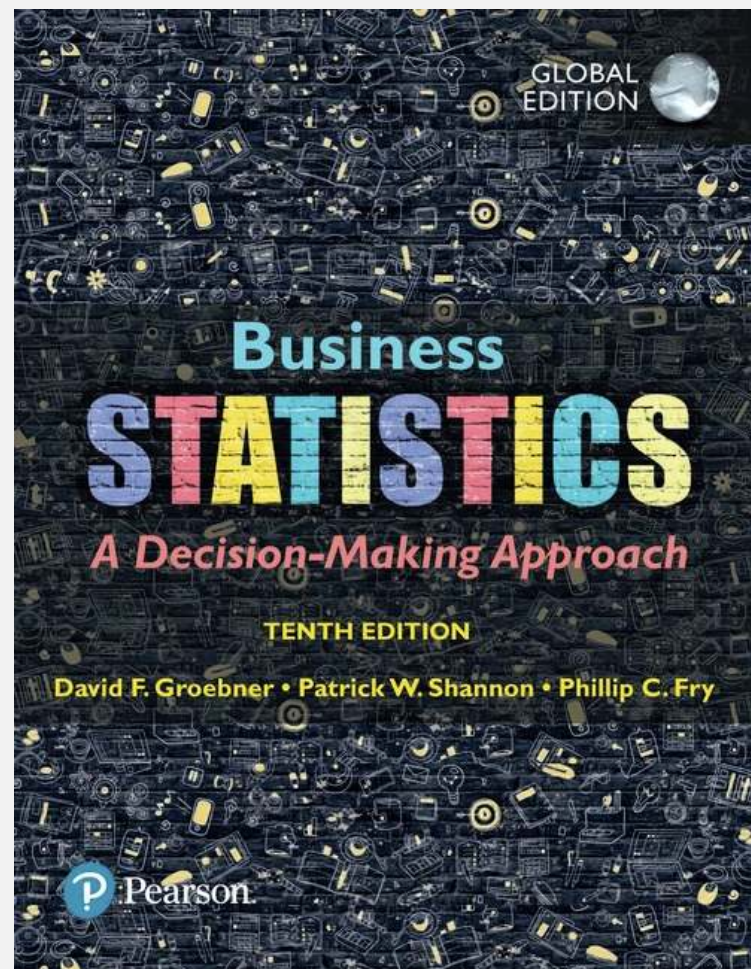


Chapter 2

Graphs, Charts, and Tables- Describing Your Data



Learning Outcomes

Outcome 1. Construct frequency distributions both manually and with your computer.

Outcome 2. Construct and interpret a frequency histogram.

Outcome 3. Develop and interpret joint frequency distributions.

Outcome 4. Construct and interpret various types of bar charts.

Outcome 5. Build a stem and leaf diagram.

Outcome 6. Create a line chart and interpret the trend in the data.

Outcome 7. Construct a scatter diagram and interpret it.



2.1 Frequency Distributions and Histograms

- Frequency Distribution

- A summary of a set of data that displays the number of observations in each of the distribution's distinct categories or classes

Student
Ages

20
18
22
19
19
18
23
25
19
18
21
21
22
23
19
18
21

Age	Frequency
18	4
19	4
20	1
21	3
22	2
23	2
24	0
25	1

Frequency Distributions

TABLE 2.1 Product Categories per Customer at the Dallas Walmart

4	2	5	8	8	10	1	4	8	3	4	1	1	3	4
1	4	4	5	4	4	4	9	5	4	4	10	7	11	4
10	2	6	7	10	5	4	6	4	6	2	3	2	4	5
5	4	11	1	4	1	9	2	4	6	6	7	6	2	3
6	5	3	4	5	6	5	3	10	6	5	7	7	4	3
8	2	2	6	5	11	9	9	5	5	6	5	3	1	7
6	6	5	3	8	4	3	3	4	4	4	7	6	4	9
1	6	5	5	4	4	7	5	6	6	9	5	6	10	4
7	5	8	4	4	7	4	6	6	4	4	2	10	4	5
4	11	8	7	9	5	6	4	2	8	4	2	6	6	6
6	4	6	5	7	1	6	9	1	5	9	10	5	5	10
5	4	7	5	7	6	9	5	3	2	1	5	5	5	5
5	9	5	3	2	5	7	2	4	6	4	4	4	4	4
6	5	8	5	5	5	5	5	2	5	5	6	4	6	5
5	7	10	2	2	6	8	3	1	3	5	6	3	3	6
5	4	5	3	3	7	9	4	4	5	10	6	10	5	9
4	3	8	7	1	8	4	3	1	3	6	7	5	5	5
4	7	4	11	6	6	3	7	9	4	4	2	9	7	5
1	6	6	8	3	8	4	4	1	9	3	9	3	4	2
9	5	5	7	10	5	3	4	7	7	6	2	2	4	4
4	7	3	5	4	9	2	3	4	3	2	1	6	4	6
1	8	1	4	3	5	5	10	4	4	4	6	9	2	7
9	4	5	3	6	5	5	3	4	6	5	7	3	6	8
3	6	1	5	7	7	5	4	6	6	6	3	6	9	5
4	5	10	1	5	5	7	8	9	1	6	5	6	6	4
10	6	5	5	5	1	6	5	6	4	7	9	10	2	6
4	4	6	11	9	5	4	4	3	5	4	6	2	6	7
3	5	6	7	4	5	4	6	9	4	3	3	6	9	4
3	7	5	6	11	4	4	8	4	2	8	2	4	2	3
6	5	1	10	5	9	5	4	5	1	4	9	5	4	4

Number of Different Product Categories Purchased by Walmart Customers

Create a Frequency Distribution



Frequency Distributions

TABLE 2.2 Dallas Walmart Product Categories Frequency Distribution

Number of Product Categories	Frequency
1	25
2	29
3	42
4	92
5	86
6	68
7	35
8	19
9	29
10	18
11	<u>7</u>
Total = 450	

Discrete Data

- Data that can take on a countable number of possible values
 - Examples
 - Student Ages
 - Walmart Customer Product Categories
 - Number of Late Deliveries Per Month
 - Number of Touchdowns Scored Per Game
 - Others?



Developing Frequency Distribution for Discrete Data

- **Step 1:** List the possible values

Number of Late Deliveries Per Month

2	1	3	2	1	0
3	5	2	1	2	3
0	3	2	2	2	4
4	2	0	1	2	3
3	2	1	3	2	0

Developing Frequency Distribution for Discrete Data

- **Step 1:** List the possible values.
- **Step 2:** Count the number of occurrences at each value.

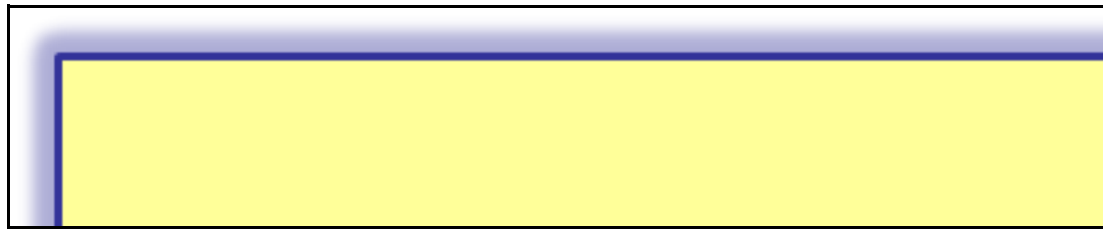
$$\frac{f_1 + \dots + f_n}{n}$$

Late Deliveries	Frequency
0	4
1	5
2	11
3	7
4	2
5	1

$$\leftarrow Rf = \frac{f}{n}$$

Relative Frequency

- **Step 3:** The proportion of total observations that are in a given category.



f_i - Frequency of the i^{th} value
 n - Total number of observations

k - The number of different values for the discrete variable

Relative Frequency Distribution

Number of Late Deliveries Per Month

Late Deliveries	Frequency	Relative Frequency
0	4	0.133
1	5	0.167
2	11	0.367
3	7	0.233
4	2	0.067
5	1	0.033
Total =	30	


$$\frac{4}{30} = .133$$

During 13.3% of the months, the company had 0 late deliveries.

Discrete Data Frequency Distribution

- Example:** An advertiser asks 200 customers how many days per week they read the daily newspaper.

Number of days read	Frequency	Relative Frequency
0	44	.22
1	24	.12
2	18	.09
3	16	.08
4	20	.10
5	22	.11
6	26	.13
7	30	.15
Total	200	1.00


$$\frac{18}{200} = .09$$

9% of the people in the sample report that they read the newspaper 2 days per week.

How to Do It in Excel 2016?

Excel 2016 Instructions

1. Open File: **SportsShoes.xlsx**.
2. Enter the Possible Values for the Variable; i.e., 0, 1, 2, 3, 4, etc.
3. Select the cells to contain the Frequency values.
4. Select the **Formulas** tab.
5. Click on the f_x button.
6. Select the **Statistical-FREQUENCY** function.
7. Enter the range of data and the bin range (the cells containing the possible number of shoes).
8. Press **Ctrl-Shift-Enter** to determine the frequency values.

FIGURE 2.1 Excel 2016 Output—Nike Shoes Frequency Distribution

Variable of Interest Number of Nike													
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Age	Annual Income	Pairs per Year	Pairs Now	Number Nike	Number Adidas	Brand Preference	Comfort	Advertising	Appearance	Price	Level of Activity	Gender
89	34	18,500	1	6	3	0	1	1	2	1	1	2	2
90	65	27,500	1	2	1	0	1	1	2	1	1	1	2
91	29	21,000	5	1	0	1	2	1	2	2	2	2	2
92	56	63,000	2	7	4	2	1	1	1	1	1	1	1
93	24	13,000	2	3	2	1	2	2	2	1	1	2	1
94	72	80,000	2	5	1	4	2	2	2	1	1	1	2
95	25	23,000	1	6	6	0	1	1	2	2	1	3	2
96	21	32,000	3	2	1	0	1	1	2	1	2	1	1
97	66	51,000	2	3	0	1	2	1	1	1	1	1	2
98	27	26,500	6	3	2			1	2	2	1	3	2
99	19	11,000	1	2				1	2	1	2	1	1
100	26	32,000	1	2	1			1	2	1	2	2	2
101	51	90,000	2	5	4	1	1	1	2	1	1	2	1
102													
103					Number of Nikes	Freq.							
104					0	27							
105					1	27							
106					2	20							
107					3	9							
108					4	6							
109					5	4							
110					6	4							
111					7	1							
112					8	2							

Frequency Distribution

Grouped Data Frequency Distributions

- Continuous data
 - data whose possible values are uncountable and that may assume any value in an interval (weight, length, time)
- Discrete data with many possible outcomes (income, stock prices, GPA's)
- Summarized in a grouped data frequency distribution
- Data are organized in classes.



Criteria for Building Classes

- Classes must be **mutually exclusive**.
 - Classes do not overlap.
- Classes must be **all-inclusive**.
 - A set of classes contains all possible data values.
- Classes should be of **equal width**, if possible.
 - The distance between the lowest and the highest possible values in each class is equal for all classes.
- Empty classes should be avoided.

Developing Frequency Distribution for Continuous Data

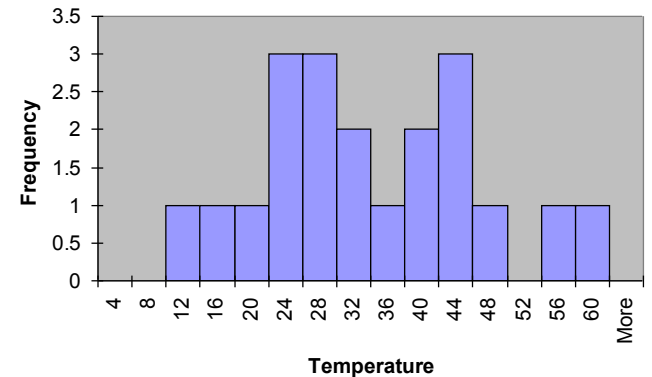
- **Step 1:** Determine the number of classes.
- **Step 2:** Establish the class width.
- **Step 3:** Determine the class boundaries for each class.
 - the upper and lower values of each class
- **Step 4:** Determine the class frequency for each class.
 - number of data points in each class



How Many Classes?

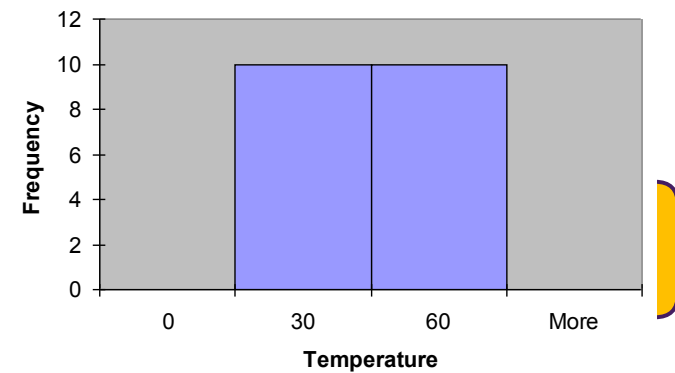
- **Too Many (Narrow class intervals)**

- May yield a very jagged distribution with gaps from empty classes
- Can give a poor indication of how frequency varies across classes



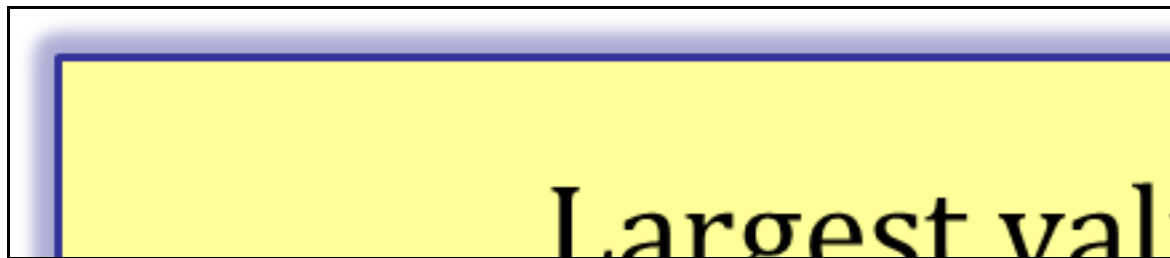
- **Too Few (Wide class intervals)**

- May compress variation too much and yield a blocky distribution
- Can obscure important patterns of variation



How Many Classes?

- Rule of thumb: between 5 and 20 classes
- $2k \geq n$ rule,
 - where k is the number of classes and is defined to be the smallest integer so that $2k \geq n$, where n is the number of data values
- The minimum class width:



Grouped Data Frequency Distributions

EXAMPLE 2-3

Frequency Distribution for Continuous Variables

Emergency Response Communication Links One of the major efforts of the U.S. Department of Homeland Security has been to improve the communication between emergency responders, like the police and fire departments. The communications have been hampered by problems involving linking divergent radio and computer systems, as well as communication protocols. While most cities have recognized the problem and made efforts to solve it, Homeland Security has funded practice exercises in 72 cities of different sizes throughout the United States. The data below are the times, in seconds, it took to link the systems.

35	339	650	864	1,025	1,261
38	340	655	883	1,028	1,280
48	395	669	883	1,036	1,290
53	457	703	890	1,044	1,312
70	478	730	934	1,087	1,341
99	501	763	951	1,091	1,355
138	521	788	969	1,126	1,357
164	556	789	985	1,176	1,360
220	583	789	993	1,199	1,414
265	595	802	997	1,199	1,436
272	596	822	999	1,237	1,479
312	604	851	1,018	1,242	1,492

72 Cities



Step 1: Determine the number of classes

- Rule of thumb: between 5 and 20 classes
- $2k \geq n$ rule,
 - where k is the number of classes and is defined to be the smallest integer so that $2k \geq n$, where n is the number of data values


$$2^7 = 128 \geq 72$$

Use 7 Classes.

2: Establish the Class Width

- The minimum class width:

$$W = \frac{\text{High Value} - \text{Low Value}}{\# \text{ of Classes}}$$

$$W = \frac{1,492 - 35}{7} = 208.1429$$

Round up to “Nicer” class width = 225



Step 3: Determine the Class Boundaries for Each Class

Class Boundaries

0	and under	225
225	and under	450
450	and under	675
675	and under	900
900	and under	1,125
1,125	and under	1,350
1,350	and under	1,575



Step 4: Determine the Class Frequency for Each Class

Time to Link Systems (in seconds)	Frequency
0 and under 225	9
225 and under 450	6
450 and under 675	12
675 and under 900	13
900 and under 1,125	14
1,125 and under 1,350	11
1,350 and under 1,575	7



More on Frequency Distributions

- **Cumulative Frequency Distribution**
 - a summary of a set of data that displays the number of observations with values less than or equal to the upper limit of each of its classes
- **Cumulative Relative Frequency Distribution**
 - a summary of a set of data that displays the proportion of observations with values less than or equal to the upper limit of each of its classes

Example: DVD Movies Owned

DVD Movies	Frequency	Relative Frequency	Cumulative Frequency	Cumulative Relative Frequency
0–3	60	0.261	60	0.261
4–7	50	0.217	110	0.478
8–11	47	0.204	157	0.683
12–15	40	0.174	197	0.857
16–19	18	0.078	215	0.935
20–23	8	0.035	223	0.970
24–27	6	0.026	229	0.996
28–31	1	0.004	230	1.000
Total = 230				

Frequency Histogram

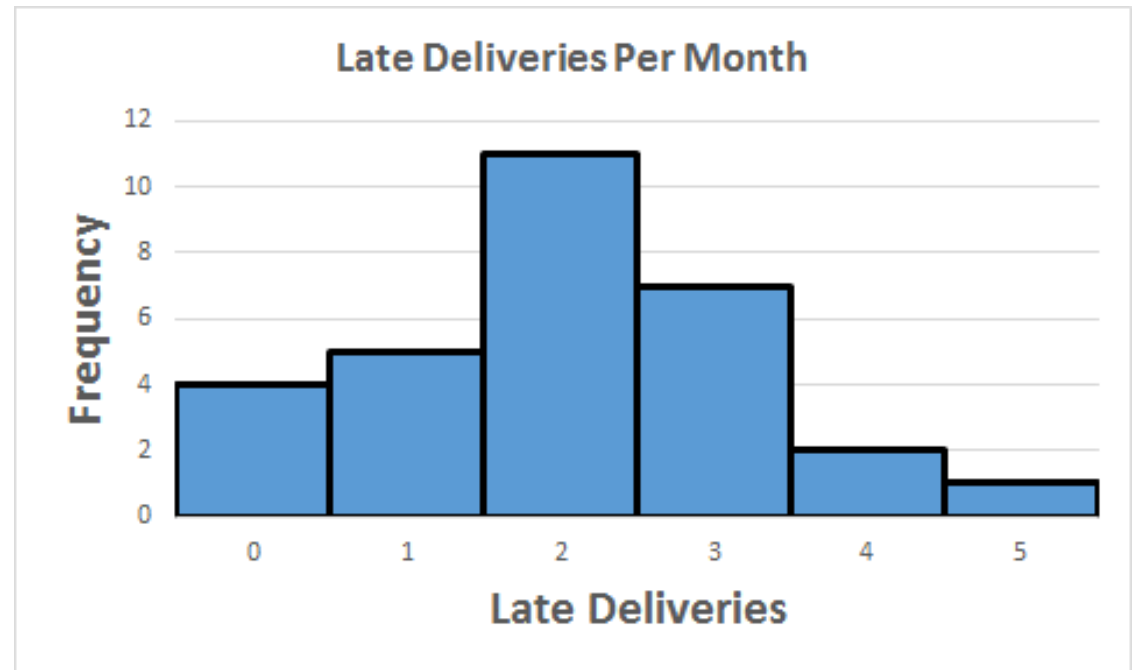
- A Graph That Displays a Frequency Distribution
 - Horizontal Axis Contains the Possible Outcomes for the Variable of Interest
 - Vertical Axis Shows the Frequency for Each Possible Outcome
 - No Gaps Between Bars

- Rectangle

Frequency Histogram

Number of Late Deliveries Per Month

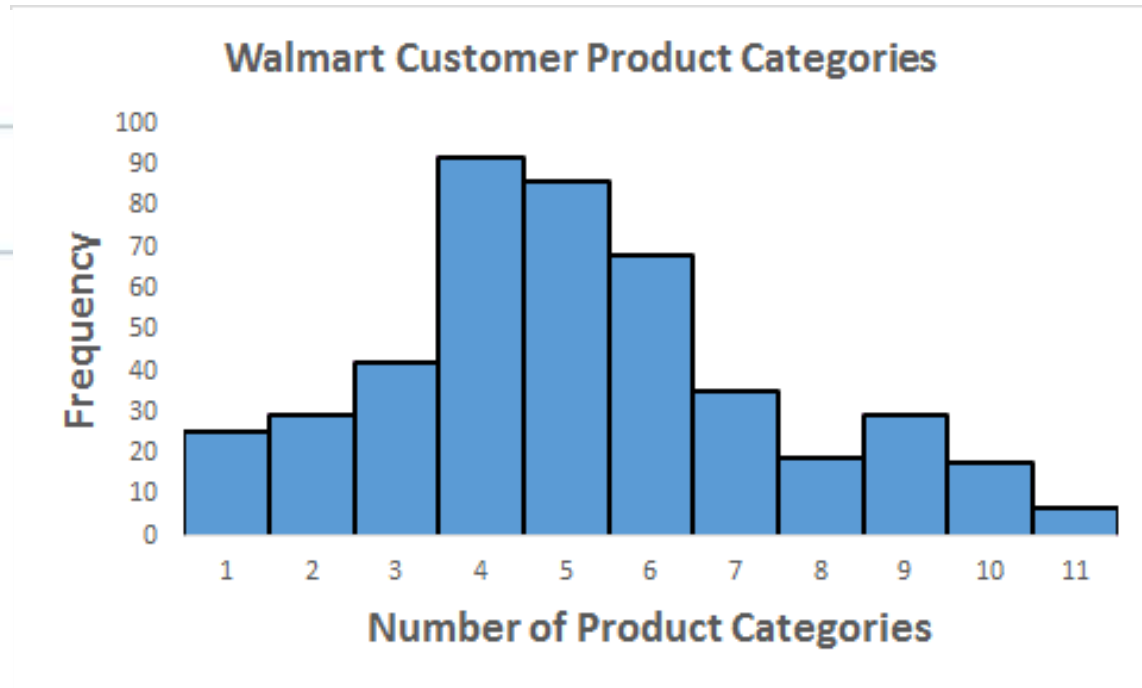
Late Deliveries	Frequency
0	4
1	5
2	11
3	7
4	2
5	1



Frequency Histogram

TABLE 2.2 Dallas Walmart Product Categories Frequency Distribution

Number of Product Categories	Frequency
1	25
2	29
3	42
4	92
5	86
6	68
7	35
8	19
9	29
10	18
11	7
Total = 450	



Histograms Provide Information

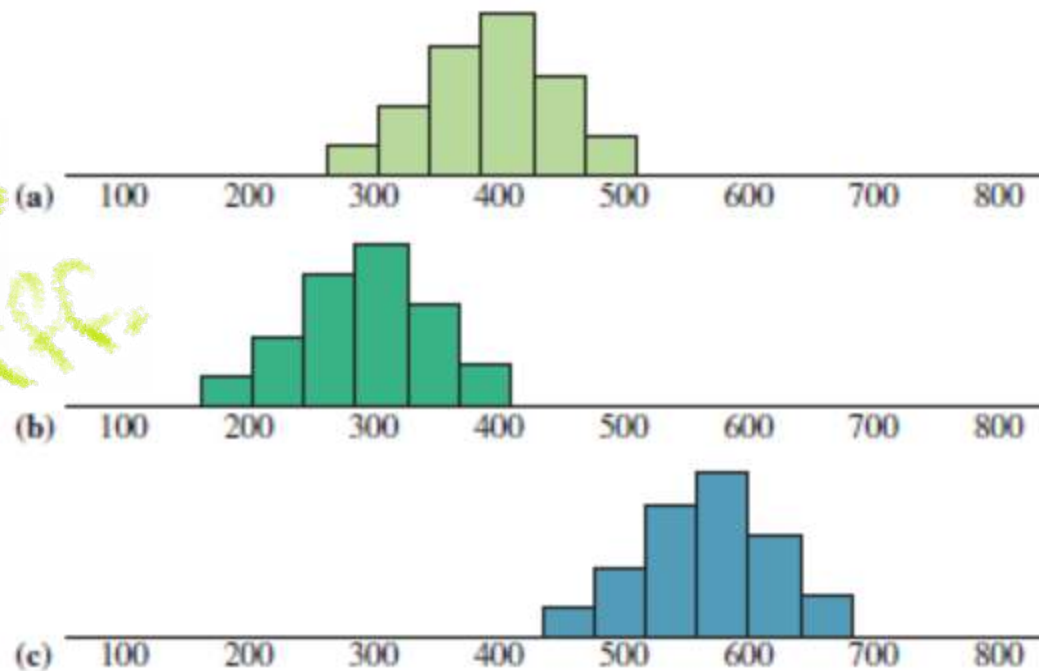
- Displays the Center of the Data
- Displays the Spread in the Data
- Displays the Shape of the Data



Histograms Provide Information

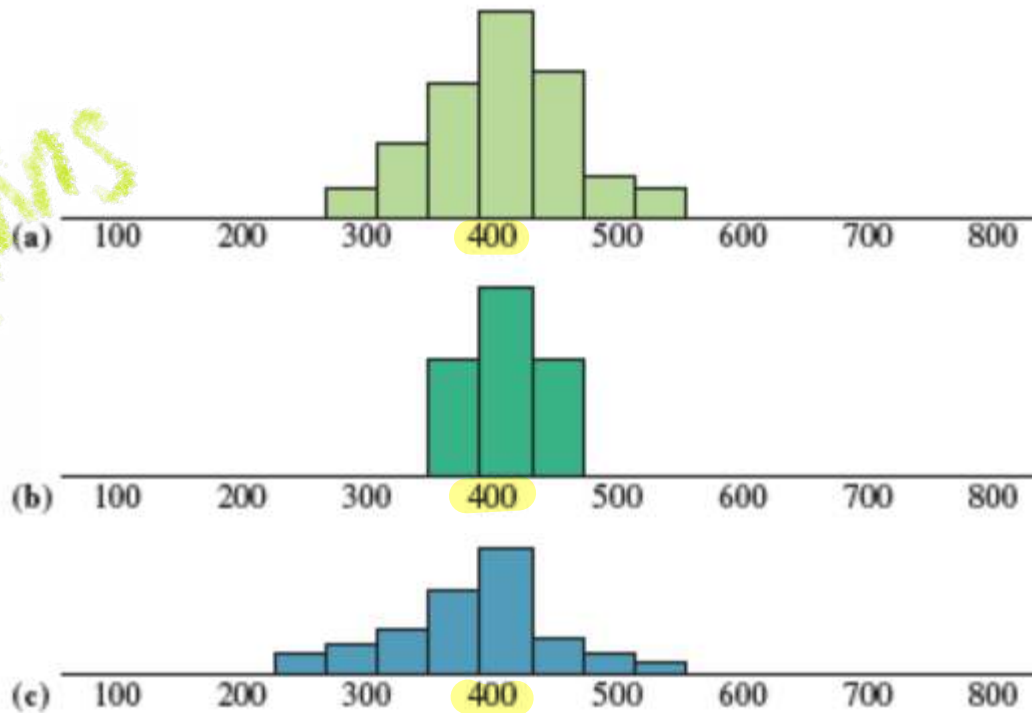
Same Spread – Same Shape – Different Centers

twins
with diff.
center



Histograms Provide Information

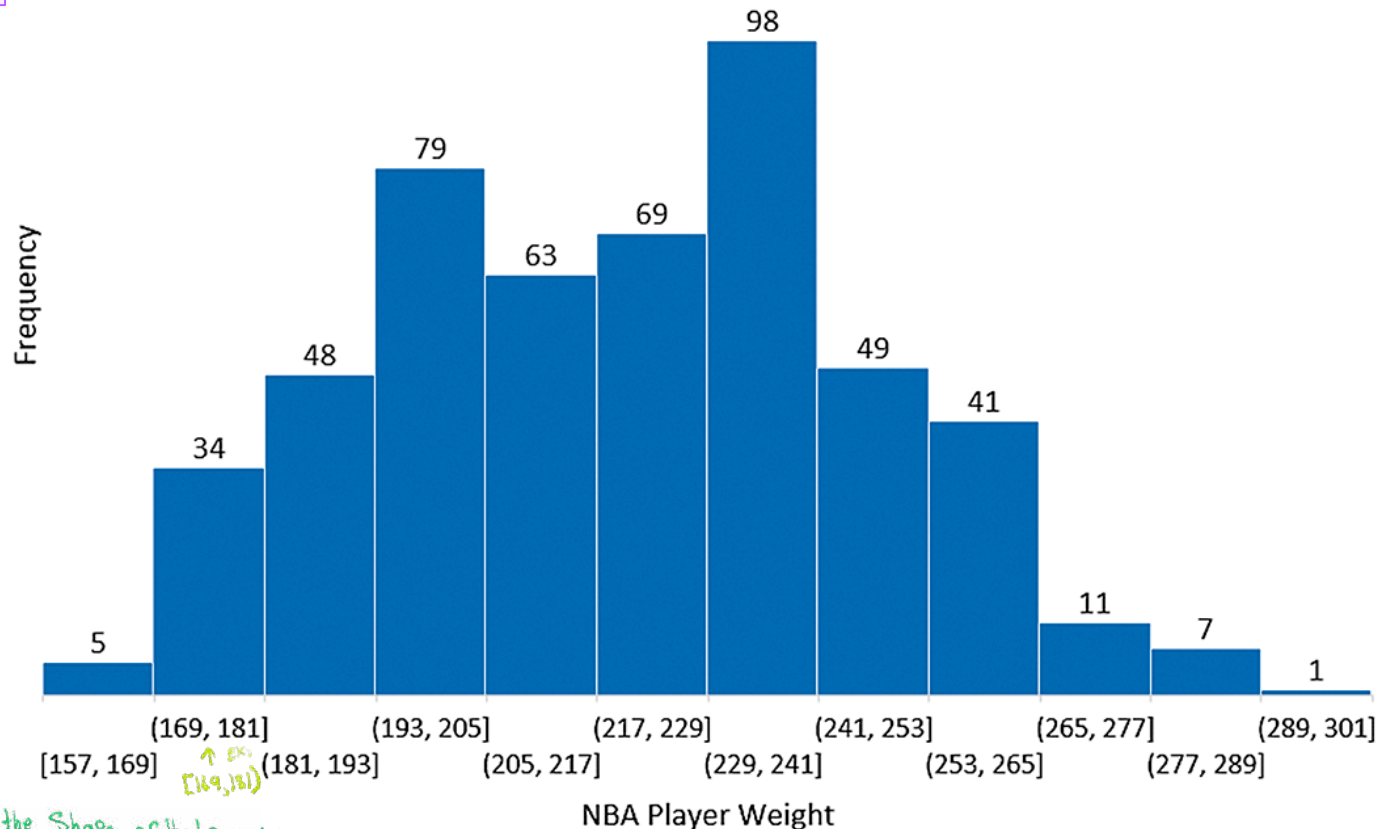
Same Center – Different Spread – Different Shape



Grouped Data Histogram – Weight for NBA Players (12 Classes)

NBA Player Weight Histogram

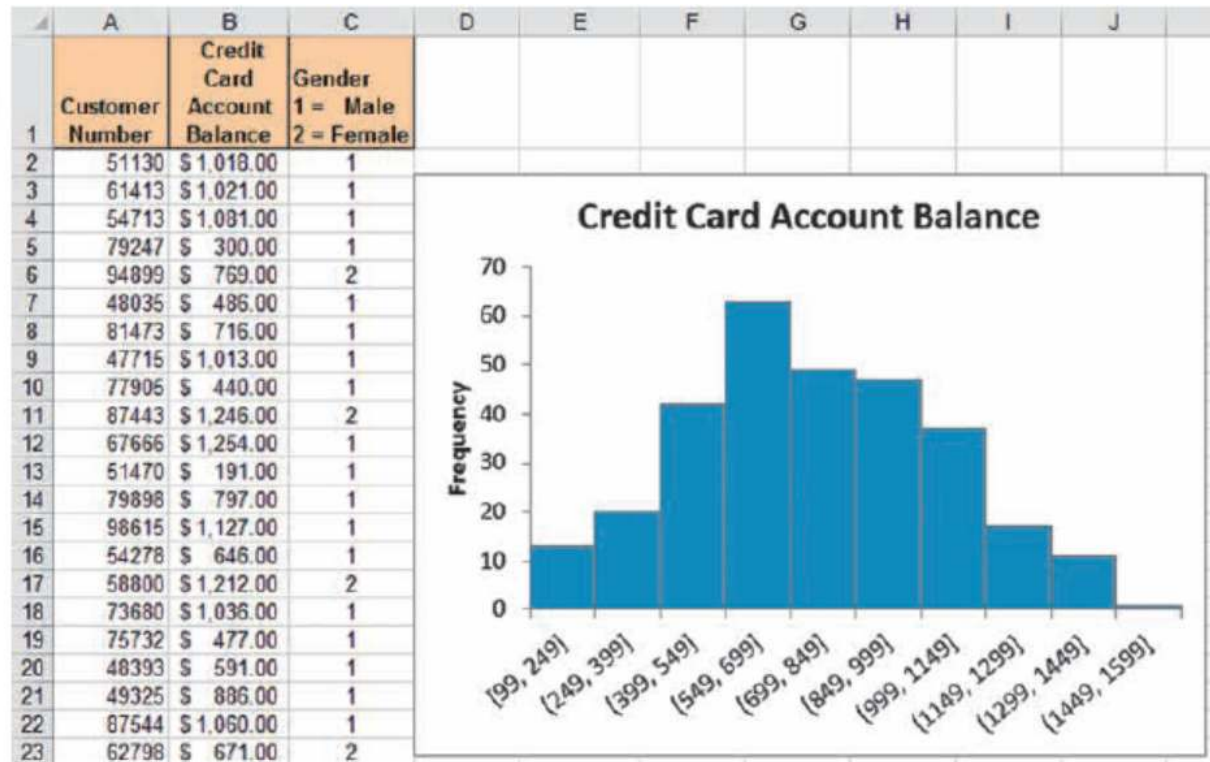
at most $\leq$
at least $\geq$



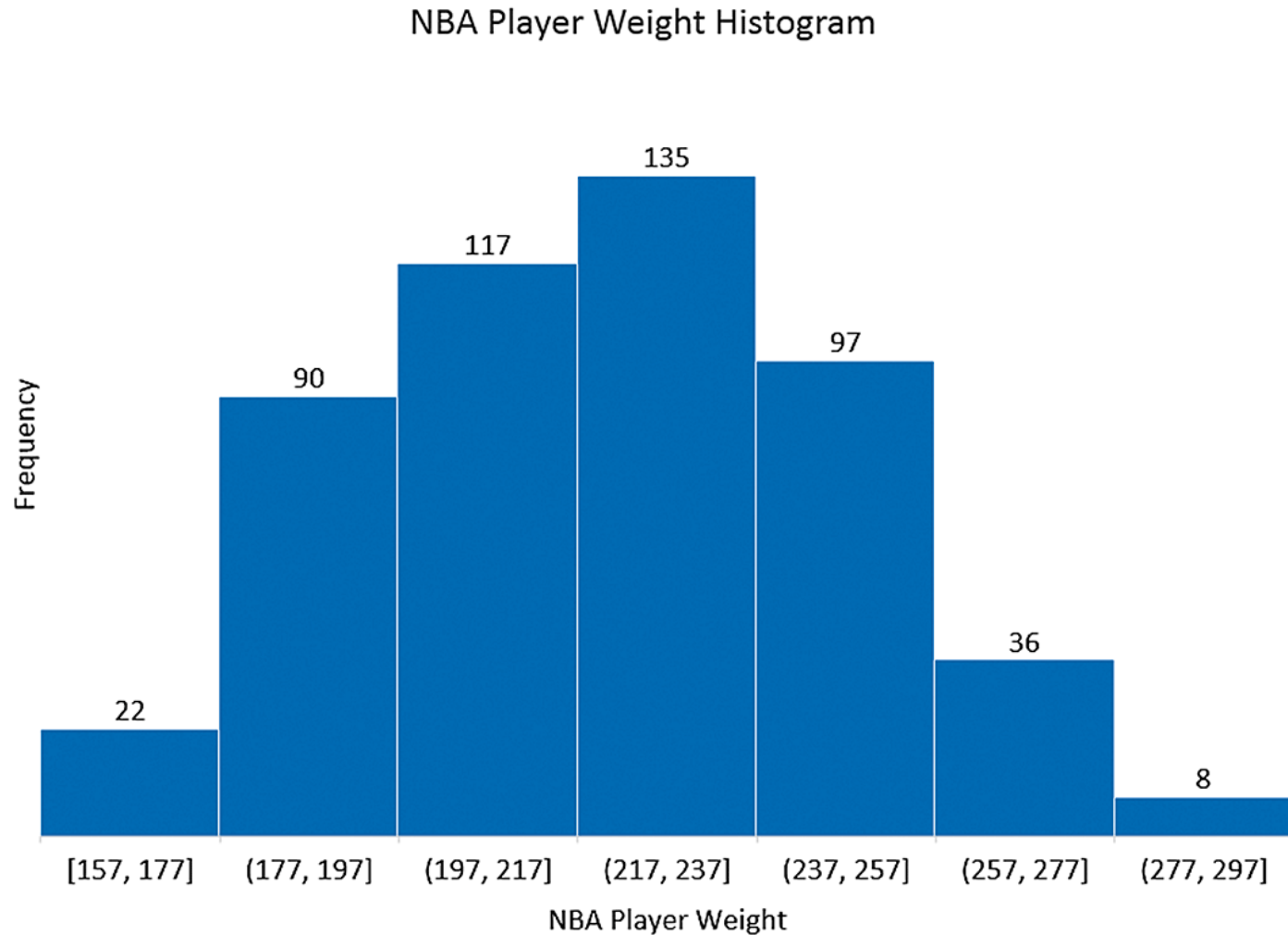
Grouped Data Histogram – Excel 2016

Excel 2016 Instructions

1. Open file: **Capital.xlsx**.
2. Select the **Credit Card Account Balance** column.
3. On the **Insert** tab, in the **Charts** group, click the **Insert Statistic Chart** arrow and click **Histogram**.
4. Select the numbers on the Horizontal Category Axis, right mouse click and select **Format Axis**. Change the Number Category to Currency with 0 Decimal places.
5. Add the Chart Title to the Histogram.

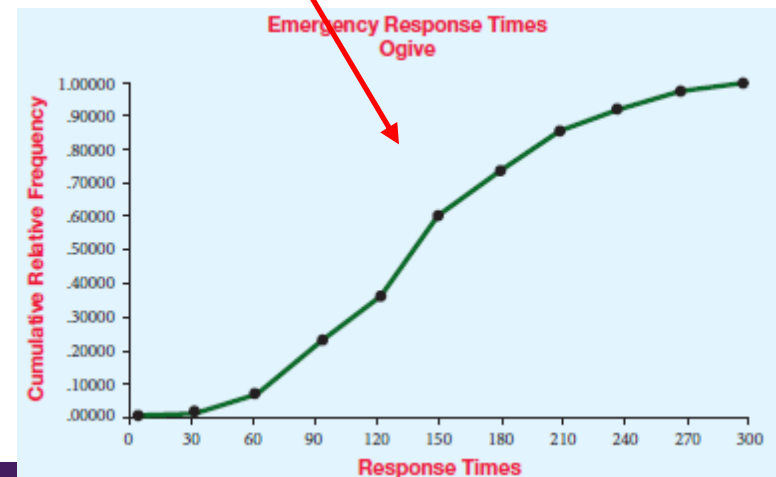
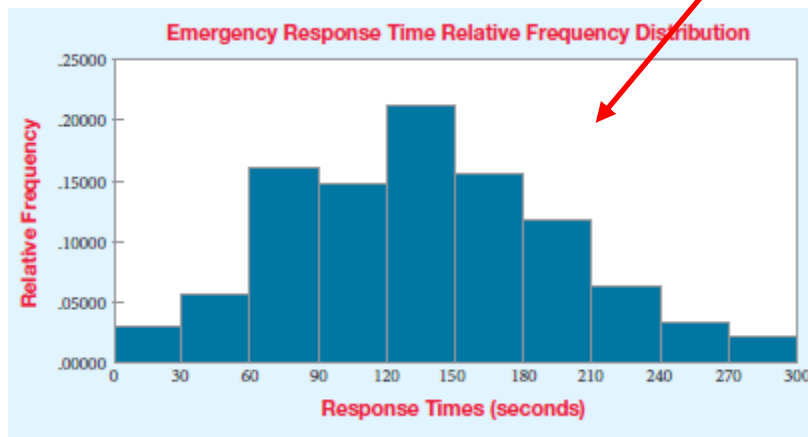


Grouped Data Histogram – Weight for NBA Players (7 Classes)

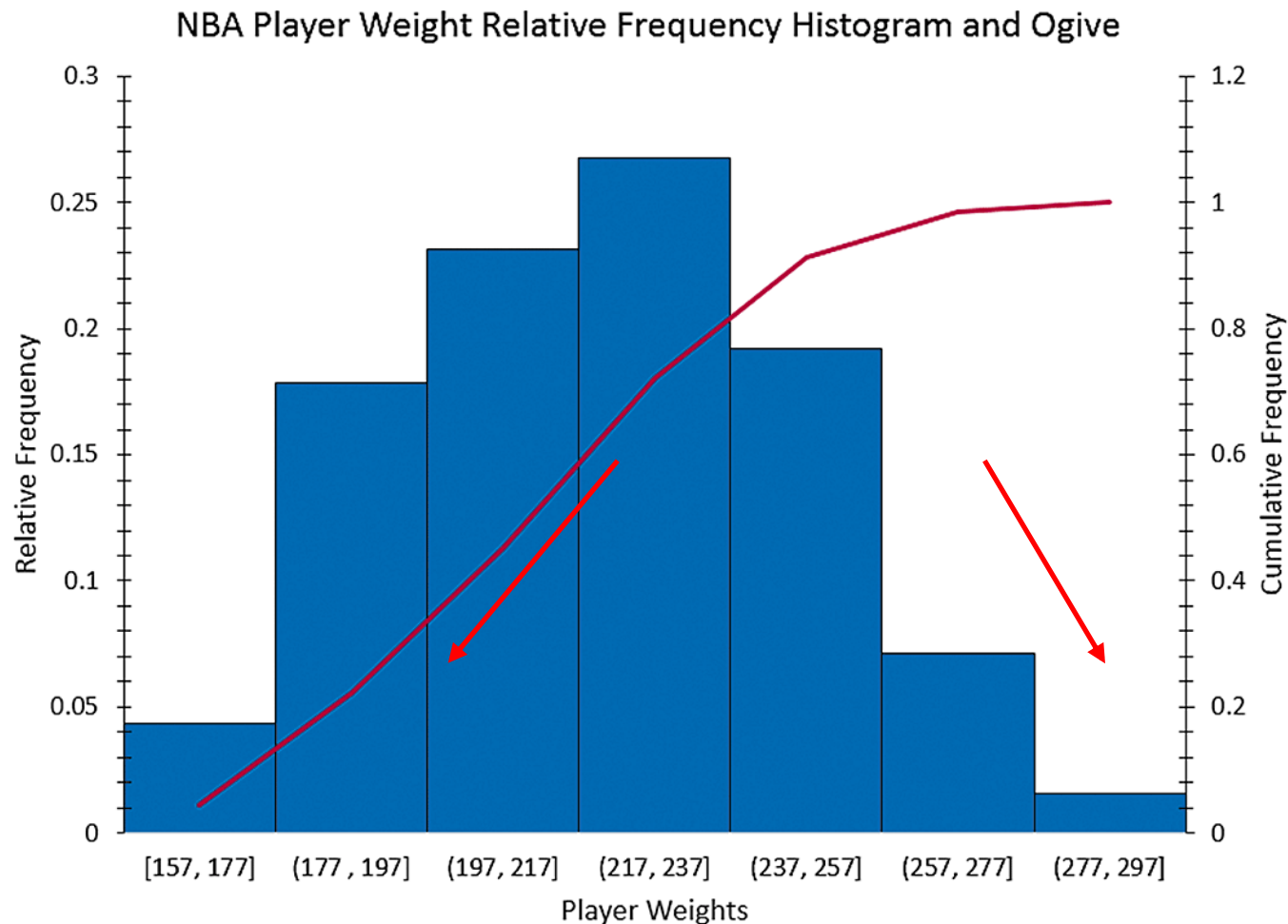


Example: Relative Frequency Distributions and Ogives

Response Time	Frequency	Relative Frequency	Cumulative Relative Frequency
0 and under 30	36	$36/1220 = 0.0295$	0.0295
30 and under 60	68	$68/1220 = 0.0557$	0.0852
60 and under 90	195	$195/1220 = 0.1598$	0.2451
90 and under 120	180	$180/1220 = 0.1475$	0.3926
120 and under 150	260	$260/1220 = 0.2131$	0.6057
150 and under 180	182	$182/1220 = 0.1492$	0.7549
180 and under 210	145	$145/1220 = 0.1189$	0.8738
210 and under 240	80	$80/1220 = 0.0656$	0.9393
240 and under 270	43	$43/1220 = 0.0352$	0.9746
270 and under 300	31	$31/1220 = 0.0254$	1.0000
	1,220	1.0000	



Relative Frequency and Ogive – Example (NBA Player Weights)



Joint Frequency Distribution

- Data are characterized by more than one variable.
- Can be constructed for qualitative and quantitative variables.
- **Step 1:** Obtain the data.

— Example:

Customer	Payment Method	Parking Garage
1	Charge	2
2	Charge	1
3	Cash	2
4	Charge	2
5	Charge	1
.	.	.
.	.	.
.	.	.

Joint Frequency Distribution

- **Step 2:** Construct the rows and columns of the joint frequency table.

		Parking Garage	
		1	2
Payment Method	Charge		
	Cash		

Joint Frequency Distribution

- **Step 3:** Count the number of joint occurrences at each row level and each column level for all combinations of row and column values and place these frequencies in the appropriate cells.

		Parking Garage	
		1	2
Payment Method	Charge	40	20
	Cash	10	10

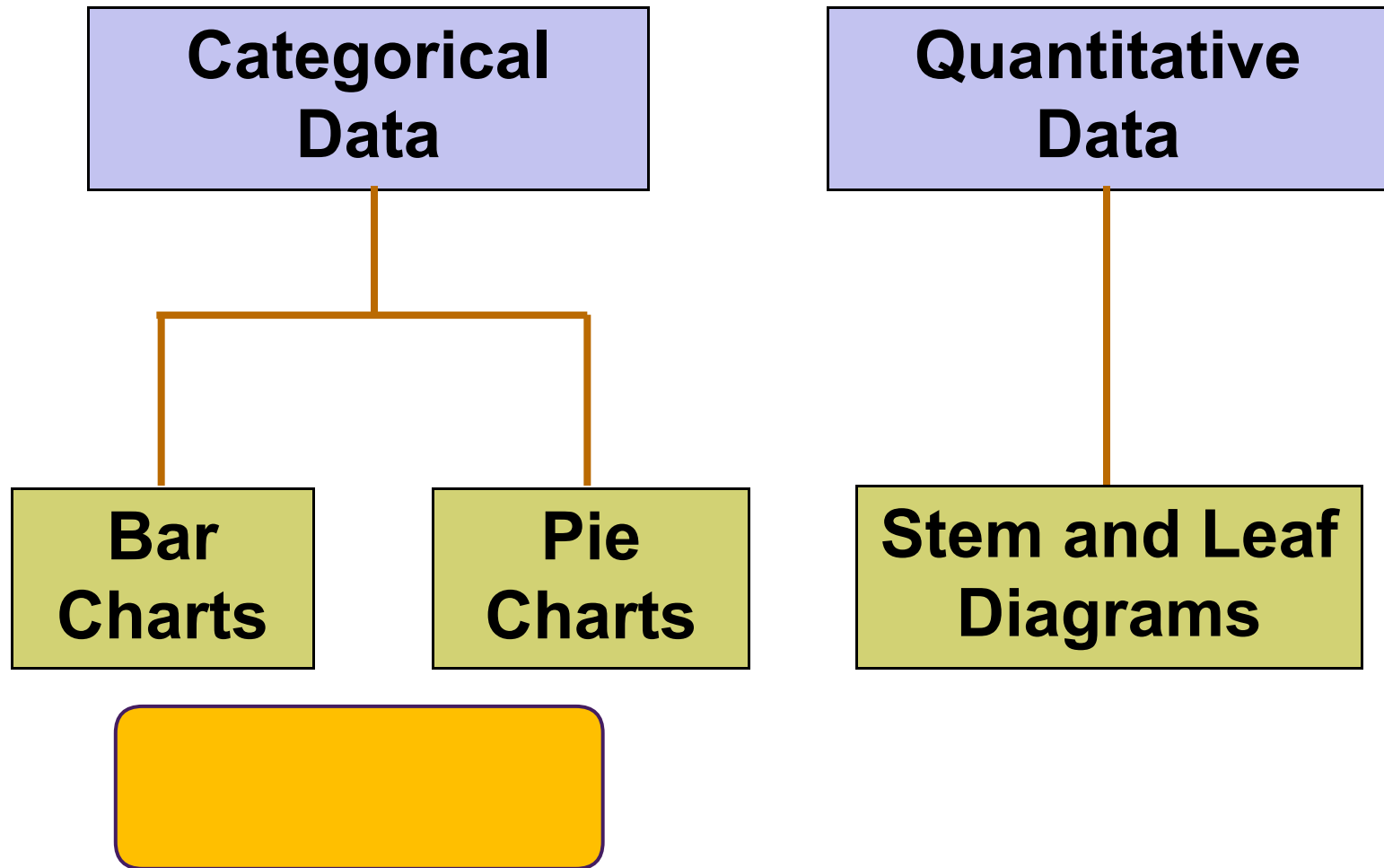
Joint Frequency Distribution

- **Step 4:** Calculate the row and column totals.

		Parking Garage		
		1	2	Total
Payment Method	Charge	40	20	60
	Cash	10	10	20
	Total	50	30	80

40 Customers Paid By Charge and Used Garage 1

2.2 Bar Charts, Pie Charts, and Stem and Leaf Diagrams

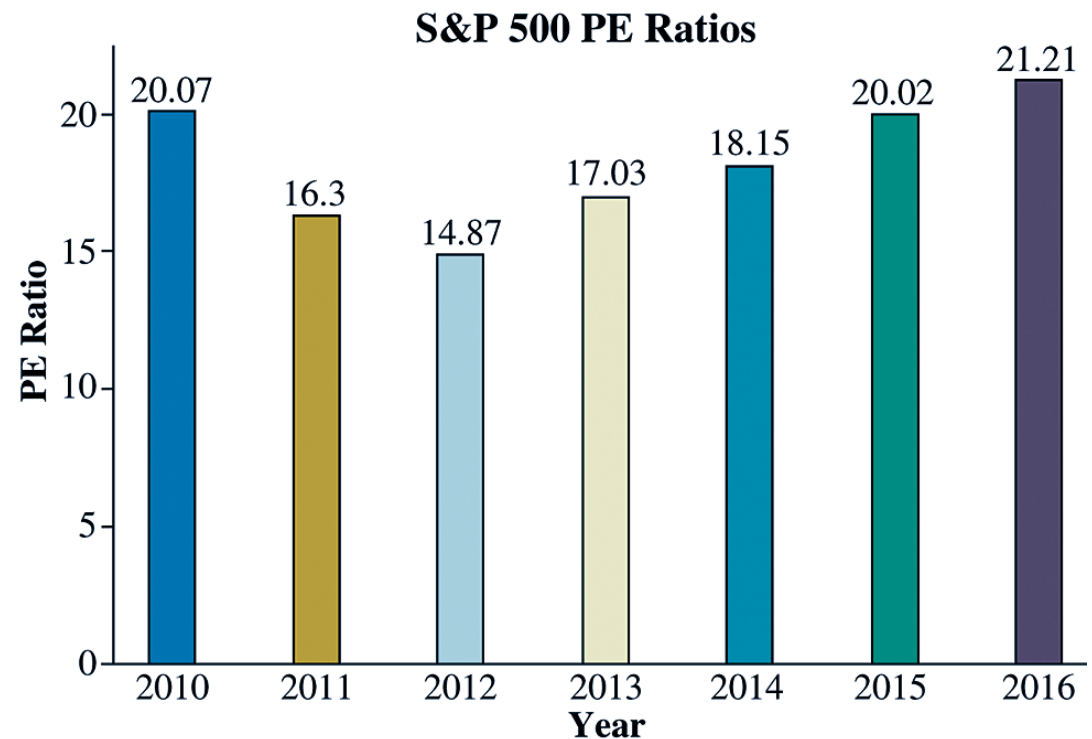


Bar Charts

- A graphical representation of a categorical data set in which a rectangle or bar is drawn over each category or class
- The length or height of each bar represents the frequency or percentage of observations or some other measure associated with the category.
- The bars may be vertical or horizontal.

Bar Chart Example (Vertical)

Year	S&P 500 PE Ratio
2016	21.21
2015	20.02
2014	18.15
2013	17.03
2012	14.87
2011	16.3
2010	20.07

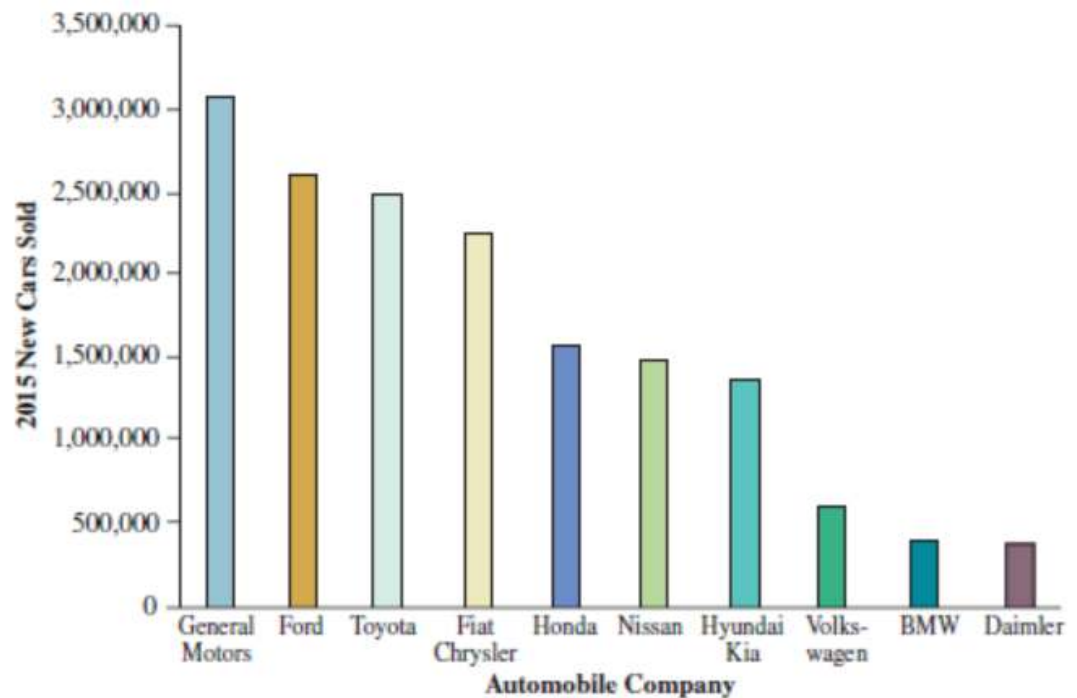


Bar Chart Example (Vertical)

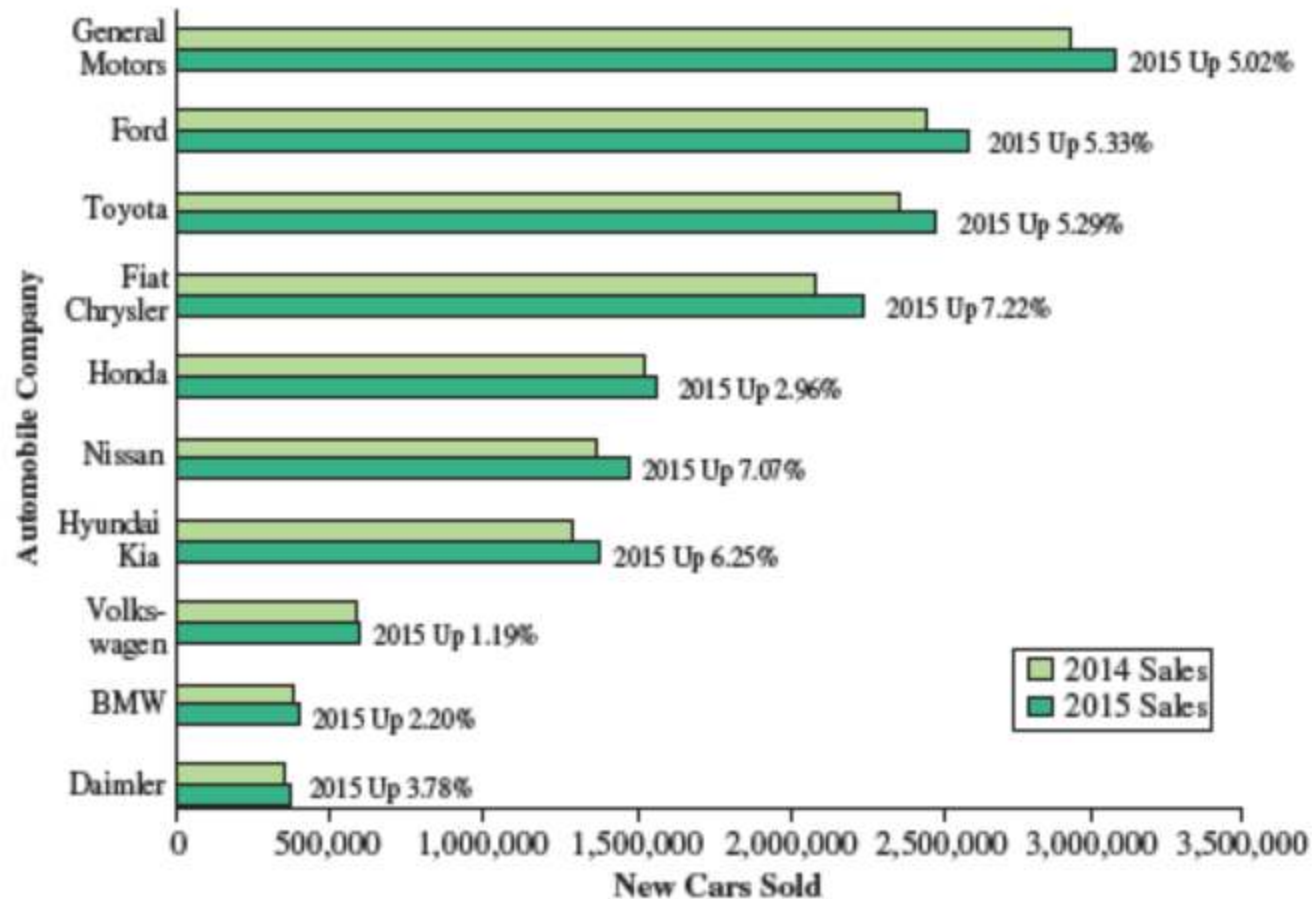
TABLE 2.8 2015 New Car Sales for the Top Ten Automobile Companies (United States)

Car Company	2015 Sales
Daimler	380,461
BMW	405,377
Volkswagen	606,840
Hyundai Kia	1,387,528
Nissan	1,484,918
Honda	1,586,551
Fiat Chrysler	2,257,728
Toyota	2,499,313
Ford	2,603,082
General Motors	3,082,366

Source: www.goodcarbadcar.net



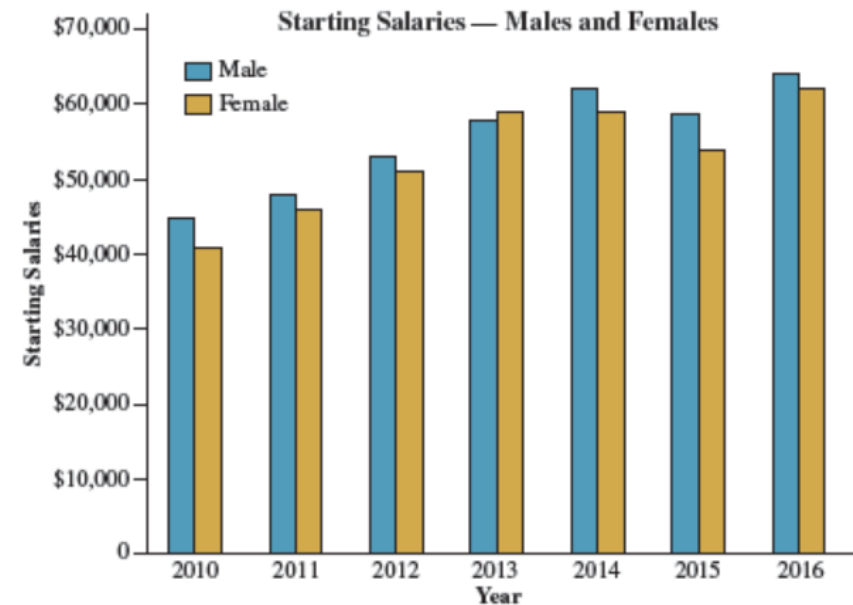
Bar Chart Example (Horizontal)



Bar Chart Example (Vertical)

TABLE 2.9 Starting Salary Data

Year	Males: Average Starting Salaries	Females: Average Starting Salaries
2010	\$45,000	\$41,000
2011	\$48,000	\$46,000
2012	\$53,000	\$51,000
2013	\$58,000	\$59,000
2014	\$62,000	\$59,000
2015	\$59,000	\$54,000
2016	\$64,000	\$62,000



Pie Charts

- A graph in the shape of a circle.
- Use to show visually the parts of a total
- The circle is divided into “slices” corresponding to the categories or classes to be displayed.
- The size of each slice is proportional to the magnitude of the displayed variable associated with each category or class.

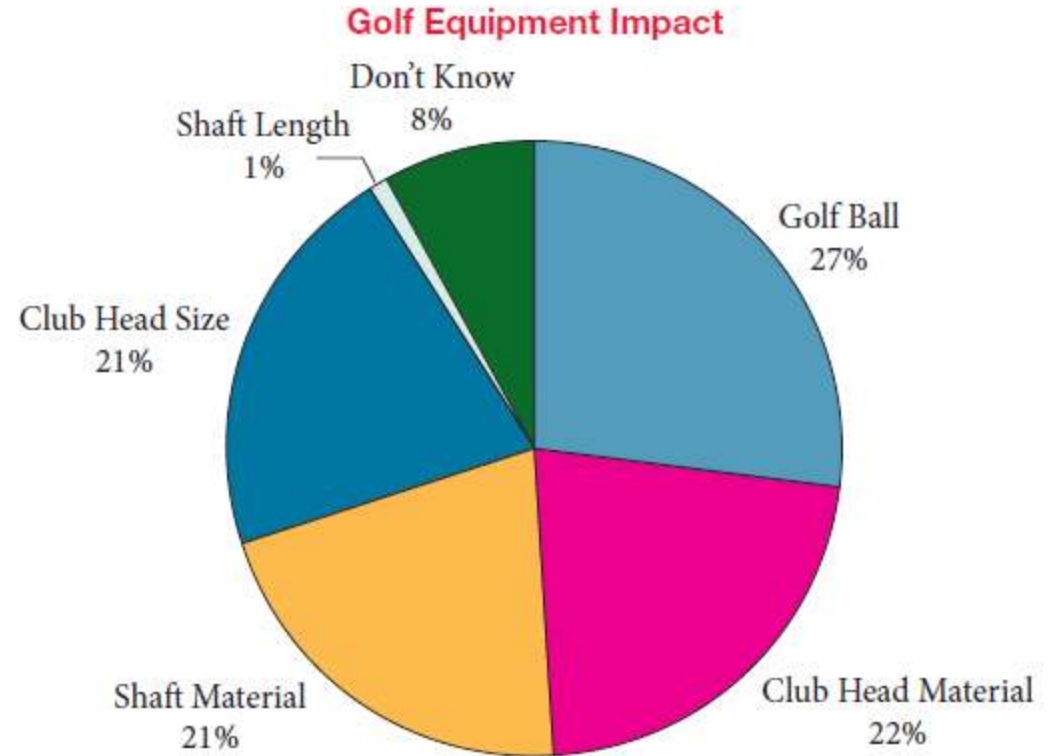
Constructing Pie Chart

- **Step 1:** Define the categories for the variable of interest.
- **Step 2:** For each category, determine the appropriate measure or value. The value assigned to each category is the proportion the category is to the total for all categories.
- **Step 3:** Construct the pie chart by displaying one slice for each category that is proportional in size to the proportion the category value is to the total of all categories.

Pie Chart Example

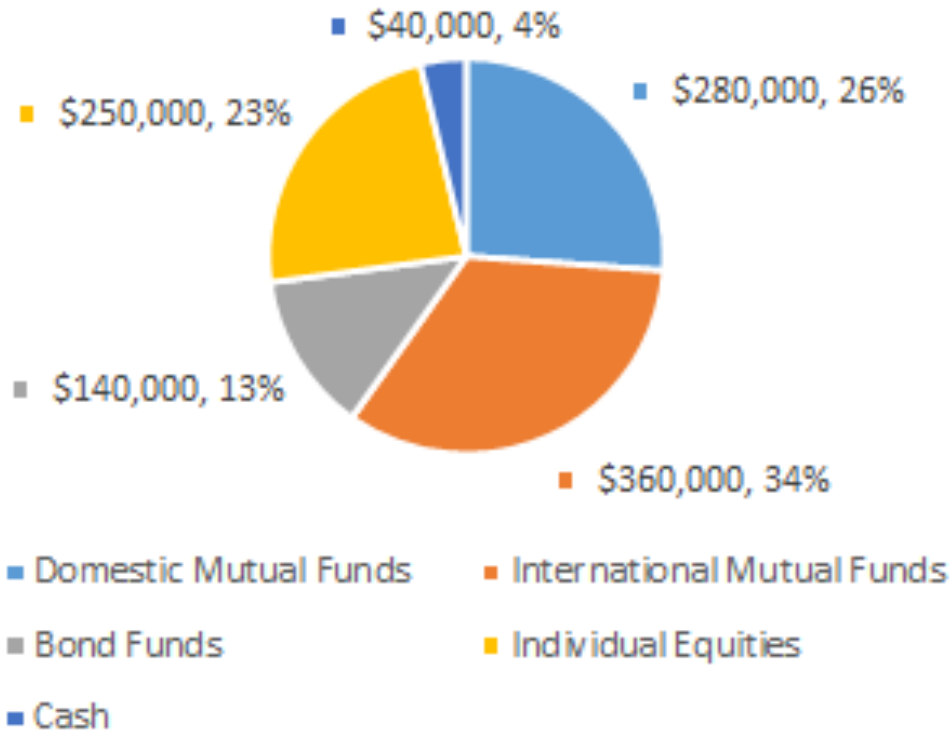
Golfers' Responses to What Technology is Most Important in Determining Driving Distance off the Tee.

Equipment	Frequency
Golf ball	81
Club head material	66
Shaft material	63
Club head size	63
Shaft length	3
Don't know	24



Pie Chart Example

Investment Portfolio Distribution



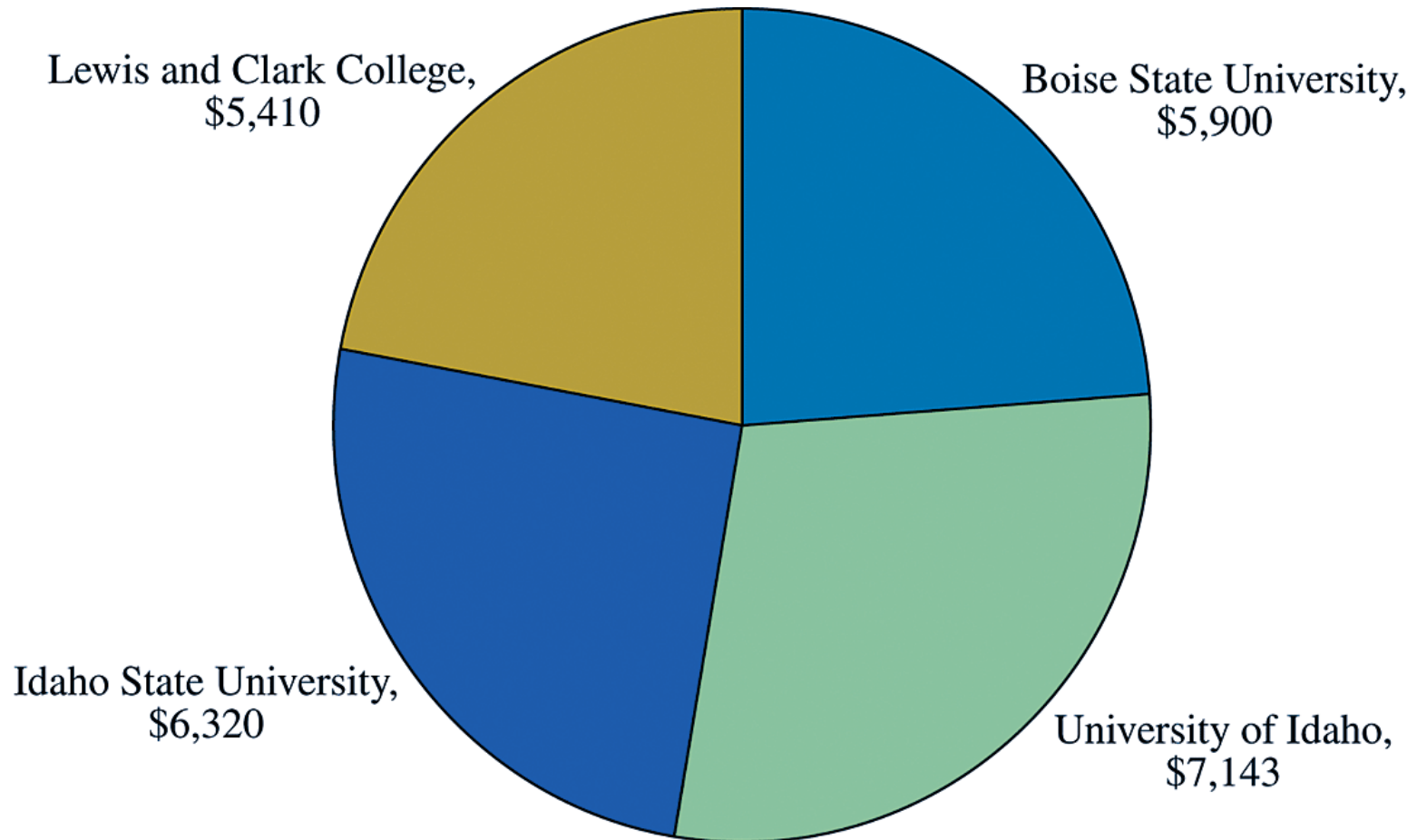
Incorrect Use of a Pie Chart

The Tax Dollars Allocated by the State of Idaho to Each of the Four Higher Education Facilities in the State

College/University	Tax Dollars Per Student
University of Idaho	\$7,143
Boise State University	\$5,900
Idaho State University	\$6,320
Lewis and Clark College	\$5,410



Why is This the Wrong Type of Chart?



Stem and Leaf Diagrams

EXAMPLE 2-9 Stem and Leaf Diagrams

Walk-In Health Clinic The administrator for the Walk-In Health Clinic is interested in the number of patients who enter the clinic daily. One method for analyzing the data for a sample of 200 days is the stem and leaf diagram. The following data represent the number of patients on each of the 200 days:

113	112	63	127	110	129	142	115	192	94
165	121	105	140	85	93	105	140	93	126
183	118	67	104	162	110	76	109	91	132
88	96	132	80	144	112	57	139	123	124
172	149	198	114	88	111	133	117	138	134
53	147	108	109	153	89	159	99	130	93
161	118	115	117	128	98	125	184	134	132
117	127	166	72	122	109	124	92	82	69
110	128	151	67	142	177	135	121	143	89
160	115	138	79	104	76	89	110	44	140
117	103	59	109	145	117	162	108	141	139
148	175	107	117	87	87	150	152	80	168
88	127	131	85	143	101	137	111	128	147
110	81	111	149	154	90	150	117	101	116
153	176	112	147	87	177	190	66	62	154
143	122	176	153	97	106	86	62	146	98
134	135	127	118	109	143	146	152	140	95
102	137	158	69	122	135	136	129	91	136
135	86	131	154	132	59	136	85	142	137
155	190	120	154	102	109	97	157	144	149



Stem and Leaf Diagrams

The stem and leaf diagram is constructed using the following steps:

STEP 1 Sort the data from low to high.

The lowest value is 44 patients and the highest value is 198 patients.

STEP 2 Split the values into a stem and leaf.

Leaf = units place; Stem = all digits left of the units place

For example, for the value 113, the stem is 11 and the leaf is 3. We are keeping one digit for the leaf.

STEP 3 List all possible stems from lowest to highest.



Stem and Leaf Diagrams

STEP 4 Itemize the leaves from lowest to highest and place next to the appropriate stems.

4	4
5	3 7 9 9
6	2 2 3 6 7 7 9 9
7	2 6 6 9
8	0 0 1 2 5 5 5 6 6 7 7 7 8 8 8 9 9 9
9	0 1 1 2 3 3 3 4 5 6 7 7 8 8 9
10	1 1 2 2 3 4 4 5 5 6 7 8 8 9 9 9 9 9 9
11	0 0 0 0 1 1 1 2 2 2 3 4 5 5 5 6 7 7 7 7 7 7 8 8 8
12	0 1 1 2 2 2 3 4 4 5 6 7 7 7 7 8 8 8 9 9
13	0 1 1 2 2 2 2 3 4 4 4 5 5 5 5 6 6 6 7 7 7 8 8 9 9
14	0 0 0 0 1 2 2 2 3 3 3 3 4 4 5 6 6 7 7 7 8 9 9 9
15	0 0 1 2 2 3 3 3 4 4 4 4 5 7 8 9
16	0 1 2 2 5 6 8
17	2 5 6 6 7 7
18	3 4
19	0 0 2 8



2.3 Line Charts, Scatter Diagrams, and Pareto Charts

- Line Chart

- A two-dimensional chart showing time on the horizontal axis and the variable of interest on the vertical axis – Use to Display Time-Series

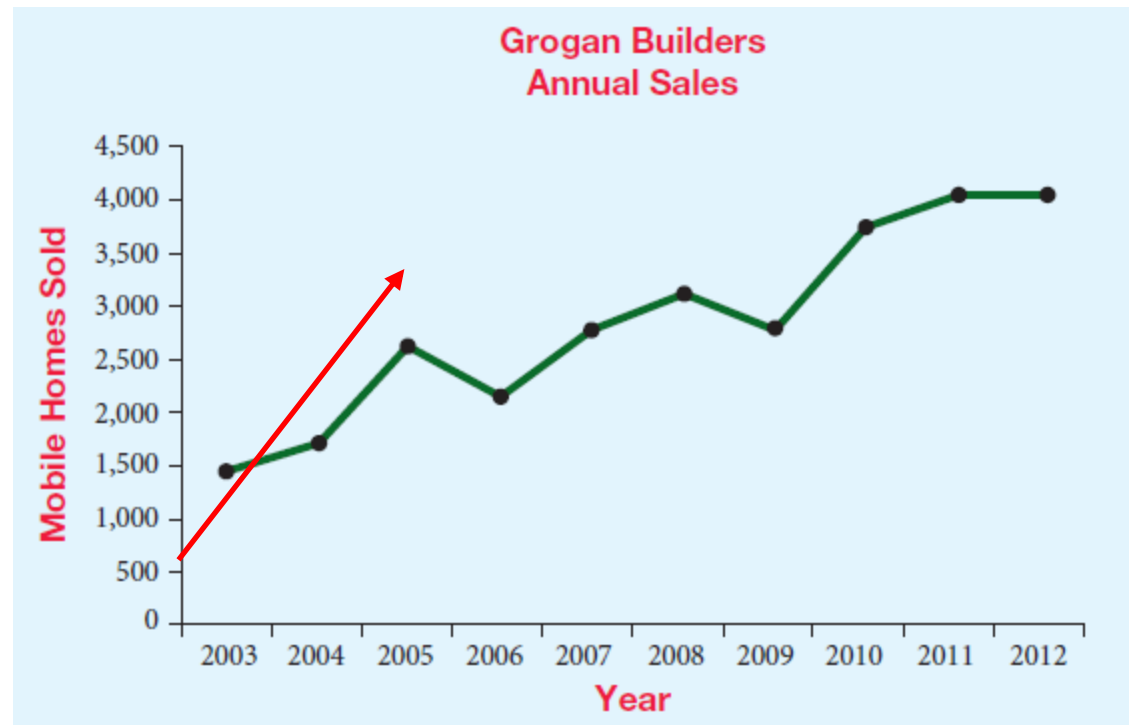
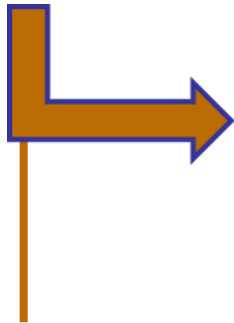
- Scatter Diagram

- A two-dimensional graph of plotted points in which the vertical axis represents values of one quantitative variable and the horizontal axis represents values of the other quantitative variable



Line Chart Example

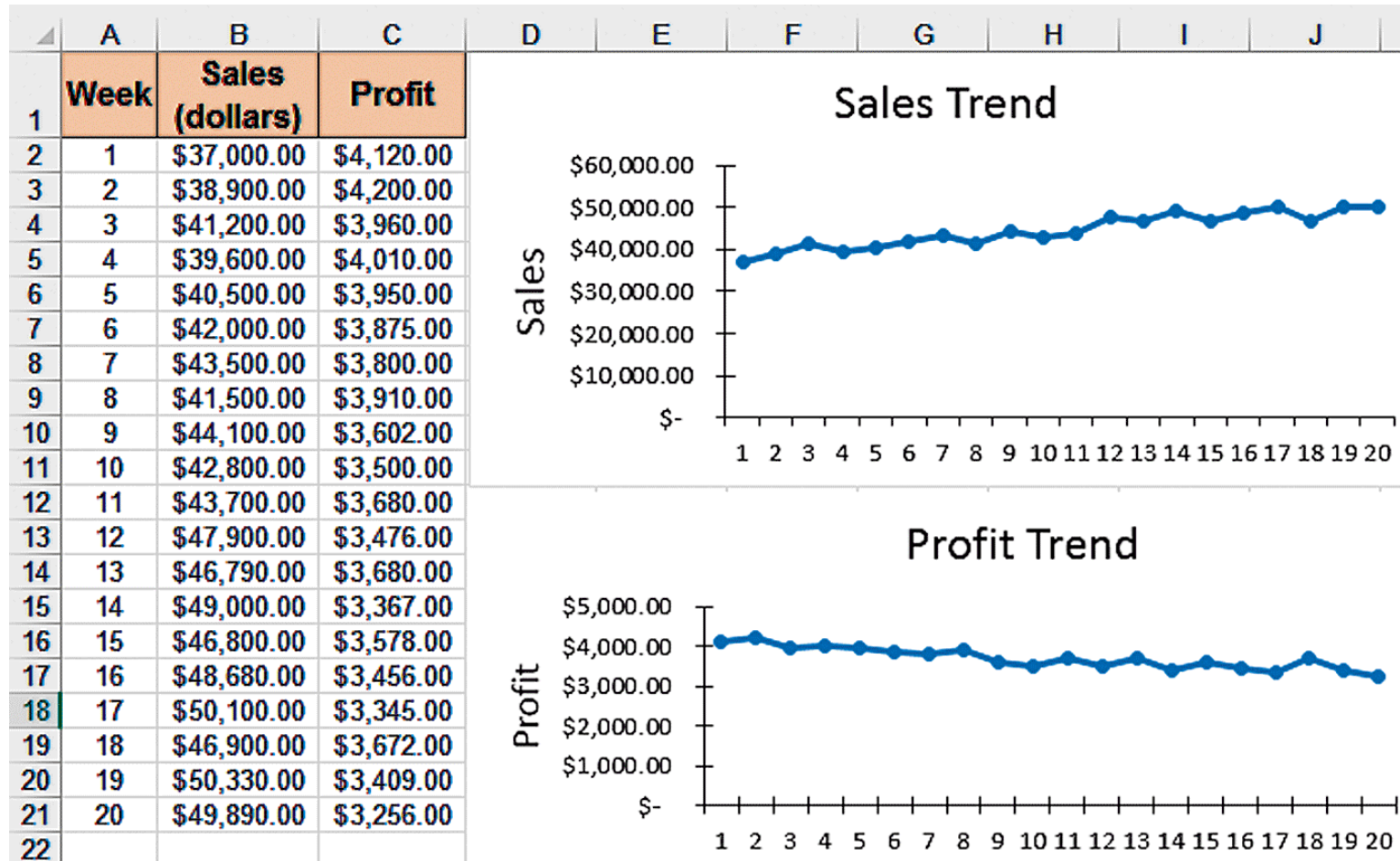
2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1,426	1,678	2,591	2,105	2,744	3,068	2,755	3,689	4,003	3,997



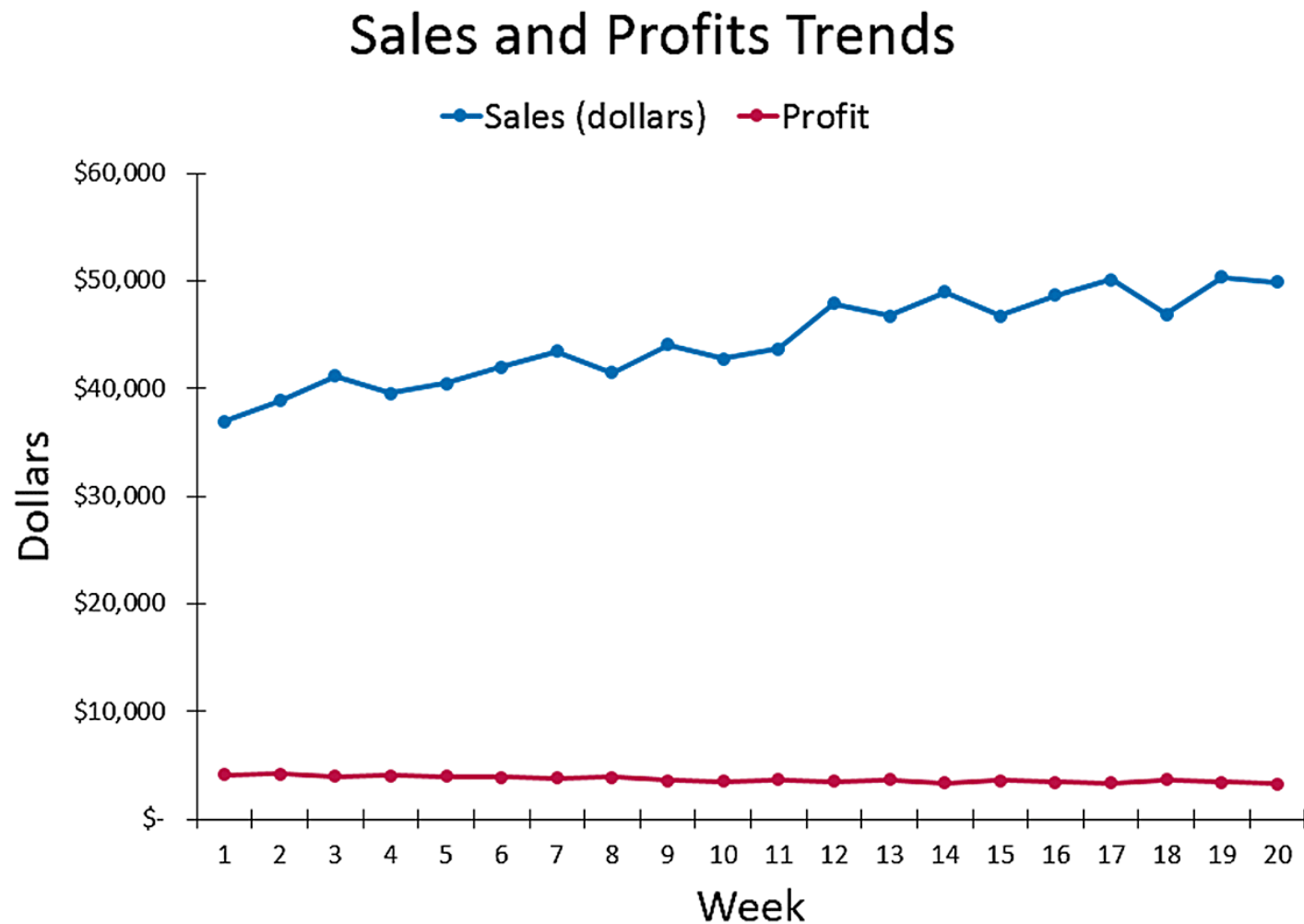
Constructing Line Charts

- **Step 1:** Identify the time-series variable of interest and determine the maximum value and the range of time periods covered in the data.
- **Step 2:** Construct the horizontal axis for the time periods. Construct the vertical axis with a scale appropriate for the range of values.
- **Step 3:** Plot the points of the graph and connect them with straight lines

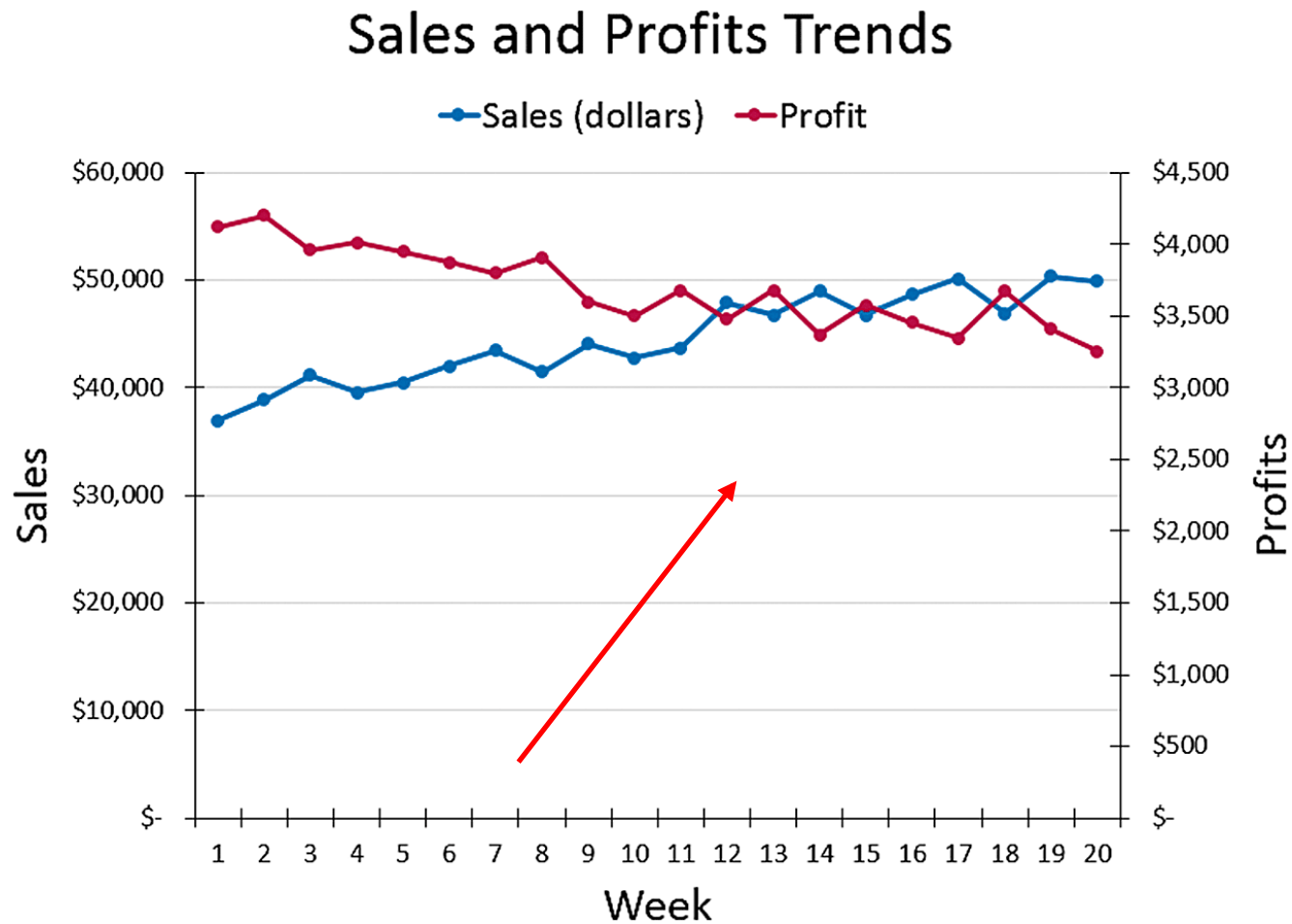
Line Chart Example – Separate Charts



Line Chart Example – Both Variables on Same Chart



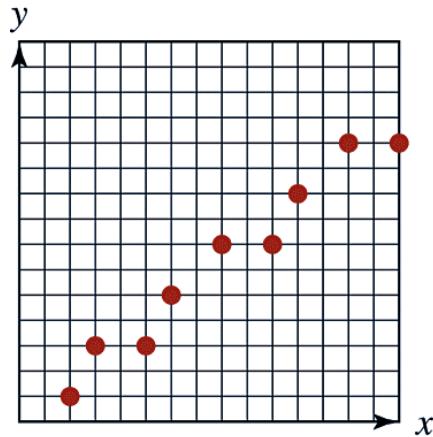
Improved Line Chart – Two Vertical Axes



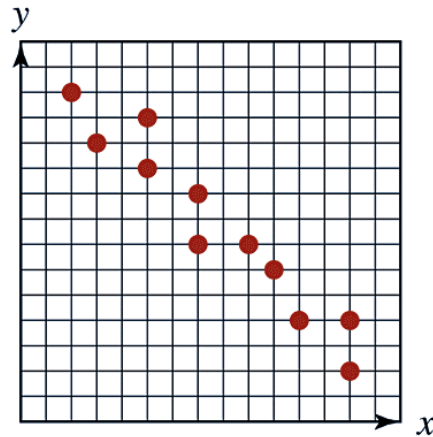
Scatter Diagram

- Also called the scatter plot
- Shows the relationship between two quantitative variables
- **Dependent Variable**
 - Values are thought to be a function of another variable
- **Independent Variable**
 - Values are thought to impact the values of the dependent variable

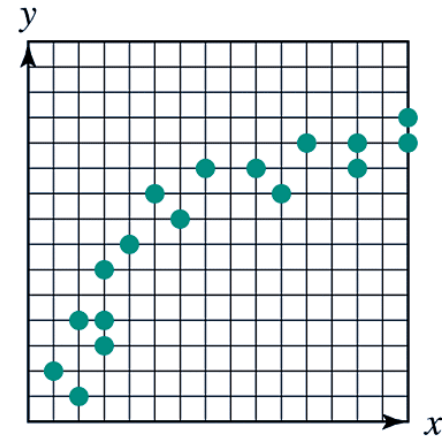
Scatter Diagrams Reveal Relationships



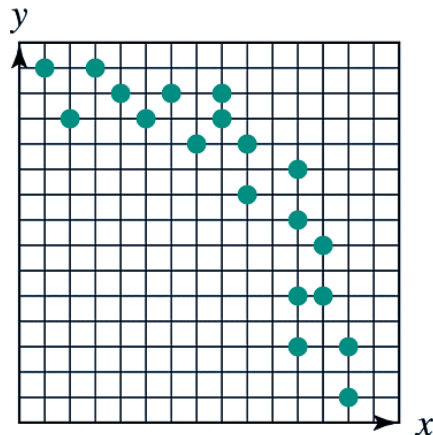
(a) Linear



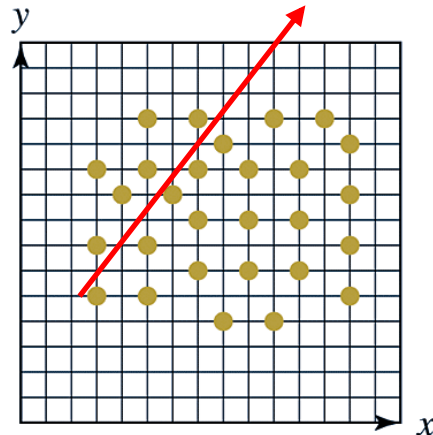
(b) Linear



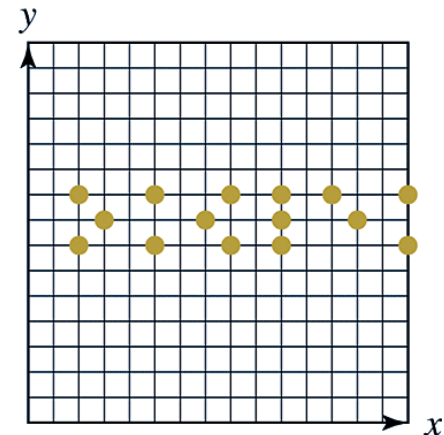
(c) Curvilinear



(d) Curvilinear

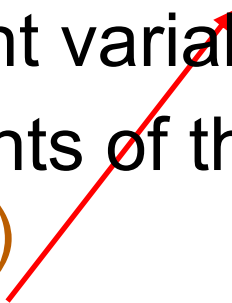


(e) No Relationship



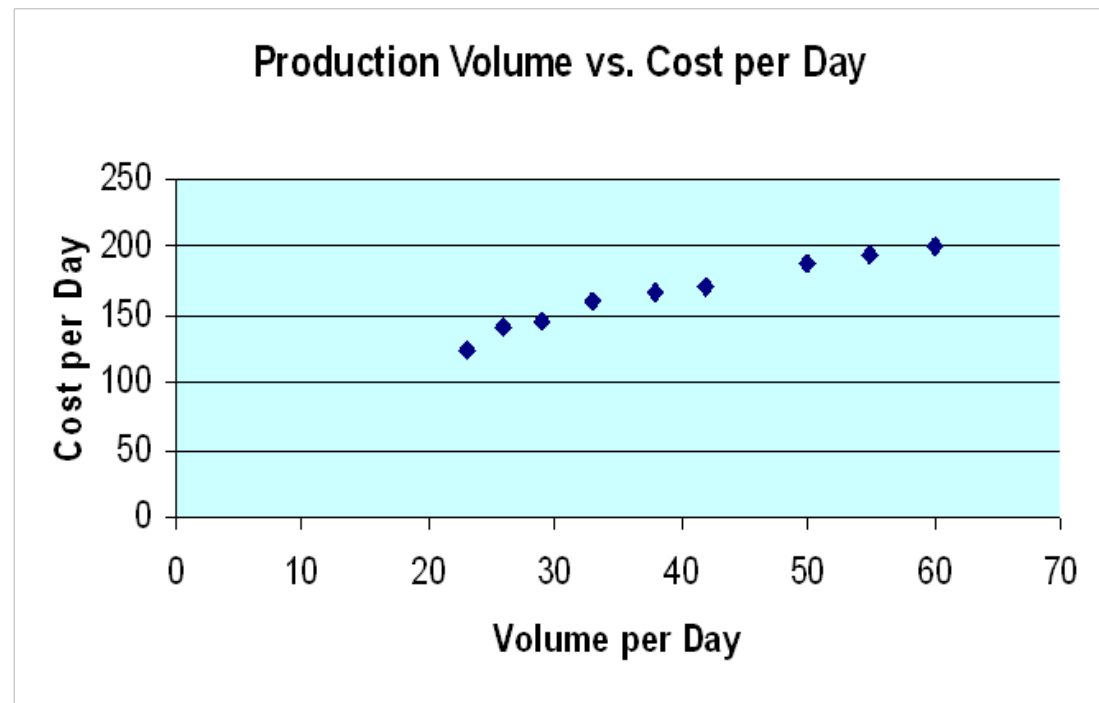
(f) No Relationship

Constructing Scatter Diagrams

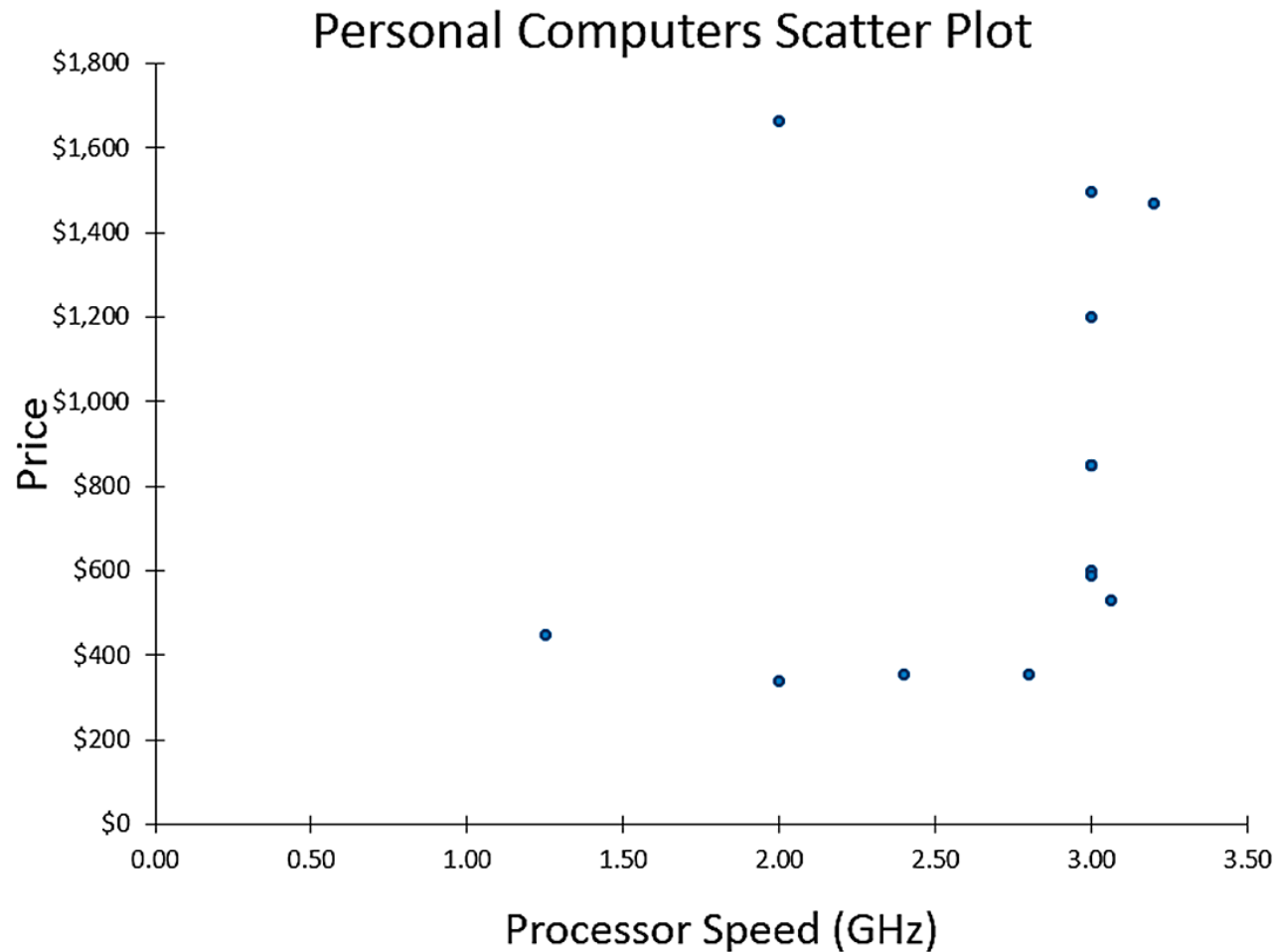
- **Step 1:** Identify the dependent and independent variable.
 - **Step 2:** Collect values for the two variables.
 - **Step 3:** Construct the horizontal axis using the independent variable. Construct the vertical axis using the dependent variable
 - **Step 4:** Plot the points of the graph. (don't connect the points.)
- 

Scatter Diagram Example

Volume per day	Cost per day
23	125
26	140
29	146
33	160
38	167
42	170
50	188
55	195
60	200



Scatter Diagram Example



Pareto Chart – A Special Type of Bar Chart

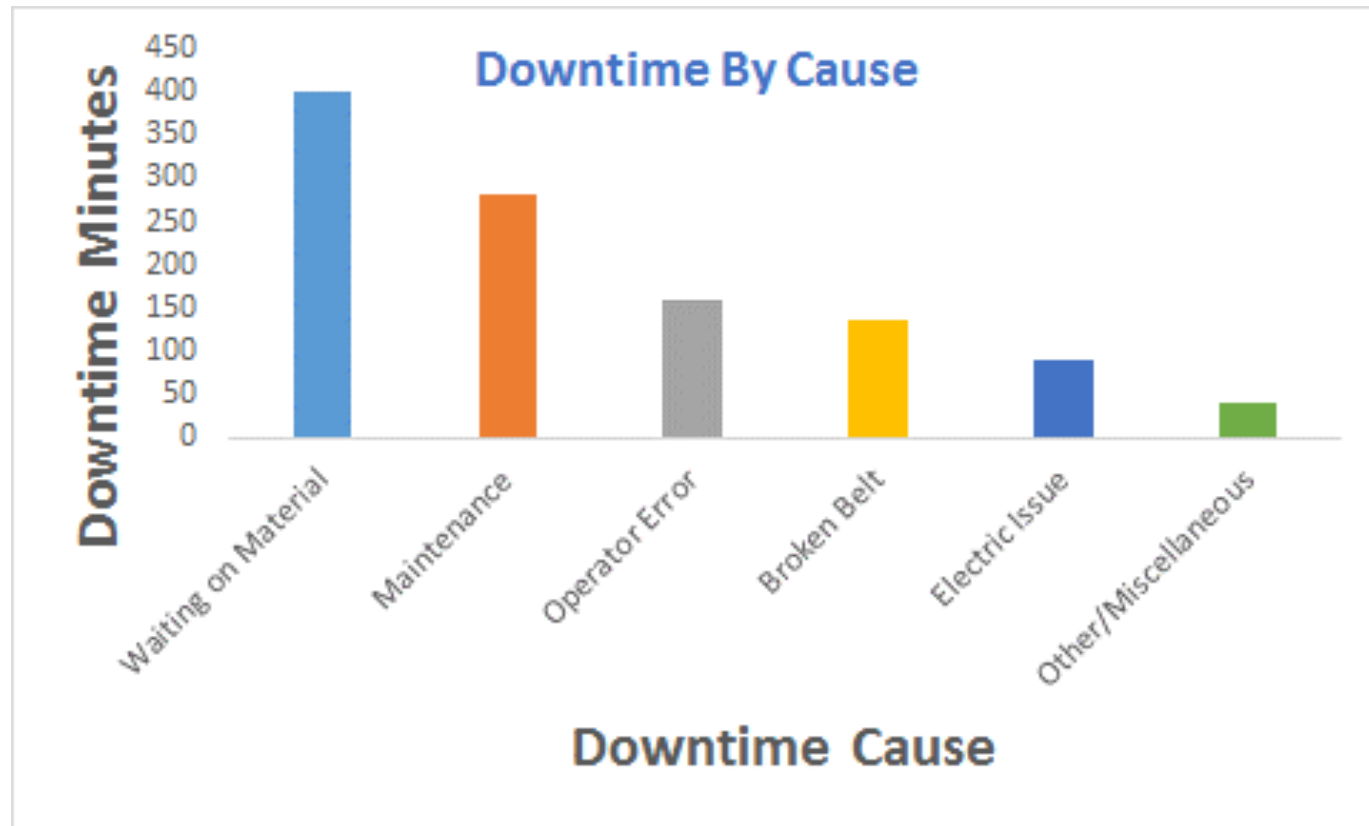
- Used to Separate the “Vital Few” from the “Trivial Many”
- Bars represent categorical values and are organized from high to low

Pareto Chart – A Special Type of Bar Chart

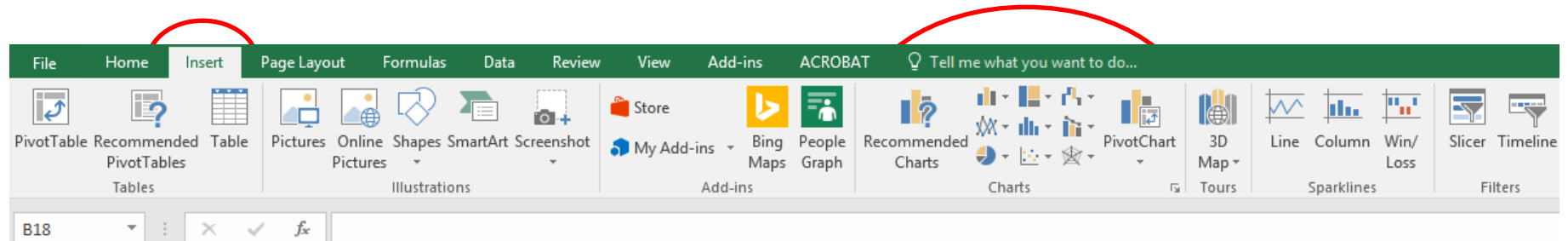
- **Example:** A Company Tracks Causes of Machine Downtime and the Minutes of Downtime Associated With Each Cause. Present Data as a Pareto Chart.

Downtime Causes	Minutes
Broken Belt	135
Electric Issue	90
Operator Error	160
Maintenance	280
Waiting on Material	400
Other/Miscellaneous	40

Pareto Chart – A Special Type of Bar Chart



Using Excel 2016 to Build Graphs



The screenshot shows the Microsoft Excel 2016 ribbon with the 'Insert' tab selected. The ribbon groups are: Tables (PivotTable, Recommended PivotTables, Table), Illustrations (Pictures, Online Pictures, Shapes, SmartArt, Screenshot), Add-ins (Store, My Add-ins, Bing Maps, People Graph), Charts (Recommended Charts, PivotChart), Tours (3D Map), Sparklines (Line, Column, Win/Loss), and Filters (Slicer, Timeline). Two red arcs highlight the 'Insert' tab and the 'Charts' group.

Below the ribbon, the formula bar shows 'B18'. The worksheet grid displays the following data:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Sales	Region	Year															
2	200	West	2015															
3	240	East	2015															
4	190	South	2015															
5	400	North	2015															
6	250	International	2015															
7	300	West	2016															
8	250	East	2016															
9	200	South	2016															
10	380	North	2016															
11	300	International	2016															
12																		

See Excel Tutorials for Details