

## Section 3.3 Percentiles and Box-and-Whisker Plots

Objective: In this lesson you learned to interpret percentile scores; compute five-number summaries; and make, interpret, and describe box-and-whisker plots.

Important Vocabulary		
Percentile	Quartiles	Interquartile Range (IQR)
Five-Number Summary	Box-and-whisker Plot	

### I. Percentiles

General definition of the  $P$ th percentile:  
for whole numbers  $P$  (where  $1 \leq P \leq 99$ ), the  $P$ th percentile of a distribution is a value such that  $P\%$  of the data fall at or below it and  $(100-P)\%$  of the data fall at or above it.

#### Focus Point:

- Interpret the meaning of percentile scores
- Compute the median, quartiles, and five-number summary from raw data

How to compute quartiles:

1. Order the data from smallest to largest

2. Find the median ( $Q_2$ )

3. The first Quartile ( $Q_1$ ) is the median of the lower half.

4. The third Quartile ( $Q_3$ ) is the median of the upper half.

} not including  $Q_2$

What is the interquartile range (IQR)? How is it calculated?

A useful measure of data spread

Measures the middle 50% of data.

$$IQR = Q_3 - Q_1$$

## II. Box-and-Whisker Plots

### Five-Number Summary

lowest value,  $Q_1$ , median,  $Q_3$ , Highest value

What is a box-and-whisker plot?

Another Exploratory Data Analysis tool

### Focus Point:

- Make a box-and-whisker plot. Interpret the results.
- Describe how a box-and-whisker plot indicates spread of data about the median

How to make a box-and-whisker plot:

1. Draw horizontal/vertical scale to include the lowest/highest value(s).
2. Above/ to the right of the scale, draw a box from  $Q_1$  to  $Q_3$
3. Include a solid line through the box at the median value.
4. Draw vertical lines called whiskers from  $Q_1$  to the lowest value and from  $Q_3$  to the highest value.

What does a box-and-whisker plot tell us:

A box-and-whisker plot is a visual display of data around the median

- the max, min,  $Q_1$ ,  $Q_3$ , & median values
- How data is spread around the median
- location of middle half of the data
- if there are outliers

### Section 3.3 Examples – Percentiles and Box-and-Whisker Plots

- (1) You took the English achievement test to obtain college credit in freshman English by examination.
- If your score is at the 89th percentile, what percentage of scores are at or below yours?

89% of the scores are at or below yours

- If the scores range from 1 to 100 and your raw score is 95, does this necessarily mean that your score is at the 95th percentile?

No, percentile gives an indication of relative position of the scores.

- (2) Many people consider the number of calories in an ice cream bar as important as, if not more important than, the cost. The *Consumer Reports* article also included the calorie count of the rated ice cream bars (see table). There were 22 vanilla-flavored bars rated. Again, the bars varied in size, and some of the smaller bars had fewer calories. The calorie counts for the vanilla bars follow.

**Calories in Vanilla-Flavored Ice Cream Bars**

342	377	319	353	295
234	294	286	377	182
310	429	111	201	182
197	209	147	190	151
131	151			

- Order the data.

Ordered Data				
111	131	147	151	151
182	182	190	197	201
209	234	286	294	295
310	319	342	353	377
377	439			

*Handwritten notes:*  $Q_1$  points to 182.  $Q_3$  points to 319. A bracket under 209 and 234 is labeled "median between these values".

- There are 22 data values. Find the median.

$$\text{Median} = \frac{209 + 234}{2} = 221.5$$

- How many values are below the median position? Find  $Q_1$ .

11 values below

$$Q_1 = 182$$

- There are the same number of data above as below the median. Use this fact to find  $Q_3$ .

11 values above

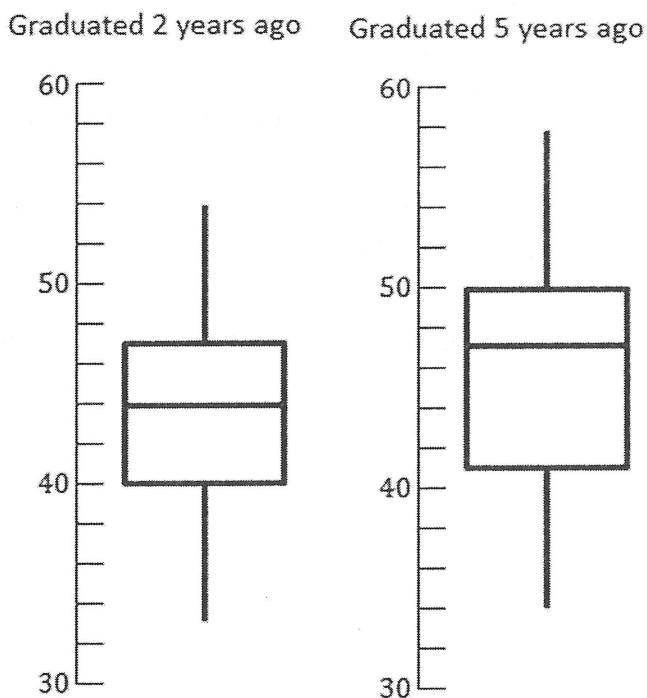
$$Q_3 = 319$$

- Find the interquartile range (IQR) and comment on its meaning.

$$IQR = 319 - 182 = 137$$

the middle 50% of the data has a range of 137

(3) The Renata College Development Office sent salary surveys to alumni who graduated 2 and 5 years ago. The voluntary responses received are summarized in the box-and-whisker plots shown below.



- a. From the plots shown, estimate the median and extreme values of salaries of alumni graduating 2 years ago. In what range are the middle half of the salaries?

<u>Extreme values</u>	<u>median</u>	<u>IQR</u>
\$33,000	\$44,000	\$40,000 - \$47,000
\$54,000		

- b. From the plots shown, estimate the median and extreme values of salaries of alumni graduating 5 years ago. What is the location of the middle half of the salaries?

<u>Extreme values</u>	<u>median</u>	<u>IQR</u>
\$34,000	\$47,000	\$41,000 - \$50,000
\$58,000		

- c. Compare the two box-and-whisker plots and make comments about the salaries of alumni graduating 2 and 5 years ago.

The salaries of the alumni graduating 5 years ago have a larger range. The salaries begin slightly higher and extend further as well. The IQR is also more spread out.