Sports Mathematics

Process Standards in Action

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Sports Mathematics. Lesson 1. Bowling

Topic: Bowling: Taking Score

Content Standards (NC Standard Course of Study):

Middle Grades (6-8):

Number and Operations:

Students understand meanings of operations and how they relate to one another. Students compute fluently and make reasonable estimates.

Algebra: Students understand patterns.

High School Introductory Mathematics:

1.02 Estimate and compute with rational numbers.

1.12 Analyze problem situations, select appropriate strategies, and use an organized approach to solve multi-step problems.

Process Standards (NCTM): Problem Solving, Reasoning and Proof, and Communication

Description of Activity: This is an activity in which students will learn how the score is computed in bowling. Students will answer questions that relate bowling to mathematics before actually studying how the score is taken. Completed frames will be given to students and they will be asked to determine how the score is taken. After this has been done students should compute the score themselves for practice. Students will work alone and then in pairs. A paper or pamphlet on how to compute the score in bowling should be prepared and presented to the class by each pair.

Teacher Notes:

* After introducing the activity, students should complete the "Bowling Questpins" worksheet. This should be discussed a because the answers will vary.
* Students should then work individually on determining how the score is taken. (This will involve problem solving and reasoning.)
* After working alone, students should be paired up to compare answers.
* When students work on "HOW WAS THE SCORE CALCULATED," they should answer the question for numbers 1-5.
    - Number one the answer is basic addition.
    - Number two should address what happens with spares
    - Number three should address what happens with strikes.
    - Number four is a combination of 1-3.
    - Number five the students should calculate the score themselves.
* Once students have determined how to take the score they should begin preparing their paper or pamphlet for the class.
* This activity should take at least one class period on the block schedule and at least two on the six/seven period schedule. Presentations should occur during the following class period.

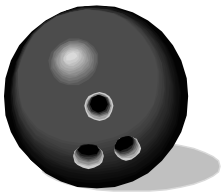
Additional Information:

Bowling Game: http://www.tucows.com/kids/preview/202125.html

How to compute the score: http://www.learn2.com/07/0732/0732.asp

Bowling Score Calculator: http://public.csusm.edu/public/public_html/veres/

Author: Tracy Foote, Mathematics Teacher at Glenn H.S., Kernersville, NC, graduate student at Wake Forest University



Bowling Questpins

1. In what ways does bowling involve mathematics?

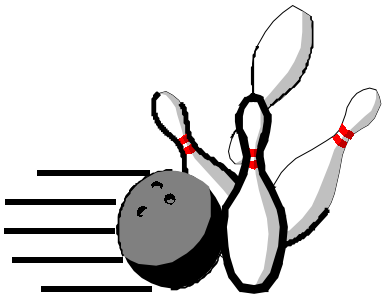
2. What math do you see?

3. What is the object of the sport?

4. What is a spare?

5. What is a strike?

6. What basic number operations are used in bowling?



Sports Mathematics

HOW WAS THE SCORE CALCULATED?

1.

4 5	6 2	8 0	2 6	8 1	9 0	7 2	9 0	3 5	7 1
9	17	25	33	42	51	60	69	77	85

2.

6 3	7 /	2 5	8 /	5 4	7 /	5 3	4 5	3 /	6 3
9	21	28	43	52	67	75	84	100	109

3.

3 5	X	5 3	7 1	8 0	2 7	5 4	X	4 3	X 5 3
8	26	34	42	50	59	68	85	92	110

4.

X	4 5	8 /	X	4 3	1 3	7 0	6 /	7 2	5 4
19	28	48	65	72	76	83	100	109	118

5.

3 6	2 /	X	4 0	9 0	X	5 /	6 3	X	4 5

Sports Mathematics. Lesson 2. Soccer

Topic: Soccer: Narrowing The Angle

Content Standards (NC Standard Course of Study)

Geometry:

- 1.01 Select appropriate operations and solve a variety of application problems using real numbers.
- 2.01 Identify, name, and draw sets of points, such as line, ray, segment, and plane.
- 2.02 Identify the coordinates of a point in the plane or space.
- 2.13 Similar triangles and the relationship of their corresponding parts.

Process Standards: Problem Solving, Communication, Connections, Representation.

Description of Activity: This activity is designed as a discovery lesson in which connections will be made between geometry and soccer. Soccer, which is a relatively new game in the US, is gaining fast popularity. The object of the game is to get the ball in the opposing teams goal. With this being the object of the game, one of the most important players on the field is the goalkeeper who is responsible for keeping the ball out of the goal. One of the techniques that the goalkeeper uses to keep the ball out is called "Narrowing the Angle"(minimizing the probability of the ball going into the goal). To do this, a goalkeeper positions himself on the line between the ball and the center of the goal. This positioning cuts down on the scoring angle and ensures the distance from the keeper to the path of the ball at its furthest point is equal on both sides. There is lots of geometry at work here that should be quite interesting for the students to discover. In this activity the students will be asked to find the equation of the line between the ball and the goal, the equations of the lines that define the boundaries of the path of the ball, and the point on the line where the goalkeeper should stand to cover air balls.

Teacher Notes:

- To introduce the activity, present the students with a field diagram (Attached). The dimensions given are those of Foxboro Stadium in Massachusetts, one of the fields used in WorldCupUSA '94.
- Next the explanation of "narrowing the angle" should be given. Here the teacher can either show the students how to calculate the lines, or put them in groups and let them figure the lines out themselves. Either way, **Part A** of the worksheet can be handed out to practice these calculations. (Attached)
- If not already in groups, break the students into groups and give them **Part B** of the worksheet. Allow them to work on this together and try to provide minimal assistance. Here they will be asked to find the exact position on the line where the goalkeeper should stand to cover air balls. Knowledge of similar triangles is necessary to do this part.
- Each group will be given different data for Part B and should present their solutions to the entire class.

Author: Cynthia L. Adams, Master Teacher Fellow, Wake Forest University.

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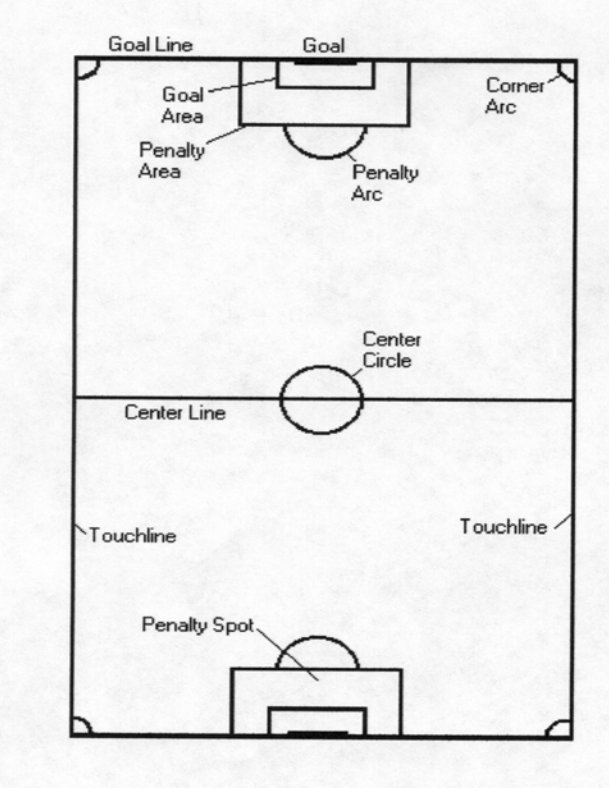
Soccer Field Diagram

Foxboro Stadium

One of the fields used during WorldCupUSA '94



Width: 75 yards
Length: 115 yards
Goal: 8 feet high x 8 yards wide
Goal Area: 6 x 20 yards
Penalty Area: 18 x 44 yards
Penalty Spot: 12 yards out from goal
Center Circle & Penalty Arc: 10 yard radius
Corner Arcs: 1 yard radius

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Worksheet Part A:

Find the equation of the line on which the goalkeeper should be standing and the boundary paths for the ball if:

1. The ball is 20 yards in front of the goal and 60 yards away from the touchline on the keeper's right. Draw a diagram.

2. The ball is 18 yards in front of the goal and 46 yards away from the touchline on the keeper's right. Draw a diagram.

3. The ball is 6 yards in front of the goal and 15 yards away from the touchline on the keeper's right. Draw a diagram.

4. The ball is 4 yards in front of the goal and 37 yards away from the touchline on the keeper's right. Draw a diagram.

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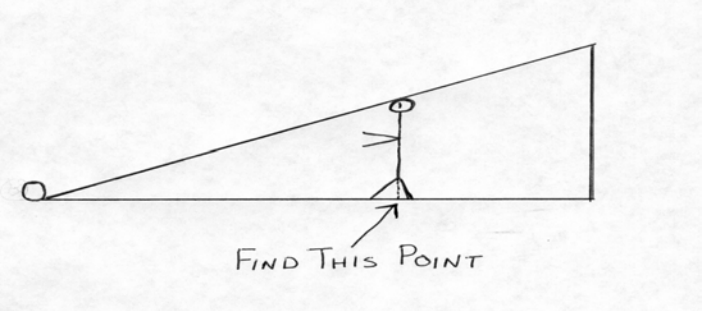
Worksheet Part B:

The situation that was investigated in Part B did not take into account air balls. It turns out that when air balls are taken into account, you can determine the exact point, on the lines in Part B, where the goalkeeper should stand to account for air as well as ground balls. This point is where the ball, the head of the goalkeeper, and the top of the goal all form a line.



Your task, as a group, is to figure out how to calculate this point. Once your group figures it out, use your assigned data below and any one of the answers from Part A to find the correct position for the keeper. Prepare a short presentation, explaining how you can up with you solution, to be presented to the class.

Group 1	Group 2	Group 3	Group 4	Group 5
Tony Meola US National Team Goalkeeper Height: 6”1’	Kasey Keller US National Team Goalkeeper Height: 6”2’	Brad Friedel US National Team Goalkeeper Height: 6”4’	Dwayne Adams Bermuda National Team Goalkeeper Height: 5”10’	Neil Andrews Charlotte Eagles Goalkeeper Height: 6”3’

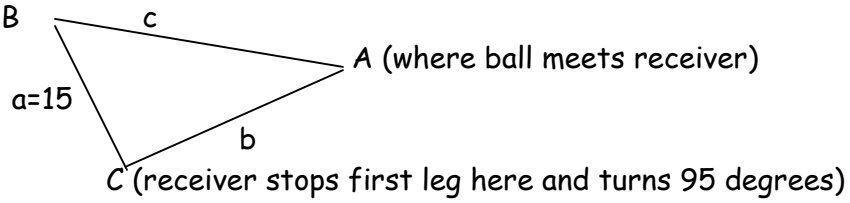
Sports Mathematics. Lesson 3. Football

Can FOOTBALL be passed off as MATH?!?

Audience: Advanced Mathematics students

Objective: Students will apply the law of cosines and other things they know about triangles to determine where football passes should be aimed based on the quarterback and receiver's locations

Explanation: In football, receivers tend to run in triangle patterns in order to receive the ball. Straight lines are preferred to curves so the quarterback can easily predict where the receiver will be. When receivers run, turn, and run, triangles are formed. For example, a receiver may run 15 yards ahead and turn 95 degrees. Then he will run forward again to meet the ball at the a given point.



Preparation:

- Students should have a good understanding of the law of cosines
- Before class, mark off triangles on an open field using string or tape (You need to know the side lengths and angles and I would label them triangles 1, 2, etc.)
- Give each group a tape measure, protractor, and stopwatch and give each student a worksheet
- Immediately before they go out, explain to students why football players use triangles and give a brief activity overview

Activity: Students will find the velocity of the ball by throwing it and clocking the air time. They will then find the velocity of the "receiver" by clocking a student's time to run (a) yards, which you will have marked off but they will have measured. Using a proportion, they can label side c in relationship to b. Finally, students will measure angle C with a protractor thus having enough information to solve for the unknowns using the Law of Cosines. Students must know how to solve quadratic equations, and will most likely have to use the quadratic formula since these numbers may not be "pretty". Students can work in groups of 3-4.

Adapted from ESPN2 Sports Figures by Christina Cronrath, Wake Forest University

Standards this activity meets:

- NC State Curriculum for Advance Math Standard 2.02: Develop and use the Law of Sines and Law of Cosines to solve problems involving triangles and vectors
- NCTM Process Standards: Communication of mathematical ideas (between group members), connection (as students see a real connection of how math is used in football), and representation (as students use models of triangles to solve problems)

Other ways to carry out this activity:

- Give students the data if you do not have class time to collect it
- Have students measure the three side lengths and solve for the angle – this forces them to use the equation in a different form and to use the inverse function of cosine

Some possible set-ups:

Triangle #	Side a	Angle BCA	Runner's Velocity	Ball Velocity
1	15 ft	120°	15 ft/sec	60 ft/sec
2	30 ft	80°	20 ft/sec	60 ft/sec
3	25 ft	90°	25 ft/sec	50 ft/sec

*If you give students this data or if you use a 90° angle in one of your triangles, ask students what other method they could use to figure out the sides of this triangle (Pythagorean Theorem)

Answers: Triangle 1 – set the law of cosines equation as
$(4b)^2 = (15)^2 + b^2 - 2(15)(b)(\cos 120°)$ which works out to be
$15b^2 - 15b - 225 = 0$, so (using the quadratic equation), b = **4.405 ft**, -3.40
(students should give positive answers only as you are dealing with distances)

Triangle 2 - using the law of cosines equation again,
$(3b)^2 = (30)^2 + b^2 - (2)(30)(\cos 80°)$ which works out to the equation
$8b^2 + 10.44b - 900 = 0$ so b = **9.97 ft**, -11.28

Triangle 3 – using the Law of Cosines equation,
$(2b)^2 = (25)^2 + b^2 - (2)(25)(\cos 90°)$ OR, using the Pythagorean Theorem,
$(25)^2 + b^2 = (2b)^2$
both of these reduce to $3b^2 - 625 = 0$, where b = **14.4 ft**, -14.4

Sports Mathematics

Can FOOTBALL be passed off as MATH?!?

Name _____

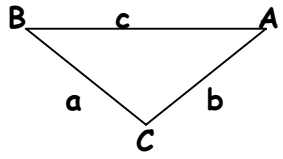
Objective: Students will apply the law of cosines and other things they know about triangles to determine where football passes should be aimed based on the quarterback and receiver's locations.

REMEMBER: Velocity=Distance/Time

Law of Cosines: =

(you fill these in)

Quadratic Equation:



We have discussed why football players run plays in triangle formations. I have set up a few possible formations. You will use the speed of one of your group members and the speed of the ball when thrown to determine velocity, and thus solve for c, how far ahead of the receiver the quarterback should throw the ball.

Fill in the chart as you work:

Triangle #	Side a	Angle BCA	Runner's Velocity	Ball Velocity

1. Measure side a. ***(Be careful of your units…you can use feet if you'd like or inches, but they must be consistent throughout!)***
2. Measure angle BCA…do not measure the other parts of the triangle besides this and side a!
3. Have one player throw the ball 20 yards and someone else catch it while a third person clocks the airtime. Use this distance and time to find the ball velocity (make sure you are using the same units as you used with side a…if you measured in feet, use ft/sec; if inches, use in/sec)!
4. Calculate the relationship between the two velocities and put them in terms of each other (it will probably be easiest to put them in terms of the runner's velocity).
5. Now use what you know and the Law of Cosines to solve for each b and c. These represent the distance ahead of the receiver that the quarterback must throw the ball and the distance the ball must travel. (Show your work on another sheet of paper.)
6. Explain why all the measurements need to be in the same units.

Sports Mathematics. Lesson 4. Rugby

Topic: Rugby Kicking: Parabolas

Content Standards (NC Standard Course of Study)

Algebra II

2.01 Write the equation in standard form of circles and parabolas; graph.

3.01 Describe graphically, algebraically and verbally realworld phenomena as functions; identify the independent and dependent variables.

3.03 Graph relations and functions and find the zeros of functions.

3.05 Use quadratic equations and inequalities to solve problems. Solve by:

a. Graphing
b. Factoring
c. Completing the square
d. Using the quadratic formula
e. Using properties of equality; justify steps needed.

3.12 Use systems of two or more equations to solve problems. Solve by:

a. Elimination and/or substitution
b. Graphing
c. Using matrix equations of the form AX=B.

4.01 Write and interpret an equation of a curve (linear, expotential, quadratic), which models a set of data.

4.02 Find the equation of the curve of best-fit (linear, expnential, quadratic) for a set of data. Interpret the constants, coefficients, and bases in the context of the data. Check the equation for goodness-of-fit and use the equation for predictions.

Process Standards (NCTM): Spatial Sense, Measurement, and Geometry; Patterns, Relationships, and Functions; Data, Probability, and Statistics

Description of Activity: This lesson plan is focused around the sport of rugby. The students will be using points given in the form of vertex-point in order to determine the graph of a parabola and determine if the parabola "cleared" a given point that represents the goal posts. The next step will be determining the formula of the parabola using three points. This will be done using matrices, systems of equations and quadratic regression. An extension of the lesson would be for the students to work in groups and present a project about parabolas they "kicked" while attempting to score points as in rugby.

Teacher Notes:

- While introducing the lesson, a generalization about the rules of the games and how it is played is important.
- Also to be used in the introduction would be the technology used to film and create still pictures of the parabola.
- Since the students will be using computers in the extension, it needs to be clear what is required and provide help for the applications.
- This lesson will probably span more than one teaching period.

Author: Wayne Miller, Wake Forest University Student

Rugby Worksheet Answers

No, V_1 =
$0 = a(22 - 10)^2 + 2$
$-2 = a(144)$
$-2/144 = a$
$y = -1/72 (x-10)^2 + 2$

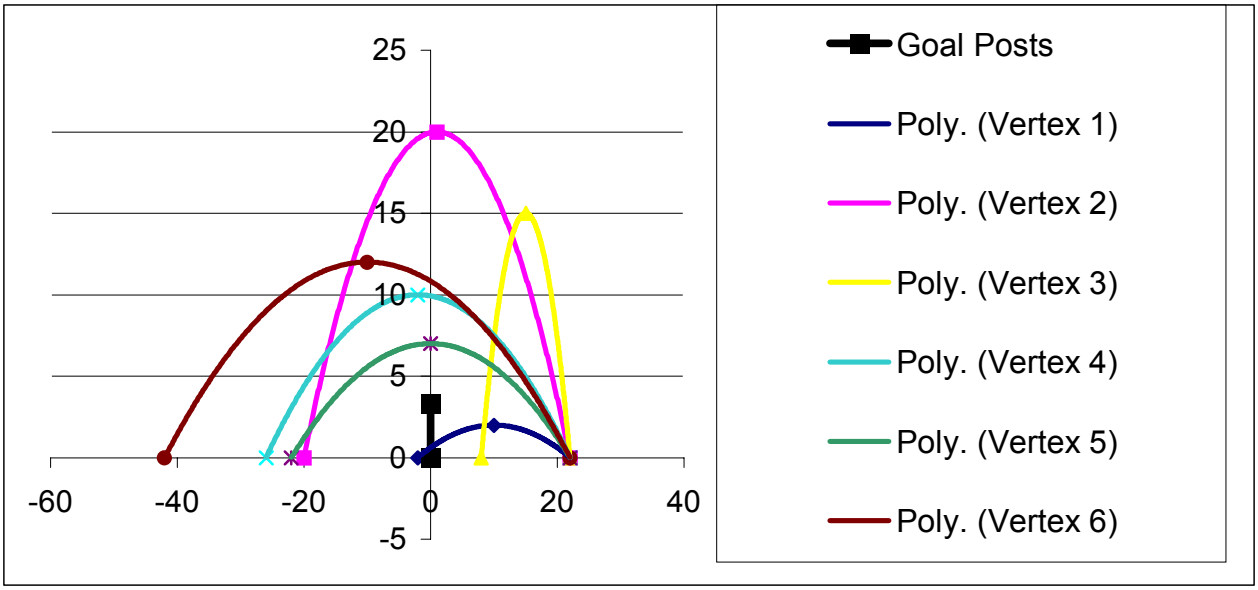
Yes, V_2 =
$0 = a(22 - 1)^2 + 20$
$-20 = a(441)$
$-20/441 = a$
$y = -20/441 (x-1)^2 + 20$

No, V_3 =
$0 = a(22 - 15)^2 + 15$
$-15 = a(49)$
$-15/49 = a$
$y = -15/49 (x-15)^2 + 15$

Yes, V_4 =
$0 = a(22 + 2)^2 + 10$
$-10 = a(576)$
$-10/576 = a$
$y = -5/288 (x + 2)^2 + 10$

Yes, V_5 =
$0 = a(22 + 0)^2 + 7$
$-7 = a(484)$
$-7/484 = a$
$y = -7/484 (x)^2 + 7$

Yes, V_6 =
$0 = a(22 + 10)^2 + 12$
$-12 = a(1024)$
$-12/1024 = a$
$y = -3/256 (x + 10)^2 + 12$



Finding Parabolas with Three Points
$y = ax^2 + bx + c$

Quadratic Regression:

a = -.03333
b = .16666
c = 5

$y = x^2/30 + x/6 + 5$

Systems of Equations:

$0 = 225(a) + 15(b) + c$
$10 = 0(a) + 0(b) + c$
$0 = 100(a) - 10(b) + c$

Matrices:
$A^{-1}B = Q$

225	15	1
0	0	1
100	-10	1

0
5
0

Sports Mathematics

Rugby and the Parabolas that are Kicked

Use $y = a (x – h)^2 + k$, where the vertex = (h, k).

Given, starting point of (22, 0), find the parabolas for the given vertices.

V1 = (10, 2) V3 = (15, 15) V5 = (0, 7)

V2 = (1, 20) V4 = (-2, 10) V6 = (-10, 12)

Assume that the parabola represents the path of a rugby ball. After finding all of the parabolas, graph them to determine whether they cleared a goal that is 10 feet high situated at the origin. Note that the other points are given in terms of yards.

Find and graph a parabola with the three points (15,0), (0,5), and (-10, 0) using quadratic regression, matrices and systems of equations.

Sports Mathematics. Lesson 5. Baseball

Topic: Major League Baseball Statistics: Atlanta Braves

Content Standards (NC Standard Course of Study):

Introductory Mathematics:

- 1.12 Analyze problem situations, select appropriate strategies, and use an organized approach to solve multi-step problems.
- 3.01 Use formulas in problem-solving situations.
- 4.04 Evaluate arguments based on data.

Algebra I:

- 3.02 Identify properties and relationships of data in tables, graphs, and equations.

Process Standards (NCTM): Problem Solving, Communication, Connections, Representations

Description of Activity: In this activity, students will discover relationships between statistics kept in the game of baseball. Students will work in pairs to calculate missing data in the provided tables. In pairs, students will answer discussion questions. Each student will input the data from the completed tables into an Excel spreadsheet and include formulas to calculate specific statistics. From the spreadsheet, students will chart batters' batting average (BA) and slugging percentage (SLG) and explain trends based on the chart.

Teacher Notes:

- Students should work in pairs for the first part of this activity. They should examine the given data in order to compute the missing entries. Students will discover how to compute the batting average (BA) from this data. Students should talk through the processes to find each missing data entry.
- Introduce the slugging percentage (SLG) to students as (total bases achieved / total at bats). From the given data, students will have to solve for the number of single hits and then find total bases.
- The last statistic is the earned run average (ERA) for pitchers. This statistic is calculated by 9*(ER / number of innings pitched). Briefly explain that an earned run is one that is a result of good hitting or poor pitching and not the result of a fielding error.
- This activity may take two class periods. A computer lab should be reserved for the second class period, if available. It is best if each student can input his/her own data and gain experience with the spreadsheet and charts, but pairs can be used again if necessary. Each student should write up his/her own responses to the discussion questions. This may be given as a homework assignment out of class.
- Extensions of this activity could involve more player statistics or team statistics. As an ongoing project, students could choose one player from their favorite team and study the statistics for a given week or month. Students can check their statistics on the Internet.

Student Handouts (attached)

Additional Information:

More Braves Statistics:

http://braves.mlb.com/NASApp/mlb/atl/homepage/atl_homepage.jsp

More Ideas on Baseball Lessons (statistics and geometry):

Battista, M.T. (1993). Mathematics in Baseball. *The Mathematics Teacher 86* (4), 336-342.

Author: Jeanie Shaw, Wake Forest University Graduate Student

Major League Baseball Statistics: Atlanta Braves
Teacher's Answer Key

1.

Atlanta Braves Hitting Stats. *(as of 9-26-01)*								
Player	**Games**	**At Bats**	**Runs**	**Hits**	**2B**	**3B**	**HR**	**BA**
A. Jones	151	589	98	148	25	2	32	0.251
C. Jones	149	538	104	175	31	4	36	0.325
B. Jordon	138	519	71	151	28	3	22	0.291
B. Surhoff	131	453	64	123	32	1	10	0.272
J. Lopez	123	425	43	113	16	1	16	0.266
R. Furcal	79	324	39	89	19	0	4	0.275
Q. Veras	71	258	39	65	14	2	3	0.252
M. Giles	60	219	29	59	9	2	7	0.269
D. Martinez	113	219	31	66	10	3	2	0.301
W. Helms	97	210	25	45	10	3	8	0.214

Discussion Questions:
- The batting average is calculated by dividing the total hits by the total at bats.
- 0.272 is the mean BA
- Highest- lowest: 0.325-0.214 = .111
- Best: 1.0 (hit at every at bat) Worst: 0.0 (no hits at any at bat)

2.

Atlanta Braves Hitting Stats. *(as of 9-26-01)*											
Player	**Games**	**At Bats**	**Runs**	**Hits**	**1B**	**2B**	**3B**	**HR**	**TB**	**BA**	**SLG**
A. Jones	151	589	98	148	89	25	2	32	273	0.251	0.463
C. Jones	149	538	104	175	104	31	4	36	322	0.325	0.599
B. Jordon	138	519	71	151	98	28	3	22	251	0.291	0.484
B. Surhoff	131	453	64	123	80	32	1	10	187	0.272	0.413
J. Lopez	123	425	43	113	80	16	1	16	179	0.266	0.421
R. Furcal	79	324	39	89	66	19	0	4	120	0.275	0.370
Q. Veras	71	258	39	65	46	14	2	3	92	0.252	0.357
M. Giles	60	219	29	59	41	9	2	7	93	0.269	0.425
D. Martinez	113	219	31	66	51	10	3	2	88	0.301	0.402
W. Helms	97	210	25	45	24	10	3	8	85	0.214	0.405

Discussion Questions:
- The SLG is the average number of bases a hitter gets per at bat.
- Yes, the SLG can be the same as the BA if the hitter only hits singles.
- The highest possible SLG is 4 meaning that the hitter hits a homerun at every at bat.
- Yes, it is really the average number of bases per at bat.
- The SLG gives the power of the hitter. This statistic can compare batters with the similar batting averages to determine which hits best for power (more triples and homeruns).
- The median: (.413 + .421) /2 = .417. This means that five of the players have SLGs higher than .417 and five have SLGs below .417.

3.

Atlanta Braves Pitching Stats. *(as of 9-26-01)*					
Player	**IP**	**Hits**	**Runs**	**ER**	**ERA**
G. Maddux	219.0	206	80	72	2.96
J. Burkett	208.0	174	76	67	2.90
T. Glavine	207.1	197	87	83	3.61
J. Marquis	115.1	101	58	46	3.60
K. Millwood	110.0	113	59	51	4.17
O. Perez	92.2	108	55	52	5.08
M. Remlinger	73.2	67	25	23	2.83
J. Cabrera	56.1	49	21	16	2.57
K. Ligtenberg	54.1	47	22	20	3.31
J. Smoltz	54.0	50	22	20	3.33

Discussion Questions:

- The best possible ERA for a pitcher is 0.
- J. Cabrera has the best ERA.
- The ERA is the average of earned runs against the pitcher. An earned run is one that results from good hitting or poor pitching. A pitcher wants a low ERA. The ERA tells the average runs that the pitcher gives up during a game.

4.

Atlanta Braves Hitting Stats. *(as of 9-26-01)*											
Player	**Games**	**At Bats**	**Runs**	**Hits**	**1B**	**2B**	**3B**	**HR**	**TB**	**BA**	**SLG**
A. Jones	151	589	98	148	89	25	2	32	273	0.251	0.463
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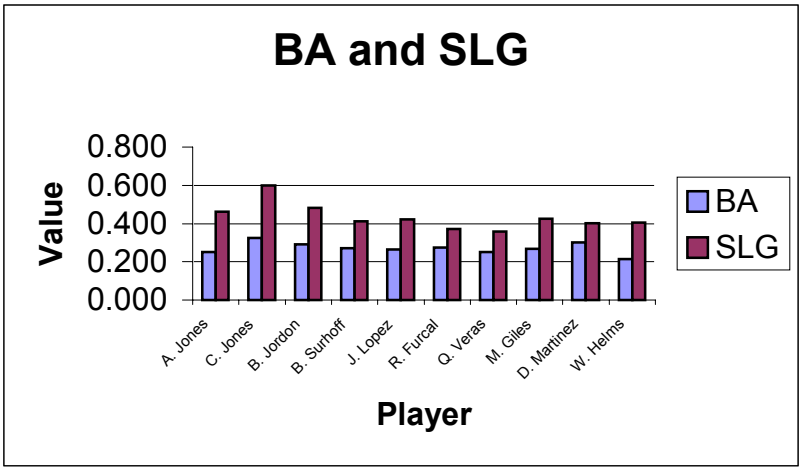
J. Lopez	123	425	43	113	80	16	1	16	179	0.266	0.421
R. Furcal	79	324	39	89	66	19	0	4	120	0.275	0.370
Q. Veras	71	258	39	65	46	14	2	3	92	0.252	0.357
M. Giles	60	219	29	59	41	9	2	7	93	0.269	0.425
D. Martinez	113	219	31	66	51	10	3	2	88	0.301	0.402
W. Helms	97	210	25	45	24	10	3	8	85	0.214	0.405



Formulas:

Students will have name cells in formulas.

1B (singles) = Hits – 2B – 3B - HR

TB = 1(1B)+2(2B) +3(3B) + 4(HR)

BA = Hits / At Bats

SLG = TB / At Bats

Discussion Questions:

- The strongest hitter is C. Jones because he has the highest SLG.
- The SLG range is greater than the range of BA. This represents the fact that the SLG shows strength.

Sports Mathematics

Major League Baseball Statistics: Atlanta Braves

1. Complete the missing data in the table below.

BA = Batting Average

Atlanta Braves Hitting Stats. *(as of 9-26-01)*								
Player	**Games**	**At Bats**	**Runs**	**Hits**	**2B**	**3B**	**HR**	**BA**
A. Jones	151	589	98	148	25	2	32	
C. Jones	149	538	104	175	31	4	36	
B. Jordon	138	519	71		28	3	22	0.291
B. Surhoff	131		64	123	32	1	10	0.272
J. Lopez	123	425	43	113	16	1	16	0.266
R. Furcal	79		39	89	19	0	4	0.275
Q. Veras	71	258	39	65	14	2	3	
M. Giles	60	219	29		9	2	7	0.269
D. Martinez	113		31	66	10	3	2	0.301
W. Helms	97	210	25	45	10	3	8	0.214

Discussion Questions:

- Explain how the batting average (BA) is calculated.
- What is the mean BA of the given players?
- What is the range of BAs in the table?
- In general, what is the best possible BA? What is the worst possible BA?

2. Complete the following table. Include answers calculated above.

SLG = Slugging Percentage: Total Bases / At Bats

Atlanta Braves Hitting Stats. *(as of 9-26-01)*											
Player	**Games**	**At Bats**	**Runs**	**Hits**	**1B**	**2B**	**3B**	**HR**	**TB**	**BA**	**SLG**
A. Jones	151	589	98	148		25	2	32			
C. Jones	149	538	104	175		31	4	36			
B. Jordon	138	519	71			28	3	22		0.291	
B. Surhoff	131		64	123		32	1	10		0.272	
J. Lopez	123	425	43	113		16	1	16		0.266	
R. Furcal	79		39	89		19	0	4		0.275	
Q. Veras	71	258	39	65		14	2	3			0.357
M. Giles	60	219	29			9	2	7		0.269	
D. Martinez	113		31	66		10	3	2		0.301	
W. Helms	97	210	25	45		10	3	8		0.214	

Discussion Questions:

- Explain in your own words what the SLG means.
- Can the SLG ever be the same as the BA? Explain.
- What is the highest SLG that a player can have?
- Can this statistic be considered an average? How?
- What does the SLG tell us about a particular batter?
- What is the median of the above SLGs and what does it mean?

Sports Mathematics

3. Complete the following table.

ER= Earned Runs ERA= Earned Run Average

Atlanta Braves Pitching Stats. *(as of 9-26-01)*					
Player	**IP**	**Hits**	**Runs**	**ER**	**ERA**
G. Maddux	219.0	206	80	72	
J. Burkett	208.0	174	76	67	
T. Glavine	207.1	197	87		3.61
J. Marquis	115.1	101	58		3.60
K. Millwood	110.0	113	59	51	
O. Perez	92.2	108	55	52	5.08
M. Remlinger	73.2	67	25	23	2.83
J. Cabrera		49	21	16	2.57
K. Ligtenberg	54.1	47	22	20	
J. Smoltz		50	22	20	3.33

Discussion Questions:

- What is the best possible ERA for a pitcher?
- Which pitcher above has the best ERA?
- What does the ERA mean (what does it say about the pitcher)?

4. Excel

- Enter all data from the table in #2 into an Excel spreadsheet. Include formulas for the statistics BA and SLG that you discovered. Also include formulas for TB (total bases) and 1B (singles) to check your work.
- Use the Chart Wizard to graph the BA and SLG for each player. Choose an appropriate chart to display the data, label the chart and axes.
- Save all work on a disk and turn in a printed copy of your chart and the completed table from Excel. Write out the formulas that you used on the paper you turn in.

Final Discussion Questions:

- Based on the chart, who is the strongest hitter overall? Explain.
- How do the range of the BAs differ from the range of the SLGs? Why do you think they are different and what does it mean in terms of the players?

Please turn in all discussion questions, your Excel table (with formulas written on the side), and the chart from Excel.

Sports Mathematics. Lesson 6. Basketball

Topic: ACC Basketball: Comparing Statistics

Content Standards (NC Standard Course of Study):

Middle Grades (6-8): Data, Probability, and Statistics.

Students investigate more complex data sets using technologies such as spreadsheets, data bases, and graphing calculators.

High School Introductory Mathematics:

1.02 Estimate and compute with rational numbers.

1.12 Analyze problem situations, select appropriate strategies, and use an organized approach to solve multi-step problems.

4.04 Evaluate arguments based on data.

Process Standards (NCTM): Problem Solving, Reasoning, Communication, Connections, Representation

Description of Activity: This is a WebQuest, where students will obtain ACC basketball statistics on the Internet, and then organize and interpret this data. Students will be asked to predict the relationship between points scored, opponents' points scored and win-loss record. Students will work in groups. Data will be represented in tables and graphs. Conclusions will be presented orally to the class.

Teacher Notes:

- After introducing the activity, student groups should be given the handout with websites for ACC athletics and instructed to complete the data table. This could be done during class time if a computer lab is available, or could be an outside assignment.
- Groups should then meet to organize and analyze data. Data should be represented in tables and graphs, which may be created using Excel or other spreadsheet, or on graph paper.
- Groups should draw conclusions from the data, and plan a presentation to the class that clearly states conclusions and supporting data. This presentation could be done with poster boards or with PowerPoint, if available.
- This activity will take at least two class periods, and might be used as a project spanning two or three weeks, where different parts are due at different times: Data tables, graphs, conclusions and justifications, and then the presentation.

Additional Information:

This lesson**:** http://www.wfu.edu/~mccoy/NCTM00/amy.html

Other WebQuests: http://www.wfu.edu/~mccoy/NCTM00/examples.html

Author: Amy Marchell, former Wake Forest student is now teaching mathematics at Ballard H.S., Louisville, KY

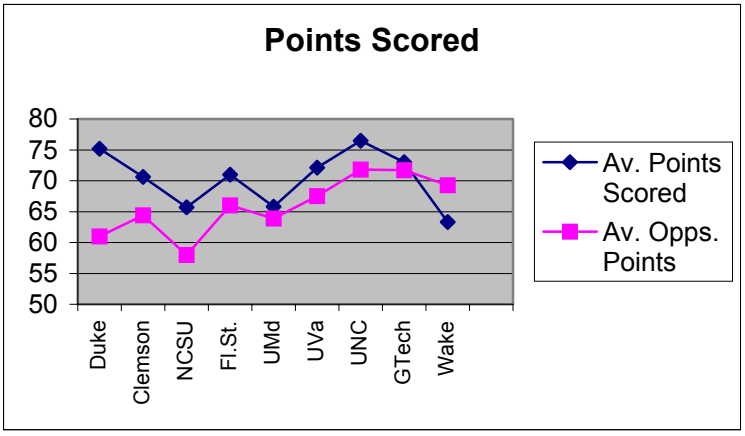
SAMPLE STUDENT WORK

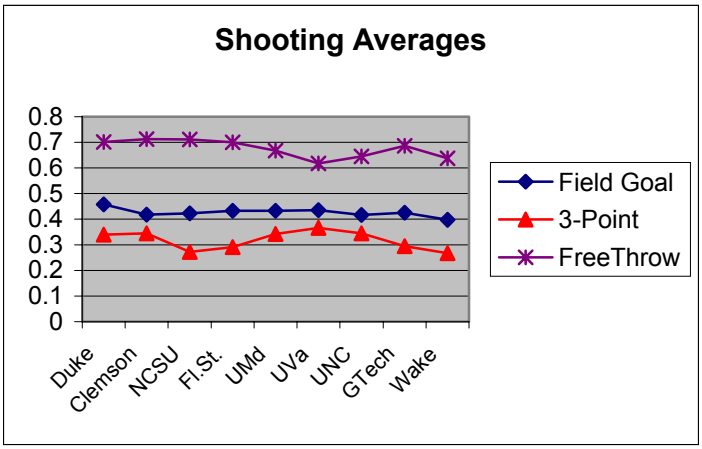
Atlantic Coast Conference Basketball: Comparing Statistics

1. Data Table:

Men or (Women) Year 2000-2001

	Clemson	Duke	Fl.St.	GTech	UMd	UNC	NCSU	UVa	Wake
ACC Rank	2	1	4	8	5	7	3	6	9
W/L Record	21-10	30-4	19-12	14-15	17-12	15-14	22-11	18-14	11-17
W/L Percent	.68	.88	.61	.48	.59	.52	.67	.56	.39
Av. Points Scored	70.6	75.2	71.0	73.0	65.8	76.5	65.7	72.1	63.3
Av. Opps. Points	64.4	61.0	66.0	71.7	63.9	71.8	58.0	67.5	69.3
Field Goal Percent	.418	.458	.433	.425	.432	.416	.423	.435	.397
3-Point Percent	.345	.340	.291	.295	.343	.345	.273	.366	.268
FreeThrow Percent	.712	.701	.700	.686	.667	.645	.711	.618	.637





- Duke did not score the most points, and their opponents did not score the least, but they were second in both cases.
- GaTech scored more than their opponents and still had a losing record.
- All teams had higher FG percentage, followed by FG and FT.
- There are no patterns in the shooting to account for winning.
- The ACC ranking was the same as the order of the winning percentage.

Sports Mathematics

Atlantic Coast Conference Basketball: Comparing Statistics

http://www.wfu.edu/~mccoy/NCTM00/amy.html

2. Data Table: Men or Women Year_____

	Clemson	Duke	Fl.St.	GTech	UMd	UNC	NCSU	UVa	Wake
ACC Rank									
W/L Record									
W/L Percent									
Points Scored									
Opponents' Points									
Field Goal Percent									
3-Point Percent									
FreeThrow Percent									

(For some teams, you may have to calculate some stats based on the information given on the website. You should decide if you want to use stats from ACC games or all games, or both. You may also collect other data to support your conclusions.)

3. Organize the above data in appropriate graphs to assist your interpretation. Use Excel.

4. Explain what the data means. Assist your group in preparing a presentation to answer the following questions. Make sure that you can justify each conclusion with data.
   - Do you think a team can have a greater average number of points scored by it's opponents each game than it's average scoring per game and still have a winning record?
   - Is it more important to score points or to keep your opponents from scoring?
   - How important are field goals, 3-point scores, and free throws?
   - What else makes a team successful or unsuccessful?

5. Evaluate the WebQuest by writing a journal entry. You will explain what you learned from the assignment, what you liked and disliked about the assignment, and if you feel the assignment had educational value.