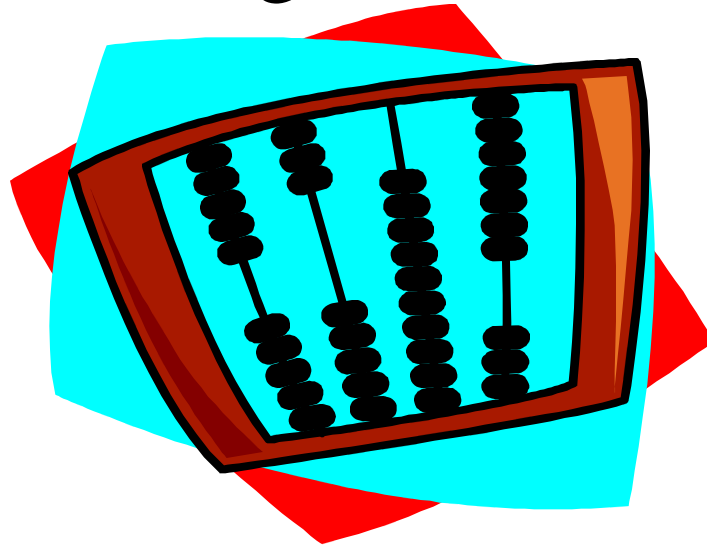


Interesting Activities of Practical Use in College Mathematics



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BASKETBALL

(This activity is taken from an article by Charles Vonder Embse and Arne Engebretsen published in the December, 1996, edition of The Mathematics Teacher, Vol. 89, No. 9.)

You are playing basketball. Your team is tied with the other team, and you have been fouled. If you make the shot, your team wins. If not, you will have an overtime situation. No pressure, but the entire team and all the fans are counting on you!!!!

Mathematically, what do you need to know that might help you make that shot? The following might be useful: How high is the rim above the floor? How far is the goal from the foul line? How tall are you? At what height will you release the ball? At what velocity will you throw the ball? At what angle will you release the ball? What effect does air resistance have on the path of the free throw? And many more!

Two programs for your calculator are included, one that does not consider air resistance, and a second one that does. The first program will ask you to provide information for three variables: Height at which the ball will be released, angle at which the ball will be released, and velocity at which you will initially throw the basketball. Try the numbers below first, and see what happens. If you make the basket, the word "swish" will appear on your screen. If you miss, you will see the path showing how badly you did! Let's pretend I am shooting. I am all of 5 feet tall, so let $H = 5$. I shoot free throws using both hands at an angle of approximately 60° , so let $\theta = 60$. I throw with all my might, so let's say velocity (or speed) is 20 ft/sec. So let $V = 20$. What happens? A big miss!!! So try again. Try increasing velocity.

Now, we know that typically basketball players are taller, so try a height of 6 feet with an angle of 60° , and a speed you think might be successful! Try changing all the variables and see how many baskets you make. Keep a record (in the table provided) of your hits and misses!

The second program allows you to consider that the gym in which you are playing might be drafty, or elevation of your area above sea level, air temperature, and relative humidity of the air. It adds a fourth variable " k ," a constant that allows you to consider the conditions listed above. Try running the program using these: $H = 5$, $\theta = 60$, $V = 25$, and $k = .2$. When we ran the program without air resistance using the same first 3 variables, it was a hit. What happens on this program? Do you need greater velocity when air resistance is considered? Again, explore several numbers and determine which ones allow you to successfully make the basket in the table provided

Table for program *without air resistance*:

H		V	Hit or Miss?
1)			
2)			
3)			
4)			
5)			
6)			
7)			
8)			
9)			
10)			
11)			
12)			

Table for program *with air resistance*:

H		V	k	Hit or Miss?
1)				
2)				
3)				
4)				
5)				
6)				
7)				
8)				
9)				
10)				
11)				
12)				

Multiplying M & M's

(adapted from an activity developed by the Mathematical Modeling Institute for Secondary Teachers)

Materials: Bag of plain M&M's candies, a cup, an a plate

Procedure: A group of 3 or 4 students are given some M & M's and a cup. The group places four M & M's in the cup. A group member places his/her hand over the cup and shakes the cup. Then, he/she spills the M & M's on to a paper place. The group counts the number of M & M's with the letter M showing, and multiply that number by 2. Add that number of M & M's to the cup along with the original ones. Record the result in the table below. Repeat the experiment at least five times.

Trials	Number of M & M's	Difference**
0	4	

**Difference is defined to be the difference in the number of M & M's at one trial minus the number of M & M's at the immediate previous trial.

Look at your data in the table above, describe what you think is happening.

What information do you think the Difference is providing?

Plot the data on the provided graph paper.

Describe the shape of the scatterplot.

Find a mathematical model that you think will fit your scatterplot.

Graph your mathematical model on to the scatterplot of your data. How well does your model fits the plot.

Use a graphing calculator put the "Trials" in L1, "Number of M & M's" in L2, and create a scatterplot on your calculator.

Use your calculator to find a model for the scatterplot.

How well does the calculator model fit the data.

What value does the calculator gives for a ? b ? What does the values represent?

Teacher's Note:

How can you use this activity in class?

How can the activity be adapted?

How Strong is Spaghetti?

Materials:

- unbroken pieces of spaghetti
- Styrofoam cup
- string
- pennies

Set Up and Procedure:

- Puncture two holes in the top of the cup so that you can thread the string through the holes. Tie the ends of the string together so that the string acts as a handle.
- Place one piece of spaghetti under the string so that the cup hangs from the middle of the piece of spaghetti.
- One person should hold both ends of the spaghetti.
- Another person begins to add pennies to the cup. When the spaghetti breaks, record the number of pennies needed to break the spaghetti.
- After you have broken one piece of spaghetti, use two pieces and again place pennies in the cup until the spaghetti breaks. Repeat the experiment until the table is completed.

Data Table and Exploration:

1. Complete the table below based on your experiments.

Pieces of Spaghetti	Number of Pennies Needed to Break Spaghetti
1	
2	
3	
4	
5	
6	

2. Graph your data on the graph paper provided. Use the pieces of spaghetti on the x - axis and the number of pennies on the y - axis.
3. Describe what you see on your graph. What kind of model do you think is appropriate for this data?
4. Pick any two points from your data table and write an equation in slope-intercept form.
5. Use your equation to complete the following table.

Pieces of Spaghetti	Number of Pennies Needed to Break Spaghetti
20	
50	
150	

6. Input the information from your data table into L1 and L2 on your calculator.
7. Calculate the line of best fit for the data.
8. How does the calculator line compare with your line? How are they alike? How are they different?
9. Use the calculator equation to predict how many pennies are needed to break 20, 50, and 150 pieces of spaghetti. How do these values compare to the predictions you made from your equation?

CSI: AMATYC

The CSI: AMATYC unit needs your help! The remains of two humans have been found. A group of medical examiners have determined that one set of remains belonged to a female and the other remains belonged to a male. Unfortunately, a complete skeletal system was not found for either human. However, each human remains did have a tibia bone.

Your assignment: Create a linear model that will predict a person's height (in centimeters) if the length of the tibia bone is known (in centimeters).

Task: Collect data of the height of males and length of their tibia bones. Collect data of the height of females and length of their tibia bones (in centimeters).

Males:

Length of Tibia (in centimeters)	Height (in centimeters)

Females:

Length of Tibia (in centimeters)	Height (in centimeters)

1. Create two scatterplots of your data. (one for the males and another for the females)
2. Describe your scatterplots.
3. Compare the two scatterplots. Explain the differences.
4. Using a graphing calculator, create a linear model for each set of data.

Now, back to your CSI assignment.

5. Suppose the female remains has a tibia that measures 26 cm, use your model to find her height.
6. Does your height for the female seem realistic?
7. Suppose the male remains has a tibia that measures 35 cm, use your model to find his height.
8. Does your height for the male seem realistic?
9. The following formulas can be used to predict the height of an adult male and female where x represents the length of the tibia bone in centimeters.

Female: $\text{height} = 2.5x + 72.6$

Male: $\text{height} = 2.4x + 81.7$

Use the formulas to find the height of the female in #7 and male in #8.

10. How does the value for the height in #9 compares to the results that you got for your model? If there is a difference, what caused it?
11. Select a female tibia length from your data and use the formula for female to calculate this person's height. How does the calculated height compare to the actual height?
12. Select a male tibia length from your data and use the formula for male to calculate this person's height. How does the calculated height compare to the actual height?

8. Create a scatter plot on the graph paper provided.

9. Describe your scatter plot.

10. Input your data from the table into L1 and L2 of your graphing calculator. Calculate a line of best fit for the data.

Are You a Survivor?

(This activity is developed from the CBS series, Survivor, and a web activity found at <http://barzilai.org/alg>)

Procedure:

1. Group members will need to select a leader (or host) for the game.
2. The leader divides the group into two teams, Sook Jai and Chuay Gahn.
3. To play the game, the leader flips a coin to see which team will start the game.
4. The leader places 21 "flags"* in front of the two teams.
*(Anything can be used as a flag. Be creative!)
5. Beginning with the team that won the coin toss and alternating teams, the teams may remove 1, 2, or 3 "flags" from the group. Each team must remove at least 1 "flag."
6. The team that makes the last legal move wins the reward challenge.
7. The reward is a surprise!!!
8. Try to develop a strategy that will allow your team to win.
9. Repeat the game and test your strategy.
10. Can you show your strategy mathematically? Can you write equations that explain what happened at different stages of the game?

BBALL 1
 Param
 Degree
 "VTcos " X_{π}
 "-16T²+VTsin +H" Y_{π}

ClrHome
 FnOff
 0 Tmin
 1.5 Tmax
 0.05 Tstep
 0 Xmin
 18.8 Xmax
 5 Xscl
 0 Ymin
 12.4 Ymax
 5 Yscl
 Line(13,10,15,10)
 Line(13,10,13.4,8.6)
 Line(14.6,10,14.2,8.6)
 Line(13.4,8.6,14.2,8.6)
 Line(13.2,9,14.2,9)
 Line(13.2,9.4,14.4,9.4)
 Line(13.8,10,13.8,8.6)
 Line(15,9.4,15,13)
 Pause
 Lbl 2
 Prompt H, ,V
 0 T
 Lbl 1
 Pt-On(X_{π} , Y_{π})
 .05+T T
 If abs($13.75 - X_{\pi}$) .35
 and abs($10 - Y_{\pi}$) 1
 Text(40,30, "SWISH")
 If T Tmax
 Goto 1
 Pause
 Disp "AGAIN(1=Y, 0=NO)"
 Input Y

BBALL2
 Param
 Degree
 "V / K*(1 - e^{-KT})* cos " X_{π}
 " V / K *(1 - e^{-KT})*
 sin + 32 / K²*
 (1 - KT - e^{-KT})) + H " Y_{π}

ClrHome
 FnOff
 0 Tmin
 1.5 Tmax
 0.05 Tstep
 0 Xmin
 18.8 Xmax
 5 Xscl
 0 Ymin
 12.4 Ymax
 5 Yscl
 Line(13,10,15,10)
 Line(13,10,13.4,8.6)
 Line(14.6,10,14.2,8.6)
 Line(13.4,8.6,14.2,8.6)
 Line(13.2,9,14.2,9)
 Line(13.2,9.4,14.4,9.4)
 Line(13.8,10,13.8,8.6)
 Line(15,9.4,15,13)
 Pause
 Lbl 2
 Prompt H, ,V,K
 0 T
 Lbl 1
 Pt-On(X_{π} , Y_{π})
 .05+T T
 If abs($13.75 - X_{\pi}$) .35
 and abs($10 - Y_{\pi}$) .25
 Text(40,30, "SWISH")
 If T Tmax
 Goto 1
 Pause
 Disp "AGAIN(1=Y, 0=NO)"
 Input Y

If Y=1
Goto 2
Stop

If Y=1
Goto 2
Stop