**Section 2.3 Additional Displays of Quantitative Data**

**Objectives**

* 1. Draw Stem-and-Leaf Plots
  2. Construct Frequency Polygons
  3. Create Cumulative Frequency and Relative Frequency Distributions
  4. Construct Frequency and Relative Frequency Ogives
  5. Draw Time-Series Graphs

***Objective 1: Draw Stem-and-Leaf Plots***

Objective 1, Page 1

1. In a stem-and-leaf plot, how are the stem and leaf identified?

Objective 1, Page 2

**Example 1 *Constructing a Stem-and-Leaf Plot***

The data in Table 14 represent the percentage of persons living in poverty, by state, in 2015. Draw a stem-and-leaf plot of the data.

Table 14 Percentage of People in Poverty by State Using Two-Year Averages: 2011–2012

| **State** | **Percent** |
| --- | --- |
| Alabama | 16.3 |
| Alaska | 9.2 |
| Arizona | 17.2 |
| Arkansas | 16.1 |
| California | 13.9 |
| Colorado | 9.9 |
| Connecticut | 9.1 |
| Delaware | 11.1 |
| District of Columbia | 16.6 |
| Florida | 16.2 |
| Georgia | 18.1 |
| Hawaii | 10.9 |
| Idaho | 12.3 |
| Illinois | 10.9 |
| Indiana | 13.5 |
| Iowa | 10.4 |
| Kansas | 14.2 |
| Kentucky | 19.5 |
| Louisiana | 18.6 |
| Maine | 12.3 |
| Maryland | 9.6 |
| Massachusetts | 11.5 |
| Michigan | 12.8 |
| Minnesota | 7.8 |
| Mississippi | 19.1 |
| Missouri | 9.8 |
| Montana | 11.9 |
| Nebraska | 10.3 |
| Nevada | 13.0 |
| New Hampshire | 7.3 |
| New Jersey | 11.2 |
| New Mexico | 19.7 |
| New York | 14.2 |
| North Carolina | 15.3 |
| North Dakota | 10.7 |
| Ohio | 13.6 |
| Oklahoma | 14.2 |
| Oregon | 11.9 |
| Pennsylvania | 12.3 |
| Rhode Island | 11.8 |
| South Carolina | 14.3 |
| South Dakota | 13.9 |
| Tennessee | 14.7 |
| Texas | 14.7 |
| Utah | 9.3 |
| Vermont | 10.7 |
| Virginia | 10.9 |
| Washington | 11.4 |
| West Virginia | 14.5 |
| Wyoming | 9.8 |

Data from united States Census Bureau

Objective 1, Page 3

1. List the four steps for constructing a stem-and-leaf plot.

Objective 1, Page 4

1. List an advantage that a stem-and-leaf plot has over frequency distributions and histograms.

Under what conditions do stem-and-leaf plots lose their usefulness?

Objective 1, Page 7

1. When constructing a stem-and-leaf plot, under what conditions is it advisable to use split stems?

***Objective 2: Construct Frequency Polygons***

Objective 2, Page 1

1. Explain how to construct a frequency polygon. A **frequency polygon** is a graph that uses points, connected by line segments, to represent the frequencies for the classes. It is constructed by plotting a point above each **class midpoint** (the sum of consecutive lower class limits divided by 2) on a horizontal axis at a height equal to the frequency of the class.

Objective 2, Page 2

**Example 2 *Constructing a Frequency Polygon***

Draw a frequency polygon of the five-year rate of return data listed in Table 16.

**Table 16 Five-Year Rate of Return of Mutual Funds (in percent)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 10.94 | 14.60 | 12.80 | 16.00 | 11.93 | 15.68 | 9.03 | 13.40 |
| 10.53 | 13.98 | 13.86 | 12.36 | 13.54 | 9.94 | 13.93 | 13.63 |
| 14.12 | 14.88 | 14.77 | 13.13 | 8.28 | 19.43 | 12.98 | 13.16 |
| 12.26 | 14.20 | 14.80 | 13.26 | 13.67 | 10.08 | 14.86 | 8.71 |
| 12.17 | 10.26 | 15.22 | 13.36 | 13.55 | 13.90 | 15.64 | 12.80 |

Data from [Morningstar.com](https://www.morningstar.com/)

***Objective 3: Create Cumulative Frequency and Relative Frequency Distributions***

Objective 3, Page 1

1. What does a cumulative frequency distribution display?
2. What does a cumulative relative frequency distribution display?
3. Explain how to find the cumulative frequency for the fifth class in a cumulative frequency distribution.

Objective 3, Page 2

**Example 3 *Constructing a Cumulative and Cumulative Relative Frequency Distribution***

Obtain a cumulative frequency distribution and cumulative relative frequency distribution for the five-year rate of return data listed in Table 13.

| **Class (5-year rate of return)** | **Frequency** | **Relative Frequency** |
| --- | --- | --- |
| 8–8.99 | 2 | 0.05 |
| 9–9.99 | 2 | 0.05 |
| 10-10.99 | 4 | 0.1 |
| 11–11.99 | 1 | 0.025 |
| 12–12.99 | 6 | 0.15 |
| 13–13.99 | 13 | 0.325 |
| 14–14.99 | 7 | 0.175 |
| 15–15.99 | 3 | 0.075 |
| 16–16.99 | 1 | 0.025 |
| 17–17.99 | 0 | 0 |
| 18–18.99 | 0 | 0 |
| 19–19.99 | 1 | 0.025 |

***Objective 4: Construct Frequency and Relative Frequency Ogives***

Objective 4, Page 1

1. What does an ogive represent?
2. Explain the difference between *x*-coordinates for a frequency polygon and a frequency ogive.
3. Explain the difference between *y*-coordinates for a frequency polygon and a frequency ogive.

Objective 4, Page 2

**Example 4 *Constructing Ogives***

Draw a relative frequency ogive of the five-year rate of return data listed in Table 17.

**Table 17**

| **Class (5-year rate of return)** | **Frequency** | **Relative Frequency** | **Cumulative Frequency** | **Cumulative Relative Frequency** |
| --- | --- | --- | --- | --- |
| 8–8.99 | 2 | 0.05 | 2 | 0.05 |
| 9–9.99 | 2 | 0.05 | 4 | 0.1 |
| 10–10.99 | 4 | 0.1 | 8 | 0.2 |
| 11–11.99 | 1 | 0.025 | 9 | 0.225 |
| 12–12.99 | 6 | 0.15 | 15 | 0.3.75 |
| 13–13.99 | 13 | 0.325 | 28 | 0.7 |
| 14–14.99 | 7 | 0.175 | 35 | 0.875 |
| 15–15.99 | 3 | 0.075 | 38 | 0.95 |
| 16–16.99 | 1 | 0.025 | 39 | 0.975 |
| 17–17.99 | 0 | 0 | 39 | 0.975 |
| 18–18.99 | 0 | 0 | 39 | 0.975 |
| 19–19.99 | 1 | 0.025 | 40 | 1 |

***Objective 5: Draw Time-Series Graphs***

Objective 5, Page 1

1. Define time-series data.

Objective 5, Page 1 (continued)

1. Explain how to create a time-series plot.

Objective 5, Page 2

**Example 5 *Drawing a Time-Series Plot***

The Partisan Conflict Index (PCI) tracks the degrees of political disagreement among U.S. politicians in the federal government. It is found by measuring the frequency of newspaper articles reporting disagreement in a given month. Higher values of the index suggest greater conflict among political parties, Congress, and the President. The data in Table 18 represent the PCI in March from 1999 to 2017. Construct a time-series plot of the data. In what year was the index highest? In what year was the index lowest?

**Table 18**

| **Year** | **Partisan Conflict Index (PCI)** |
| --- | --- |
| 1999 | 85.87 |
| 2000 | 94.67 |
| 2001 | 78.23 |
| 2002 | 86.67 |
| 2003 | 88.49 |
| 2004 | 98.55 |
| 2005 | 100.07 |
| 2006 | 91.49 |
| 2007 | 85.44 |
| 2008 | 90.87 |
| 2009 | 88.04 |
| 2010 | 142.42 |
| 2011 | 155.83 |
| 2012 | 154.18 |
| 2013 | 180.56 |
| 2014 | 131.4 |
| 2015 | 163.54 |
| 2016 | 173.88 |
| 2017 | 207.72 |

*Source*: Federal Reserve Bank of Philadelphia