

# Chapter 2

volunteers to read  
p. 90

Human dot plot

What percent of the students in the class  
have heights less than yours?

What percent of the students have  
heights less than or equal to yours?

- ESSENTIAL QUESTION *Where do I stand?*
- PACING **7 days**

**Chapter 2: Modeling Distributions of Data**

2.1 Describing Location in a Distribution	2 Days
2.2 Density Curves and Normal Distributions	3 Days
Review, FRAPPY!, and Test	2 Days

Next Test  
Wed 9/25

Aim

Find and interpret  
the percentile of an  
individual value in a  
distribution of data

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Find and interpret the percentile of an individual value in a distribution of data

Find & Interpret the Standardize score (z-score) of an individual value in a distribution of data

Aim

Find and interpret the percentile of an individual value in a distribution of data

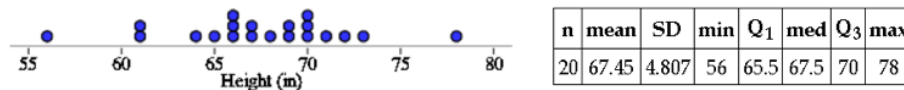
Find & Interpret the Standardize score (z-score) of an individual value in a distribution of data

Estimate Percentiles using a Cumulative Relative Frequency graph

Pick Up  
the handout  
do #1 and #2

AP Stats 2.1 Day 1 **Where do I stand?**  
How does my height compare with other AP Stats students?

The dotplot below represents a random sample of the heights of 20 AP Stats students to the nearest inch.



1. Do you agree with the description of the distribution below.

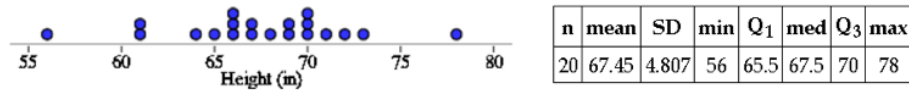
The shape of the distribution of heights is bimodal and fairly symmetric. There are outliers at 56 and 78 inches. The center is around the mean of 67.45 inches and the standard deviation of 4.807 inches

2. a. Arianna is 65 inches tall. What percent of the heights are less than or equal to 65?
- b. What is your height? \_\_\_\_\_ Assuming this was your class, what percent of the heights are less than or equal to your height?

SOCV  
+  
context

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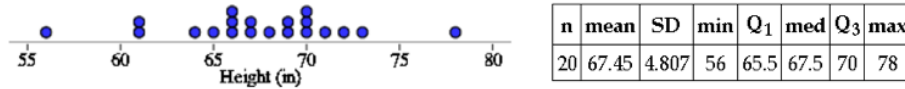
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Formalize

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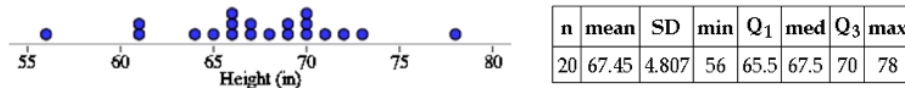
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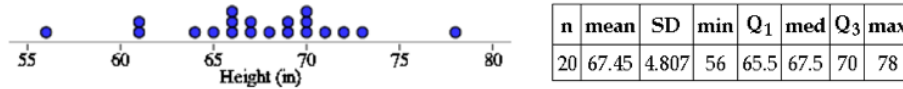
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Percentile  
- describe  
locations  
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The shape of the distribution of heights is bimodal and fairly symmetric. There are outliers at 56 and 78 inches. The center is around the mean of 67.45 inches and the standard deviation 4.807 inches.

2. a. Arianna is 65 inches tall. What percent of the heights are less than or equal to 65?  $5/20 = 0.25 = 25\%$  at the 25<sup>th</sup> percentile  
 b. What is your height? \_\_\_\_\_ Assuming this was your class, what percent of the heights are less than or equal to your height?

SOCV  
+  
context

Percentile  
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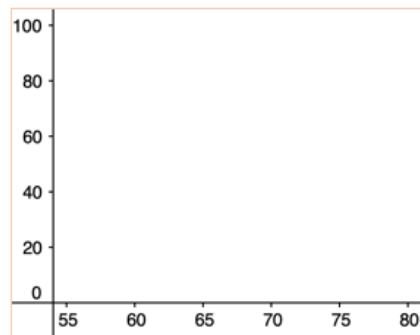
3. Complete the table. <sup>+</sup>

Height	Frequency	Relative Frequency	Cumulative Relative Freq.
55-60	1	$1/20 = 5\%$	5%
61-65	4	$4/20 = 20\%$	25%
66-70	11	$11/20 = 55\%$	80%
71-75	3	$3/20 = 15\%$	95%
76-80	1	$1/20 = 5\%$	100%

3. Complete the table.

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4. Use the info in the table to create a **cumulative relative frequency graph**.Cumulative  
Relative  
Frequency

Height (in)

a. If Mr. C is 70 inches tall. Estimate and interpret the percentile he is at using the graph.

b. Estimate and interpret the 80<sup>th</sup> percentile.

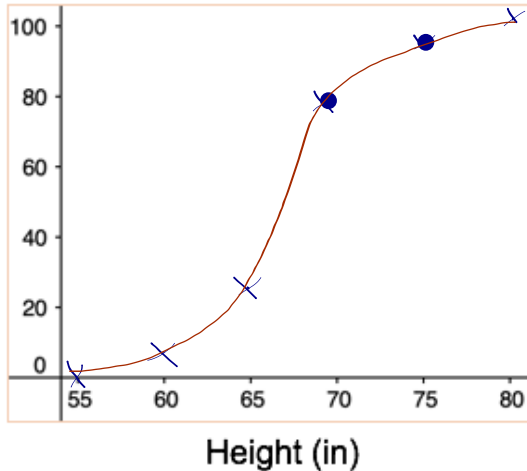


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PLOT

$(60, 5)$   
 $(65, 25)$   
 $(70, 80)$   
 $(75, 95)$   
 $(80, 100)$

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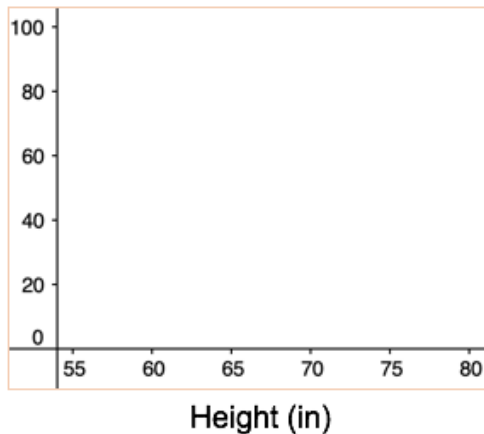
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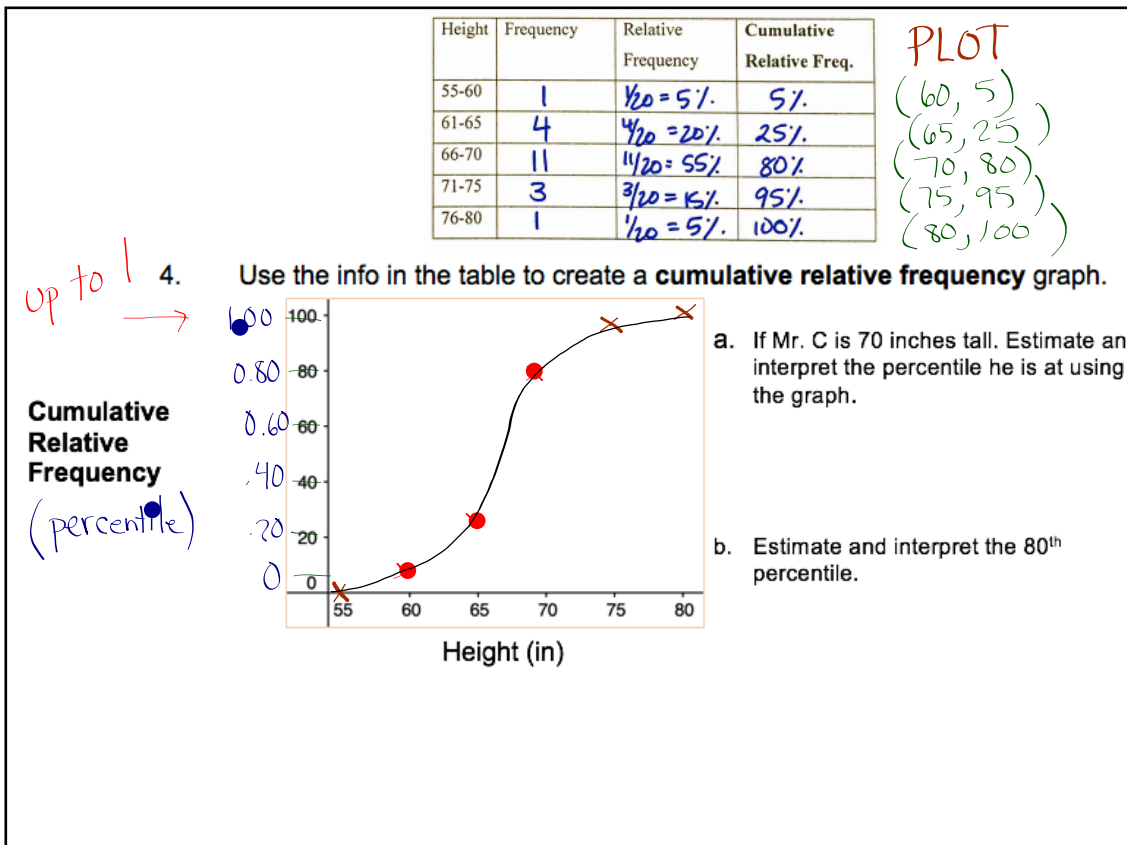
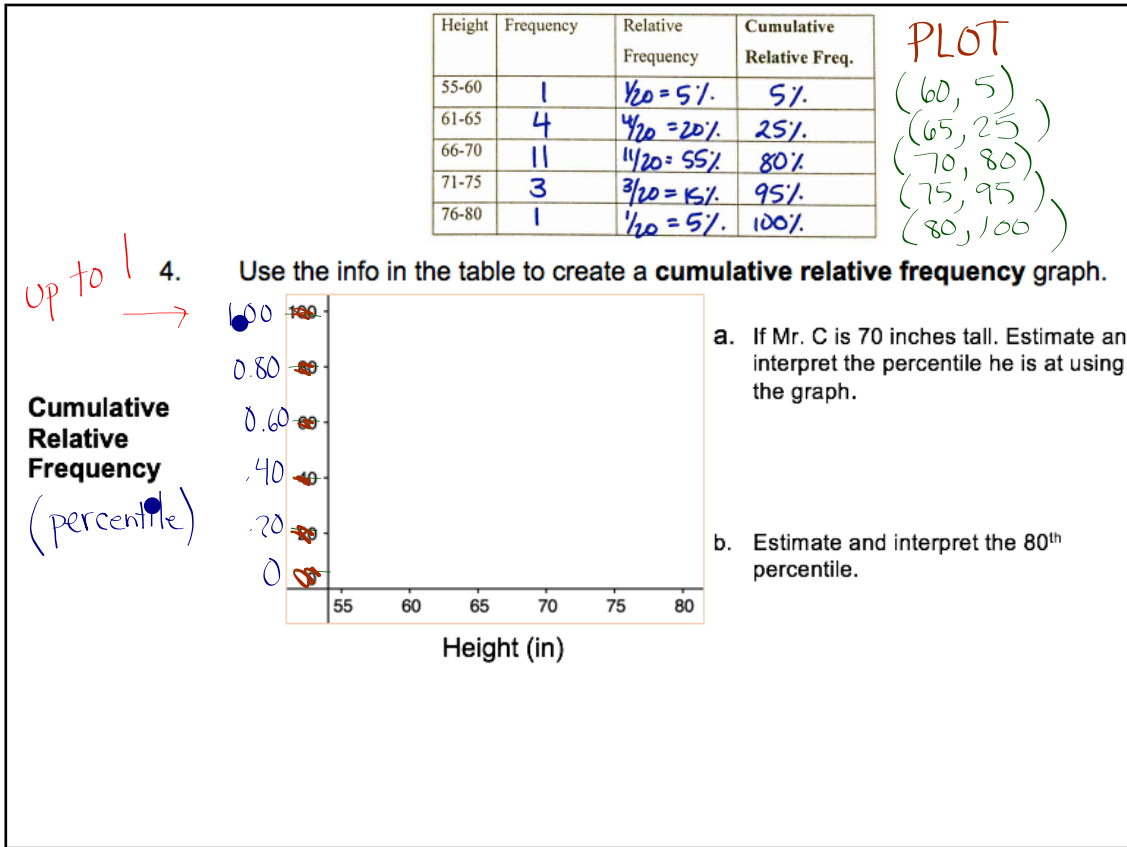
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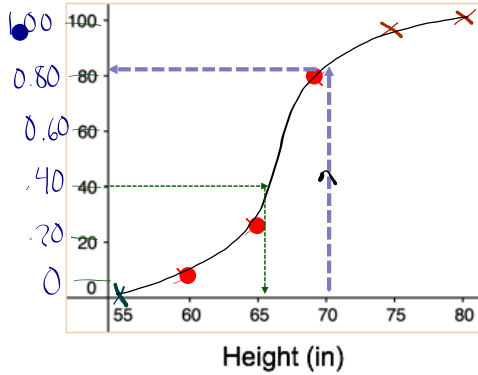
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**PLOT**  
 (60, 5)  
 (65, 25)  
 (70, 80)  
 (75, 95)  
 (80, 100)

up to 1 → 4.

Use the info in the table to create a cumulative relative frequency graph.

**Cumulative Relative Frequency**  
 (percentile)



a. If Mr. C is 70 inches tall. Estimate and interpret the percentile he is at using the graph.

82% of the students are at or below Mr. C's height

b. Estimate and interpret the 80<sup>th</sup> percentile.

66 in. 40% of the heights are at or below 66 inches

**Describing Location in a Distribution (with Percentiles)**

PERCENTILE

Cumulative Relative Freq Graph

**Describing Location in a Distribution** (with Percentiles)**PERCENTILE**

The % of values that are less than or equal to a given value.

• "at", not "in" •

**Cumulative Relative Freq Graph**

Note: Percentiles are boundaries so you can't be in a percentile. •

### Describing Location in a Distribution (with Percentiles)

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#### Cumulative Relative Freq Graph (Percentile Graph)

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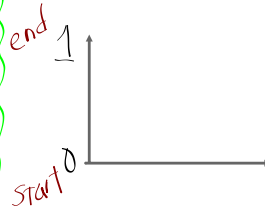
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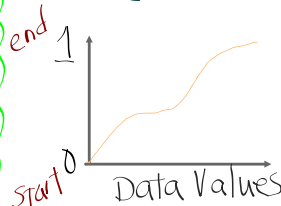
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$Q_1 = 25^{\text{th}}$  percentile

$Q_2 = 50^{\text{th}}$  percentile

$Q_3 = 75^{\text{th}}$  perc.

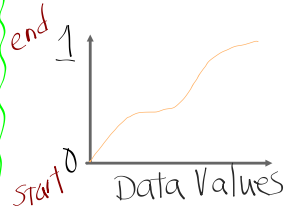
## Describing Location in a Distribution (with Percentiles)

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$Q_1 = 25^{\text{th}}$  percentile

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New to AP stats  
but  
not in your textbook

### Check Your Understanding:

1. Mrs. Munson is concerned about how her daughter's height and weight compare with those of other girls of the same age. She uses an online calculator to determine that her daughter is at the 87th percentile for weight and the 67th percentile for height. Explain to Mrs. Munson what these values mean.

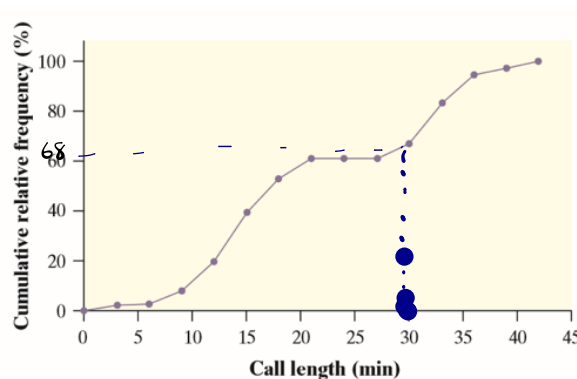
**Check Your Understanding:**

1. Mrs. Munson is concerned about how her daughter's height and weight compare with those of other girls of the same age. She uses an online calculator to determine that her daughter is at the 87th percentile for weight and the 67th percentile for height. Explain to Mrs. Munson what these values mean.

87% of girls of the same age have a weight that is less than or equal to her daughter's weight.

67% of the girls of the same age have a height that is less than or equal to her daughter's height.

2. The graph displays the cumulative relative frequency of the lengths of phone calls made from the mathematics department office at Gabalot High last month.



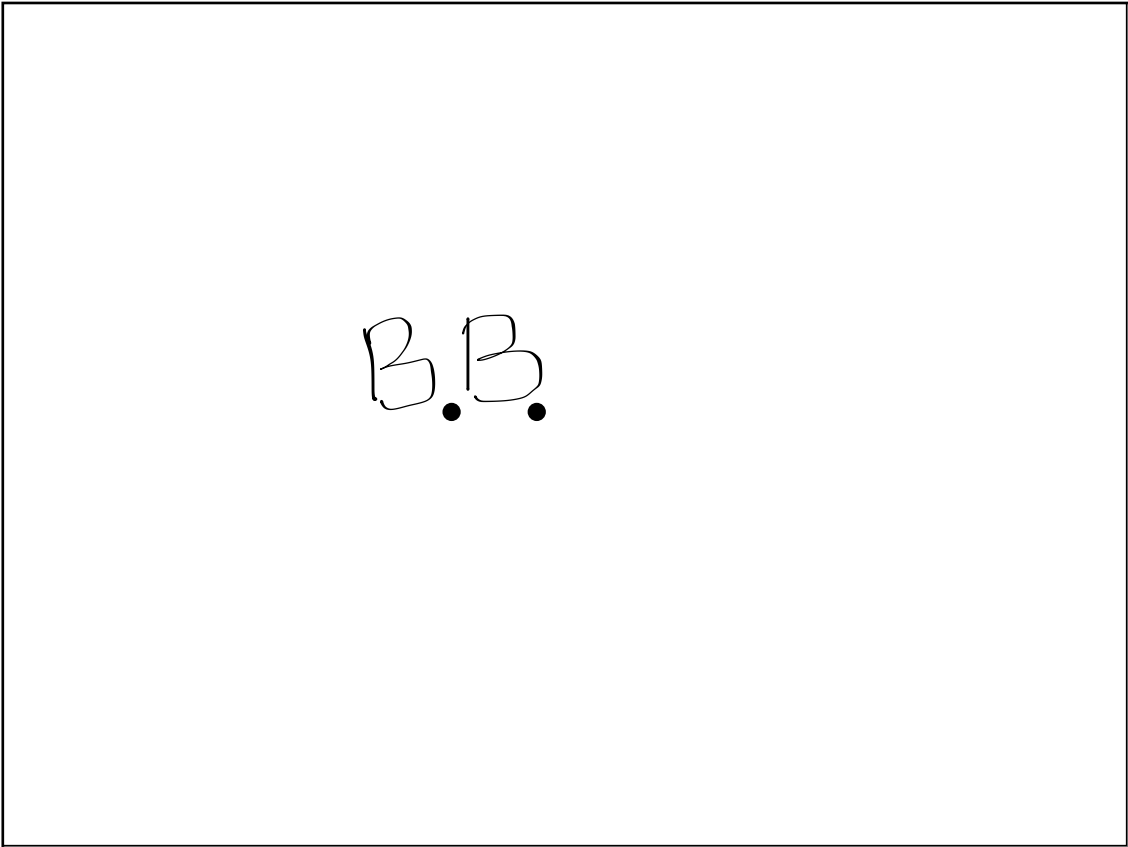
- a. About what percent of calls lasted less than or equal to 30 minutes? More than 30 minutes?

68% = Less than or equal to 30 min  
 32% are less than or equal to 30 min.

- b. Estimate Q1, Q3, and the IQR of the distribution of phone call length.

Q1 = 13 min  
 Q3 = 30 min  
 IQR = 17 min





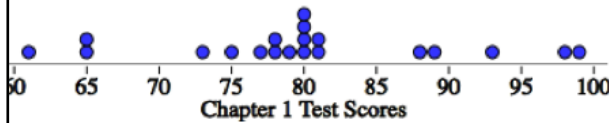
### How Did I Do?



How well did you do on the Chapter 1 Test? How well did you do relative to your classmates?

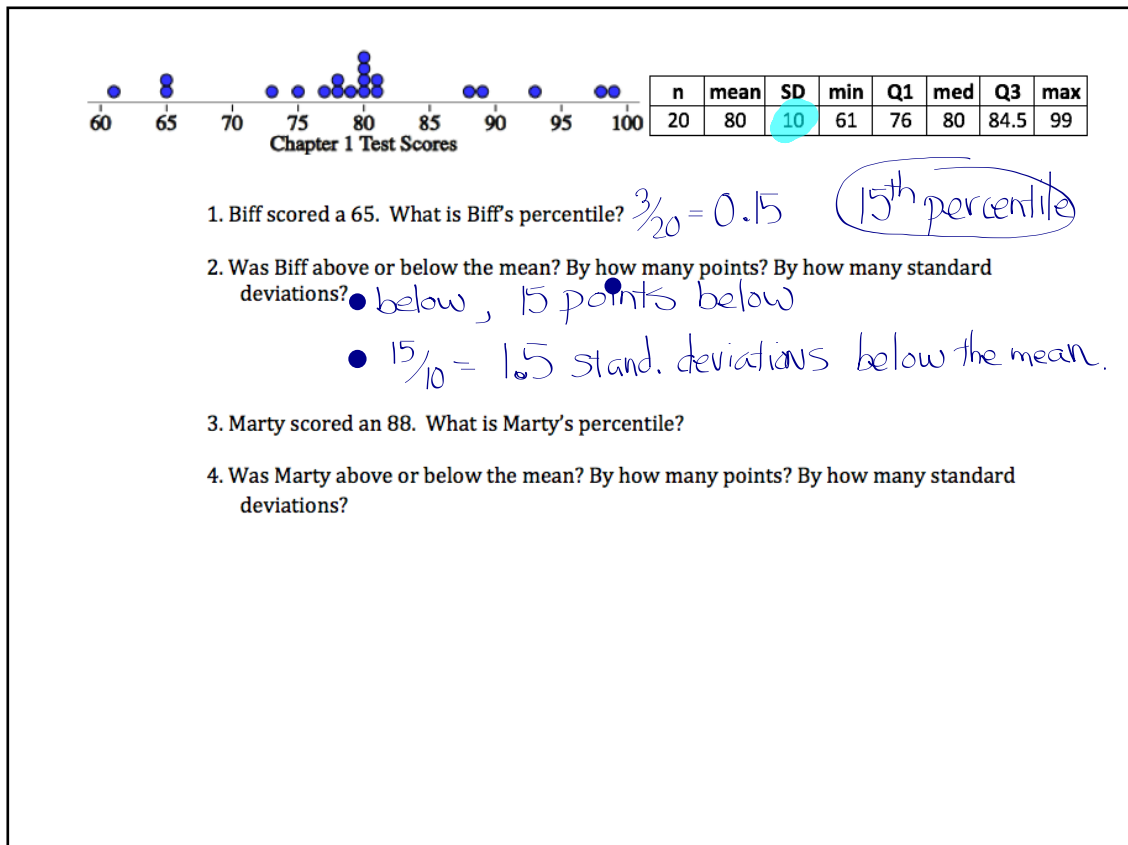
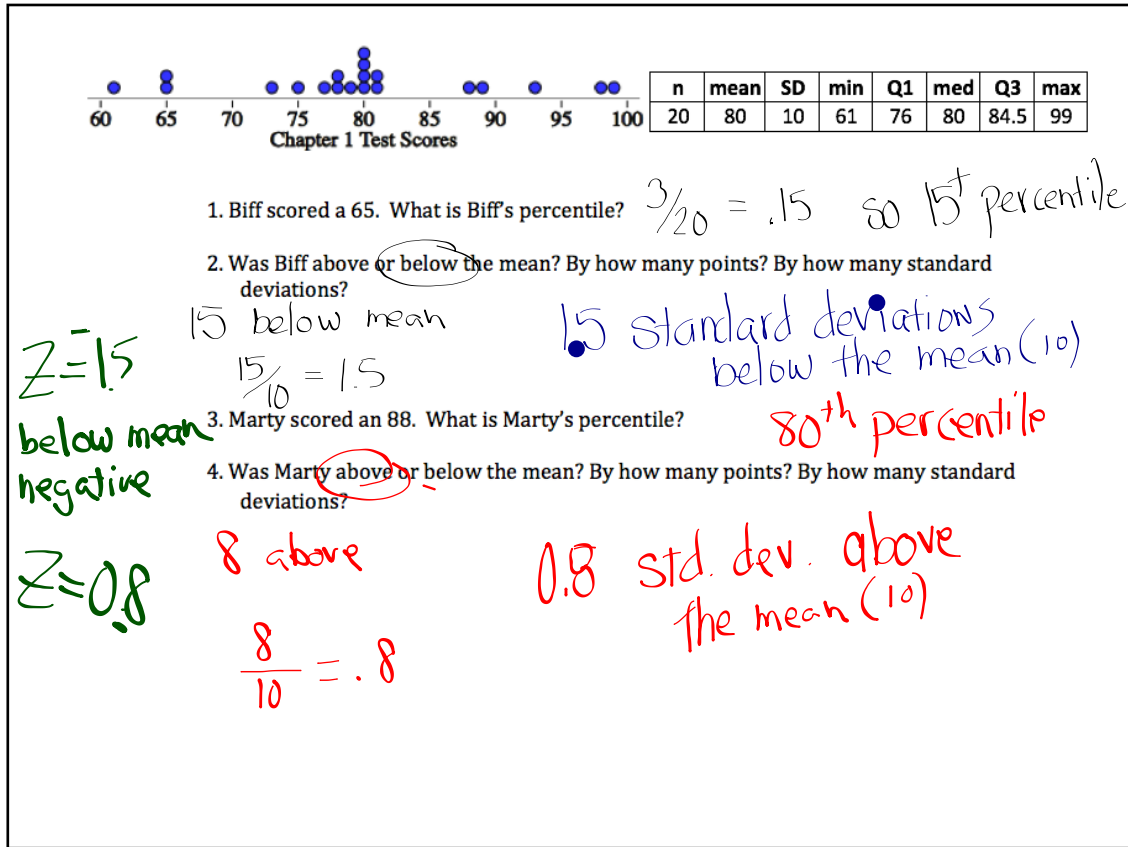
Here are the results of a random sample of 20 of the Chapter 1 Tests, along with a dotplot and summary statistics.

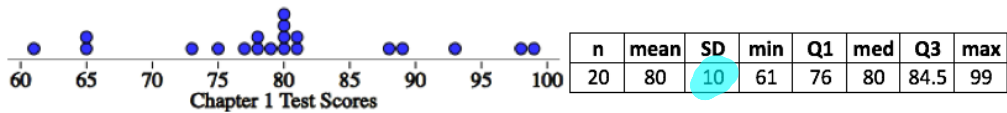
Test Scores	61	65	65	73	75	77	78	78	79	80	80	80	80	80	81	81	88	89	93	98	99
-------------	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----



n	mean	SD	min	Q1	med	Q3	max
20	80	10	61	76	80	84.5	99

1. Biff scored a 65. What is Biff's percentile?





- Biff scored a 65. What is Biff's percentile?  $\frac{3}{20} = 0.15$  (15<sup>th</sup> percentile)
- Was Biff above or below the mean? By how many points? By how many standard deviations?
  - below, 15 points below
  - $\frac{15}{10} = 1.5$  stand. deviations below the mean.
- Marty scored an 88. What is Marty's percentile?  $\frac{16}{20} = 0.8$  (80<sup>th</sup> percentile)
- Was Marty above or below the mean? By how many points? By how many standard deviations?
  - Above
  - 8 points above
  - $\frac{8}{10} = 0.8$  0.8 stand dev. above the mean

# Formalize

back → forward

A z-score is defined as the number of standard deviations above or below the mean.

5. Write a formula for calculating a z-score.  $z = \frac{\text{value} - \text{mean}}{\text{SD}}$

6. Goldie scored a 98 on the Chapter 1 Test. Find and interpret the z-score.

$$\frac{98-80}{10} = 1.8 \quad \text{Goldie's score is}$$

Bonus: Goldie was aspiring for what job? 1.8 standard deviations above the mean by

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$$z = \frac{98 - 80}{10} = 1.8$$

Goldie's ch.1 test score is 1.8 stand. deviations above the mean.

Bonus: Goldie was aspiring for what job?

**Mayor**

### Describing Location in a Distribution (with Z-Scores)

Standardized Values (z-scores)

### Describing Location in a Distribution (with Z-Scores)

#### Standardized Values (z-scores)

$$z = \frac{\text{Value} - \text{mean}}{\text{SD}}$$

**Context** is **Zscore** standard deviations above (or below) the mean.

Can be negative if below mean

### Measuring Position: z-Scores

Jenny earned a score of 86 on her test. The class mean is 80 and the standard deviation is 4. How many standard deviations above the mean is her score?



#### CAUTION:

Do not interpret the z-score as a distance "away" from the mean. Always indicate if the value is greater than (above) or less than (below) the mean.

Jenny's test score is 0.99 standard deviations above the class mean of 80.

1. In 2016, the mean number of wins for teams in Major League Baseball was 81 wins with a standard deviation of 10.7 wins.

- (a) The Chicago Cubs broke the Curse of the Billy Goat by winning the World Series in 2016. Find and interpret the z-score for the Chicago Cubs, who had 103 wins in 2016.

$$z = \frac{103 - 81}{10.7} = 2.06$$

103 wins is 2.06 std. dev above the mean (81)

- (b) The Chicago White Sox had a z-score of 20.28. Find the number of wins for the Chicago White Sox for 2016.

$$\frac{x - 81}{10.7} = 20.28 \rightarrow x - 81 = 216.996$$

$x \approx 298$  wins

2. Is being 10 above average a big deal?

What. Another baseball example? In 2016, the mean number of wins for teams in Major League Baseball was 81 wins with a standard deviation of 10.7 wins.

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$$z = \frac{103 - 81}{10.7} = 2.06$$

So 103 wins was 2.06 std. dev. above mean

- (b) The Chicago White Sox had a z-score of 20.28. Find the number of wins for the Chicago White Sox for 2016.

$$-28 = \frac{\text{Value} - 81}{10.7}$$

$$\text{Value} = 78$$

The Chi Sox had 78 wins in 2016.

Is being in a high Percentile  
always a good thing ?

*What about cholesterol  
levels in men?*

3. Macy, a 3-year-old female is 100 cm tall. Brody, her 12-year-old brother is 158 cm tall. Obviously, Brody is taller than Macy—but who is taller, relatively speaking? That is, relative to other kids of the same ages, who is taller?

According to the CDC, the heights of three-year-old females have a mean of 94.5 cm and a standard deviation of 4 cm. The mean height for 12-year-olds males is 149 cm with a standard deviation of 9 cm.



# Assignment

**2.1** ..... 1, 3, 7, 9, 11, 13, 15, 19

and study pp. 91-97