Lesson 3 – Pre-Visit
Averages & Percentages

Objective: Students will be able to:

- Convert averages to percentages and vice versa.
- Use basic linear algebra to solve for an unknown variable.

Time Required: 1 class period

Materials Needed:

- Copies of the "Performance Percentages" worksheet (included) – 1 for each student
- “Linear Equations Activity Cards” (included), printed and cut out
- “Averages and Percentages Activity Cards” (included), printed and cut out

Vocabulary:

Batting Average – A measure of a batter’s performance, calculated as the number of hits divided by the number of times at bat

Statistics - A branch of mathematics dealing with the collection, analysis, interpretation, and presentation of numerical data

Applicable Common Core State Standards:

CCSS.Math.Content.6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.

CCSS.Math.Content.6.RP.A.2 Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship.

CCSS.Math.Content.6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.

CCSS.Math.Content.6.NS.B.2 Fluently divide multi-digit numbers using the standard algorithm.

CCSS.Math.Content.6.EE.A.2 Write, read, and evaluate expressions in which letters stand for numbers.

- **CCSS.Math.Content.6.EE.A.2a** Write expressions that record operations with numbers and with letters standing for numbers.

CCSS.Math.Content.6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.

CCSS.Math.Content.6.SP.A.1 Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers.

CCSS.Math.Content.6.SP.B.5 Summarize numerical data sets in relation to their context, such as by:

- **CCSS.Math.Content.6.SP.B.5a** Reporting the number of observations.
- **CCSS.Math.Content.6.SP.B.5b** Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.

CCSS.Math.Content.7.RP.A.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.

Applicable Common Core State Standards (*Continued*):

CCSS.Math.Content.7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

CCSS.Math.Content.7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

CCSS.Math.Content.8.EE.C.7 Solve linear equations in one variable.

Lesson

Part 1

1. Review the formula for finding a batting average: Batting Average = Hits/At Bats.

2. Discuss that this statistic is used to describe how successful a batter is at getting hits (singles, doubles, triples, and home runs) when he gets a chance to bat. Although this statistic is called an "average," it could also be called a "percentage." The data shows us what *percent* of the time the batter was successful.

3. Write down the average .275 on the board. Ask students, "How would this average be converted to a percentage?"

4. Using the example of .275, demonstrate that in order to change an average to a percentage, the decimal is moved two places to the right. Thus, .275 becomes 27.5%

5. Discuss that for a major league player, a .275 average is pretty good. However this means that the batter was successful just over 25% of the time. Nearly 73% of the time, he *didn't* get a hit! This demonstrates just how difficult it is to be a major league batter.

6. Now demonstrate how to turn a percentage into a decimal. Write down the percentage 32% on the board. Ask students, "If we know that a player hit successfully 32% of the time, what is his batting average?"

7. Using the example of 32%, demonstrate that in order to change a percentage to an average, the decimal is moved two places to the left. Thus, 32% becomes a .320 average.

8. Have students complete the "Performance Percentages" worksheet before moving on to the activity.

9. If your students are very comfortable with this material, move on to Part 2 of this lesson, otherwise move directly to the activity.

Part 2

10. Part 2 of this lesson places the information addressed earlier in the form of a linear equation. Students will use basic algebra to solve for a particular variable.

11. Ask students, "Let's say we know that Derek Jeter went to bat 8 times during a double header. He hit successfully 62.5% of the time. How many hits did he get?"

12. Explain the process of solving the problem:
    - First, convert the percentage to a decimal.
      62.5% becomes .625
    - Now, place that information in the formula for batting average.
      H/AB = Average
      H/AB = .625
    - The problem also tells us how many times Jeter went to bat. Place that information in the equation as well.
      H/8=.625
    - To solve a linear equation, you have to add, subtract, multiply, or divide both sides of the equation by numbers and variables, so that you end up with a single variable on one side and a single number on the other. Any operation done on one side must be done on the other.
    - In this case, in order to get H by itself, multiply each side by 8.
      H/8 x 8 = .625 x 8
    - We now have the answer: H = 5

13. Try a similar problem, this time solving for at bats. "Let's say we know that Prince Fielder got 7 hits during a 3-game series. He hit successfully 63.6% of the time. How many times did Prince Fielder bat?"
    - Again, start by converting the percentage to a decimal.
      63.6% becomes .636
    - Place that information in the formula for batting average.
      H/AB = Average
      H/AB = .636
    - Place Fielder's number of hits into the equation.
      7/AB = .636
    - This time, in order to solve for AB, we need to first multiply by AB.
      7/AB x AB = .636 x AB
      7 = .636AB
    - Now we need to get AB by itself, so we divide by .636 on each side.
      7/.636 = .636AB/.636
    - We now have the answer: 11 = AB

14. Remind students that when solving for hits or at bats, the answer must be a whole number. No one gets 6.5 hits in a game. Therefore the answer must be rounded to the nearest whole.

15. Introduce the activity.

Activity

Option 1 – Averages & Percentages Only

1. Pass out "Averages and Percentages Activity Cards" (included), one to each student in the class.

2. Have the students convert the fractions into batting averages, then into percentages.

3. Once every student has finished, have students put themselves in order from the highest batting percentage to the lowest.

4. Finally, add the fractions to compute a collective batting average and batting percentage for the entire class.

Option 2 – Linear Equations

1. Pass out "Linear Equations Activity Cards" (included), one to each student in the class. Some students will solve for number of hits, some students will solve for number of at bats.

2. Have students solve their equations, then convert the player's batting average to a percentage.

3. Once every student has finished, have students put themselves in order from the highest batting percentage to the lowest.

4. Finally, using the data determined from their equations, have students calculate a collective batting average and batting percentage for the entire class.

Conclusion:
To complete this lesson and check for understanding, for homework, have students research the statistics for two baseball players of their choice. Compare their performances and determine which of the two had a better year statistically. Students should write an analysis that justifies their position.

Performance Percentages

Name: _____ Date:_____

Part 1: You have been given players' decimal batting averages, and players' batting percentages. Convert each decimal to a percentage, and each percentage to a decimal.

Player	Average	Percentage
Alex Rios	.227	
Mark Teixeira		24.8%
Carl Crawford	.255	
Torii Hunter	.262	
Brett Gardner		25.9%
Adrian Gonzalez		33.8%
Juan Pierre	.279	
Casey Kotchman		30.6%
Michael Young	.338	

Part 2: You have been given each player's number of hits and number of at bats. Determine each player's batting average, then convert the average into a percentage. The first problem has been done for you.

Player	Hits	At Bats	Average	Percentage
Miguel Cabrera	197	572	.344	34.4%
Jacoby Ellsbury	212	660		
David Ortiz	162	525		
Alex Gordon	185	611		
Billy Butler	174	597		
Robinson Cano	188	623		
Ichiro Suzuki	184	677		
Coco Crisp	140	531		
Kevin Youkilis	111	431		
B.J. Upton	136	560		
Evan Longoria	118	483		

"Performance Percentages Answer Key"

Part 1: You have been given players' decimal batting averages, and players' batting percentages. Convert each decimal to a percentage, and each percentage to a decimal.

Player	Average	Percentage
Alex Rios	.227	22.7%
Mark Teixeira	.248	24.8%
Carl Crawford	.255	25.5%
Torii Hunter	.262	26.2%
Brett Gardner	.259	25.9%
Adrian Gonzalez	.338	33.8%
Juan Pierre	.279	27.9%
Casey Kotchman	.306	30.6%
Michael Young	.338	33.8%

Part 2: You have been given each player's number of hits and number of at bats. Determine each player's batting average, then convert the average into a percentage. The first problem has been done for you.

Player	Hits	At Bats	Average	Percentage
Miguel Cabrera	197	572	.344	34.4%
Jacoby Ellsbury	212	660	.321	32.1%
David Ortiz	162	525	.309	30.9%
Alex Gordon	185	611	.303	30.3%
Billy Butler	174	597	.291	29.1%
Robinson Cano	188	623	.302	30.2%
Ichiro Suzuki	184	677	.272	27.2%
Coco Crisp	140	531	.264	26.4%
Kevin Youkilis	111	431	.258	25.8%
B.J. Upton	136	560	.243	24.3%
Evan Longoria	118	483	.244	24.4%

Averages & Percentages Activity Cards

Jose Reyes **181** **537**	**Ryan Braun** **187** **563**	**Victor Martinez** **178** **540**
Matt Kemp **195** **602**	**Lance Berkman** **147** **488**	**Hunter Pence** **190** **606**
Joey Votto **185** **599**	**Carlos Beltran** **156** **520**	**Nelson Cruz** **125** **475**
Albert Pujols **173** **579**	**Aramis Ramirez** **173** **565**	**Derek Jeter** **162** **546**
Melky Cabrera **201** **658**	**Matt Holliday** **132** **446**	**Alex Avila** **137** **464**
Austin Jackson **147** **591**	**Jose Bautista** **155** **513**	**Michael Bourn** **193** **656**

Vladimir Guerrero **163** **562**	**Justin Upton** **171** **592**	**Jason Bay** **109** **444**
Corey Hart **140** **492**	**Seth Smith** **135** **476**	**Miguel Montero** **139** **493**
Adam Jones **159** **567**	**Elvis Andrus** **164** **587**	**Placido Polanco** **130** **469**
Dexter Fowler **128** **481**	**Carlos Lee** **161** **585**	**Neil Walker** **163** **596**

Linear Equations Activity Cards

Jose Reyes $\frac{181}{X} = .337$	**Ryan Braun** $\frac{X}{563} = .332$	**Victor Martinez** $\frac{178}{X} = .330$
Matt Kemp $\frac{X}{602} = .324$	**Lance Berkman** $\frac{147}{X} = .301$	**Hunter Pence** $\frac{190}{X} = .314$
Joey Votto $\frac{X}{599} = .309$	**Carlos Beltran** $\frac{X}{520} = .300$	**Nelson Cruz** $\frac{125}{X} = .263$
Albert Pujols $\frac{173}{X} = .299$	**Aramis Ramirez** $\frac{173}{X} = .306$	**Derek Jeter** $\frac{X}{546} = .297$
Melky Cabrera $\frac{X}{658} = .305$	**Matt Holliday** $\frac{X}{446} = .296$	**Alex Avila** $\frac{137}{X} = .295$
Austin Jackson $\frac{147}{X} = .249$	**Jose Bautista** $\frac{155}{X} = .302$	**Michael Bourn** $\frac{X}{656} = .294$
Vladimir Guerrero $\frac{X}{562} = .290$	**Justin Upton** $\frac{X}{592} = .289$	**Jason Bay** $\frac{109}{X} = .245$

Corey Hart **140 = .285** **X**	**Seth Smith** **135 = .284** **X**	**Miguel Montero** **X = .282** **493**
Adam Jones **X = .280** **567**	**Elvis Andrus** **X = .279** **587**	**Placido Polanco** **130 = .277** **X**
Dexter Fowler **128 = .266** **X**	**Carlos Lee** **161 = .275** **X**	**Neil Walker** **X = .273** **596**

Activity Cards Answer Key

Jose Reyes 181 537 (.337)	Ryan Braun 187 563 (.332)	Victor Martinez 178 540 (.330)
Matt Kemp 195 602 (.324)	Lance Berkman 147 488 (.301)	Hunter Pence 190 606 (.314)
Joey Votto 185 599 (.309)	Carlos Beltran 156 520 (.300)	Nelson Cruz 125 475 (.263)
Albert Pujols 173 579 (.299)	Aramis Ramirez 173 565 (.306)	Derek Jeter 162 546 (.297)
Melky Cabrera 201 658 (.305)	Matt Holliday 132 446 (.296)	Alex Avila 137 464 (.295)
Austin Jackson 147 591 (.249)	Jose Bautista 155 513 (.302)	Michael Bourn 193 656 (.294)

Vladimir Guerrero 163 562 (.290)	Justin Upton 171 592 (.289)	Jason Bay 109 444 (.245)
Corey Hart 140 492 (.285)	Seth Smith 135 476 (.284)	Miguel Montero 139 493 (.282)
Adam Jones 159 567 (.280)	Elvis Andrus 164 587 (.279)	Placido Polanco 130 469 (.277)
Dexter Fowler 128 481 (.266)	Carlos Lee 161 585 (.275)	Neil Walker 163 596 (.273)