

# Vision - Potential

Vision Within Every Instructor - Potential Within Every Student

Newsletter of the HBCU College Algebra Reform Consortium\*

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### [1] Opportunity

The start of a new school year is a time for *new beginnings*, particularly for first year students in a Contemporary College Algebra class. For many of these students, their college algebra will be their terminal or near terminal mathematics class. You, as instructor for this college gateway course, have the opportunity (i.e., responsibility) to mold student attitudes and to develop students to be *exploratory learners*. In addition, you have the challenge to create and manage learning experiences for your students that:

- \* Prepare them for the quantitative work they will encounter in their academic careers and as a member of society;
- \* Engender a positive and appreciative attitude toward mathematics;
- \* Develop problem-solving skills.

\* Supported by the U.S. Military Academy.

Although there is no definitive way to achieve these objectives, a common thread that runs through instructor success stories is a student-centered pedagogy that replaces lecturing with small-group activities and projects. Here are a few of the suggestions that instructors have made for developing positive attitudes and problem-solving skills:

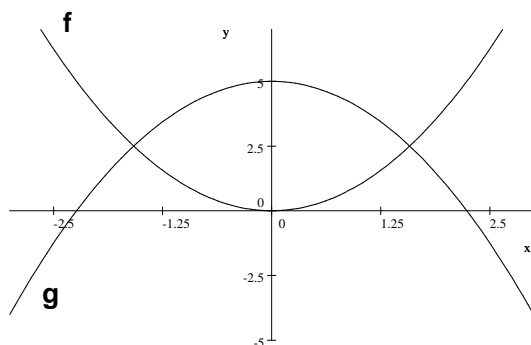
1. Begin with "easy" activities and then build on success. E.g., give an example of 10 numbers with a mean of 7. What-if the activity to require a mean of 7 and a median of 5. What-if again to also require a mode of 4.
2. Give students the opportunity to present to the class their solution to an activity and explain their reasoning.
3. As part of a homework assignment, ask students to bring to class real-life examples of the topic being studied, e.g., "Applications of Linear Equations." Provide class time for students to present and discuss their examples.
4. Let students pick their own small-group project. The instructor needs to clearly specify the objectives and the format for the project report.
5. Ask specific students to discuss the homework assignment - e.g., What is the main topic? What questions did the reading evoke in your mind? How does the new material relate to previous material? How can you use the new material? etc.

One of the purposes of the *Vision-Potential* Newsletter is to provide examples of small-group, in-class activities.

## [2] "Warm-up" Exercises

This is an example of a set of exercises for starting a class. For each of the statements a to e, state if it is True or False and then give an example that supports your answer. (That is, assign integer values to "a" and "b" and then compute the value of each side of the equation.)

- $-a^2 = a^2$
- $(-a)^2 = a^2$
- $(a - b)^2 = a^2 - b^2$
- $\sqrt{a^2 + b^2} = a + b$
- $2b + 3ab - 5bc = (2 + 3a + 5c)b$
- In the following multiplot, the function  $g$  has been obtained by shifting and/or scaling the function  $f$ .



- Determine the equation for the function  $f$ .
- Describe how  $f$  was shifted and/or scaled to obtain the function  $g$ .

## [3] Writing Assignment

Taxes are a hot topic in this period of political debate. Should taxes be cut? Should new, specialized taxes be imposed such as an

excess profit tax or an additional gas tax? Should the income tax be changed to a flat tax? These are just a few of the questions that are being raised as we enter into a time of presidential campaigning. "Fairness" is an issue that is often interpreted differently depending on whether a person is favoring or opposing a given tax proposal.

Suppose the issue at hand is to reduce the federal income tax rate by 5%. If you were arguing for this issue based on the savings people would realize, would you refer to the *average* savings people would receive or would you refer to the *median* savings? Write a one-half page paper supporting your choice of average or median.

## [4] Mark-up or Discount Pricing?

Mark-up and Discount are the two primary ways a store manager determines the list price of an item. For example, if the manager of your College Bookstore marks-up your college algebra text by 30% it means that she increases the wholesale price by 30% to get the list price (i.e., the list price is 130% of the wholesale price). Whereas using the discount method, the store manager determines a list price that when reduced by 30% gives the wholesale price. Answer the following questions:

- Do the mark-up and discount methods give the same list price?
- If the manager wants to increase her profit, should she use the mark-up or the discount method of pricing? Explain your reasoning.
- Explain how you determine the list price using the discount method.
- Determine the list price on an item marked up 30% if its wholesale cost is \$90.
- Determine the list price on an item discounted by 30% if its wholesale cost is \$90.

Ask your Bookstore manager which method of pricing she uses to price textbooks.

### [5] ATV Registrations in Maine

Over the past 10-15 years, All Terrain Vehicle (ATV) riding has grown tremendously as a recreational sport in Maine, complimenting the snowmobile sport. The continuing growth is shown by the increase in ATV clubs from about 36 to over 130 within the past five years. The sport is a major contributor to Maine's economy as reported by a 2005 study that estimated ATVs contributed approximately \$200 million to the Maine's economy. The following data shows the number of ATV registrations in Maine for the years specified. Source: Bangor Daily News, August 18, 2007.

Display this data in a scatter plot and then graphically fit a polynomial and an exponential function to the data (without using any regression program). In order to lessen round-off errors, let the independent variable be the number of years since 1990 (i.e., shift the plot 1990 units to the left. Thus 1993 is written as 3, 1995 is written as 5, etc. Determine which of your two functions provides a better fit to the data (e.g., compare the errors for each of the years). Explain your reasoning.

Year	#ATV Registrations
1993	21,447
1995	23,857
1997	27,270
1999	33,854
2001	44,796
2003	59,857
2004	66,023

### [6] Scientific Notation

Very large or very small numbers are usually expressed in scientific notation rather than

in decimal notation in order to avoid writing long decimal expressions. For example, the mean distance between Earth and Pluto is 3,700,000,000 miles which is  $3.7 \text{ E}9$  in scientific notation.

Notice the zeros in 500 represent multiplication by 10. Thus we can write  $500 = 5 * 10^2$ . Similarly, 6,000,000 may be written (in scientific notation) as  $6 * 10^6$ . The format for a number written in scientific notation is:  $a * 10^b$  or  $a \text{ E}b$  where:

$a$  is a number between 0 and 10 written in decimal form

$b$  is an integer: positive, negative, or zero.

Examples:

The decimal number 8264.596 written in scientific notation is  $8.264596 * 10^3$  or  $8.264596 \text{ E}03$ .

The decimal number 0.00000782 written in scientific notation is  $7.82 * 10^{-6}$  or  $7.82 \text{ E}06$ .

The number (scientific notation)  $2.8 \text{ E}04$  written in decimal notation is 28000.

Answer the following questions:

- Avogadro's number,  $6.023 * 10^{23}$ , is the number of molecules in a mole of gas. Write this number in decimal form.
- How large (miles) is one light-year (the distance light travels in one year)? Light travels at the rate of 186,000 miles per second. Assume that a year has 365 days.
- Proxima Centuri, the closest star to Earth, is approximately 4 light-years away. Express the distance (miles) between Earth and Proxima Centuri in scientific notation.
- At 7:52 pm on September 7, 2007, the national debt was \$9,008,761,055,587.33. Express the debt in scientific notation.
- Compute and express in scientific notation:  $(4.805 * 10^4) * (7.825 * 10^3)$ .

f. Compute and express in scientific notation:  
 $\frac{2.06 \cdot 10^2}{3.55 \cdot 10^4}$

### [7] Running, Running, Running

With the exception of your own favorite track and field event, the running of the mile is probably considered to be the premier event in track and field. In the late 1940s and early 1950s, the hottest topic in track and field was when would someone run a sub (below) 4-minute mile. Based on the 1913-1984 data for the world records for the mile, in what year was the first sub 4-minute mile run? Note the years listed are those from 1913.

Year	Time	Year	Time
0=1913	(sec.)	0=1913	(sec.)
0	254.4	41	238.0
2	252.6	44	237.2
10	250.4	45	234.5
18	249.2	49	234.4
20	247.6	51	234.1
21	246.8	52	233.6
24	246.4	53	223.3
29	246.2	54	231.1
29	244.6	62	223.0
30	242.6	62	229.4
31	241.6	66	229.0
32	241.4	70	228.8
41	239.4	71	227.3

Develop a linear and an exponential model of the world records for the mile. That is, draw a scatter plot showing the data and then fit a linear and an exponential curve to the scatter plot. The functions representing your curves are the models. Use your models to answer the following questions:

- Explain which model is "better." In what way is it better?
- State the symbolic forms of your functions.
- Superimpose the graphs of your models on your scatter plot.

d. Use your model to predict the world record in 2010, in 2030.

e. Explain how reliable your prediction is for 2030.

Here is some additional information: on July 7, 1999, Hicham El Guerrouj of Morocco ran the mile in 205.88 seconds, a record that stands today (2007). Based on this additional information, how, if at all, would you alter your answers to parts e and f?

### [8] Queries

- Pick a number, add 3 to it, double the result, subtract 4 from the answer, and then triple the result. If the result is 39, what number did you pick to start?
- The radius of a wheel (including the tire) on a 998 Buick Regal is 12 inches. How fast (revolutions per minute) is the wheel turning when the car is moving at 60 mph?

### [9] Notices

- The American Mathematical Association of Two-Year Colleges will hold its 33<sup>rd</sup> Annual Conference at Minneapolis, Minnesota, November 1-4, 2007.
- Deadline for contributions to the October Newsletter is Monday, October, 2007. Opinion articles, suggestions for writing assignments, small group in-class activities, small group out-of-class projects, Queries, announcements, etc. are welcomed.
- To subscribe to this Newsletter, write to Don Small, Department of Mathematics, U.S. Military Academy, West Point, NY 10996 or contact him via e-mail at don-small@usma.edu.