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

Chapter 2

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GOALS

- Organize qualitative data into a frequency table.
- Present a frequency table as a bar chart or a pie chart.
- Organize quantitative data into a frequency distribution.
- Present a frequency distribution for quantitative data using histograms, frequency polygons, and cumulative frequency polygons.

Bar Charts

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.

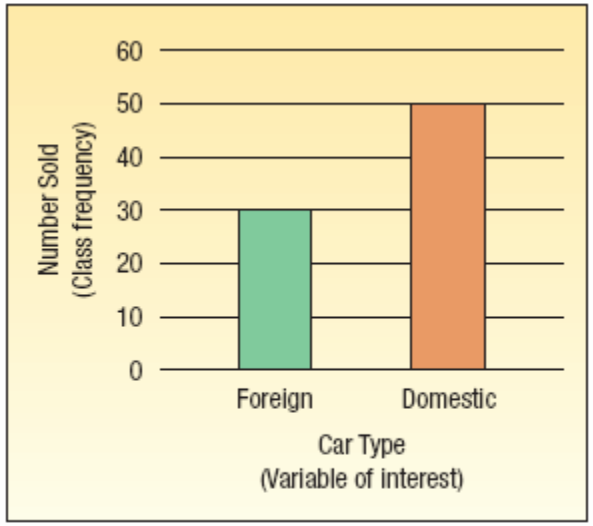

CHART 2–1 Vehicle Sold by Type Last Month At Whitner Autoplex

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Pie Charts

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

Use of Sales	Amount ($ million)	Percent of Share
Prizes	1,276.0	59
Payments to Education	648.1	30
Bonuses/Commissions	132.8	6
Operating Expenses	97.7	5
Total	2,154.6	100

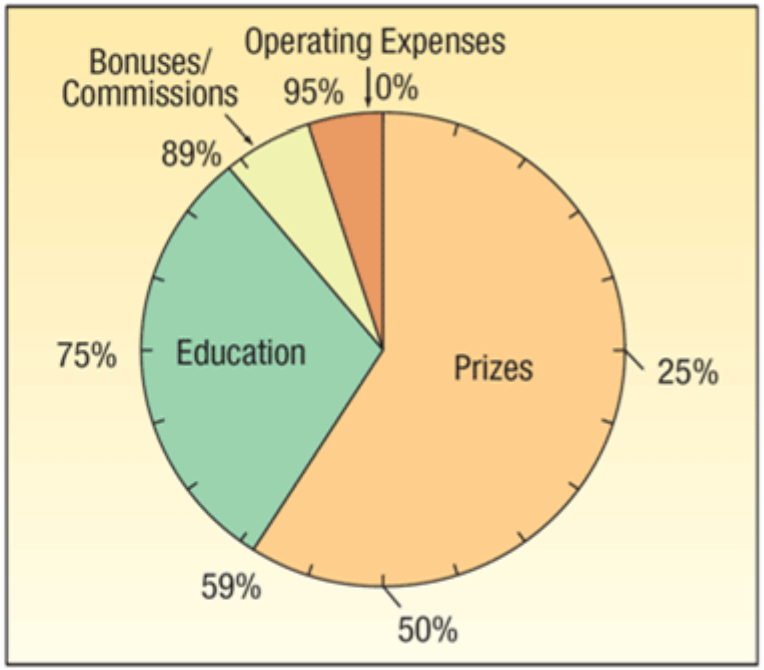
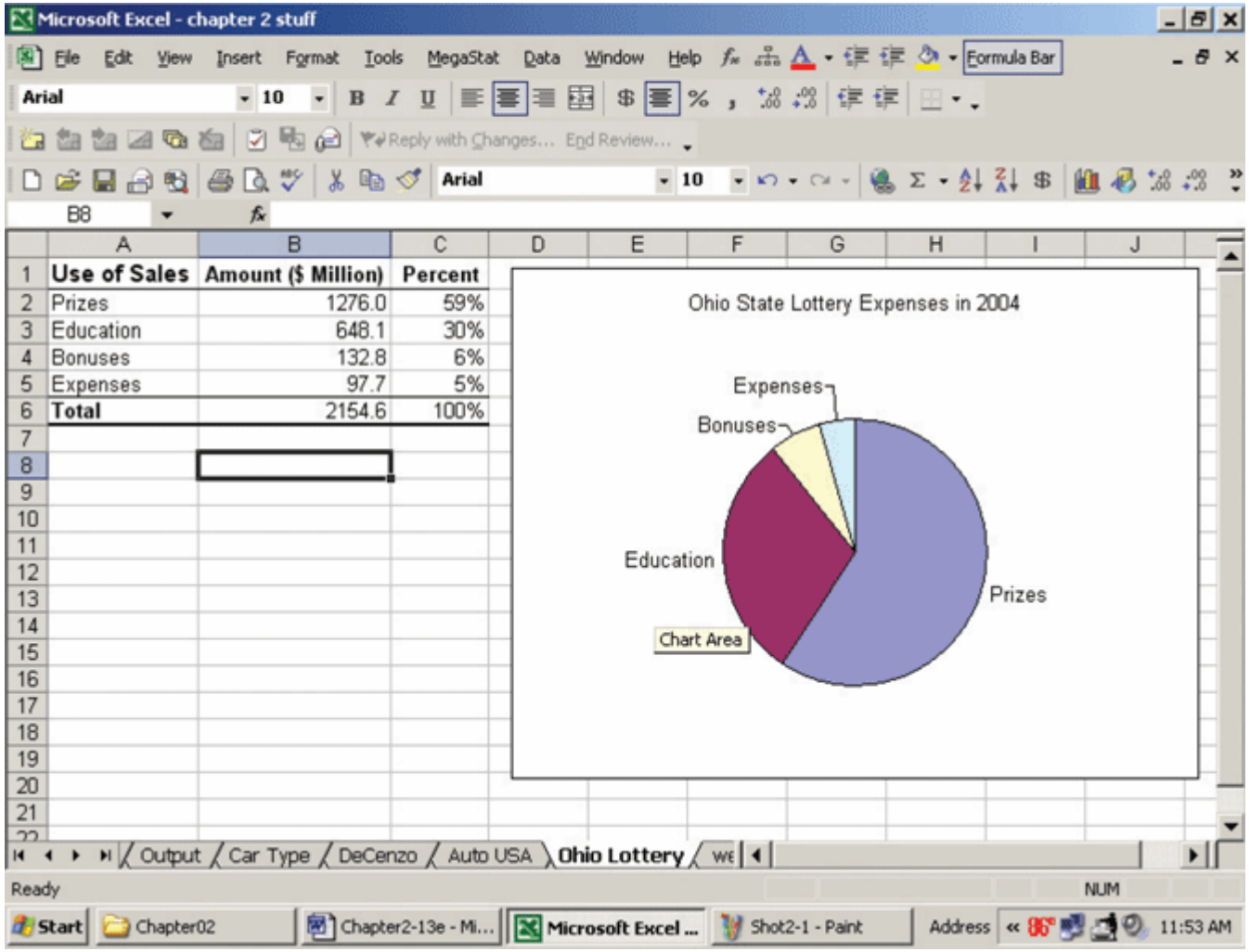


CHART 2–2 Pie Chart of Ohio Lottery Expenses in 2004

Pie Chart Using Excel



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Frequency Distribution

Selling Prices ($ thousands)	Frequency
15 up to 18	8
18 up to 21	23
21 up to 24	17
24 up to 27	18
27 up to 30	8
30 up to 33	4
33 up to 36	2
Total	80

A Frequency distribution is a grouping of data into mutually exclusive categories showing the number of observations in each class.

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Frequency Table

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

TABLE 2–1 Frequency Table for Vehicles Sold at Whitner Autoplex Last Month

Car Type	Number of Cars
Domestic	50
Foreign	30

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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	80	1.000

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Frequency Distribution

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

Class frequency: 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.

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EXAMPLE – Creating a Frequency Distribution Table

Ms. Kathryn Ball of AutoUSA 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 80 vehicles sold last month at Whitner Autoplex.

TABLE 2–4 Prices of Vehicles Sold Last Month at Whitner Autoplex

$23,197	$23,372	$20,454	$23,591	$26,651	$27,453	$17,266
18,021	28,683	30,872	19,587	23,169	35,851	19,251
20,047	24,285	24,324	24,609	28,670	15,546	15,935
19,873	25,251	25,277	28,034	24,533	27,443	19,889
20,004	17,357	20,155	19,688	23,657	26,613	20,895
20,203	23,765	25,783	26,661	32,277	20,642	21,981
24,052	25,799	15,794	18,263	35,925	17,399	17,968
20,356	21,442	21,722	19,331	22,817	19,766	20,633
20,962	22,845	26,285	27,896	29,076	32,492	18,890
21,740	22,374	24,571	25,449	28,337	20,642	23,613
24,220	30,655	22,442	17,891	20,818	26,237	20,445
21,556	21,639	24,296				

Lowest

Highest

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 80 vehicles sold. So $n = 80$. If we try $k = 6$, which means we would use 6 classes, then $2^6 = 64$, somewhat less than 80. Hence, 6 is not enough classes. If we let $k = 7$, then 2^7 128, which is greater than 80. So the recommended number of classes is 7.

- **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.

  ($35,925 - $15,546)/7 = $2,911

  Round up to some convenient number, such as a multiple of 10 or 100. Use a class width of $3,000

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Constructing a Frequency Table - Example

- **Step 3: Set the individual class limits**

$15,000 up to 18,000
18,000 up to 21,000
21,000 up to 24,000
24,000 up to 27,000
27,000 up to 30,000
30,000 up to 33,000
33,000 up to 36,000

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Constructing a Frequency Table

Class	Tallies
$15,000 up to $18,000	𝍸 III
$18,000 up to $21,000	𝍸 𝍸 𝍸 𝍸 III
$21,000 up to $24,000	𝍸 𝍸 𝍸 II
$24,000 up to $27,000	𝍸 𝍸 𝍸 III
$27,000 up to $30,000	𝍸 III
$30,000 up to $33,000	IIII
$33,000 up to $36,000	II

Selling Prices ($ thousands)	Frequency
15 up to 18	8
18 up to 21	23
21 up to 24	17
24 up to 27	18
27 up to 30	8
30 up to 33	4
33 up to 36	2
Total	80

- **Step 4: Tally the vehicle selling prices into the classes.**
- **Step 5: Count the number of items in each class.**

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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 the Prices of Vehicles Sold Last Month at Whitner Autoplex

Selling Price ($ thousands)	Frequency	Relative Frequency	Found by
15 up to 18	8	0.1000	8/80
18 up to 21	23	0.2875	23/80
21 up to 24	17	0.2125	17/80
24 up to 27	18	0.2250	18/80
27 up to 30	8	0.1000	8/80
30 up to 33	4	0.0500	4/80
33 up to 36	2	0.0250	2/80
Total	80	1.0000	

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Graphic Presentation of a Frequency Distribution

The three commonly used graphic forms are:

- Histograms
- Frequency polygons
- Cumulative frequency distributions

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Histogram

Histogram for a frequency distribution based on quantitative data is very similar to the bar chart showing the distribution of qualitative data. 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.

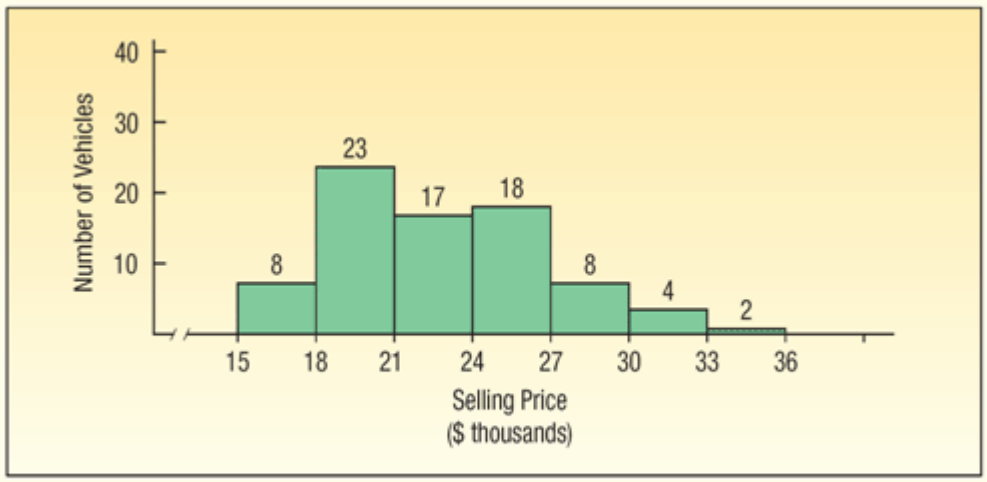

CHART 2–4 Histogram of the Selling Prices of 80 Vehicles at Whitner Autoplex

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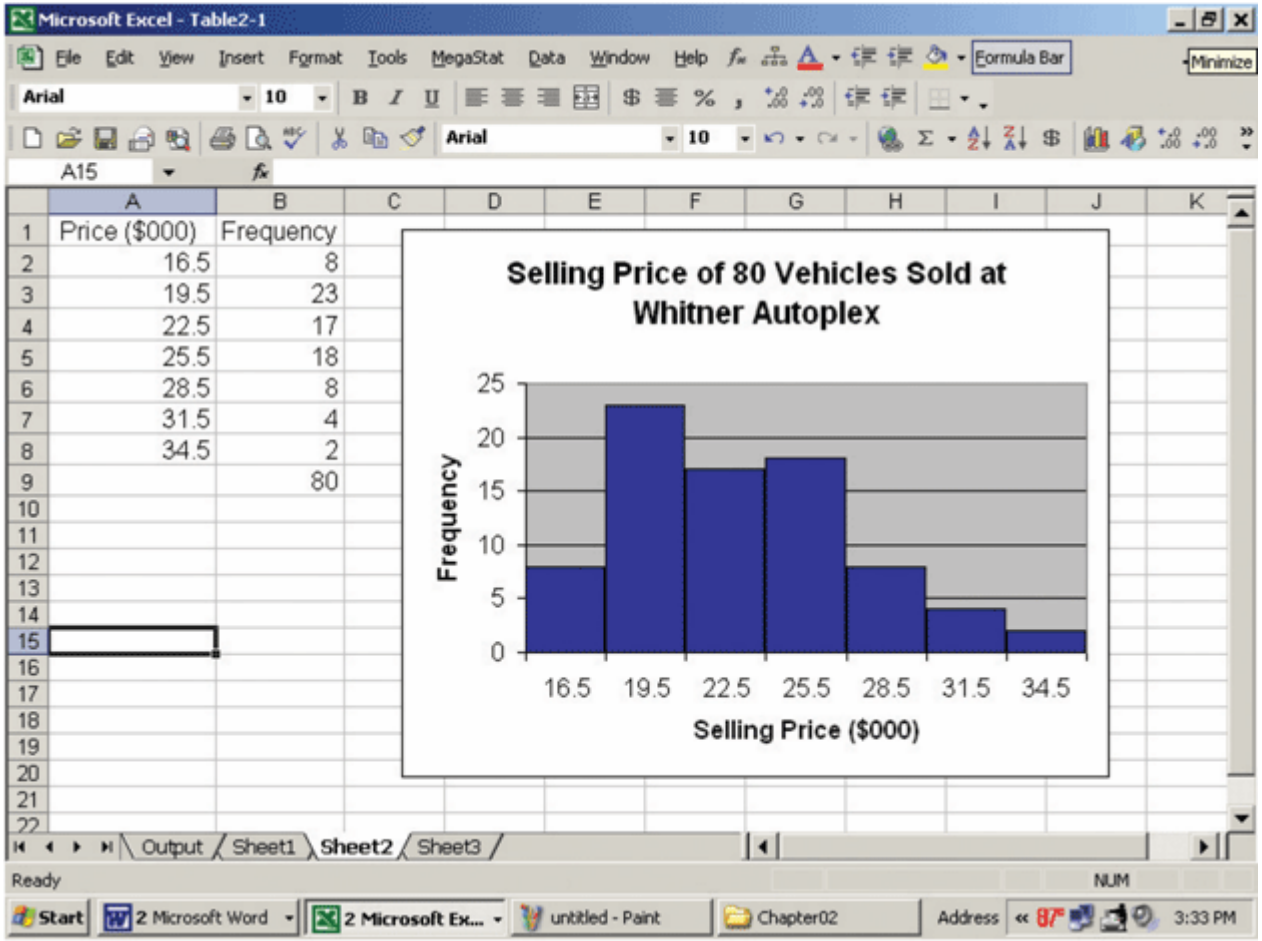
Histogram Using Excel



Price ($000)	Frequency
16.5	8
19.5	23
22.5	17
25.5	18
28.5	8
31.5	4
34.5	2
	80

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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.

Selling Price ($ thousands)	Midpoint	Frequency
15 up to 18	16.5	8
18 up to 21	19.5	23
21 up to 24	22.5	17
24 up to 27	25.5	18
27 up to 30	28.5	8
30 up to 33	31.5	4
33 up to 36	34.5	2
Total		80

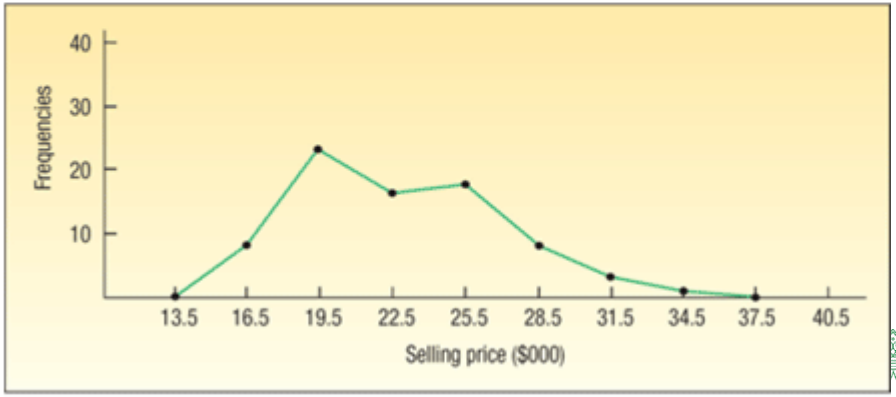

CHART 2–5 Frequency Polygon of the Selling Prices of 80 Vehicles at Whitner Autoplex

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Cumulative Frequency Distribution

TABLE 2–9 Cumulative Frequency Distribution for Vehicle Selling Price

Selling Price ($ thousands)	Frequency	Cumulative Frequency	Found by
15 up to 18	8	8	
18 up to 21	23	31	← 8 + 23
21 up to 24	17	48	8 + 23 + 17
24 up to 27	18	66	8 + 23 + 17 + 18
27 up to 30	8	74	⋮
30 up to 33	4	78	
33 up to 36	2	80	
Total	80		

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Cumulative Frequency Distribution

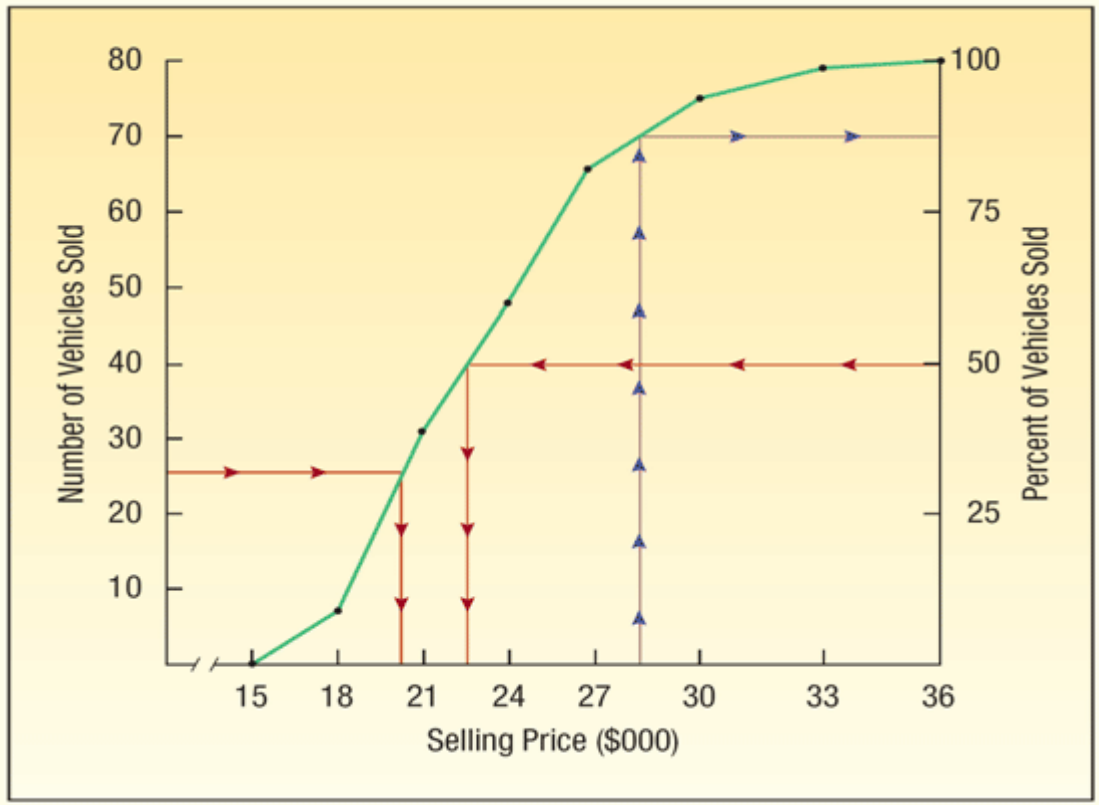

CHART 2–7 Cumulative Frequency Distribution for Vehicle Selling Price

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End of Chapter 2