STATISTICS

INFORMED DECISIONS USING DATA

Fifth Edition

Chapter 3

Numerically Summarizing Data

Pearson

3.5 The Five-Number Summary and Boxplots

Learning Objectives

1. Compute the **five-number summary**
2. Draw and interpret **boxplots**

3.5 The Five-Number Summary and Boxplots

3.5.1 Compute the Five-Number Summary (1 of 4)

The five-number summary of a set of data consists of the smallest data value, Q_1, the median, Q_3, and the largest data value. We organize the five-number summary as follows:

Five-Number Summary

MINIMUM Q_1 M Q_3 MAXIMUM

3.5 The Five-Number Summary and Boxplots

3.5.1 Compute the Five-Number Summary (2 of 4)

EXAMPLE Obtaining the Five-Number Summary

Every six months, the United States Federal Reserve Board conducts a survey of credit card plans in the U.S. The following data are the interest rates charged by 10 credit card issuers randomly selected for the July 2005 survey. **Determine the five-number summary of the data.**

3.5 The Five-Number Summary and Boxplots

3.5.1 Compute the Five-Number Summary (3 of 4)

EXAMPLE Obtaining the Five-Number Summary

Institution	Rate
Pulaski Bank and Trust Company	6.5%
Rainier Pacific Savings Bank	12.0%
Wells Fargo Bank NA	14.4%
Firstbank of Colorado	14.4%
Lafayette Ambassador Bank	14.3%
Infibank	13.0%
United Bank, Inc.	13.3%
First National Bank of The Mid-Cities	13.9%
Bank of Louisiana	9.9%
Bar Harbor Bank and Trust Company	14.5%

Source: http://www.federalreserve.gov/pubs/SHOP/survey.htm

3.5 The Five-Number Summary and Boxplots

3.5.1 Compute the Five-Number Summary (4 of 4)

EXAMPLE Obtaining the Five-Number Summary

First, we write the data in ascending order:

6.5%, 9.9%, 12.0%, 13.0%, 13.3%, 13.9%, 14.3%, 14.4%, 14.4%, 14.5%

The smallest number is 6.5%. The largest number is 14.5%. The first quartile is 12.0%. The second quartile is 13.6%. The third quartile is 14.4%.

Five-number Summary:

Min=6.5% Q1=12.0% Med=13.6% Q3=14.4% max=14.5%

3.5 The Five-Number Summary and Boxplots

3.5.2 Draw and Interpret Boxplots (1 of 6)

Drawing a Boxplot

Step 1 Determine the lower and upper fences.

Lower Fence = $Q_1 - 1.5(\text{IQR})$

Upper Fence = $Q_3 + 1.5(\text{IQR})$

where IQR = $Q_3 - Q_1$

Step 2 Draw a number line long enough to include the maximum and minimum values. **SCALE LINE ACCURATELY FIRST!!!** Insert vertical lines at Q_1, *Med*, and Q_3. Enclose these vertical lines in a box.

Step 3 Label the lower and upper fences.

3.5 The Five-Number Summary and Boxplots

3.5.2 Draw and Interpret Boxplots (2 of 6)

Drawing a Boxplot

Step 4 Draw a line from Q_1 to the smallest data value that is larger than the lower fence. Draw a line from Q_3 to the largest data value that is smaller than the upper fence. These lines are called **whiskers**.

Step 5 Any data values less than the lower fence or greater than the upper fence are outliers and are marked with an asterisk (*) or an open circle (∘).

3.5 The Five-Number Summary and Boxplots

3.5.2 Draw and Interpret Boxplots (3 of 6)

EXAMPLE Constructing a Boxplot

Every six months, the United States Federal Reserve Board conducts a survey of credit card plans in the U.S. The following data are the interest rates charged by 10 credit card issuers randomly selected for the July 2005 survey. **Construct a boxplot of the data.**

3.5 The Five-Number Summary and Boxplots

3.5.2 Draw and Interpret Boxplots (4 of 6)

EXAMPLE Constructing a Boxplot

Institution	Rate
Pulaski Bank and Trust Company	6.5%
Rainier Pacific Savings Bank	12.0%
Wells Fargo Bank NA	14.4%
Firstbank of Colorado	14.4%
Lafayette Ambassador Bank	14.3%
Infibank	13.0%
United Bank, Inc.	13.3%
First National Bank of The Mid-Cities	13.9%
Bank of Louisiana	9.9%
Bar Harbor Bank and Trust Company	14.5%

Source: http://www.federalreserve.gov/pubs/SHOP/survey.htm

3.5 The Five-Number Summary and Boxplots

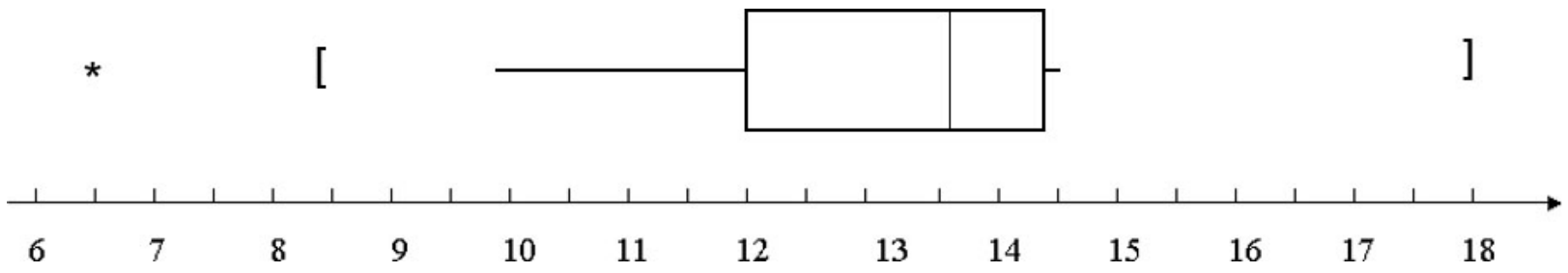
3.5.2 Draw and Interpret Boxplots (5 of 6)

Step 1: The interquartile range (IQR) is 14.4% − 12% = 2.4%. The lower and upper fences are:

$$\text{Lower Fence} = Q_1 - 1.5(\text{IQR}) = 12 - 1.5(2.4) = 8.4\%$$

$$\text{Upper Fence} = Q_3 + 1.5(\text{IQR}) = 14.4 + 1.5(2.4) = 18.0\%$$

Step 2:

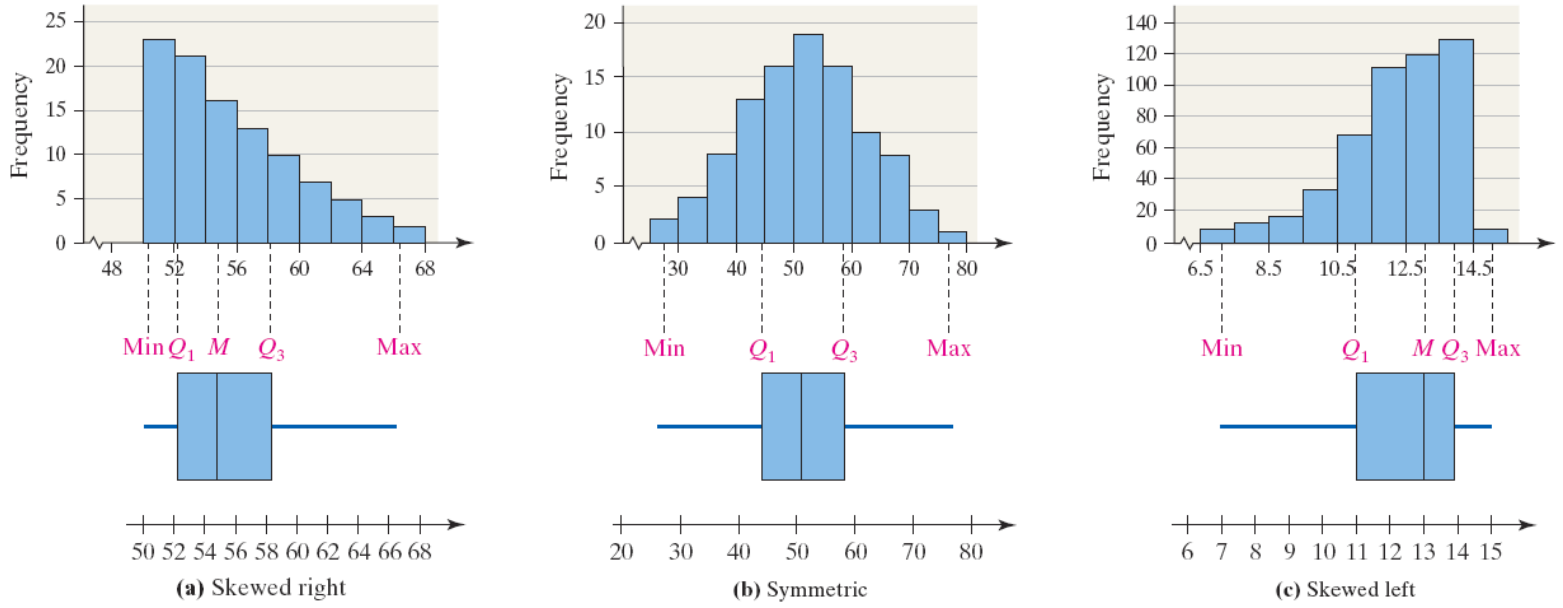


Important Tip: Don't rely on calculator drawing. Do it by hand and scale the number line accurately first!!!!!

3.5 The Five-Number Summary and Boxplots

3.5.2 Draw and Interpret Boxplots (6 of 6)

Use a boxplot and quartiles to describe the shape of a distribution.



The interest rate boxplot indicates that the distribution is skewed left.