KYMAA Newsletter

Fall 2021

KYMAA Calendar

Mar 04   Distinguished Teaching Award Nominations Due
Mar 16   Abstract Submissions Due
Mar 18   Nominations for Officer Positions Requested
Mar 25   Registration Requested
Apr 01   KYMAA Conference

Regional Conferences

Sep 24   Miami (OH) Conference
Nov 05   KAS (virtual)
Feb ??   WKU Symposium
Apr 01   Allegheny MAA in Fairmont, WV

National Conferences

Nov 17   NCTM (virtual)
Oct 25   SACNAS (virtual)
Oct 28   AMATYC in Phoenix
Jan 05   JMM in Seattle, WA
Jun 03   Mastery Grading (virtual)
Jun 16   AWM in Minneapolis, MN
Jul 11   SIAM Annual in Pittsburgh, PA
Aug 03   MAA Mathfest in Philadelphia, PA
Aug 06   ASA JSM in Washington, DC

Maths Competitions

Nov 03   COMAP HiMCM/MiMCM
Nov 10   MAA AMC 10/12 A
Nov 16   MAA AMC 10/12 B
Dec 04   MAA Putnam
Jan 18   MAA AMC 8
Feb 17   COMAP MCM/ICM

From the KYMAA Chair

Welcome to the fall 2021 term! I hope you had a rejuvenating summer and are enjoying the start of the new academic year. Let me mention a few things.

First, the executive committee meets in October to plan for the KYMAA Spring 2022 meeting. If you haven't already filled out the survey on your meeting preferences (it was originally posted in our section's Connect mailing), please provide your input. It also asks about your department's participation in secondary school math competitions. The survey should only take you about five minutes to complete and can be found at https://bit.ly/399R1WV.

Also, begin thinking about nominating a deserving colleague for the 2022 Outstanding Teacher award. Let's continue to showcase what makes our section so good!

Finally, there are a few section offices for which we need to fill after this year. When the nomination process begins, consider nominating yourself or someone else who would be good in one of these positions. We will select the following officers.

- Vice-Chair (Conducts the book sales and prepares the meeting survey, as well as presides at meetings the chair cannot make.)
- Newsletter Editor (In charge of publishing the newsletter that typically comes out twice a year.)
- Webmaster (Maintains the section's website.)

Steve Wilkinson
KYMAA Chair

Mathematics for a Better World: The Value of Vaccines

Last winter I reflected on the International Day of Mathematics' theme of "Mathematics for a Better World." Recently, I've found that I am frequently thinking about another contribution of mathematics for a better world: the SIR model.

For anyone unfamiliar, the SIR model is a system of differential equations modeling the spread of disease;

- S represents the number of individuals *susceptible* to infection,
- I represents the number of individuals currently *infected*, and
- R represents the number of individuals who have *recovered* from infection,

all of which are functions of time.

As susceptible individuals become infected, S decreases (and I increases). As infected individuals recover, R increases (and I decreases). The movement of individuals from susceptible, to infected, to recovered can be modeled as

$$\frac{dS}{dt} = -\alpha SI \qquad \frac{dI}{dt} = \alpha SI - \beta I \qquad \frac{dR}{dt} = \beta I,$$

where α is the infection rate and β is the recovery rate.

When $\frac{dI}{dt}$ is positive the epidemic is growing, and when it is negative the epidemic is waning. A Calculus 1 examination of the middle equation identifies a peak of infections at $S = \frac{\beta}{\alpha}$.

Toward ending an epidemic, the goal would be to get $S < \frac{\beta}{\alpha}$. This could be accomplished by (1) decreasing the infection rate, (2) increasing the recovery rate, or (3) decreasing the size of the susceptible population. Which begs the question, what is the most practicable solution for the ongoing pandemic?

Public health experts advocate for large-scale administration of safe and effective vaccines. Why? There are certainly health reasons they cite; preventable deaths and the risk of more deadly variant perhaps being the primary ones. From a mathematical modeling perspective, vaccines enable an added dynamic to the SIR model. Specifically, vaccines enable individuals to move from the susceptible population to the recovered population without first becoming infected. An updated model would look something like

$$\frac{dS}{dt} = -\alpha SI - \gamma S \qquad \frac{dI}{dt} = \alpha SI - \beta I \qquad \frac{dR}{dt} = \beta I + \gamma S,$$

where γ is the vaccination rate. A larger γ means the susceptible population decreases faster. As a result, the goal of ending an epidemic by getting $S < \frac{\beta}{\alpha}$ would be attained faster.

There are (perhaps unsurprisingly) more advanced epidemic models, some of which you can explore online. These include one that also considers *exposed* individuals,[a] one with parameters for transmission and clinical dynamics that allows for consideration of *hospitalized* individuals,[b] and another that explores the impacts of adaptive immunity.[c]

As mathematical literacy retains its value in our complex world, I hope that engaging with students in the mathematics of current topics (like epidemic modeling) contributes to mathematically-informed decisions toward a better world.

Axel Brandt
Northern Kentucky University

Want to help keep the celebration of mathematics going?
Share your thoughts on how mathematics contributes toward a better world!
Send your ideas or a write-up to the Newsletter Editor.

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[a]https://robmoss.github.io/seir-demo/
[b]http://gabgoh.github.io/COVID/index.html
[c]https://sineadmorris.shinyapps.io/sarscov2/

Student Challenge Corner

2021.3: Let $\sigma(x)$ be the function that sums the digits of a positive integer x; e.g. $\sigma(524) = 5 + 2 + 4 = 11$. Consider N where $N = x + \sigma(x) + \sigma(\sigma(x))$. Prove that N is a multiple of an integer k with $k > 1$.

Students: Think you've figured it out? Write up your answer and email it to the Newsletter Editor Submissions received on or before **January 21** will be recognized alongside one correct submission selected to be published in the next newsletter.

Faculty: Have a challenge to contribute or willing to help review submissions? Email the Newsletter Editor to be included!

Previous Challenge

2021.2: For every pair of numbers x and y, the operation $\otimes$ assigns a number $x \otimes y$ in such a way that

$$x \otimes x = 0, \text{ and } x \otimes (y \otimes z) = (x \otimes y) + z \text{ for any } x, y, z.$$

Determine $2021 \otimes 1979$ (with proof!).

Answer. In the second equation, setting $x = y = z$ and applying the first equation gives

$$x \otimes 0 = x \otimes (x \otimes x) = (x \otimes x) + x = 0 + x = x.$$

Similarly, setting $y = z$ gives

$$x \otimes 0 = x \otimes (y \otimes y) = (x \otimes y) + y.$$

Equating these two representations of $x \otimes 0$ gives $x \otimes y = x - y$. Therefore, $2021 \otimes 1979 = 2021 - 1979 = 42$. □

Call for Nominations

Distinguished Teaching Award

Nominations for the KYMAA Distinguished Teaching Award are typically due to the nominating committee in late February. Nominating a colleague consists of emailing a single letter of recommendation and biographical form to the KYMAA Secretary. More detailed information is available at the KYMAA website.

KYMAA Officers

At the Annual Meeting, KYMAA will be electing officers to 3-year terms for the positions of

Vice-Chair and **Newsletter Editor**.

After the Annual Meeting, the KYMAA Executive Committee will appoint an officer to a 3-year term in the position of

Webmaster

and would welcome volunteers and nominations.

Duties for each position are described in the KYMAA Bylaws. Officers must be members of the MAA Kentucky Section, and can volunteer or be nominated in advance of the spring meeting via email by sending name, contact information, and a short biographical sketch to the nominating committee by mid-March.

The mission of the Mathematical Association of America is to advance the mathematical sciences by:

- supporting effective mathematical education at all levels,
- supporting research and scholarship,
- providing professional development,
- influencing public policy, and
- promoting public appreciation and understanding of mathematics.

The Kentucky Section of the Mathematical Association of America is devoted to promoting and encouraging the study, the teaching, and the learning of mathematics in the state of Kentucky.

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Back to Contents

Links of Potential Interest

maa.org   sections.maa.org/kentucky   mathcareers.maa.org   mathprograms.org