

SECTION 3.5 – The Five-Number Summary and Boxplots

Five Number Summary

A list of the following five statistics obtained from a set of data: Minimum Value, First Quartile, Second Quartile, Third Quartile, and Maximum Value (abbreviated Min, Q_1 , Q_2 , Q_3 , Max.)

Boxplot (Box-And-Whisker Diagram)

A graph where the five-number summary and any possible outliers can be displayed.

Drawing a Boxplot

Step 1 Determine the lower and upper fences.

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

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

Step 2 Draw a number line long enough to include the maximum and minimum values. Insert vertical lines at Q_1 , M , and Q_3 . Enclose the vertical lines in a box.

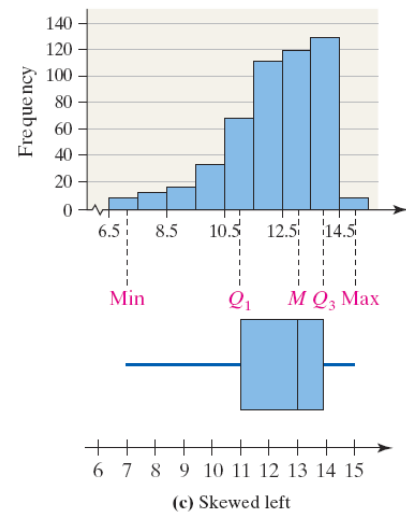
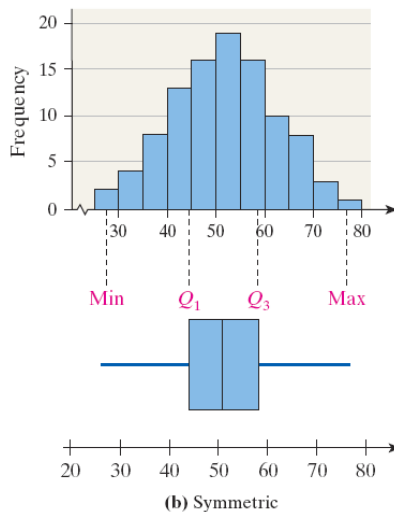
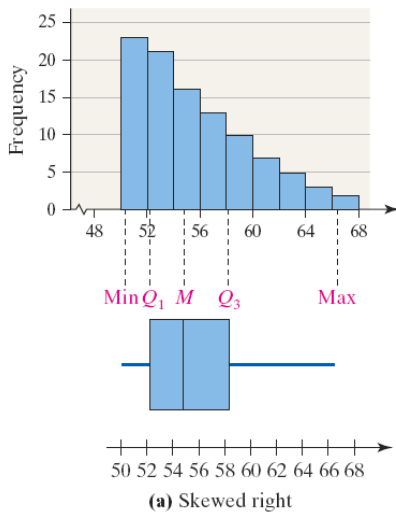
Step 3 Label the lower and upper fences.

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 And data value(s) less than the lower fence or greater than the upper fence are outliers are marked with an asterisk (*).

Using a Boxplot and Quartiles to Describe the Shape of a Distribution

The figure below shows three histograms and their corresponding boxplots with the five-number summary labeled.



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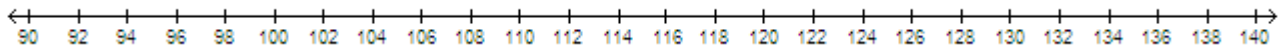
☺ **Exercises:**

- 1) Recall Problem #10 from Section 3.4:

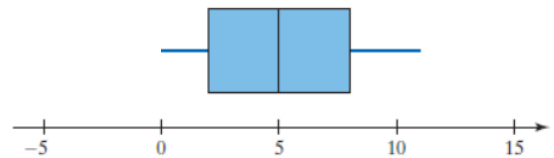
Here are the highest temperatures ever recorded (in °F) in 32 different U.S. states.

93 , 105 , 105 , 105 , 106 , 106 , 107 , 107 , 108 , 110 , 110 , 112 , 112 , 112 , 114 , 114
114 , 115 , 116 , 117 , 118 , 118 , 118 , 118 , 118 , 119 , 121 , 124 , 127 , 129 , 132 , 134

So, we found that $Q_1 = 107.5$, $Q_2 = 114$, $Q_3 = 118$, $IQR = 10.5$, $LF = 91.75$, & $UF = 133.75$. We also concluded that the observation 134 was an outlier. Construct a boxplot of the data.

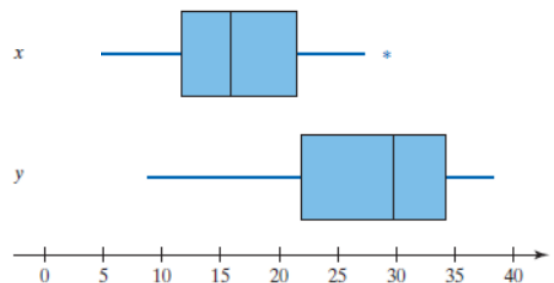


- 2) Identify the shape of the distribution and determine the five-number summary. Assume that each number in the five-number summary is an integer.



- 3) Use the side-by-side boxplots shown to answer the questions that follow.

- a) To the nearest integer, what is the median of variable x ?
- b) To the nearest integer, what is the first quartile of variable y ?
- c) Which variable has more dispersion? Why?
- d) Does the variable x have any outliers? If so, what is the value of the outlier(s)?
- e) Describe the shape of the variable y .



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☺ **Exercises:**

- 4) **Credit Card Plans.** 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.

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

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%

