

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

Chapter 2





LEARNING OBJECTIVES

- LO1 Make a frequency table for a set of data.
- LO2 Organize data into a bar chart.
- LO3 Present a set of data in a pie chart.
- LO4 Create a frequency distribution for a data set.
- LO5 Understand a relative frequency distribution.
- LO6 Present data from a frequency distribution in a histogram or frequency polygon.

LO1 Make a frequency table for a set of data

Frequency Table and Frequency Distribution

FREQUENCY TABLE A grouping of qualitative data into mutually exclusive classes showing the number of observations in each class.

Class interval: The class interval is obtained by subtracting the lower limit of a class from the lower limit of the next class.

Class frequency: The number of observations in each class.

Class midpoint: A point that divides a class into two equal parts. This is the average of the upper and lower class limits.

APPLEWOOD AUTO GROUP					
	A	B	C	D	E
1	Age	Profit	Location	Vehicle-Type	Previous
2	21	\$1,387	Tionesta	Sedan	0
3	23	\$1,754	Sheffield	SUV	1
4	24	\$1,817	Sheffield	Hybrid	1
5	25	\$1,040	Sheffield	Compact	0
6	26	\$1,273	Kane	Sedan	1
7	27	\$1,529	Sheffield	Sedan	1
8	27	\$3,082	Kane	Truck	0
9	28	\$1,951	Kane	SUV	1
10	28	\$2,692	Tionesta	Compact	0
11	29	\$1,206	Sheffield	Sedan	0
12	29	\$1,342	Kane	Sedan	2
13	30	\$443	Kane	Sedan	3
14	30	\$754	Olean	Sedan	2
15	30	\$1,621	Sheffield	Truck	1

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

FREQUENCY DISTRIBUTION A grouping of data into mutually exclusive classes showing the number of observations in each class.

Bar Charts

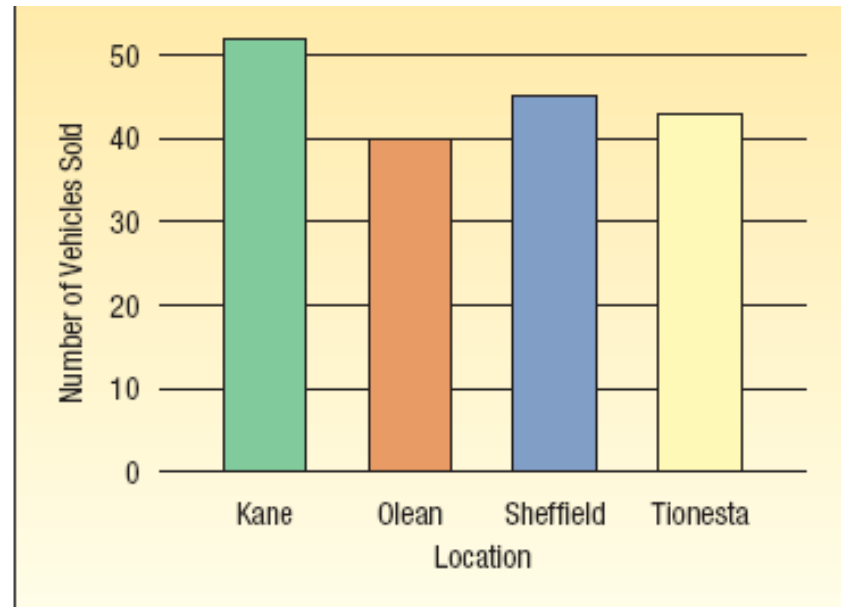


CHART 2-1 Number of Vehicles Sold by Location

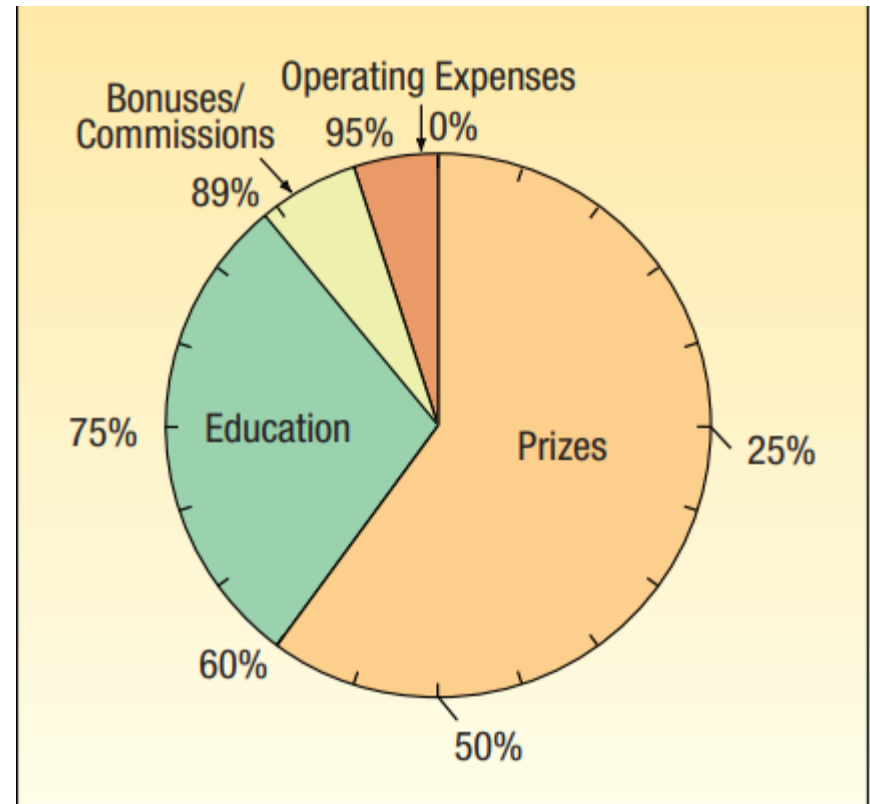
BAR CHART A graph in which the classes are reported on the horizontal axis and the class frequencies on the vertical axis. The class frequencies are proportional to the heights of the bars.

Pie Charts

PIE CHART A chart that shows the proportion or percent that each class represents of the total number of frequencies.

TABLE 2-3 Ohio State Lottery Expenses in 2009

Use of Sales	Amount (\$ million)	Percentage of Sales
Prizes	1,460.0	60
Education	702.3	29
Bonuses	150.0	6
Expenses	124.3	5
Total	2,436.6	100



LO4 Create a frequency distribution for a data set.

EXAMPLE – Creating a Frequency Distribution Table

Ms. Kathryn Ball of Applewood Auto Group wants to develop tables, charts, and graphs to show the typical selling price on various dealer lots. The table on the right reports only the price of the 180 vehicles sold last month.



TABLE 2-4 Profit on Vehicles Sold Last Month by the Applewood Auto Group

								Highest
\$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	3,292	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
1,206	1,761	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	294	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	1,761	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
								Lowest

Constructing a Frequency Table - Example

■ Step 1: Decide on the number of classes.

A useful recipe to determine the number of classes (k) is the “2 to the k rule.” such that $2^k > n$.

There were 180 vehicles sold, so $n = 180$. If we try $k = 7$, then $2^7 = 128$, somewhat less than 180. Hence, 7 is not enough classes. If we let $k = 8$, then $2^8 = 256$, which is greater than 180. So the recommended number of classes is 8.

■ Step 2: Determine the class interval or width.

The formula is: $i \geq (H-L)/k$ where i is the class interval, H is the highest observed value, L is the lowest observed value, and k is the number of classes.

$$i \geq \frac{H - L}{k} = \frac{\$3,292 - \$294}{8} = \$374.75$$

Round up to some convenient number, such as a multiple of 10 or 100.
Use a class width of \$400

Constructing a Frequency Table - Example

- Step 3: Set the individual class limits
- Step 4: Tally the vehicle selling prices into the classes.

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

TABLE 2-7 Frequency Distribution of Profit for Vehicles Sold Last Month at Applewood Auto Group

Profit	Frequency
\$ 200 up to \$ 600	III
600 up to 1,000	IIII I
1,000 up to 1,400	IIII IIII III
1,400 up to 1,800	IIII IIII IIII III
1,800 up to 2,200	IIII IIII IIII IIII II
2,200 up to 2,600	IIII IIII IIII II
2,600 up to 3,000	IIII IIII III
3,000 up to 3,400	IIII
Total	

- Step 5: Count the number of items 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 Class Frequencies

- Class frequencies can be converted to **relative class frequencies** to show the fraction of the total number of observations in each class.
- A relative frequency captures the relationship between a class total and the total number of observations.

TABLE 2-2 Relative Frequency Table of Vehicles Sold By Type At Whitner Autoplex Last Month

Vehicle Type	Number Sold	Relative Frequency
Domestic	50	0.625
Foreign	30	0.375
Total	<u>80</u>	<u>1.000</u>

Relative Frequency Distribution

To convert a frequency distribution to a *relative* frequency distribution, each of the class frequencies is divided by the total number of observations.

TABLE 2–8 Relative Frequency Distribution of Profit for Vehicles Sold Last Month at Applewood Auto Group

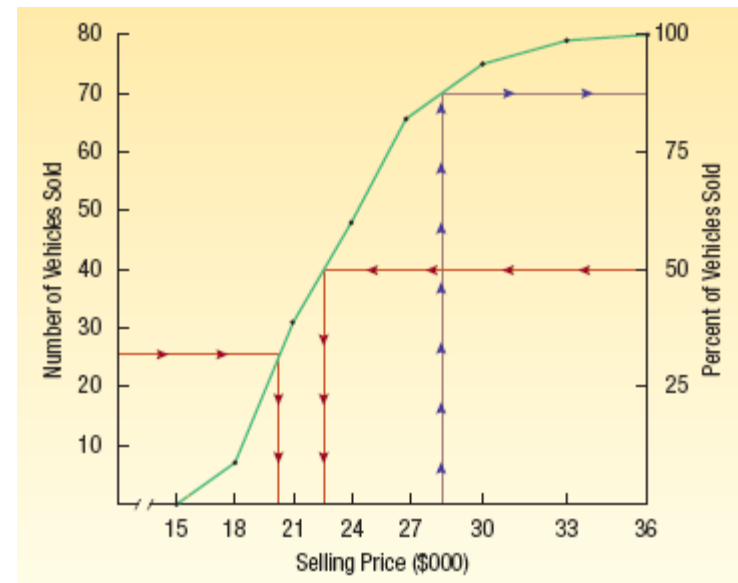
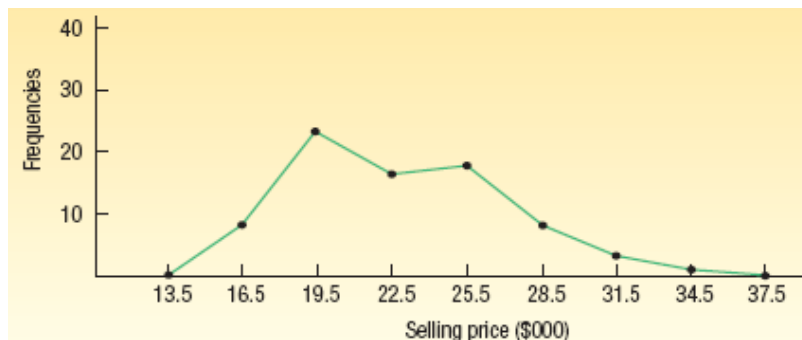
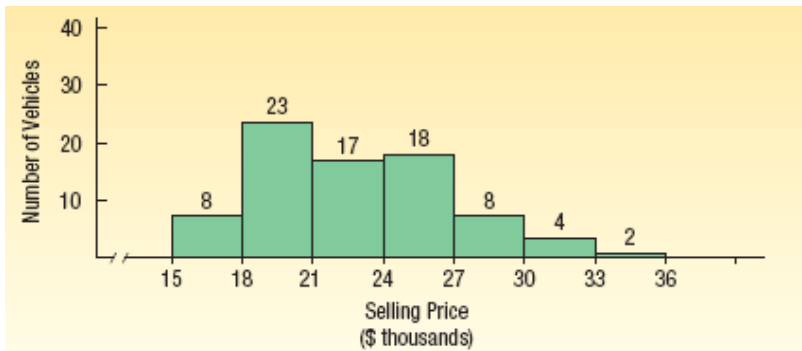
Profit	Frequency	Relative Frequency	Found by
\$ 200 up to \$ 600	8	.044	8/180
600 up to 1,000	11	.061	11/180
1,000 up to 1,400	23	.128	23/180
1,400 up to 1,800	38	.211	38/180
1,800 up to 2,200	45	.250	45/180
2,200 up to 2,600	32	.178	32/180
2,600 up to 3,000	19	.106	19/180
3,000 up to 3,400	4	.022	4/180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

LO6 Present data from a frequency distribution in a histogram or frequency polygon.

Graphic Presentation of a Frequency Distribution

The three commonly used graphic forms are:

- Histograms
- Frequency polygons
- Cumulative frequency distributions



Histogram

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.

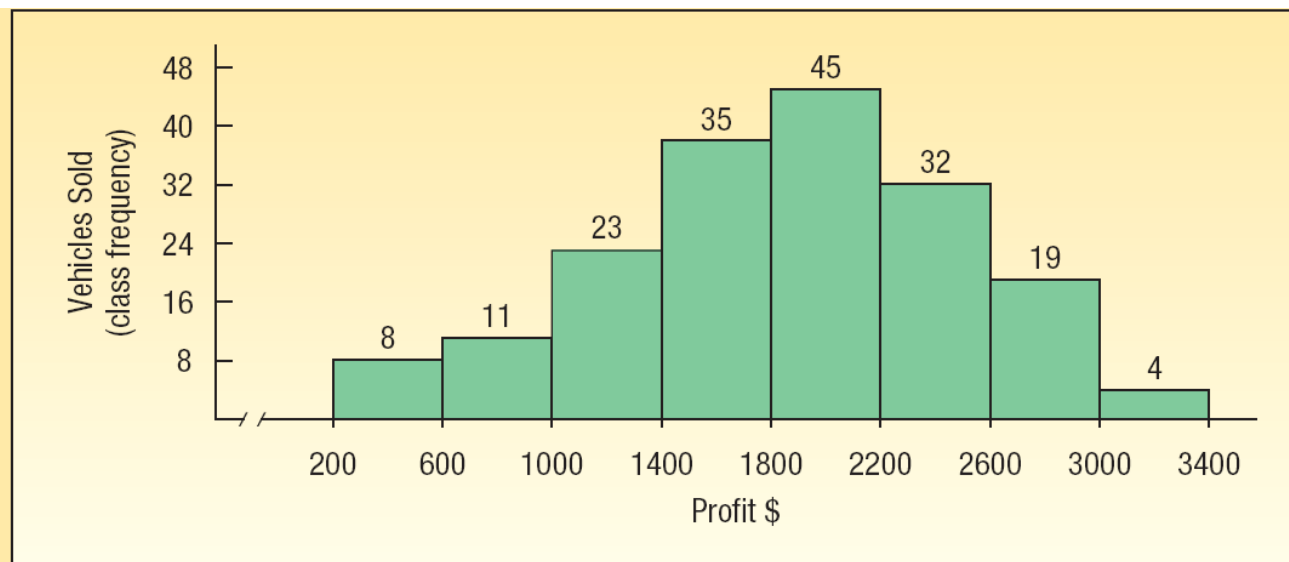
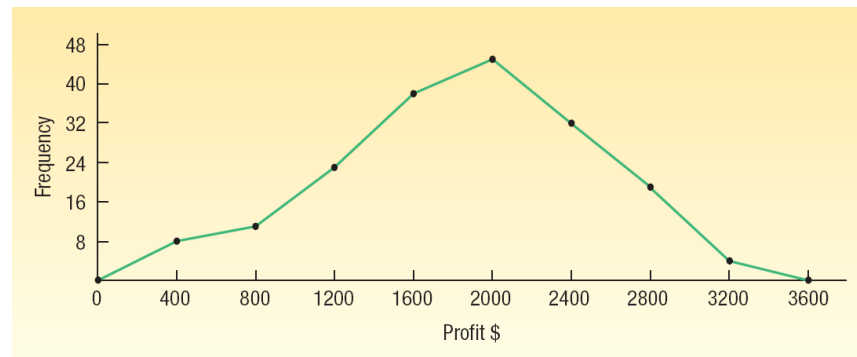


CHART 2-4 Histogram of the Profit on 180 Vehicles Sold at the Applewood Auto Group

Frequency Polygon

- A **frequency polygon** also shows the shape of a distribution and is similar to a histogram.
- It consists of line segments connecting the points formed by the intersections of the class midpoints and the class frequencies.

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

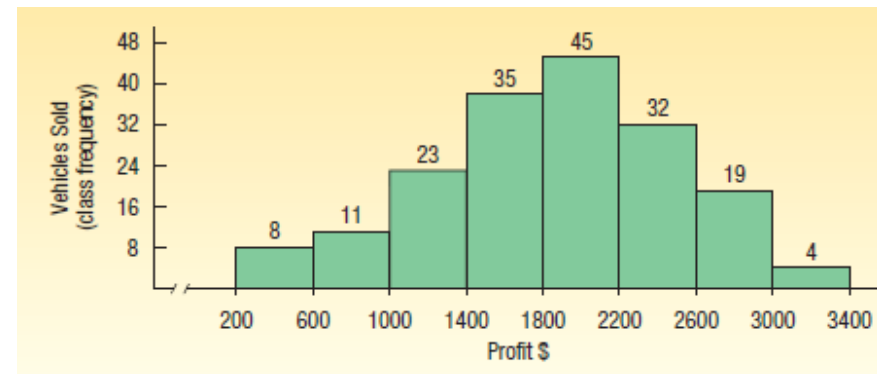


Histogram Versus Frequency Polygon

- Both provide a quick picture of the main characteristics of the data (highs, lows, points of concentration, etc.)
- The histogram has the advantage of depicting each class as a rectangle, with the height of the rectangular bar representing the number in each class.
- The frequency polygon has an advantage over the histogram. It allows us to compare directly two or more frequency distributions.



CHART 2-6 Distribution of Profit at Applewood Auto Group and Fowler Motors



Cumulative Frequency Distribution

TABLE 2-9 Cumulative Frequency Distribution for Profit on Vehicles Sold Last Month at Applewood Auto Group

Profit	Frequency	Cumulative Frequency	Found by
\$ 200 up to \$ 600	8	8	8
600 up to 1,000	11	19	8 + 11
1,000 up to 1,400	23	42	8 + 11 + 23
1,400 up to 1,800	38	80	8 + 11 + 23 + 30
1,800 up to 2,200	45	125	8 + 11 + 23 + 30 + 45
2,200 up to 2,600	32	157	8 + 11 + 23 + 30 + 45 + 32
2,600 up to 3,000	19	176	8 + 11 + 23 + 30 + 45 + 32 + 19
3,000 up to 3,400	4	180	8 + 11 + 23 + 30 + 45 + 32 + 19 + 4
Total	180		

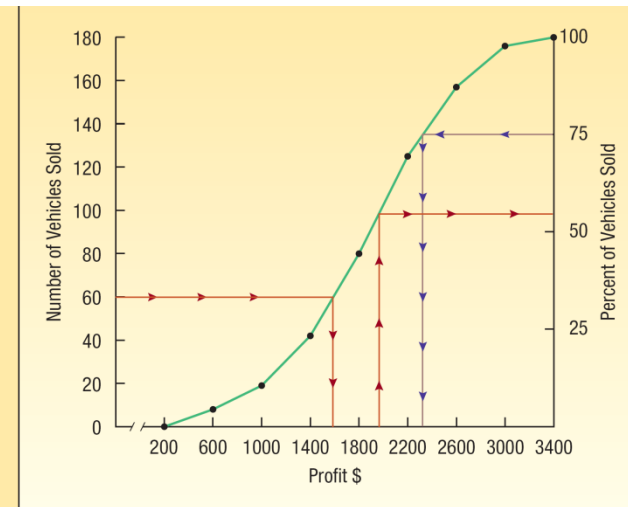


CHART 2-7 Cumulative Frequency Distribution for Vehicle Profit