	0.3
Gender identity	31	.005	0.5
Total	5,922	1.000	100.0

Source: Adapted from *Hate Crimes Statistics—2013* from the Federal Bureau of Investigation (2013b).

Table 3.2 **Number of Prior Arrests for a Sample of Armed Robbery Suspects**

Number	*f*	%
0	38	25.33
1	35	23.33
2	10	6.67
3	9	6.00
4	14	9.33
5	7	4.67
6	11	7.33
7	8	5.33
8	10	6.67
9	5	3.33
10 or more	3	2.00
Total	n = 150	99.99*

*Percentages may not sum to 100% due to rounding.

Figure 3.2 Number of Prior Arrests Among 150 Suspected Armed Robbers

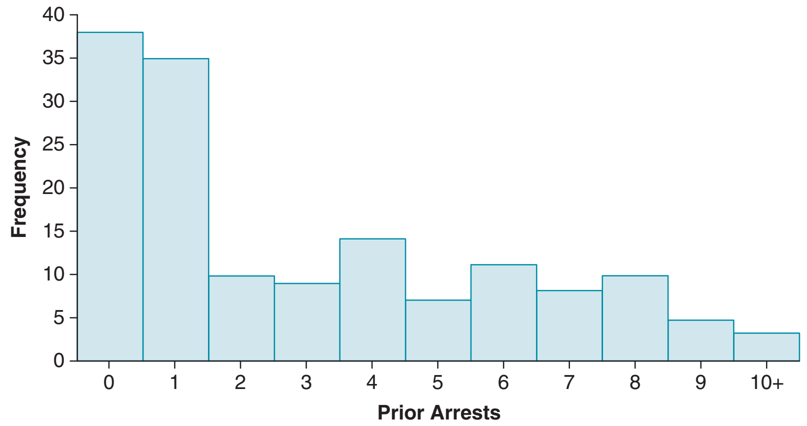


Table 3.3 Grouped Frequency Distribution for Time-Until-Rearrest Data for 120 Released Offenders

Stated Limits (Days)	*f*	*Midpoint*
17–19	4	18
20–22	1	21
23–25	12	24
26–28	16	27
29–31	28	30
32–34	28	33
35–37	21	36
38–40	10	39
	n = 120	

Figure 3.3 Histogram of Grouped Frequency Data for Time Until Rearrest

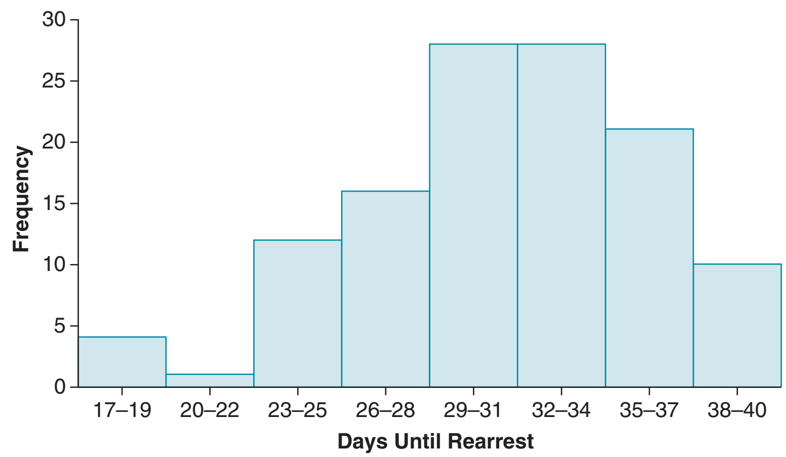


Table 3.4 Number of New Charges for Domestic Violence for 60 Men Arrested for Domestic Abuse

Number of New Charges	*f*
0	14
1	7
2	5
3	8
4	6
5	4
6	3
7	3
8	5
9	3
10 or more	2
	$n = 60$

Rank	*Score*
1	1 minute
2	2 minutes
3	3 minutes
4	6 minutes
5	9 minutes
6	12 minutes
7	15 minutes

Rank	*Score*
1	1 minute
2	2 minutes
3	3 minutes
4	6 minutes
5	9 minutes
6	12 minutes
7	15 minutes
8	18 minutes

Table 3.5 Reported Number of Times Committing Vandalism for 77 Boys

# of Times	*f*	*cf*	%	*c*%
0	15	15	19	19
1	10	25	13	32
2	5	30	7	39
3	11	41	14	53
4	7	48	9	62
5	8	56	10	72
6	5	61	7	79
7	4	65	5	84
8	5	70	7	91
9	4	74	5	96
10 or more	3	77	4	100
Total	n = 77		100	

Table 3.6 Grouped Frequency Distribution for Time-Until-Rearrest Data for 120 Inmates

Stated Limits	*Real Limits*	*f*	*cf*
17–19 days	16.5–19.5 days	4	4
20–22 days	19.5–22.5 days	1	5
23–25 days	22.5–25.5 days	12	17
26–28 days	25.5–28.5 days	16	33
29–31 days	28.5–31.5 days	28	61
32–34 days	31.5–34.5 days	28	89
35–37 days	34.5–37.5 days	21	110
38–40 days	37.5–40.5 days	10	120
		n = 120	

Table 3.7 Rape Rates (per 100,000 People) for Selected U.S. Cities in 2013

Rank	*City*	*Rate*	*Rank*	*City*	*Rate*	*Rank*	*City*	*Rate*
1	Binghamton, NY	22.2	1	Binghamton, NY	22.2	1	Goldsboro, NC	4.0
2	Albany, GA	23.5	2	Albany, GA	23.5	2	Binghamton, NY	22.2
3	Redmond, OR	28.0	3	Redmond, OR	28.0	3	Albany, GA	23.5
4	Cedar Rapids, IA	28.1	4	Cedar Rapids, IA	28.1	4	Redmond, OR	28.0
5	Charleston, SC	28.4	5	Charleston, SC	28.4	5	Cedar Rapids, IA	28.1
6	Boston, MA	33.8	6	Boston, MA	33.8	6	Charleston, SC	28.4
7	Akron, OH	38.4	7	Akron, OH	38.4	7	Boston, MA	33.8
			8	Anchorage, AK	133.2	8	Akron, OH	38.4

Source: Adapted from *Crime In the United States* from the Federal Bureau of Investigation (2013a).

Table 3.8 Response Times to 911 Calls for Police Assistance

Minutes	f_i	$x_i f_i$
1	5	5
2	6	12
3	9	27
4	8	32
5	6	30
6	7	42
7	3	21
8	2	16
9	2	18
10	1	10
11	1	11
	n = 50	Σ = 224

Table 3.9 Calculating a Mean Using Grouped Data: Time Until Rearrest for 120 Inmates

Stated Limits (Days)	*F*	*Midpoint*	mf_i
17–19	4	18	72
20–22	1	21	21
23–25	12	24	288
26–28	16	27	432
29–31	28	30	840
32–34	28	33	924
35–37	21	36	756
38–40	10	39	390
	n = 120		Σ = 3,723

Table 3.10 Calculating a Mean Using Ungrouped Data: Time Until Rearrest for 120 Inmates

x_i	f_i	$x_i f_i$
17	1	17
18	1	18
19	2	38
20	1	20
21	0	0
22	0	0
23	3	69
24	4	96
25	5	125
26	3	78
27	7	189
28	6	168
29	11	319
30	7	210
31	10	310
32	7	224
33	12	396
34	8	272
35	8	280
36	8	288
37	6	222
38	4	152
39	2	78
40	4	160
	$n = 120$	$\Sigma = 3{,}729$

X	*f*
None	20
Some	85
Most	30
All	10

City	*Homicide Rate*
Boston, MA	6.8
Cincinnati, OH	4.5
Denver, CO	6.0
Las Vegas, NV	8.8
New Orleans, LA	43.3
New York, NY	8.7
Pittsburgh, PA	10.5
Salt Lake City, UT	5.6
San Diego, CA	4.3
San Francisco, CA	7.7

Person Number	*Number of Crimes Committed*	*Person Number*	*Number of Crimes Committed*
1	4	11	4
2	16	12	11
3	10	13	10
4	7	14	88
5	3	15	9
6	112	16	12
7	5	17	8
8	10	18	5
9	6	19	7
10	2	20	10

Request	*Frequency*
Offense against person	213
Offense against property	496
Other criminal offense	238
Potential offense	3,784
Individual in distress	139
Noncriminal incident	986

Narcotics Investigation (%)	*Frequency*
0–9	5
10–19	13
20–29	26
30–39	38
40–49	14
50–59	2
60–69	2

Year	*# of Executions*
2007	42
2008	37
2009	52
2010	46
2011	43
2012	43
2013	39
2014	35

Number of Times Assaulted	*Frequency*
0–1	85
2–3	70
4–5	30
6–7	15

Person	*Resting Heart Rate*	*Person*	*Resting Heart Rate*
1	59	11	60
2	62	12	55
3	69	13	52
4	62	14	70
5	64	15	52
6	70	16	57
7	54	17	53
8	66	18	61
9	51	19	64
10	56	20	63

Table 4.1 Number of Years of Prison Time for Convicted Armed Robbery Defendants

Defendant	*Judge 1*	*Judge 2*
	Sentence Given	*Sentence Given*
1	5	1
2	7	2
3	7	2
4	7	3
5	7	3
6	7	3
7	8	4
8	8	4
9	8	5
10	8	8
11	9	9
12	9	10
13	9	11
14	10	14
15	11	15
16	11	15
17	11	16
18	12	17
19	12	18
20	14	20
$n = 20$	$\Sigma = 180$ $\overline{X} = 9$	$\Sigma = 180$ $\overline{X} = 9$

Figure 4.1 Sentence Length in Years Given by Two Judges

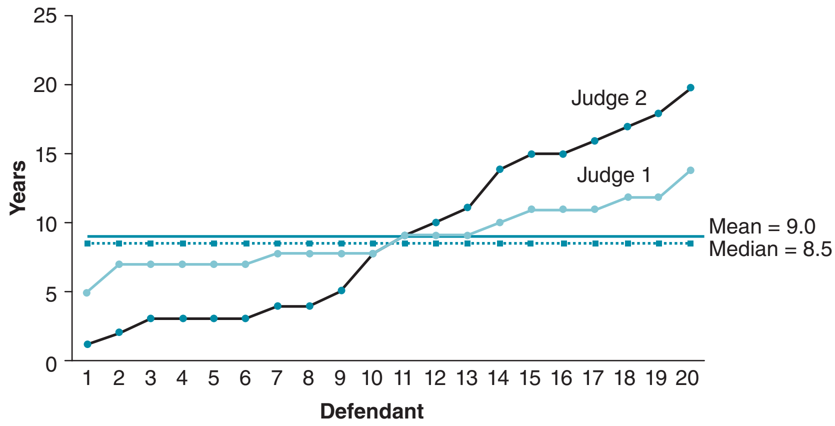


Table 4.2 Type and Frequency of Patrolling Used in Police Shifts in One U.S. City

	f
Foot patrol only	5
Car patrol only	30
Foot and car patrol	10
Total number of shifts	45

Table 4.3 Type of Hate Crime Incident Reported to Police in 2013

Basis of Hate	*f*	*Proportion*	*%*
Race	2,871	.485	48.5
Religion	1,031	.174	17.4
Sexual orientation	1,233	.208	20.8
Ethnicity/National origin	655	.111	11.1
Disability	83	.014	1.4
Gender	18	.003	0.3
Gender identity	31	.005	0.5
Total	5,922	1.0	100.0

Source: Adapted from *Hate Crime Statistics—2013* from the Federal Bureau of Investigation (2013b).

Table 4.4 Hypothetical Hate Crime Data

Type of Hate	*f*	*Proportion*
Racial	4,975	.840
Religious	414	.070
Sexual orientation	272	.046
Ethnicity/National origin	148	.025
Disability	53	.009
Gender	30	.005
Gender identity	30	.005
Total	5,922	1.000

Table 4.5 Hypothetical Hate Crime Data

Type of Hate	*f*	*Proportion*
Racial	846	.143
Religious	846	.143
Sexual orientation	846	.143
Ethnicity/National origin	846	.143
Disability	846	.143
Gender	846	.143
Gender identity	846	.143
Total	5,922	1.001*

*Greater than 1.0 due to rounding.

Table 4.6 Grouped Frequency Distribution for Time-Until-Failure Data for 120 Inmates

Stated Limits (Days)	*f*	*Midpoint*
17–19	4	18
20–22	1	21
23–25	12	24
26–28	16	27
29–31	28	30
32–34	28	33
35–37	21	36
38–40	10	39
	$n = 120$	

Table 4.7 Number of Years of Prison Time for Convicted Armed Robbery Defendants

Judge 1		*Judge 2*	
Years Sentenced	*f*	*Years Sentenced*	*f*
5	1	1	10
6	1	20	10
7	3		
8	4		
9	3		
10	1		
11	3		
12	2		
13	1		
14	1		
	$n = 20$		$n = 20$

Table 4.8 The Relationship Among Percentiles, Deciles, and Quartiles

Percentile	*Decile*	*Quartile*
100th	10th	4th (Q_4)
99th		
98th		
90th	9th	
.		
80th	8th	
.		
.		
75th		3rd (Q_3)
.		
.		
60th	6th	
.		
.		
50th	5th	2nd (Q_2)
.		
.		
.		
30th	3rd	
29th		
28th		
25th		1st (Q_1)
.		
.		
20th	2nd	
.		
3rd		
2nd		
1st		

Table 4.9 Number of Escapes From 20 Correctional Institutions in Two States

Institution	*State A*	*State B*
1	3	3
2	2	4
3	4	1
4	9	2
5	2	3
6	5	6
7	6	5
8	4	3
9	1	4
10	3	4
11	4	5
12	5	2
13	2	3
14	0	5
15	7	8
16	1	1
17	7	6
18	6	8
19	9	9
20	23	10

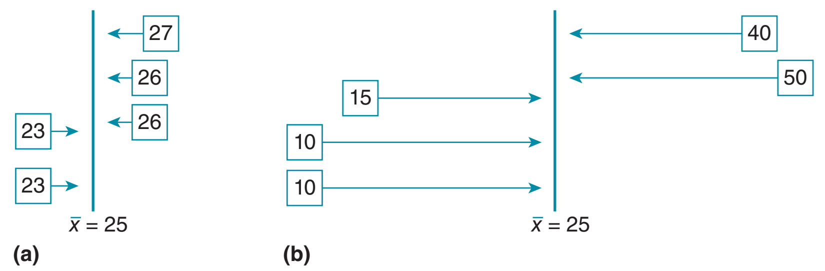
Table 4.10 Rank-Ordered Number of Escapes From 20 Correctional Institutions in Two States From Table 4.9

Institution	*State A*	*State B*
1	0	1
2	1	1
3	1	2
4	2	2
5	2	3
6	2	3
7	3	3
8	3	3
9	3	4
10	4	4
11	4	4
12	4	5
13	5	5
14	5	5
15	6	6
16	6	6
17	7	8
18	7	8
19	9	9
20	23	10

Table 4.11 Frequency Counts, Percentages, and Cumulative Percentages for Escape Data From Two States

State A # of Escapes	*f*	*%*	*Cum %*	*State B # of Escapes*	*f*	*%*	*Cum %*
0	1	5	5	1	2	10	10
1	2	10	15	2	2	10	20
2	3	15	30	3	4	20	40
3	3	15	45	4	3	15	55
4	3	15	60	5	3	15	70
5	2	10	70	6	2	10	80
6	2	10	80	8	2	10	90
7	2	10	90	9	1	5	95
9	1	5	95	10	1	5	100
23	1	5	100				
	$n = 20$	100			$n = 20$	100	

Figure 4.2 Two Sample Distributions of One Variable: (a) Five Scores With Little Dispersion About the Mean and (b) Five Scores With a Great Deal of Dispersion About the Mean



For the scores in Figure 4.2(a)

Score	*Mean*	*Deviation From Mean*	*Squared Deviation*
23	25	23 – 25 = –2	4
26	25	26 – 25 = +1	1
23	25	23 – 25 = –2	4
27	25	27 – 25 = +2	4
26	25	26 – 25 = +1	1

For the scores in Figure 4.2(b)

Score	*Mean*	*Deviation From Mean*
10	25	10 – 25 = –15
50	25	50 – 25 = +25
15	25	15 – 25 = –10
40	25	40 – 25 = +15
10	25	10 – 25 = –15

For the scores in Figure 4.2(a):

Score	*Mean*	*Deviation From Mean*
23	25	23 – 25 = –2
26	25	26 – 25 = +1
23	25	23 – 25 = –2
27	25	27 – 25 = +2
26	25	26 – 25 = +1

For the scores in Figure 4.2(b):

Score	*Mean*	*Deviation From Mean*	*Squared Deviation*
10	25	10 – 25 = –15	225
50	25	50 – 25 = 25	625
15	25	15 – 25 = –10	100
40	25	40 – 25 = 15	225
10	25	10 – 25 = –15	225

Table 4.12 Definitional Formulas for Population and Sample Variance and Standard Deviation

Population	
Variance (σ^2)	$\sigma^2 = \frac{\Sigma(xi - \mu)^2}{N}$
Standard deviation (σ)	$\sigma = \sqrt{\frac{\Sigma(x_i - \mu)^2}{N}}$
Sample	
Variance (s^2)	$s^2 = \frac{\Sigma(x_i - \bar{X})^2}{n-1}$
Standard deviation (s)	$s = \sqrt{\frac{\Sigma(x_i - \bar{X})^2}{n-1}}$

Table 4.13 Calculations for the Variance and Standard Deviation in Judge 1's Sentencing ($n = 20$)

x	$x_i - \bar{x}$	$(x_i - \bar{x})^2$
5	5 – 9 = –4	16
7	7 – 9 = –2	4
7	7 – 9 = –2	4
7	7 – 9 = –2	4
7	7 – 9 = –2	4
7	7 – 9 = –2	4
8	8 – 9 = –1	1
8	8 – 9 = –1	1
8	8 – 9 = –1	1
8	8 – 9 = –1	1
9	9 – 9 = 0	0
9	9 – 9 = 0	0
9	9 – 9 = 0	0
10	10 – 9 = 1	1
11	11 – 9 = 2	4
11	11 – 9 = 2	4
11	11 – 9 = 2	4
12	12 – 9 = 3	9
12	12 – 9 = 3	9
14	14 – 9 = 5	25
		$\Sigma = 96$

Table 4.14 Calculations for the Variance and Standard Deviation in Judge 2's Sentencing ($n = 20$)

x	$x_i - \bar{x}$	$(x_i - \bar{x})^2$
1	1 – 9 = –8	64
2	2 – 9 = –7	49
2	2 – 9 = –7	49
3	3 – 9 = –6	36
3	3 – 9 = –6	36
3	3 – 9 = –6	36
4	4 – 9 = –5	25
4	4 – 9 = –5	25
5	5 – 9 = –4	16
8	8 – 9 = –1	1
9	9 – 9 = 0	0
10	10 – 9 = 1	1
11	11 – 9 = 2	4
14	14 – 9 = 5	25
15	15 – 9 = 6	36
15	15 – 9 = 6	36
16	16 – 9 = 7	49
17	17 – 9 = 8	64
18	18 – 9 = 9	81
20	20 – 9 = 11	121
		$\Sigma = 754$

Table 4.15 Self-Control Scores for a Sample of 25 Incarcerated Youths

x	$x_i - \bar{x}$	$(x_i - \bar{x})^2$
85	85 – 91 = –6	36
100	100 – 91 = 9	81
87	87 – 91 = –4	16
93	93 – 91 = 2	4
78	78 – 91 = –13	169
103	103 – 91 = –12	144
88	88 – 91 = –3	9
94	94 – 91 = 3	9
94	94 – 91 = 3	9
101	101 – 91 = 10	100
94	94 – 91 = 3	9
92	92 – 91 = 1	1
83	83 – 91 = –8	64
70	70 – 91 = –21	441
110	110 – 91 = 19	361
87	87 – 91 = –4	16
91	91 – 91 = 0	0
79	79 – 91 = –12	144
84	84 – 91 = –7	49
88	88 – 91 = –3	9
90	90 – 91 = –1	1
104	104 – 91 = 13	169
100	100 – 91 = 9	81
98	98 – 91 = 7	49
82	82 – 91 = –9	81
		Σ = 2,052

Table 4.16 Stated Class Limits, Midpoints, and Frequencies for Grouped Frequency Distribution of Time-Until-Rearrest Data ($n = 120$)

Stated Class Limits	*Midpoints* (m_i)	f
17–19	18	4
20–22	21	1
23–25	24	12
26–28	27	16
29–31	30	28
32–34	33	28
35–37	36	21
38–40	39	10

Table 4.17 Calculations for Variance and Standard Deviation for Time-Until-Rearrest Data ($n = 120$)

Midpoint of Class Interval	$m_i - \overline{X}$	$(m_i - \overline{X})^2$	f_i	$f_i(m_i - \overline{X})^2$
18	18 – 31 = –13	169	4	4(169) = 676
21	21 – 31 = –10	100	1	1(100) = 100
24	24 – 31 = –7	49	12	12(49) = 588
27	27 – 31 = –4	16	16	16(16) = 256
30	30 – 31 = –1	1	28	28(1) = 28
33	33 – 31 = 2	4	28	28(4) = 112
36	36 – 31 = 5	25	21	21(25) = 525
39	39 – 31 = 8	64	10	10(64) = 640
				Σ = 2,925

Table 4.18 Data and Calculations for Variance and Standard Deviation: Judge Sentencing Data From Table 4.1

Judge 1		*Judge 2*	
x	x^2	x	x^2
5	25	1	1
7	49	2	4
7	49	2	4
7	49	3	9
7	49	3	9
7	49	3	9
8	64	4	16
8	64	4	16
8	64	5	25
8	64	8	64
9	81	9	81
9	81	10	100
9	81	11	121
10	100	14	196
11	121	15	225
11	121	15	225
11	121	16	256
12	144	17	289
12	144	18	324
14	196	20	400
$\Sigma = 180$	$\Sigma = 1{,}716$	$\Sigma = 180$	$\Sigma = 2{,}374$

Table 4.19 Calculations for Variance and Standard Deviation for Grouped Time-Until-Rearrest Data

Midpoint	*mf*	f_i	$m_i^2 f_i$	$m_i f_i$
18	324	4	1,296	72
21	441	1	441	21
24	576	12	6,912	288
27	729	16	11,664	432
30	900	28	25,200	840
33	1,089	28	30,492	924
36	1,296	21	27,216	756
39	1,521	10	15,210	390
			Σ = 118,431	3,723

		Current Offense Is:			
		Property	Violent	Drug	Status
Previous offense was:	Property	75	50	40	120
	Violent	10	30	30	20
	Drug	20	10	110	115
	Status	20	20	50	320
Total		125	110	230	575

Number of Thefts	*f*
0–4	76
5–9	52
10–14	38
15–19	21
20–24	10
25–29	8

Person	*Years of Education*	*Person*	*Years of Education*
1	11	11	9
2	8	12	9
3	12	13	5
4	9	14	9
5	9	15	7
6	9	16	6
7	10	17	10
8	10	18	12
9	10	19	9
10	11	20	5

Year	*Race*	*f*
1980	White	852
	Black	675
	Hispanic	112
	Asian	25
	Other	59
1990	White	979
	Black	756
	Hispanic	262
	Asian	86
	Other	78
2000	White	1,211
	Black	925
	Hispanic	636
	Asian	310
	Other	120
2010	White	1,300
	Black	1,017
	Hispanic	750
	Asian	400
	Other	145

State	*Robbery Arrest Rate*	*State*	*Robbery Arrest Rate*
Arizona	29	New York	70
Arkansas	22	North Carolina	41
Colorado	17	North Dakota	7
Georgia	32	Oregon	30
Idaho	6	Pennsylvania	51
Kentucky	29	South Carolina	32
Maine	17	Texas	25
Maryland	56	Utah	13
Missouri	33	Wyoming	5

Source: Adapted from Puzzanchera and Kang © 2014 from the Office of Juvenile Justice and Delinquency Prevention.

Figure 5.1 Two Mutually Exclusive Events, Event *A* and Event *B*

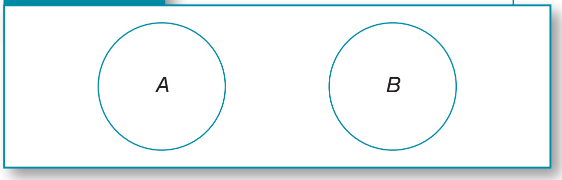


Figure 5.2 Two Non-Mutually-Exclusive Events, Event *A* and Event *B*

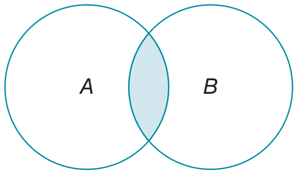


Table 5.1 **Adolescents' Delinquent Conduct by Family Status**

Parents Are Divorced/ Separated	*Number of Delinquent Acts Committed*			*Total*
	0	*1–4*	*5 or More*	
No	125	60	15	200
Yes	10	35	65	110
Total	135	95	80	310

Table 5.2 Joint Frequency Distribution for Right- and Left-Handedness and Delinquency

Handedness	*Committed Delinquent Act Last Year?*		*Total*
	No	*Yes*	
Left-handed	25	25	50
Right-handed	25	25	50
Total	50	50	100

Table 5.3 Joint Frequency Distribution for Impulsivity and Delinquency

Youth Impulsive?	*Committed Delinquent Act Last Year?* No	*Committed Delinquent Act Last Year?* Yes	*Total*
No	40	10	50
Yes	10	40	50
Total	50	50	100

Table 5.4 **Probability Rules**

Rule 1: The Bounding Rule
The probability of an event (event *A*) must always be greater than or equal to zero or less than or equal to 1.0.
$0 \leq P(A) \leq 1$
Rule 2: The Addition Rule
Rule 2a: The Restricted Addition Rule for Mutually Exclusive Events
If two events (events *A* and *B*) are mutually exclusive, the probability of either event *A* or event *B* occurring is equal to the sum of their separate probabilities.
$P(A \text{ or } B) = P(A) + P(B)$
Rule 2b: The General Addition Rule
If two events (events *A* and *B*) are not mutually exclusive, the probability of either event *A* or event *B* occurring is equal to the sum of their separate probabilities minus their joint probability.
$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$
Rule 3: The Multiplication Rule
Rule 3a: The Restricted Multiplication Rule for Independent Events
If two events (events *A* and *B*) are independent, the probability of event *A* and event *B* occurring simultaneously is equal to the product of their separate probabilities.
$P(A \text{ and } B) = P(A) \times P(B)$
Rule 3b: The General Multiplication Rule
If two events (events *A* and *B*) are not independent, the probability of event *A* and event *B* occurring simultaneously is equal to the product of the unconditional probability of *A* and the conditional probability of *B* given *A*.
$P(A \text{ and } B) = P(A) \times P(B \mid A)$

Table 5.5 Probability Distribution of the Number of Heads From Flipping a Coin Two Times

Number of Heads	*p*
0	.25
1	.50
2	.25

Table 5.6 Observed Results From the Flipping of a Coin Twice 10

Number of Heads	*f*	*p*
0	5	.50
1	3	.30
2	2	.20
Total	10	1.00

Table 5.7 Probability Distribution of Appearance at Trial Where p (Success) = .8, q (Failure) = .2, and n = 5

Number of Successes	*Calculation*	*p*
0	$\left(\frac{5!}{0!(5-0)!}\right).8^0.2^5$	.0003
1	$\left(\frac{5!}{1!(5-1)!}\right).8^1.2^4$	.0064
2	$\left(\frac{5!}{2!(5-2)!}\right).8^2.2^3$	.0512
3	$\left(\frac{5!}{3!(5-3)!}\right).8^3.2^2$	.2048
4	$\left(\frac{5!}{4!(5-4)!}\right).8^4.2^1$	.4096
5	$\left(\frac{5!}{5!(5-5)!}\right).8^5.2^0$	.3277
		Total = 1.00

Figure 5.3 Histogram of Probability Distribution From Table 5.7

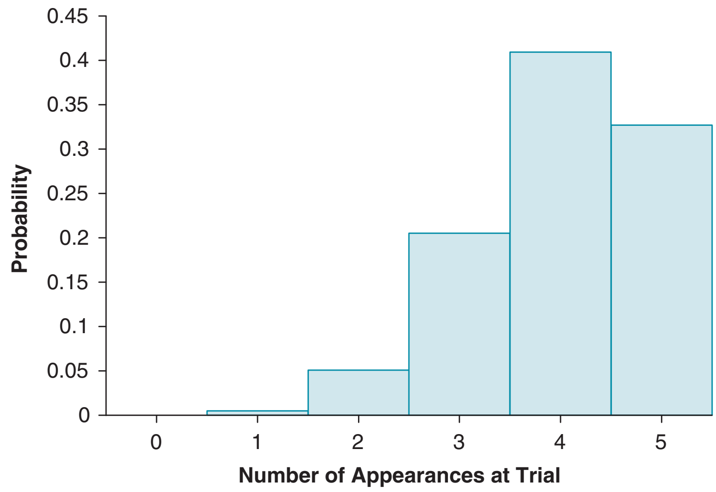


Table 5.8 Decision Making in Hypothesis Tests

True State of Affairs	*Decision Regarding Null Hypothesis*	
	Fail to Reject	*Reject*
Null hypothesis is true	Correct decision	Type I error
Null hypothesis is false	Type II error	Correct decision

Table 5.9 **Probability Distribution of Recovering a Stolen Car With LoJack Where p (Success) = .4, q (Failure) = .6, and n = 10**

Number of Successes	*Calculation*	*P*
0	$\left(\frac{10!}{0!(10-0)!}\right).4^0.6^{10}$	.0060
1	$\left(\frac{10!}{1!(10-1)!}\right).4^1.6^9$	.0403
2	$\left(\frac{10!}{2!(10-2)!}\right).4^2.6^8$	.1209
3	$\left(\frac{10!}{3!(10-3)!}\right).4^3.6^7$	.2150
4	$\left(\frac{10!}{4!(10-4)!}\right).4^4.6^6$	.2508
5	$\left(\frac{10!}{5!(10-5)!}\right).4^5.6^5$	.2007
6	$\left(\frac{10!}{6!(10-6)!}\right).4^6.6^4$	.1115
7	$\left(\frac{10!}{7!(10-7)!}\right).4^7.6^3$	.0425
8	$\left(\frac{10!}{8!(10-8)!}\right).4^8.6^2$	.0106
9	$\left(\frac{10!}{9!(10-9)!}\right).4^9.6^1$	.0016
10	$\left(\frac{10!}{10!(10-10)!}\right).4^{10}.6^0$	.0001 Total = 1.00

Figure 5.4 Histogram of Probability Distribution of Stolen Car Recoveries

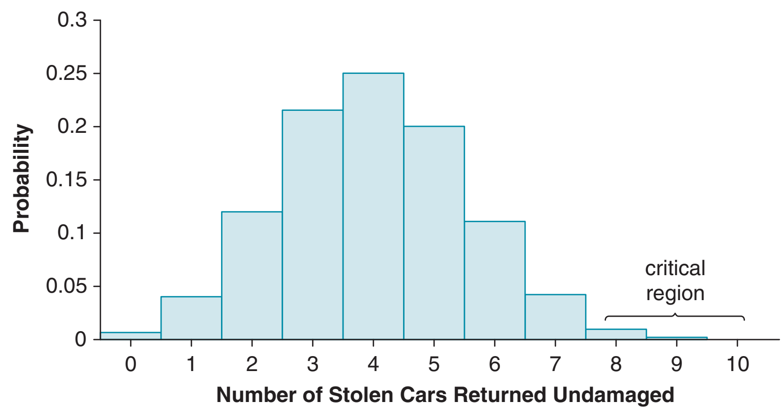


Figure 5.5 Representation of a Standard Normal Distribution

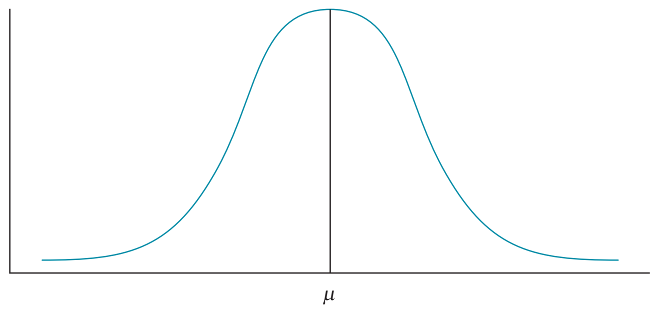


Figure 5.6 Two Normal Distributions With Unequal Means ($\mu_1 \neq \mu_2$) but Equal Variances ($\sigma^2_1 = \sigma^2_2$)

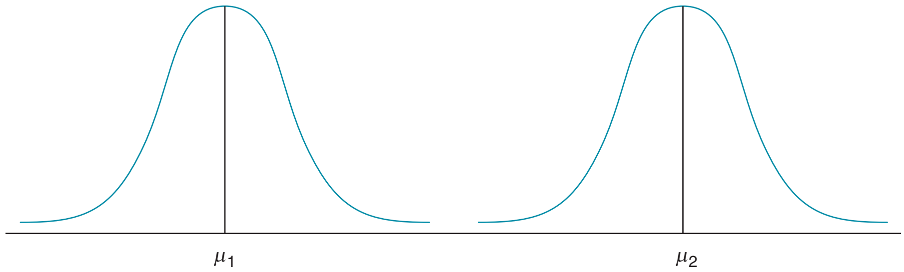


Figure 5.7 **Two Normal Distributions With Equal Means ($\mu_1 = \mu_2$) but Unequal Variances ($\sigma^2_1 \neq s^2_2$)**

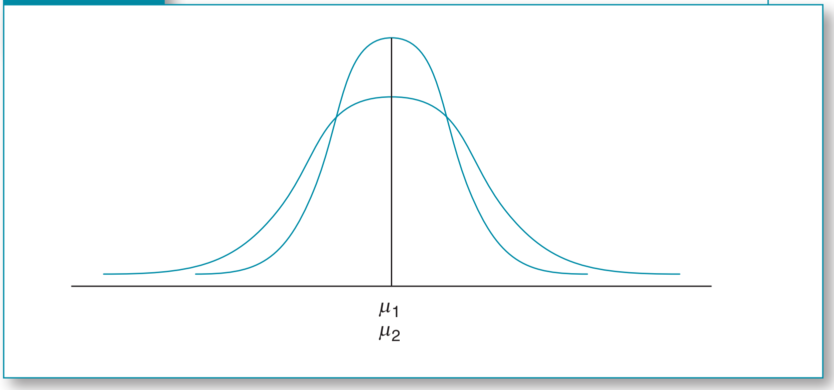


Figure 5.8 Two Normal Distributions With Unequal Means ($\mu_1 \neq \mu_2$) and Unequal Variances ($\sigma^2_1 \neq s^2_2$)

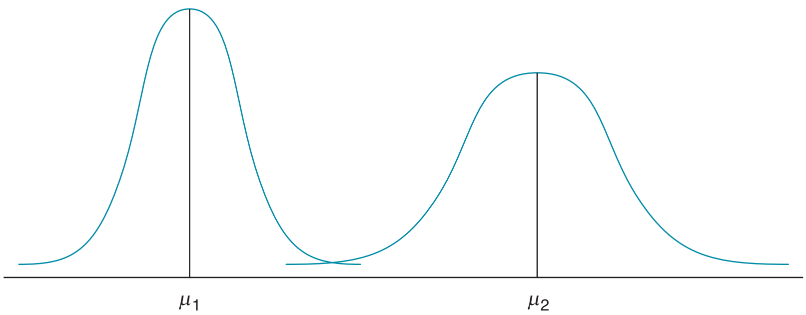


Figure 5.9 Area of the Normal Curve From the Mean to Points 1.0, 2.0, and 3.0 Standard Deviations to the Right

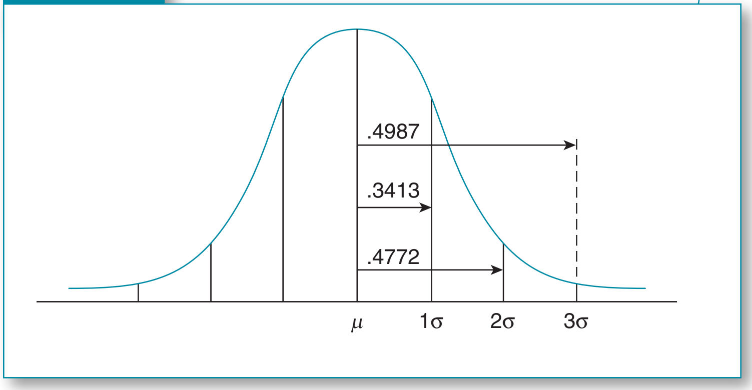


Figure 5.10 Area of the Normal Curve From the Mean to Points ±1, ±2, and ±3 Standard Deviations Away

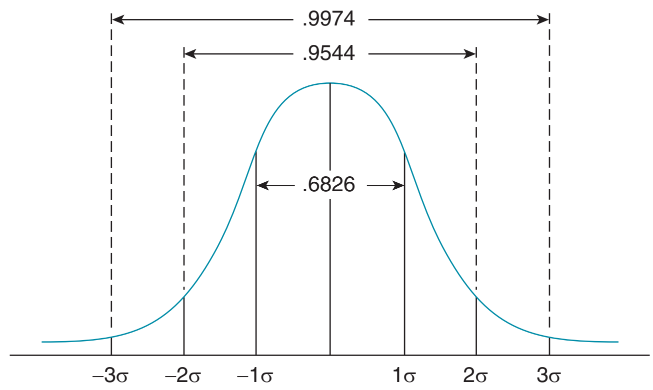


Table 5.10 Number of Prior Arrests for Sample of 10 Persons Arrested During Past Year

Person	*Number of Prior Arrests*
1	3
2	2
3	0
4	8
5	0
6	6
7	13
8	4
9	10
10	5

Figure 5.11 Area of the Normal Curve From the Mean to 1.47 Standard Deviations to the Right

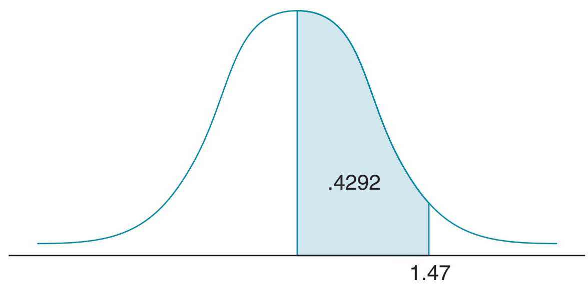


Figure 5.12 Area of the Normal Curve to the Left of –1.96 Standard Deviation Units From the Mean

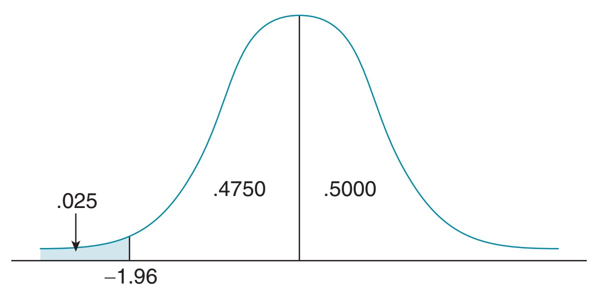


Figure 5.13 Area of the Normal Curve to the Left and Right of ±1.96 Standard Deviation Units From the Mean

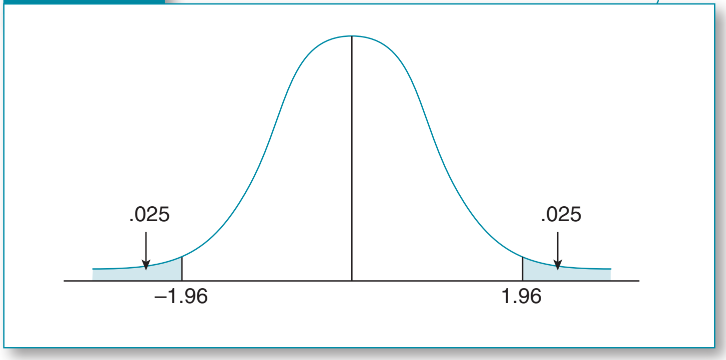


Figure 5.14 Area of the Normal Curve Corresponding to the Top 1% of the Distribution

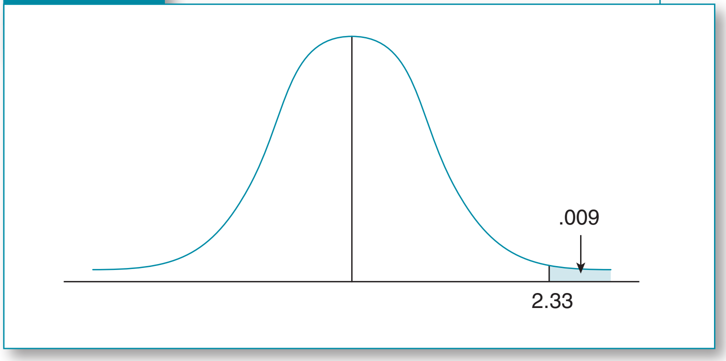


Figure 5.15 Relationship Between Sample Size and Shape of the Sampling Distribution

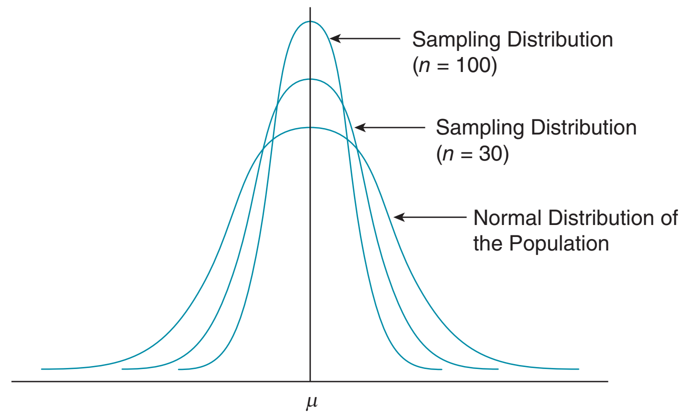
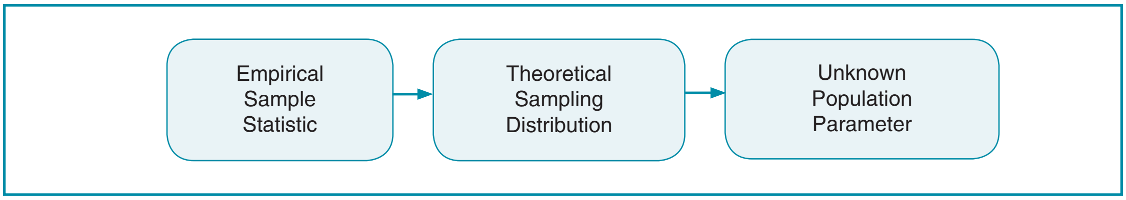


Table 5.11 Characteristics of Three Types of Distributions

	Mean	*Standard Deviation*	*Distribution*
Sample	$\bar{X}$	s	Empirical and known
Population	μ	σ	Empirical but not known
Sampling distribution	μ	$\frac{\sigma}{\sqrt{n}}$	Theoretical


Empirical Sample Statistic
Theoretical Sampling Distribution
Unknown Population Parameter

Salary	*f*
$25,000	6
$26,000	8
$27,500	9
$28,000	10
$30,000	16
$31,500	19
$32,000	12
$32,500	15
$34,000	8
$35,000	7
Total	110

Impulsivity	*Was the Person Deterred?*		*Total*
	Deterred	*Not Deterred*	
Not impulsive	75	15	90
Impulsive	5	25	30
Total	80	40	120

Number of Violent Acts	*Type of Preventive Measure*				*Total*
	No Measures	*Metal Detectors Only*	*Guards Only*	*Guards and Metal Detectors*	
None	5	10	15	30	60
1–4 acts	25	20	15	15	75
5 or more acts	50	30	25	10	115
Total	80	60	55	55	250

	Favor (%)
Background checks for private and gun show sales	85
Preventing people with mental illness from purchasing guns	80
Federal database to track gun sales	67
Ban on semi-automatic weapons	58
Ban on high-capacity ammunition clips	54

Table 6.1 Top Crime Worries of Americans

Crime Worries in United States
How often do you, yourself, worry about the following things—frequently, occasionally, rarely, or never? How about …

	% Frequently or Occasionally Worry
Having the credit card information you have used at stores stolen by computer hackers	69
Having your computer or smartphone hacked and the information stolen by unauthorized persons	62
Having your home being burglarized when you are not there	45
Having your car stolen or broken into	42
Having a school-aged child physically harmed attending school	31
Getting mugged	31
Having your home being burglarized when you are there	30
Being the victim of terrorism	28
Being attacked while driving your car	20
Being a victim of a hate crime	18
Being sexually assaulted	18
Getting murdered	18
Being assaulted/killed by a coworker/employee where you work	7

Source:

Figure 6.1 A Hypothetical Example of 95% Confidence Intervals Computed From 20 Different Samples of the Same Size Drawn From the Same Population

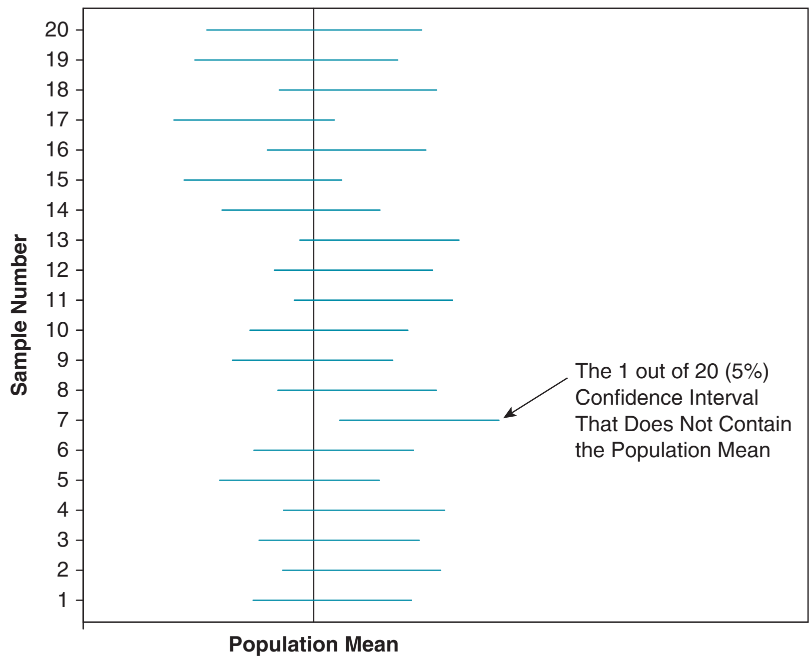


Table 6.2 Properties of the Sampling Distribution of $\bar{X}$

1. The mean of this sampling distribution of $\bar{X}$ is μ.
2. The standard deviation of the sampling distribution of $\bar{X}$ is

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

   where σ is the standard deviation of the original population, n is the sample size, and $\sigma_{\bar{x}}$ is used to denote the standard deviation of the sampling distribution. This entire term is called the **standard error of the mean**.
3. Because of the central limit theorem, when n is large (safely, when $n \geq 30$), the sampling distribution is normally distributed regardless of the distribution of the population from which the sample was drawn.
4. As the sample size increases, the standard deviation of the sampling distribution (the standard error of the mean) decreases.

Table 6.3 Common Confidence Intervals and Their Corresponding Critical Values of *z* From the Sampling Distribution of *z*

Confidence Level (%)	*Significance (α)*	*z Score*
90	.10	1.65
95	.05	1.96
99	.01	2.58
99.9	.001	3.27

Figure 6.2 The *z* Distribution and the *t* Distribution

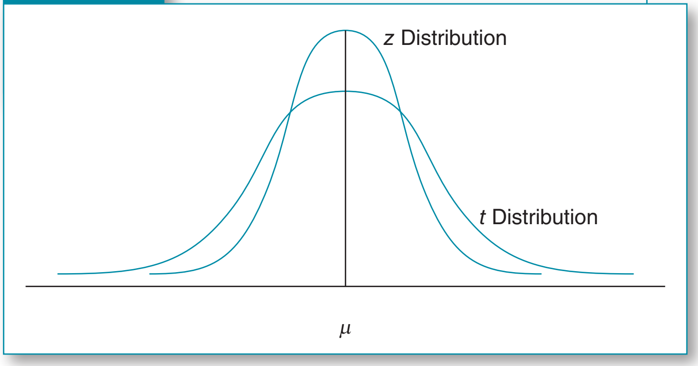


Table 6.4 **Properties of the Sampling Distribution of *t***

1. The *t* distribution is bell-shaped and symmetrical and centers around $t = 0$.
2. The *t* distribution is flatter and has fatter tails than the *z* distribution.
3. There are many different *t* distributions based on the sample size. More specifically, the distribution of *t* that we use for our statistical test is based on a parameter called the degrees of freedom (*df*). The number of degrees of freedom is different for different kinds of statistical problems. For confidence intervals, there are $n - 1$ degrees of freedom where *n* is the sample size.
4. With sample sizes of 120 or more, the *t* distribution becomes virtually identical to the *z* distribution.

Police Officers' Overload Score in Our Sample
$\bar{X} = 31$
$s = 3$
$n = 14$

Female Police Officers' Scores on Work Overload Test	*Male Police Officers' Scores on Work Overload Test*
$\bar{X} = 41.9$	$\bar{X} = 32.5$
$s = 7.8$	$s = 9.3$
$n = 15$	$n = 15$

Figure 7.1 **Formal Steps for Hypothesis Testing**

Step 1: Formally state your null (H_0) and research (H_1) hypotheses.

Step 2: Select an appropriate test statistic and the sampling distribution of that test statistic.

Step 3: Select a level of significance (alpha = α) and determine the critical value and rejection region of the test statistic based on the selected level of alpha.

Step 4: Conduct the test; calculate the obtained value of the test statistic and compare it with the critical value.

Step 5: Make a decision about your null hypothesis and interpret this decision in a meaningful way based on the research question, sample, and population.

	Population	*Sample*
Mean reading level	$\mu = 7.5$	$\bar{x} = 9.3$
Standard deviation	$\sigma =$ unknown	$s = 2.2$
	$N =$ unknown	$n = 100$

Figure 7.2 Two Populations With Different Mean Reading Levels

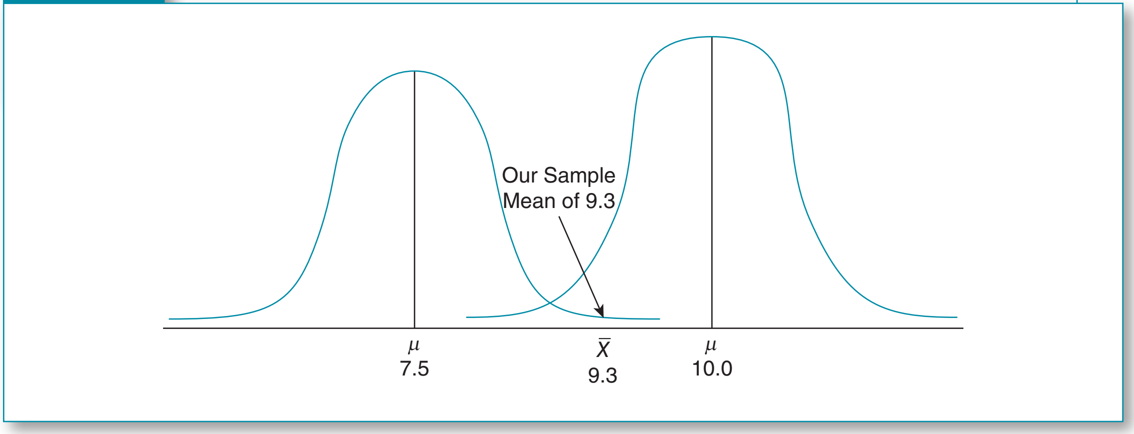


Figure 7.3 One Population With a Mean of 7.5 and the Location of a Sample From that Population With a Higher Mean

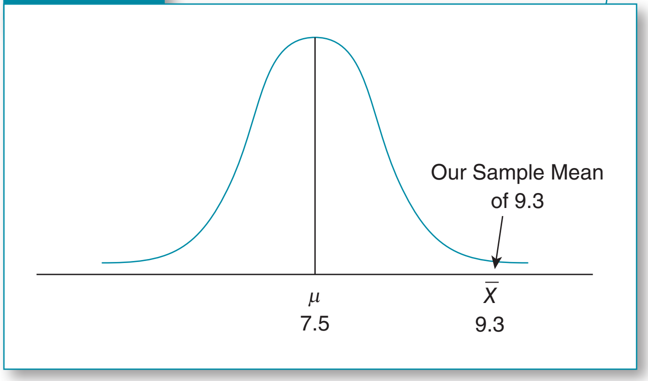
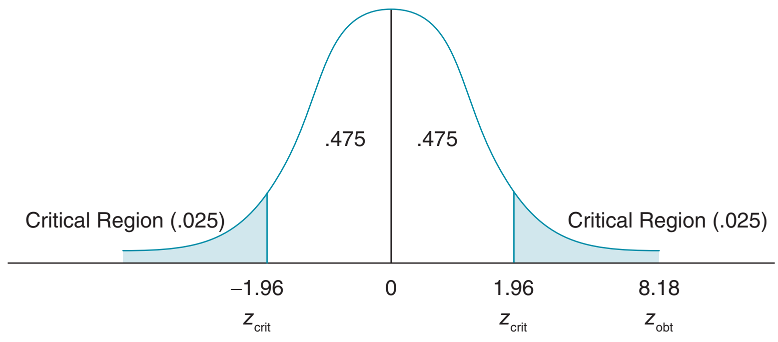


Table 7.1 Alpha (α) Levels and Critical Values of *z* for One- and Two-Tailed Hypothesis Tests

Type of Hypothesis Test	*Significance/Alpha Level*	*Critical Area in Each Tail*	*Critical z*
Two-tailed	.10	.05	1.65
One-tailed	.10	.10	1.29
Two-tailed	.05	.025	1.96
One-tailed	.05	.05	1.65
Two-tailed	.01	.005	2.58
One-tailed	.01	.01	2.33
Two-tailed	.001	.0005	3.27
One-tailed	.001	.001	3.08

Figure 7.4 Critical *z* and Critical Region for Two-Tailed Test and Alpha = .05



Population Parameters for Armed Robberies Before New Legislation	*Sample Statistics for Armed Robberies After New Legislation*
μ = 52.5 months	$\bar{x}$ = 53.2 months
σ = unknown	s = 6
N = unknown	n = 110

Figure 7.5 Critical z and Critical Region for Two-Tailed Test With Alpha = .01

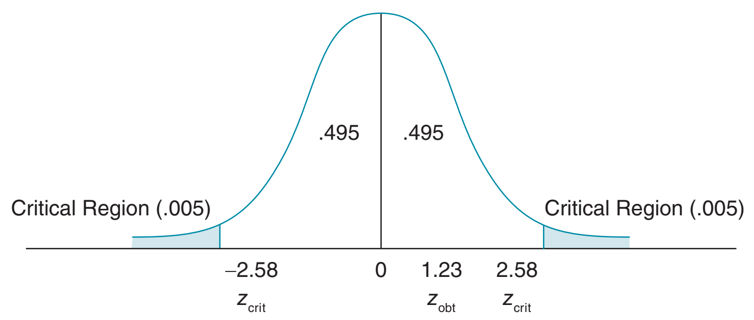


Figure 7.6 Three Populations of Convicted Armed Robbers With Different Mean Sentence Lengths (in Months)

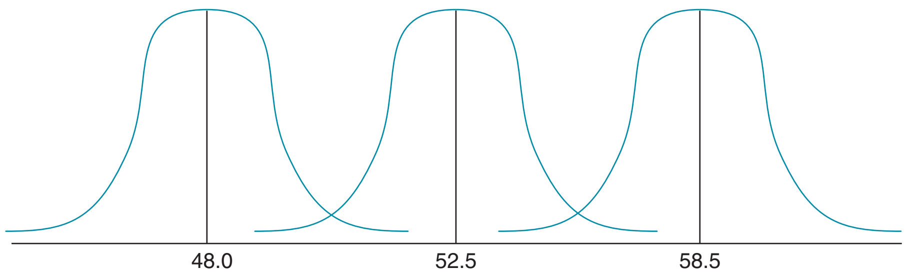


Figure 7.7 Two Populations of Convicted Armed Robbers, One With Mean = 52.5 and One With Mean = 58.5

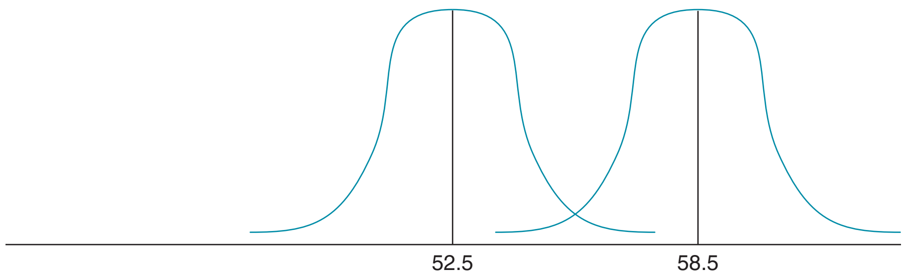


Figure 7.8 Two Populations of Convicted Armed Robbers, One With Mean = 48.0 and One With Mean = 52.5

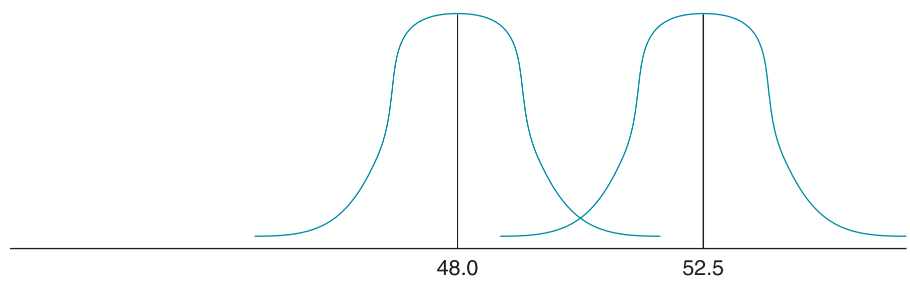


Figure 7.9 **Critical *z* and Critical Region for Two-Tailed Test With Alpha = .05**

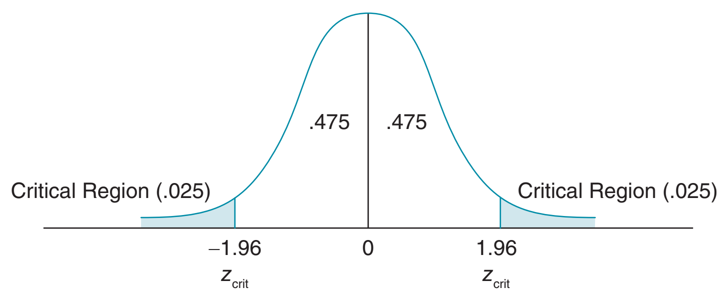


Figure 7.10 Critical *z* and Critical Region for One-Tailed Test and Alpha = .05

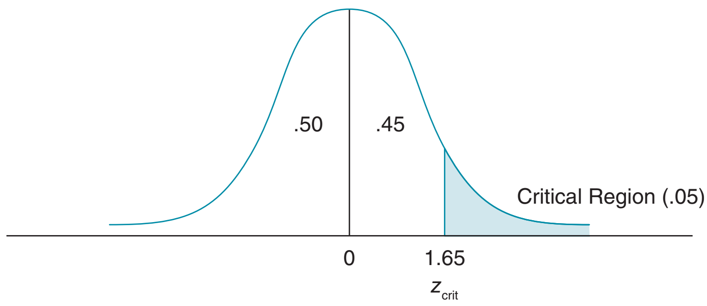
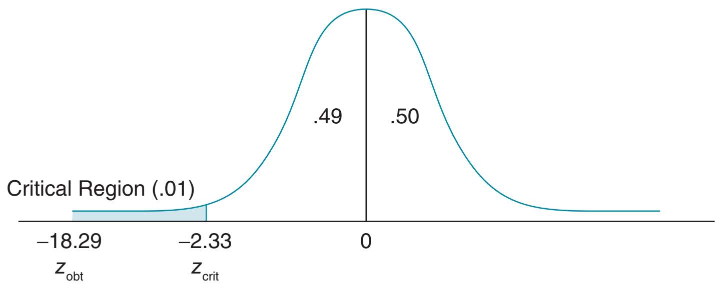


Figure 7.11 Critical *t* and Critical Region for Two-Tailed Test and Alpha = .01



National Sample of Asset Seizures in Dollars from ATF	*Sample of 14 Asset Seizures in Our State in Dollars*
μ = \$75,200	$\bar{x}$ = \$71,500
σ = unknown	s = \$3,900
N = unknown	n = 14

Figure 7.12 **Critical *t* and Critical Region for Two-Tailed Test and Alpha = .01**

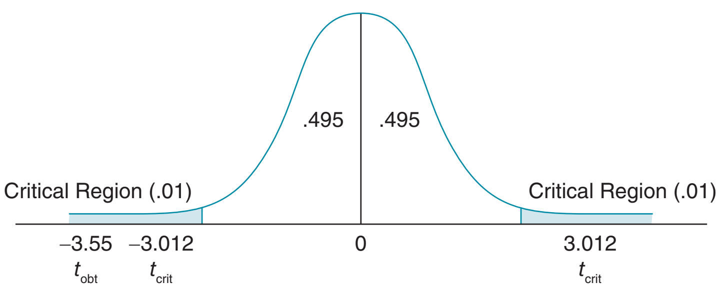


Figure 7.13 Critical *t* and Critical Region for Two-Tailed Test and Alpha = .01

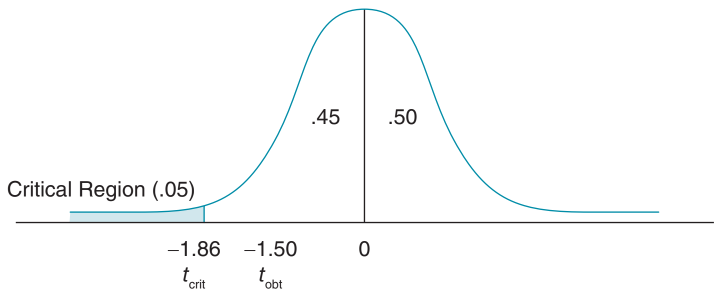
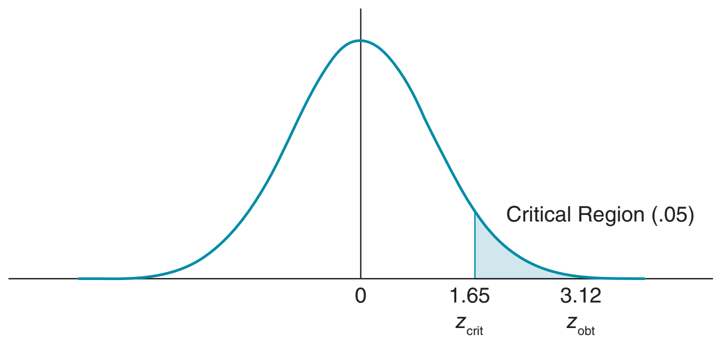
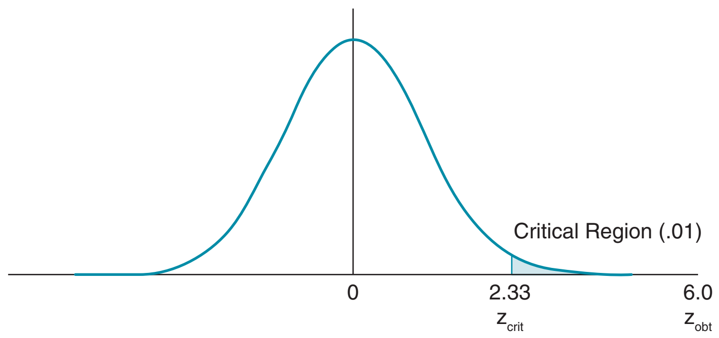


Figure 7.14 Critical *z* and Critical Region for One-Tailed and Alpha = .05



Population	*Sample*
$P = 12\%$	$\hat{p} = 36\%$
	$n = 100$

Figure 7.15 Critical *z* and Critical Region for a One-Tailed Test With Alpha = .05



Facility Number	*Hours Spent in Cells*
1	16.3
2	21.1
3	14.9
4	13.5
5	22.2
6	15.3
7	18.1
8	19.0
9	14.2
10	9.3
11	10.1
12	21.1
13	22.3
14	15.4
15	13.2

Table 8.1 **Distribution of Gender and Negative Emotionality and Joint Distribution of Gender and Negative Emotionality in Contingency Table**

Gender	*f*
Female	60
Male	60
Negative Emotionality	***f***
Low	90
High	30

Contingency Table of Observed Joint Frequency Distribution

	Negative Emotionality		
Gender	*Low*	*High*	*Total*
Female	46	14	60
Male	44	16	60
Total	90	30	120

Table 8.2 Labeling a 2×2 Contingency Table

Number of Rows	*Number of Columns* 1	2	*Row Marginals*
1	*A**	*B**	R_1
2	*C**	*D**	R_2
Column marginals	C_1	C_2	N

*Cell frequencies.

Table 8.3 **Relationship Between Gender and Negative Emotionality: Comparing Percentages Across the IV Categories Within a DV Category**

	Negative Emotionality (DV)		
Gender (IV)	*Low*	*High*	*Row Total*
Female	A 46 77%	B 14 23%	60 100%
Male	C 44 73%	D 16 27%	60 100%
Column total	90	30	*n* =120

Calculate percentages based on the marginals of the independent variable

Compare on a category of the dependent variable across categories of the independent variable

Table 8.4 Relationship Between Attitudes Toward School and Self-Reported Delinquency: Observed Frequencies

DV: Number of Self-Reported Delinquent Acts	*IV: Do You Like School?*		*Total*
	Like	*Dislike*	
0	140	25	165
1	105	50	155
2+	70	60	130
Total	315	135	450

Table 8.5 Relationship Between Attitudes Toward School and Self-Reported Delinquency: Observed Frequencies With Percentages and Making Comparisons Across the IV Categories

DV: Number of Self-Reported Delinquent Acts	*IV: Do You Like School?*		*Total*
	Like	*Dislike*	
0	140 45%	25 19%	165
1	105 33%	50 37%	155
2+	70 22%	60 44%	130
Total	315 100%	135 100%	450

Table 8.6 Observed Cell Frequencies and Expected Cell Frequencies for Relationship Between Gender and Negative Emotionality

	Negative Emotionality		
Gender	*Low*	*High*	*Row Total*
Female	A 46 $f_e = 45$	B 14 $f_e = 15$	60
Male	C 44 $f_e = 45$	D 16 $f_e = 15$	60
Column total	90	30	$n = 120$

Table 8.7 Row and Column Marginals for Gender and Negative Emotions Data Found in Table 8.6

	Negative Emotionality		
Gender	*Low*	*High*	*Total*
Female	?	?	60
Male	?	?	60
Total	90	30	120

Table 8.8 Determining Degrees of Freedom in a 2 × 2 Table: Fixing the Frequencies for the First Cell

	Negative Emotionality		
Gender	*Low*	*High*	*Total*
Female	A 46	B ?	60
Male	C ?	D ?	60
Total	90	30	120

Table 8.9 Calculation of the Chi-Square Statistic for the Null Hypothesis That Gender and Negative Emotions Are Independent

f_o	f_e	$f_o - f_e$	$(f_o - f_e)^2$	$\frac{(f_o - f_e)^2}{f_e}$
46	45	1	1	.022
14	15	–1	1	.067
44	45	–1	1	.022
16	15	1	1	.067
				$\chi^2_{obt} = .178$

Table 8.10 Calculations for Chi-Square Statistic on Gender and Negative Emotions Data Using the Computational Formula

f_o	f_o^2	f_e	$\frac{f_o^2}{f_e}$
46	2,116	45	(2,116 / 45) = 47.022
14	196	15	(196 / 15) =13.067
44	1,936	45	(1,936 / 45) = 43.022
16	256	15	(256 / 15) = 17.067
			Σ= 120.178
			χ^2 = 120.178 – 120 = .178

Table 8.11 Joint Distribution of Neighborhood Socioeconomic Status and Police Response Time to a 911 Call for Assistance

	Police Response Time			
Neighborhood Socioeconomic Status	*Less Than 3 Minutes*	*3–7 Minutes*	*More Than 7 Minutes*	*Total*
Low	A 11	B 17	C 35	63
Medium	D 16	E 24	F 13	53
High	G 48	H 20	I 7	75
Total	75	61	55	191

Table 8.12 Relationship Between Neighborhood Socioeconomic Status and Police Response Time to a 911 Call for Assistance: Examining Percentages

	Police Response Time			
Neighborhood Socioeconomic Status	*Less Than 3 Minutes*	*3–7 Minutes*	*More Than 7 Minutes*	*Total*
Low	11 17%	17 27%	35 56%	63 100%
Medium	16 30%	24 45%	13 25%	53 100%
High	48 64%	20 27%	7 9%	75 100%
Total	75	61	55	191

Table 8.13 Observed and Expected Cell Frequencies Under the Null Hypothesis of Independence

	Police Response Time			
Neighborhood Socioeconomic Status	*Less Than 3 Minutes*	*3–7 Minutes*	*More Than 7 Minutes*	*Total*
Low	11 $f_e = 25$	17 $f_e = 20$	35 $f_e = 18$	63
Medium	16 $f_e = 21$	24 $f_e = 17$	13 $f_e = 15$	53
High	48 $f_e = 29$	20 $f_e = 24$	7 $f_e = 22$	75
Total	75	61	55	191

Table 8.14 Computational Formula: Calculation of the Chi-Square Statistic for the Null Hypothesis That Neighborhood Socioeconomic Status and Police Response Time Are Independent

f_o	f_o^2	f_e	$\frac{f_o^2}{f_e}$
11	121	25	4.84
17	289	20	14.45
35	1,225	18	68.06
16	256	21	12.19
24	576	17	33.88
13	169	15	11.27
48	2,304	29	79.45
20	400	24	16.67
7	49	22	2.23
			$\Sigma = 243.04$
			$\chi^2_{obt} = 243.04 - 191$
			$\chi^2_{obt} = 52.04$

Table 8.15 Joint Distribution of Gender of Police Officer and Type of Work Performed

Gender	*Desk Job*	*Patrol*	*Total*
Low	45 36%	80 64%	125 100%
Medium	30 67%	15 33%	45 100%
Total	75	95	170

Table 8.16 Joint Distribution for Type of Lawyer and Type of Sentence Received

	Type of Sentence Received			
Type of Lawyer	*Probation*	*Fine Only*	*Fine and Jail Time*	*Total*
Court-appointed	5 9%	10 18%	40 73%	55 100%
Public defender	15 23%	20 31%	30 46%	65 100%
Private	25 63%	10 25%	5 12%	40 100%
Total	45	40	75	160

Table 8.17 Joint Distribution of Number of Hours Worked per Week During the School Year and Number of Times a Youth Has Used Drugs or Alcohol

	Number of Times Used Drugs/Alcohol		
Number of Hours Worked per Week	*0*	*1 or More*	*Total*
Court-appointed	15 20%	60 80%	75 100%
Public defender	40 67%	20 33%	60 100%
Total	55	80	135

Person Number	*Level on V_1*	*Level on V_2*
1	1	2
2	2	3
3	3	2
4	3	3
5	3	2

Table 8.18 Grades in School and Self-Reported Acts of Petty Theft

	Self-Reported Thefts			
Grades in School	*0*	*1 to 5*	*6 or More*	*Total*
Mostly Ds and Fs	23	19	20	62
Mostly Cs	307	157	123	587
Mostly Bs	762	345	155	1,262
Mostly As	418	166	56	640
Total	1,510	687	354	2,551

Type of Institution	*Satisfied With Job?*		*Total*
	No	*Yes*	
Medium security	15	30	45
Maximum security	100	40	140
Total	115	70	185

Type of Institution	*Social Organization*		*Total*
	Socially Organized	*Socially Disorganized*	
Low crime rate	90	98	188
High crime rate	10	52	62
Total	100	150	250

Type of Sentence Received	*Where Defendant Was Tried*			*Total*
	Rural Court	*Suburban Court*	*Urban Court*	
Jail only	18	30	94	142
Fine and jail	22	37	36	95
Less than 60 days of jail time	24	38	50	112
60 or more days of jail time	16	20	40	76
Total	80	125	220	425

Race	*Number of property Crimes*		*Total*
	0–4	*5 or More*	
Non-White	77	33	110
White	180	70	250
Total	257	103	360

Number of Arrests Within 3 Years	*Stable Employment*	*Sporadic Employment*	*Unemployed*	*Total*
None	30	14	10	54
One or more	15	16	30	61
Total	45	30	40	115

Tattoo Status	*0–4 Adult Offenses*	*5–9 Adult Offenses*	*10–14 Adult Offenses*	*15 or More Adult Offenses*	*Total*
No tattoos	78	56	34	15	183
Has tattoos	15	22	37	63	137
Total	93	78	71	78	320

Table 9.1 Characteristics and Notations for Two-Sample Problems

	Population 1	*Population 2*
Population mean	m_1	m_2
Population standard deviation	s_1	s_2
Sample mean	$\overline{X}_1$	$\overline{X}_2$
Sample standard deviation	s_1	s_2
Sample size	n_1	n_2

Figure 9.1 Distribution of Male and Female Delinquent Offending With Different Population Means

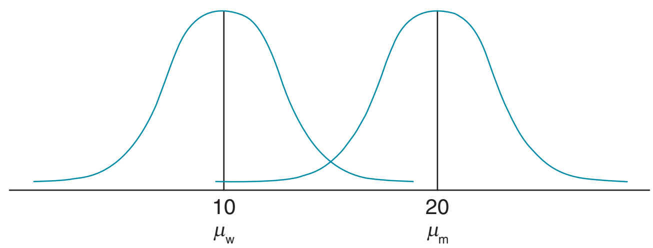


Figure 9.2 Distribution of Male and Female Delinquent Offending With Equal Population Means

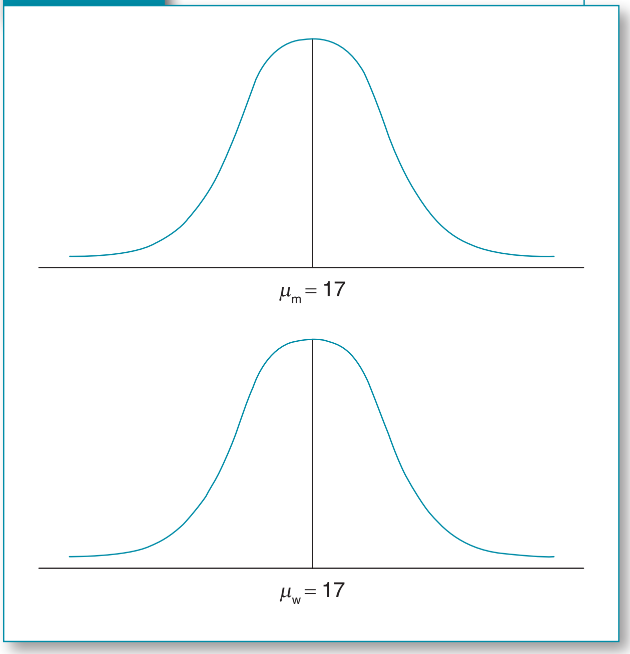


Figure 9.3 Hypothesis Test for Difference Between Two Means or Proportions

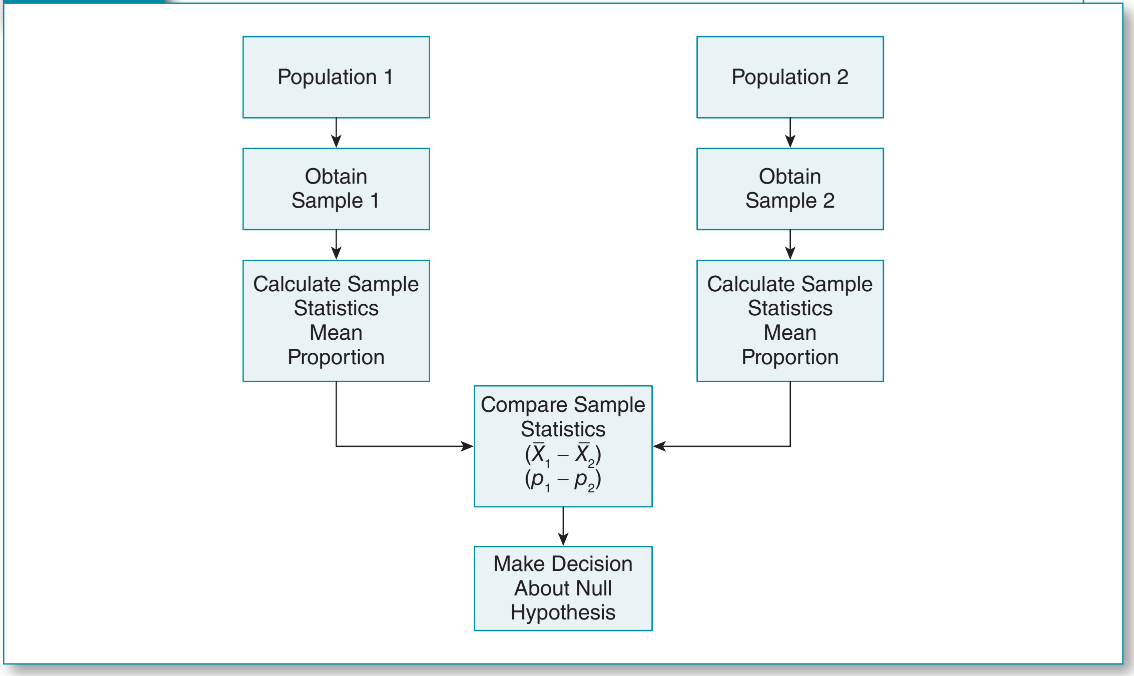


Figure 9.4 Sampling Distribution of the Difference Between Two Sample Means

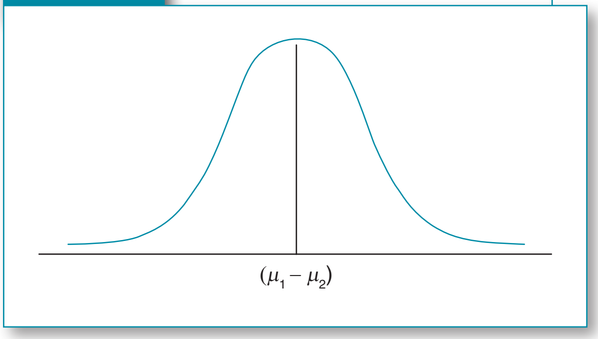


Table 9.2 Prison Expenditures per Inmate per Day by State and Region, 2011

State	*Daily Mean State Prison Operating Expenditures per Inmate (in Dollars)*
West	
Nevada	56.59
Idaho	53.55
Arizona	67.96
Montana	82.81
Colorado	83.22
California	129.92
Washington	128.48
Utah	80.41
Sample Statistics for the West $\bar{X}_1 = 85.37$ $s_1 = 29.33$ $n_1 = 8$	
Northeast	
New Hampshire	93.37
Pennsylvania	116.00
New York	164.59
New Jersey	150.32
Vermont	135.62
Connecticut	137.70
Maine	127.13
Rhode Island	134.61
Sample Statistics for the Northeast $\bar{X}_2 = 132.42$ $s_2 = 21.45$ $n_2 = 8$	

Source: Adapted from *The Cost of Prisons: What Incarceration Costs Taxpayers* © 2012 from the Vera Institute of Justice.

Table 9.3 Steps Taken When Conducting a Hypothesis Test

Step 1: Formally state your null (H_0) and research (H_1) hypotheses.

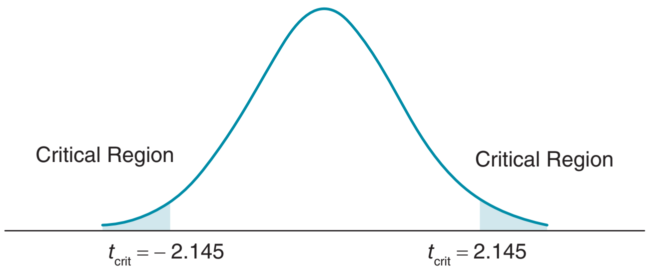
Step 2: Select an appropriate test statistic and the sampling distribution of that test statistic.

Step 3: Select a level of significance (alpha = α) and determine the critical value and rejection region of the test statistic based on the selected level of alpha and degrees of freedom.

Step 4: Conduct the test: Calculate the obtained value of the test statistic and compare it with the critical value.

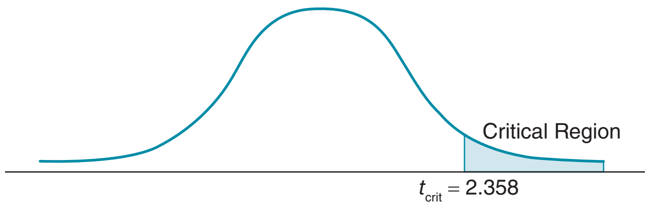
Step 5: Make a decision about your null hypothesis and interpret this decision in a meaningful way based on the research question, sample, and population.

Figure 9.5 Critical t and Critical Region for Alpha = .05 (df = 14) and a Two-Tailed Test



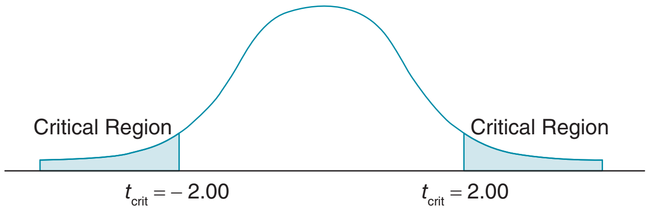
Less Than 1 Year	*More Than 1 Year*
$\bar{X}_1 = 22.4$ $s_1^2 = 4.3$ $n_1 = 49$	$\bar{X}_2 = 16.2$ $s_2^2 = 4.1$ $n_2 = 53$

Figure 9.6 Critical t and Critical Region for Alpha = .01 (df = 120) and a One-Tailed Test



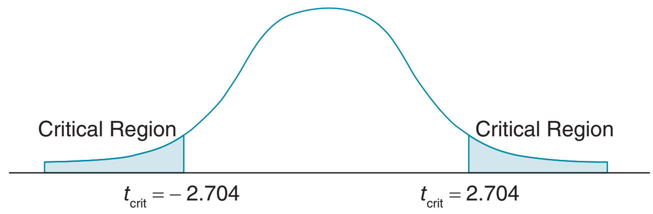
Boot Camp Group	*Prison Group*
$\bar{X}_1 = 15.2$ offenses $s_1^2 = 4.7$ $n_1 = 32$	$\bar{X}_2 = 15.9$ offenses $s_2^2 = 5.1$ $n_2 = 29$

Figure 9.7 Critical t and Critical Regions for Alpha = .05 (df = 60) and a Two-Tailed Test



Short-Term Detention	*Long-Term Detention*
$\overline{X}_1 = 6.4$	$\overline{X}_2 = 8.1$
$s_1 = 2.2$	$s_2 = 3.9$
$n_1 = 14$	$n_2 = 42$

Figure 9.8 Critical *t* and Critical Region for alpha = .01 (*df* = 40) and a Two-Tailed Test



Male Defendants	*Female Defendants*
$\overline{X}_1 = 12.02$	$\overline{X}_2 = 3.32$
$s_1 = 72.68$	$s_2 = 11.31$
$n_1 = 50$	$n_2 = 25$

Figure 9.9 Critical *t* and Critical Region for Alpha = .05 (*df* = 60) and a One-Tailed Test

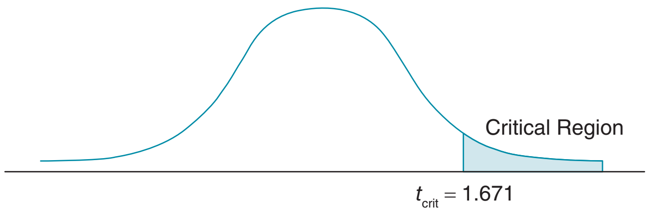


Table 9.4 Number of Arrests for Violent Offenses in Neighborhoods Before (First Score) and After (Second Score) Implementation of Problem-Oriented Policing

Pair Number	*First Score x_1*	*Second Score x_2*	$x_2 - x_1$	$(x_2 - x_1)^2$
1	25	21	–4.00	16
2	29	25	–4.00	16
3	32	32	0.00	0
4	42	39	–3.00	9
5	21	25	4.00	16
6	29	25	–4.00	16
7	33	29	–4.00	16
8	35	36	1.00	1
9	32	29	–3.00	9
10	36	35	– 1.00	1
11	39	40	1.00	1
12	25	21	–4.00	16
13	27	25	–2.00	4
14	41	35	–6.00	36
15	36	35	– 1.00	1
16	21	23	2.00	4
17	38	31	–7.00	49
18	25	21	–4.00	16
19	29	25	–4.00	16
20	25	20	– 5.00	25
			$\Sigma = -48$	$\Sigma = 268$
			$\overline{X}_D = -2.40$	

Figure 9.10 Critical *t* and Critical Regions for Alpha = .01 (df = 19) and a Two-Tailed Test

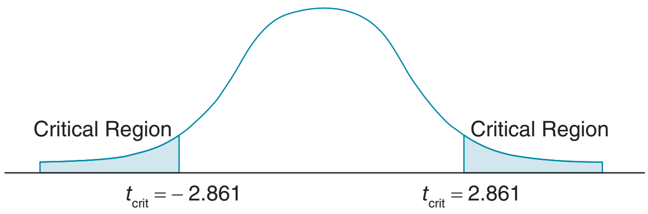


Table 9.5 Standard Deviations of the Sampling Distribution for the Number of Neighborhood Arrests for Violent Offenses Before (First Score) and After (Second Score) Problem-Oriented Policing Implementation

Pair	$x_D - \bar{X}_D$	$(x_D - \bar{X}_D)^2$
1	–4 – (–2.4) = –1.60	2.56
2	–4 – (–2.4) = –1.60	2.56
3	0 – (–2.4) = 2.40	5.76
4	–3 – (–2.4) = –0.60	0.36
5	4 – (–2.4) = 6.40	40.96
6	–4 – (–2.4) = –1.60	2.56
7	–4 – (–2.4) = –1.60	2.56
8	1 – (–2.4) = 3.40	11.56
9	–3 – (–2.4) = –0.60	0.36
10	–1 – (–2.4) = 1.40	1.96
11	1– (–2.4) = 3.40	11.56
12	–4 – (–2.4) = –1.60	2.56
13	–2 – (–2.4) = 0.40	0.16
14	–6 – (–2.4) = –3.60	12.96
15	–1 – (–2.4) = 1.40	1.96
16	2 – (–2.4) = 4.40	19.36
17	–7 – (–2.4) = –4.60	21.16
18	–4 – (–2.4) = –1.60	2.56
19	–4 – (–2.4) = –1.60	2.56
20	–5 – (–2.4) = –2.60	6.76
$n = 20$		$\Sigma(X_D - \bar{X}_{D2}) = 152.80$

Table 9.6 Number of Delinquent Siblings for 15 Delinquent Youths and a Matched Group of 15 Non-Delinquent Youths and the Calculations Necessary for a Matched-Group *t* Test

Pair	*Non-Delinquent Score* x_1	*Delinquent Score* x_2	x_D $x_2 - x_1$	x_D^2 $(x_2 - x_1)^2$	$x_D - \bar{X}_D$	$(x_D - \bar{X}_D)^2$
1	1	3	2	4	2 – 1.40 = 0.60	0.36
2	0	2	2	4	2 – 1.40 = 0.60	0.36
3	0	1	1	1	1 – 1.40 = –0.40	0.16
4	1	4	3	9	3 – 1.40 = 1.60	2.56
5	2	1	–1	1	–1 – 1.40 = –2.40	5.76
6	0	3	3	9	3 – 1.40 = 1.60	2.56
7	2	2	0	0	0 – 1.40 = –1.40	1.96
8	1	4	3	9	3 – 1.40 = 1.60	2.56
9	0	1	1	1	1 – 1.40 = –0.40	0.16
10	0	2	2	4	2 – 1.40 = 0.60	0.36
11	0	0	0	0	0 – 1.40 = –1.40	1.96
12	1	2	1	1	1 – 1.40 = –0.40	0.16
13	0	2	2	4	2 – 1.40 = 0.60	0.36
14	1	3	2	4	2 – 1.40 = 0.60	0.36
15	0	0	0	0	0 – 1.40 = –1.40	1.96
$n = 15$			$\Sigma x_D = 21$ $\bar{X}_D = 21/15 = 1.40$ $\Sigma x_D^2 = 51$			$\Sigma(x_D - \bar{X}_D)^2 = 21.60$ $s_D = \sqrt{\frac{21.60}{15-1}} = 1.24$

Figure 9.11 Critical *t* and Critical Regions for alpha = .05 (*df* = 14) and a One-Tailed Test

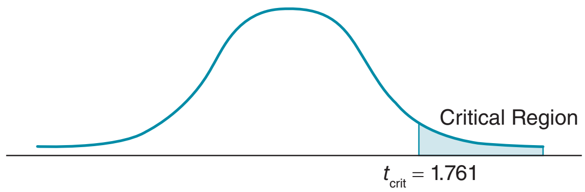


Figure 9.12 **Decision Chart for Using the Appropriate Statistical Test for Two-Sample Mean Problems**

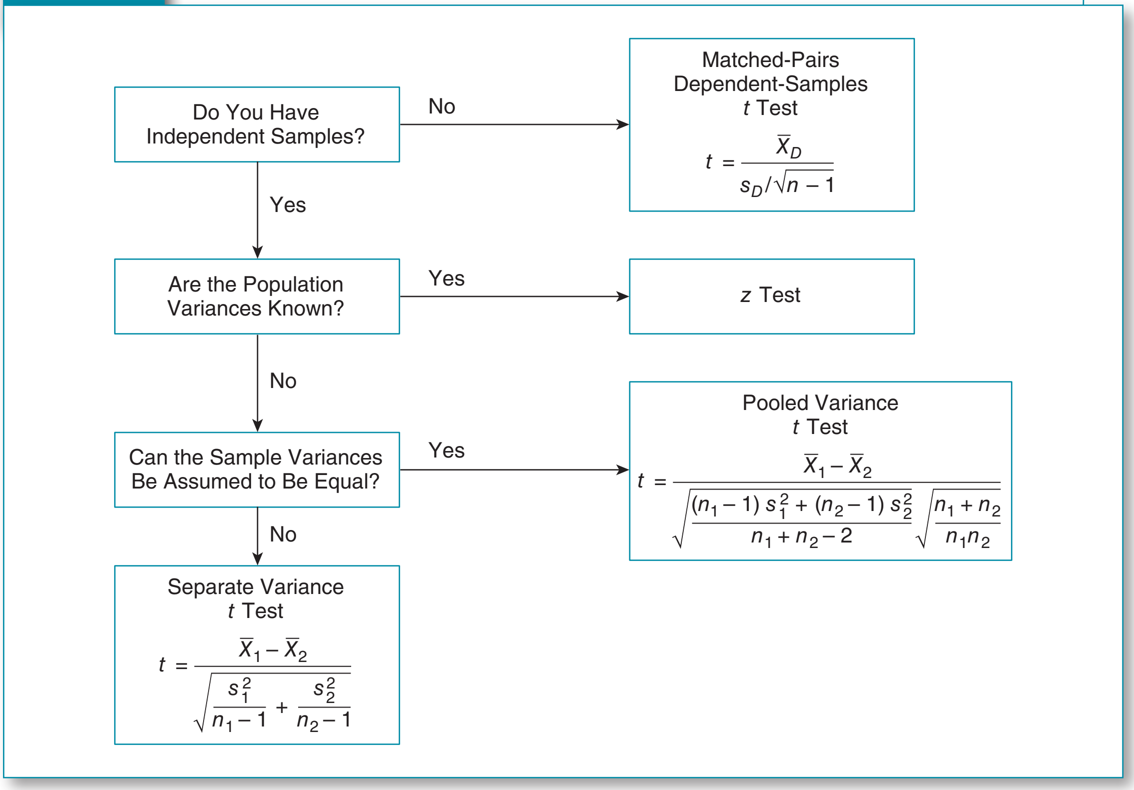
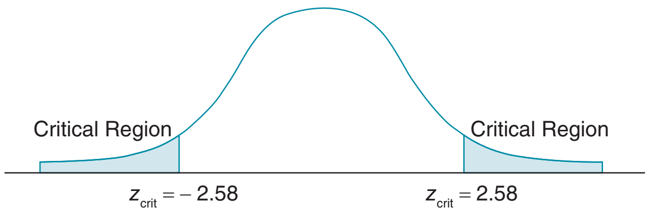


Figure 9.13 Critical *z* and Critical Regions for Alpha = .01 and a Two-Tailed Test



Would Not Approve of Driving Drunk	*Would Approve of Driving Drunk*
$n_1 = 40$	$n_2 = 25$
$x_1 = 2.1$	$x_2 = 8.2$
$s_1 = 1.8$	$s_2 = 1.9$

Judge	*Untrained*	*Trained*
1	3	0
2	1	3
3	2	4
4	7	4
5	5	2
6	4	5
7	6	1
8	2	1
9	7	0
10	5	6
11	3	4
12	4	2
13	5	5
14	6	3
15	2	1

Person	*Before*	*After*
1	5	7
2	9	5
3	2	3
4	7	7
5	8	11
6	11	13
7	8	4
8	8	10
9	5	7
10	2	1
11	9	3

Figure 10.1 Distribution of the Number of New Offenses for Three Groups of Intimate Partner Assault Suspects

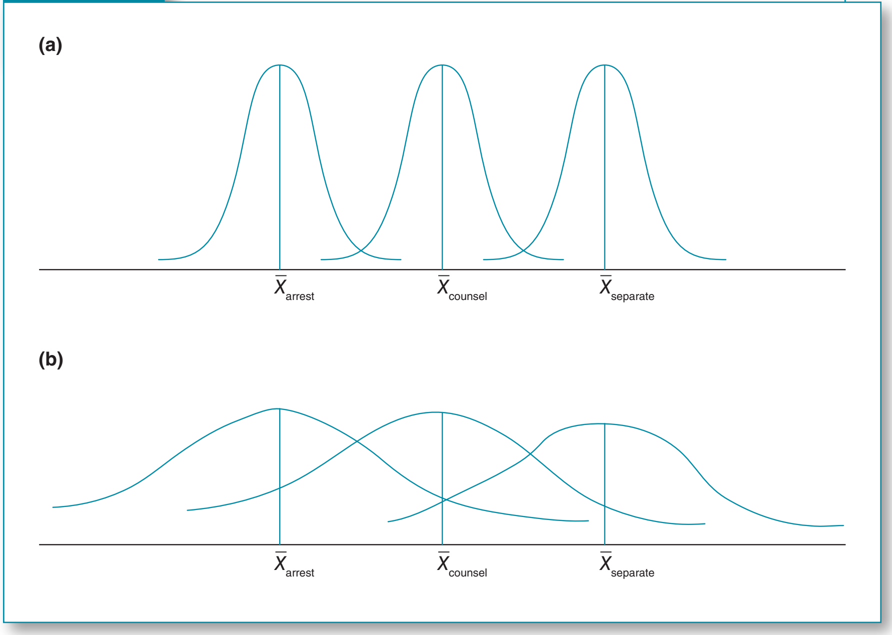


Table 10.1 **Number of New Offenses for Suspects Arrested, Counseled, or Separated by Police in Response to a 911 Call for Intimate Partner Assault**

Arrested	*Counseled*	*Separated*
0	6	8
2	4	10
1	4	9
1	6	10
1	5	8
$\bar{X}_{arrest} = 1.0$	$\bar{X}_{counsel} = 5.0$	$\bar{X}_{separate} = 9.0$

Total Variability		*Within-Group Variability*		*Between-Groups Variability*
$(x_i - \bar{X}_{\text{grand}})$	=	$(x_i - \bar{X}_k)$	+	$(\bar{X}_k - \bar{X}_{\text{grand}})$
(0 – 5)	=	(0 – 1)	+	(1 – 5)
–5	=	–1	+	–4
–5	=	–5		

Total Variability		*Within-Group Variability*		*Between-Groups Variability*
$(x_i - \bar{X}_{\text{grand}})$	=	$(x_i - \bar{X}_k)$	+	$(\bar{X}_k - \bar{X}_{\text{grand}})$
(6 – 5)	=	(6 – 5)	+	(5 – 5)
1	=	1	+	0
1	=	1		

Total Variability		*Within-Group Variability*		*Between-Groups Variability*
$(x_i - \bar{X}_{\text{grand}})$	=	$(x_i - \bar{X}_k)$	+	$(\bar{X}_k - \bar{X}_{\text{grand}})$
(8 – 5)	=	(8 – 9)	+	(9 – 5)
3	=	–1	+	4
3	=	3		

Table 10.2 Calculations of Sums of Squares for Analysis of Variance Test

Total Sum of Squares

$(X_i - \bar{X}_{grand})$	$(X_i - \bar{X}_{grand})^2$
(0 – 5) = –5	25
(2 – 5) = –3	9
(1 – 5) = –4	16
(1 – 5) = –4	16
(1 – 5) = –4	16
(6 – 5) = 1	1
(4 – 5) = –1	1
(4 – 5) = –1	1
(6 – 5) = 1	1
(5 – 5) = 0	0
(8 – 5) = 3	9
(10 – 5) = 5	25
(9 – 5) = 4	16
(10 – 5) = 5	25
(8 – 5) = 3	9
	Σ = 170

Within–Group Sum of Squares

$(X_i - \bar{X}_k)$	$(X_i - \bar{X}_k)^2$
(0 – 1) = –1	1
(2 – 1) = –1	1
(1 – 1) = 0	0
(1 – 1) = 0	0
(1 – 1) = 0	0
(6 – 5) = 1	1
(4 – 5) = –1	1
(4 – 5) = –1	1
(6 – 5) = 1	1
(5 – 5) = 0	0
(8 – 9) = –1	1
(10 – 9) = 1	1
(9 – 9) = 0	0
(10 – 9) = 1	1
(8 – 9) = –1	1
	Σ = 10

Between–Groups Sum of Squares

$(\bar{X}_k - \bar{X}_{grand})$	$(\bar{X}_k - \bar{X}_{grand})^2$
(1 – 5) = –4	16
(1 – 5) = –4	16
(1 – 5) = –4	16
(1 – 5) = –4	16
(1 – 5) = –4	16
(5 – 5) = 0	0
(5 – 5) = 0	0
(5 – 5) = 0	0
(5 – 5) = 0	0
(5 – 5) = 0	0
(9 – 5) = 4	16
(9 – 5) = 4	16
(9 – 5) = 4	16
(9 – 5) = 4	16
(9 – 5) = 4	16
	Σ = 160

Table 10.3 Summary *F* Table for Police Response to Domestic Violence Data

Source	*Sum of Squares*	*df*	*Variance*	*F*
Between groups	160	2	80.00	96.39
Within group	10	12	0.83	
Total	170	14		

Table 10.4 Size of Probation Officer Caseload and Number of Crimes and Violations Committed on Release

Caseload Supervision Size		
Low	*Moderate*	*Heavy*
7	10	11
12	14	8
13	8	7
5	7	10
8	9	9
11	11	9
10	13	7
14	12	8
9	8	3
6	8	3
$\bar{X}_{low} = 9.5$	$\bar{X}_{moderate} = 10.0$	$\bar{X}_{heavy} = 7.5$

Table 10.5 Calculations for Caseload Size and Probation Success

Total Sum of Squares		*Within-Group Sum of Squares*		*Between-Groups Sum of Squares*	
$(X_i - \bar{X}_{grand})$	$(X_i - \bar{X}_{grand})^2$	$(X_i - \bar{X}_k)$	$(X_i - \bar{X}_k)^2$	$(\bar{X}_k - \bar{X}_{grand})$	$(\bar{X}_k - \bar{X}_{grand})^2$
7 – 9 = –2	4	7 – 9.5 = –2.5	6.25	9.5 – 9 = 0.5	0.25
12 – 9 = 3	9	12 – 9.5 = 2.5	6.25	9.5 – 9 = 0.5	0.25
13 – 9 = 4	16	13 – 9.5 = 3.5	12.25	9.5 – 9 = 0.5	0.25
5 – 9 = –4	16	5 – 9.5 = –4.5	20.25	9.5 – 9 = 0.5	0.25
8 – 9 = –1	1	8 – 9.5 = –1.5	2.25	9.5 – 9 = 0.5	0.25
11 – 9 = 2	4	11 – 9.5 = 1.5	2.25	9.5 – 9 = 0.5	0.25
10 – 9 = 1	1	10 – 9.5 = 0.5	0.25	9.5 – 9 = 0.5	0.25
14 – 9 = 5	25	14 – 9.5 = 4.5	20.25	9.5 – 9 = 0.5	0.25
9 – 9 = 0	0	9 – 9.5 = –0.5	0.25	9.5 – 9 = 0.5	0.25
6 – 9 = –3	9	6 – 9.5 = –3.5	12.25	9.5 – 9 = 0.5	0.25
10 – 9 = 1	1	10 – 10 = 0	0.00	10 – 9 = 1	1.00
14 – 9 = 5	25	14 – 10 = 4	16.00	10 – 9 = 1	1.00
8 – 9 = –1	1	8 – 10 = –2	4.00	10 – 9 = 1	1.00
7 – 9 = –2	4	7 – 10 = –3	9.00	10 – 9 = 1	1.00
9 – 9 = 0	0	9 – 10 = –1	1.00	10 – 9 = 1	1.00
11 – 9 = 2	4	11 – 10 = 1	1.00	10 – 9 = 1	1.00
13 – 9 = 4	16	13 – 10 = 3	9.00	10 – 9 = 1	1.00
12 – 9 = 3	9	12 – 10 = 2	4.00	10 – 9 = 1	1.00
8 – 9 = –1	1	8 – 10 = –2	4.00	10 – 9 = 1	1.00
8 – 9 = –1	1	8 – 10 = –2	4.00	10 – 9 = 1	1.00
11 – 9 = 2	4	11 – 7.5 = 3.5	12.25	7.5 – 9 = –1.5	2.25
8 – 9 = –1	1	8 – 7.5 = 0.5	0.25	7.5 – 9 = –1.5	2.25
7 – 9 = –2	4	7 – 7.5 = –0.5	0.25	7.5 – 9 = –1.5	2.25
10 – 9 = 1	1	10 – 7.5 = 2.5	6.25	7.5 – 9 = –1.5	2.25
9 – 9 = 0	0	9 – 7.5 = 1.5	2.25	7.5 – 9 = –1.5	2.25
9 – 9 = 0	0	9 – 7.5 = 1.5	2.25	7.5 – 9 = –1.5	2.25
7 – 9 = –2	4	7 – 7.5 = –0.5	0.25	7.5 – 9 = –1.5	2.25
8 – 9 = –1	1	8 – 7.5 = 0.5	0.25	7.5 – 9 = –1.5	2.25
3 – 9 = –6	36	3 – 7.5 = –4.5	20.25	7.5 – 9 = –1.5	2.25
3 – 9 = –6	36	3 – 7.5 = –4.5	20.25	7.5 – 9 = –1.5	2.25
	Σ = 234		Σ = 199		Σ = 35

Table 10.6 Summary *F* Table for the Relationship Between Caseload Size and Success on Probation

Source	*Sum of Squares*	*df*	*Variance*	*F*
Between groups	35	2	17.50	2.374
Within group	199	27	7.37	
Total	234	29		

Level of Stress		
High	*Medium*	*Low*
x	*x*	*x*
4	2	3
6	4	1
12	5	2
10	3	0
5	0	2
9	3	2
8	2	4
11	5	1
10	5	0
8	4	1

Get Tough States	*Moral Appeal States*	*Control States*
$n_1 = 15$	$n_2 = 15$	$n_3 = 15$
$\bar{X}_1 = 125.2$	$\bar{X}_2 = 119.7$	$\bar{X}_3 = 145.3$

	Sum of Squares	*df*	*SS/df*	*F*
Between groups	475.3			
Within group	204.5			
Total	679.8			

	Very High Fear Spot	*High Fear Spot*	*Medium Fear Spot*	*Low Fear Spot*	*Very Low Fear Spot*
Mean	14.5	14.3	14.7	13.4	13.9
n	50	50	50	50	50

	Sum of Squares	*df*	*SS/df*	*F*
Between groups	12.5			
Within group	616.2			
Total	628.7			

How Many Friends Each Female Has		
A Lot	*Some*	*A Few*
5	7	2
8	5	3
9	4	0
4	9	3
7	6	1
10	4	3
6	7	2

Observation	*x Score*	*y Score*
1	3	3
2	5	5
3	2	2
4	4	4
5	8	8
6	10	10
7	1	1
8	7	7
9	6	6
10	9	9

Observation	*x Score*	*y Score*
1	2	9
2	4	7
3	9	2
4	7	4
5	8	3
6	1	10
7	5	6
8	6	5
9	10	1
10	3	8

Figure 11.1 Positive Relationship Between *x* and *y*

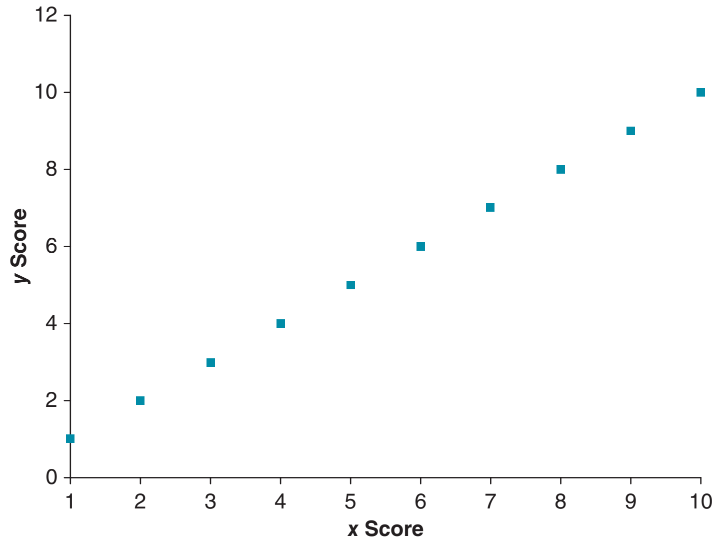
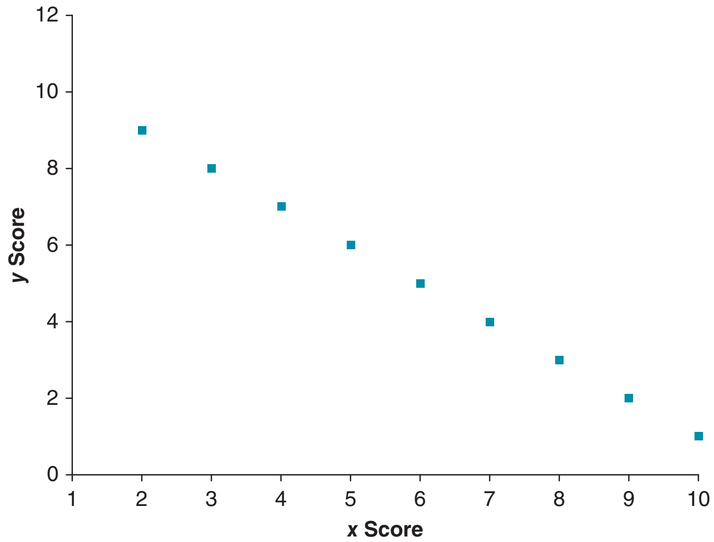


Figure 11.2 Negative Relationship Between *x* and *y*



Observation	*x Score*	*y Score*
1	6	4
2	9	4
3	2	4
4	7	4
5	3	4
6	4	4
7	1	4
8	8	4
9	5	4
10	10	4

Figure 11.3 No Relationship Between *x* and *y*

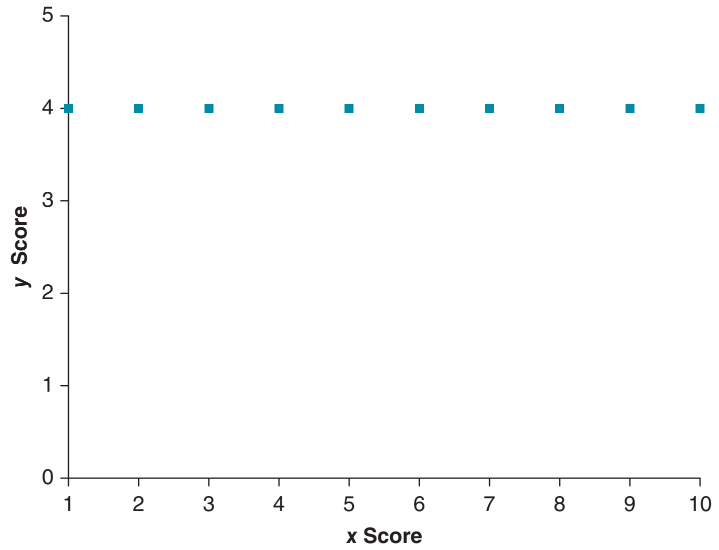


Figure 11.4 Perfect Positive Relationship Between *x* and *y*

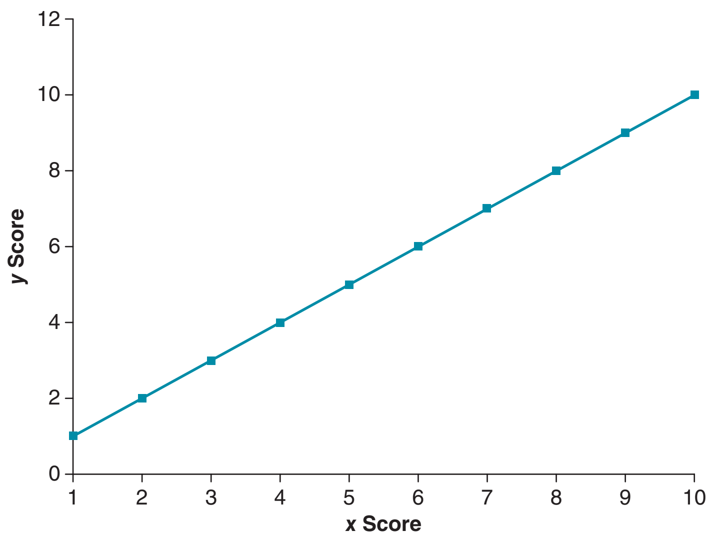


Figure 11.5 Perfect Negative Relationship Between *x* and *y*

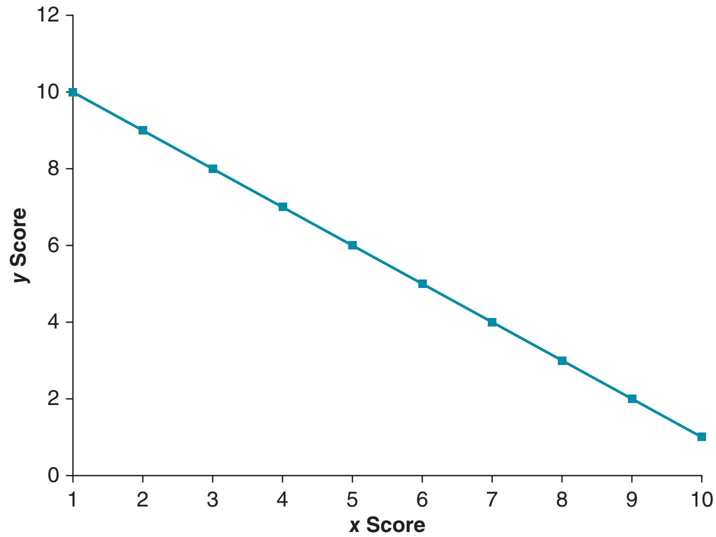


Figure 11.6 No Relationship Between *x* and *y*

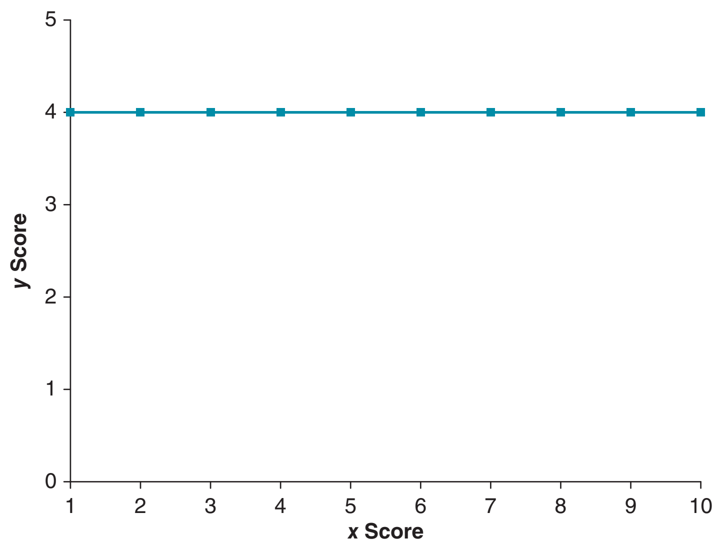


Figure 11.7 Predicting *y* Scores ($\hat{y}$) from *x* Scores With Perfect Positive Correlation

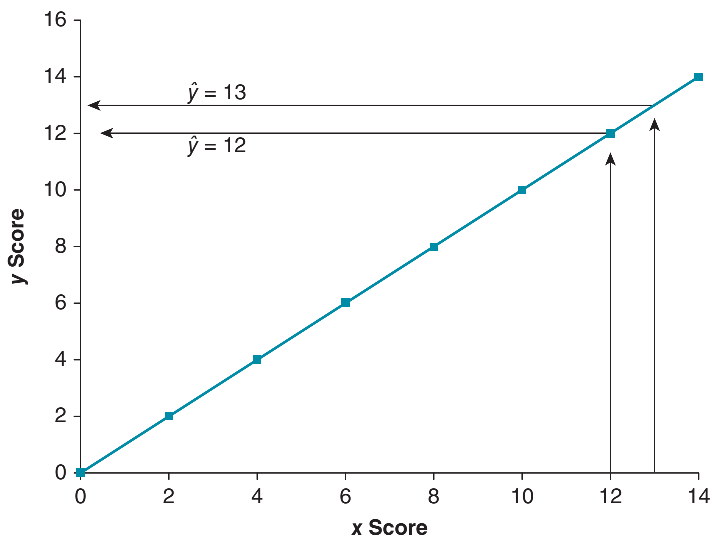


Figure 11.8 Predicting *y* Scores ($\hat{y}$) from *x* Scores With No Correlation

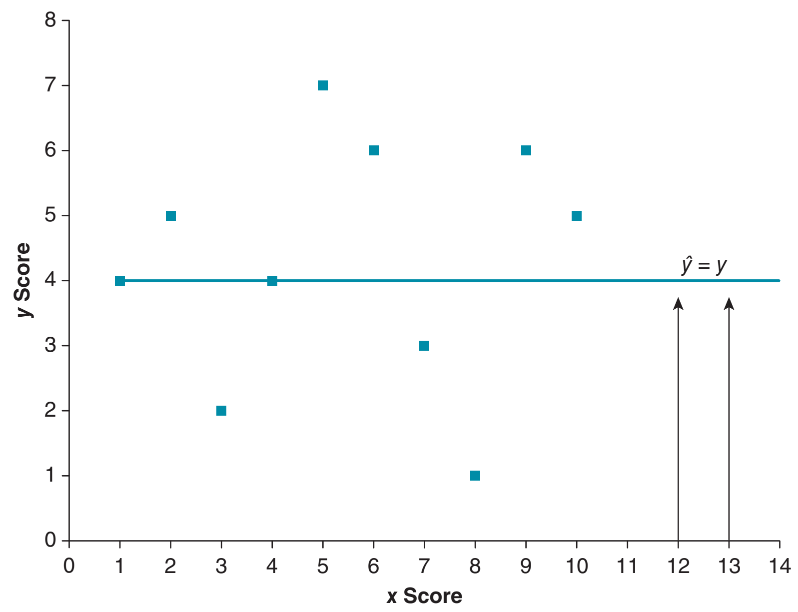


Table 11.1 **Murder Rate per 100,000 and Percentage of Individuals in State Living Below the Poverty Level for 20 States, 2013**

State	*Murder Rate (y)*	*Poverty Rate (x)*
Alaska	3.2	9.0
Arizona	5.5	16.5
California	5.4	14.2
Delaware	4.6	10.8
Florida	5.5	14.9
Indiana	5.3	14.4
Louisiana	12.3	17.3
Maine	2.0	12.3
Maryland	7.7	9.1
Massachusetts	2.7	10.3
Michigan	6.3	16.2
Missouri	6.6	14.6
Nebraska	2.5	12.3
New Jersey	3.7	9.4
New Mexico	10.0	18.0
New York	4.0	14.2
Pennsylvania	5.4	12.5
South Carolina	6.7	17.1
Texas	5.4	17.2
Wyoming	2.0	9.8

Source: Adapted from the Uniform Crime Reports and *Population by Age and Sex* from the FBI (2014) and the U.S. Bureau of the Census (2014), respectively.

Figure 11.9 Scatterplot of Poverty Rate (x) and Murder Rate (y) for 20 States

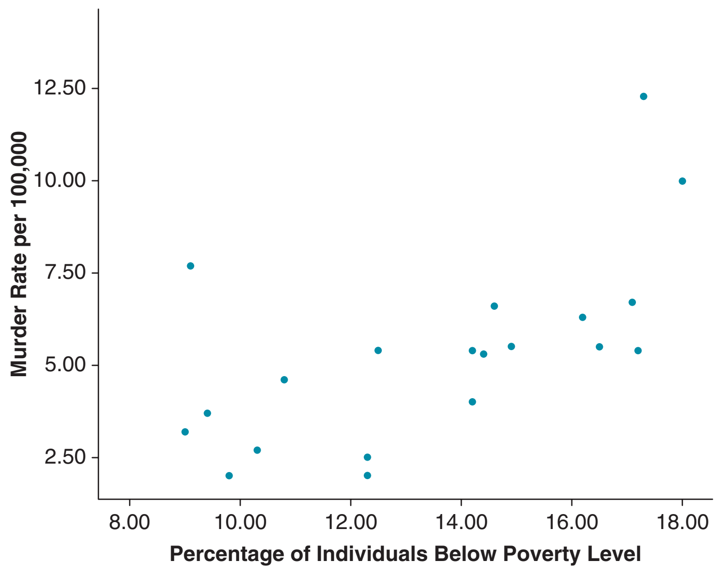


Figure 11.10 Scatterplot of Poverty Rate (*x*) and Murder Rate (*y*) for 20 States With Regression Line

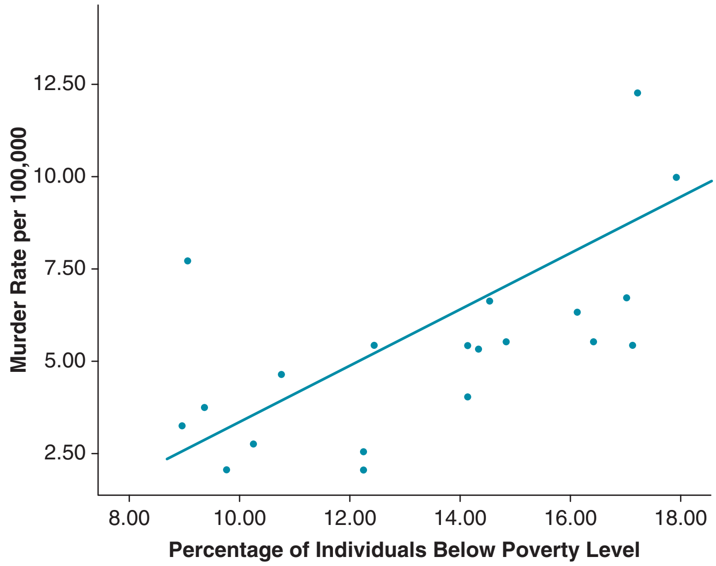


Table 11.2 Robbery Rate per 100,000 and Percentage of Individuals in State Living in Rural Areas for 20 States, 2013

State	*Robbery Rate (y)*	*% Rural (x)*	*State*	*Robbery Rate (y)*	*% Rural (x)*
Alaska	94.0	30.4	Michigan	126.5	25.5
Arizona	123.9	9.5	Missouri	127.1	28.6
California	173.7	5.1	Nebraska	74.7	28.4
Delaware	189.7	17.4	New Jersey	133.7	5.4
Florida	166.8	9.1	New Mexico	98.7	22.1
Indiana	129.4	27.4	New York	144.5	12.3
Louisiana	142.3	27.0	Pennsylvania	142.4	22.2
Maine	30.3	57.4	South Carolina	126.0	34.3
Maryland	210.7	12.8	Texas	153.6	14.5
Massachusetts	114.1	8.4	Wyoming	14.3	30.5

Source: Adapted from the Uniform Crime Reports and *Population by Age and Sex* from the FBI (2014) and the U.S. Bureau of the Census (2014), respectively.

Figure 11.11 Scatterplot of Percentage Rural (x) and Robbery Rate (y) for 20 States With Regression Line

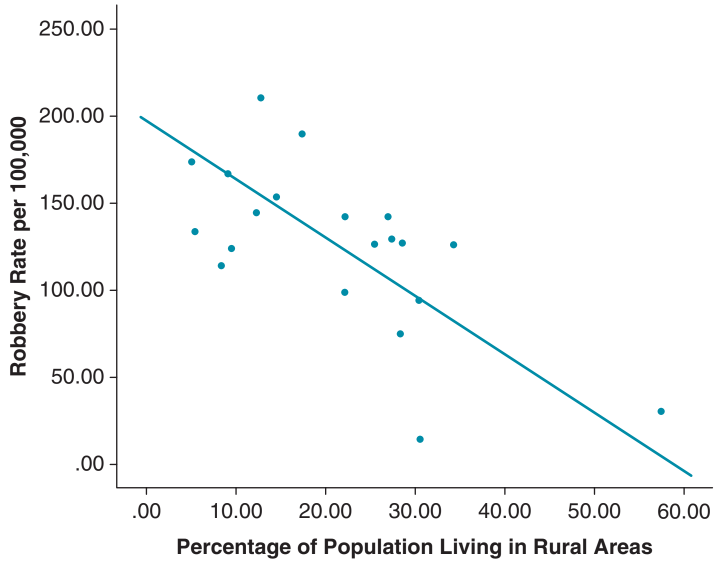


Table 11.3 **Burglary Rate per 100,000 and Divorce Rate per 1,000 in State Living in Rural Areas for 20 States, 2013**

State	*Burglary Rate (y)*	*Divorce Rate (x)*	*State*	*Burglary Rate (y)*	*Divorce Rate (x)*
Alaska	514.2	7.8	Michigan	768.1	5.4
Arizona	817.3	5.4	Missouri	733.5	6.5
California	622.1	5.8	Nebraska	499.4	6.7
Delaware	784.0	5.4	New Jersey	424.2	5.1
Florida	981.2	7.5	New Mexico	1117.3	5.1
Indiana	815.9	7.9	New York	321.6	6.4
Louisiana	1036.4	7.1	Pennsylvania	439.2	5.3
Maine	510.4	7.2	South Carolina	991.7	7.4
Maryland	647.5	5.8	Texas	967.4	7.1
Massachusetts	524.1	5.5	Wyoming	399.8	8.2

Source: Adapted from the Uniform Crime Reports and *Population by Age and Sex* from the FBI (2014) and the U.S. Bureau of the Census (2014), respectively.

Figure 11.12 Scatterplot of Divorce (*x*) and Burglary Rate (*y*) for 20 States With Regression Line

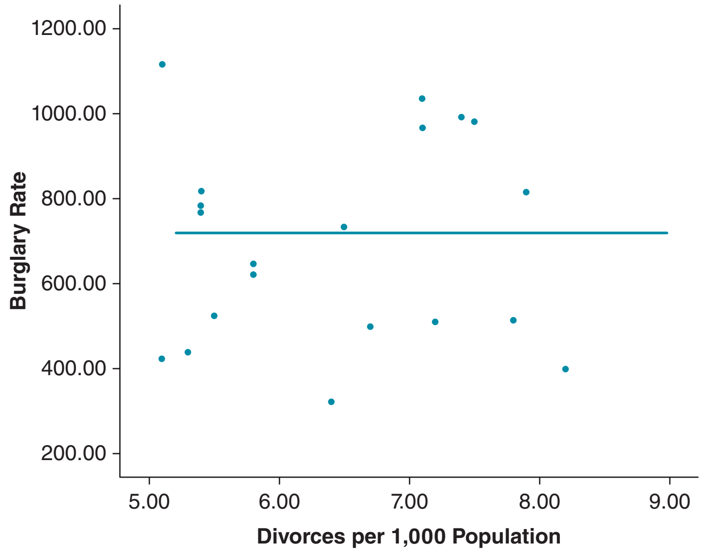


Figure 11.13 Interpretation of Pearson's *r* Values

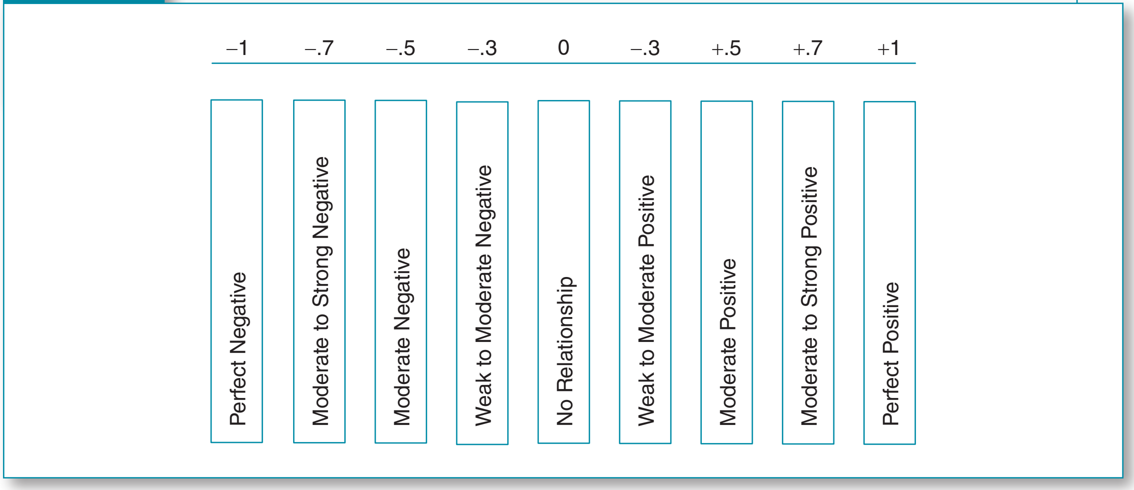


Table 11.4 Calculation of Pearson Correlation Coefficient, *r*, for Correlation Between State Murder Rate and Poverty Rate (Table 11.1)

State	*Poverty Rate (x)*	*Murder Rate (y)*	x^2	y^2	*xy*
Alaska	9.0	3.2	81.0	10.2	28.8
Arizona	16.5	5.5	272.3	30.3	90.8
California	14.2	5.4	201.6	29.2	76.7
Delaware	10.8	4.6	116.6	21.2	49.7
Florida	14.9	5.5	222.0	30.3	82.0
Indiana	14.4	5.3	207.4	28.1	76.3
Louisiana	17.3	12.3	299.3	151.3	212.8
Maine	12.3	2.0	151.3	4.0	24.6
Maryland	9.1	7.7	82.8	59.3	70.1
Massachusetts	10.3	2.7	106.1	7.3	27.8
Michigan	16.2	6.3	262.4	39.7	102.1
Missouri	14.6	6.6	213.2	43.6	96.4
Nebraska	12.3	2.5	151.3	6.3	30.8
New Jersey	9.4	3.7	88.4	13.7	34.8
New Mexico	18.0	10.0	324.0	100.0	180.0
New York	14.2	4.0	201.6	16.0	56.8
Pennsylvania	12.5	5.4	156.3	29.2	67.5
South Carolina	17.1	6.7	292.4	44.9	114.6
Texas	17.2	5.4	295.8	29.2	92.9
Wyoming	9.8	2.0	96.0	4.0	19.6
$n = 20$	$\Sigma x = 270.1$	$\Sigma y = 106.8$	$\Sigma x^2 = 3{,}821.8$	$\Sigma y^2 = 697.8$	$\Sigma xy = 1{,}535.1$

Table 11.5 Calculation of Pearson Correlation Coefficient, *r*, for Correlation Between Percentage of Population Living in Rural Areas in a State and Rate of Robbery for 20 States (Table 11.2)

State	*Rural Area (%) (x)*	*Robbery Rate (y)*	x^2	y^2	xy
Alaska	30.4	94.0	924.2	8836.0	2857.6
Arizona	9.5	123.9	90.3	15351.2	1177.1
California	5.1	173.7	26.0	30171.7	885.9
Delaware	17.4	189.7	302.8	35986.1	3300.8
Florida	9.1	166.8	82.8	27822.2	1517.9
Indiana	27.4	129.4	750.8	16744.4	3545.6
Louisiana	27.0	142.3	729.0	20249.3	3842.1
Maine	57.4	30.3	3294.8	918.1	1739.2
Maryland	12.8	210.7	163.8	44394.5	2697.0
Massachusetts	8.4	114.1	70.6	13018.8	958.4
Michigan	25.5	126.5	650.3	16002.3	3225.8
Missouri	28.6	127.1	818.0	16154.4	3635.1
Nebraska	28.4	74.7	806.6	5580.1	2121.5
New Jersey	5.4	133.7	29.2	17875.7	722.0
New Mexico	22.1	98.7	488.4	9741.7	2181.3
New York	12.3	144.5	151.3	20880.3	1777.4
Pennsylvania	22.2	142.4	492.8	20277.8	3161.3
South Carolina	34.3	126.0	1176.5	15876.0	4321.8
Texas	14.5	153.6	210.3	23593.0	2227.2
Wyoming	30.5	14.3	930.3	204.5	436.2
$n = 20$	$\Sigma x = 428.3$	$\Sigma y = 2{,}516.4$	$\Sigma x^2 = 12{,}188.8$	$\Sigma y^2 = 359{,}678.1$	$\Sigma xy = 46{,}331.2$

Table 11.6 Calculation of Pearson Correlation Coefficient, *r*, for Correlation Between Divorce Rate in a State and Rate of Burglary for 20 States (Table 11.3)

State	*Divorce Rate (x)*	*Burglary Rate (y)*	x^2	y^2	*xy*
Alaska	7.8	514.2	60.8	264401.6	4010.8
Arizona	5.4	817.3	29.2	667979.3	4413.4
California	5.8	622.1	33.6	387008.4	3608.2
Delaware	5.4	784.0	29.2	614656.0	4233.6
Florida	7.5	981.2	56.3	962753.4	7359.0
Indiana	7.9	815.9	62.4	665692.8	6445.6
Louisiana	7.1	1036.4	50.4	1074125	7358.4
Maine	7.2	510.4	51.8	260508.2	3674.9
Maryland	5.8	647.5	33.6	419256.3	3755.5
Massachusetts	5.5	524.1	30.3	274680.8	2882.6
Michigan	5.4	768.1	29.2	589977.6	4147.7
Missouri	6.5	733.5	42.3	538022.3	4767.8
Nebraska	6.7	499.4	44.9	249400.4	3346.0
New Jersey	5.1	424.2	26.0	179945.6	2163.4
New Mexico	5.1	1117.3	26.0	1248359	5698.2
New York	6.4	321.6	41.0	103426.6	2058.2
Pennsylvania	5.3	439.2	28.1	192896.6	2327.8
South Carolina	7.4	991.7	54.8	983468.9	7338.6
Texas	7.1	967.4	50.4	935862.8	6868.5
Wyoming	8.2	399.8	67.2	159840.0	3278.4
$n = 20$	$\Sigma x = 128.6$	$\Sigma y = 13,915.3$	$\Sigma x^2 = 847.5$	$\Sigma y^2 = 10,772,261.6$	$\Sigma xy = 89,736.6$

Table 11.7 Hypothetical Data for 20 Students

Student	*Age (x)*	*Self-Reported Delinquency (y)*
1	12	0
2	12	2
3	12	1
4	12	3
5	13	4
6	13	2
7	13	1
8	14	2
9	14	5
10	14	4
11	15	3
12	15	4
13	15	6
14	15	8
15	16	9
16	16	7
17	16	6
18	17	8
19	17	10
20	17	7

Figure 11.14 Age (x) and Number of Self-Reported Delinquent Acts (y)

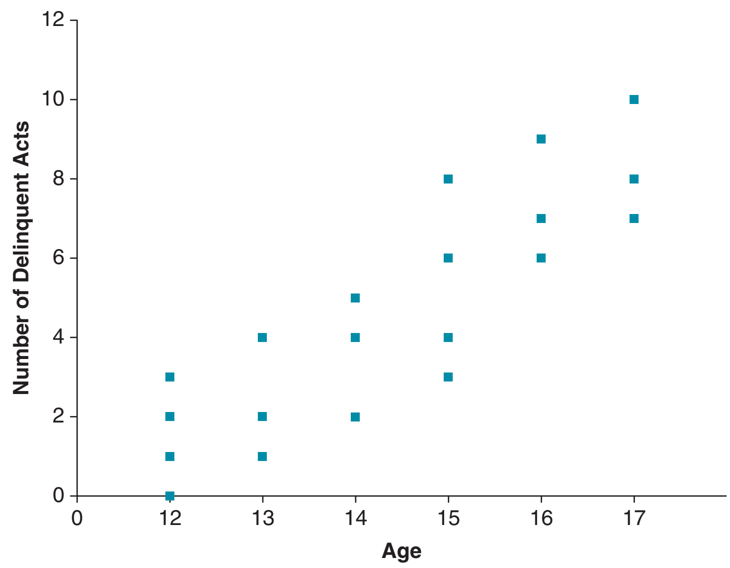


Table 11.8 Conditional Means (means of *y* for fixed values of *x*) for the Data on Age and Self-Reported Delinquency

Age	*y Scores*	*Conditional* $\bar{Y}$
12	0, 1, 2, 3	1.5
13	4, 2, 1	2.3
14	2, 5, 4	3.7
15	3, 4, 6, 8	5.2
16	9, 7, 6	7.3
17	8, 10, 7	8.3

Figure 11.15 Conditional Mean Value of *y* at Different Levels of *x*

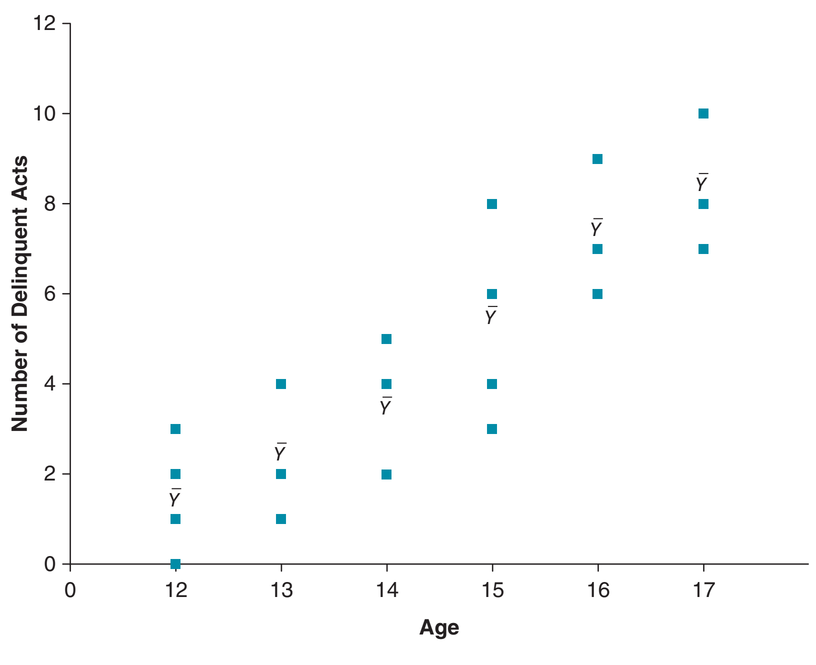


Figure 11.16 Distance Between Conditional Means of *y* and Estimated Regression Line

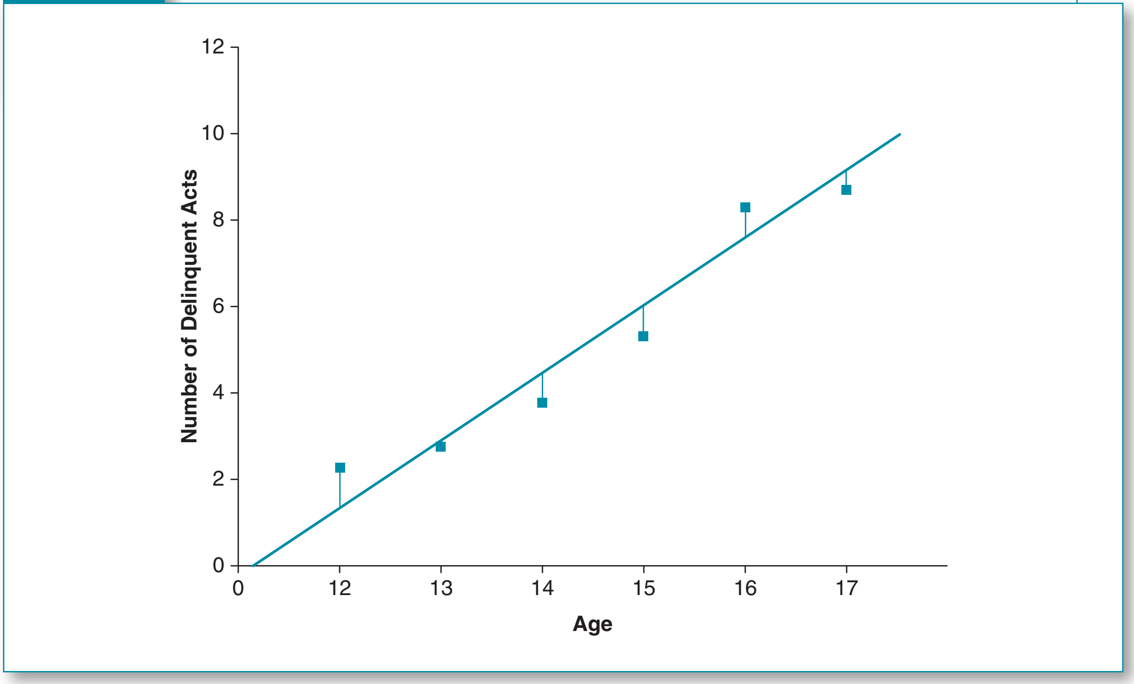


Table 11.9 Calculations for Determining the Slope (b) for the Data on Age and Self-Reported Delinquency

ID Number	*Age (x)*	*Self-Reported Delinquency (y)*	x^2	xy
1	12	0	144	0
2	12	2	144	24
3	12	1	144	12
4	12	3	144	36
5	13	4	169	52
6	13	2	169	26
7	13	1	169	13
8	14	2	196	28
9	14	5	196	70
10	14	4	196	56
11	15	3	225	45
12	15	4	225	60
13	15	6	225	90
14	15	8	225	120
15	16	9	256	144
16	16	7	256	112
17	16	6	256	96
18	17	8	289	136
19	17	10	289	170
20	17	7	289	119
$n = 20$	$\Sigma x = 288$	$\Sigma y = 92$	$\Sigma x^2 = 4{,}206$	$\Sigma xy = 1{,}409$

Figure 11.17 Fitting a Regression Line to the Data on Age and Delinquency

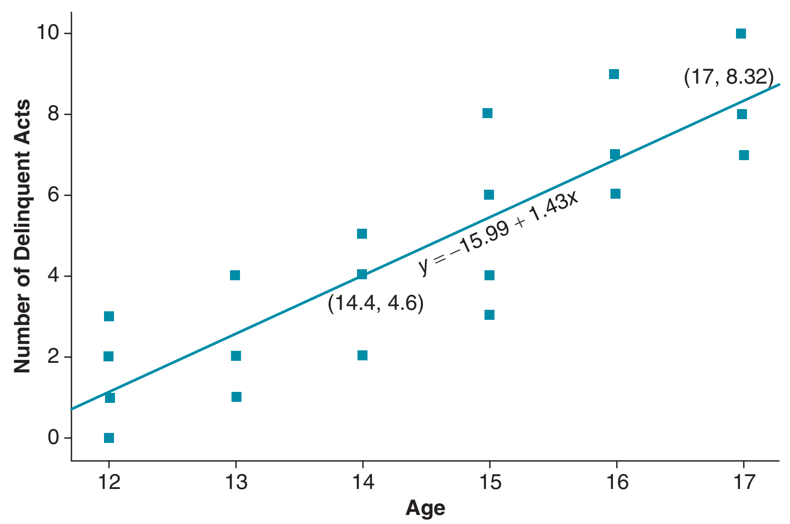


Figure 11.18 Fitting the Regression Line to the Data for Poverty Rate (x) and Murder Rate (y) for 20 States Using the Regression Equation $y = -1.86 + .53(x)$

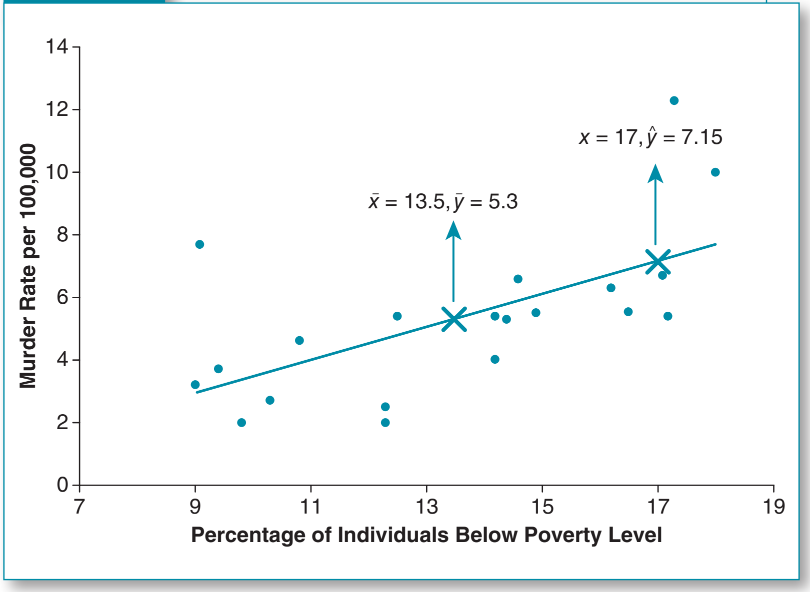


Figure 11.19 Fitting the Regression Line to the Data for Percentage Rural (x) and Robbery Rate (y) for 20 States Using the Regression Equation $y = 179.5 + -2.51(x)$

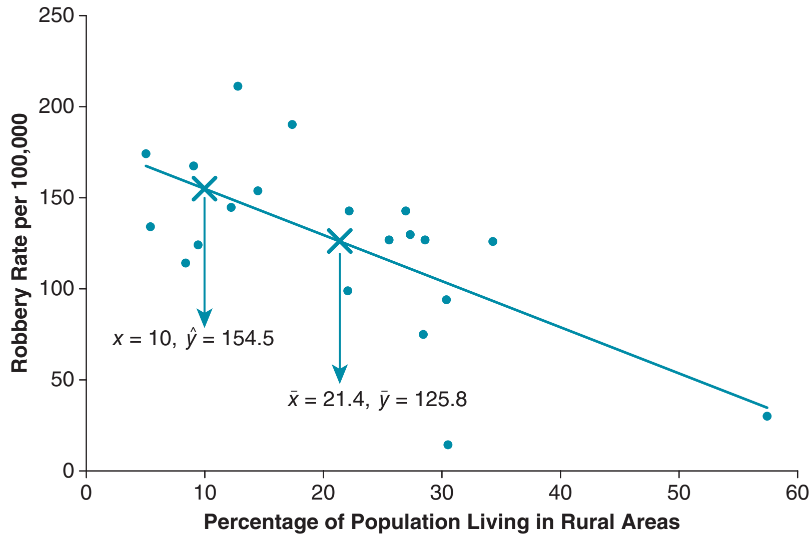


Figure 11.20 Fitting the Regression Line to the Data for Divorce Rate (x) and Burglary Rate (y) for 20 States Using the Regression Equation $y = 614.24 + -12.68(x)$

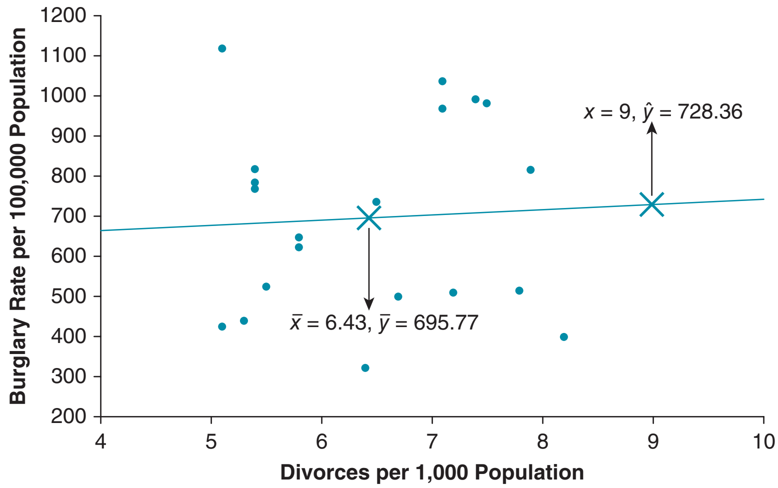


Figure 11.21 Linear Relationship With Equal Variance of *y* at Each Level of *x*

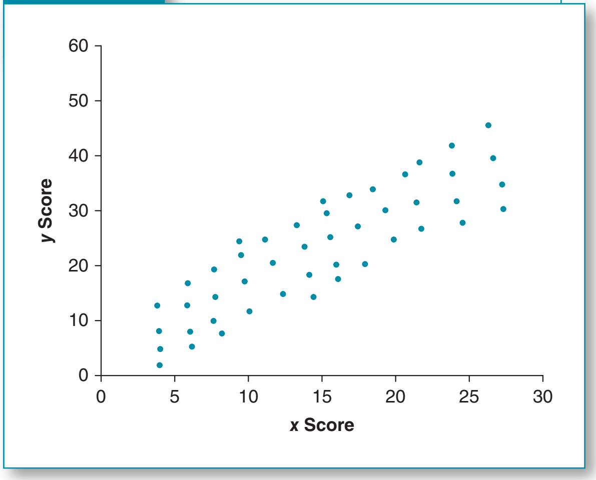
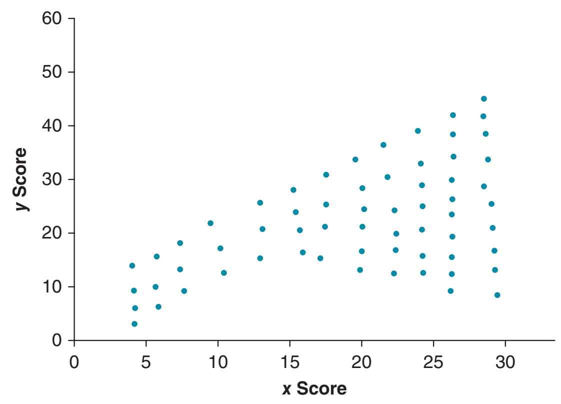


Figure 11.22 Linear Relationship With Unequal Variance of *y* at Each Level of *x*



Self-Control (x)	*Self-Reported Delinquency (y)*
45	5
63	10
38	2
77	23
82	19
59	7
61	17
88	24
52	14
67	20

Police Response Time in Minutes (x)	*Community Rate of Crime per 1,000 (y)*
14	82.9
3	23.6
5	42.5
6	39.7
5	63.2
8	51.3
7	58.7
4	44.5
10	61.2
12	73.5

Community Number	*Percentage on Welfare (x)*	*Hours of Daily Police Patrol (y)*
1	40	20
2	37	15
3	32	20
4	29	20
5	25	15
6	24	20
7	17	15
8	15	20
9	12	10
10	8	20
11	4	40
12	2	50

Figure 12.1(a) Causal Relationship Where *z* Causes *x*, Which Causes *y*

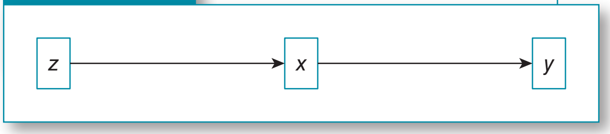


Figure 12.1(b) Spurious Relationship Between *x* and *y*

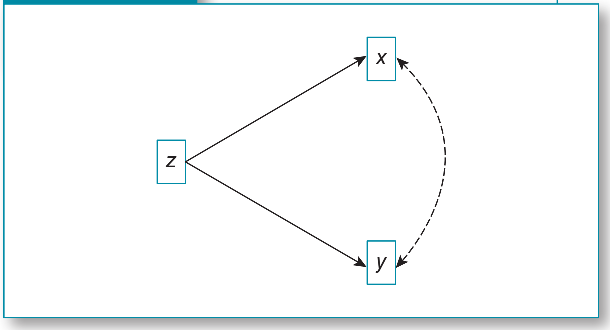


Figure 12.2 **Data From a Hypothetical Study Examining the Relationship Between Attending a Boot Camp Prison and the Likelihood of Committing Crimes After Prison (Recidivating)**

All Prisoners, $n = 350$

	Attended Boot Camp	Did Not Attend Boot Camp
Recidivated	75 47%	105 55%
Did Not Recidivate	85 53%	85 45%

	Female Prisoners, $n = 150$		Male Prisoners, $n = 200$	
	Attended Boot Camp	Did Not Attend	Attended Boot Camp	Did Not Attend
Recidivated	40 40%	20 40%	30 60%	90 60%
Did Not Recidivate	60 60%	30 60%	20 40%	60 40%

Table 12.1 Calculations Necessary to Compute the Partial Slope Coefficient Between Delinquency and Both Age and Family Closeness ($n = 23$)

Delinquency y	Age x_1	Family Closeness x_2	y^2	x_1^2	x_2^2	x_1y	x_2y
80	17	10	6,400	289	100	1,360	800
60	15	20	3,600	225	400	900	1,200
50	14	25	2,500	196	625	700	1,250
70	17	15	4,900	289	225	1,190	1,050
10	13	35	100	169	1,225	130	350
15	13	30	225	169	900	195	450
20	14	28	400	196	784	280	560
5	13	40	25	169	1,600	65	200
70	13	15	4,900	169	225	910	1,050
55	14	20	3,025	196	400	770	1,100
40	15	25	1,600	225	625	600	1,000
35	16	20	1,225	256	400	560	700
10	17	30	100	289	900	170	300
15	16	25	225	256	625	240	375
10	14	20	100	196	400	140	200
15	16	25	225	256	625	240	375
0	14	25	0	196	625	0	0
0	13	35	0	169	1,225	0	0
20	14	20	400	196	400	280	400
0	13	20	0	169	400	0	0
20	14	30	400	196	900	280	600
45	16	30	2,025	256	900	720	1,350
50	17	25	2,500	289	625	850	1,250
$\Sigma = 695$	$\Sigma = 338$	$\Sigma = 568$	$\Sigma = 34{,}875$	$\Sigma = 5{,}016$	$\Sigma = 15{,}134$	$\Sigma = 10{,}580$	$\Sigma = 14{,}560$
$\bar{Y} = 30.22$ $s_y = 25.11$ $r_{yx_1} = .445$ $r_{yx_2} = -.664$ $r_{x_1x_2} = -.366$	$\bar{X}_{x_1} = 14.70$ $s_{x_1} = 1.49$	$\bar{X}_{x_2} = 24.70$ $s_{x_2} = 7.09$					

Figure 12.3 Variance in Dependent Variable Explained Uniquely by Independent Variables x_1 and x_2 and Variance Jointly Explained

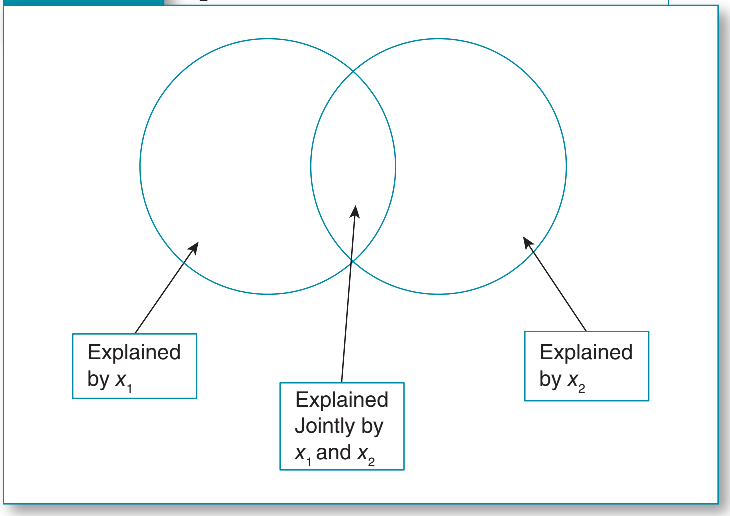


Figure 12.4 Multiple Regression Output From SPSS Predicting Delinquency by Age and Family Closeness

Regression

Variables Entered/removed[a]

Model	Variables Entered	Variable Removed	Method
1	Family Attachments, Age[b]		Enter

a. Dependent variable: Delinquency

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.699[a]	.488	.437	18.837

a. Predicators: (Constant),Family Attachments, Age

Multiple R

Multiple Coefficient of Determination R^2

Adjusted R^2

ANOVA[a]

Model		Sum of Square	df	Mean Square	F	Sig
1	Regression	6777.010	2	3388.505	9.549	.001[b]
	Residual	7096.903	20	354.845		
	Total	13873.913	22			

a. Dependent Variable: Delinquency

b. Predicators: (Constant),Family Attachments, Age

F Statistics and corresponding sig/alpha for the Null Hypothesis that $R^2 = 0$

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig
		B	Std. Error	Beta		
1	(Constant)	23.102	50.199		460	.650
	Age	3.929	2.896	.233	1.357	.190
	Family Attachments	-2.050	.608	-.579	-3.369	.003

a. Dependent Variable: Delinquency

Value of intercept (*a*)

Standardized slopes (Betas)

Partial Slope Coefficient for Age and Family Attachments

t Statistics and corresponding sig/alpha for the Null Hypothesis that each partial slope is equal to 0 ($\beta_1, \beta_2 = 0$)

Table 12.2 **Hypothetical Inmate-to-Inmate Assault Rates per 100 Inmate Population, Prison Density Index (overcrowding), and Mean Age of Inmates for a Random Sample of 30 Prisons**

Case	*Prison*	*Assault Rate y*	*Density Index x_1*	*Mean Age x_2*
1	Prison A	10.2	1.5	25.8
2	Prison B	8.2	1.0	32.1
3	Prison C	11.3	1.6	26.2
4	Prison D	9.2	1.2	29.6
5	Prison E	5.3	1.0	34.5
6	Prison F	8.5	1.1	27.5
7	Prison G	8.6	1.3	30.2
8	Prison H	7.5	0.9	33.2
9	Prison I	15.3	1.9	27.2
10	Prison J	10.5	1.5	26.3
11	Prison K	12.5	1.5	28.3
12	Prison L	5.4	1.1	32.3
13	Prison M	10.5	1.4	23.5
14	Prison N	15.4	1.4	24.5
15	Prison O	12.8	1.2	24.5
16	Prison P	13.5	1.3	27.5
17	Prison Q	17.5	1.8	25.8
18	Prison R	11.5	1.6	32.6
19	Prison S	19.0	1.4	21.2
20	Prison T	14.2	1.2	26.5
21	Prison U	11.4	1.6	32.0
22	Prison V	9.8	1.1	29.9
23	Prison W	6.6	0.9	36.2
24	Prison X	8.9	1.0	35.0
25	Prison Y	10.6	1.1	29.8
26	Prison Z	12.5	1.2	25.6
27	Prison AA	7.4	1.1	33.5
28	Prison BB	3.3	1.2	38.2
29	Prison CC	17.5	1.7	25.2
30	Prison DD	13.2	0.9	33.1
		$\Sigma_y = 328.10$	$\Sigma x_1 = 38.7$	$\Sigma x_2 = 877.80$
		$\bar{Y} = 10.94$	$\bar{X}_{x_1} = 1.29$	$\bar{X}_{x_2} = 29.26$
		$s_y = 3.78$	$s_{x_1} = .27$	$s_{x_2} = 4.19$
		$\Sigma y^2 = 4002.07$	$\Sigma x_1^2 = 52.11$	$\Sigma x_2^2 = 26{,}193.2$
	$\Sigma yx_1 = 441.7$	$\Sigma yx_2 = 9{,}251.0$	$\Sigma x_1 x_2 = 1{,}114.2$	
	$r_{yx_1} = .61$	$r_{yx_2} = -.76$	$r_{x_1 x_2} = -.55$	

Figure 12.5 Multiple Regression Output From SPSS Predicting Inmate-to-Inmate Assaults in Prison by Mean Age in the Prison and Overcrowding

Regression

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Mean Age of inmates, Overcrowding index[b]		Enter

a. Dependent Variable: Inmate to Inmate Assault Rate

b. All requested variables entered.

Multiple R

Multiple Coefficient of Determination R^2

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.795[a]	. 632	.605	2.3742

a. Predictors, (Constant),Mean Age of Inmates Overcrowding Index

F Statistic and corresponding sig/alpha for the Null Hypothesis that $R^2 = 0$

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	261.556	2	130.778	23.201	.000[b]
	Residual	152.193	27	5.637		
	Total	413.750	29			

a. Dependent Variable: Inmate to Inmate Assault Rate
b. Predictors: (Constant), Mean Age of Inmates, Overcrowding Index

Value of intercept (*a*)

Standardized slopes (Betas)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig
		B	Std. Error	Beta		
1	(Constant)	22169.	5.469		4.053	.000
	Overcrowding Index	3.721	1.891	.277	1.968	.059
	Mean Age of Inmates	-.547	.127	-.607	-4.317	.000

a. Dependent Variable:Inmate to Inmate Assault Rate

Partial Slope Coefficients for Overcrowding and Mean Age

t Statistics and corresponding sig/alpha for the Null Hypothesis that each partial slope is equal to 0 ($\beta_1, \beta_2 = 0$)

Table 12.3 Data and Calculations Necessary to Compute the Partial Slope Coefficient Among Murder Rates, Poverty Rate, and South Region (0 = Non-South, 1 = South) for $n = 20$ States

Case	State	Murder Rate y	Percentage Poor x_1	Southern Region x_2
1	Alaska	3.2	9.0	0
2	Arizona	5.5	16.5	0
3	California	5.4	14.2	0
4	Delaware	4.6	10.8	1
5	Florida	5.5	14.9	1
6	Indiana	5.3	14.4	0
7	Louisiana	12.3	17.3	1
8	Maine	2.0	12.3	0
9	Maryland	7.7	9.1	1
10	Massachusetts	2.7	10.3	0
11	Michigan	6.3	16.2	0
12	Missouri	6.6	14.6	0
13	Nebraska	2.5	12.3	0
14	New Jersey	3.7	9.4	0
15	New Mexico	10.0	18.0	0
16	New York	4.0	14.2	0
17	Pennsylvania	5.4	12.5	0
18	South Carolina	6.7	17.1	1
19	Texas	5.4	17.2	1
20	Wyoming	2.0	9.8	0
		$\Sigma_y = 106.8$	$\Sigma x_1 = 270.1$	$\Sigma x_2 = 6$
		$\bar{Y} = 5.34$	$\bar{X}_{x_1} = 13.5$	$\bar{X}_{x_2} = .30$
		$s_y = 2.59$	$s_{x_1} = 3.03$	$s_{x_2} = .47$
		$\Sigma y^2 = 697.4$	$\Sigma x_1^2 = 3821.8$	$\Sigma x_2^2 = 6$
	$\Sigma yx_1 = 1534.8$	$\Sigma yx_2 = 42.2$	$\Sigma x_1x_2 = 86.4$	
	$r_{yx_1} = .62$	$r_{yx_2} = .44$	$r_{y_1x_2} = .56$ $r_{x_1x_2} = .20$	

Figure 12.6 Multiple Regression Output From SPSS Predicting Murder Rates With Percentage Poor and Southern Region (0 = Non-South and 1 = South) for $n = 20$ States

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	State in South, Percent Individuals below poverty[b]		Enter

a. Dependent Variable: Murder Rate per 100K

b. All requested variables entered.

Model Summary

Model	R	Square	Adjusted R Square	Std. Error of the Estimate
1	.700[a]	.490	.430	1.9525

a. Predictors: (Constant), State in South, Percent Individuals below poverty

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	62.298	2	31.149	8.170	.003[b]
	Residual	64.810	17	3.812		
	Total	127.108	19			

a. Dependent Variable: Murder Rate per 100K

b. Predictors: (Constant), State in South, Percent Individuals below poverty

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std.Error	Beta	t	Sig.
1	(Constant)	−1.617	2.049		−.789	.441
	Percent Individuals below poverty	.475	.151	.556	3.145	.006
	State in South	1.812	.972	.329	1.864	.080

a. Dependent Variable: Murder Rate per 100K

Figure 12.7 Multiple Regression Output for Problem 1: Predicting the Violent Crime Rate for States

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Divorce Mean Age		Enter

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.795[a]	.632	.609	1.9525

a. Predictors: (Constant), Divorce, Mean Age

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	324.538	2	162.26	27.531	.000[b]
	Residual	188.604	20	5.893		

a. Dependent Variable: Violent Crime Rate per 100,000
b. Predictors: (Constant), Divorce, Mean Age

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	19.642	2.736		.600	.552
	Divorce	.871	.119	.594	4.268	.000
	Mean Age	-.146	.158	-.133	-3.110	.001

Jail	*# of Escapes*	*Morale Score*	*Staff-to-Inmate Ratio*
1	12.00	3.00	.22
2	10.00	7.00	.41
3	3.00	14.00	.66
4	7.00	8.00	.45
5	9.00	9.00	.32
6	13.00	5.00	.33
7	17.00	2.00	.10
8	12.00	5.00	.30
9	15.00	4.00	.20
10	9.00	5.00	.50
11	3.00	7.00	.60
12	5.00	3.00	.40
13	11.00	2.00	.20
14	14.00	5.00	.50
15	7.00	8.00	.40
16	10.00	5.00	.20
17	14.00	3.00	.30
18	15.00	2.00	.40
19	17.00	2.00	.10
20	6.00	8.00	.20
21	9.00	4.00	.20
22	3.00	10.00	.50
23	2.00	11.00	.60
24	4.00	7.00	.30
25	13.00	2.00	.30
26	11.00	8.00	.50
27	14.00	4.00	.30
28	9.00	4.00	.30
29	5.00	11.00	.40
30	4.00	14.00	.50

$\Sigma_y = 283$	$\Sigma_{x_1} = 182$	$\Sigma_{x_2} = 10.7$
$s_y = 4.49$	$s_{x_1} = 3.47$	$s_{x_2} = .15$
$\bar{y} = 9.43$	$\bar{x}_1 = 6.07$	$\bar{x}_2 = .36$
$\Sigma y^2 = 3255$	$\Sigma x_{x_1}^2 = 1454$	$\Sigma x_{x_1}^2 = 4.44$
	$r_{yx_1} = -.77$	
	$r_{yx_2} = -.63$	
	$r_{x_1x_2} = .67$	
$r_{yx_1.x_2} = -.59$	$r_{yx_2.x_1} = -.245$	

Figure 12.8 Multiple Regression Output for Problem 3: Jurors' Religious Characteristics and Their Verdicts and Sentencing Decisions

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	ENV, REL		Enter

Model Summary

Model	R	R Square	Adjusted R Square
1	.811[a]	.659	.602

a. Predictors: (Constant), ENV, REL

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	481.341	2	240.670	11.565	.001[b]
	Residual	249.058	12	20.754		

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	16.245	5.514		2.946	.012
	ENV	-1.467	.443	-608	-3.312	.006
	REL	1.075	.570	.346	1.184	.084

+	Addition	>	Is greater than
−	Subtraction	≥	Is greater than or equal to
×	Multiplication	≈	Is approximately equal to
/ or ÷	Division	x^2	The number *x* squared
=	Equals	$\sqrt{x}$	The square root of the number *x*
≠	Is not equal to	ln *x*	The natural log of the number *x*
±	Plus or minus	log *x*	The common log of the number *x*
<	Is less than	$\|x\|$	The absolute value of the number *x*
≤	Is less than or equal to		

Uppercase	*Lowercase*	
A	α	Alpha
B	β	Beta
Γ	γ	Gamma
Δ	δ	Delta
E	ε	Epsilon
Λ	λ	Lambda
M	μ	Mu
P	ρ	Rho
Σ	σ	Sigma
T	τ	Tau
Φ	ϕ	Phi
X	χ	Chi

Table B.1 Table of Random Numbers

16408	81899	04153	53381	79401	21438	83035	92350	36693	31238	59649	91754	72772
18629	81953	05520	91962	04739	13092	97662	24822	94730	06496	35090	04822	86774
73115	35101	47498	87637	99016	71060	88824	71013	18735	20286	23153	72924	35165
57491	16703	23167	49323	45021	33132	12544	41035	80780	45393	44812	12515	98931
30405	83946	23792	14422	15059	45799	22716	19792	09983	74353	68668	30429	70735
16631	35006	85900	98275	32388	52390	16815	69298	82732	38480	73817	32523	41961
96773	20206	42559	78985	05300	22164	24369	54224	35083	19687	11052	91491	60383
38935	64202	14349	82674	66523	44133	00697	35552	35970	19124	63318	29686	03387
31624	76384	17403	53363	44167	64486	64758	75366	76554	31601	12614	33072	60332
78919	19474	23632	27889	47914	02584	37680	20801	72152	39339	34806	08930	85001
03931	33309	57047	74211	63445	17361	62825	39908	05607	91284	68833	25570	38818
74426	33278	43972	10119	89917	15665	52872	73823	73144	88662	88970	74492	51805
09066	00903	20795	95452	92648	45454	09552	88815	16553	51125	79375	97596	16296
42238	12426	87025	14267	20979	04508	64535	31355	86064	29472	47689	05974	52468
16153	08002	26504	41744	81959	65642	74240	56302	00033	67107	77510	70625	28725
21457	40742	29820	96783	29400	21840	15035	34537	33310	06116	95240	15957	16572
21581	57802	02050	89728	17937	37621	47075	42080	97403	48626	68995	43805	33386
55612	78095	83197	33732	05810	24813	86902	60397	16489	03264	88525	42786	05269
44657	66999	99324	51281	84463	60563	79312	93454	68876	25471	93911	25650	12682
91340	84979	46949	81973	37949	61023	43997	15263	80644	43942	89203	71795	99533
91227	21199	31935	27022	84067	05462	35216	14486	29891	68607	41867	14951	91696
50001	38140	66321	19924	72163	09538	12151	06878	91903	18749	34405	56087	82790
65390	05224	72958	28609	81406	39147	25549	48542	42627	45233	57202	94617	23772
27504	96131	83944	41575	10573	08619	64482	73923	36152	05184	94142	25299	84387
37169	94851	39117	89632	00959	16487	65536	19071	39782	17095	02330	74301	00275
11508	70225	51111	38351	19444	66499	71945	05422	13442	78675	84081	66938	93654
37449	30362	06694	54690	04052	53115	62757	95348	78662	11163	81651	50245	34971
46515	70331	85922	38329	57015	15765	97161	17869	45349	61796	66345	81073	49106
30986	81223	42416	58353	21532	30502	32305	86482	06174	07901	54339	58861	74818
63798	64995	46583	09785	44160	78128	83991	42865	92520	83531	80377	35909	81250
82486	84846	99254	67632	43218	50076	21361	64816	51202	88124	41870	52689	51275
21885	32906	92431	09060	64297	51674	64126	62570	26123	05155	59194	52799	28225
60336	98782	07408	53458	13564	59089	26445	29789	85205	41001	12535	12133	14645
43937	46891	24010	25560	86355	33941	25786	54990	71899	15475	95434	98227	21824
97656	63175	89303	16275	07100	92063	21942	18611	47348	20203	18534	03862	78095
03299	01221	05418	38982	55758	92237	26759	86367	21216	98442	08303	56613	91511
79626	06486	03574	17668	07785	76020	79924	25651	83325	88428	85076	72811	22717
85636	68335	47539	03129	65651	11977	02510	26113	99447	68645	34327	15152	55230
18039	14367	61337	06177	12143	46609	32989	74014	64708	00533	35398	58408	13261
08362	15656	60627	36478	65648	16764	53412	09013	07832	41574	17639	82163	60859
79556	29068	04142	16268	15387	12856	66227	38358	22478	73373	88732	09443	82558
92608	82674	27072	32534	17075	27698	98204	63863	11951	34648	88022	56148	34925
23982	25835	40055	67006	12293	02753	14827	23235	35071	99704	37543	11601	35503
09915	96306	05908	97901	28395	14186	00821	80703	70426	75647	76310	88717	37890
59037	33300	26695	62247	69927	76123	50842	43834	86654	70959	79725	93872	28117
42488	78077	69882	61657	34136	79180	97526	43092	04098	73571	80799	76536	71255
46764	86273	63003	93017	31204	36692	40202	35275	57306	55543	53203	18098	47625
03237	45430	55417	63282	90816	17349	88298	90183	36600	78406	06216	95787	42579
86591	81482	52667	61582	14972	90053	89534	76036	49199	43716	97548	04379	46370
38534	01715	94964	87288	65680	43772	39560	12918	86537	62738	19636	51132	25739

Source: Adapted with permission from Beyer, W. H. (Ed.). 1991. *CRC Standard Probability and Statistics: Tables and Formulae, XII.3*. Boca Raton, FL: CRC Press.

Table B.2 Area Under the Standard Normal Curve (*z* Distribution)*

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

Source: Adapted with permission from Frederick Mosteller and Robert E. K. Rourke, 1973. *Sturdy Statistics.* Table A-1. Reading, MA: Addison–Wesley.

*Proportion of the area under the normal curve corresponding to the distance between the mean (0) and a point that is *z* standard deviation units away from the mean.

Table B.3 The *t* Distribution

	Level of Significance for a One-Tailed Test					
	.10	*.05*	*.025*	*.01*	*.005*	*.0005*
	Level of Significance for a Two-Tailed Test					
	.20	*.10*	*.05*	*.02*	*.01*	*.001*
1	3.078	6.314	12.706	31.821	63.657	636.619
2	1.886	2.920	4.303	6.965	9.925	31.598
3	1.638	2.353	3.182	4.541	5.841	12.941
4	1.533	2.132	2.776	3.747	4.604	8.610
5	1.476	2.015	2.571	3.365	4.032	6.859
6	1.440	1.943	2.447	3.143	3.707	5.959
7	1.415	1.895	2.365	2.998	3.499	5.405
8	1.397	1.860	2.306	2.896	3.355	5.041
9	1.383	1.833	2.262	2.821	3.250	4.781
10	1.372	1.812	2.228	2.764	3.169	4.587
11	1.363	1.796	2.201	2.718	3.106	4.437
12	1.356	1.782	2.179	2.681	3.055	4.318
13	1.350	1.771	2.160	2.650	3.012	4.221
14	1.345	1.761	2.145	2.624	2.977	4.140
15	1.341	1.753	2.131	2.602	2.947	4.073
16	1.337	1.746	2.120	2.583	2.921	4.015
17	1.333	1.740	2.110	2.567	2.898	3.965
18	1.330	1.734	2.101	2.552	2.878	3.922
19	1.328	1.729	2.093	2.539	2.861	3.883
20	1.325	1.725	2.086	2.528	2.845	3.850
21	1.323	1.721	2.080	2.518	2.831	3.819
22	1.321	1.717	2.074	2.508	2.819	3.792
23	1.319	1.714	2.069	2.500	2.807	3.767
24	1.318	1.711	2.064	2.492	2.797	3.745
25	1.316	1.708	2.060	2.485	2.787	3.725
26	1.315	1.706	2.056	2.479	2.779	3.707
27	1.314	1.703	2.052	2.473	2.771	3.690
28	1.313	1.701	2.048	2.467	2.763	3.674
29	1.311	1.699	2.045	2.462	2.756	3.659
30	1.310	1.697	2.042	2.457	2.750	3.646
40	1.303	1.684	2.021	2.423	2.704	3.551
60	1.206	1.671	2.000	2.390	2.660	3.460
120	1.289	1.658	1.980	2.358	2.617	3.373
∞	1.282	1.645	1.960	2.326	2.576	3.291

Source: Table B.3 is adapted with permission from Table III of R. A. Fisher and F. Yates, *Statistical Tables for Biological, Agricultural and Medical Research* (6th ed.). Published by Longman Group UK Ltd., 1974.

Table B.4 Critical Values of the Chi-Square Statistic at the .05 and .01 Significance Levels

	Area to the Right of the Critical Value	
	Level of Significance	
df	*.05*	*.01*
1	3.841	6.635
2	5.991	9.210
3	7.815	11.345
4	9.488	13.277
5	11.070	15.086
6	12.592	16.812
7	14.067	18.475
8	15.507	20.090
9	16.919	21.666
10	18.307	23.209
11	19.675	24.725
12	21.026	26.217
13	22.362	27.688
14	23.685	29.141
15	24.996	30.578
16	26.296	32.000
17	27.587	33.409
18	28.869	34.805
19	30.144	36.191
20	31.410	37.566

	Area to the Right of the Critical Value	
	Level of Significance	
df	*.05*	*.01*
21	32.671	38.932
22	33.924	40.289
23	33.924	40.289
24	36.415	42.980
25	37.652	44.314
26	38.885	45.642
27	40.113	46.963
28	41.337	48.278
29	42.557	49.588
30	43.773	50.892
40	55.758	63.691
50	67.505	76.154
60	79.082	88.379
70	90.531	100.425
80	101.879	112.329
90	113.145	124.116
100	124.342	135.807

Source: Adapted from Donald Owen, *Handbook of Statistical Tables*, © 1962 by Addison–Wesley Publishing Company, Inc. Reprinted by permission of Addison–Wesley Publishing Company, Inc.

Table B.5a The *F* Distribution ($\alpha = .01$ in the right tail)

df (between) / df (within)	Numerator Degrees of Freedom								
Denominator Degrees of Freedom	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1	4052.2	4999.5	5403.4	5624.6	5763.6	5859.0	5928.4	5981.1	6022.5
2	98.503	99.000	99.166	99.249	99.299	99.333	99.356	99.374	99.388
3	34.116	30.817	29.457	28.710	28.237	27.911	27.672	27.489	27.345
4	21.198	18.000	16.694	15.977	15.522	15.207	14.976	14.799	14.659
5	16.258	13.274	12.060	11.392	10.967	10.672	10.456	10.289	10.158
6	13.745	10.925	9.7795	9.1483	8.7459	8.4661	8.2600	8.1017	7.9761
7	12.246	9.5466	8.4513	7.8466	7.4604	7.1914	6.9928	6.8400	6.7188
8	11.259	8.6491	7.5910	7.0061	6.6318	6.3707	6.1776	6.0289	5.9106
9	10.561	8.0215	6.9919	6.4221	6.0569	5.8018	5.6129	5.4671	5.3511
10	10.044	7.5594	6.5523	5.9943	5.6363	5.3858	5.2001	5.0567	4.9424
11	9.6460	7.2057	6.2167	5.6683	5.3160	5.0692	4.8861	4.7445	4.6315
12	9.3302	6.9266	5.9525	5.4120	5.0643	4.8206	4.6395	4.4994	4.3875
13	9.0738	6.7010	5.7394	5.2053	4.8616	4.6204	4.4410	4.3021	4.1911
14	8.8616	6.5149	5.5639	5.0354	4.6950	4.4558	4.2779	4.1399	4.0297
15	8.6831	6.3589	5.4170	4.8932	4.5556	4.3183	4.1415	4.0045	3.8948
16	8.5310	6.2262	5.2922	4.7726	4.4374	4.2016	4.0259	3.8896	3.7804
17	8.3997	6.1121	5.1850	4.6690	4.3359	4.1015	3.9267	3.7910	3.6822
18	8.2854	6.0129	5.0919	4.5790	4.2479	4.0146	3.8406	3.7054	3.5971
19	8.1849	5.9259	5.0103	4.5003	4.1708	3.9386	3.7653	3.6305	3.5225
20	8.0960	5.8489	4.9382	4.4307	4.1027	3.8714	3.6987	3.5644	3.4567
21	8.0166	5.7804	4.8740	4.3688	4.0421	3.8117	3.6396	3.5056	3.3981
22	7.9454	5.7190	4.8166	4.3134	3.9880	3.7583	3.5867	3.4530	3.3458
23	7.8811	5.6637	4.7649	4.2636	3.9392	3.7102	3.5390	3.4057	3.2986
24	7.8229	5.6136	4.7181	4.2184	3.8951	3.6667	3.4959	3.3629	3.2560
25	7.7698	5.5680	4.6755	4.1774	3.8550	3.6272	3.4568	3.3239	3.2172
26	7.7213	5.5263	4.6366	4.1400	3.8183	3.5911	3.4210	3.2884	3.1818
27	7.6767	5.4881	4.6009	4.1056	3.7848	3.5580	3.3882	3.2558	3.1494
28	7.6356	5.4529	4.5681	4.0740	3.7539	3.5276	3.3581	3.2259	3.1195
29	7.5977	5.4204	4.5378	4.0449	3.7254	3.4995	3.3303	3.1982	3.0920
30	7.5625	5.3903	4.5097	4.0179	3.6990	3.4735	3.3045	3.1726	3.0665
40	7.3141	5.1785	4.3126	3.8283	3.5138	3.2910	3.1238	2.9930	2.8876
60	7.0771	4.9774	4.1259	3.6490	3.3389	3.1187	2.9530	2.8233	2.7185
120	6.8509	4.7865	3.9491	3.4795	3.1735	2.9559	2.7918	2.6629	2.5586
∞	6.6349	4.6052	3.7816	3.3192	30173	2.8020	2.6393	2.5113	2.4073

Table B.5b The F Distribution ($\alpha = .01$ in the right tail)

df (between) / *df (within)* — Denominator Degrees of Freedom	*Numerator Degrees of Freedom* 10	12	15	20	24	30	40	60	120	∞
1	241.88	243.91	245.95	248.01	249.05	250.10	251.14	252.20	253.25	254.31
2	19.396	19.413	19.429	19.446	19.454	19.462	19.471	19.479	19.487	19.496
3	8.7855	8.7446	8.7029	8.6602	8.6385	8.6166	8.5944	8.5720	8.5494	8.5264
4	5.9644	5.9117	5.8578	5.8025	5.7744	5.7459	5.7170	5.6877	5.6581	5.6281
5	4.7351	4.6777	4.6188	4.5581	4.5272	4.4957	4.4638	4.4314	4.3985	4.3650
6	4.0600	3.9999	3.9381	3.8742	3.8415	3.8082	3.7743	3.7398	3.7047	3.6689
7	3.6365	3.5747	3.5107	3.4445	3.4105	3.1758	3.3404	3.3043	3.2674	3.2298
8	3.3472	3.2839	3.2184	3.1503	3.1152	3.0794	3.0428	3.0053	2.9669	2.9276
9	3.1373	3.0729	3.0061	2.9365	2.9005	2.8617	2.8259	2.7872	2.7475	2.7067
10	2.9782	2.9110	2.8450	2.7740	2.7372	2.6996	2.6609	2.6211	2.5801	2.5379
11	2.8536	2.7876	2.7186	2.6464	2.6090	2.5705	2.5309	2.4901	2.4480	2.4045
12	2.7534	2.6866	2.6169	2.5436	2.5055	2.4663	2.4259	2.3842	2.3410	2.2962
13	2.6710	2.6037	2.5331	2.4589	2.4202	2.1801	2.3392	2.2966	2.2524	2.2064
14	2.6022	2.5342	2.4630	2.3879	2.3487	2.1082	2.2664	2.2229	2.1778	2.1307
15	2.5437	2.4753	2.4034	2.3275	2.2878	2.2468	2.2043	2.1601	2.1141	2.0658
16	2.4935	2.4247	2.3522	2.2756	2.2354	2.1938	2.1507	2.1058	2.0589	2.0096
17	2.4499	2.3807	2.3077	2.2304	2.1898	2.1477	2.1040	2.0584	2.0107	1.9604
18	2.4117	2.3421	2.2686	2.1906	2.1497	2.1071	2.0629	2.0166	1.9681	1.9168
19	2.3779	2.3080	2.2341	2.1555	2.1141	2.0712	2.0264	1.9795	1.9302	1.8780
20	2.3479	2.2776	2.2033	2.1242	2.0825	2.0391	1.9938	1.9464	1.8963	1.8432
21	2.3210	2.2504	2.1757	2.0960	2.0540	2.0102	1.9645	1.9165	1.8657	1.8117
22	2.2967	2.2258	2.1508	2.0707	2.0283	1.9842	1.9380	1.8894	1.8380	1.7831
23	2.2747	2.2036	2.1282	2.0476	2.0050	1.9605	1.9139	1.8648	1.8128	1.7570
24	2.2547	2.1834	2.1077	2.0267	1.9838	1.9390	1.8920	1.8424	1.7896	1.7330
25	2.2365	2.1649	2.0889	2.0075	1.9643	1.9192	1.8718	1.8217	1.7684	1.7110
26	2.2197	2.1479	2.0716	1.9898	1.9464	1.9010	1.8533	1.8027	1.7488	1.6906
27	2.2043	2.1323	20558	1.9736	1.9299	1.8842	1.8361	1.7851	1.7306	1.6717
28	2.1900	2.1179	2.0411	1.9586	1.9147	1.8687	1.8203	1.7689	1.7138	1.6541
29	2.1768	2.1045	2.0275	1.9446	1.9005	1.8543	1.8055	1.7537	1.6981	1.6376
30	2.1646	2.0921	2.0148	1.9317	1.8874	1.8409	1.7918	1.7396	1.6835	1.6223
40	2.0772	2.0035	1.9245	1.8389	1.7929	1.7444	1.6928	1.6373	1.5766	1.5089
60	1.9926	1.9174	1.8364	1.7480	1.7001	1.6491	1.5943	1.5343	1.4673	1.3893
120	1.9105	1.8337	1.7505	1.6587	1.6084	1.5543	1.4952	1.4290	1.3519	1.2539
∞	1.8307	1.7522	1.6664	1.5705	1.5173	1.4591	1.3940	1.3180	1.2214	1.0000

Table B.6 The Studentized Range Statistic, *q*

df (within) \ k	q Value When Alpha = .05																		
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	18.0	27.0	32.8	37.1	40.4	43.1	45.4	47.4	49.1	50.6	52.0	53.2	54.3	55.4	56.3	57.2	58.0	58.8	59.6
2	6.09	8.3	9.8	10.9	11.7	12.4	13.0	13.5	14.0	14.4	14.7	15.1	15.4	15.7	15.9	16.1	16.4	16.6	16.8
3	4.50	5.91	6.82	7.50	8.04	8.48	8.85	9.18	9.46	9.72	9.95	10.15	10.35	10.52	10.69	10.84	10.98	11.11	11.24
4	3.93	5.04	5.76	6.29	6.71	7.05	7.35	7.60	7.83	8.03	8.21	8.37	8.52	8.66	8.79	8.91	9.03	9.13	9.23
5	3.64	4.60	5.22	5.67	6.03	6.33	6.58	6.80	6.99	7.17	7.32	7.47	7.60	7.72	7.83	7.93	8.03	8.12	8.21
6	3.46	4.34	4.90	5.31	5.63	5.89	6.12	6.32	6.49	6.65	6.79	6.92	7.03	7.14	7.24	7.34	7.43	7.51	7.59
7	3.34	4.16	4.68	5.06	5.36	5.61	5.82	6.00	6.16	6.30	6.43	6.55	6.66	6.76	6.85	6.94	7.02	7.09	7.17
8	3.26	4.04	4.53	4.89	5.17	5.40	5.60	5.77	5.92	6.05	6.18	6.29	6.39	6.48	6.57	6.65	6.73	6.80	6.87
9	3.20	3.95	4.42	4.76	5.02	5.24	5.43	5.60	5.74	5.87	5.98	6.09	6.19	6.28	6.36	6.44	6.51	6.58	6.64
10	3.15	3.88	4.33	4.65	4.91	5.12	5.30	5.46	5.60	5.72	5.83	5.93	6.03	6.11	6.20	6.27	6.34	6.40	6.47
11	3.11	3.82	4.26	4.57	4.82	5.03	5.20	5.35	5.49	5.61	5.71	5.81	5.90	5.99	6.06	6.14	6.20	6.26	6.33
12	3.08	3.77	4.20	4.51	4.75	4.95	5.12	5.27	5.40	5.51	5.62	5.71	5.80	5.88	5.95	6.03	6.09	6.15	6.21
13	3.06	3.73	4.15	4.45	4.69	4.88	5.05	5.19	5.32	5.43	5.53	5.63	5.71	5.79	5.86	5.93	6.00	6.05	6.11
14	3.03	3.70	4.11	4.41	4.64	4.83	4.99	5.13	5.25	5.36	5.46	5.55	5.64	5.72	5.79	5.85	5.92	5.97	6.03
15	3.01	3.67	4.08	4.37	4.60	4.78	4.94	5.08	5.20	5.31	5.40	5.49	5.58	5.65	5.72	5.79	5.85	5.90	5.96
16	3.00	3.65	4.05	4.33	4.56	4.74	4.90	5.03	5.15	5.26	5.35	5.44	5.52	5.59	5.66	5.72	5.79	5.84	5.90
17	2.98	3.63	4.02	4.30	4.52	4.71	4.86	4.99	5.11	5.21	5.31	5.39	5.47	5.55	5.61	5.68	5.74	5.79	5.84
18	2.97	3.61	4.00	4.28	4.49	4.67	4.82	4.96	5.07	5.17	5.27	5.35	5.43	5.50	5.57	5.63	5.69	5.74	5.79
19	2.96	3.59	3.98	4.25	4.47	4.65	4.79	4.92	5.04	5.14	5.23	5.32	5.39	5.46	5.53	5.59	5.65	5.70	5.75
20	2.95	3.58	3.96	4.23	4.45	4.62	4.77	4.90	5.01	5.11	5.20	5.28	5.36	5.43	5.49	5.55	5.61	5.66	5.71
24	2.92	3.53	3.90	4.17	4.37	4.54	4.68	4.81	4.92	5.01	5.10	5.18	5.25	5.32	5.38	5.44	5.50	5.54	5.59
30	2.89	3.49	3.84	4.10	4.30	4.46	4.60	4.72	4.83	4.92	5.00	5.08	5.15	5.21	5.27	5.33	5.38	5.43	5.48
40	2.86	3.44	3.79	4.04	4.23	4.39	4.52	4.63	4.74	4.82	4.91	4.98	5.05	5.11	5.16	5.22	5.27	5.31	5.36
60	2.83	3.40	3.74	3.98	4.16	4.31	4.44	4.55	4.65	4.73	4.81	4.88	4.94	5.00	5.06	5.11	5.16	5.20	5.24
120	2.80	3.36	3.69	3.92	4.10	4.24	4.36	4.48	4.56	4.64	4.72	4.78	4.84	4.90	4.95	5.00	5.05	5.09	5.13
∞	2.77	3.31	3.63	3.86	4.03	4.17	4.29	4.39	4.47	4.55	4.62	4.68	4.74	4.80	4.85	4.89	4.93	4.97	5.01

(*Continued*)

Table B.6 **(Continued)**

q Value When Alpha = .01																			
df (within) \ k	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	90.0	135	164	186	202	216	227	237	246	253	260	266	272	277	282	286	290	294	298
2	14.0	19.0	22.3	24.7	26.6	28.2	29.5	30.7	31.7	32.6	33.4	34.1	34.8	35.4	36.0	36.5	37.0	37.5	37.9
3	8.26	10.6	12.2	13.3	14.2	15.0	15.6	16.2	16.7	17.1	17.5	17.9	18.2	18.5	18.8	19.1	19.3	19.5	19.8
4	6.51	8.12	9.17	9.96	10.6	11.1	11.5	11.9	12.3	12.6	12.8	13.1	13.3	13.5	13.7	13.9	14.1	14.2	14.4
5	5.70	6.97	7.80	8.42	8.91	9.32	9.67	9.97	10.24	10.48	10.70	10.89	11.08	11.24	11.40	11.55	11.68	11.81	11.93
6	5.24	6.33	7.03	7.56	7.97	8.32	8.61	8.87	9.10	9.30	9.49	9.65	9.81	9.95	10.08	10.21	10.32	10.43	10.54
7	4.95	5.92	6.54	7.01	7.37	7.68	7.94	8.17	8.37	8.55	8.71	8.86	9.00	9.12	9.24	9.35	9.46	9.55	9.65
8	4.74	5.63	6.20	6.63	6.96	7.24	7.47	7.68	7.87	8.03	8.18	8.31	8.44	8.55	8.66	8.76	8.85	8.94	9.03
9	4.60	5.43	5.96	6.35	6.66	6.91	7.13	7.32	7.49	7.65	7.78	7.91	8.03	8.13	8.23	8.32	8.41	8.49	8.57
10	4.48	5.27	5.77	6.14	6.43	6.67	6.87	7.05	7.21	7.36	7.48	7.60	7.71	7.81	7.91	7.99	8.07	8.15	8.22
11	4.39	5.14	5.62	5.97	6.25	6.48	6.67	6.84	6.99	7.13	7.25	7.36	7.46	7.56	7.65	7.73	7.81	7.88	7.95
12	4.32	5.04	5.50	5.84	6.10	6.32	6.51	6.67	6.81	6.94	7.06	7.17	7.26	7.36	7.44	7.52	7.59	7.66	7.73
13	4.26	4.96	5.40	5.73	5.98	6.19	6.37	6.53	6.67	6.79	6.90	7.01	7.10	7.19	7.27	7.34	7.42	7.48	7.55
14	4.21	4.89	5.32	5.63	5.88	6.08	6.26	6.41	6.54	6.66	6.77	6.87	6.96	7.05	7.12	7.20	7.27	7.33	7.39
15	4.17	4.83	5.25	5.56	5.80	5.99	6.16	6.31	6.44	6.55	6.66	6.76	6.84	6.93	7.00	7.07	7.14	7.20	7.26
16	4.13	4.78	5.19	5.49	5.72	5.92	6.08	6.22	6.35	6.46	6.56	6.66	6.74	6.82	6.90	6.97	7.03	7.09	7.15
17	4.10	4.74	5.14	5.43	5.66	5.85	6.01	6.15	6.27	6.38	6.48	6.57	6.66	6.73	6.80	6.87	6.94	7.00	7.05
18	4.07	4.70	5.09	5.38	5.60	5.79	5.94	6.08	6.20	6.31	6.41	6.50	6.58	6.65	6.72	6.79	6.85	6.91	6.96
19	4.05	4.67	5.05	5.33	5.55	5.73	5.89	6.02	6.14	6.25	6.34	6.43	6.51	6.58	6.65	6.72	6.78	6.84	6.89
24	3.96	4.54	4.91	5.17	5.37	5.54	5.69	5.81	5.92	6.02	6.11	6.19	6.26	6.33	6.39	6.45	6.51	6.56	6.61
30	3.89	4.45	4.80	5.05	5.24	5.40	5.54	5.65	5.76	5.85	5.93	6.01	6.08	6.14	6.20	6.26	6.31	6.36	6.41
40	3.82	4.37	4.70	4.93	5.11	5.27	5.39	5.50	5.60	5.69	5.77	5.84	5.90	5.96	6.02	6.07	6.12	6.17	6.21
60	3.76	4.28	4.60	4.82	4.99	5.13	5.25	5.36	5.45	5.53	5.60	5.67	5.73	5.79	5.84	5.89	5.93	5.98	6.02
120	3.70	4.20	4.50	4.71	4.87	5.01	5.12	5.21	5.30	5.38	5.44	5.51	5.56	5.61	5.66	5.71	5.75	5.79	5.83
∞	3.64	4.12	4.40	4.60	4.76	4.88	4.99	5.08	5.16	5.23	5.29	5.35	5.40	5.45	5.49	5.54	5.57	5.61	5.65

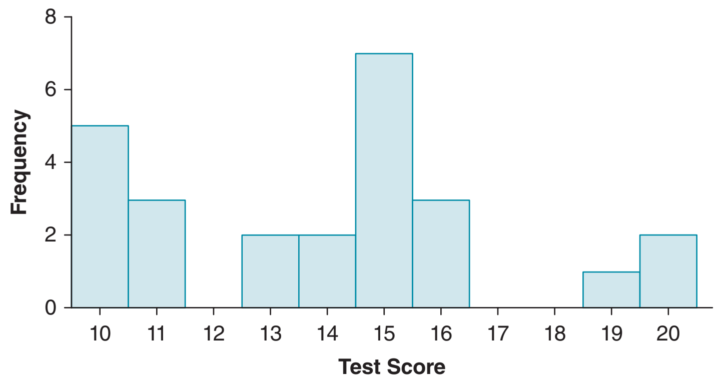
	f	*Proportion*	%
Less than $10	16	.029	2.9
$10–$49	39	.072	7.2
$50–$99	48	.088	8.8
$100–$249	86	.159	15.9
$250–$999	102	.188	18.8
$1,000 or more	251	.463	46.3
	n = 542		

Value	*f*	*p*	%
Never	30	.2000	20.00
A few times	75	.5000	50.00
More than a few times	35	.2333	23.33
A lot	10	.0667	6.67

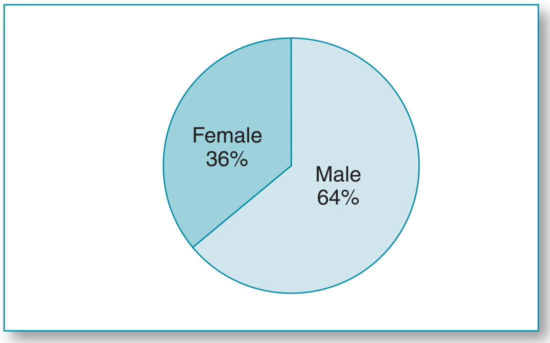
Value	*f*	*cf*	*p*	*cp*	*%*	*c%*
10	5	5	.20	.20	20	20
11	3	8	.12	.32	12	32
12	0	8	.00	.32	0	32
13	2	10	.08	.40	8	40
14	2	12	.08	.48	8	48
15	7	19	.28	.76	28	76
16	3	22	.12	.88	12	88
17	0	22	.00	.88	0	88
18	0	22	.00	.88	0	88
19	1	23	.04	.92	4	92
20	2	25	.08	1.00	8	100

Value	*f*	*p*	%
Male	16	.64	64
Female	9	.36	36

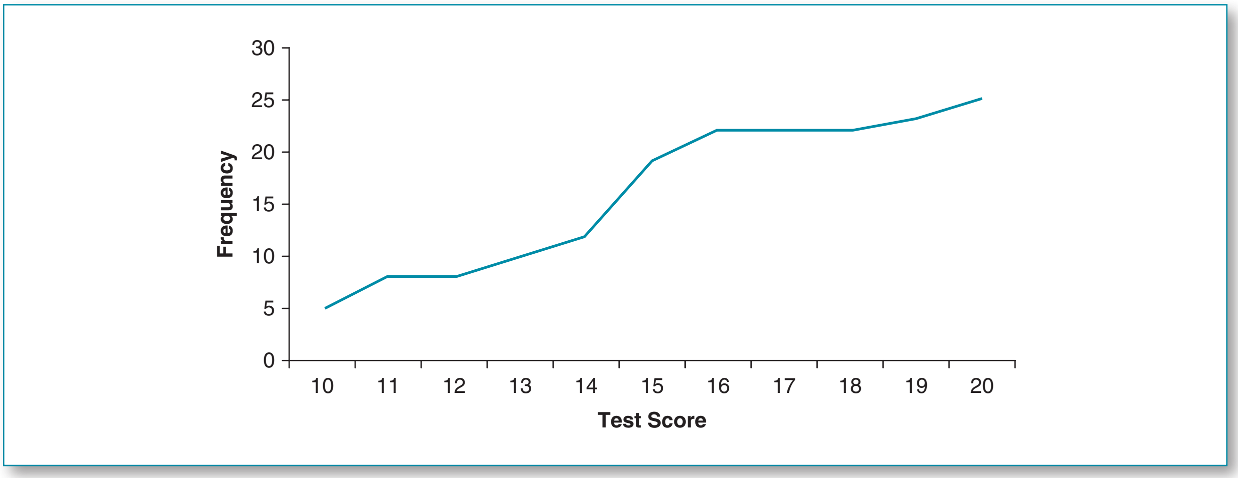
Distribution of Test Scores for Recruit Class



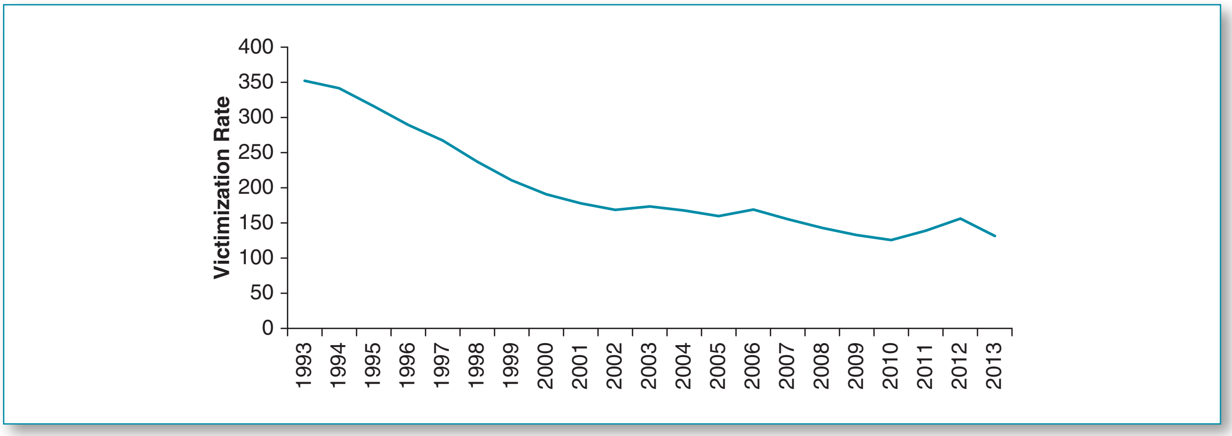
Gender Distribution of Recruit Class



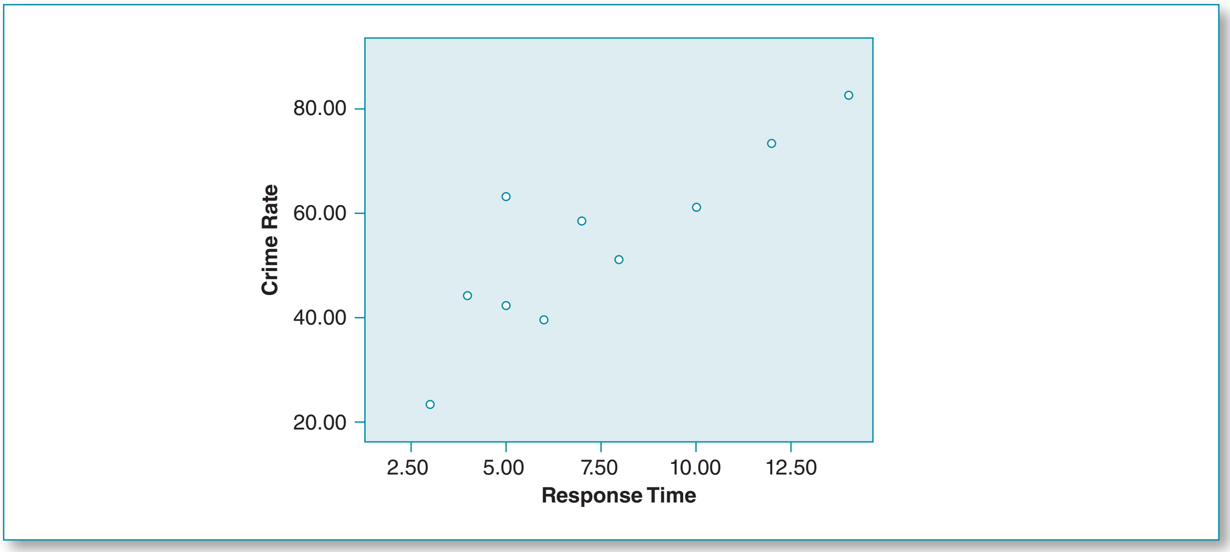
Cumulative Frequency Line Graph for Test Score Data



Time Plot of NCVS Property Crime Victimization Rates per 1,000 Households



m_i	$m_i - \overline{X}$	$(m_i - \overline{X})^2$	f	$f(m_i - \overline{X})^2$
2	2 – 8.6 = –6.6	43.56	76	3,310.56
7	7 – 8.6 = –1.6	2.56	52	133.12
12	12 – 8.6 = – 3.4	11.56	38	439.28
17	17 – 8.6 = 8.4	70.56	21	1,481.76
22	22 – 8.6 = 13.4	179.56	10	1,795.60
27	27 – 8.6 = 18.4	338.56	8	2,708.48
				Σ = 9,868.80



80.00
60.00
40.00
20.00
Crime Rate
2.50
5.00
7.50
10.00
12.50
Response Time