

Last time:

13.4 #18, 20, 29, 41 (from last time)

Additional Homework for Tonight:

13.4 #1-3, 5-8, 22-23, 25, 28, 34

Quiz Thursday on 13.1 - 13.4, plus 13.5's empirical rule and z-scores.

Oct 7-9:02 AM

## Construct a box plot.

The depth of snow at a ski resort are collected every year for 12 years on the 1st of February. All data is in centimeters and arranged in numerical order...

40, 45, 55,  $Q_1$  60, 65, 65,  $m$  70, 75, 75,  $Q_3$  80, 85, 90

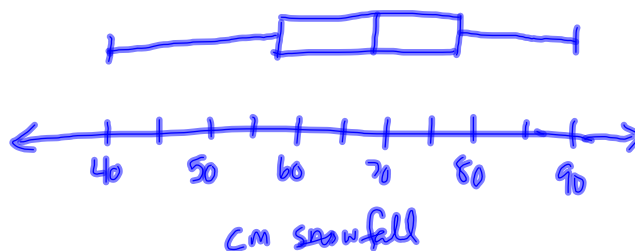
$$\text{Min} = 40$$

$$Q_1 = 57.5$$

$$\text{Med} = 67.5$$

$$Q_3 = 77.5$$

$$\text{Max} = 90$$



Oct 6-9:32 AM

# IQR and Outliers

← a measure of spread  
(it is resistant  
to outliers)

We define the interquartile range as the difference between the first and the third quartile,  $Q_3 - Q_1$ . It tells us the boundary for which 50% of the data lies.

To find outliers:

- Find the IQR
- Multiply the IQR by 1.5
- Outliers will be any points that lie 1.5IQR below  $Q_1$  and 1.5IQR above  $Q_3$ .

Oct 6-9:32 AM

The data represents the annual chocolate sales (in billion of dollars) for a sample of eight countries in the world. Show that \$16.6 billion is an outlier for this data set.

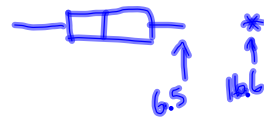
\$2.0, 2.1, 3.2, 4.9, 5.1, 5.7, 6.5, 16.6  
 $Q_1$                        $m$                        $Q_3$

$$M = 5.0$$

$$Q_1 = 2.65$$

$$Q_3 = 6.1$$

$$\left. \begin{array}{l} Q_1 = 2.65 \\ Q_3 = 6.1 \end{array} \right\} Q_3 - Q_1 = IQR = 3.45$$



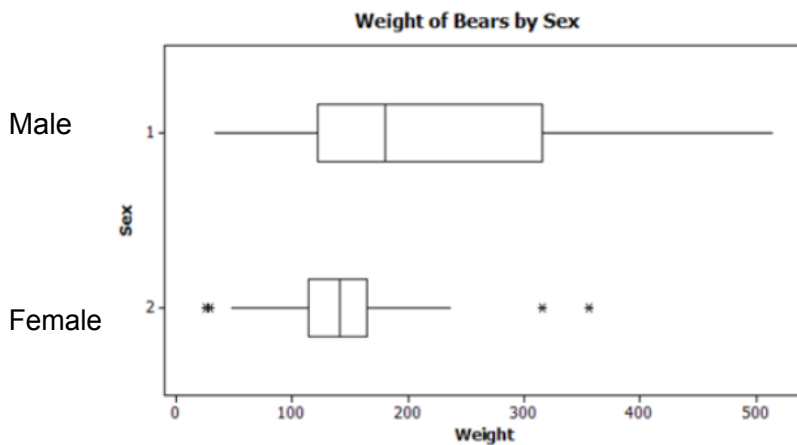
$$\text{Outliers: } Q_3 + 1.5(IQR)$$

$$= 6.1 + 5.175 = 11.275$$

Since  $16.6 > 11.275$ , we say that 16.6 is an outlier.

Oct 6-9:32 AM

# Interpreting Box Plots



Describe the weight differences between male and female bears.

- \*male bears heavier; also have wider range of weights.
- \*lower weights for females, but some exceptions (outliers).
- \*males tend to be heavier (median is higher, and Q3 is higher)

Oct 6-9:32 AM

In a study about truck drivers, the heart rates of 33 sampled drivers were taken. The results of the study are summarized using a stem-and-leaf plot given below.

1. Find any outliers.
2. Construct a modified box plot, marking outliers with \*.

5	2355579
6	003334466788
7	113346777
8	0246
9	1

$$Q_1 = 60$$

$$M = 67$$

$$Q_3 = 76.5$$

$$IQR: 16.5$$

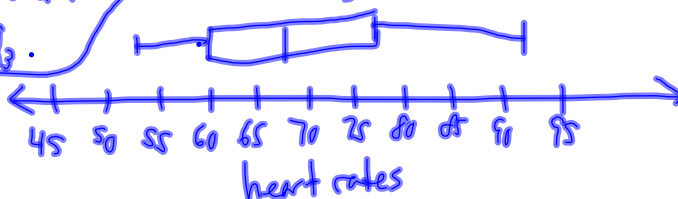
$$1.5 \times IQR = 24.75$$

$$Q_1 - 24.75 = 35.25$$

$$Q_3 + 24.75 = 101.25$$

} no outlier outside this range

Remember to exclude the median when finding  $Q_1$  &  $Q_3$ .



Oct 6-9:32 AM

## Measures of Position - Overview

Percentile: The number  $x$  is "in the  $n$ th percentile" if approximately  $n\%$  of the items in the distribution are less  $x$ .

Quartiles:  
 Q1 = 25th percentile  
 Q2 = 50th percentile (a.k.a., the median)  
 Q3 = 75th percentile

Deciles:  
 D1 = 10th percentile  
 D2 = 20th percentile  
 ...  
 D9 = 90th percentile

z-scores:  $z = (x - \text{mean}) / \text{st.dev}$   
 Tells how many standard deviations  $x$  is above the mean.  
 (If  $z < 0$ , then  $x$  is below the mean.)

Oct 7-8:43 AM

*Key: 1/0 is 1.0*

### Reaction Time Data (drop distances in inches)

1	00
2	
3	0005
4	00055
5	000055
6	0000055
7	0000055
8	00000
9	5
10	003
11	5
12	0
13	0
14	0
15	
16	5

<b>n =</b>	<b>45</b>
<b>Mean =</b>	<b>6.7</b>
<b>Std Dev =</b>	<b>3.2</b>
<b>max</b>	<b>16.5</b>
<b>min</b>	<b>1.0</b>
<b>q1</b>	<b>5.0</b>
<b>q3</b>	<b>8.0</b>
<b>median</b>	<b>6.0</b>

1. What reaction time is in the 3rd decile (a.k.a the 30th percentile)?

*30% of 45 = 13.5, → so 5.0 is the score in the 30th percentile*

2. What reaction time is the 75% percentile?

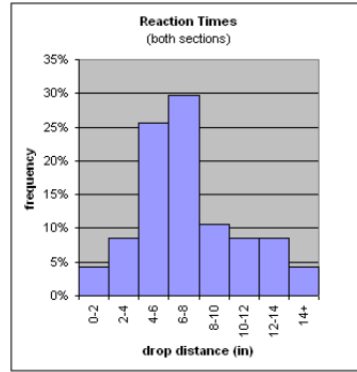
*8.0*

Oct 7-8:51 AM

1 00  
 2  
 3 0005  
 4 00055  
 5 0000055  
 6 0000055  
 7 0000055  
 8 0000  
 9 5  
 10 003  
 11 5  
 12 0  
 13 0  
 14 0  
 15  
 16 5

Reaction Time Data  
 (drop distances in inches)

n =	45
Mean =	6.7
Std Dev =	3.2
max	16.5
min	1.0
q1	5.0
q3	8.0
median	6.0



3. Calculate the skewness coefficient  $k = 3(\text{mean} - \text{median})/\text{st.dev.}$

Is this data set skewed left or right?

$$k = 3(6.7 - 6.0) / 3.2 \approx .66 > 0$$

4. What is the z-score for 3.5 inches? for 7 inches? 10 inches?

Interpret your result.

$$z = \frac{3.5 - 6.7}{3.2} = -1 \quad (\text{So } 3.5 \text{ is } 1 \text{ st. dev. below the mean.})$$

$$z = \frac{(10 - 6.7)}{3.2} \approx 1.02$$

Oct 7-8:58 AM

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Oct 7-9:28 AM