Introduction to the Student
and
Chapter 1
Displaying the Order in a Group of Numbers Using Tables and Graphs

Instructor's Summary of Chapter

Difficulty of course: We have never had a student who could pass other college-level psychology courses who could not also pass this course—though, for many students, this course requires more work.

Reasons for psychology students to learn statistical methods: reading the psychology research literature, conducting research, and developing analytic and critical thinking.

How to gain the most from this course: attend to the concepts (not just the numbers), master each concept before going on to the next, keep up with reading and assignments, study intensely during the first half of the course, do the *How Are You Doing?* self-tests, and study with other students. Students will also benefit from using the MyStatLab online supplement, available at http://www.mystatlab.com and http://www.pearsonhighered.com/aron.

Descriptive statistics summarize and make understandable a group of numbers collected in a research study.

Inferential statistics make inferences about larger groups based on numbers from a particular group of people studied.

Some basic concepts. Variables, values, and scores are differentiated.

Kinds of variables. Variables used in psychology are numeric (equal-interval or ratio), rank-order (ordinal), or nominal (categorical). Sometimes, variables are also described as discrete or continuous.

Frequency tables organize the numbers into a table in which each of the possible values is listed along the left from lowest to highest, accompanying each value by the number of cases and the percentage of cases that have that value. Grouped frequency tables are used when there are a large number of different values.

Histograms and bar graphs. A histogram is a graph in which the height of each bar represents the frequency for a particular value. A bar graph is like a histogram except that it is used for nominal variables, and there are spaces between the bars.

Distribution shapes. The general shape of the histogram can be unimodal, bimodal, multimodal, or rectangular; symmetrical or skewed (positive or negative); normal or kurtotic (peaked or flat). The normal curve is bell-shaped, unimodal, and symmetrical.

Controversy: Misleading graphs. Graphs presented to the general public sometimes mislead the eye for reasons such as failing to use equal intervals and exaggerating proportions.

How the procedures of this chapter are reported in research articles. When frequency tables appear in research articles, it is usually in order to compare distributions and often involves frequencies and percentages for various categories. Histograms rarely appear in articles, though the shapes of distributions are occasionally described in words.

Box 1-1. Important trivia for poetic statistics students. Summarizes the major historical sources of statistical methods.

Box 1-2. Math anxiety, statistics anxiety, and you: A message for those of you who are truly worried about this course. Summarizes research and thinking on various kinds of anxiety associated with studying statistics, plus methods for coping with these anxieties.

List of Transparencies

1.1 Basic Terminology (Table 1-1)
1.2 Levels of Measurement (Table 1-2)
1.3 Stress Ratings Example: (A) data, and (B) frequencies (Table 1-3)
1.4 Live-in-Country Example: data and frequency table
1.5 Horn Honking Example: (A) data, frequency table, and (B) grouped frequency table
1.6 Steps for Making a Frequency Table
1.7 Stress Ratings Example: histogram (Figure 1-3)
1.8 Live-in-Country Example: histogram
1.9 Horn Honking Example: interval midpoints and grouped frequency histogram
1.10 Steps for Making a Histogram
1.11 Closest Person Example: frequency table (Table 1-4) and bar graph (Figure 1-5)
1.12 Distribution Shapes: modes, skewness, and kurtosis (Figures 1-7, 1-9, and 1-11)
1.13 Bimodal and Rectangular Distributions (Figure 1-8)
1.14 Positively and Negatively Skewed Distributions (Figure 1-8)
1.15 Kurtotic Distributions

Lecture 1.1: Introduction to the Course

Materials

Lecture outline
Transparencies or PowerPoint slides of your syllabus
Questionnaires to hand out to students
Syllabi to hand out to students
Enrollment forms (as appropriate to your institution) to hand out to students

Outline for Blackboard

[Name and number of course and name of instructor]

I. Complete Questionnaires
II. Why Study Statistics?
III. What Will You Learn in This Course?
IV. Introductions
V. Course Structure and Requirements
VI. Administrative Matters
VII. First Assignment
VIII. Review This Class

Instructor's Lecture Outline

I. Complete Questionnaires

NOTE: The questionnaire, description of its content, and instructions for administering it, are provided in Chapter C of this *Manual*.

A. Distribute questionnaires as students enter classroom.
B. Collect questionnaires when nearly all are done (the remainder can finish during class).
C. Briefly explain content of questionnaire and how it will be used for data for examples throughout the course (see material in Chapter C of this *Manual*).

II. Why Study Statistics?

A. It is required for psychology majors! But why is it required?
B. Statistical methods are essential tools used in most psychological research (including in clinical and other areas of applied psychology). Therefore:
    1. This course prepares you for later psychology courses, which usually require reading research articles.
    2. This course prepares you for more advanced statistics courses, which equip you to use statistics in research you conduct yourself.
C. This course often meets a general education requirement in quantitative reasoning. But why is there such a requirement, and how does psychological statistics fulfill this requirement?
    1. Psychological statistics involves abstract logical and numeric methods.
    2. Mastering these methods develops your ability to think clearly and very precisely about these kinds of abstractions—something every educated person ought to be able to do.

III. What Will You Learn in This Course?

A. How to understand statistical methods. Note: the course is not very math-oriented, but it is very logic-oriented.
    1. You will write essays describing statistical procedures, as well as carry them out.
    2. We will emphasize "definitional formulas," which express the concepts, rather than "computational formulas." Computational formulas ease computation, but obscure the concepts; they are largely antiquated in the age of computers.
B. Hand out syllabi and systematically go through goals and topics. [An example syllabus is included in Chapter B of this *Manual*.]

IV. Introductions

A. Introduce yourself.
B. Introduce any teaching assistants.
C. Ask students about themselves using the following categories and any others you think are appropriate (if a small class, each student introduces self; if a large class, ask for numbers of students in each category):
    1. Area of psychology that most interests you.

2. Year.
3. If not a psychology major, what is your major?
4. Have you had introductory psychology?
5. What other psychology courses have you taken?

V. Course Structure and Requirements: Read and discuss each section of syllabus—be sure to discuss any aspects that involve the use of statistics software, any laboratory or discussion sections, and the policies regarding late and missing assignments and exams.

VI. Administrative Matters

A. Research participant pool requirements (if any).
B. Instructor's and teaching assistants' office hours.
C. Organizational matters, such as enrollment, etc., as required by your institution.

VII. First Assignment: Go over instructions at end of syllabus (see Chapter B of this *Manual*).

VIII. Review This Class: Use Blackboard outline.

Lecture 1.2: Some Basics and Frequency Tables

Materials

Lecture outline
Transparencies 1.1 through 1.6 (All "transparencies" are included in this *Manual* in a form suitable to use to make transparencies. PowerPoint slides containing comparable material are also available through the text's Web page.)
Syllabi for students who missed first class
Questionnaires for students who missed first class

Outline for Blackboard

I. Organizational Matters
II. Review First Assignment
III. Roles of Statistics in Psychological Research
IV. Some Basics
V. Frequency Tables
VI. Review This Class

Instructor's Lecture Outline

I. Organizational Matters

A. Be sure each student has a syllabus; answer questions on course structure, etc.
B. Arrange for those who missed the first class to complete the questionnaire.
C. Complete any remaining administrative matters.

II. Review First Assignment

A. Discuss and answer questions.
B. Remind students of late assignment policy.

III. Roles of Statistics in Psychological Research

A. Describe data—"descriptive statistics." Focus of the beginning part of the course, and the foundation of the rest of the course.

B. Make inferences based on data—"inferential statistics." Focus of most of the course after the beginning, but builds on beginning material.

IV. Some Basics

A. Variables, values, and scores. Show TRANSPARENCY 1.1:
   1. A person's score is that person's value on the variable.
   2. Example: A 20-year old has a score of 20 on the variable age; that is, this person's score of 20 is one of many possible values the variable age can have.

B. Levels of measurement. Show TRANSPARENCY 1.2:
   1. Numeric.
      a. Usually equal-interval. Example: GPA.
      b. Can be ratio. Example: number of seconds for something to happen.
   2. Rank-order (also called ordinal). Examples: class standing, place finished in a race, birth order.
   3. Nominal (also called categorical). Examples: gender, religion, marital status.
   4. Emphasize importance (different statistical procedures are used for each kind of variable), but note that most of the course focuses on the most common kind of variable, numeric.
   5. Discrete (example: number of siblings) versus continuous (example: distance from person sitting next to you).
      a. Nominal and rank-order variables are discrete.
      b. Equal-interval variables may be presented as discrete or continuous.

V. Frequency Tables

A. General question: Given a set of numbers, how can we make sense of them? Show TRANSPARENCY 1.3.A.

B. Show TRANSPARENCY 1.3.B:
   1. Key terms:
      a. Frequency: Number of scores with a particular value.
      b. Frequency distribution: The pattern of frequencies over different values.
   2. Points in making a frequency table:
      a. Go from lowest (top row) to highest (bottom row).
      b. Meaning of symbols at top.
      c. All cases are included.
      d. Percentages.

C. Live-in-country example: Show and discuss TRANSPARENCY 1.4.
D. Horn honking example: Show and discuss TRANSPARENCY 1.5.A.
E. Review steps for making a frequency table. Show and discuss TRANSPARENCY 1.6.
F. Grouped frequency tables. Show TRANSPARENCY 1.5.B:
    1. Needed to make large distributions with many different values more comprehensible.
    2. Values are grouped into intervals.

VI. **Review This Class:** Use Blackboard outline and show TRANSPARENCY 1.6.

Lecture 1.3: Describing a Distribution Graphically

Materials

Lecture outline
Transparencies 1.2, 1.4, and 1.6 through 1.15

Outline for Blackboard

I. Review/Last Assignment
II. Histograms
III. Bar Graphs
IV. Shapes of Distributions
V. Review This Class

Instructor's Lecture Outline

I. **Review/Last Assignment** (Take questions on last assignment and use answers to review points below.)

A. Descriptive statistics.
B. Kinds of variables: Show TRANSPARENCY 1.2.
C. Frequency tables: Show TRANSPARENCIES 1.4.A and 1.6.

II. Histograms

A. Purpose: Provides a picture of the distribution.
B. Show TRANSPARENCY 1.7, and use it to explain steps for making a histogram:
   1. Make a frequency table.
   2. Put the values along the bottom of the page, from left to right, from lowest to highest.
   3. Make a scale of frequencies along the left edge of the page that goes from 0 at the bottom to the highest frequency for any value.
   4. Make a bar above each value with a height for the frequency of that value.
C. Live-in-country example: Show and discuss TRANSPARENCY 1.8.
D. Horn honking example: Show and discuss TRANSPARENCY 1.9.

E. Review steps for making a histogram: Show TRANSPARENCY 1.10.

III. Bar Graphs

A. Purpose: Visual presentation of nominal (categorical) variables.

B. Show TRANSPARENCY 1.11:

1. Referred to as a bar graph, rather than a histogram.
2. Follow steps for making a frequency table and histogram. Use categories, rather than values. Because categories are unordered, leave a space between the bars.

IV. Shapes of Distributions

A. Modes.

1. Show and discuss TRANSPARENCY 1.12.A.
2. Show TRANSPARENCIES 1.8 (unimodal) and 1.13 (bimodal, rectangular).

B. Skewness.

1. Show and discuss TRANSPARENCY 1.12.B.
2. Show TRANSPARENCY 1.14. Demonstrates positive skew (skewed to the right) and negative skew (skewed to the left).

C. Kurtosis.

1. Show and discuss TRANSPARENCY 1.12.C.
2. Show TRANSPARENCY 1.15. Demonstrates peaked and flat distributions.

V. **Review This Class:** Use Blackboard outline.

TRANSPARENCY 1.1

Table 1-1 Some Basic Terminology

Term	Definition	Examples
Variable	Condition or characteristic that can have different values	Stress level; age; gender; religion
Value	Number or category	0, 1, 2, 3, 4; 25, 85; female; Catholic
Score	A particular person's value on a variable	0, 1, 2, 3, 4; 25, 85; female; Catholic

Table 1-2 Levels of Measurement

Level	Definition	Example
Equal-interval	Numeric variable in which differences between values correspond to differences in the underlying thing being measured	Stress level; age
Rank-order	Numeric variable in which values correspond to the relative position of things measured	Class standing; position finished in a race
Nominal	Variable in which the values are categories	Gender; religion

TRANSPARENCY 1.2

Table 1-2 Levels of Measurement

Level	Definition	Example
Equal-interval	Numeric variable in which differences between values correspond to differences in the underlying thing being measured	Stress level; age
Rank-order	Numeric variable in which values correspond to the relative position of things measured	Class standing; position finished in a race
Nominal	Variable in which the values are categories	Gender; religion

TRANSPARENCY 1.3

Stress Ratings Example
(from text)

8, 7, 4, 10, 8, 6, 8, 9, 9, 7, 3, 7, 6, 5, 0, 9, 10, 7, 7, 3, 6, 7, 5, 2, 1, 6, 7, 10, 8, 8

Table 1-3 Frequency Table of Number of Students Rating Each Value of the Stress Scale

Stress Rating	Frequency	Percent
0	1	3.3
1	1	3.3
2	1	3.3
3	2	6.7
4	1	3.3
5	2	6.7
6	4	13.3
7	7	23.3
8	5	16.7
9	3	10.0
10	3	10.0

Source: Data based on Aron et al. (1995).

TRANSPARENCY 1.4

Live-in-Country Example
(class questionnaire data)

Question: "Would you prefer to live out in the country with not many people around?"

1	2	3	4	5	6	7
Not at All			Moderately			Extremely

7, 5, 1, 4, 7, 7, 5, 1, 3, 4, 3, 4, 6, 2, 4, 4, 2, 3, 4, 1, 4, 2, 3, 2, 1, 3, 2, 3, 4, 6,
4, 2, 6, 4, 2, 1, 1, 4, 6, 2, 5, 6, 1, 3, 2, 2, 4, 4, 4, 5, 4, 4, 7, 5, 5, 5, 1, 6, 2, 1,
2, 6, 6, 3, 4, 5, 1, 1, 5, 2, 3, 5, 7, 4, 2, 4, 5, 4, 4, 7, 4, 1, 5, 3, 4, 4, 4, 3, 5, 2,
2, 3, 4, 7, 1, 4, 7, 1, 3, 3, 4, 5, 6, 4, 1, 2, 7, 1, 4, 2

X	**f**	%
1	16	14.0
2	18	15.8
3	14	12.3
4	30	26.3
5	14	12.3
6	9	7.9
7	9	7.9

TRANSPARENCY 1.5

Horn Honking Example
(fictional data based on Kenrick & McFarland, 1986)

Interpersonal hostility measured as delay in seconds for 29 cars before honking horn at stalled car after the light has changed to green.

3.5, 2.0, 0.0, 5.0, 0.5, 1.0, 4.0, 3.5, 3.0, 1.5,
1.5, 2.0, 2.5, 3.0, 3.0, 3.5, 4.5, 2.0, 2.5, 4.5,
4.0, 3.5, 3.0, 2.5, 2.5, 3.5, 3.5, 4.0, 3.0

Frequency Table

	X	**f**	%
0.0 - /	0.0	1	3.45
0.5 - /	0.5	1	3.45
1.0 - /	1.0	1	3.45
1.5 - //	1.5	2	6.90
2.0 - ///	2.0	3	10.35
2.5 - ////	2.5	4	13.80
3.0 - /////	3.0	5	17.25
3.5 - //////	3.5	6	20.70
4.0 - ///	4.0	3	10.35
4.5 - //	4.5	2	6.90
5.0 - /	5.0	1	3.45

Grouped Frequency Table
(interval = 1 second)

Interval	**f**	%
0.0 - 0.9	2	6.9
1.0 - 1.9	3	10.3
2.0 - 2.9	7	24.1
3.0 - 3.9	11	37.9
4.0 - 4.9	5	17.2
5.0 - 5.9	1	3.4

TRANSPARENCY 1.6

Steps for Making a Frequency Table

❶ **Make a list down the page of each possible value, from lowest to highest.**

❷ **Go one by one through the scores, making a mark for each next to its value on your list.**

❸ **Make a table showing how many times each value on your list is used.**

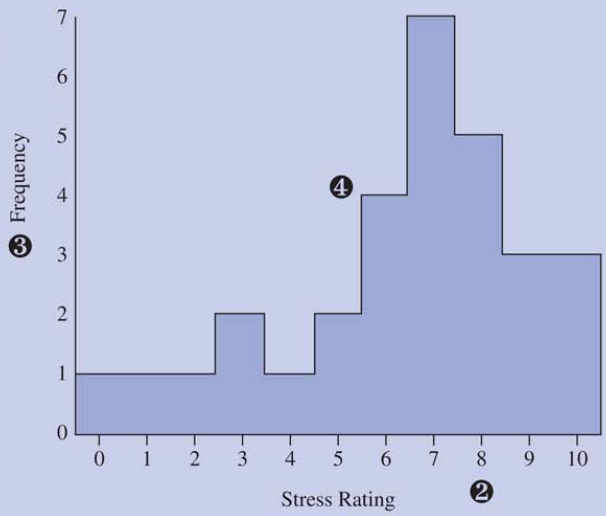
❹ **Figure the percentage of scores for each value.**

TRANSPARENCY 1.7

(a) Frequency Table

❶

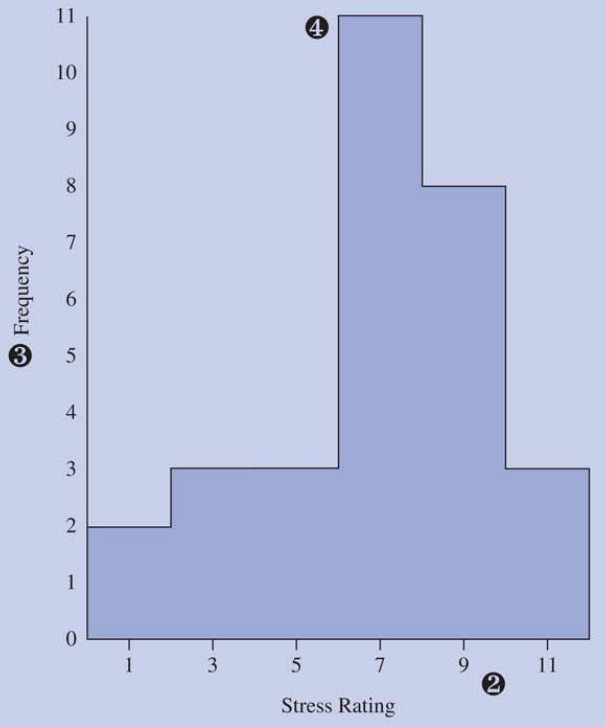
STRESS RATING	FREQUENCY
0	1
1	1
2	1
3	2
4	1
5	2
6	4
7	7
8	5
9	3
10	3



(b) Grouped Frequency Table

❶

STRESS RATING INTERVAL	FREQUENCY
0 – 1	2
2 – 3	3
4 – 5	3
6 – 7	11
8 – 9	8
10 – 11	3



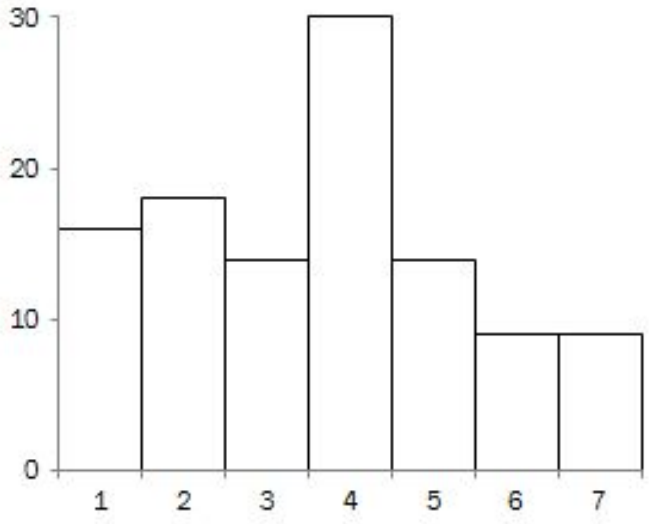
TRANSPARENCY 1.8

Live-in-Country Example
(class questionnaire data)

Question: "Would you prefer to live out in the country with not many people around?"

1	2	3	4	5	6	7
Not at All			Moderately			Extremely

X	f	%
1	16	14.0
2	18	15.8
3	14	12.3
4	30	26.3
5	14	12.3
6	9	7.9
7	9	7.9



TRANSPARENCY 1.9

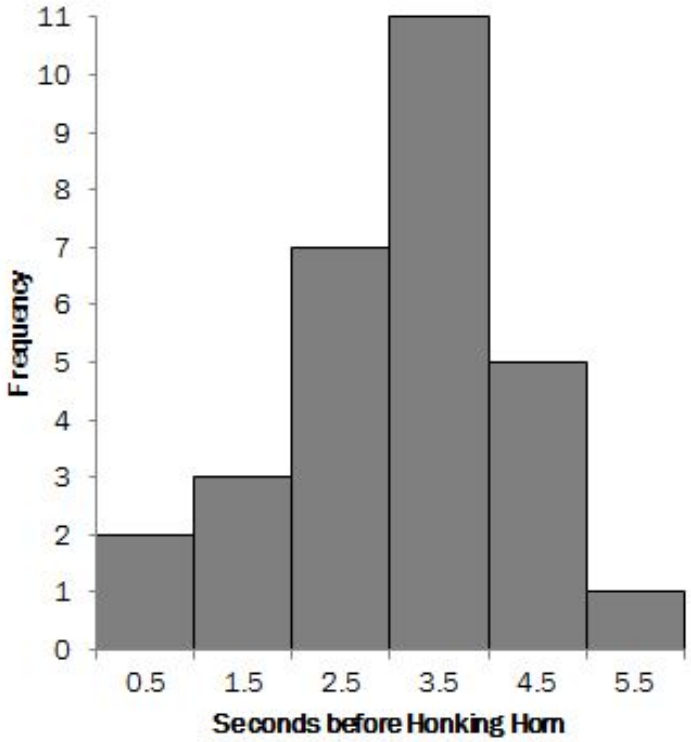
Horn Honking Example

(fictional data based on Kenrick & McFarland, 1986)

Interpersonal hostility measured as delay in seconds for 29 cars before honking horn at stalled car after the light has changed to green.

Grouped Frequency Table
(interval = 1 second)

Interval	Midpoint	f	%
0.0 - 0.9	0.5	2	6.9
1.0 - 1.9	1.5	3	10.3
2.0 - 2.9	2.5	7	24.1
3.0 - 3.9	3.5	11	37.9
4.0 - 4.9	4.5	5	17.2
5.0 - 5.9	5.5	1	3.4



TRANSPARENCY 1.10

Steps for Making a Histogram

❶ **Make a frequency table (or grouped frequency table).**

❷ **Put the values along the bottom of the page, from left to right, from lowest to highest.**

❸ **Make a scale of frequencies along the left edge of the page that goes from 0 at the bottom to the highest frequency for any value.**

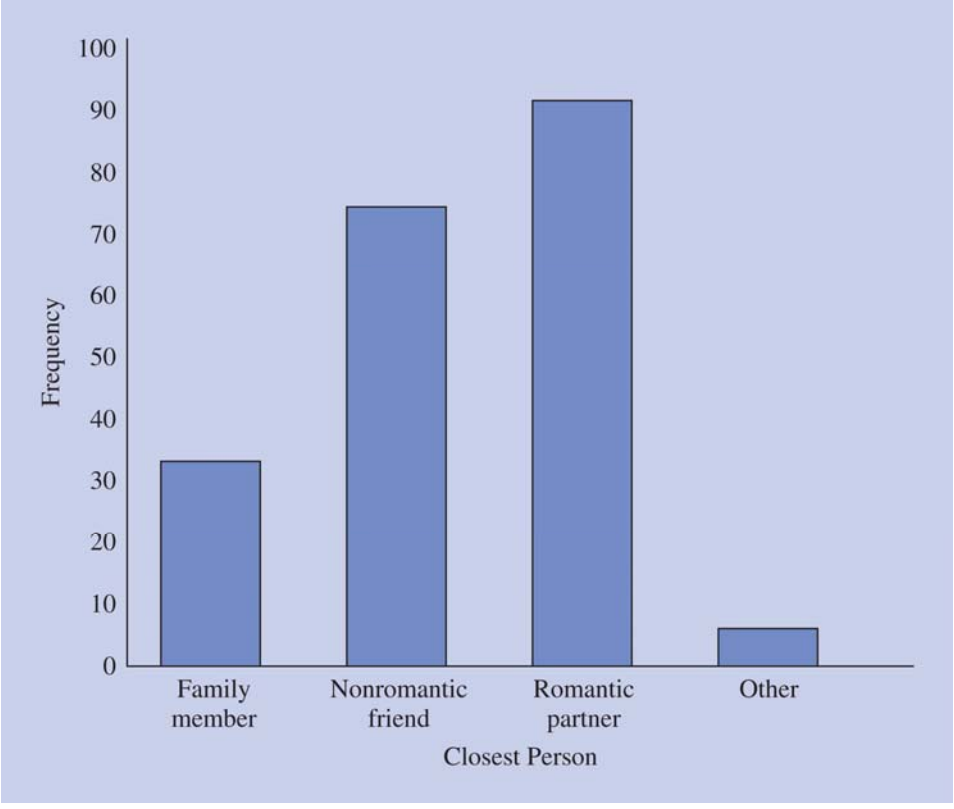
❹ **Make a bar above each value with a height for the frequency of that value.**

TRANSPARENCY 1.11

Table 1-4 Frequency Table for a Nominal Variable: Closest Person in Life for 208 Students

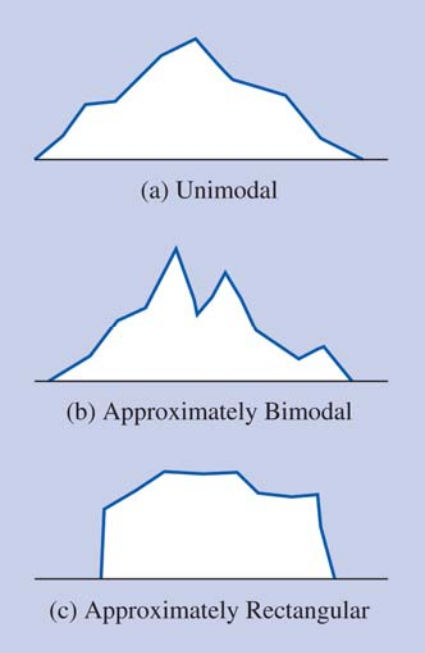
Closest Person	Frequency	Percent
Family member	33	15.9
Nonromantic friend	76	36.5
Romantic partner	92	44.2
Other	7	3.4

Source: Data from Aron et al. (1992).

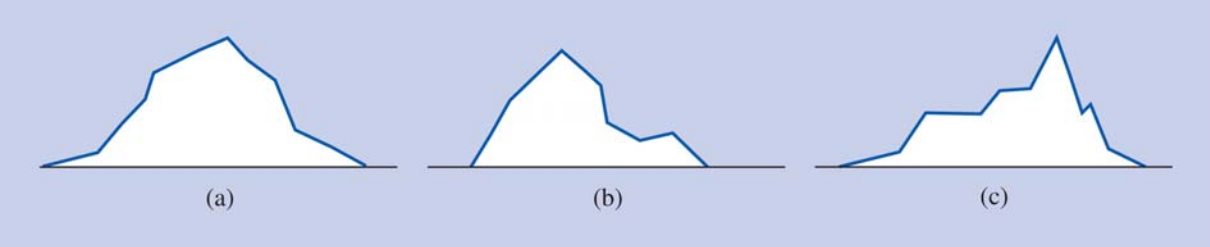


TRANSPARENCY 1.12

A. Modes

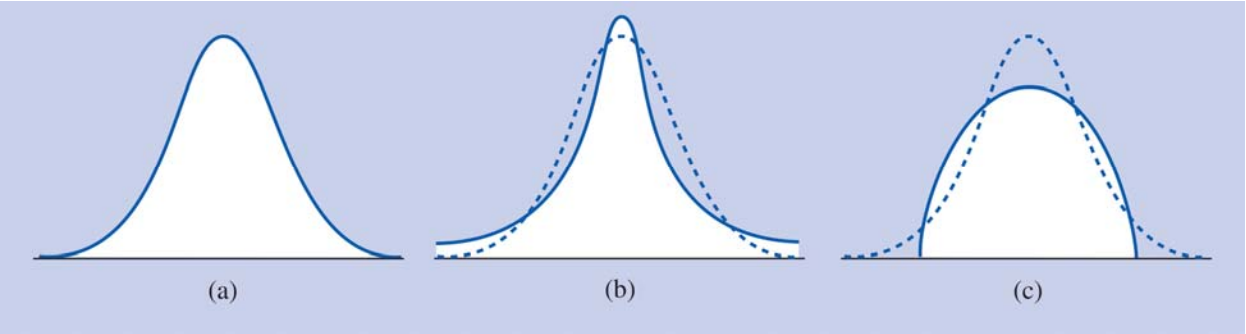


B. Skewness



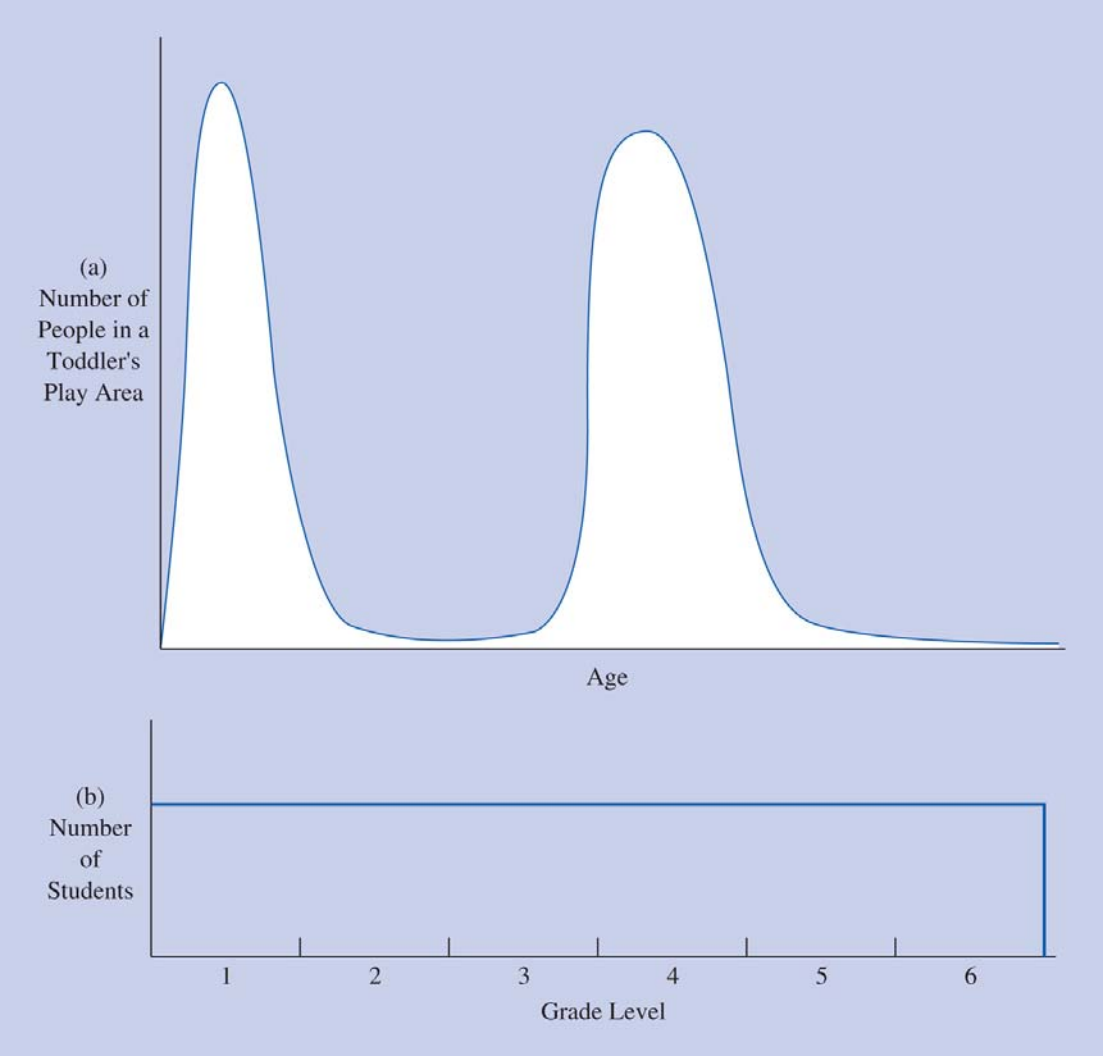
symmetrical **positive skew** **negative skew**

C. Kurtosis

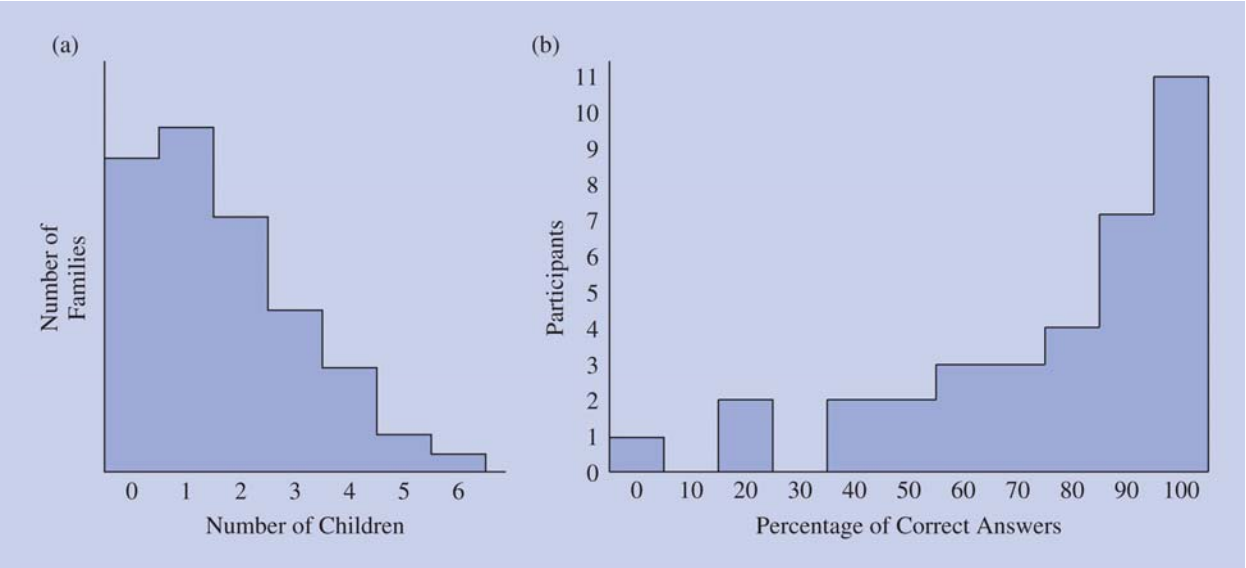


normal **peaked (heavy-tailed)** **flat (light-tailed)**

TRANSPARENCY 1.13



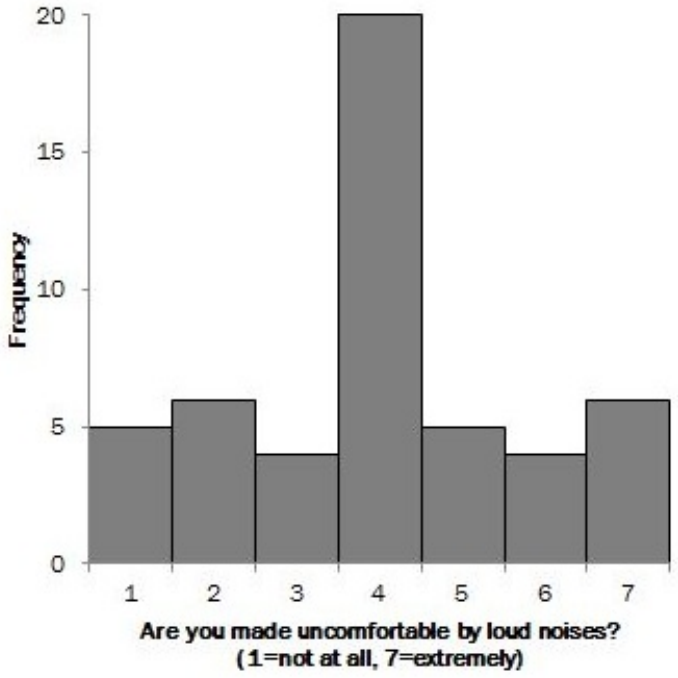
TRANSPARENCY 1.14



TRANSPARENCY 1.15

Kurtotic Distributions
(fictional data)

X	f
1	5
2	6
3	4
4	20
5	5
6	4
7	6



X	f
1	7
2	6
3	8
4	9
5	6
6	7
7	7