Chapter 2: Frequency Distributions

Chapter Outline

2.1 Introduction to Frequency Distributions
2.2 Frequency Distribution Tables
       Obtaining ΣX from a Frequency Distribution Table
       Proportions and Percentages
       Grouped Frequency Distribution Tables
       Real Limits and Frequency Distributions
2.3 Frequency Distribution Graphs
       Graphs for Interval or Ratio Data (Histograms and Polygons)
       Graphs for Nominal or Ordinal Data (Bar Graphs)
       Graphs for Population Distributions (Relative Frequencies and Smooth Curves)
2.4 The Shape of a Frequency Distribution

Learning Objectives and Chapter Summary

1. Students should understand the concept of a frequency distribution as an organized display showing where all of the individual scores are located on a scale of measurement.

    Note that one goal of descriptive statistics is to organize research results so that researchers can see what happened. Also note that a frequency distribution does not simply summarize the scores, but rather shows the entire set of scores.

2. Students should be able to organize data into a regular or a grouped frequency distribution table, and understand data that are presented in a table.

    If scores are presented in a regular table, students should be able to retrieve the complete list of original scores.

    The purpose for a grouped table is to keep the presentation relatively simple and easy to understand. All of the guidelines for constructing a grouped table are intended to help make the result easy and simple. Note, however, that after the scores have been put into a grouped table, the individual score values are lost.

3. Students should be able to organize data into frequency distribution graphs, including bar graphs, histograms, and polygons. Also, students should be able to understand data that are presented in a graph.

    Bar graphs (space between bars) are used to display data from nominal and ordinal scales. Polygons and histograms are used for data from interval or ratio scales. If scores are presented in a frequency distribution graph, students should be able to retrieve the complete list of original scores.

4. Students should understand that most population distributions are drawn as smooth curves showing relative proportions rather than absolute frequencies.

5. Students should be able to identify the shape of a distribution shown in a frequency distribution graph. Students should recognize symmetrical distributions (including but not limited to normal distributions), as well as positively and negatively skewed distributions.

Other Lecture Suggestions

1. Begin with an unorganized list of scores as in Example 2.1, and then organize the scores into a table. If you use a set of 20 or 25 scores, it will be easy to compute proportions and percentages for the same example.

2. Present a relatively simple, regular frequency distribution table (for example, use scores of 5, 4, 3, 2, and 1 with corresponding frequencies of 1, 3, 5, 3, 2. Ask students to determine the values of N and ΣX for the scores. Note that ΣX can be obtained two different ways: 1) by computing and summing the fX values within the table, and 2) by retrieving the complete list of individual scores and working outside the table.

  Next, ask students to determine the value of ΣX^2. You probably will find a lot of wrong answers from students who are trying to use the fX values within the table. The common mistake is to compute $(fX)^2$ and then sum these values. Note that whenever it is necessary to do complex calculations with a set of scores, the safe method is to retrieve the list of individual scores from the table before you try any computations.

3. It sometimes helps to make a distinction between graphs that are being used in a formal presentation and sketches that are used to get a quick overview of a set of data. In one case, the graphs should be drawn precisely and the axes should be labeled clearly so that the graph can be easily understood without any outside explanation. On the other hand, a sketch that is intended for your own personal use can be much less precise. As an instructor, if you are expecting precise, detailed graphs from your students, you should be sure that they know your expectations.

Test Bank

MULTIPLE CHOICE

1. What is the total number of scores for the distribution shown in the following table?

X	f
4	3
3	5
2	4
1	2

   a. 4
   b. 10
   c. 14
   d. 37

   ANS: C   REF: 2.2

2. A sample of $n = 15$ scores ranges from a high of $X = 11$ to a low of $X = 3$. If these scores are placed in a frequency distribution table, how many X values will be listed in the first column?
   a. 8
   b. 9
   c. 10
   d. It depends on whether any scores have a zero frequency.

   ANS: B   REF: 2.2

3. For the following data, N = _____.

X	f
4	2
3	4
2	3
1	2

   a. 10
   b. 11
   c. 28
   d. Cannot be determined from the table

   ANS: C   REF: 2.2

4. For the data in the following table, what is the value of ΣX?

X	f
4	1
3	2
2	4
1	2

   a. 10
   b. 15
   c. 20
   d. Cannot be determined from the table

   ANS: C   REF: 2.2

5. For the scores in the following table, what is the value of ΣX^2?

		X	f
a.	30	4	1
b.	41	3	2
c.	65	2	1
d.	225	1	3

ANS: B   REF: 2.2

6. For the following frequency distribution of quiz scores, how many individuals took the quiz?

		X	f
a.	$n = 5$	5	6
b.	$n = 15$	4	5
c.	$n = 21$	3	5
d.	Cannot be determined	2	3
		1	2

ANS: C   REF: 2.2

7. For the following distribution of quiz scores, if a score of $X = 3$ or higher is needed for a passing grade, how many individuals failed the quiz?

		X	f
a.	2	5	6
b.	3	4	5
c.	5	3	5
d.	10	2	3
		1	2

ANS: C   REF: 2.2

8. For the following distribution of quiz scores, How many individuals had a score of $X = 2$?

		X	f
a.	1	5	6
b.	3	4	5
c.	5	3	5
d.	Cannot be determined	2	3
		1	2

ANS: B   REF: 2.2

9. For the following distribution, what percentage of the individuals have scores of X = 1?

X	f
5	2
4	8
3	5
2	3
1	2

   a. 2%
   b. 5%
   c. 10%
   d. 20%

   ANS: C   REF: 2.2

10. A researcher surveys a sample of $n = 200$ college students and asks each person to identify his or her favorite movie from the past year. If the data were organized in a frequency distribution table, what would be listed in the first column?
   a. A list of movies
   b. A list of students
   c. A list of frequencies
   d. None of the other options is correct

   ANS: A   REF: 2.2

11. A set of scores ranges from a high of X = 72 to a low of X = 28. If these scores were put in a grouped frequency distribution table, what would be the best choice for the interval width?
   a. 2 points
   b. 5 points
   c. 7 points
   d. 10 points

   ANS: B   REF: 2.2

12. A set of scores ranges from a high of X = 24 to a low of X = 5. If these scores were put in a frequency distribution table with an interval width of 2 points, which of the following would be the top interval in the table?
   a. 4-5
   b. 23-24
   c. 24-25
   d. 22-24

   ANS: C   REF: 2.2

13. A set of scores ranges from a high of X = 96 to a low of X = 11. If these scores were placed in a grouped frequency distribution table, what is the best value for the interval width?
   a. 5 points
   b. 8 points
   c. 9 points
   d. 10 points

   ANS: D   REF: 2.2

14. A biologist records the number of trout, bass, perch, and other types of fish caught in a local lake during a 2-week period. If the results are organized in a frequency distribution table, what values would be listed in the first column?
   a. Frequencies   c. The 14 days
   b. Different types of fish   d. The days of the week

   ANS: B   REF: 2.2

15. For the following frequency distribution, what is ΣX?
   a. 8   X   f
   b. 90   30-34 1
   c. 110   25-29 1
   d. Cannot be determined   20-24 3
                              15-19 2
                              10-14 1

   ANS: D   REF: 2.2

16. For the following frequency distribution of exam scores, how many students had scores higher than $X = 79$?   X   f
   a. 7   90-94 3
   b. 12   85-89 4
   c. 19   80-84 5
   d. Cannot be determined   75-79 2
                              70-74 1

   ANS: B   REF: 2.2

17. For the following frequency distribution of exam scores, what is the lowest score on the exam?
                              X   f
   a. $X = 70$ 90-94 3
   b. $X = 74$ 85-89 4
   c. $X = 90$ 80-84 5
   d. Cannot be determined   75-79 2
                              70-74 1

   ANS: D   REF: 2.2

18. For the following frequency distribution of exam scores, how many students had scores lower than X = 80?

X	f
90-94	3
85-89	4
80-84	5
75-79	2
70-74	1

a. 2
b. 3
c. 7
d. Cannot be determined

ANS: B   REF: 2.2

19. In a grouped frequency distribution, one interval is listed as 50-59. Assuming that the scores are measuring a continuous variable, what are the real limits for this interval?
a. 50 and 59   c. 49.5 and 59.5
b. 50.5 and 59.5   d. 49.5 and 60.5

ANS: C   REF: 2.2

20. For the following distribution, how many people had scores less than X = 19?

X	f
20-24	2
15-19	5
10-14	4
5-9	1

a. 5
b. 10
c. 11
d. Cannot be determined

ANS: D   REF: 2.2

21. For the following distribution, what is the highest score?

X	f
20-24	2
15-19	5
10-14	4
5-9	1

a. 5
b. 20
c. 24
d. Cannot be determined

ANS: D   REF: 2.2

22. For the following distribution, how many people have scores greater than X = 14?

X	f
20-24	2
15-19	5
10-14	4
5-9	1

a. 2
b. 5
c. 7
d. 11

ANS: C   REF: 2.2

23. For the following distribution, what is the width of each class interval?

    a. 4
    b. 4.5
    c. 5
    d. 10

X	f
20-24	2
15-19	5
10-14	4
5-9	1

    ANS: C   REF: 2.2

24. If the following distribution were shown in a histogram, the width of the bar above the 15-19 interval would reach from _____ to _____.

    a. $X = 14.5$ to $X = 19.5$
    b. $X = 15.5$ to $X = 18.5$
    c. $X = 15.5$ to $X = 19.5$
    d. $X = 15.0$ to $X = 19.0$

X	f
20-24	2
15-19	5
10-14	4
5-9	1

    ANS: A   REF: 2.3

25. In a frequency distribution graph, frequencies are presented on the ___, and the scores (categories) are listed on the ___.

    a. X axis; Y axis
    b. horizontal line; vertical line
    c. Y axis; X axis
    d. class interval; horizontal line

    ANS: C   REF: 2.3

26. Which types of graphs are used for data from an interval scale?

    a. Histograms and bar graphs
    b. Polygons and bar graphs
    c. Histograms and polygons
    d. Histograms, bar graphs, and polygons

    ANS: C   REF: 2.3

27. What frequency distribution graph is appropriate for scores measured on a nominal scale?

    a. Only a histogram
    b. Only a polygon
    c. Either a histogram or a polygon
    d. Only a bar graph

    ANS: D   REF: 2.3

28. If a distribution of scores is shown in a bar graph, you know that the scores were measured on a(n) _____ scale of measurement.

    a. nominal or ordinal
    b. ordinal or interval
    c. interval or ratio
    d. discrete or continuous

    ANS: A   REF: 2.3

29. A researcher surveys a sample of $n = 200$ college students and asks each person to identify his or her favorite movie from the past year. If the results were presented in a frequency distribution graph, what kind of graph would be appropriate?
   a. A histogram
   b. A polygon
   c. A histogram or a polygon
   d. A bar graph

   ANS: D   REF: 2.3

30. A researcher collects a sample of $n = 20$ Introductory Psychology textbooks and records the number of pages in each book. The results are then placed in a grouped frequency distribution table using intervals of 0-99 pages, 100-199 pages, 200, 299 pages, and so on. If the results were converted into a frequency distribution graph, what kind of graph should be used?
   a. A bar graph
   b. A histogram
   c. A polygon
   d. Either a histogram or a polygon

   ANS: D   REF: 2.3

31. A biologist records the number of trout, bass, perch, and other types of fish caught in a local lake during a 2-week period. If the results are organized in a frequency distribution graph, what kind of graph should be used?
   a. A bar graph
   b. A histogram
   c. A polygon
   d. Either a histogram or a polygon

   ANS: A   REF: 2.3

32. After recording the final grade (A, B, C, D, E) for each individual in a class of $n = 26$ students, the professor would like to display the grade distribution in a frequency distribution graph. What kind of graph should be used?
   a. A bar graph
   b. A histogram
   c. A polygon
   d. Either a histogram or a polygon

   ANS: A   REF: 2.3

33. What kind of frequency distribution graph shows the frequencies as bars, with no space between adjacent bars?
   a. A bar graph
   b. A histogram
   c. A polygon
   d. All of these

   ANS: B   REF: 2.3

34. If a set of scores is displayed in a frequency distribution polygon, what scale of measurement was used to measure the scores?
    a. Nominal or ordinal   c. Ratio
    b. Interval   d. Interval or ratio

    ANS: D   REF: 2.3

35. A frequency distribution graph represents frequencies with vertical bars without space between them. What scale of measurement was used to measure the scores?
    a. Nominal   c. Nominal or ordinal
    b. Ordinal   d. Interval or ratio

    ANS: D   REF: 2.3

36. If a set of scores is displayed in a frequency distribution bar graph, what scale of measurement was used to measure the scores?
    a. Nominal   c. Nominal or ordinal
    b. Ordinal   d. Interval or ratio
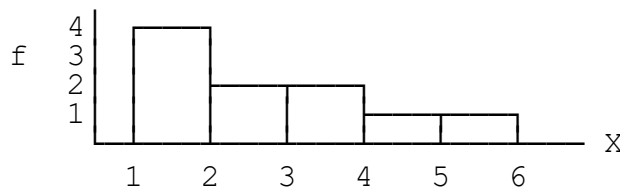
    ANS: C   REF: 2.3

37. What kind of frequency distribution graph shows the frequencies as bars that are separated by spaces?
    a. A bar graph   c. A polygon
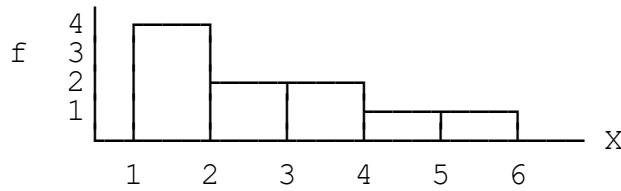   b. A histogram   d. All of these

    ANS: A   REF: 2.3

38. How many individual scores are in the following distribution?

    a. n = 5   c. n = 10
    b. n = 6   d. cannot be determined

    ANS: C   REF: 2.3

39. For the following distribution, what is ΣX?

a. $\Sigma X = 10$ c. $\Sigma X = 21$
b. $\Sigma X = 15$ d. $\Sigma X = 23$

ANS: D   REF: 2.3

40. The normal distribution is an example of
    a. a histogram showing data from a sample.
    b. a polygon showing data from a sample.
    c. a bar graph showing data from a population.
    d. a smooth curve showing data from a population.

ANS: D   REF: 2.3

41. If a set of exam scores forms a symmetrical distribution, what can you conclude about the students scores?
    a. Most of the students had relatively high scores.
    b. Most of the students had relatively low scores.
    c. About 50% of the students had high scores and the rest had low scores.
    d. It is not possible to draw any conclusions about students' scores.

ANS: C   REF: 2.4

42. If a set of exam scores forms a negatively skewed distribution, what can you conclude about the students' scores?
    a. Most of the students had relatively high scores.
    b. Most of the students had relatively low scores.
    c. About 50% of the students had high scores and the rest had low scores.
    d. It is not possible to draw any conclusions about students' scores.

ANS: A   REF: 2.4

43. What term is used to describe the shape of a distribution in which the scores pile up on the left-hand side of the graph and taper off to the right?
   a. Symmetrical
   b. Positively skewed
   c. Negatively skewed
   d. Normal

   ANS: B   REF: 2.4

44. A skewed distribution typically has _____ tail(s) and a normal distribution has _____ tail(s).
   a. 1; 1
   b. 1; 2
   c. 2; 1
   d. 2; 2

   ANS: B   REF: 2.4

45. The students in a psychology class seemed to think that the midterm exam was very easy. If they are correct, what is the most likely shape for the distribution of exam scores?
   a. Symmetrical
   b. Positively skewed
   c. Negatively skewed
   d. Normal

   ANS: C   REF: 2.4

46. In a distribution with positive skew, scores with the highest frequencies are _____.
   a. on the right side of the distribution
   b. on the left side of the distribution
   c. in the middle of the distribution
   d. represented at two distinct peaks

   ANS: B   REF: 2.4

47. What is the shape of the distribution for the following set of data? Scores: 1, 2, 3, 3, 4, 4, 4 5, 5, 5, 5, 6
   a. Symmetrical
   b. Positively skewed
   c. Negatively skewed
   d. Normal

   ANS: C   REF: 2.4

48. What is the shape of the distribution for the following set of data?
   a. Symmetrical
   b. Positively skewed
   c. Negatively skewed
   d. Normal

X	f
5	1
4	1
3	2
2	4
1	5

   ANS: B   REF: 2.4

49. What is the shape of the distribution for the following set of data?

X	f
5	5
4	3
3	1
2	3
1	5

   a. Symmetrical
   b. Positively skewed
   c. Negatively skewed
   d. Normal

   ANS: A   REF: 2.4

TRUE/FALSE

1. A researcher surveys a sample of $n = 200$ college students and asks each person to identify his or her favorite movie from the past year. If the data were organized in a frequency distribution table, the first column would be a list of movies.

   ANS: T   REF: 2.2

2. A group of quiz scores ranges from 3 to 10, but no student had a score of $X = 5$. If the scores are put in a frequency distribution table, $X = 5$ would not be listed in the X column.

   ANS: F   REF: 2.2

3. It is customary to list the score categories in a frequency distribution from the highest down to the lowest.

   ANS: T   REF: 2.2

4. For the distribution shown in the following table, $n = 5$.

X	f
5	2
4	8
3	5
2	3
1	2

   ANS: F   REF: 2.2

5. For the following distribution of scores, 20% of the individuals have scores of $X = 1$.

X	f
5	2
4	8
3	5
2	3
1	2

ANS: F   REF: 2.2

6. For the following distribution of scores, $\Sigma X = 18$.

X	f
4	1
3	2
2	3
1	2

ANS: T   REF: 2.2

7. For the following distribution of scores, $\Sigma X^2 = 92$.

X	f
4	1
3	2
2	3
1	2

ANS: F   REF: 2.2

8. A grouped frequency distribution table lists one interval as, 20-29. The width of this interval is 9 points.

ANS: F   REF: 2.2

9. If a distribution with more than 15 or 20 scores is being organized in a frequency distribution table, then a grouped table should be used.

ANS: F   REF: 2.2

10. In a grouped frequency distribution table, one interval is identified as 30-34. This interval has a width of 5 points.

ANS: T   REF: 2.2

11. If a set of scores covers a range of 80 points, then the grouped frequency table for the scores should use an interval width of 8 points.

ANS: F   REF: 2.2

12. A set of scores ranges from $X = 18$ to $X = 91$. If the scores were put in a grouped frequency distribution table with an interval width of 10 points, the top interval would be 91-100.

ANS: F   REF: 2.2

13. In a grouped frequency distribution table, the top value in each class interval should be a multiple of the interval width.

ANS: F   REF: 2.2

14. A set of scores ranges from a low of $X = 18$ to a high of $X = 98$. If the scores are put in a grouped frequency distribution table with an interval width of 10 points, the bottom interval should be 10-19.

ANS: T   REF: 2.2

15. A grouped frequency distribution table does not provide enough information to obtain a complete listing of the original set of scores.

ANS: T   REF: 2.2

16. For the following distribution, 11 people have scores greater than $X = 14$.

X	f
20-24	2
15-19	5
10-14	4
5-9	1

ANS: F   REF: 2.2

17. In the following distribution, the scores are grouped into class intervals that are each 5 points wide.

X	f
20-24	2
15-19	5
10-14	4
5-9	1

ANS: T   REF: 2.2

18. A professor records the number of students who are absent each day for the semester. Because this is a discrete variable, a bar graph should be used to show the frequency distribution.

    ANS: F   REF: 2.3

19. If a frequency distribution is presented in a polygon, then the scores were measured on an interval or a ratio scale.

    ANS: T   REF: 2.3

20. A sports historian recorded the number of times that the New York Yankees finished 1st, 2nd, 3rd, and so on, in their division for the past 20 years. If the results are presented in a frequency distribution graph, then a histogram should be used.

    ANS: F   REF: 2.3

21. A space is left between adjacent bars in a bar graph.

    ANS: T   REF: 2.3

22. A set of scores ranging from a high of 47 to a low of 6 is organized in a grouped frequency distribution table using an interval width of 5 points. If the distribution is shown in a graph, then a histogram or polygon should be used.

    ANS: T   REF: 2.3

23. The classrooms in the Psychology department are numbered from 100 to 108. A professor records the number of classes held in each room during the fall semester. If the results were presented in a frequency distribution graph, the professor should use a bar graph.

    ANS: T   REF: 2.3

24. If it is appropriate to present a distribution of scores in a polygon, then it would also be appropriate to present the scores in a bar graph.

    ANS: F   REF: 2.3

25. A histogram is constructed so that adjacent bars touch.

    ANS: T   REF: 2.3

26. The normal distribution is an example of a symmetrical distribution.

    ANS: T   REF: 2.4

27. In February in New York, the daily high temperatures are typically low with only a few relatively warm days. A frequency distribution showing the daily high temperatures would probably form a negatively skewed distribution.

ANS: F   REF: 2.4

28. The scores for a very easy exam would probably form a positively skewed distribution.

ANS: F   REF: 2.4

29. If a set of exam scores forms a negatively skewed distribution, it suggests that the majority of the students did not score well on the exam.

ANS: F   REF: 2.4

30. In a positively skewed distribution, the scores pile up on the left side of the distribution and taper off to the right.

ANS: T   REF: 2.4

SHORT ANSWER

1. Find each value requested for the set of scores in the following frequency distribution table.

	X	f
a. n	5	2
b. ΣX	4	2
c. ΣX^2	3	3
	2	5
	1	2

ANS:
a. $n = 14$
b. $\Sigma X = 39$
c. $\Sigma X^2 = 131$

REF: 2.2

2. Briefly explain what information is available in a regular frequency distribution table that is not available in a grouped table.

ANS: A regular table identifies each individual score. However, in a grouped table, you simply know that an individual score is located in a particular interval, but you do not know its exact value.
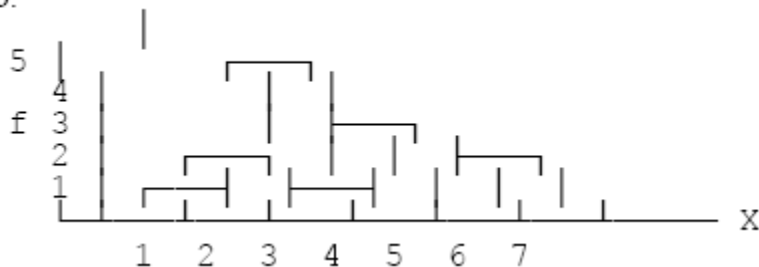
REF: 2.2

3. For the following scores
    a. construct a frequency distribution table.
    b. sketch a histogram of the frequency distribution.
         6, 4, 3, 5, 4, 2, 4
         5, 4, 6, 1, 4, 5, 2

ANS:

a.

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

b.

REF: 2.2, 2.3

4. For the following scores, construct a grouped frequency distribution table using an interval width of 10 points. Based on the table, what is the shape of the distribution?
         30, 23, 58, 28, 35, 67, 74, 59, 27, 42, 46, 35
         51, 33, 18, 33, 25, 38, 48, 36, 31, 39, 63, 40

ANS:

X	f	
70-79	1	positively skewed
60-69	2	
50-59	3	
40-49	4	
30-39	9	
20-29	4	
10-19	1	

REF: 2.2, 2.4

36