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CONTEMPORARY BUSINESS MATHEMATICS

for Colleges



Deitz / Southam

24

Business Statistics

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Learning Objectives

By studying this chapter and completing all assignments, you will be able to:

Learning Objective

1

Compute the mean.

Learning Objective

2

Determine the median.

Learning Objective

3

Determine the mode.

Learning Objective

4

Construct frequency tables.

Learning Objective

5

Construct histograms.

Learning Objective

6

Construct bar graphs.

Learning Objective

7

Construct line graphs.

Learning Objective

8

Construct pie charts.

TERMS

- **Business statistics**
- **Statistics**
- **Purposes of statistics**
 - **To summarize and report performance**
 - **To analyze options in making decisions**
- **Average**
- **Mean**
- **Median**
- **Mode**

EXAMPLE

Statistical Averages: Computing the Mean

EXAMPLE A

Find the mean salary of five employees whose actual salaries are \$51,500, \$54,400, \$57,600, \$62,000, and \$64,500.

$$\text{Sum} = \$51,500 + \$54,400 + \$57,600 + \$62,000 + \$64,500 = \$290,000$$

$$\text{Mean} = \$290,000 \div 5 = \$58,000$$

EXAMPLE

Determining the Median

EXAMPLE B

Find the median salary of five employees whose salaries are \$51,500, \$54,400, \$57,600, \$62,000, and \$254,500.

The salaries are already in numerical order; the median is \$57,600 because it is the middle number of the five numbers arranged in order.

In example B, the mean is $\$480,000 \div 5 = \$96,000$, but \$96,000 is not representative of the salaries of the five employees. The mean is very large because one employee (perhaps the owner) has a very large salary compared to the rest of the group. The median salary, \$57,600, is more typical of the group.

If the number of values is even, the median will be halfway between the two middle values. The median will be the mean of the middle two values.

EXAMPLE

Determining the Mode

EXAMPLE D

Find the mode shoe size of 12 pairs of cross trainer running shoes, sizes 6, 6, $7\frac{1}{2}$, $7\frac{1}{2}$, 8, $8\frac{1}{2}$, 9, 9, 9, 9, 9, and $9\frac{1}{2}$.

The mode is size 9, because 9 occurs most frequently.

In example D neither the mean nor the median makes any sense. The mean is $98 \div 12 = 8.17$, or $8\frac{1}{6}$. The median is halfway between sizes $8\frac{1}{2}$ and 9, which would be 8.75, or $8\frac{3}{4}$. The store owner could not buy any shoes in either size $8\frac{1}{6}$ or size $8\frac{3}{4}$ because those shoe sizes do not exist. However, the store owner does want to stock several shoes in size 9.

STEPS

to Develop a Frequency Table

- 1. Determine the classes of data, and list the classes in one column.**
- 2. Tally the data by making one mark for each data item in the column next to the appropriate class.**
- 3. Count the tally marks for each class and write the number in the column next to the tally marks.**

Figure 24.1

Frequency Table

Class	Tally	Frequency (F)
\$40,000 up to \$45,000		5
\$45,000 up to \$50,000	II	7
\$50,000 up to \$55,000	I	6
\$55,000 up to \$60,000		4
\$60,000 up to \$65,000		+3
Total		<u>25</u>

STEPS

to Compute the Mean for a Large Data Set

- 1. Add all the numbers in each column.**
- 2. Add all the numbers in each row.**
- 3. Compute the grand total by adding all the column totals.**
- 4. Check the grand total by adding all the row totals.**
- 5. Divide the grand total by the number of values to get the mean.**

EXAMPLE F

Compute the mean of the 25 salaries in example E.

\$ 42,500	\$ 41,300	\$ 53,500	\$ 62,400	\$ 47,500	\$ 247,200
45,400	54,600	41,000	44,400	59,100	244,500
48,000	52,000	57,500	62,500	44,000	264,000
53,600	46,200	53,500	51,800	56,400	261,500
+ 55,500	+ 46,000	+ 45,200	+ 46,000	+ 60,800	+ 253,500
<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
\$245,000	\$240,100	\$250,700	\$267,100	\$267,800	\$1,270,700

The sum of the row totals and the sum of the column totals are both \$1,270,700.

$$\text{Mean} = \$1,270,700 \div 25 = \$50,828$$

Figure 24.2

Histogram

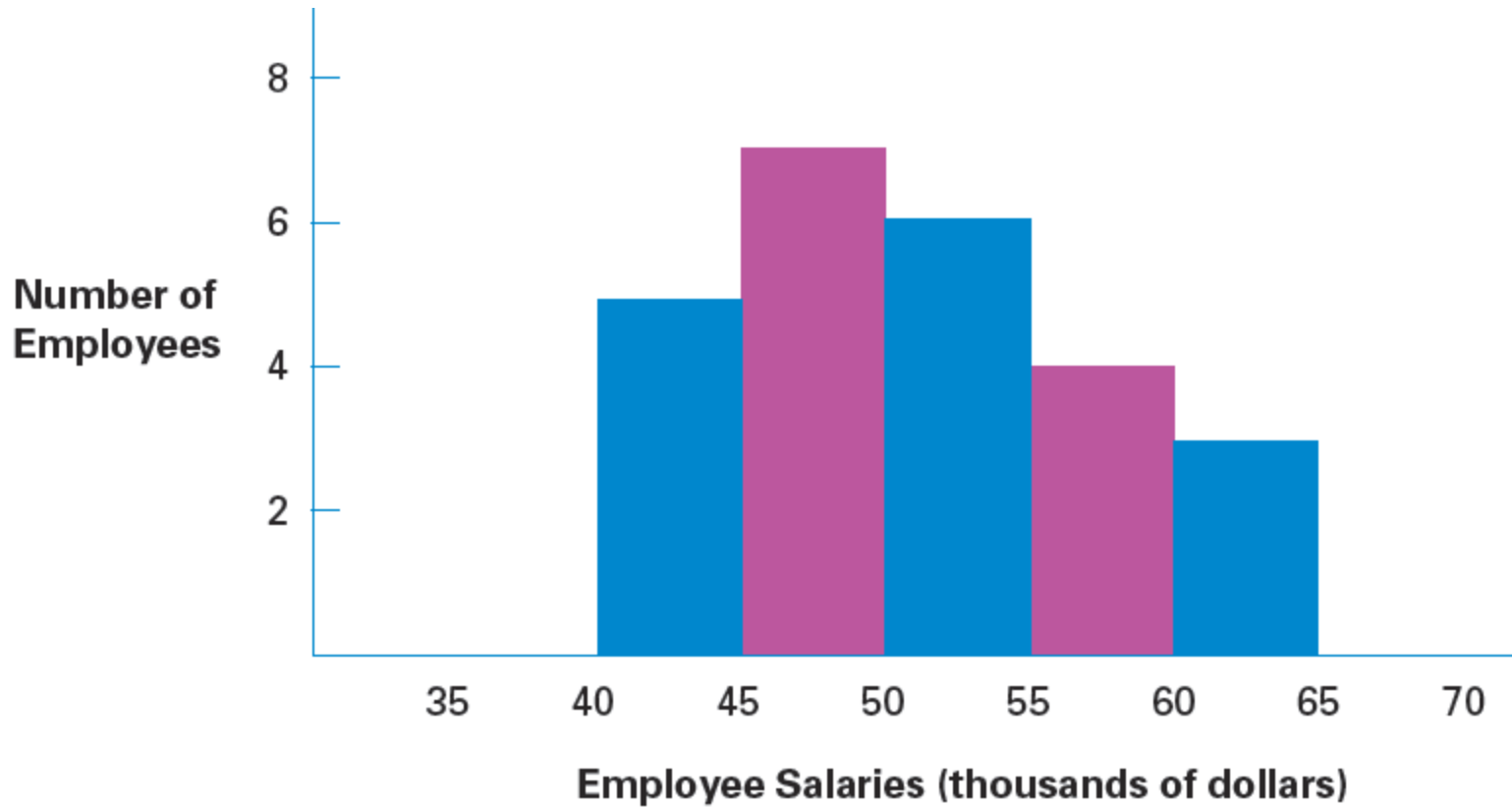


Figure 24.3

Revenues, Expenses, and Net Profits
(in millions of dollars)**SOSA'S MARKETS SALES DATA FOR THE
CURRENT YEAR (IN MILLIONS OF DOLLARS)**

Location	Sales Revenue	Cost of Goods Sold	Operating Expenses	Net Profit (This Year)	Net Profit (Last Year)
Davis	1.50	0.75	0.50	0.25	0.15
Hubbard	3.25	1.75	1.00	0.50	0.75
Bay View	2.00	1.00	0.75	0.25	0.50
Easton	4.00	2.00	1.25	0.75	0.50

Figure 24.4

Bar Graph

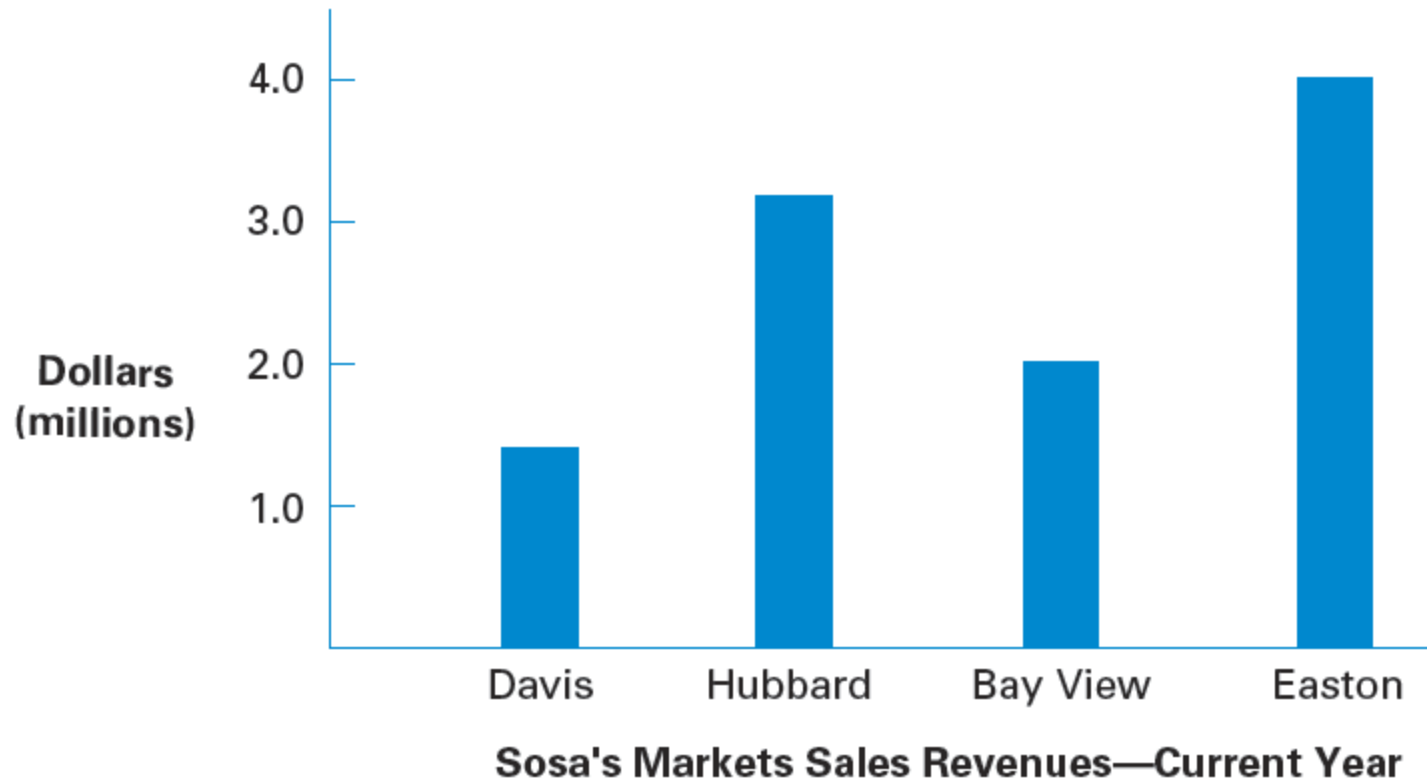


Figure 24.5

Comparative Bar Graph

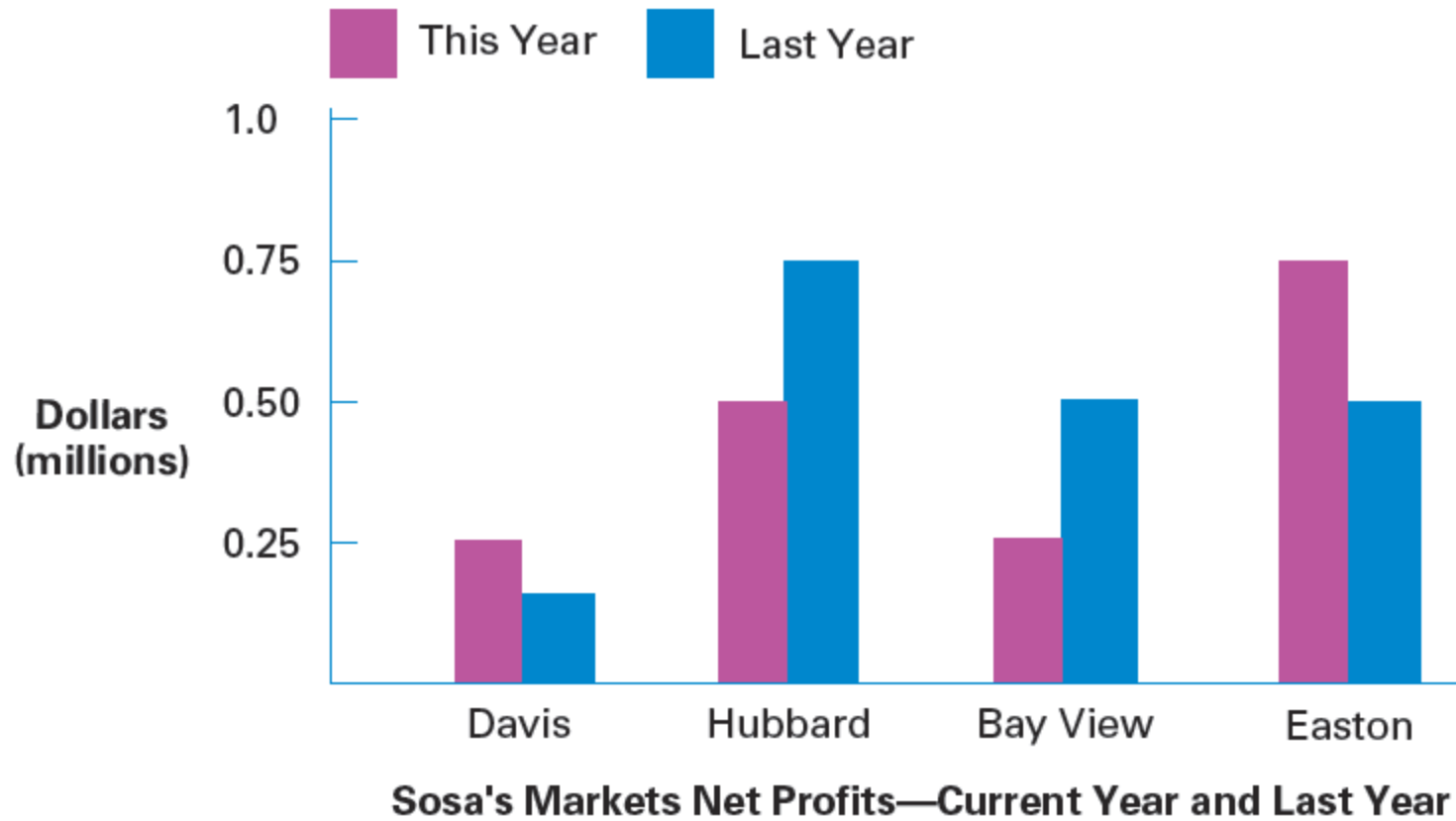


Figure 24.6

Component Bar Graph

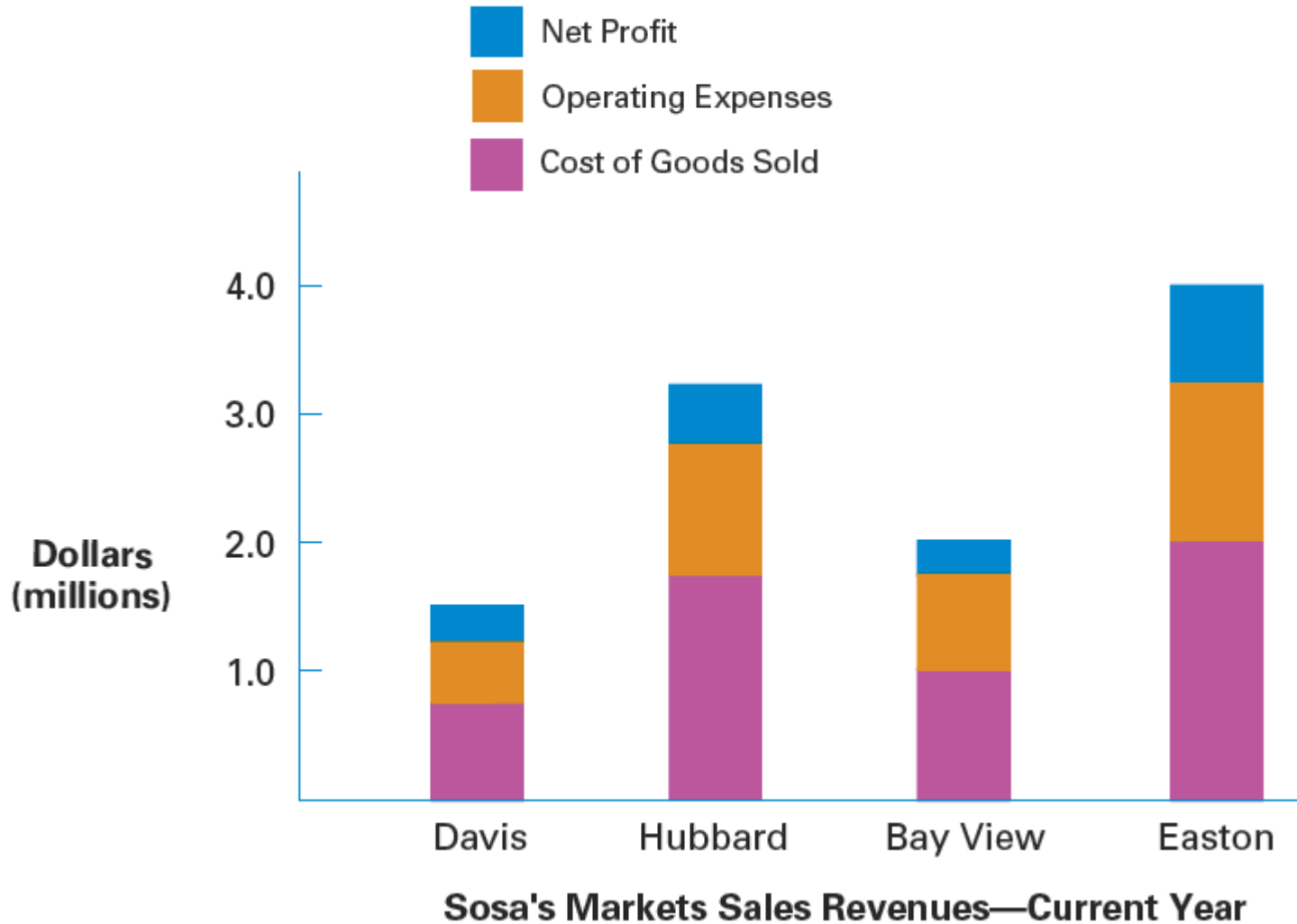


Figure 24.7

Comparative Bar Graph

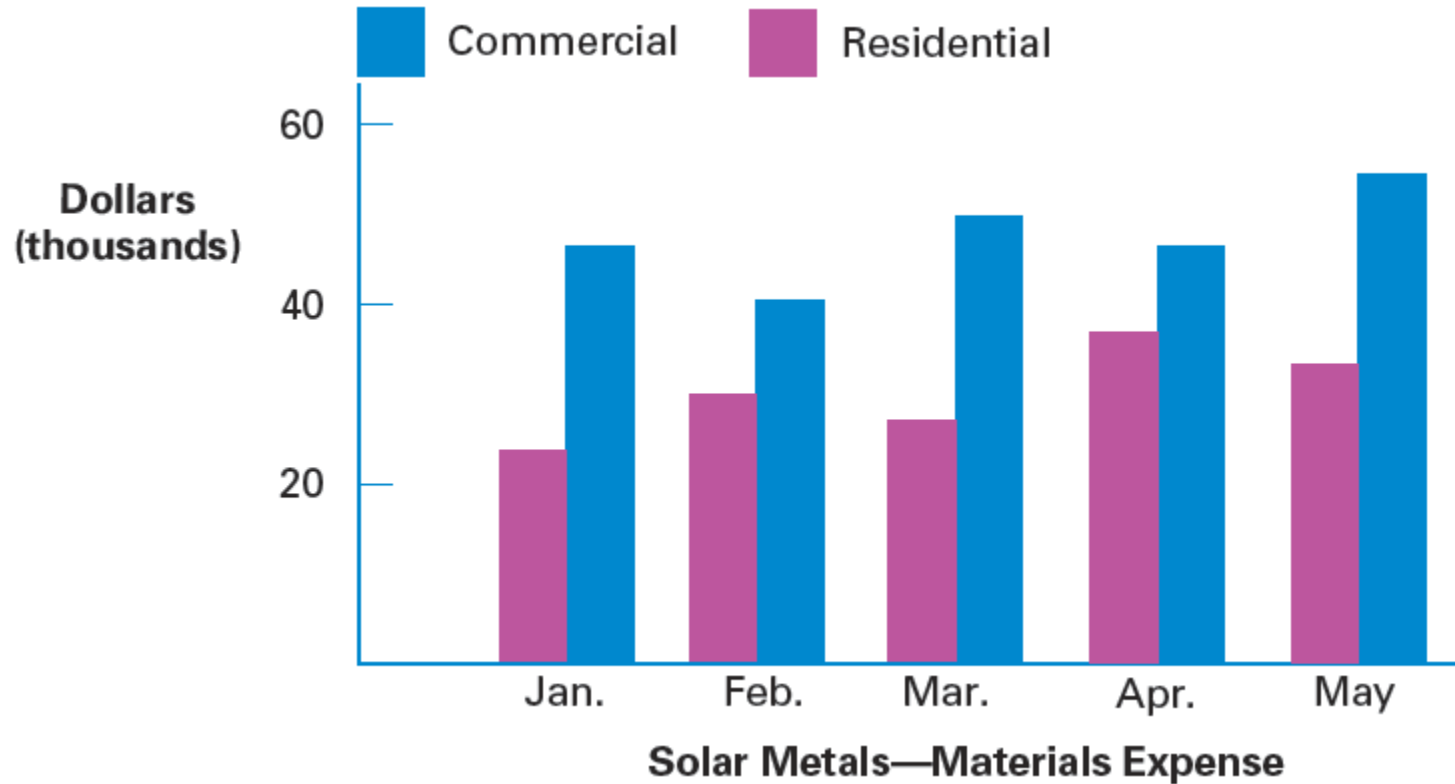


Figure 24.8

Line Graph

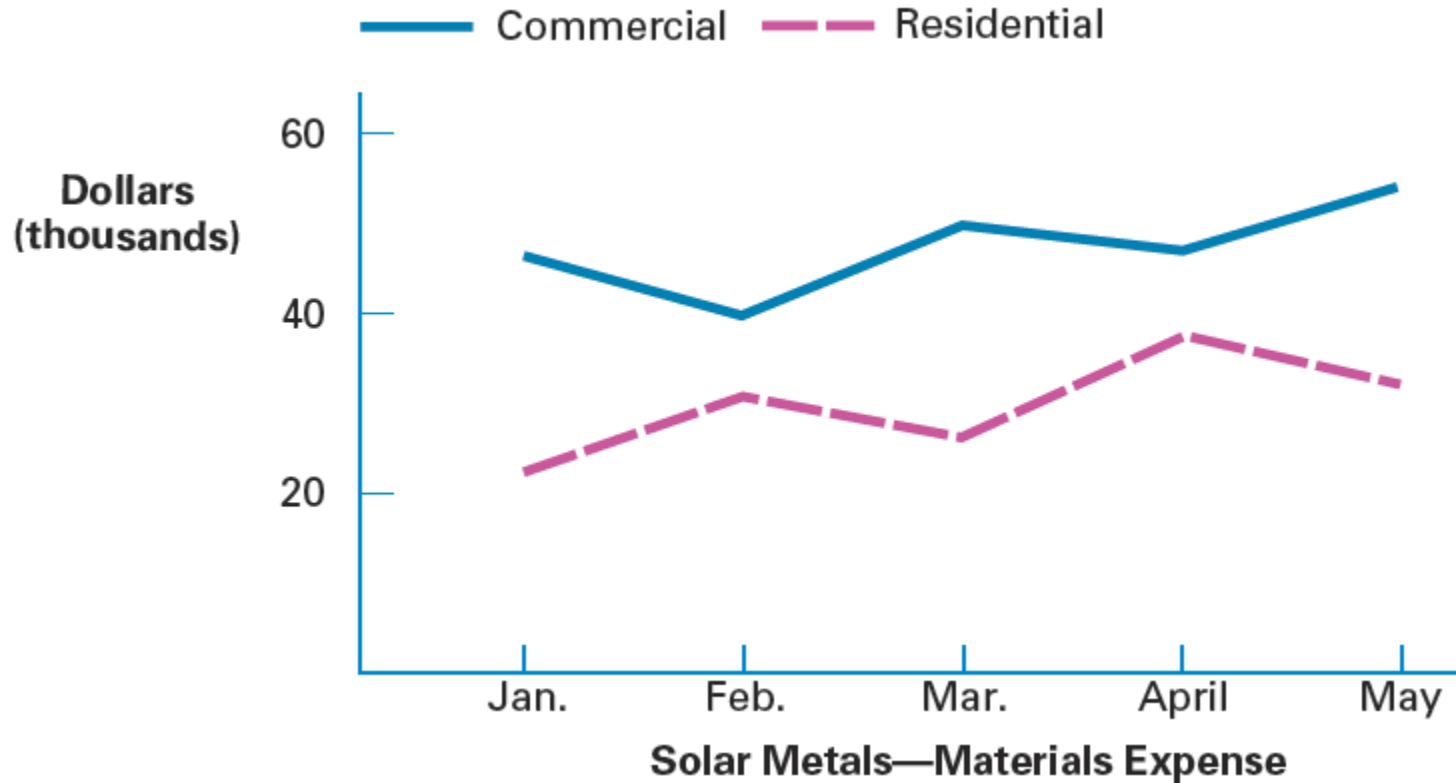


Figure 24.9

Histogram—Residential Division

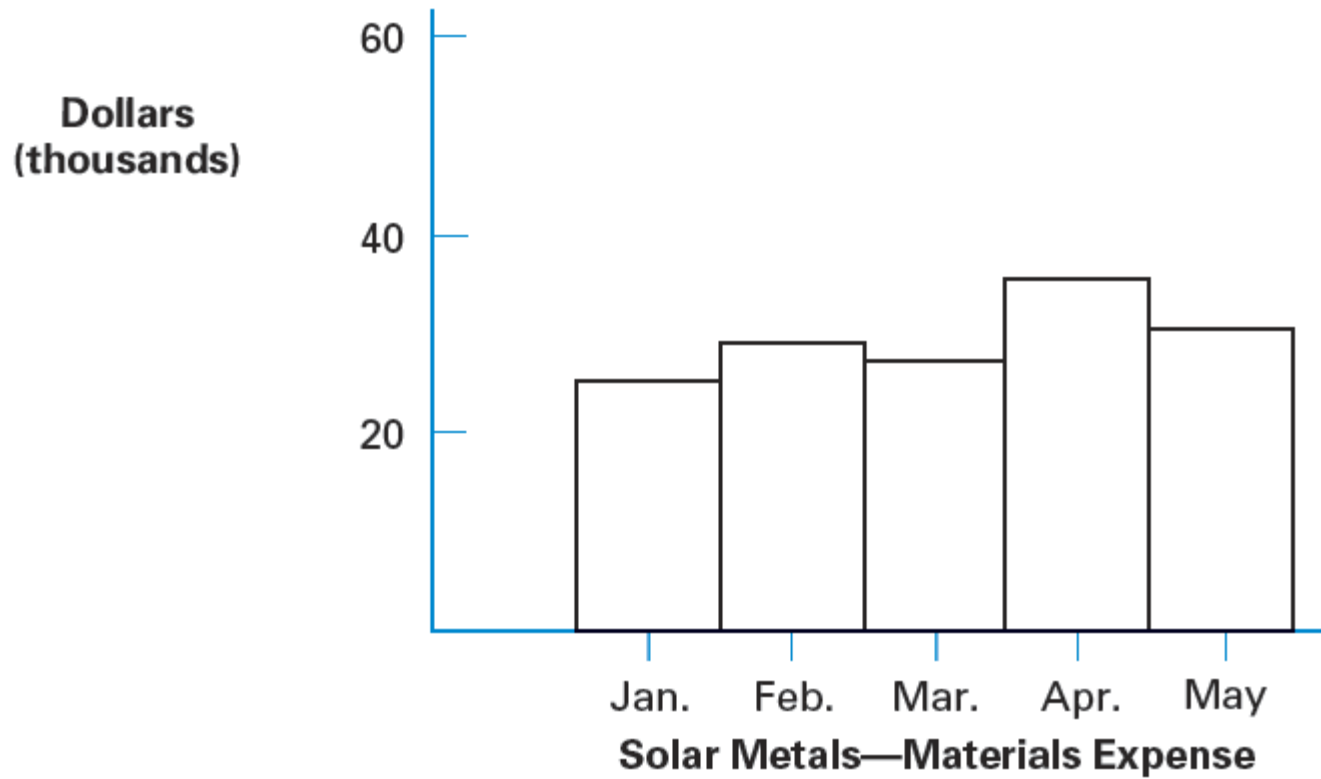


Figure 24.10

Histogram—Commercial Division

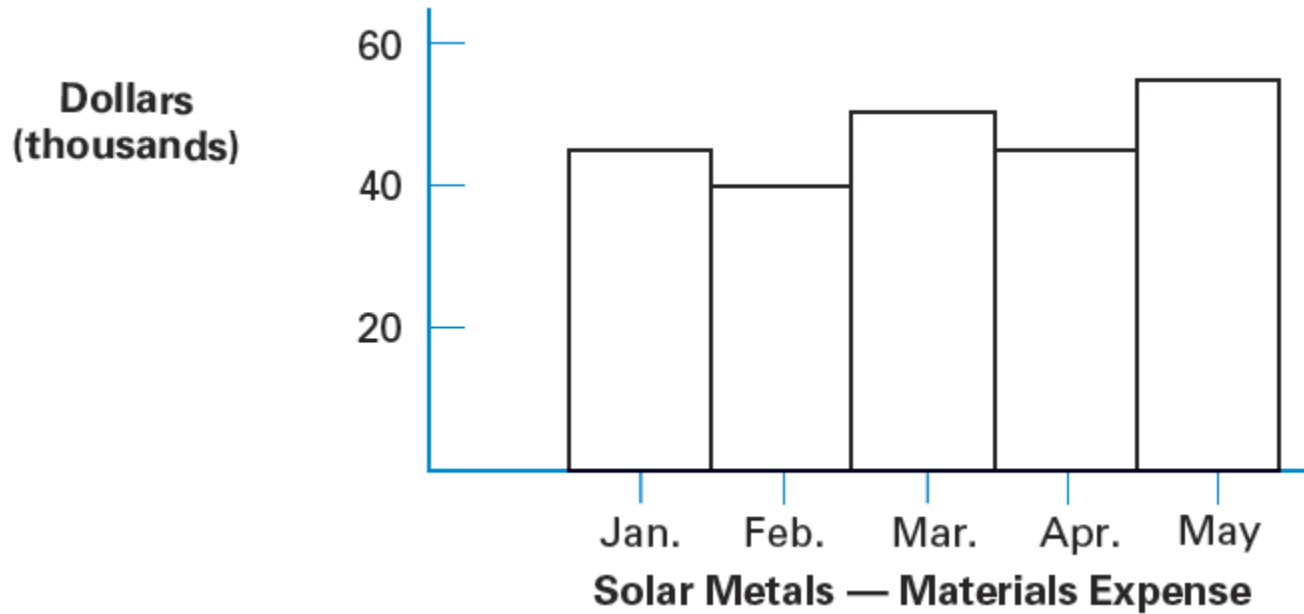


Figure 24.11

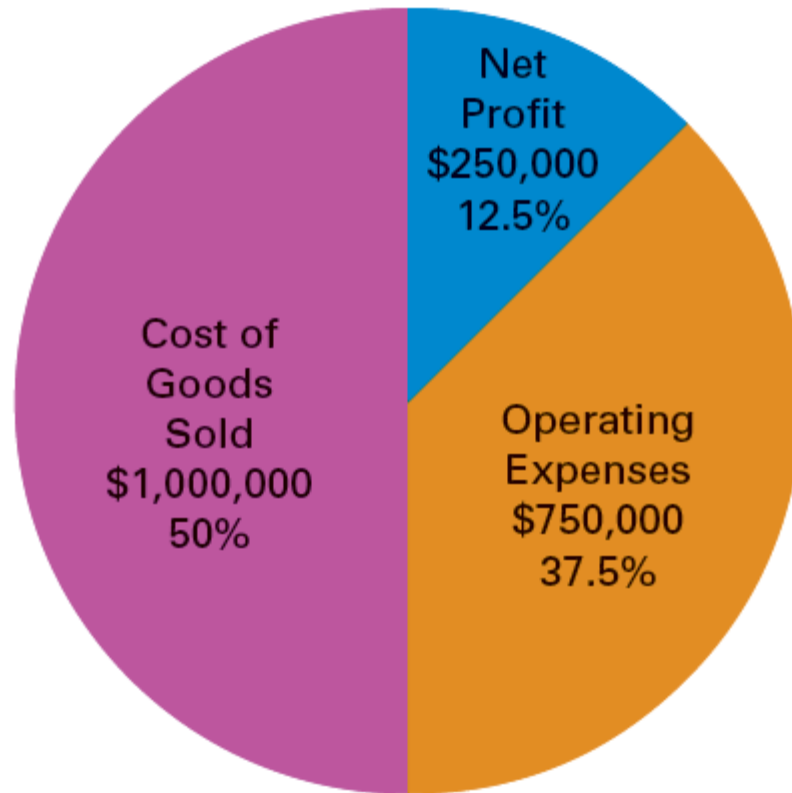
Sales Revenue for Bay View Market—Current Year

	Amount	Percent
Cost of Goods Sold	\$1,000,000	50.0%
Operating Expenses	750,000	37.5%
Net Profit Last Year	<u>+ 250,000</u>	<u>+ 12.5%</u>
Sales Revenue	\$2,000,000	100.0%

$$\$1,000,000 \div \$2,000,000 = 50.0\%$$

$$\$750,000 \div \$2,000,000 = 37.5\%$$

$$\$250,000 \div \$2,000,000 = 12.5\%$$



Bay View Market Sales Revenue—Current Year

Chapter Terms for Review

average

bar graph

business statistics

classes of data

comparative bar graph

component bar graph

frequency

frequency table

grouped data

histogram

line graph

mean

median

mode

pie chart

statistics

ungrouped data

Assignment 24.1: Statistical Averages

A Solve the following problems.

1. A department store has three local locations: Burch Plaza, Schaer Center, and Matthews Mall. The store gives every applicant for any type of managerial job a test of basic business skills. Listed here are the scores from the tests given to applicants at the three locations last week.

Burch Plaza	Schaer Center	Matthews Mall
59	89	64
88	60	44
62	89	53
47	55	77
68	46	58
88	74	43
78	64	77
59	89	82
45	<u>+46</u>	66
88		<u>+62</u>
<u>+87</u>		
<u>769</u>	<u>612</u>	<u>626</u>

- b. Combine all the scores into one frequency distribution with the classes as shown. (1 point for each correct answer)

Class	Tally	Frequency
40 up to 50	<u> </u>	<u>6</u>
50 up to 60	<u> </u>	<u>5</u>
60 up to 70	<u> </u>	<u>7</u>
70 up to 80	<u> </u>	<u>4</u>
80 up to 90	<u> </u>	<u>8</u>

Assignment 24.1: Statistical Averages

A Solve the following problems.

a. Find the mean, median, and mode for each location. (3 points for each correct answer)

	Burch	Schaer	Matthews
Sum	769	612	626
Mean	69.9	68	62.6
Median	68	64	63
Mode	88	89	77

Burch Plaza: 88, 88, 88, 87, 78, 68, 62, 59, 59, 47, 45

Schaer Center: 89, 89, 89, 74, 64, 60, 55, 46, 46

Matthews Mall: 82, 77, 77, 66, 64, 62, 58, 53, 44, 43

$$\text{Burch Plaza mean} = \frac{769}{11} = 69.9$$

$$\text{Schaer Center mean} = \frac{612}{9} = 68$$

$$\text{Matthews Mall mean} = \frac{626}{10} = 62.6$$

$$\text{Matthews Mall median} = \frac{64 + 62}{2} = \frac{126}{2} = 63$$

Assignment 24.1: Statistical Averages

A Solve the following problems.

2. Cirano Aguilar operates a popular coffee cart from which he also sells sandwiches. He has the opportunity to open another cart in the inner patio of a complex of office buildings, but he won't be allowed to sell sandwiches. Perform a statistical analysis on Cirano's sales receipts for nonsandwich items for the first 15 work days of May and October. (3 points for each correct answer)

May			October		
\$250	\$380	\$340	\$320	\$240	\$230
470	450	240	220	250	370
350	260	360	320	280	340
320	310	190	310	430	200
280	250	410	360	420	180

- a. Find the mean for May. \$324
- b. Find the mean for October. \$298
- c. Find the median for May. \$320
- d. Find the median for October. \$310
- e. Find the combined mean for all 30 days.
(Hint: Add the two sums and divide by 30.)
\$311

$$\text{May sum} = \$4,860; \text{ May mean} = \frac{\$4,860}{15} = \$324$$

May sales: 470, 450, 410, 380, 360, 350, 340, 320, 310, 280, 260, 250, 250, 240, 190

$$\text{May median} = \$320$$

$$\text{Oct. sum} = \$4,470; \text{ Oct. mean} = \frac{\$4,470}{15} = \$298$$

Oct: 430, 420, 370, 360, 340, 320, 320, 310, 280, 250, 240, 230, 220, 200, 180

$$\text{Oct. median} = \$310$$

$$\text{Combined mean} = \frac{\$4,860 + \$4,470}{30} = \$311 \text{ or, } \frac{\$324 + \$298}{2} = \$311$$

Assignment 24.1: Statistical Averages

B Solve the following problems.

3. Mingus Bank & Trust Co. has several retail branches. Bank management wants to compare the ages of personal banking customers at two specific branches—the Financial District Branch, downtown, and the University Branch, located in a residential area between the local university and a retirement community. The bank’s analyst randomly selects 30 personal banking customers from each bank and writes down their ages. The following two tables show the results.

Financial District Branch						University Branch					
43	30	43	51	60	227	74	82	46	19	20	241
68	32	72	52	27	251	21	36	73	57	18	205
28	73	43	19	64	227	54	17	18	75	84	248
70	35	56	55	31	247	76	22	24	19	68	209
63	24	47	44	34	212	27	21	75	34	18	175
52	61	66	57	58	294	81	64	22	60	70	297
324	255	327	278	274	1,458	333	242	258	264	278	1,375

- a. Compute the mean age of the group of customers from the Financial District Branch. (8 points) 48.6

$$\text{Mean} = 1,458 \div 30 = 48.6$$

- b. Compute the mean age of the group of customers from the University Branch. (8 points) 45.8

$$\text{Mean} = 1,375 \div 30 = 45.8$$

Assignment 24.1: Statistical Averages

B Solve the following problems.

- c. Make two frequency tables of customer ages, one for the Financial District Branch and one for the University Branch. For each table, use frequency classes 10 up to 20, 20 up to 30, . . . , 80 up to 90. (2 points for each correct row in each table)

Financial District Branch		
Class	Tally	Frequency
10 up to 20	I	1
20 up to 30	III	3
30 up to 40	III	5
40 up to 50	III	5
50 up to 60	III II	7
60 up to 70	III I	6
70 up to 80	III	3
80 up to 90		<u>+0</u>
Total		30

University Branch		
Class	Tally	Frequency
10 up to 20	III I	6
20 up to 30	III II	7
30 up to 40	II	2
40 up to 50	I	1
50 up to 60	II	2
60 up to 70	III	3
70 up to 80	III I	6
80 up to 90	III	<u>+3</u>
Total		30

Assignment 24.2: Graphs and Charts

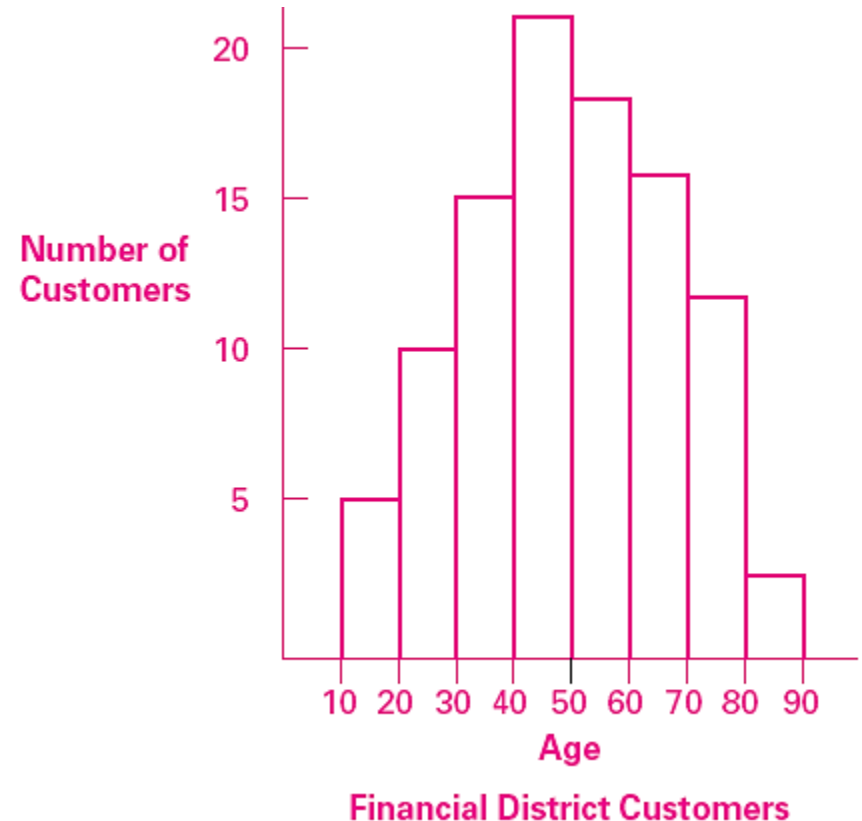
A Complete the following problem as directed.

1. After doing the initial research in problem 3 of Assignment 24.1, the analyst from Mingus Bank randomly selected 100 customers from the Financial District Branch and 100 customers from the University Branch. She found the age of each customer and summarized the data in the following two frequency tables.

Financial District Branch

<u>Class</u>	<u>Frequency</u>
10 up to 20	5
20 up to 30	10
30 up to 40	15
40 up to 50	21
50 up to 60	18
60 up to 70	16
70 up to 80	12
80 up to 90	+ 3
Total	100

- a. Draw a histogram for the Financial District Branch. Label each axis, and write a title under the graph.

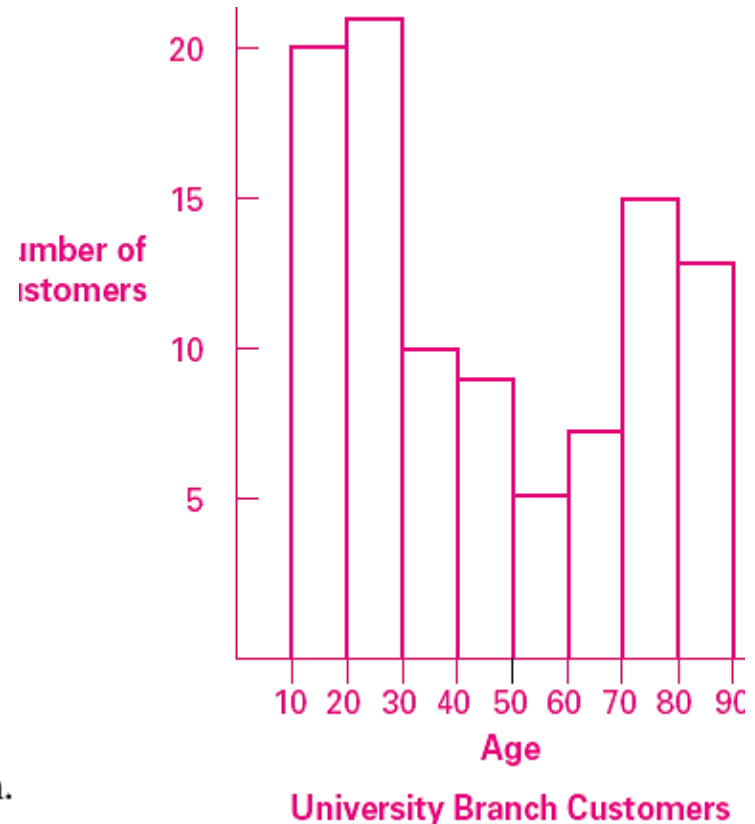


Assignment 24.2: Graphs and Charts

A Complete the following problem as directed.

1. After doing the initial research in problem 3 of Assignment 24.1, the analyst from Mingus Bank randomly selected 100 customers from the Financial District Branch and 100 customers from the University Branch. She found the age of each customer and summarized the data in the following two frequency tables.

University Branch	
Class	Frequency
10 up to 20	20
20 up to 30	21
30 up to 40	10
40 up to 50	9
50 up to 60	5
60 up to 70	7
70 up to 80	15
80 up to 90	<u>+13</u>
Total	100



- b. Draw a histogram for the University Branch.
Label each axis, and write a title under the graph.

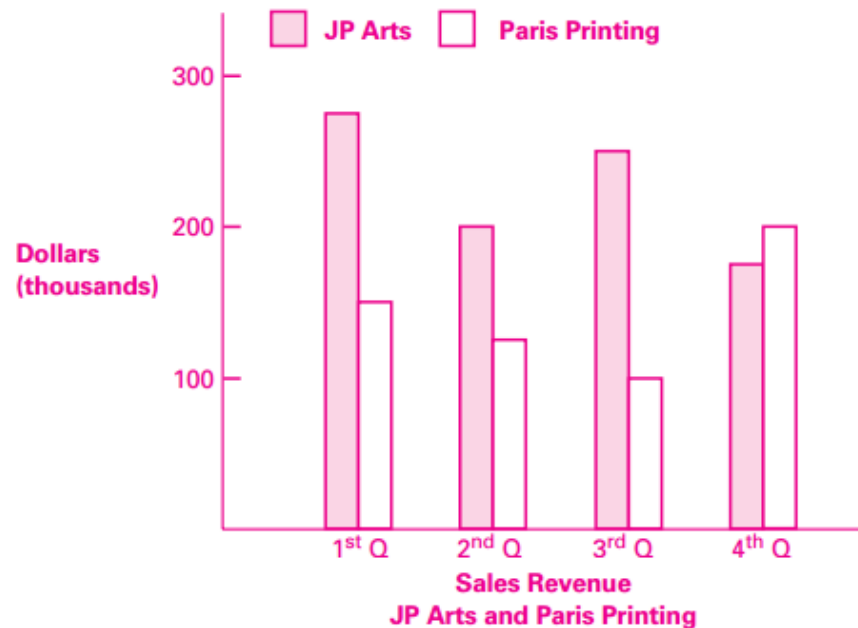
Assignment 24.2: Graphs and Charts

B Complete the following problem as directed.

2. Judy Paris owns two businesses that do both copying and custom printing. One, JP Industrial Arts, is in the central business district where she specializes in high-volume copying and artwork for both corporations and non-profits. The other, Paris Printing, is in a large residential subdivision where she does custom printing, like wedding invitations and greeting cards for individuals, and advertisements for small businesses. The following table shows Judy's quarterly sales revenues from last year.

Shop	1 st Q	2 nd Q	3 rd Q	4 th Q
JP Industrial Arts	\$275,000	\$200,000	\$250,000	\$175,000
Paris Printing	150,000	125,000	100,000	200,000

- a. Make a comparative bar graph showing the monthly sales revenue for each shop. Label each axis, and write a title under the graph. Shade the bars for each shop differently.



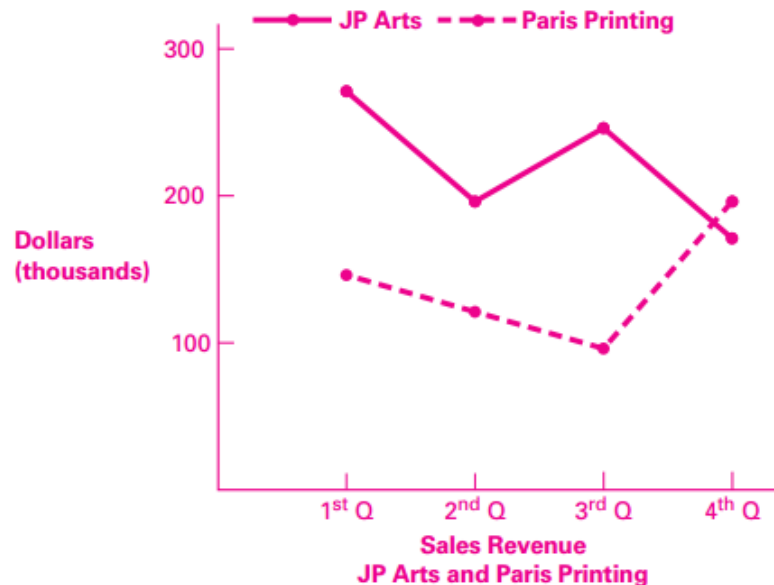
Assignment 24.2: Graphs and Charts

B Complete the following problem as directed.

2. Neta Gray owns two printing/copying businesses: Gray Printing and Copies by Neta. Gray Printing is near City Hall and does most of its work for corporations and government offices. Copies by Neta is in a residential district and does primarily printing and copying for individuals and small businesses. The following table shows sales revenues for the two shops for the first 4 months of the year.

Shop	January	February	March	April
Gray Printing	\$150,000	\$110,000	\$140,000	\$100,000
Copies by Neta	65,000	75,000	50,000	130,000

- b. On the same grid, make line graphs showing the monthly sales revenue for each shop. Label each axis, and write a title under the graph. Use a solid line for Gray Printing and a dashed line for Copies by Neta.

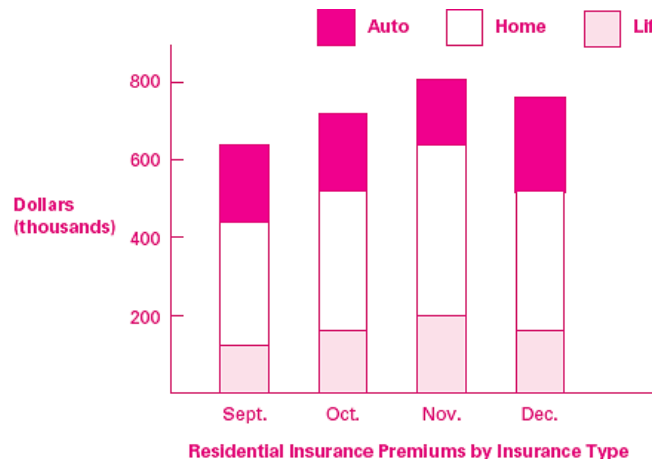


Assignment 24.2: Graphs and Charts

B Complete the following problem as directed.

3. RFP Insurance Brokers records the totals of residential (as opposed to commercial) insurance policy premiums billed each month. The results for the last 4 months of the year are shown classified by automobile insurance, homeowner's insurance, and life insurance. Construct a component bar graph showing the premiums for each insurance type each month. Label each axis, and write a title under the graph. Shade the three types of insurance differently.

Insurance Type	September	October	November	December
Auto	\$200,000	\$200,000	\$160,000	\$240,000
Home	320,000	360,000	440,000	360,000
Life	<u>+120,000</u>	<u>+160,000</u>	<u>+200,000</u>	<u>+160,000</u>
Total	\$640,000	\$720,000	\$800,000	\$760,000



Assignment 24.2: Graphs and Charts

C Complete the following problem.

4. ArielMedia.com is an Internet website selling primarily downloadable audio and video recordings, as well as some CDs and DVDs. For its own internal sales analysis, ArielMedia.com classifies every music sale as either Rock/Pop, Folk, Country Western, or Classical/Jazz. In December, ArielMedia.com had the music sales shown in the table below.

- a. Compute the percent of the total and the fraction of the total represented by each category of music. (2 points for each correct percent, 1 point for each correct fraction)

Music Type	Sales	Percent	Fraction
Rock/Pop	\$280,000	50%	$\frac{1}{2}$
Folk	70,000	12.5%	$\frac{1}{8}$
Country	140,000	25%	$\frac{1}{4}$
Classical/Jazz	+ 70,000	12.5%	$\frac{1}{8}$
Total	\$560,000	100.0%	$\frac{8}{8}$, or 1

$$\$280,000 \div \$560,000 = 0.50 \text{ or } 50\% \text{ or } \frac{1}{2}$$

$$\$70,000 \div \$560,000 = 0.125 \text{ or } 12.5\% \text{ or } \frac{1}{8}$$

$$\$140,000 \div \$560,000 = 0.25 \text{ or } 25\% \text{ or } \frac{1}{4}$$

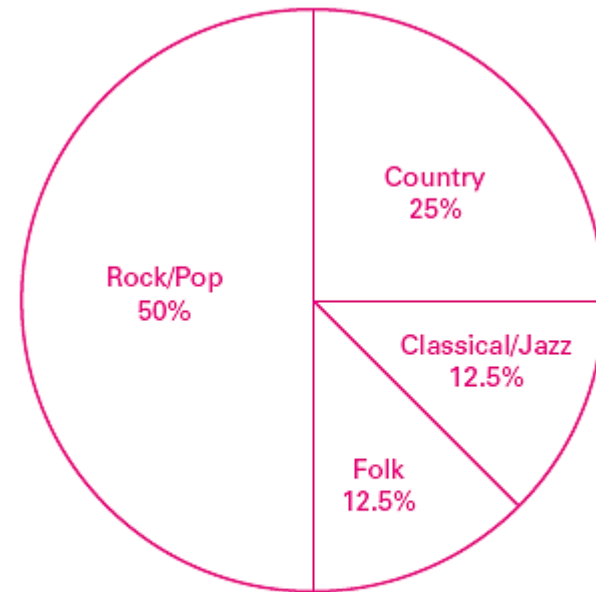
$$\$70,000 \div \$560,000 = 0.125 \text{ or } 12.5\% \text{ or } \frac{1}{8}$$

Assignment 24.2: Graphs and Charts

C Complete the following problem.

- b. Construct the pie chart to show the percent of total December music sales for each category of music. Label each section with the music category and percent and write a title under the graph. (8 points)

<u>Music Type</u>	<u>Sales</u>	<u>Percent</u>
Rock/Pop	\$280,000	<u>50%</u>
Folk	70,000	<u>12.5%</u>
Country	140,000	<u>25%</u>
Classical/Jazz	+ 70,000	<u>12.5%</u>
Total	<u>\$560,000</u>	100.0%



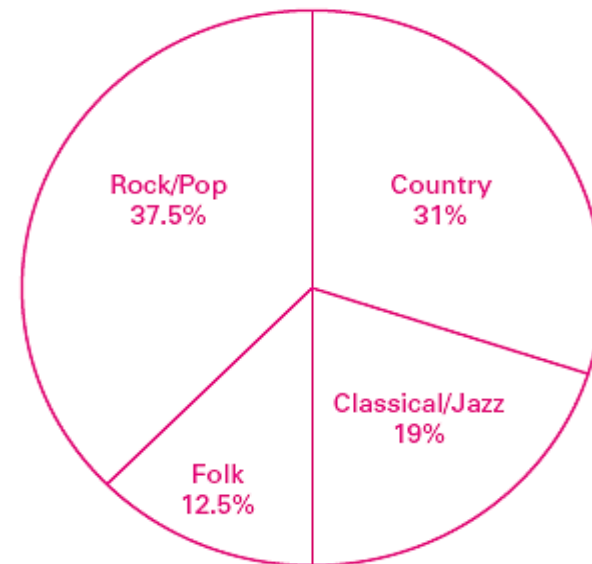
ArielMedia.com
December Music Sales

Assignment 24.2: Graphs and Charts

C Complete the following problem.

- c. The percents of music sales at ArielMedia.com for November are shown below. Construct an approximate pie chart to show the percent of total November sales for each category of music. Label each section with the music category and percent, and write a title under the graph. (*Hint: 37.5% is $\frac{3}{8}$; 12.5% is $\frac{1}{8}$; 31% is approximately between 25% and 37.5%; 19% is approximately between 12.5% and 25%.*) (8 points)

<u>Music Type</u>	<u>Percent</u>
Rock/Pop	37.5%
Folk	12.5%
Country	31%
Classical/Jazz	+ 19%
	<hr/> 100.0%



**ArielMedia.com
November Music Sales**