Accelerated Pre-Calculus

9.01: Review of Measures of Center and Spread

Date: _____

median 4
↓
1 2 4 9 100 | 1 1 2 2 5 6
1 2 ④ ⑥ 12 15

3 MEASURES OF CENTRAL TENDENCY

Mean	Median	Mode
Denoted as $\bar{x}$, "x-bar" the average $\bar{x} = \dfrac{\Sigma x}{n}$ Sum of all the values # of terms	The number in the middle when the data is arranged in ascending order. If there are 2 numbers in the middle, then find their average.	The number which occurs most frequently. There does not have to be a mode. There can be more than one mode. Bimodal – 2 modes Trimodal – 3 modes

Example 1: Given scores from the latest test: 90, 89, 78, 81, 68, 100, 84, 83, 83, 74, 88, 80, 73, 89, 32

a) Find the measures of central tendency. Don't forget to put the data in ascending order!!!

$n = 15$

$\dfrac{1192}{15} =$

32 68 73 74 78 80 81 |83| 83 84 88 89 89 90 100

Q1 (74)   Q2   89 (Q3)

Mean: 79.47   Median: 83   Mode: 83, 89

5 NUMBER SUMMARY

| Minimum (Lower Extreme)	Lower (1st) Quartile Q_1	Median (2nd Quartile) Q_2	Upper (3rd) Quartile Q_3	Maximum (Upper Extreme)
Smallest number	The median of the lower half. If there are 2 numbers find their average.	Divides the data into a lower and upper half.	The median of the upper half. If there are 2 numbers find their average.	Largest number

b) Find the 5-Number Summary of the test data above.

Min: 32 Q_1: 74   Median: 83 Q_3: 89   Max: 100

Box and Whisker Plot - A plot that displays the 5 number summary:

1. Draw a number line and scale it appropriately. Keep the minimum and maximum in mind.
2. Place points above the number line for each number in the 5 number summary.
3. Connect the minimum and Q_1 with a segment as well as Q_3 and the maximum.
4. Draw a box from Q_1 to Q_3.
5. Draw a vertical segment through the median.

c) Draw a box and whisker plot for the previous test data.

Min   Q1   Q2 Q3   Max

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30   40   50   60   70   80   90   100
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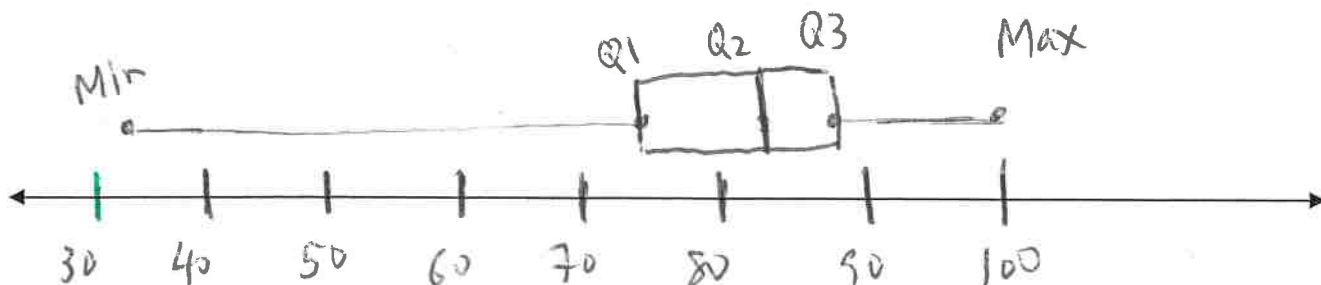
SHAPE OF A BOX AND WHISKER PLOT

Symmetric	Skewed Left	Skewed Right
mean = median	mean < median	mean > median

MEASURES OF DISPERSION (SPREAD)

Range	Interquartile Range	Mean Absolute Deviation mean = 79.47
The difference in the **maximum** and the **minimum**. (Max – Min)	The difference in the **upper** quartile and **lower quartile**. ($Q_3 - Q_1$) $Q3 = 89$ $Q1 = 74$	$$MAD = \frac{\sum |x_i - \bar{x}|}{n}$$

d) Find the measures of spread for the given data set of test scores.

Range = ___68___   IQR = ___15___   MAD = _____
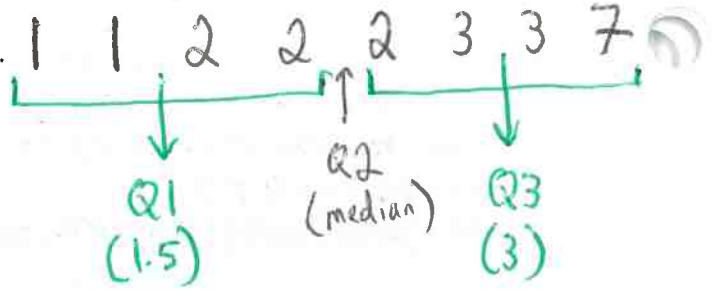
$$MAD = \frac{144.65}{15}$$

$$MAD = 9.64$$

$100 - 32 =$

X	$\bar{X}$	$X - \bar{X}$
90	79.47	10.53
89	79.47	9.53
78	79.47	1.47
81	79.77	1.53
68	79.47	11.47

X	$\bar{X}$	$X - \bar{X}$
100	79.47	20.53
84		4.53
83		3.53
83		3.53
74		5.47
88		8.53

X	$\bar{X}$	$X - \bar{X}$
80	79.47	0.53
73		6.47
89		9.53
32		47.47

Example 2:

a) List the number of pets from 8 of your classmates. $1 \quad 1 \quad 2 \quad 2 \quad 2 \quad 3 \quad 3 \quad 7$

$$\bar{x} = \frac{21}{8} = 2.625$$

Q1 (1.5)   Q2 (median)   Q3 (3)

b) Calculate all measures of center, and the 5 number summary for the data.

$\bar{x} =$ ___2.63___   Median: ___2___   Mode: ___2___

Min: ___1___ Q_1: ___1.5___   Median: ___2___ Q_3: ___3___   Max: ___7___

c) Construct a box plot and describe the shape of the data.

Shape: ___skewed right___

1 7
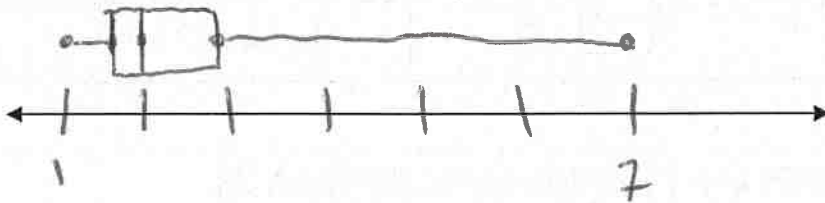
d) Calculate the measures of spread.

Range = ___$7-1 = \boxed{6}$___   IQR = $\dfrac{3-1.5}{} = \boxed{1.5}$ MAD = ___1.282___

MAD

X	$\bar{x}$	$x-\bar{x}$
1	2.63	1.63
1	2.63	1.63
2	2.63	0.63
2	2.63	0.63

X	$\bar{x}$	$x-\bar{x}$
2	2.63	0.63
3		0.37
3		0.37
7		4.37

$$MAD = \frac{10.26}{8} = 1.282$$

BEST MEASURE OF CENTER AND SPREAD	
SYMMETRIC WITH NO OUTLIERS	SKEWED or WITH OUTLIERS
Mean and Mean Absolute Deviation (MAD)	Median and Interquartile Range (IQR)

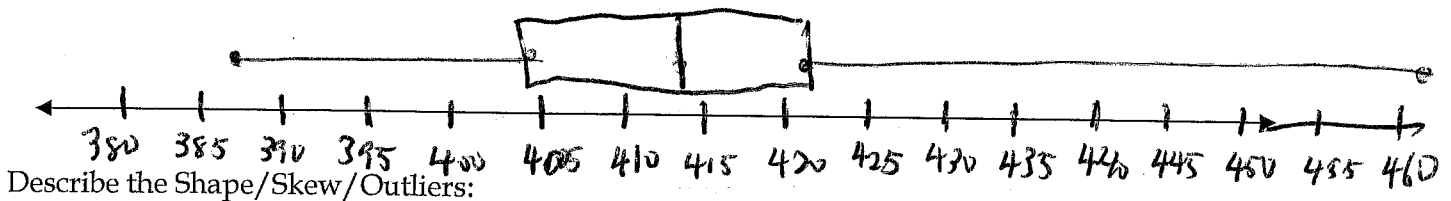9.01 Homework: Statistics Review   Date: _____

1. Calculate all measures of center, spread, and the 5 number summary for the data provided. Construct a box plot and describe the shape of the data. Indicate if there are any outliers.

Homerun distances (in feet) to center field in 13 ballparks: $n = 13$
387, 400, 400, 410, 410, 410, 414, 415, 420, 420, 421, 457, 461

405
(Q1)

Q2
(median)
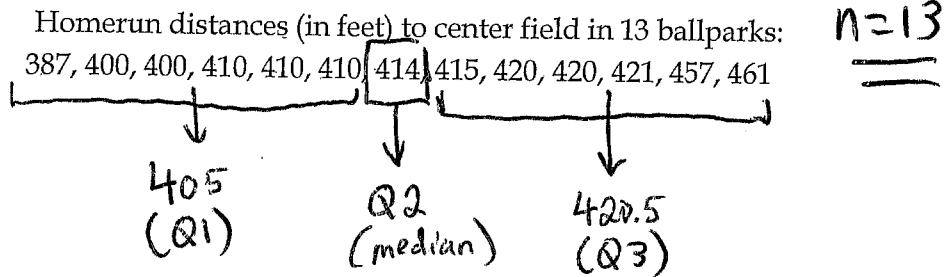
420.5
(Q3)

$\bar{x} =$ __417.308__   Median: __414__   Mode: __410__

Min: __387__   Q1: __405__   Median: __414__   Q3: __420.5__   Max: __461__

461 − 387   Q3 − Q1

Range = __74__   IQR = __15.5__   MAD = __14.225__

380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460

Describe the Shape/Skew/Outliers:

Skewed Right

outliers: 457, 461

2. Suppose that the numbers of unnecessary procedures recommended by five doctors in a 1 month period are 2, 2, 8, 10, and 18. If we ask a 6th doctor and find out that they recommend 35 procedures.

(a) How will the Median and Mean be affected?

first 5 $\bar{x} = 8$ 6 doctors   Both mean and median will both increase
          Median = 8 $\bar{x} = 12.5$ but mean increases by larger amount since
                               Median = 10   data is skewed right.

(b) How will the IQR and Mean Absolute Deviation be affected?

IQR = 8   IQR = 16   Both IQR and MAD still
MAD = 4.8   MAD = 9   increases by double the
                                    value.

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3. Suppose the salaries (in dollars) of six employees are: 8000, 10000, 15000, |16000, 20000 and 39000.

Q2

   a. What are the Median and Mean salaries?

   Median: $ 15,500

   Mean: 18,000

   b. Why are they such different numbers?

   $39,000 is an outlier that more significantly impacts the mean

   c. Which measure of center is the better pick to describe this data? Why?

   Median b/c it's less affected by the outlier

4. Based solely on the given mean and median, decide on the shape of each distribution (skewed left, skewed right, or approximately symmetric):

   a. Mean = 100 Median = 98   Shape: approximately symmetric
            close together

   b. Mean = 20   Median = 41   Shape: skewed left
         mean significantly
              less

   c. Mean = 934 Median = 850   Shape: skewed right
         mean significantly
              more