Unit 11

Lessons 11.2

Box and Whisker Plots

Objective: To find the Q1,Q2,Q3,interquartile range, range, outliers, maximum, minimum,lower and upper extremes for a set of data from a box and whisker plot.

Life Skills/Math Skills: To be able to interpret box and whisker plots and understand variations in the spread of data and the conclusions that can be made from them.
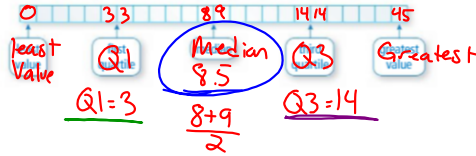
Numbers of First Cousins
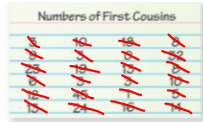
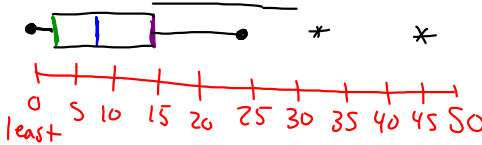**a.** Order the data on a strip of grid paper with 24 equally spaced boxes.

Fold the paper in half to find the median.

b. Fold the paper in half again to divide the data into four groups. Because there are 24 numbers in the data set, each group should have 6 numbers. Find the least value, the greatest value, the first quartile, and the third quartile.

0   33   89   14 14   45

least value   Q1   Median 8.5   Q3   Greatest value

Q1 = 3

$\dfrac{8+9}{2}$

Q3 = 14

mean 10.5

Mode 3

least

0 5 10 15 20 25 30 35 40 45 50

Outliers:

$$IQR = Q3 - Q1$$
$$= 14 - 3$$
$$\boxed{IQR = 11}$$

$$11 \cdot 1.5 = 16.5 \text{ distance}$$

$$Q3 + 16.5$$
$$14 + 16.5 = 30.5$$

anything above 30.5 is an outlier

Song...

YouTube

Verse 1

So, sit right back and I'll tell a tale.
A tale of a guy named Scott.
He figured out the way to draw a Box and Whisker plot
Repeat (A box and whisker plot)

Screencast-O-Matic.com
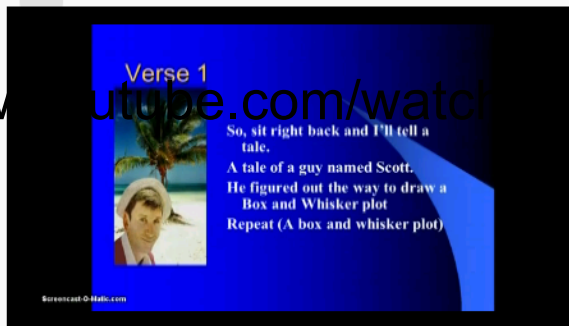
Another explanation.....

https://www.youtube.com/watch?v=UE_NSjgMOBQ

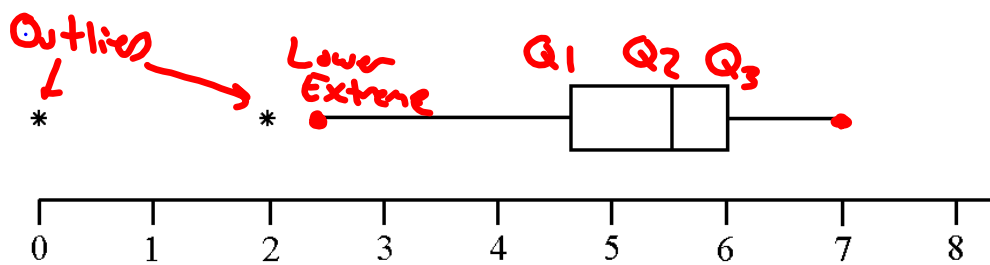Need more examples?

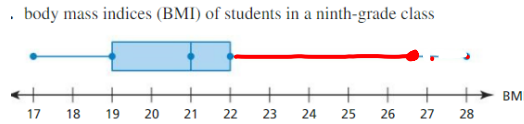https://www.youtube.com/watch?v=BXq5TFLvsVw
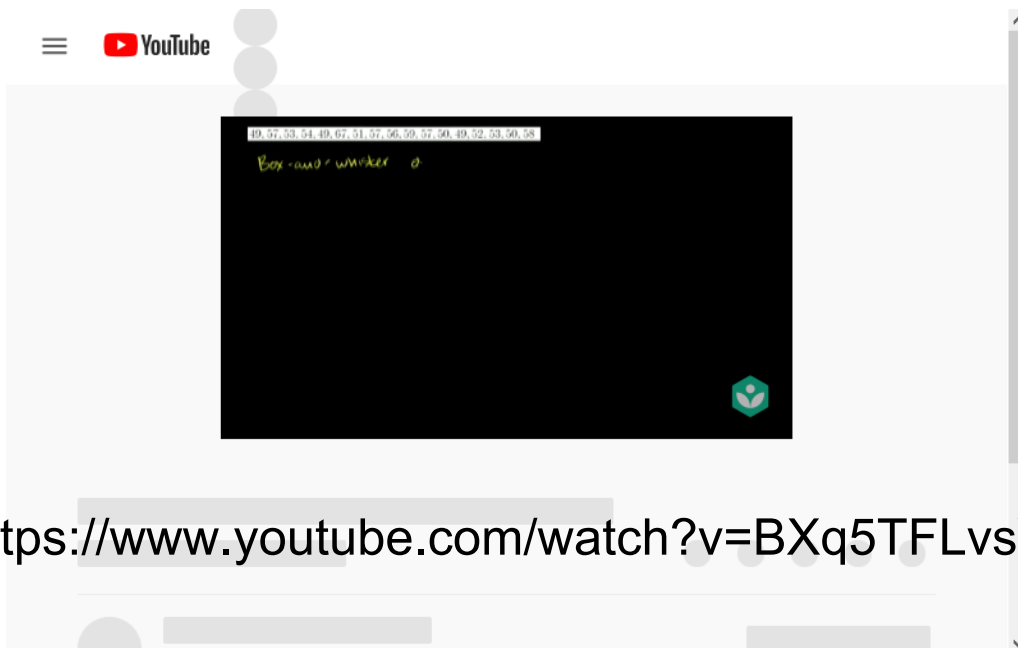
How to draw a Box and Whisker Plot
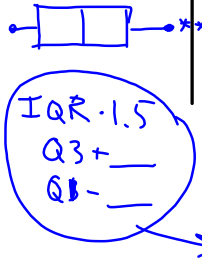
1) Find the Median or Q2: List all data values in order from least to greatest and find the median and draw a vertical line

2) Find the Lower Quartile or Q1: Find the median of the lower half set of data and draw a vertical line

3) Find the Upper Quartile or Q3: Find the median of the upper half set of data draw a vertical line

4) Finish drawing a box around these quartiles

5) Calculate Outliers: Find IQR (subtract Q3 - Q1) and multiply by 1.5. Add to Q3 and subtract fromQ1

6) Draw points at the lower extreme/minimum and the upper extreme/maximum that are not outliers and the whisker lines from them to the box

6) Draw detached points at any outliers

$IQR \cdot 1.5$
$Q3 + \_\_$
$Q1 - \_\_$

Box-and-Whisker Plots

Q1/LQ: 4.6

Q2/Median: 5.5

Q3/UQ: 6

Lower extreme not outlier: 2.3

Upper extreme not oultier: 7

Outliers: 0 and 2

Outlies

Lower Extreme

Q1 Q2 Q3

*   *

0   1   2   3   4   5   6   7   8

Example 1) Use the box-and-whisker plot to answer the questions:

· body mass indices (BMI) of students in a ninth-grade class

a) What are the maximum and minimum values?

$22 - 19 = 3 \rightarrow 3 \cdot 1.5 = 4.5$

28 BMI   17 BMI

b) What are the values of the Lower extreme, Upper Extreme, Lower Quartile Q1, Median Q2, and Upper Quartile Q3?

22   19   21

c) Are there any outliers? If so, what are they?

Yes any BMIs above 26.5 are outliers

d) How is the data spread out?

e) Which direction is the data skewed?

Range   IQR
max - min   Q3 - Q1
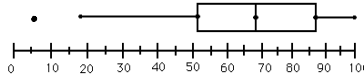28 - 17   22 - 19
  11   3

Distribution	the spread of data far distance : spread out close distance : compact Bell curve / Box & whisker mean average / median
Skewed Left	Screwed up on the left (longer tail on the left) flat on left
Skewed Right	Screwed up on the right (longer tail on the right) flat on right

Example 1) Use the box-and-whisker plot to answer the questions:

max = 100
min = 5

LowExt = 18 — estimate — $Q_1 = 51$
Upper Ext = 100
$Q_2 = 68$
$Q_3 = 87$

a) What are the maximum and minimum values?
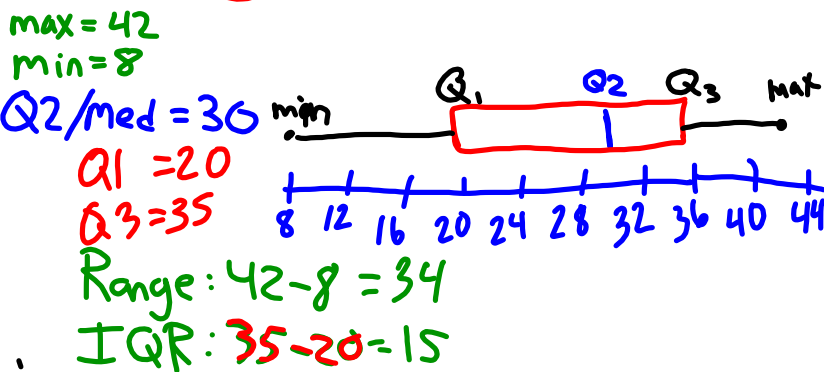Yes at 5

$IQR = Q_3 - Q_1 = 87 - 51$
IQR = 36

b) What are the values of the Lower extreme, Upper Extreme, Lower Quartile Q1, Median Q2, and Upper Quartile Q3?
Range = Max - Min = 100 - 5
Range = 95

c) Are there any outliers? If so, what are they?

d) What is the IQR and the overall range of the data?

ex.   14   30   35   8   29   28
       31   42   20   36   32
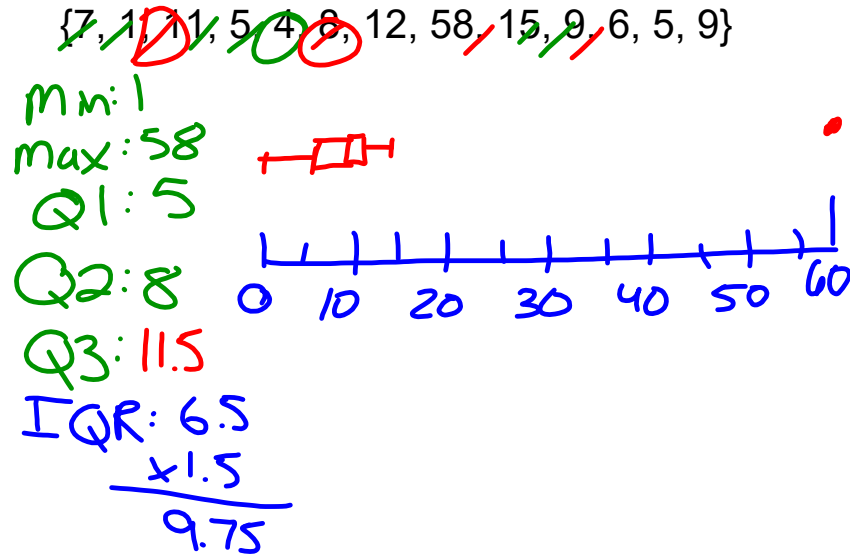
8, 14, (20), 28, 29, (30), 31, 32, (35), 36, 42

max = 42
min = 8
Q2/med = 30
Q1 = 20
Q3 = 35

Range: 42 - 8 = 34
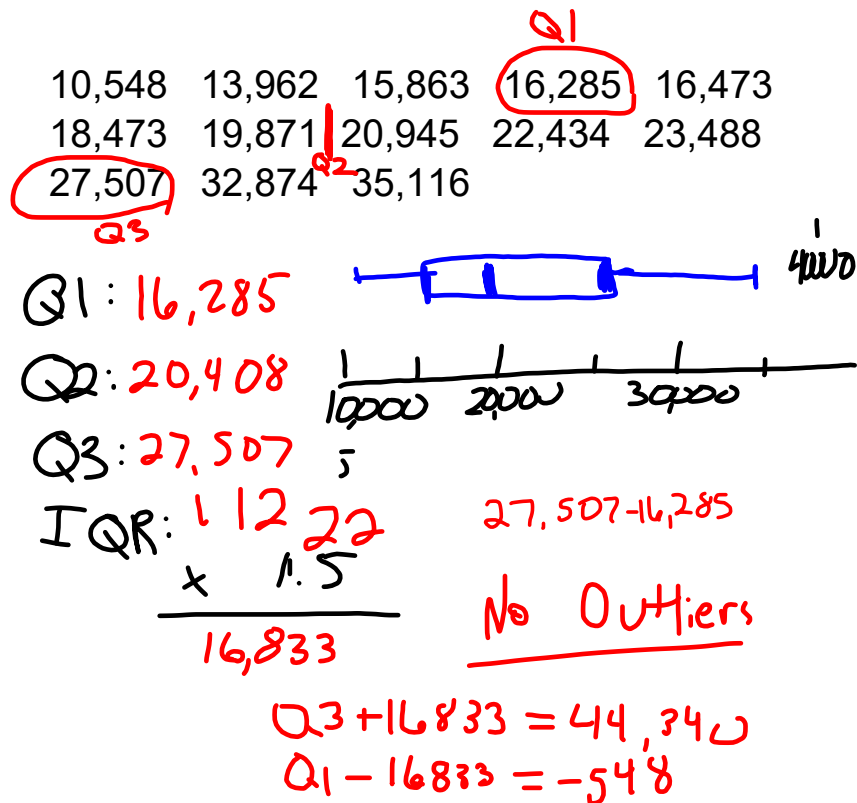IQR: 35 - 20 = 15

Outliers : None
IQR × 1.5 = 15 × 1.5 = 22.5
$Q_1 - 22.5 = 20 - 22.5 = -2.5$ ✓
$Q_3 + 22.5 = 35 + 22.5 = 57.5$ ✓

Example 2) Find the minimum, maximum, Q1, Q2, Q3, and any
outliers in the set of data. Then draw a box-and-whisker plot for
the provided set of data

{7, 1, 11, 5, 4, 8, 12, 58, 15, 9, 6, 5, 9}

min: 1
max: 58
Q1: 5
Q2: 8
Q3: 11.5
IQR: 6.5
$\times 1.5$
_____
9.75

0   10   20   30   40   50   60

Example 3) Use the data from Example 1 to
draw a box-and-whisker plot

Q1
10,548   13,962   15,863   (16,285)   16,473
18,473   19,871 20,945   22,434   23,488
(27,507) 32,874   35,116
Q3   Q2

Q1: 16,285
Q2: 20,408
Q3: 27,507 ;
IQR: 11222
      $\times$ 1.5
   _____
     16,833

10000   20000   30000   40000

27,507-16,285

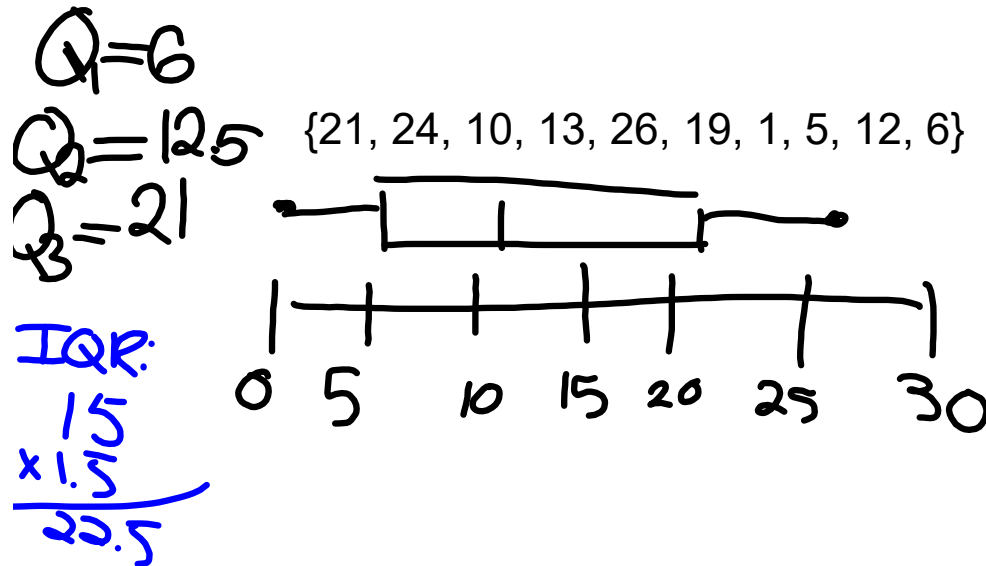**No Outliers**

Q3 + 16833 = 44,340
Q1 - 16833 = -548

Example 4) Find the minimum, maximum, Q1, Q2, Q3, and any
outliers in the set of data. Then draw a box-and-whisker plot for
the provided set of data

$Q_1=6$

$Q_2=12.5$ {21, 24, 10, 13, 26, 19, 1, 5, 12, 6}

$Q_3=21$

IQR:
15
×1.5
22.5

0   5   10   15 20   25   30

Summary

Objective: To find the
Q1,Q2,Q3,interquartile range, range,
outliers, maximum, minimum,lower and
upper extremes for a set of data from a box
and whisker plot.

Virtues/Skills: To be able to interpret box
and whisker plots and understand
variations in the spread of data and the
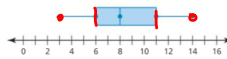conclusions that can be made from them.

Assignment: Textbook pg. 597

#3-15

Box and Whisker Plot Homework

Name:_____

In Exercises 3–8, use the box-and-whisker plot to find the given measure.

In Exercises 9–12, make a box-and-whisker plot that represents the data. *(See Example 1.)*

9. Hours of television watched: 0, 3, 4, 5, 3, 4, 6, 5

Put in order: 0, 2|3, 4, 4, 5|5, 6

Median Q2: **4**   First quartile Q1: **2.5**   Third quartile Q3: **5**

3. least value **3**
4. greatest value **14**   Minimum value: **0**   Maximum value: **6**
5. third quartile **1**
6. first quartile **6**
7. median **8**.
8. range **14 – 3** = **11**

IQR: 5 – 2.5 = 2.5   No.
2.5 × 1.5 = 3.75   Outliers

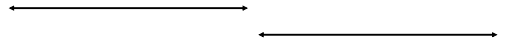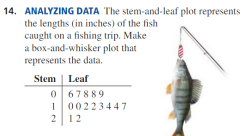**10.** Cat lengths (in inches): 16, 18, 20, 25, 17, 22, 23, 21

Put in order:

Median Q2:___ Q1:___ Q3:___ Min:___ Max:___
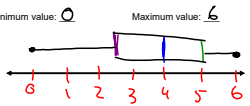
11. Elevations (in feet): −2, 0, 5, −4, 1, −3, 2, 0, 2, −3, 6

Put in order:

Median Q2:___ Q1:___ Q3:___ Min:___ Max:___

12. MP3 player prices (in dollars): 124, 95, 105, 110, 95, 124, 300, 190, 114

95, 95, 105, 110 (114) 124, 124, 190, 300

57 · 1.5 = 85.5
Q3 + 85.5 = 2425
Q1 − 85.5 = 14.5
*

95+105 / 2
Q2 median

124+190 / 2

Q1: 100   IQR: Q3 – Q1   157 – 100 = 57   Q3: 157

13. ANALYZING DATA The dot plot represents the numbers of hours students spent studying for an exam. Make a box-and-whisker plot that represents the data.
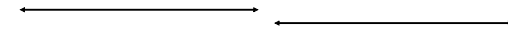
List data in order:
0, 0, 1, 1, 1, 1, 2, 2, 2, 2, 3, 3, 3, 4, 4, 5, 5, 7

Median Q2:___ Q1:___ Q3:___ Min:___ Max:___

14. ANALYZING DATA The stem-and-leaf plot represents the lengths (in inches) of the fish caught on a fishing trip. Make a box-and-whisker plot that represents the data.

Stem	Leaf
0	6 7 8 8 9
1	0 0 2 2 3 4 4 7
2	1 2

Key: 1|0 = 10 inches

List data in order: 6, 7, 8, 8, 9, 10, 10, 12, 12, 13, 14, 14, 17, 21, 22

Median Q2:___ Q1:___ Q3:___ Min:___ Max:___

What measures of center are very easy to find from a dot plot?

What do you notice out the distribution or spread of the dot plot as compared to the box and whisker plot?

What measures of center are very easy to find from a stem and leaf plot?

Was it easier to list the data from a stem and leaf plot, from a dot plot or from a list? Explain your choice.

9.

 Hours

3. 3

4. 14

10.

 Length (inches)

5. 11

6. 6

11.

 Elevation (feet)

7. 8

12.

 Price (dollars)

8. 11

13.

 Hours

14.

 Length (inches)

15. a. 9.5; The prices vary by no more than $9.50.
   b. 25% of the prices are between $8.75 and $10.50, 50% of the prices are between $10.50 and $14.75, and 25% of the prices are between $14.75 and $18.25.
   c. 4.25; The middle half of the prices vary by no more than $4.25.
   d. above Q3; the whisker is longer