Points & Angles

Newsletter of the Metropolitan Mathematics Club of Chicago
Volume LII No. 6 Mar./Apr. 2023

X + Y: A Mathematician's Manifesto for Rethinking Gender

May Speaker
Eugenia Cheng

At the Des Plaines Elks Club:

Friday, May 5, 2023
Doors Open/Social Hour: 6:00 PM
Dinner & Talk: 7:00 PM

Des Plaines Elks Club
495 Lee Street, Des Plaines
$35 for Members, $40 for Nonmembers

Reserve by noon, Monday, May 1
Online at mmcchicago.org

The question of why women and minorities are under-represented in mathematics is complex, and there are no simple answers, only many contributing factors. Dr. Cheng will draw on a combination of precise mathematical reasoning, techniques of abstract mathematical thinking, and her experiences as a woman in the male-dominated field of mathematics. She will argue that if we focus on character traits rather than gender, we can have a more productive and less divisive conversation about math and beyond. She will present a new theory for doing so, showing that we can use abstract mathematical thinking to work towards a more inclusive society in this politically divisive era.

Dr. Cheng will present the abstract field of Category Theory as a particularly inclusive subject area, according to the dimensions of her new theory, and demonstrate its scope for deepening the curiosity and social awareness of high school students, rather than just pushing and evaluating them. This goes against the assumption that abstract mathematics can only be taught to high-level undergraduates and graduate students and the accusation that abstract mathematics is removed from real life. No prior knowledge will be needed.

Dr. Eugenia Cheng is a mathematician, educator, author, public speaker, columnist, concert pianist and artist. She was an early pioneer of math on YouTube, and her videos have been viewed over 20 million times to date. In addition to teaching undergraduates, she has assisted with mathematics in elementary, middle, and high schools for over 25 years. She is the author of popular math books, including *How to Bake Pi*, as well as two children's books. Dr. Cheng is Scientist in Residence at the School of the Art Institute of Chicago, won tenure at the University in Sheffield, and holds a PhD in pure mathematics from the University of Cambridge.

Points from the Interior
by Laura Kaplan

Long has been the discussion among math teachers about the use of mnemonics, tricks, and algorithms. Where does one start and another begin? Are they all bad all the time, some of them good at least some of the time? How do we settle this with the Common Core Standards that tell us to teach arithmetic "including the standard algorithm"? What even is the "standard" algorithm intended by the authors?

These questions, among others, have been debated several times over the years in department offices, at conferences, and on MyNCTM. Recently, a few conversations on MyNCTM caught my attention. One discussion was centered on 5th grade multi-digit multiplication and formalizing the "standard algorithm." A variety of methods were shared for obtaining the answer to the problem presented and various people weighed in on what was intended by "standard algorithm."

The other discussions were concerned with the use of "helpers" like PEMDAS and FOIL. There is an overall backlash against any method that removes the understanding from the process. Whether one calls that a "trick" or a "mnemonic" or even an "algorithm," it is seen as harmful to students to let them carry out procedures where the mathematics is absent. I should note that the algorithms for multi-digit addition, subtraction, multiplication, and division are somewhat new to this argument, but there exists some push-back against them in the absence of understanding by students.

What really got me thinking was whether we should call a procedure a trick just because it is different from the "standard algorithm." Or if a particular procedure was helpful to a student, then maybe it wasn't a trick at all, but the procedure that made sense to them and helped them make sense of the mathematics.

Is it a "trick" when a student uses the box method to multiply polynomials? What about when a student cross multiplies to solve a proportion because they have recognized that this is the same as multiplying both ratios by each denominator, but cross multiplying is more efficient? Isn't it true that either of these is AN algorithm, if not THE algorithm? Does that make one of them better? Worse? I'm not even sure anymore.

My concern is the tendency to give a blanket statement that all tricks, mnemonics, or even algorithms are bad and should be eliminated. I am very much in favor of emphasizing sense-making with our students and modeling procedures that help with that sense-making, but where to draw the line is a trickier matter (pun unintended). Perhaps instead of vilifying certain procedures or words, continued education and examples for a variety of strategies and how to better make sense of the math we are teaching is in order.

The discussion on MyNCTM didn't come to any real conclusion, but there is quite a bit of material that addresses this need for education and examples. Even if you are not teaching the specific math topics under discussion, the conversation makes for interesting reading, and you might just update your thoughts on the debate a bit. Search for "trick" or "algorithm" in the discussion area of MyNCTM and see what comes up.

The Evolution of Batting Statistics in Baseball

by Steve Condie

Dr. Scott Powers welcomed us to the 2023 baseball season with a discussion of the history of batting statistics in baseball. He discussed the evolution of batting statistics from the early moments of Henry Chadwick's "true test of batting" right up to the current trends.

In 1867, Chadwick argued that the true test of a batter was hits per game. Thus began the century and a half search for how to measure a batter's proficiency. Four years passed before Hervie Alden Dobson argued that hits per at bat was a better measure. To this day, Dobson's "batting average" is commonly used when discussing the best hitters in the league.

Scott told us that not much more was done in batting statistics until 1923 when slugging percentage was adopted as an official statistic in the National League. Slugging percentage weighs extra base hits more heavily using the formula $SLG = \frac{\text{1B+ }\cdot\text{2B+3}\cdot\text{3B+4}\cdot\text{4B}}{\text{AB}}$. The American League adopted slugging percentage in 1946.

In 1954, Branch Rickey and Allan Roth published "The Equation" in *Life* magazine, where they introduced the idea of on-base percentage (OBP). Scott pointed out how odd it would be today for the General Manager of a major league team to publish this type of article in a popular magazine. They introduced the formula $OBP = \frac{\text{H+BB+HBP}}{\text{AB+BB+HBP+SF}}$.

In 1984, John Thorn and Pete Palmer started an explosion of research into batting statistics. They introduced "The Linear Weights System" and "On-base Plus Slugging" in *The Hidden Game of Baseball.* They define On-base Plus Slugging by: $OPS = \frac{\text{H+BB+HBP}}{\text{AB+BB+HBP+SF}} + \frac{\text{1B+2}\cdot\text{2B+3}\cdot\text{3B+4}\cdot\text{4B}}{\text{AB}}$. Over the last few decades OPS has become the most used batting statistic in measuring a batter's proficiency. As a mathematician, Scott was amused that this statistic adds two fractions with different denominators!

Much of the remainder of the talk was devoted to an in-depth discussion of a Markov model for an inning of baseball. An inning state is described by which bases are occupied and how many outs there are. There are 25 states in this model. There are two possibilities for each base from first to third (0 = unoccupied and 1 = runner on that base), and three possibilities for the number of outs (0-2). This gives $24 = 2 \times 2 \times 2 \times 3$ states, plus the end of inning gives a twenty-fifth state. Empirical data over the past eight seasons give a probability for getting from one state to any other state. Scott looked at the example of state 0-0-1-2, which describes a runner on third with two outs. The transition probabilities can then be calculated for the transition to each of the other 24 states; for example, the probability of transitioning to 1-0-0-2 is 14% and the probability of transitioning to the end of the inning is 64%.

Scott then described the 25×25 transition probability matrix, A, where entry a_{ij} is the probability of going from state j to state i. We can get two-step probabilities by squaring A, three-step probabilities by raising A to the 3rd power, and so on. Scott then posed the question: "How can we use this model to calculate the expected number of runs scored from each initial state?"

Dr. Powers came up with an elegant solution to this problem. His method was to track runs in the inning states. For example, 0-0-1-2-X = runner on third with two outs, X runs have scored. If we ignore X >9 (probability very low), there now are 250 states (25 from earlier and 10 possible values of X). The transition matrix A then becomes a 250×250 matrix.

The Evolution of Batting Statistics in Baseball (cont.)

The talk ended with a discussion of run expectancy by base-out state and the reliability of some of the batting statistics discussed. Scott took us on a tour of run expectancy and how the number of expected runs changed by event (plate appearance). For example, a home run raised the number of runs expected in an inning by 1.38 while a strikeout lowered the expected runs by .27.

Dr. Powers left us with two takeaways from his discussion of batting statistics:

1. Sports analytics is less *crafting* metrics and more *deriving* them.
2. Reliability is key in sport analytics, and the tradeoff between metrics depends on sample size. (Hint: You can blend them!)

Throughout the evening, Scott involved the audience in questions on the derivations of these statistics and on their reliability. Participants are taking a deeper understanding of how to measure a batter's proficiency into the new baseball season. Now, "Play ball!"

February Board Notes
By Beth Ann Ball

The MMC Board of Directors met on Thursday, February 9, 2023, at 6:45 p.m. via Zoom. The virtual MMC Conference was successful. Participants and presenters were located around the country. Next year, the plan is to return to an in-person conference. Sara Curran is turning over the *Points & Angles* editorship to the partnership of Janice Krouse and Serg Cvetkovic at the end of this school year. President-elect Dan Hall is working with a committee to assemble the speaker schedule for next year. A conversation was held about reducing the number of people on the Board of Directors. The current by-laws have the number of directors ranging between 15-21. An idea was put forth about reducing the number to a range of 12-18. This will require a by-law change. A committee was charged with constructing the language to make the proposal.

The next scheduled MMC board meeting will be on Sunday, May 21, 2023, at 2:00 p.m. There will be both a Zoom link available and an in-person meeting. MMC members are welcome to attend any board meeting. Please contact President Laura Kaplan, lkaplan@rdpanthers.org, if you are interested in a link to the meeting or if you would like to attend in person.

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Upcoming Events

Fri., Apr. 14		**ICTM's Western Illinois Math In-Person Conference**
Fri., May 5	Eugenia Cheng	**X + Y: A Mathematician's Manifesto for Rethinking Gender** (Des Plaines Elks Club)

Send upcoming event items to sburnett_308@yahoo.com no later than the date of the MMC dinner meeting preceding the issue in which the item should appear. All items are subject to editing.

Your membership renewal date appears in the upper right corner of the label

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