

Vision - Potential

Vision Within Every Instructor - Potential Within Every Student

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[1] Math in the Life of a 99-Year-Young Quilt Maker

Jackie Giles
Texas Southern University

Flora Jackson, a 99-year-young lady, quilts while watching NFL and NBA sports into the wee hours of the night. Her quilting and interest in sports has helped make her sharp mind, sharper. This sewer of patterns has lived a rich life during her nearly 100 year journey in America. Born October 15, 1909 in Pitts View, Alabama (now living in Cleveland, Ohio), she raised eight children of her own and, as a midwife, assisted in the delivery of fifty babies.

Flora Jackson has sown more than 100 original quilts, and is still going strong. Although never formally educated in mathematics beyond arithmetic, her understanding of geometrical concepts is clearly evident in

* Supported by the U.S. Military Academy.

her quilt patterns. Several were filled with reflections, rotations, and scaling. Never having studied the theory of rotational matrices, she saw beauty in transformations and designed her quilts to give a beautiful visual impression. One quilt was made with triangles and squares. The triangles were inscribed in a square, four in each square, and each one was rotated 90 degrees to yield the position of the next one. In the world of matrix algebra, this transformation can be represented by

$$\begin{bmatrix} \cos(\pi/2) & -\sin(\pi/2) \\ \sin(\pi/2) & \cos(\pi/2) \end{bmatrix}$$

I know what you are saying, "Mrs. Jackson does not know what you are talking about." I would answer, "Mrs. Jackson does not need to know my language. Her language is expressed in the design of each and every one of her quilts."

She told me that it takes her five weeks to make a quilt, working about eight hours per weekday designing, sewing and finishing her mathematical artwork. Flora charges only \$250 for one of her fine quilts. This means that she is making \$50 per week for each quilt. An interesting computation is to figure out her hourly wage, assuming a forty hour work week, and compare it to the official minimum wage. How much should she charge for one of her quilts if she were to receive the minimum wage for her work?

This beautiful, creative, and wise woman hums her favorite hymn "Amazing Grace" and when asked for her favorite scripture

replies Psalm 119:105: "Thy word is a lamp unto my feet, and a light unto my path." Her words of advice to young people: "Tend to your business, and let everybody else's alone."

[2] Interpreting Slope

The concept of rate of change is central to any study of change. Thus the concept of slope, as a rate of change, deserves a full class discussion, possibly seeded with several "Explain" type questions. The following list of statements and questions are offered as stimulants to an in-depth discussion of slope.

- Slope is presented graphically as rise over run, in function language as change in output over change in input, and algebraically as an average rate of change. How can a quotient represent a rate of change?

- When \$100 is invested at 4% annually, the plot of interest versus time (years) is a straight line. How is the slope of the line interpreted in terms of the investment?

- Hook's Law says that (for small displacements) the restorative force of a spring is proportional to the spring's displacement (i.e., the length that the spring has been stretched or compressed). Thus the force is a linear function of the spring's displacement and the corresponding graph is a straight line. How is the slope of the line interpreted in terms of the spring?

- Explain why a linear function is said to be increasing (decreasing) if its slope is positive (negative).

- A distance (ft) versus time (sec) of a car that speeds up from a stop position is probably not a straight line. Suppose (2,20) and (10, 800) are two points on the plot. The average rate is $(800-20)/(10-2)$ is approximately 75 mph. This average rate is the slope of what line?

- What is the difference between average rate of change and instantaneous rate of

change? What does the speedometer of your car register?

- Slope, average rate of change, is associated with a straight line. Would it make sense to speak of the instantaneous rate of change of a curve at a point as the slope of the line tangent to the curve at that point? Explain.

[3] Polynomials

The purpose of this exercise is to let students discover the relationships between the roots and coefficients of a quadratic polynomial equation. It is assumed that students understand the terms *factor* and *root* and their relation to one another.

Begin by computing the following:

a. Determine the quadratic equation whose roots are 2 and 3.

b. Determine the quadratic equation whose roots are -2 and -3 .

c. Determine the quadratic equation whose roots are -2 and 3.

d. Determine the quadratic equation whose roots are 2 and -3 .

Based on the results for parts a, b, c, and d, conjecture the relationship between the coefficients in the quadratic polynomial equation $ax^2+bx+c=0$ and the roots of the equation. Prove or disprove your conjecture by denoting the roots r_1 and r_2 and forming the corresponding quadratic polynomial equation.

Follow-on exercise: Experiment, conjecture, and verify the relationships between the roots and the coefficients of a cubic polynomial equation.

[4] Planning a Reunion Dinner

Candy Hodges

Bethune-Cookman University

A committee has been formed to plan for a Refocused College Algebra Reunion dinner

for the Joint Mathematics Meetings scheduled for January 2010. The committee is working to determine a ticket price which will cover the banquet room rental cost of \$750 and the \$20 (each) dinner charge. The committee also plans to price the tickets so that the three guests of honor - Don Small, Archie Wilmer, and Tony Johnson - will not pay to attend.

The committee began by completing a table, realizing that if 30 people attended the reunion dinner, only 27 would be charged for tickets. Complete the following table after being certain that you understand the computations for the row the committee completed.

#Attendees	Total Cost	Cost for Paying Attendee
30	\$1,350	\$50
50		
100		
200		
n		

Write a function for the cost per paying attendee, $C(n)$, as a function of the total number of attendees n .

Sketch the graph of the cost function on a 200 by 200 grid, being sure to label the axes. (The grid is omitted.)

Note To Instructor. Once the tasks above are completed, a discussion about the equation of the asymptote and the lowest possible value for the cost per paying attendee can be discussed.

Candy Hodges: "I have a lot of fun in class with the reunion dinner problem. We talk about keeping the price down and "play" the -I'll bet if 200 people come, THAT will get the price under \$20 -Maybe if 250 come, THAT will get the price under \$20. etc. It is eventually fun to talk about the equations of the asymptotes, and, for example, though the one is 3, how within the context of the problem, actually FOUR people must come (3

guests of honor PLUS ONE) and that fourth person will not be pleased to have to pay for his and the three guests of honors tickets. It's just a lot of fun!"

[5] Queries

- (Volume versus Area) Can the surface area of a cube ever be the same as the volume of the cube? If so, give the dimensions of such a cube. If not, explain why not.
- (Volume versus Area) Can the surface area of a sphere ever be the same as the volume of the sphere? If so, give the radius of such a sphere. If not, explain why not.
- (Area versus Circumference) Can the area of a circle ever be the same as the length of the circumference of that circle? If so, give the radius of such a circle. If not, explain why not.
- (Volume versus Label Area) Can the volume of a cylindrical can be the same as the label area of the can? (Label area is the surface area of the can not including the top or bottom of the can.)

[6] Wolfram|Alpha Website

The website for computations, Wolfram|Alpha, is (should be) raising questions in the minds of college algebra instructors, as well as others, as to how this website will effect their teaching. Not only does this site provide answers to the computational questions found in traditional college algebra textbooks, it also provides an explanation of the process for determining the answer. Check out the site by entering <http://WolframAlpha.com> and clicking on Wolfram|Alpha. Experiment by posing questions (e.g., type $(2x - 4)^2 - 11 = 0$ and press Enter; after getting the solution click on Show Steps).

The site is much more than a computational site for mathematics. The mission statement

states “Wolfram|Alpha’s long-term goal is to make all systematic knowledge immediately computable and accessible to everyone. We aim to collect and curate all objective data; implement every known model, method, and algorithm; and make it possible to compute whatever can be computed about anything. Our goal is to build on the achievements of science and other systematizations of knowledge to provide a single source that can be relied on by everyone for definitive answers to factual queries.

Wolfram|Alpha aims to bring expert-level knowledge and capabilities to the broadest possible range of people—spanning all professions and education levels. Our goal is to accept completely free-form input, and to serve as a knowledge engine that generates powerful results and presents them with maximum clarity.

Wolfram|Alpha is an ambitious, long-term intellectual endeavor that we intend will deliver increasing capabilities over the years and decades to come. With a world-class team and participation from top outside experts in countless fields, our goal is to create something that will stand as a major milestone of 21st century intellectual achievement.”

[7] Notices

1. The Joint Mathematics Meetings will be held in San Francisco, CA January 13-16, 2010. Mathematics and Education Reform (MER) will hold a special session Friday afternoon. The program will begin with a panel session discussing the MAA/CRAFTY College Algebra Guidelines. This will be followed by twenty minute talks given by Bill Haver (Virginia commonwealth Univ.), Irene Haskins (Husson Univ.), Erick Hofacker (Univ. of Wisconsin at River Falls), Burnedette Turner/Donna Stallings (Lincoln Univ.), Andy Bennett/Rachel Manspeaker/ Jennifer Paulhus (Kansas State Univ.), and Barbara Edwards (Oregon State Univ.).
2. The sixth edition of *Contemporary College Algebra: Data, Functions, Modeling* by Don Small is now available. Contact Kathy Kilburg (563-584-6322, Kathyj_Kilburg@mcgraw-hill.com) for an examination copy.
3. <http://usmasvdzdeanext/departments/math/HBCU/> is a resource website for the seventeen HBCUs in the U.S. Military Academy’s program to assist HBCUs in refocusing their college algebra courses, as well as for anyone else interested in refocusing college algebra.
4. Past issues of the *Vision - Potential* Newsletter are available on our website: www/ContemporaryCollegeAlgebra.org.
5. Deadline for contributions to the November Newsletter is November 1, 2009. Opinion articles, suggestions for writing assignments, small group in-class activities, small group out-of-class projects, Queries, announcements, etc. are welcomed.
6. To subscribe to this Newsletter, contact Don Small via e-mail at don-small@usma.edu.

“If your class is productive, the teacher doesn’t have to teach all the time. The students can teach each other and as students we sometimes learn better from our peers.”
(Student at Bethune-Cookman Univ.)