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Your Calculator Does Not Know That $4x(1-x) = 4x-4x^2$

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How can that be? Well, your calculator doesn't know very much at all. For example, it doesn't even understand the value of 1/3. After all 1/3 = 0.333.... Although you understand that the 3's continue for ever, your calculator cannot deal with this. It has to truncate the expansion at some point. Consequently it is only dealing with an (albeit very good) approximation to 1/3. It is easy to believe that working to 8 or 16 places of accuracy is sufficient. However, it is just not true. Certain calculations are very sensitive. That is if you feed two very similar inputs into a calculation then it is not always the case that the outputs will be so similar. This can be demonstrated in many different ways if you will spend a little time programming your calculator.

The idea is to program the calculator to take an input x and then find the value of $4x(1-x)$. We will restrict the input to satisfy $0 \le x \le 1$, then it is easy to check that the output ($4x(1-x)$) satisfies the same inequalities. The idea is to take this output and now use it as the input. In fact we just continually feed the output of this calculation back into the same calculation. In the language of dynamical systems, we are creating the orbit of x under the function f where $f(x) = 4x(1-x)$. It may surprise you to learn that your calculator almost certainly cannot handle this very simple calculation even if you ask for only 30 or so repetitions. Indeed, different makes of calculators will give different answers and they will all most likely be wrong. In fact, you can frequently detect the make of the calculator just by knowing the answer it gives to this sort of calculation - what a great party trick! If you only have access to one programmable calculator then you can still quickly see that all is not well by having it simultaneously do the calculations with $f(x) = 4x(1-x)$ and $g(x) = 4x - 4x^2$. You've most likely been told that these are the same. Well, let's see what your calculator thinks of this. Here is a program listing for a TI 83+ calculator. You should find it easy to modify for other brands and models of calculator.

:C1rHome	this just clears the screen
:Input "X=", X	the calculator will request an input and assign its value to X this will be the initial value of X to start the calculations
:Input "N=", N	this will be the number of times the calculation is performed
:X →W	this assigns the original input value X to the variable W too
:X→U	I think you can guess what this does
For(M,1, N,1)	this is the beginning of a loop which will be repeated N times
:4W - 4W^2→Y	the value of 4W - 4W^2 is stored as Y
:1 - U→A	the value of 1 - U is stored as A
:4UA→Z	the value of 4U(1 - U) is stored as Z
:Disp {round(Y,4) round(Z,4)}	this displays the value of 4W - 4W^2 = 4x - 4x^2 and the value of 4U(1 - U) = 4x(1 - x)
:Y→W	the number 4W - 4W^2 is stored as W, ready to start the loop again
:Z→U	the number 4U(1 - U) is stored as U, ready to start the loop again
:End	this sends you back to the beginning of the loop with the new values of W and U

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News

• National Convention

Come for a heapin' helpin' of
Southern hostipality, charm, and
Magnolia Math
at the 32nd Annual
Mu Alpha Theta National Convention
to be held at
Mississippi State University
in
Starkville, Mississippi

July 26- 31, 2002

Hosted by Mississippi School of Mathematics and Science

For more information contact:
Claudia Carter (ccarter@msms.k12.ms.us)
or
Aubrey Knight (aknight@msms.k12.ms.us)

• MAΘ National Listserve

In an organization as large and as geographically vast, a listserve can provide a convenient way for members to keep in touch and up-to-date. Since every member sees each
posted email, it provides an excellent way to quickly distribute information. The list also provides a forum for extended discussions. Members can read each post when convenient and if desired submit their comments or suggestions.

There are two ways to subscribe

1. Send an email to
   MuAlphaTheta-subscribe@topica.com.
The *listserve* will automatically extract your email address and add you to the list.

2. A subscription form is also available at:
http://www.topica.com/lists/MuAlphaTheta/subscribe/?location=listinfo

2. If you still can't get subscribed, send an email toSam Koski at ASKoski@aol.com with the email addresses that you want to included.

• Mu Alpha Theta Student Delegate/Chapter President Listserve

Student Delegates and Chapter Presidents are invited to join a *listserve* by sending an e-mail to subscribe-delegate@topica.com. Student Delegates and Chapter Presidents will all play a large role in the success of Mu Alpha Theta this year, through this mail list. The mail list throughout the year will have an open discussion of any topics related to Mu Alpha Theta. Sponsors are also invited to join the list to provide some additional suggestions and comments to members.

• MAΘ Website

Check out the National Office website at
www.mualphatheta.org
for the latest information from
the national office.

• *The Art of Problem Solving*

*Paul Zeitz, former coach of the United States Olympiad team, referred to the texts as a **must** for any serious math library.*

The ART of PROBLEM SOLVING is a pair of texts for those students involved in extracurricular mathematics. The authors, Sandor Lehoczky and Richard Rusczyk are former Mu Alpha Theta students and participants in Math Olympiad Programs (students who pass the AHSME/AIME/USAMO series of tests produced by the Mathematical Association of America).

The texts have been used by successful students, teams, and clubs in grades 7-12 since 1994. Volume 1 covers mathematics commonly occurring in MATHCOUNTS and the AHSME, as well as many local and state math contests. Volume 2 covers more advanced topics found on the AHSME, as well as the AIME and USAMO. Included in the texts are hundreds of challenging problems from national tests such as ARML, MathCounts, the national Mu Alpha Theta conventions, and the MAA series of exams which determine the national math team. If you have further questions about the texts, contact the national office at matheta@ou.edu or 405-325-4489. Prices are shown below; make checks and purchase orders payable to Mu Alpha Theta. Discounts for bulk orders are available.

Volume 1 text	$26
Volume 1, text and solutions	$34
Volume 2, text	$28
Volume 2, text and solutions	$37
Volume 1 and 2, text	$50
Volume 1 and 2, text and solutions	$64

MATH IS FUN

The Story of Mu Alpha Theta and Mrs. Susan Doker during the past Four Years at Lincoln High School From a Student's Perspective

Julie N. Lawson

If I were creative, I would have a clear, concise title, but this one does its duty, describing well the piece of Mrs. Doker's story that led to her nomination for the ***Huneke Award***.

When I entered Lincoln MAΘ four years ago, Mrs. Doker was the Algebra II sponsor. She still is, as a matter of fact. Not until my junior year did she officially become "Head Sponsor," but everyone knew, or quickly learned, that if you had a question, Mrs. Doker was the answer. Who do I turn this in to? Mrs. Doker. Where do I find…? Mrs. Doker. Why do we have to…? Mrs. Doker. You get the idea. If not for her, us wee little freshmen could have become as lost in the ranks of our large MAΘ organization as we were in the maze of our school.

So like I said, Mrs. Doker knew everything. She fulfilled her "sponsorly duties" to the highest degree going so far as to befriend bus drivers (making up for our not-quite-so-perfect-all-of-the-time behavior, no doubt), as well as direct them to competitions with the use of maps and memory.

This was the Sue Doker I met upon entering Lincoln High School in the fall of 1997.

By the spring of 1998 I was talking to her about how cool it would be if we had a competition at Lincoln. A year later, all we needed was use of the school and Mrs. Doker's "ok," organizational skills, support, connections, time, money, and knowledge of what on earth goes on behind the scenes of a competition. Not too much to ask of her, right? She took on the challenge and the Lincoln High Pre-Season Invitational was born. She remains the backbone as we plan for this year's Invitational.

The same year, Rickards High School lost their head sponsor. Darryl Hill, Rickards President for the year described their solution to the predicament as follows: "Since I was very familiar with the great success that Lincoln High has had with Mu Alpha Theta, I contacted Mrs. Doker, with the hope that she would give me the insight on what it took to make our organization successful. I did this with some hesitation…. My worries of Mrs. Doker being overly competitive ended with our first encounter. She received my inquiries about Mu Alpha Theta very warmly and sympathized deeply for the Rickards students."

Her room, open to students half an hour before and after school, if not until 5:00 pm for students practicing, has become a crossroads for all math people; rarely could I catch her alone before school, since she is usually explaining math to one or more of her students. I myself have tutored many students in her room, both before and after school. She has allowed us to invade her room with scrapbook meetings, flurries of other projects, and blizzards of pictures. What more could we expect from our very own Teacher of the Year?

I asked her once why she decided to become a teacher. She told me that one of those career-inventory questionnaires had suggested she be a guidance counselor. I think the job would have suited her, but, as she explained to me, as a teacher you have more of a chance to get to know the students, work with them everyday.

Mrs. Doker is very human in all she does and for this students like me love her. The little things are what make her especially special: playing cards with us on the bus; bringing us popcorn or candy at practices after school; singing with us in the car, everything from Simon and Garfunkel's "Cecilia" to songs from a CD entitled "Touched by Love," to some of her sons' music which I am still not all that familiar with; coming to her students' piano recitals; bending curfew a little as she sees that the friendships being formed in the club may be more important than that one extra half hour of sleep; sending us "Boo Bags" and "Bunny Bundles" of candy as a thanks for helping her; and always, always holding a sympathetic ear open to us.

I, personally, have come to know her kind ear well. I entered Algebra II my sophomore year believing myself to be about average, nothing special in the math field. She told me otherwise. Her encouragement coupled with peers' kind words and math tricks boosted me to fourth at a regional competition that year, and my first placing at State. Since then, Mrs. Doker and I have conquered a little of our fear of roller coasters on a trip to Busch Gardens, both concluding that Montu was not for us, and conspired with other students to make new members feel welcome in what was becoming known around school as the "math cult." I would call it a family, with Mrs. Doker dubbed "Mama Doker" by the 1999-2000 scrapbook after the trip to Tennessee.

She may not always be perfect, but the love she shows us makes her perfect, and while the big things she does may make her stand out, the little things make her whole.

She's one in a million. In fact, she's one in 6.2 billion!

Julie N. Lawson
Former Lincoln MAΘ Co-historian and Vice-President
Lincoln High School, Tallahassee, Florida

Your Calculator Does Not Know That $4x(1-x)=4x-4x^2$

continued

Most people would expect that the numbers shown on the screen by the command line :Disp ... would be the same. Unfortunately a calculator cannot live up to these great expectations. Starting with the input x = 0.1 and *N = 50* the last three pairs on the screen of my TI 83+ are

{0.0626 0.1105}
{0.2349 0.3931}
{0.7188 0.9543}

My computer seems to be even worse. Writing the equivalent program in basic yields the last three pairs

{0.8582 0.9711}
{0.4867 0.1124}
{0.9993 0.3991}

So what's going on. Well, it's a long story. To really understand the problem you should read the very interesting book *An Introduction to Chaotic Dynamics* by Robert Devaney, Addison-Wesley 1990. Not to give the secret away, but the number 4 is the essential feature. If you were to replace it by 3, for example, you would not encounter any problems.

December and June

by JoAnne Growney

cold
winds howl
geese go south
nights long tea steeps
temperatures fall low
ponds freeze snowmen grow
toboggans slide down hillsides
sun hides ice coats spring waits
wood-fires flame groundhogs hibernate

sun glows raspberries ripen
catbird sings iris blooms
days long streams rush jays scream
holiday picnics catch flies
wheat thrives crickets chirp
tomato plants climb
hay dries tea's iced
catbird sings
sun glows
warm

The numbers of syllables in the phrases of this poem follow the patterns of factorization of the integers from 1 to 10, then 10 to 1, into prime factors 2, 3, and 5. For example, line six has phrases of two syllables and three syllables, using factorization 6 = 2 * 3. Line eight has three phrases with two syllables, using 8 = 2 * 2 * 2.

The Mathematical Log is the official publication of Mu Alpha Theta, national high school and junior college mathematics honor society and mathematics club federation. Founded in 1957 by Richard and Josephine Andree, Mu Alpha Theta is co-sponsored by the Mathematical Association of America (MAA), the National Council of Teachers of Mathematics (NCTM), and the Society of Industrial and Applied Mathematics (SIAM). Correspondence may be directed to Mu Alpha Theta National Office, 610 Elm Ave., Room 423, Norman, OK 73019, email: matheta@ou.edu or to Log editor Pat Bowler Johnson, New Trier High School, 385 Winnetka Avenue, Winnetka, IL 60093,

email: bowlerjp@newtrier.k12.il.us

The true spirit of delight, the exaltation, the sense of being more than man, which is the touchstone of high excellence, is to be found in mathematics as surely as in poetry.

-- Bertrand Russell

Letter from...

- **Claudia Carter,**
  2002 National MAΘ National Convention Chairperson

I also want to give you some preliminary info about 2002. The dates for next summer will be July 26-31, 2002. The location is Mississippi State University campus. I am still working on exact costs, but I can tell you now that it will be no more than $300 per person, and probably closer to $250, I hope. MS State is located in Starkville, MS which is about 40 miles east of the Alabama border on MS Highway 82. There is a regional airport to fly into, known as GTR (Golden Triangle Regional) that both Delta and Northwest fly into it. Delta does offer a small jet service. NW provides only what I fondly call "puddle jumpers" prop planes. Those traveling up from the Gulf Coast would want to note MS Highway 45 and take alternate Hwy 45 up from Meridian, MS.

I hope to have "the packet" at the website soon and MAΘ is looking at getting an online registration set up. So that may take us a little longer, but you will have the basic info you need early on. Please be sure that you email me at ccarter@ebicom.net if you are planning to attend so that I am sure to keep a listing and include you with updates and information as becomes available.

One event that is already planned is a Fifties costume and dance contest. A band, named Dual Exhaust, from New Orleans will provide the real touches for the 50's. They dress up as the famous singers and entertain as well as provide super music. Another event will involve use of the entire athletic complex on campus complete with a pool party. The ERC (Engineering Research Center) as a Virtual Reality room, they call "The Cave" which I think you will really enjoy! There are other things I am currently working on which I will share as soon as I can settle up.

Claudia Carter

Harold and Opal Huneke

His Spirit Lives On

Harold Huneke
August 26, 1917 – November 15, 2001
Former Secretary-Treasurer of MAΘ

by Claudia Carter
National MAΘ Past President

Harold Huneke was a professor of mathematics at Oklahoma University from 1951 until 1983 when he retired. The Andrees had just created this wonderful organization to promote mathematics at the high school and junior college levels that is fondly known as Mu Alpha Theta. In 1972, Harold Huneke picked up the torch and became the OU mathematics faculty member who served as Secretary-Treasurer for National MAΘ. Harold served from 1972 to 1983. For those of us who knew Harold, he was a great inspiration. I was a fairly new teacher back then, and had finally gotten my chapter motivated to attend a national convention. Harold made me feel so welcome and showed me how worthwhile giving up summer time and working many hours throughout the school year was for my students. It was such an uplifting experience to see Harold at national conventions. His undying energy always motivated me to put forth my best. He knew sponsors by name and greatly appreciated all the hard work, sacrifices and time that each sponsor devoted to making Mu Alpha Theta chapters the top organizations on school campuses. His beaming smile and encouraging words could brighten any sponsor's day. Most importantly, every minute he spent with sponsors and students was genuinely sincere! It is no wonder that each year an exceptionally dedicated sponsor is awarded an honor that bears his name, the ***Huneke Award***.

Huneke Award Winners

1986: Paul Forester, San Antonio, Texas
1987:Adel Hanson, Milwaukee, Wisconsin
1988:Sister Scholastica, San Antonio,Texas :
1989: Martha Howell, Tuscaloosa, Alabama
1990: Grace Mutz, Knoxville,Tennessee
1991: Dorothy Wendt, Huntsville, Alabama
1992: Claudia Carter, Columbus, Mississippi
1993: Norman Johnson, Richland, Washington
1994: Pete Pedersen, Vinalhaven, Maine
1995: Helen Dostal, North Miami Beach, Florida
1996: Thom Morris, Tampa, Florida
1997: Sam Koski, Miami Springs, Florida
1998: Mary Emma Bunch, Knoxville, Tennessee
1999: Michael Carpenter, Tuscaloosa, Alabama
2000: Dorothy Martin, Bellevue, Washington
2001: Susan Doker, Tallahassee, Florida

WELCOME

Newly Chartered Chapters

Archbishop Ed McCarthy High School, Ft. Lauderdale, FL
Arp High School, Arp, TX
Bay High School, Bay St. Louis, MS
Bayshore Christian School, Tampa, FL
Bishop Moore High School, Orlando, FL
Cedar City High School, Cedar City, UT
Christian Home & Bible School, Mt. Dora, FL
City Honors School, Buffalo, NY
Creighton Preparatory School, Omaha, NE
D'Evelyn Jr. Sr. High School, Golden, CO
Douglas County High School, Castle Rock, CO
Gibbs High School, Corryton, TN
Goldsboro High School, Goldsboro, NC
Greenhills School, Ann Arbor, MI
Grenada High School, Grenada, MS
Gulf Coast High School, Naples, FL
Hathaway Brown Upper School, Shaker Heights, OH
James Madison High School, Houston, TX
Jamestown High School, Williamsburg,VA
Kentlake High School, Kent, WA
Kingwood Christian School, Alabaster, AL
LaGrange High School, Lake Charles, LA
Lakenheath High School,Apo, AE
National Cathedral School, Washington, DC
New Brockton High School, New Brockton, AL
Parkview Baptist High School, Baton Rouge, LA
The Pebble School, Highstown, NJ
Presbyterian Christian School, Hattiesburg, MS
Port Isabel High School, Drawer, AH
Ridgeview High School, Orange Park, FL
St. Francis Xavier High School, Sumter, SC
Science Academy of South Texas, Mercedes, TX
Trion High School, Trion, GA
Torrey Pines High School, Encinitas, CA
Vanguard College Prep School, Waco, TX
Westside High School, Macon, GA
Wm. H. Turner Technical Arts High School, Miami, FL
Winter Springs High School, Winter Springs, FL

Reactivated Chapters

Armwood Senior High School, Seffner, FL
Atlantic Community High School, Delray Beach, FL
Baker High School, Mobile, AL
Booker T. Washington High School, Shreveport, LA
Cape Coral High School, Cape Coral, FL
Carney High School, Carney, OK
Crosby High School, Crosby, TX
Cypress Lake High School, Cypress, FL
Douglas County High School, Castle Rock, CO
Fairfield Community High School, Fairfield, IL
C. W. Flanagan High School, Pembroke Pines, FL
Fort Myers High School, Fort Myers, FL
Gulfport High School, Gulfport, MS
Humansville R-IV High School, Humansville, MO
Jim Hill High School, Jackson, MS
Kings High School, Kings Mills, OH
Louise S. McGehee School, New Orleans, LA
Maine Township High School, Park Ridge, IL
Marietta High School, Marietta, GA
Minor High School, Adamsville, AL
Palos Verdes Peninsula HS, Rolling Hills Estates, CA
Pearl River High School, Pearl River, NY
Piper High School, Sunrise, FL
River Ridge Middle/High School, New Port Richey, FL
Saint Edward's School, Vero Beach, FL
Section High School, Section, AL
Sun Valley High School, Monroe, NC
Thayer County High School, Hebron, NE
Tri Cities High School, East Point, GA
Ursuline Academy, New Orleans, LA

What would you like to see in the Mathematical Log?

Articles written by Mu Alpha Theta Members/Sponsors? Math Applications? Technology Articles? Interesting Math Concepts? Puzzles? Articles about chapters? Let me know what you'd like to see! Send your comments and any topics you would like to see in the Mathematical Log to:

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If you like to read the newspaper in addition to enjoying mathematics you may want to read the book A Mathematician Reads the Newspaper by John Allen Paulos. After reading the book you will read the newspaper in a whole different light.