

## Chapter 2

Describing Data: Frequency Tables,  
Frequency Distributions, and Graphic  
Presentation

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# Learning Objectives

- LO2-1 Summarize qualitative variables with frequency and relative frequency tables.
- LO2-2 Display a frequency table using a bar or pie chart.
- LO2-3 Summarize quantitative variables with frequency and relative frequency distributions.
- LO2-4 Display a frequency distribution using a histogram or frequency polygon.

# Constructing Frequency Tables <sup>1</sup>

**Frequency Table** A grouping of qualitative data into mutually exclusive and collectively exhaustive classes showing the number of observations in each class.

- Mutually exclusive: Each observation in only one class.
- Collectively exhaustive: There is a class for each value.

# Constructing Frequency Tables <sup>2</sup>

1. Sort the data into classes.
  2. Count the number in each class.
  3. Report as the class frequency.
- Example: Car sales by location.

Location	Number of Cars
Kane	52
Olean	40
Sheffield	45
Tionesta	43
Total	180

# Constructing Frequency Tables <sup>3</sup>

- Convert each frequency to a relative frequency.
- Shows the fraction of the total number observations in each class.
- Each of the class frequencies is divided by the total number of observations.
- Captures the relationship between a class frequency and the total number of observations.
- Example: Car sales by location.

Location	Number of Cars	Relative Frequency	Found by
Kane	52	.289	52/180
Olean	40	.222	40/180
Sheffield	45	.250	45/180
Tionesta	43	.239	43/180
Total	180	1.000	

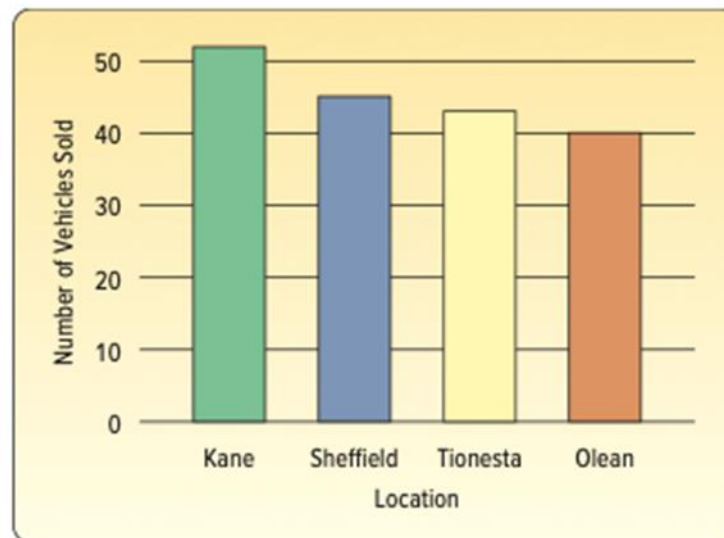
# Graphic Presentation of Qualitative Data <sup>1</sup>

**Bar Chart** A graph that shows the qualitative classes on the horizontal axis and the class frequencies on the vertical axis. The class frequencies are proportional to the heights of the bars.

- A bar chart is the most common graphic to present a qualitative variable.
- Describes a frequency table using a series of uniformly wide rectangles.
- The height of each rectangle is the class frequency.
- Mode: The class with the highest frequency.

# Graphic Presentation of Qualitative Data <sup>2</sup>

- For a nominal variable, the order of the classes does not matter.
- You can order the classes by decreasing or increasing order.
- Example: Car sales by location.



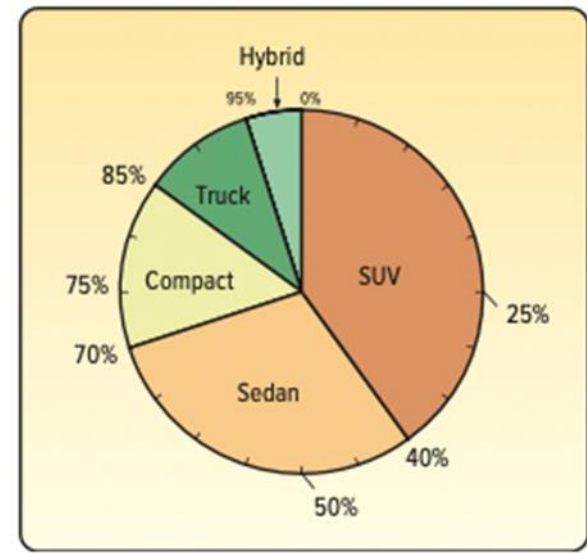
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# Graphic Presentation of Qualitative Data <sup>3</sup>

**Pie Chart** A chart that shows the proportion or percentage that each class represents of the total number of frequencies.

- Example: Car sales by location.

Vehicle Type	Number Sold	Percent Sold
SUV	72	40
Sedan	54	30
Compact	27	15
Truck	18	10
Hybrid	9	5
Total	180	100





# Constructing Frequency Distributions

**Frequency Distribution** A grouping of quantitative data into mutually exclusive and collectively exhaustive classes showing the number of observations in each class.

- Step 1: Decide on the number of classes.
- Step 2: Determine the class interval (same for all classes).
- Step 3: Set the individual class limits.
- Step 4: Tally the data into classes and determine the number of the observations in each class.

# Frequency Distributions <sub>1</sub>

- Example: Profit on vehicles sold last month.

**Table 2-4** Profit on Vehicles Sold Last Month by the Applewood Auto Group.

								Maximum
\$1,387	\$2,148	\$2,201	\$ 963	\$ 820	\$2,230	\$3,043	\$2,584	\$2,370
1,754	2,207	996	1,298	1,266	2,341	1,059	2,666	2,637
1,817	2,252	2,813	1,410	1,741	<b>3,292</b>	1,674	2,991	1,426
1,040	1,428	323	1,553	1,772	1,108	1,807	934	2,944
1,273	1,889	352	1,648	1,932	1,295	2,056	2,063	2,147
1,529	1,166	482	2,071	2,350	1,344	2,236	2,083	1,973
3,082	1,320	1,144	2,116	2,422	1,906	2,928	2,856	2,502
1,951	2,265	1,485	1,500	2,446	1,952	1,269	2,989	783
2,692	1,323	1,509	1,549	369	2,070	1,717	910	1,538

# Frequency Distributions <sup>2</sup>

1,206	1,760	1,638	2,348	978	2,454	1,797	1,536	2,339
1,342	1,919	1,961	2,498	1,238	1,606	1,955	1,957	2,700
443	2,357	2,127	<b>294</b>	1,818	1,680	2,199	2,240	2,222
754	2,866	2,430	1,115	1,824	1,827	2,482	2,695	2,597
1,621	732	1,704	1,124	1,907	1,915	2,701	1,325	2,742
870	1,464	1,876	1,532	1,938	2,084	3,210	2,250	1,837
1,174	1,626	2,010	1,688	1,940	2,639	377	2,279	2,842
1,412	1,762	2,165	1,822	2,197	842	1,220	2,626	2,434
1,809	1,915	2,231	1,897	2,646	1,963	1,401	1,501	1,640
2,415	2,119	2,389	2,445	1,461	2,059	2,175	1,752	1,821
1,546	1,766	335	2,886	1,731	2,338	1,118	2,058	2,487

**Minimum**

# Frequency Distributions <sup>3</sup>

- Step 1: Decide on the number of classes.
- Use the  $2^k > n$  rule, where  $n = 180$ .
- $k$  is the number of classes.
- $n$  is the number of values in the data set.
- $2^k > 180$ , let  $k = 8$ .
- So use 8 classes.

# Frequency Distributions <sup>4</sup>

- Step 2: Determine the class interval.
- The classes all taken together must cover the distance from the minimum to the maximum.
- The class interval:  $i = \frac{\textit{Maximum value} - \textit{Minimum value}}{k}$ .
- $\frac{\$3292 - \$294}{8} = \$374.75$  round up to \$400.
- Use this class interval width for all intervals.

# Frequency Distributions <sup>5</sup>

- Step 3: Set the individual class limits.

Classes
\$ 200 up to \$ 600
600 up to 1,000
1,000 up to 1,400
1,400 up to 1,800
1,800 up to 2,200
2,200 up to 2,600
2,600 up to 3,000
3,000 up to 3,400

# Frequency Distributions <sup>6</sup>

Step 4: Tally the data into classes and determine the number of the observations in each class.

Profit	Frequency
\$ 200 up to \$ 600	8
600 up to 1,000	11
1,000 up to 1,400	23
1,400 up to 1,800	38
1,800 up to 2,200	45
2,200 up to 2,600	32
2,600 up to 3,000	19
3,000 up to 3,400	4
Total	180

# Relative Frequency Distributions

- To find the relative frequencies, take the class frequency and divide by the total number of observations.
- Example: Profit on vehicles sold last month.

Profit	Frequency	Relative Frequency	Found by
\$ 200 up to \$ 600	8	.044	8/180
600 up to 1,000	11	.061	11/180
1,000 up to 1,400	23	.128	23/180
1,400 up to 1,800	38	.211	38/180
1,800 up to 2,200	45	.250	45/180
2,200 up to 2,600	32	.178	32/180
2,600 up to 3,000	19	.106	19/180
3,000 up to 3,400	<u>4</u>	<u>.022</u>	4/180
Total	180	1.000	



# Graphic Presentation of a Frequency Distribution <sup>1</sup>

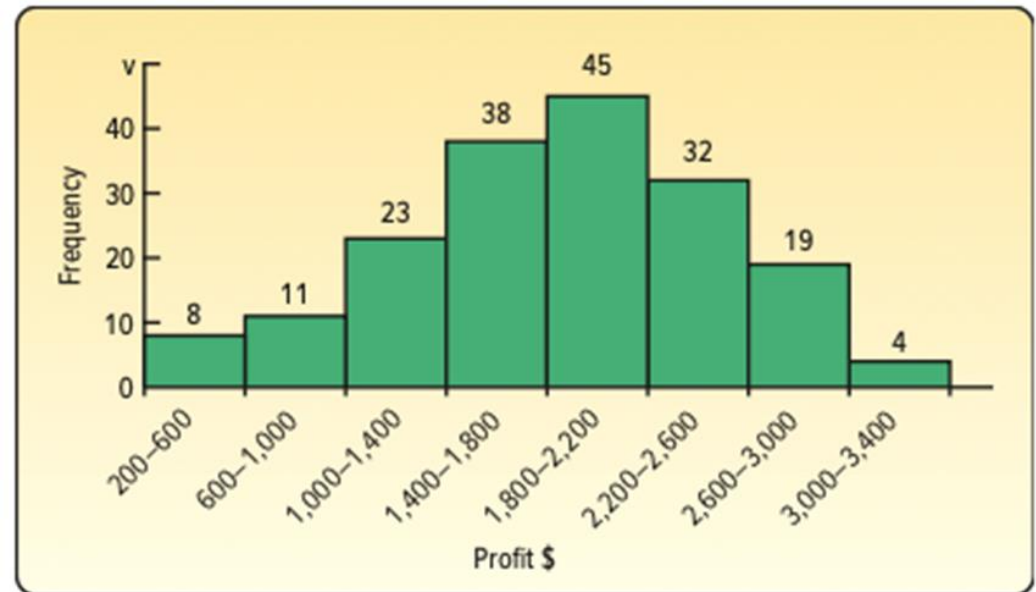
**Histogram** A graph in which the classes are marked on the horizontal axis and the class frequencies on the vertical axis. The class frequencies are represented by the heights of the bars, and the bars are drawn adjacent to each other.

- A histogram shows the shape of a distribution.
- Each class is depicted as a rectangle.
- The height of the bar representing the number in each class.

# Graphic Presentation of a Frequency Distribution <sub>2</sub>

- Example: Profit on vehicles sold last month.

Profit	Frequency
\$ 200 up to \$ 600	8
600 up to 1,000	11
1,000 up to 1,400	23
1,400 up to 1,800	38
1,800 up to 2,200	45
2,200 up to 2,600	32
2,600 up to 3,000	19
3,000 up to 3,400	4
Total	180



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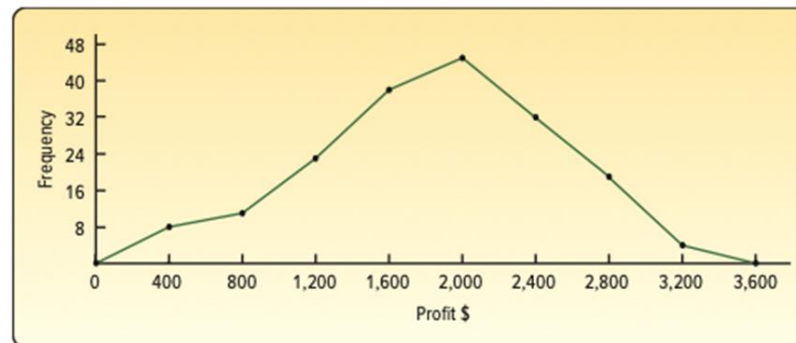
# Graphical Presentation of a Frequency Distribution <sup>1</sup>

- A frequency polygon also shows the shape of a distribution.
- Consists of line segments connecting the points formed by connecting the class midpoints.
- Gives a quick picture of the main characteristics of the data.
- Good to use when comparing two or more distributions.

# Graphical Presentation of a Frequency Distribution <sup>2</sup>

- Example: Profit on vehicles sold last month.

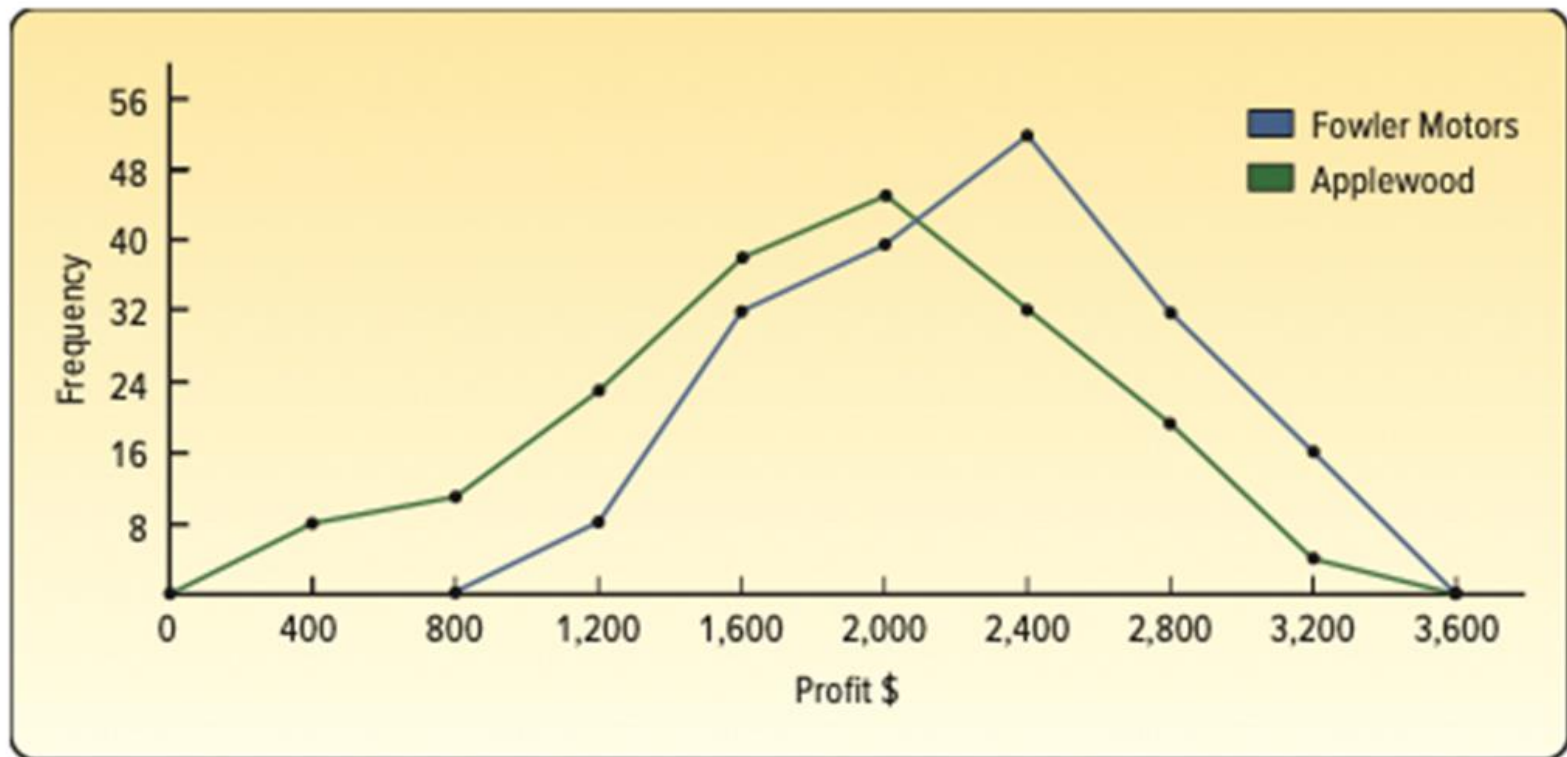
Profit	Midpoint	Frequency
\$ 200 up to \$ 600	\$ 400	8
600 up to 1,000	800	11
1,000 up to 1,400	1,200	23
1,400 up to 1,800	1,600	38
1,800 up to 2,200	2,000	45
2,200 up to 2,600	2,400	32
2,600 up to 3,000	2,800	19
3,000 up to 3,400	3,200	4
Total		180



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# Graphical Presentation of a Frequency Distribution <sup>3</sup>

- Example continued.



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# Cumulative Frequency and Relative Frequency Distributions <sup>1</sup>

- Cumulative frequency distribution: Add each frequency to the frequencies before it.
- Cumulative relative frequency distribution: Divide the cumulative frequencies by the total number of observations.
- This shows how many values have accumulated as you move from one class down to the next class.

# Cumulative Frequency and Relative Frequency Distributions <sup>2</sup>

- Example: Profit on vehicles sold last month.

Profit	Frequency
\$ 200 up to \$ 600	8
600 up to 1,000	11
1,000 up to 1,400	23
1,400 up to 1,800	38
1,800 up to 2,200	45
2,200 up to 2,600	32
2,600 up to 3,000	19
3,000 up to 3,400	4
Total	180

Profit	Cumulative Frequency	Found by
Less than \$ 600	8	8
Less than 1,000	19	8+11
Less than 1,400	42	8+11+23
Less than 1,800	80	8+11+23+38
Less than 2,200	125	8+11+23+38+45
Less than 2,600	157	8+11+23+38+45+32
Less than 3,000	176	8+11+23+38+45+32+19
Less than 3,400	180	8+11+23+38+45+32+19+4

# Cumulative Frequency and Relative Frequency Distributions <sub>3</sub>

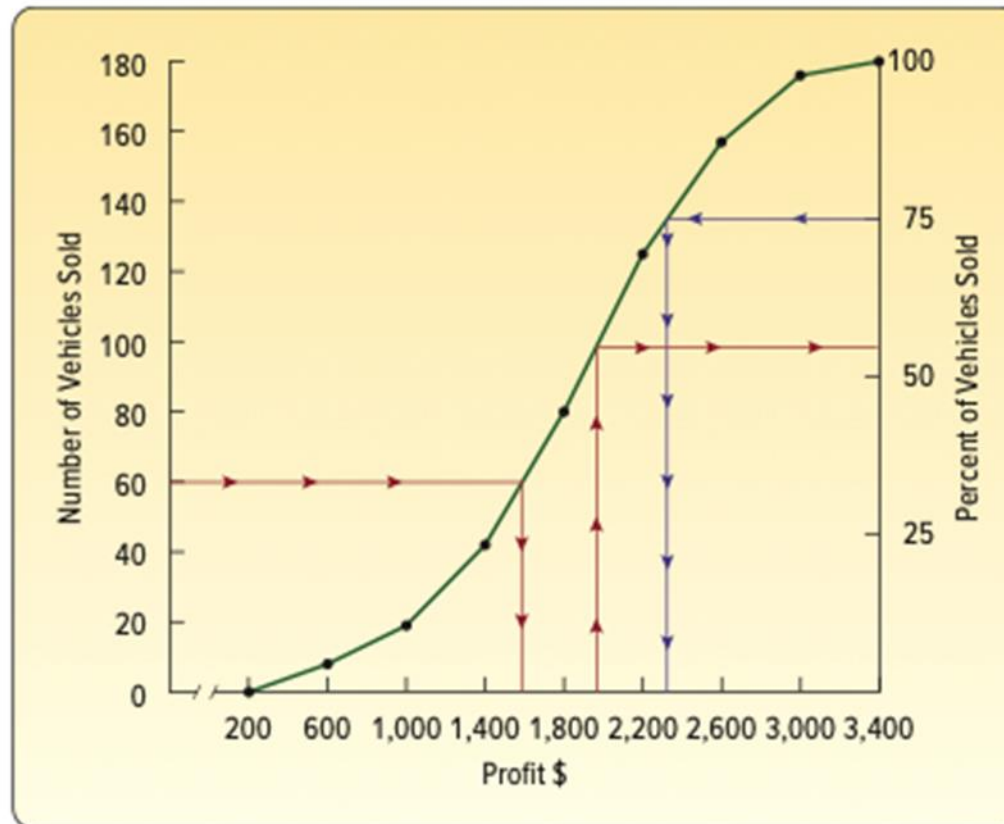
- Example continued.

Profit	Cumulative Frequency	Cumulative Relative Frequency
Less than \$ 600	8	$8/180 = 0.044 = 4.4\%$
Less than 1,000	19	$19/180 = 0.106 = 10.6\%$
Less than 1,400	42	$42/180 = 0.233 = 23.3\%$
Less than 1,800	80	$80/180 = 0.444 = 44.4\%$
Less than 2,200	125	$125/180 = 0.694 = 69.4\%$
Less than 2,600	157	$157/180 = 0.872 = 87.2\%$
Less than 3,000	176	$176/180 = 0.978 = 97.8\%$
Less than 3,400	180	$180/180 = 1.000 = 100\%$



# Cumulative Frequency and Relative Frequency Distributions <sup>4</sup>

- Example: Profit on vehicles sold last month.



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# Chapter 2 Practice Problems

# Question 5

LO2-2

Wellstone Inc. produces and markets replacement covers for cell phones in five different colors: bright white, metallic black, magnetic lime, tangerine orange, and fusion red. To estimate the demand for each color, the company set up a kiosk for several hours in the Mall of America and asked randomly selected people which cover color was their favorite.

- What is the table called?
- Draw a bar chart for the table.
- Draw a pie chart.
- If Wellstone Inc. plans to produce one million cell phone covers, how many of each color should it produce?

Bright white	130
Metallic black	104
Magnetic lime	325
Tangerine orange	455
Fusion red	286

# Question 11

LO2-3

Wachesaw Manufacturing Inc. produced the following number of units in the last 16 days.

27	27	27	28	27	25	25	28
26	28	26	28	31	30	26	26

The information is to be organized into a frequency distribution.

- How many classes would you recommend?
- What class interval would you suggest?
- What lower limit would you recommend for the first class?
- Organize the information into a frequency distribution and determine the relative frequency distribution.
- Comment on the shape of the distribution.

# Question 17

LO2-4

The following frequency distribution reports the number of frequent flier miles, reported in thousands, for employees of Brumley Statistical Consulting Inc. during the most recent quarter.

Frequent Flier Miles (000)	Number of Employees
0 up to 3	5
3 up to 6	12
6 up to 9	23
9 up to 12	8
12 up to 15	2
Total	50

- How many employees were studied?
- What is the midpoint of the first class? What lower limit would you recommend for the first class?
- Construct a histogram.
- A frequency polygon is to be drawn. What are the coordinates of the plot for the first class?
- Construct a frequency polygon.
- Interpret the frequent flier miles accumulated using the two charts.



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