Lesson 2.5 A

Objective:

SSBAT find the first, second and third quartiles of a data set.
SSBAT find the interquartile range of a data set.
SSBAT represent data using a box and whisker plot.

Standards: M11.E.2.1.2, M11.E.1.1.2

Fractiles

- Numbers that partition or divide an ordered data set into equal parts.

- The median of a data set is a fractile

Quartiles

- Approximately divide a data set into 4 equal parts
- There are 3 quartiles: First, Second, Third

2nd Quartile, Q_2

- The Median of the entire data set

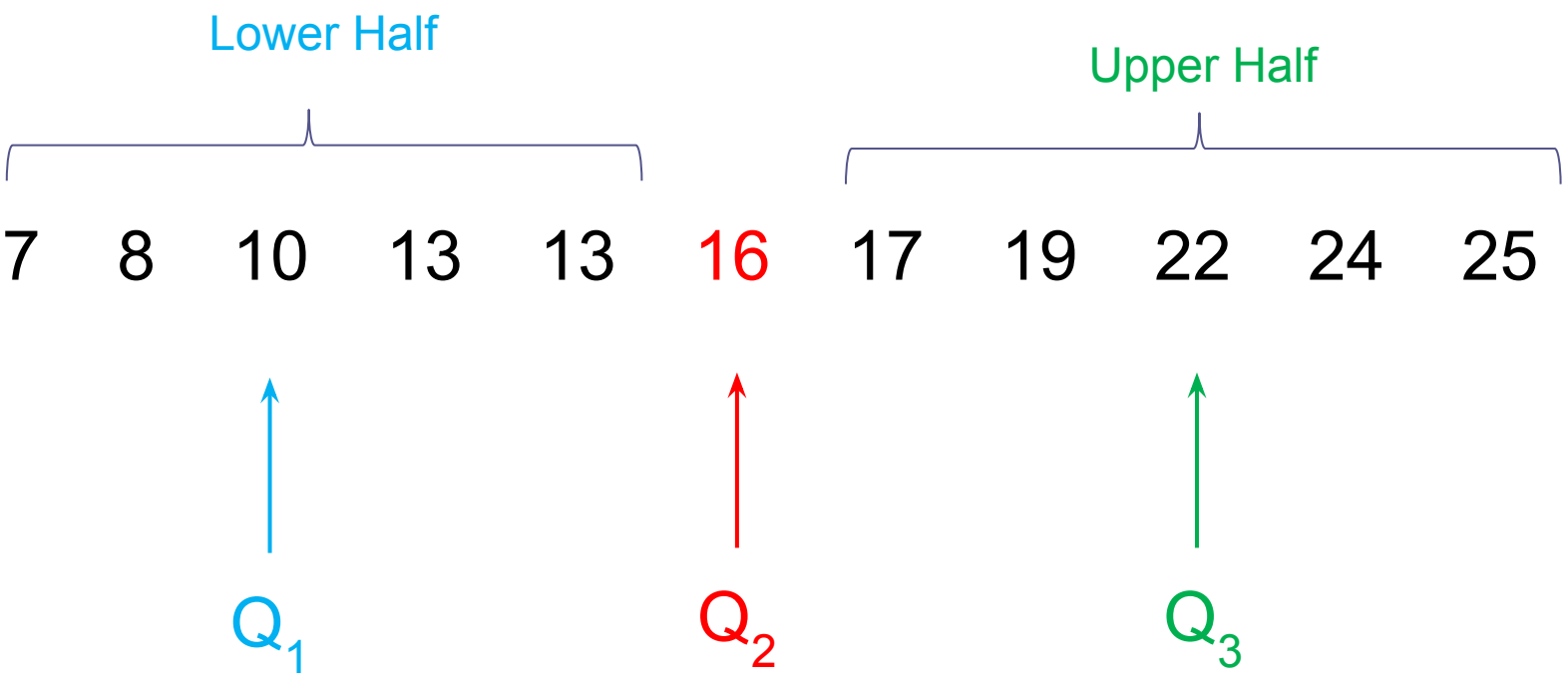
- Half the data entries lie on or below Q_2 and the other half lies on or above Q_2

1st Quartile, Q_1

- The Median of the Lower half of the data set (below Q_2)
- It divides the lower half of the data in half

3rd Quartile, Q_3

- The Median of the Upper half of the data set (above Q_2)
- It divides the upper half of the data in half


Lower Half
Upper Half
7 8 10 13 13 16 17 19 22 24 25
Q1
Q2
Q3

- The Quartiles approximately divide the data into 4 equal parts, therefore 25% of the data is in each part

25% of the data is below Q_1
25% of the data is between Q_1 and Q_2
25% of the data is between Q_2 and Q_3
25% of the data is above Q_3

Example 1: the test scores of 15 employees enrolled in a CPR training course are listed. Find the first, second, and third quartiles of the test scores.

13 9 18 15 14 21 7 10 11 20 5 18 37 16

1st: Write the numbers in order from least to greatest

5 7 9 10 11 13 14 15 16 18 18 20 21 37

$Q_2 = 14.5$

$Q_1 = 10$

$Q_3 = 18$

Example 2: The tuition costs (in thousands of dollars) for 11 universities are listed. Find the first, second, and third quartiles.

20, 26, 28, 19, 31, 17, 15, 21, 31, 32, 16

1st: Write the numbers in order from least to greatest

15 16 17 19 20 21 26 28 31 31 32

$Q_2 = 21$

$Q_1 = 17$

$Q_3 = 31$

Interquartile Range (IQR)

- The difference between the third and first quartiles

$$IQR = Q_3 - Q_1$$

Find the Interquartile range from Example 1

- $Q_1 = 10$ and $Q_3 = 18$

$18 - 10 = 8$

IQR = 8

Find the Interquartile range from Example 2

- $Q_1 = 17$ and $Q_3 = 31$

$31 - 17 = 14$

IQR = 14

IQR – Interquartile Range $(Q_3 - Q_1)$

- Gives an idea of how much the middle 50% of the data varies

- It can also be used to identify Outliers

  - Any number that is more than 1.5 times the IQR to the left of Q_1 or to the right of Q_3 is an outlier

Take a look at Example 1 □ The IQR is 8

5 7 9 10 11 13 14 15 16 18 18 20 21 37

$Q_2 = 14.5$ $Q_1 = 10$ $Q_3 = 18$

Check for Outliers: Multiply 1.5 times the IQR

(1.5)(8) = 12

Add 12 to Q_3 □ 30

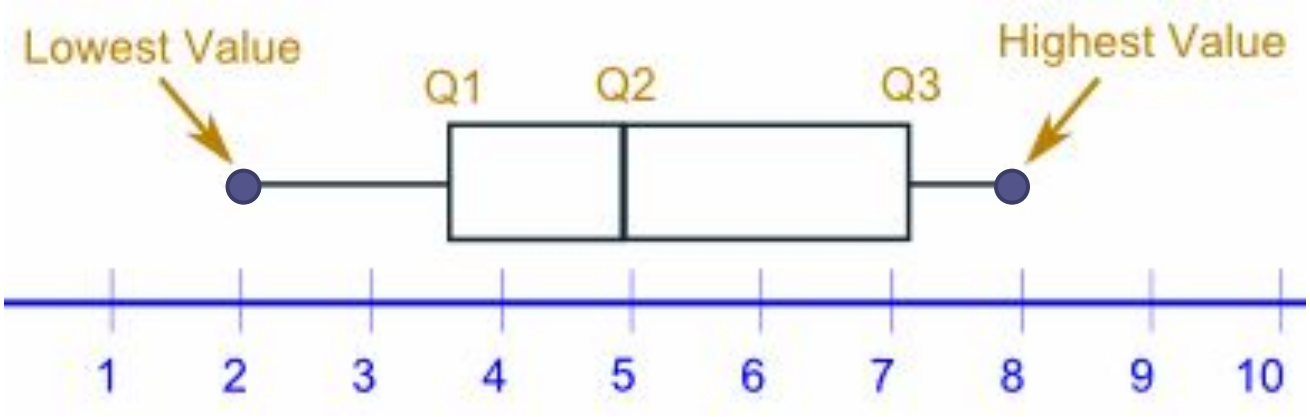
Any number greater than 30 in the set is an outlier □ therefore 37 is an outlier

Subtract 12 from Q_1 □ -2

Any number less than -2 is an outlier □ there are none

Box and Whisker Plot

Example:

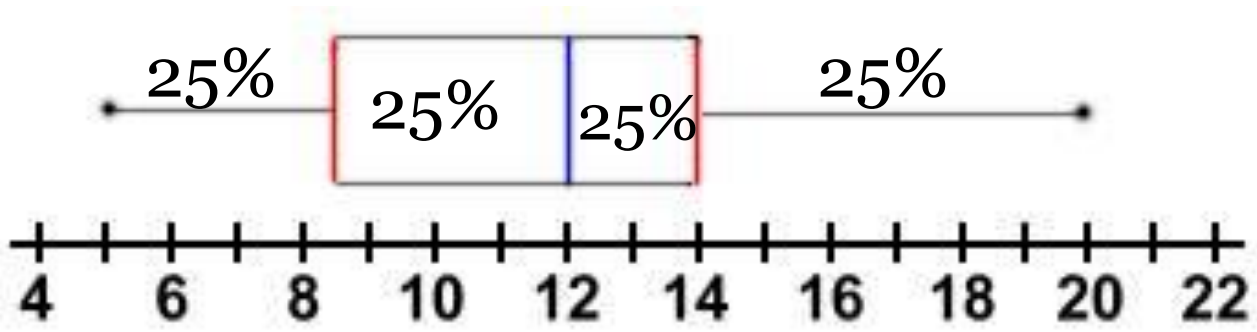


http://www.mathsisfun.com/data/images/box-whisker-plot.gif

Box and Whisker Plot

- A graph that shows the Median (Q_2), Quartile 1, Quartile 3, the lowest number in the set and the highest number in the set

- About 25% of the data set is in each section



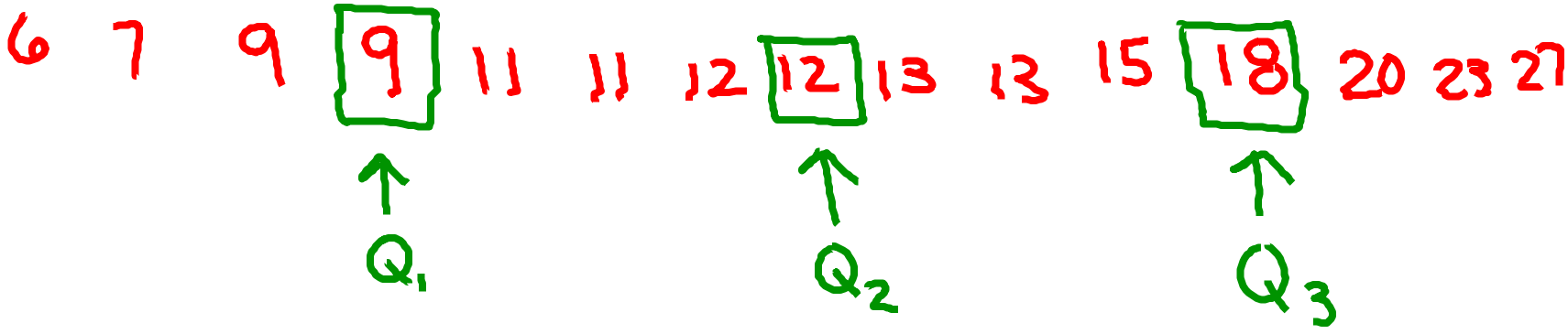
Steps for creating a box and whisker plot

1. Find the Median (Q_2) of all the numbers
2. Find Quartile 1 and Quartile 3
3. Identify the smallest and largest number in the set
4. Make a number line that spans all of the numbers in the set
5. Above the number line, Create a box using Q_1 and Q_3 and draw a vertical line through the box at Q_2
6. Draw whiskers on each side of box to the smallest and largest value in the set – Put a dot at both of these endpoints

Examples: Create a Box and Whisker Plot for each.

1. Years of service of a sample of PA state troopers

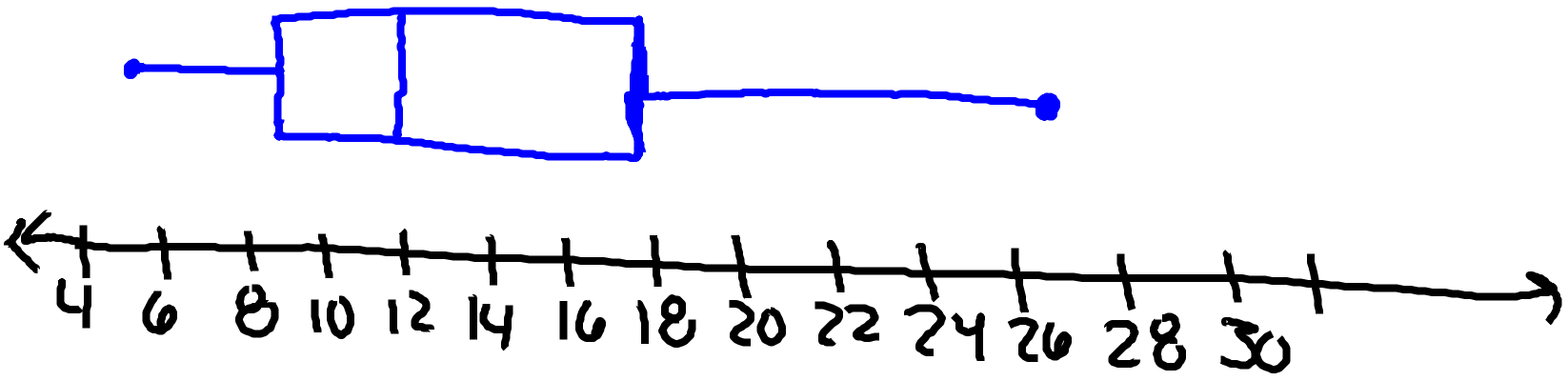
12 7 9 18 9 12 11 13
6 13 20 27 15 11 23



Smallest = 6
Largest = 27

$Q_1 = 9$ $Q_2 = 12$ $Q_3 = 18$

PA State Troopers Years of Service



2. 111 115 122 127 127 147
151 159 160 160 163 168

$Q_2 = 149$

$Q_1 = 124.5$

$Q_3 = 160$

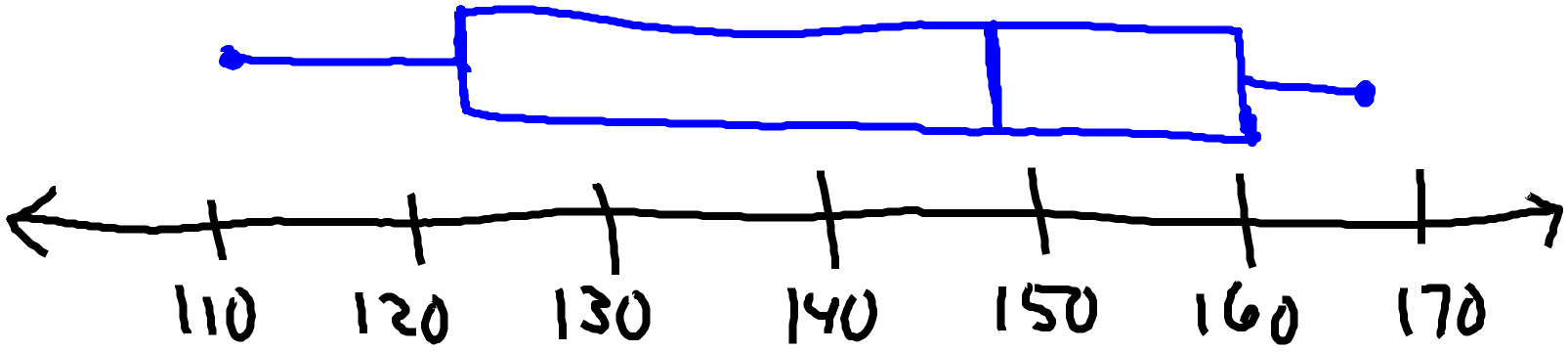
$Q_1 = 124.5$

$Q_2 = 149$

$Q_3 = 160$

Smallest: 111

Largest: 168



Distribution Shape Based on Box and Whisker Plot

- If the median is near the center of the box and each whisker is approximately the same length, the distribution is roughly **Symmetric**.

- If median is to the left of center of the box or right whisker is substantially longer than the left, the distribution is **Skewed Right**.

- If median is to the right of center of the box or the left whisker is substantially longer than the right, the distribution is **Skewed Left**.

- Complete together #11 on page 109

Homework

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#1, 12, 14, 18, 19, 20