# Mathematical Sciences

UNIVERSITY OF MONTANA SPRING 2018


## David Perkins' "$\varphi, \pi, e$ & $i$"

**A Book Review by P. Mark Kayll**

Last year, Dave Perkins (PhD, 2005) published his second book in the MAA's popular Spectrum Series, which includes works by many well-known mathematical expositors: Martin Gardner, Constance Reid, Paul Halmos, Judith Grabiner, and Underwood Dudley (just to name a few). To paraphrase its Preface, Perkins' goals include: (i) illustrating to calculus students how the techniques can be used to discover intriguing, useful results, and (ii) compiling – as a resource for teachers – many of the most elementary proofs related to the numbers in the book's eye-catching title. Though it's pretty light on calculus, I'd say this book achieves these goals and then some.

Full disclosure: Dave was my doctoral student (lo, those many moons ago), and in the intervening years, we've published a handful of papers together. I hope readers of this review won't judge too harshly my objectivity.

I'll start near the book's end with a unifying formula exemplifying the plentiful surprises that even experienced mathematicians will find inside:

$$\varphi = e^{i\pi/5} + e^{-i\pi/5}$$

I never noticed this before! (If I've gotten a little ahead

**Continued on page 7**

## Graduate Awards in Honor of Gloria Hewitt at UW and UM

**By Nikolaus Vonessen**

*Gloria C. Hewitt*

Emeritus Professor Gloria Hewitt was recently honored with the establishment of graduate student awards named after her at both the University of Washington and the University of Montana. The award at UW is already endowed, but at UM we still have work to do: While many generous donors already contributed $12,500, we have to double this amount by the end of the year to reach the minimum of $25,000 for an endowed scholarship at UM.

Gloria earned her Ph.D. in Mathematics from the University of Washington in 1962, making her one of the first African American women to earn a doctorate in math-

**Continued on page 4**

## Stanley I. Grossman 1942-2017

We are sad to report that Emeritus Professor Stanley I. Grossman passed away last December. Professor Grossman earned his Ph.D. at Brown University in 1969, and spent the next three years at McGill University in Montreal before joining UM's math department in 1972. He was well-known as a prolific writer of widely-used college level mathematics textbooks. He retired from the University of Montana in 1994 and relocated to London, England. During his many years in the UK, Dr. Grossman was a Research Associate at University College London and served as Director of Rocky Mountain Traders, Ltd, Bloomsbury Innovations and DrugLab118. Contributions in his memory can be made to the Parkinson's Foundation (parkinson.org).

**Inside**

# Notes from the Chair

**By Emily Stone**

It has been a challenging year for the Math Dept. In Fall semester we completed a very thorough review of all our programs as part of a prioritization process at the University. Much writing was done, much data was analyzed that was used in the creation of our "numbers", such as number of student credit hours generated, Math Degrees awarded, etc. We weathered storms of rumor and speculation for months, until the administration made its intentions clear only in late April, with many, many vagaries and false steps. At the end, we lost two lecturers and that may be just the beginning. We could lose up to three more tenure track lines over the next three years, if the current plan is enacted.

While we recognize that we must bear some of the brunt of the "rightsizing" of UM in light of declining enrollments, it is still inexplicable to us how we can be so successful in all areas and get so heavily taxed. We are not a dying major or area. We lay the foundation of many disciplines; over three quarters of our offerings are for other majors. In addition, this is a renaissance time for mathematics as a career path for students. The need for young people trained in logical thinking, computation, statistics, and the algorithms of data science is ever growing. We are rightly excited about being able to offer students at all levels an education that will suit them for many, many different kinds of careers. We are left with the challenge of rising to this opportunity while faced with severe resource cuts.

*President's Senior Recognition Award Winners Anastasia Halfpap, Katerina Hall, and Soren Ormseth*

Our path forward is two-fold. First, we must do what we can to convince the administration that we should not bear the brunt of the downsizing, that the reductions should be distributed between the active and successful units in a much more equitable way. That is our stick. Our carrot is the advantage a high profile program in Mathematical Sciences would bring to the University, attracting students from across the state and elsewhere to study Math in a unique environment. To become high profile the administration must support our interdisciplinary effort in training students in data science, which would suffer greatly if the current resource cuts are allowed to go through. We are working with Business and Computer Science to create an Interdisciplinary BS degree in Data Science. The degree would have core requirements in all three departments, while offering specializations in each area. This degree will fill out our existing offerings in Data Science, which include a Master's in Data Science (Math), a Master's in Business Analytics, and an interdisciplinary Big Data Analytics undergraduate certificate, to better serve our students and address an identified need for trained personnel in the region.

Furthermore, we are proposing a Center for Data Science, which would organize our efforts and be a cost center to capture overhead and support itself. It would be unique in the region, combining experiences working on real world projects with business and computer science students. It would also be "vertically integrated" by drawing together students at the undergrad, Master's and PhD level to solve challenging problems offered up by industry and other researchers on campus.

We must also use the solidarity we feel as a department in the face of this assault, to further strengthen and develop all our programs. How can we implement strategies for student success in our developmental courses in the most effective way? What will make an undergrad degree in math/stat/math-ed be a unique experience and amazing opportunity for our students? What can we do to mold our graduate offerings to best serve our PhD and Master's students? Higher education is constantly reinventing itself out of necessity in a changing world. We must take this challenge as an opportunity to become an even better version of ourselves as a department. I look forward to working with my colleagues in the coming years to see this vision become a reality.

Emily F. Stone

# A New Strategy to Help Students Succeed in Introductory College Math Courses

**By Lauren Fern**

Many students arrive on campus not prepared to take college-level math classes. Under the traditional model, these students first take developmental math courses to make up for their knowledge gaps. However, this approach is not working well. In fact, national data collected by Complete College America (CCA) show that only 36% of students enrolled in developmental classes at four-year institutions complete the associated college level course within two years.

I am excited to introduce at UM a new strategy, called co-requisite remediation, that addresses this issue. Essentially, the co-requisite opportunity provides students who have not placed into their desired college level math class with supplementary instruction, which frees them up from having to take an additional semester of developmental coursework (which does not even carry college credit). According to the CCA, for certain student populations, co-requisite remediation "is increasing college-level gateway course pass rates to nearly three times the rate of traditional remediation, and it's happening in about a quarter of the time".


*Lauren Fern on the jumbotron in Washington-Grizzly Stadium last November, when she was honored by the Athletics Department during a football game as "Professor of the Week". (Can you spot the typo?)*

Last summer I developed the curriculum for our first math co-requisite class here at UM for one of our most popular gateway courses, Probability and Linear Math (M 115, formerly known as MATH 117). Since then, I ran two pilot sections each semester. Participating students

***Continued on page 5***

# New Faculty: Elizabeth Gillaspy and Javier Pérez Álvaro

**By John Bardsley**

This past fall, Elizabeth Gillaspy and Javier ('Javi') Pérez Álvaro joined the UM Math Department. They started out in very different places: Elizabeth in the small town of Colville, Washington, 70 miles north of Spokane; and Javi in Alcalá de Henares, Spain, a town of approximately 200,000 people near Madrid.

*Elizabeth and Javi skiing at Lolo Pass*

Elizabeth's mathematical journey began in childhood with her parents' influence. When she was 10, her mother gave her the book *Math for Smarty Pants*, which she describes as 'transformational,' and she recalls her father showing her how to construct a Möbius strip as a teenager. She attended Macalester College in Saint Paul, Minnesota, for her undergraduate degree, from 2004-07. For graduate school, she moved on to Dartmouth, settling on C*-algebras as her research area. In 2012, well-into her dissertation research, she felt the need for new surroundings and perspective, and so decided to spend a year in Spain. She ended up at the Universidad Carlos III of Madrid, which had a group in C*-algebras, and where Javi was a PhD student. She returned to Dartmouth in 2013, finishing her PhD in 2014.

Javi grew up in a family that instilled a love of learning, but didn't discover a passion for mathematics until his undergraduate studies, which he did from 2004-09 at the Universidad Autónoma of Madrid. Javi continued on to graduate school in mathematics at the Universidad Carlos III of Madrid, discovering a love for Numerical Analysis (his research area) while studying Gilbert Strang's *Introduction to Applied Mathematics*, in preparation for his Master's exams. Javi decided to do his PhD research in Numerical Linear Algebra, as there was a strong group in that area at Universidad Carlos III of Madrid. He obtained his PhD in 2015 under the direction of Professor Froilán Dopico, with whom he maintains a strong connection and research collaboration.

Elizabeth and Javi became a couple in 2014, a year or so after they met, and spent the next two years at

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*Emily Stone, Ron Irving, Gloria Hewitt, Gail Irving, and Edray Goins*

***Gloria Hewitt* (continued from page 1)**

ematics. She joined our department in 1961, and stayed here until her retirement in 1999, serving the last four years as department chair. You can read more about her interesting background and career in an article by Randy Lattimore (Mathematics Teacher, January 2001).

For several years, Ron Irving, Chair of the Department of Mathematics at the University of Washington, has been working on creating an endowment for graduate awards at UW honoring Gloria. Recently he successfully completed the first stage of fundraising, establishing the *Gloria Hewitt Endowed Graduate Student Support Fund* at UW. Ron is now working to increase the endowment of this support fund with the goal of establishing an endowed graduate fellowship at UW "for students who contribute to the goal of a more equitable representation of underrepresented minorities and women in the field of mathematics."

Inspired by this, our chair, Emily Stone, decided to pursue a similar goal at the University of Montana, and worked hard with the UM Foundation towards the establishment of the *Gloria C. Hewitt Graduate Scholarship in Mathematical Sciences*; we hope we will reach the necessary minimum endowment of $25,000 by the end of the year.

All these developments culminated in an event on March 19 at UM, organized jointly by Ron Irving and Emily Stone. First, Edray H. Goins, Professor of Mathematics at Purdue University and President of the National Association of Mathematicians (NAM), gave a special colloquium talk. It deserves mentioning that Gloria had been active in the NAM, including serving on its Board of Directors. Afterwards, we had a special reception. Among the many speakers who shared memories of Gloria's career were Dave Patterson, Edray Goins, and Ron Irving. At the end, Gloria also spoke. It was a deeply moving event. Congratulations, Gloria!

***And if you should feel inspired to help us realize our dream of the Gloria C. Hewitt Graduate Scholarship in Mathematical Sciences, please consider making a donation.***

## Donors to the Gloria C. Hewitt Graduate Scholarship in Mathematical Sciences

*(as of April 30, 2018)*

Rodney & Mary Jean Brod
Cynthia Bryan
Susan Cole
James Conyers
Elizabeth Gillaspy
Bill & Jeannette Gregg
Gloria Hewitt
Ron & Gail Irving
Don & Nenette Loftsgaarden
Jennifer McNulty
Peg McPartland
David & Margie Patterson
Howard & C.W. Reinhardt
Greg & Jan St. George
Carol Ulsafer
Nikolaus Vonessen & Regina Souza
Keith Yale
Yong Zhao

The Department of Mathematical Sciences increasingly relies on donations to support its activities. In particular, scholarships are very important for our students. Please consider a gift to the *Math Department's Excellence Fund*, to be used where the need is greatest, or to one of the other funds and endowments:

**Endowed Scholarship Funds:** *The Adams Scholarships, Anderson Mathematics Scholarship, Joseph Hashisaki Memorial Scholarship, Mac Johnson Family Scholarships, Merle Manis Award, William Myers Mathematics Scholarship*

**Gloria C. Hewitt Graduate Scholarship in Mathematical Sciences** ***Currently our highest priority!***

**George and Dorothy Bryan Endowment:** Supports undergraduate and graduate students

**Lennes Fund:** Provides funds for the Lennes Exam Competition

**Colloquium Fund:** Provides funds to bring in visiting speakers

To donate online, please visit http://hs.umt.edu/math. For information on other ways to give, please contact Chris Ritrievi: chris.ritrievi@supportum.org or by phone at 406-243-4607 (or call toll free 1-800-443-2593).

# Spring 2018 Scholarship and Award Winners

**Joseph Hashisaki Memorial Scholarship**
Kit Fieldhouse

**The Adams Scholarships**
*Junior:* Ian Gonzales *Senior:* Matthew Kingston

**Anderson Mathematics Scholarship**
Kyra Glidewell

**Mac Johnson Family Scholarships**
Ethan Peace Jennifer Powers
Glen Woodworth

**Merle Manis Award**
Megan Finley

**Undergraduate Research Scholars**
Andrew Bedunah Kyra Glidewell
Ian Gonzales Denise LaFontaine

**Undergraduate Teaching Scholars**
Emily Engstrom Matthew Kingston

**Undergraduate Tutorial Scholar**
Mielle Hubbard

**N.J. Lennes Competition**
Anastasia Halfpap Jake Rooster Pennington
(*tied for 1st place*)

**William Myers Mathematics Scholarship**
Esmaeil Parsa

**Graduate Student Distinguished Teaching Awards**
Theodore Owen Esmaeil Parsa

**Graduate Student Summer Research Awards**
Richard Brown Quy Xuan Cao
Ricela Feliciano-Semidei Omid Khormali
Esmaeil Parsa Denis Shchepakin

**Bertha Morton Scholarship**
Omid Khormali

**Carolyn and Johnny Lott Elementary Education Scholarship**
Nicole Luhrs

**John A. Peterson Mathematics Education Awards**
Margaret Dennison Brook Gruntowicz
Randall Rivas

**President's Senior Recognition Awards**
Margaret Dennison Anastasia Halfpap
Katerina Hall Soren Ormseth
Ryan Smith

***Helping Students*** **(continued from page 3)**

attended the usual large M 115 lectures, but I also facilitated an additional two days per week in a small class setting where I provided supplemental instruction. Prerequisite material was covered before it was needed in the actual course. Consequently, the students not only learned the material needed for success in the college-level class before it was used, but also immediately saw the relevance and applicability of that prerequisite material. While this is important for any student, it is essential for students who are learning developmental math.

In the co-requisite sections, I was able to watch students who had barely been exposed to algebra learn how to graph and solve basic equations, and from there be able to set up and solve word problems. This, of course, meant a lot of student effort (and some hours in my office!), but putting forth the effort paid off tremendously and these students not only learned the material, but they gained a TON of confidence in their own abilities. One cannot speak enough of the importance of this as a benefit for the students' futures. Of similar importance, these students completed their first college-level math course without having to spend an additional semester (or longer) in developmental math.

Over the next two academic years, we plan to increase the number of co-requisite remediation sections we offer, and to expand them to other high-demand courses, in particular to College Algebra. The goal is to enable significantly more students to successfully complete their math coursework in a timely fashion, and without lowering academic standards.

***New Faculty*** **(continued from page 3)**

post-docs far apart: Elizabeth at the University of Colorado-Boulder and Javi at the University of Manchester. In 2016, they were hired into their current jobs at UM, but took a year's deferment to spend another post-doc year abroad: Elizabeth at the University of Münster in Germany and Javi at the University of Leuven in Belgium. They arrived in Missoula in the summer of 2017 and love it here: the Math Department, the University, Missoula, and the surrounding area. They are avid bike commuters, and made it through their first Montana winter biking to work every day. We are lucky to have such great additions to our department.

# Degree Recipients 2017-18

## Bachelor Degrees

Sean Corbett
Margaret Dennison
Caleb Matthias Urbano Douglas
Brooke Gruntowicz
Anastasia Halfpap
Katerina Hall
Jessica Henning
Michelle Jean "Micki" Howell
Tyson Hubbard
Heather Nicole Kelly
Tanner Maier
Jordan L. Miller
Elijahwa Waters Ninnemann
Soren John Ormseth
Alec Patterson
Randall Rivas
Ben Schmitz
Ryan Smith
Holden Tarver

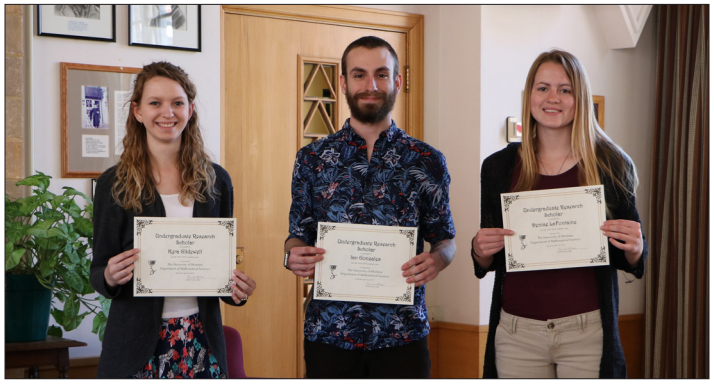
## Master's Degrees

Daniel Barthelmeh
Dominika Dec
Claire Seibold
Alyssa Ziegler

## Doctoral Degrees

Elham Bayat Mokhtari - Advisor: Emily Stone
Thesis: *Effect of Neuromodulation of Short-Term Plasticity on Information Processing in Hippocampal Interneuron Synapses*

Nhan Nguyen - Advisor: Kelly McKinnie
Thesis: *Central Simple Algebras and Related Objects in Both Zero and Positive Characteristic*



Photos from the Math Awards Ceremony in April:
***Undergraduate Research Scholars***
*Kyra Glidewell, Ian Gonzales, and Denise LaFontaine*

***Graduate Student Summer Research Award Winners***
*Omid Khormali, Denis Shchepakin, Esmaeil Parsa and Richard Brown*

# Honor Roll of Donors

Duane & Kathleen Adams
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Lucille Bradley
Ruth Brocklebank
Rodney & Mary Jean Brod
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Michelle Harris
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Rebekah Yates

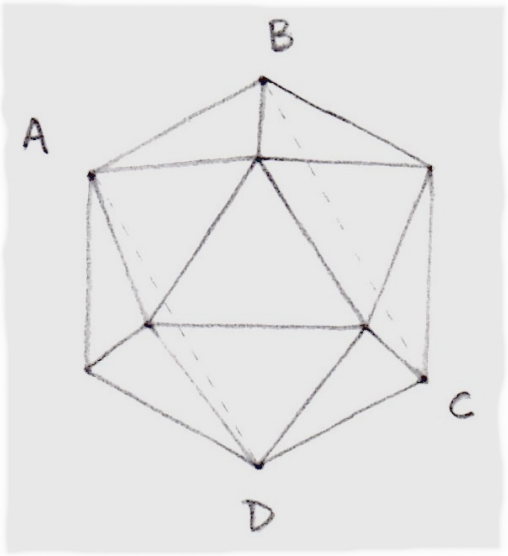
***(Donations to the Gloria C. Hewitt Graduate Scholarship in Mathematical Sciences are acknowledged on page 4.)***

***Dave Perkin's Book* (continued from page 1)**

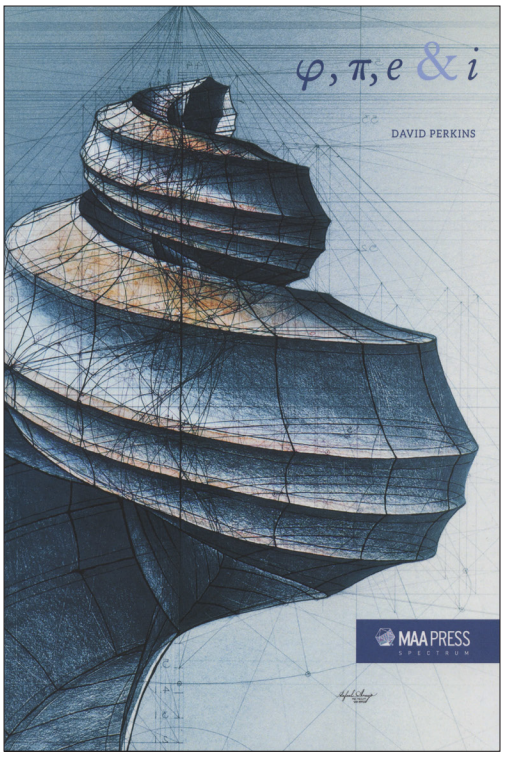
of myself here, $\varphi$ denotes the golden ratio $(1+\sqrt{5})/2$, $i$ the complex unit $\sqrt{-1}$, $e$ the natural logarithm base $2.71828\ldots$, and $\pi$ exactly what you think.) Have a look in Chapter 4 (p. 122) for the proof.

Let's rewind to Chapter 1 for another charming tidbit, now focusing on $\varphi$. (Conveniently enough, the four main chapters sport titles following the symbols in the main title.) Recall that a *golden rectangle* is one whose long to short sides have ratio $\varphi$. And an *icosahedron* – one of the five Platonic solids and the key element in the MAA's logo – has 20 facets (all congruent equilateral triangles) arranged to create 12 vertices, each of which forms an apex crowning 5 facets. The aforementioned tidbit is that the icosahedron $\mathcal{H}$ contains a golden rectangle; in fact, it contains 15. On seeing one, it's not hard to count them all because $\mathcal{H}$'s 30 edges pair off as the rectangles' short sides. So let me quote Perkins' passage arguing the presence of a golden rectangle in $\mathcal{H}$.

As a starting point, we take it as known that in a regular pentagon (i.e., one with five equal sides and five equal angles), the ratio of a chord (diagonal) to a side is $\varphi$. Proving this assertion is a nice exercise on its own; Perkins presents one satisfying "algebro-geometric" proof himself (p. 4). Now for the tidbit (p. 5):




"Consider the icosahedron [in the figure above]. Five equilateral triangles meet at each vertex, and their bases form a regular pentagon. Choose any pair of neighboring vertices, such as A and B … and their opposites D and C. Set the length of each edge to 1 unit. Both AD and BC are diagonals of pentagons, and we saw … that if a regular pentagon has sides of length 1 then $\varphi$ is the length of each of its diagonals. So the shape ABCD in the figure is a rectangle with sides proportional to each other in the same ratio as the diagonal and the side of a pentagon."




This image brings to mind one of the book's attractions, namely its carefully hand-drawn figures. All are so-rendered, and I counted more than thirty. Historical passages to contextualize the author's material also feature strongly, and I found this particularly effective. As I did Perkins' personal anecdotes and storytelling. For example, in his lead-in to Chapter $e$, he relates the time his father presented a trade of all the money in the senior Perkins' wallet for his son's next five weeks' allowance. Though it doesn't relate directly to the book's math, this story does pull the reader into the overall narrative to create a page-turner.

All math books contain errors. I found one surprising one near the end of Chapter 1, but I'll leave it to readers to find it and any others for themselves. This book's goofs don't distract and in any case don't lower my endorsement.

To illustrate Perkins' historical content and cultural scope, here are a few sample section headings: "The Eye, and the arithmetic of $\varphi$"; "Liu Hui approximates $\pi$ using polygons"; "Euler's constant $\gamma$ via $e$ and $\pi$"; and "Khayyám's geometric solution to a cubic". And while I'm sampling, let me mention a few more formulas I was glad to see make Perkins' cut (respectively, on pp. 44, 89, 119):

$$\left(\frac{1}{2}\right)!=\frac{\sqrt{\pi}}{2}\;;\quad e=2+\cfrac{2}{3+\cfrac{3}{4+\cfrac{4}{5+\ldots}}}\;;\quad i^{\,i}=e^{-\pi/2}$$

Enlightening discussions of these and oodles of other beautiful formulas form the foundation of this book. I recommend "$\varphi$, $\pi$, $e$ & $i$" as enjoyable recreational reading for anyone whose interest is piqued by the title.

*Dave Perkins' book is available from the Mathematical Association of Amarica at https://www.maa.org/press/books/phi-pi-e-and-i.*

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# UM Mathematics Faculty

We thought you might enjoy this group photo of current and retired faculty, especially if you haven't seen us in a while. It was taken at an event honoring Professor Emeritus Gloria Hewitt (more inside the newsletter).

*Front:* Emily Stone, Nenette Loftsgaarden, Don Loftsgaarden, Rudy Gideon, Gloria Hewitt, Lauren Fern, Javi Pérez-Álvaro, and Elizabeth Gillaspy; *Middle:* Mary Jean Brod, Jen Brooks, Jenny McNulty, Greg St. George, Regina Souza, Kelly McKinnie, Katia Smirnova, Leonid Kalachev, and David Patterson; *Back:* Nikolaus Vonessen, Fred Peck, George McRae, Eric Chesebro, Rick Billstein, Karel Stroethoff, Cory Palmer, Mark Kayll, Jim Hirstein, John Bardsley, and Matt Roscoe

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