Appendix 2: Parallel Session Abstracts

Theological Implications of the Identical Ancestors Point

Samuel Allen Alexander

Let t be the most recent time (called the identical ancestors point) such that every human alive at time t was either an ancestor of all humans alive today, or of no humans alive today. Candidates for t include the time of Adam or Noah, but mathematical models suggest t might be more recent (see Rohde et al, 2004, https://doi.org/10.1038/nature02842). We discuss mathematics of the identical ancestors point and explore theological implications that would follow from various values of t within Biblical times.

Flowcharts in Introduction to Proofs

Brandon Bate

For most students, the transition from concrete, computationally intensive content to abstract, proof-based course work can be daunting. The task of developing logical arguments that connect hypothesis to conclusion and then expressing these arguments in succinct, accurate writing can be deeply discouraging for students. At the high school level, flowchart proofs are frequently used to help with this transition as they provide a mechanism both for proof discovery and expression. The same can also be done at the college-level, although some adaptations are required due to the increased complexity that college-level work often entails. In this talk, I will share how I have used flowcharts in my Introduction to Proofs and also discuss the strengths and weaknesses of this approach.

From Perfect Shuffles to Landau's Function

Brian D. Beasley

If we view a given shuffle of a deck of cards as a permutation, then repeatedly applying this same shuffle will eventually return the deck to its original order. In general, how many steps will that take? What happens in the case of so-called perfect shuffles? What type of shuffle will require the greatest number of applications before restoring the original deck? This talk will address those questions and provide a brief history of the work of Edmund Landau on the maximal order of a permutation in the symmetric group on n objects. It will also note some recent progress in refining his results.

The Boundless Confusion Between Mathematics and Metaphysics

Matthew Bone, James Turner

Many metaphysicians have attempted to co-opt topology in the pursuit of understanding real space. It's no surprise why topology is an incredibly useful tool in solving spatial problems and has the benefit of being a mathematically precise framework. However, adopting topology into a metaphysical framework is a precarious endeavor and often leads to undesirable or inconsistent metaphysical conclusions. One such conclusion is that boundaries are real spatial objects. Since boundaries are an integral part of understanding the topology of a space, when people use topology to describe real space, they take boundaries to be real objects. Using topology to describe the essence of real space is untenable because topology is an abstraction from objects in real space and, therefore, cannot capture its whole essence. In this talk, we hope to show why the idea of a real boundary is untenable and how topology is limited in its ability to describe real space. In doing so, we hope to make a more general point: just because people have a good mathematical model for something does not mean they have a good understanding of its essence.

Adventures in Introductory Statistics: Hybrid, Traditional, and then Hybrid Again

Ryan Botts, Greg Crow

Introductory statistics is a high-enrollment service course with a diverse student population posing many interesting teaching challenges. At PLNU we have approached this using a blended flipped pedagogy. However, when our content provider priced us out of their software, we returned to the traditional modality for one semester allowing us to test different pedagogical approaches. We have been gathering student performance and student satisfaction data before, during and after the traditional semester. The student performance data includes nearly identical mid-semester and final exams. So how did they do, and how did they like the hybrid, traditional and then hybrid again?

A Different Way to Teach Infinite Series

Robert Brabenec

The chapter on infinite series in most calculus texts follows a standard rigorous approach which was developed by the end of the nineteenth century. It begins with the definition of a convergent series in terms of a sequence of partial sums, followed by the statement and proof of many convergence tests, and concludes with the Maclaurin series representation of functions and their applications. This approach does not take into consideration the fact that for hundreds of years, individuals worked on specific examples, often for decades before finding a solution. During this time, there was no thought of starting with an attempt to prove that a given series converged. The only concern was to find a value for the given series by any possible method.

Calculus students today experience little of this exciting challenge of looking for patterns and techniques to find a value for a given series. In the fall 2018 semester, I will teach this unit from my own notes. I will use examples of specific series that were solved prior to the development of the axiom system approach described above, which is non-intuitive and confusing to our calculus students. The emphasis will be on group work and student explanation of their ideas about these specific examples. I have rather high hopes and great expectations of a positive response from my students, but my talk will provide an honest account of what really happened.

A Modest Conjecture Based on *Eternity in Their Hearts*

Stefan Brandle

Don Richardson was a missionary to a tribal group called the Sawi. He was starting to despair of communicating the gospel until he learned about their cultural "peace child" tradition. When Don told them that Jesus was God's peace child, the Sawi hearts changed essentially instantly. Based on his experience as related in *Peace Child* and using a title inspired by Ecclesiastes 3:11 ("[God] has planted Eternity in their heart"), Don conjectured that every people group has been prepared by God to receive the Gospel and has "redemptive analogies" that can cross the communication divide.

A parallel conjecture is that within every discipline there are faith and learning integration opportunities waiting to be used. As an example of a redemptive analogy, the expression $3N^2+N\log_2 N+20$ describes the complexity of a particular algorithm. Identifying the most significant factor allows categorization into general performance groupings (constant time, logarithmic, linear, quadratic, etc.). As N gets larger, the dominant term is N^2; everything else can be discarded when classifying the algorithm. The point is to isolate the most significant factor.

The application to faith and learning is: isolate the most significant factor and act based on that factor. For instance, in stimulating personal growth, don't get sidetracked by the less significant factors when dealing with sin, habits, etc. (or use them for avoidance purposes). There is little point in taking some extra vitamins when major aspects of your eating and exercise lifestyle are in a mess. Don't bother with little acts of piety if you do not love God and your brother. Order of magnitude, you must first remove the beam from your own eye, before removing the splinter from someone else's eye. A set of other redemptive analogies will be presented.

Top Ten

Owen Byer and Deirdre L. Smeltzer

We will present our "Top Ten" problems, choosing mostly from those that appear in our recently published textbook *Journey into Discrete Mathematics* (MAA/AMS Press, November 2018). The problems vary in difficulty, but a common feature is that each of the solutions is elegant or clever. Here is one of them: How many positive integers have their digits arranged in strictly decreasing order?

Effective Practice and Feedback Methods in Calculus I

Kristin A. Camenga

How do students learn most effectively in Calculus? Research suggests that the time students spend practicing problems and the feedback that they receive have a positive effect on student learning. However, there are many ways to accomplish this practice and give feedback, so what is most effective? In the context of a small private liberal arts college with Calculus 1 sections of about 30 students, we are studying the effects of three types of practice and feedback on student achievement on exams. The methods of practice and feedback include WeBWorK, textbook homework with students self-checking, and teacher-designed homework with a student grader. We will share preliminary results from two semesters of the study.

Supporting Underrepresented and First-Generation Students in Data Science

Judith E. Canner

In 2015, through the support of the NIH BD2K dR25 Enhancing Diversity in Biomedical Data Science Grant, California State University, Monterey Bay (CSUMB), a federally classified Hispanic Serving Institution, started to develop several programs to support undergraduate training in biomedical data science. The programs include new majors, concentrations, and minors relevant to biomedical data science and professional and research training for undergraduate students and faculty at CSUMB. We will present the evaluation of the first three years of the program and discuss plans for the upcoming years. We will provide case studies of the impact of academic, professional, and personal supports developed specifically for our program to support first-generation and underrepresented students to pursue graduate studies in biomedical data science. Specifically, we will discuss the program specific structures we developed to support students "late" in their undergraduate careers that want to pursue graduate education in biomedical data science and our plans to institutionalize the new structures through programs and coursework. The institutionalization of structures beyond our funded program will allow us to recruit more first-generation and underrepresented students, especially transfer students, into the data science graduate programs and careers.

Mom and the JABEZ Principle – Getting from Vulnerable to Resilient

Linn Carothers

Jabez was more honorable than his brothers, . . . his mother named him Jabez saying, ". . . I bore him with pain." 1 Chronicles 4:9 NASB95

The pain of family dysfunction is part of 21st Century life. As parents and parental surrogates, what are key factors to communicate faith, hope and love to the next generation? Using the longitudinal perspective of a Danish cohort ($N = 9125$), variables measuring the family's stability and structure, parental characteristics, household characteristics, and the child's social and academic competencies were examined. Biostatistical data mining using discriminant analysis, coupled with loglinear modeling, reveal additive and interactive contributions of instability of adult constellations, parent crime, poor economic conditions, and the work organization and athletic skills of the child; however, critical elements of mothers and their response or reaction played pivotal roles. For parents and parental surrogates, the key to resilience centers on teaching self-monitoring skills, valuing work, and engagement during latency, providing tools for faith-integrated change.

Including Ethics in Computer Science and Mathematics Education

Lori Carter, Catherine Crockett

Several speakers at recent ACMS conferences have pointed out that the discussion of computing ethics extends beyond a security course looking at computer viruses, identity theft, and hacking. Ethical discussions now must involve issues of transparency, mental and physical health, accessibility, dignity, the environment, and the list is growing. Furthermore, with the surging popularity of data science, a blend of computer science and mathematics, computing ethics must extend into the mathematics realm as well. Math-related topics may include ethical data visualization, data cleaning, and transparent predictive algorithms. Leaving the discussion of ethics to a class in the philosophy department sometimes leaves students unable to make the connection between theory and practice, especially discipline-specific practice. Even housing a dedicated ethics course in the mathematics or computer science department runs the risk of making it seem separate from daily practice. We believe that the best way to help students think about ethical issues related to computer science and mathematics is to integrate these discussions into core courses. Spreading this integration over the four years, will, we believe, make it more naturally come to mind in the future. This presentation describes an ethics curriculum consisting of modules to be embedded into computer science and mathematics courses so students can practice recognizing and making judgements on ethical dilemmas in context. The contents of the modules go from general concepts in early courses to more area-specific concepts in later courses. In addition to the overview, we will present several modules in both computer science and mathematics.

Almost 20 Years of *Mathematics in a PostModern Age* A Personal Reflection

Jeremy Case

Mathematics in a Postmodern Age was published in 2001 and has been used in our Mathematics Capstone since 2002. Initiated by members of the ACMS, the book examined how Postmodernism might apply to the field of mathematics in its truth claims, its apparent universality, and its cultural influence. While some material is not as hotly debated today, the rejection of mathematical imperialism and other points continue to remain relevant and are almost prescient. The benefits of MIAPA as a course text include its examination of mathematical history, mathematical philosophy, and mathematical education. There are plenty of challenging perspectives to prompt students to evaluate and articulate their own beliefs and values. This presentation will report on how students have viewed the book and its ideas. Many students find the reading difficult, and pedagogical strategies will be provided on how to alleviate their struggle. Finally, I will assess the book's influence on my own spiritual journey and teaching practice.

Doing Mathematics the Wright Way

Thomas J. Clark

The British theologian N.T. Wright describes how the Scriptures, specifically the books of John and Colossians, reveal that the creation was made in and through Christ. It reasonably follows that aspects of the character of Jesus should arise naturally in the creation. Therefore, mathematics, the study of the numerical and spatial aspects of creation, should be rife with Christ's fingerprints. We explore what it means to do mathematics with this in mind, juxtaposing the character of Christ as shown in the gospels with the experience of actually doing mathematics and find a veritable bouquet of connections. A look into various ways in which students can participate in this endeavor will conclude the session.

25 Bible Verses to Connect Faith and Mathematics Using Weekly Devotionals, Written Reflections, and Memory Verses

Mark Colgan

One of the goals for all my students is to help them make connections between issues of faith and mathematics. As a former Bible quizzer myself, I sought to find Bible verses that illustrated some of these connections. I present a math memory verse as a devotional each Monday in all my classes that connects in some way to the content we are studying that week. I ask students to write short reflections that relate to the verses, and they have the option to memorize the verses for bonus points. I have categorized the verses into mathematical topics that connect with issues of faith such as beauty, fourth dimension, infinity, saving and exponential growth, debt and credit, reasoning and proof, gambling, group work, maximizing and minimizing, why study mathematics, etc. I will share my list of verses and include a video, a short article, and a few discussion questions that go with each verse.

The Joys & Pains of Managing Real World Course Projects

Patrice Conrath

Leading students through real world projects is an exciting exercise that can inspire students and show them how to use their math and computer science skills to make a difference in the world. However, the management challenges of these projects can deter even the most eager professor from providing these opportunities. Finding clients, managing teams, and pushing students towards significant solutions are some of the trials.

At the 2013 ACMS conference, I presented, "Simulation Projects in an Operations Research Course," highlighting techniques I have used for project management in my Operations Research course. Since then, I have continued to manage semester long projects, such as our last project related to a proposed Feed My Starving Children packing plant in Nepal (student portfolio). I recognize the value of these projects, but management continues to be challenging. Therefore, I am currently taking a project management course and will have a sabbatical in spring 2020, where I will examine project management techniques. In this session, I will share some of my challenges and current materials, and will also gather pain points and ideas from attendees to guide my future study. Through the gathering, I hope to start a small group to share resources and encourage one another in this worthy activity, as we inspire students to serve God and others with their talents.

The Applicability of Abstract Mathematics and the Naturalist Die

Ricardo J. Cordero-Soto

Philosopher and Christian apologist William Lane Craig has proposed a valid deductive argument for God's existence that is rooted in the applicability of mathematics to the physical universe. This argument was presented by Craig during a debate with philosopher and atheist Alex Rosenberg. During the debate, Rosenberg presented a rebuttal to the soundness of this argument by appealing to chance as an explanation to the applicability of mathematics to the physical universe. In this talk, the presenter will discuss how the naturalist die is unable to produce "chance application" of mathematics while defending the soundness of the argument in light of the ontology of mathematics. In passing, the problem of abstract objects and God will be addressed.

Marin Mersenne: Minim Monk and Modern Messenger of Monotheism, Mathematics, and Music

Karl-Dieter Crisman

If you have taught a number theory course or even watched the mathematical news, you know that occasionally a new (and enormous) "Mersenne prime" is discovered. Those who have introduced students to the prehistory of calculus may know of a certain Marin Mersenne as the interlocutor who drew Fermat and Descartes (and others) out to discuss their methods of tangents (and more).

But who was Mersenne, and what did he actually do? This presentation will give an overview of his times, his role in the history of science, and his own writings. We'll especially look into why a monk from an order devoted to being the least of all delved so deeply into (among other things) exploratory mathematics, practical acoustics, and defeating freethinkers.

Ongoing Adventures in Writing a Calculus Textbook

Bryan Dawson

Issues, challenges, joys, and benefits are just a few of the words that describe the textbook writing process. This talk will describe the speaker's thoughts on intentionality, textbook design, the writing process, and what motivated the journey in the first place.

Statistical Consultancy as Service Learning in Undergraduate Statistics Courses

Stacy DeRuiter

Best practices and recommendations for undergraduate statistics courses increasingly emphasize student analysis of real data, effective use of statistical computing software, and meaningful problem-solving and decision-making. Academic service learning allows students to put their academic and technical skills to use for community good. Integration of faith and statistical learning, at a Christian institution, often means considering the moral or religious motivations or consequences of drawing conclusions from data. Combining real data with community service is one way to bring all these ideas together. At Calvin College we recently introduced a second course in statistics (Advanced Data Analysis) in which students learn modern regression techniques. As a term project for this course, groups of students act as statistical consultants for area non-profit organizations or academic researchers. These statistical consultancy service-learning projects combine real-world data wrangling and analysis with community service, and provide an opportunity for meaningful integration of faith and learning. In this presentation, I will consider case studies from the first two years of the Calvin course, offering comparisons with similar projects at other institutions and highlighting areas that show promise and others that need revision.

Developing Mathematicians: The Benefits of Weaving Spiritual and Disciplinary Discipleship

Patrick Eggleton

Part of the goal of discipleship at the Christian university is for faith development to seep into the hearts of the students. Similarly, the goal of the development of future mathematicians is for the mathematical proficiencies, the practices like problem solving and analytical reasoning that permeate each of the courses, to seep into the hearts of our majors. This presentation shares how the weaving of our spiritual and disciplinary discipleship efforts benefits the faith development of our students while also helping them to think like a mathematician.

What are We 95% Confident About Anyway? A Software-Embedded Curriculum for Learning Statistical Inference

Katie Fitzgerald

Much of scientific inquiry relies on statistical inference, and nearly every person has consumed "evidence" that arose from statistical inference, whether they are aware of it or not. Despite being ubiquitous in our society, the mechanisms behind statistical inference are notoriously abstract and confound students and users of statistics at all levels. The widespread and persistent lack of sound statistical reasoning is well-documented and researched. Introductory statistics courses often focus on formulas and procedures but fail to develop intuition for why statistical methods work. This talk discusses a software-embedded curriculum I designed to make the mechanisms behind statistical inference more salient. The software and supporting curriculum help learners explore—and even construct for themselves—properties of the normal distribution that play a critical role in determining what constitutes valid and convincing statistical evidence. The design is informed by both a constructionist learning philosophy as well as my own experience working with undergraduate students and social science researchers who use statistical methods but lack sound statistical reasoning. The software harnesses the power of simulation-based methods and an agent-based modeling environment, NetLogo, to allow students to see stable aggregate patterns and complex properties emerge from individual observations, without relying on knowledge of calculus or probability theory.

Teaching Mathematics Conceptually: Promoting Change in K-12 Mathematics Classrooms

Jim Freemyer, Lauren Sager, Dave Klanderman

Recent measures of mathematical achievement by students in the United States document limited mastery problem solving and more conceptual, as compared to procedural, understanding of mathematics, as reported by the National Assessment of Educational Progress (NAEP, 2018). Comparisons to developed countries around the world have shown the US to be average or worse (cf. TIMSS, 2015). In response to these data, the mathematics education community has called for a greater focus on conceptual learning, as seen in *Principles and Standards for School Mathematics* (2000) and *Principles to Actions: Ensuring Mathematical Success for All* (2014). This session provides an overview of a current book project written for school principals, superintendents, and other school decision makers. The thesis of the book is that a collaborative transformation of mathematics teachers is required to prepare K-12 students for a competitive workplace in the current and coming decades. Attention is given to providing teachers with resources, time for both professional development and lesson design, and appropriate recognition for improved student learning outcomes.

Paradigm Shift: One College's Transition from Math to Data Analytics

Rachel Grotheer

Goucher College has recently gone through a campus-wide curriculum change to rethink the meaning of a liberal arts education and how to best prepare students for life after college. As a result of this reflection, our "Mathematical Reasoning" general education requirement has changed into a Data Analytics requirement that requires students to take one semester-long course learning the foundations of data analytics and then another semester-long course learning data analytics techniques in the context of another discipline, usually their major. Further, a program prioritization process in the last year led to the discontinuation of the traditional mathematics major. In response to both stimuli, Goucher math and computer science faculty have designed a new Integrative Data Analytics major. This talk will discuss the process and challenges of creating such a major at the undergraduate level, as well as the challenges and successes of incorporating data analytics across the college curriculum.

Numerical Range of Toeplitz Matrices Over Finite Fields

Maddi Guillaume Baker, Amish Mishra, Derek Thompson

We characterize the kth numerical range of all $n \times n$ Toeplitz matrices with a constant main diagonal and another single, non-zero diagonal, where the matrices are over the field $\mathbb{Z}_p[i]$, with p a prime congruent to 3 mod 4. We find that, for $k \in \mathbb{Z}_p^*$, the kth numerical range is always equal to $\mathbb{Z}_p[i]$ with the exception of the scaled identity. We also use similar techniques to discover a general connection between the 0th numerical range and the kth numerical range. Lastly, we conclude with a conjecture regarding the general numerical range of all triangular Toeplitz matrices.

Overcoming Stereotypes Through a Liberal Arts Math Course

Jessie A. Hamm

"I'm just not a math person." We've heard this comment countless times from our students. It is a mentality that both paralyzes and strangely comforts them. In this talk I will describe how I use my liberal arts Joy of Mathematics course to help students address and overcome stereotypes. In particular, I will discuss a specific assignment as well as share some student comments and perspectives on how this course helped change their viewpoint on more than just math.

Character and Cybersecurity Education

Seth Hamman

It has been said that a person's character is who they are when nobody is looking; today it may be better said that a person's character is who they are in cyberspace. This is because the medium of cyberspace embodies a troublesome combination of temptation, opportunity, and plausible deniability. But cyberspace is also the enabler of extraordinary modern conveniences, and its impact on daily life will only continue to expand. These two facts, cyberspace's bias towards malicious activity and society's increasing dependence upon it, make cybersecurity, which seeks to protect the rights of individuals and organizations in cyberspace, a worthy challenge. Colleges around the country are creating cybersecurity programs to help meet this challenge. In a nutshell, these programs teach the good guys what the bad guys already know. Cyber students are taught technical knowledge and skills, adversarial thinking, and the tricks of the hacking trade. This is essential for helping to level the cyber battlefield. But this type of education, especially when it is combined with the privileged access grads will require, is also a cause for concern. Will the good guys not also face moral ambiguity and temptation in this perversely-bent world? Can they be trusted to recognize right from wrong and to make the right choice every time even when nobody may ever know the difference? The best cyber defenders will have the moral clarity and integrity to match their technical expertise. For this reason, cyber programs that deliberately cultivate character will enrich the cybersecurity education landscape.

The n-Children Problem

Adam Hammett

In 1959, Martin Gardner posed the Two-Children Problem and provided its solution. In it, he asked two questions:

1. Mr. Jones has two children. The older child is a girl. What is the probability that both children are girls?
2. Mr. Smith has two children. At least one of them is a boy. What is the probability that both children are boys?

Gardner stated that the answer to the first question is 1/2 (as expected), but then caused quite a ruckus by claiming that the answer to the second is 1/3. However, he later corrected his solution due to the ambiguity involved in the procedure for obtaining the given information. In 2010, Gary Foshee posed a generalization of Gardner's problem by considering an additional condition beyond gender, namely the birth day of the week. In this talk we will seek to unify and extend both these famous problems, but not before taking in the historical, and sometimes controversial, landscape surrounding them. At the conclusion of our exploration, we will be able to state and prove a robust generalization to any number of children and any number of conditions we might require of them, under one explicit procedure for obtaining the given information.

Analyzing the Impact of Active Learning in General Education Mathematics Courses

Amanda Harsy, Marie Meyer, Michael Smith, Brittany Stephenson

This talk shares the preliminary results of a study that explores the general perceptions and attitudes of students in general education mathematics courses taught using primarily active learning-based methods (like group work, projects, and discovery learning), and compares them with those enrolled in a general education mathematics course taught in a more traditional and lecture-based method. We present an analysis of survey data collected throughout the semester, which explores the disposition and mindset of students, their mathematical confidence and anxiety, and perceptions of pedagogical methods used for the teaching of mathematics. We also explored how these perceptions and dispositions changed throughout the course by comparing pre, mid, and post surveys.

Mosaic Number of Torus Knots

Lisa Hernández

A torus knot is a knot that can be embedded into the surface of a torus. The Mosaic Number of a knot is the minimum number n such that a knot can be fit onto an $n \times n$ grid in such a way that each tile contains at most one arc or crossing. We investigate the relationship between torus knots and their mosaic numbers.

When the Fundamental Theorem of Algebra Goes Awry

Russell W. Howell

One form of the fundamental theorem of algebra states that a polynomial of degree n has n roots (counting multiplicities). This talk will show that, as stated, the theorem is false. To illustrate, we exhibit a polynomial of degree 3 (with real coefficients) that has 9 (distinct!) zeros. We then explore why such an anomaly occurs, and give initial results and conjectures regarding the number of zeros that certain types of polynomials might attain.

EventFinder: A Program for Screening Remotely Captured Images

Michael Janzen

Camera traps are becoming ubiquitous tools for ecologists managing and making decisions for wildlife. While easily deployed they require human time to organize, review, and classify images including sequences of images of the same individual, and non-target images triggered by environmental conditions. For such cases we developed an automated computer program, EventFinder, to reduce operator time by pre-processing and classifying images using background subtraction techniques and colour histogram comparisons. We tested the accuracy of the program against images previously classified by a human operator. The automated classification, on average, reduced the data requiring human input by 90.8% with an accuracy of 96.1%, and produced a false positive rate of only 3.4%. Thus, EventFinder provides an efficient method for reducing the time for human operators to review and classify images making camera trap projects, which compile a large number of images, less costly to process.

Lagrange's Interpolation, the Chinese Remainder Theorem, and Linear Equations

Jesús Jiménez

Consider a finite set of points $\{(x_1, y_1), (x_2, y_2), \ldots, (x_k, y_k)\}$ in $\mathbb{R}^2$. The Lagrange's interpolation problem is to find a polynomial $p(x)$ of degree $k-1$ satisfying $p(x_i) = y_i$ for $1 \leq i \leq k$. We will recall the solution to Lagrange's interpolation problems as an instance of the Chinese Remainder Theorem. Next, we will show that a similar approach can be used to construct solutions to a system of linear equations.

Speak for Yourself: Self-Assessment as a Tool for Measuring Participation

Jill Jordan

In each of my classes, I give my students responsibility for grading themselves on the attendance and participation component of their final grade, following rubrics that I provide. In this talk I will explain both my reasoning for incorporating participation into the final grade calculation and my rationale for having students be the ones who determine these grades. In addition, I will give specific examples of participation grading for various types of classes, including a general education math course, calculus, and an upper-level math major course.

Making the Connection Between Biblical Concepts and Programming Basics

Hyunju Kim

With the exception of ethical issues, it is not easy to integrate Christian faith into Computer Science (CS) and relate the principles and teachings from the Bible to what we teach and learn in the classroom. This talk will share my effort to identify biblical concepts that can be associated with some of the basics of programming. Since joining the college some three years ago, I have taught Programming I, the first programming course for CS and non-CS students, and wanted to show students, as well as myself, that what they learn in the programming course is not separate from what the Bible teaches and reveals. This includes framework and modeling, naming and identity, languages and communications, causality, inheritance, recursion, and diagrams. As part of class devotions, these programming concepts have been discussed along with the scriptures, Genesis in particular, which are associated with the creation, the cultural mandate, the Fall, the dispersion at Babel, and so on. Through this talk, I hope to gain a better insight into faith integration and expand this list through feedback from colleagues.

Mathematical YouTubing and Blogging

Bill Kinney

Interested in posting mathematical content on YouTube and/or a blog? Interested in collaborating on such platforms? I'll share my experiences with my YouTube channel and my blog, as well as some of my content. I'll also get into the details of how I post and promote content, as well as working with some of the details in Wordpress. If you are interested and have the time, I welcome collaborating on and/or developing synergy between our content.

Factors that Motivate Students to Learn Mathematics

Dave Klanderman, Benjamin Gliesmann, Josh Wilkerson,
Sarah Klanderman, Patrick Eggleton

What motivates some students to want to learn mathematics while others do not share similar motivation? Are these factors intrinsic, extrinsic, or a combination of both? To answer these questions, we adapted a survey originally developed by Tapia (1996) and later shortened by Lim and Chapman (2015). We administered the survey in multiple middle schools, a high school, and multiple colleges and universities. We obtained over 100 completed surveys for each of these educational levels. This presentation offers an analysis of these data, including descriptive statistics and confidence intervals for each educational level. For the college and university sample, we also provide comparisons among students majoring in mathematics or mathematics education, those majoring in elementary education, and those with a variety of other majors. In addition to the Likert scale items from the original survey, we explore qualitative data from a free response item. Join us to learn more about why students enjoy learning mathematics and later choose undergraduate majors in the discipline.

Computations in Topological CoHochschild Homology

Sarah Klanderman

Hochschild homology (HH) is a classic invariant of rings that is defined in the realm of algebra and that can be extended as an invariant in topology, called topological Hochschild Homology (THH), to apply to ring spectra. Dually, Doi gave a way to extend Hochschild's work when he defined coHochschild Homology (coHH), which applies to coalgebras, and then Shipley and Hess defined topological coHochschild homology (coTHH) to be the topological extension of these ideas to coalgebra spectra. In this talk we will discuss coTHH calculations and the tools needed to do them.

If the last few sentences were complete jargon to you, come hear about what they really mean and how they exemplify approaches found in the field of algebraic topology in general. Sarah is graduating in May 2020, and so this presentation is designed to give an overview of her dissertation work.

Viewing Mathematics as an Opportunity to Practice Intellectual Virtue

Cory Allen Krause

The most important thing you learn in any course is a way of thinking. When students take a course in mathematics, we wish them to finish having gained the ability to think, in some small way, more like a mathematician. But are such habits of mind also good for us as human persons with a moral dimension? The answer may depend on whether we choose to view mathematics as an opportunity to practice intellectual virtue. Virtue is what the ancients called the practiced conformity of one's thinking and action toward a positive standard. In this talk, I will discuss how I view the study of mathematics as providing a unique way to practice the virtues of honesty, humility, patience, diligence, and even kindness.

Using Agile Project Management Techniques as a Pedagogical Framework

Michael Leih

In the fall of 2015, a Faculty Lead Academic Research Experience (FLARE) course was offered to students to design and build a mobile app for a new start-up company. Each student in the course was responsible for a different aspect of app development, including mobile programming, UX design, graphic design, project management, testing, documentation, cloud technology and database design. Students in the course consisted of juniors and seniors and majored in business, information technology, graphics design, and other disciplines. The challenge of the course was developing a pedagogical framework that would support activities and assessments where each student had unique tasks and responsibilities. In this talk, I will describe how agile project management techniques along with an action research approach were used as a pedagogical framework to support a course were each student had a unique responsibility and the primary deliverable of the course was unknown at the beginning of the semester.

Teaching at a University in a Developing Country – My Experience

Kathy Lewis

For eight years (2010-2018), I was the head of the math department at The University of The Gambia, a small, new (started in 1999) university in a very small, mostly Muslim, West African country that most Americans have never heard of. During that time, a number of other Americans and Europeans came to teach for shorter periods of time.

I will talk about what this experience was like for us, both the good and the bad. I will describe the possibilities for others to spend either a sabbatical or an extended period of time at such a university and suggest some questions to ask of a university before going there. I think teaching overseas can be a real ministry opportunity.

Calculus: A Part of God's Story

Melissa Lindsey

The Educational Framework of Dordt College sets forth a structure for the overall education program at Dordt College. The content of the curriculum and the curricular goals are organized under four broad headings: religious orientation, creational structure, creational development, and contemporary response. To better tell the story of Calculus—and how it fits into God's story, I had students read the Educational Framework and complete a series of four assignments throughout the semester that were geared towards those four curricular-coordinates. This talk will cover what those four assignments were, how they tied to the curricular coordinates, what their strengths were, where they can be improved, and student responses to them.

A Christian Mathematician's Response to *A Mathematician's Apology*

Matt D. Lunsford

G. H. Hardy was a prominent British mathematician during the first half of the twentieth century. In 1940, Hardy wrote an essay defending his career choice of becoming a mathematician. Hardy's essay, *A Mathematician's Apology*, has become a definitive piece in the history of mathematics. Since its publication, several authors have attempted to revise and expound upon Hardy's essay. Possibly the best known of these is the British mathematician Ian Stewart's book *Letters to a Young Mathematician*. In Letters, Stewart seeks to bring Hardy's message into the 21st century, with a particular goal of gender inclusivity. Christian mathematicians James Bradley and Russell Howell, co-editors of *Mathematics Through the Eyes of Faith*, also reference Hardy's essay in their text. In the concluding chapter "An Apology," Howell restates two key questions posed originally by Hardy, hoping to convey Hardy's questions to a broader audience of readers. This talk will provide an overview of the conversation initiated by Hardy, and expounded on by Stewart and Howell, and will incorporate the speaker's endeavor to examine Hardy's essay from a Christian viewpoint.

Faith, Mathematics and Science: The Priority of Scripture in the Pursuit and Acquisition of Truth

Bob Mallison

Sanctify them by the truth; your word is truth. (John 17:17)

This research will examine some approaches for identifying truth as well as some issues involved in recognizing reliable sources of information. We will proceed from a decidedly Christian perspective including the conviction that God created an orderly universe (and that studying nature provides valuable information about Him) and that His Word, the Bible, even more clearly expresses information about Him. We will discuss some of the essential tools used by mathematicians and scientists for the discovery of truth – namely, models. We will examine some valuable models from history, and briefly discuss that as additional scientific information became available, the models required refinement, and sometimes replacement. The Bible, on the other hand, is perfect and needs no corrections. We will also consider the following items:

1. The nature of higher dimensions and possible relationships with certain Bible passages;
2. The role of hermeneutics in Biblical interpretation (and scientific interpretation) regarding reconciliation of science with the Bible;
3. Finally, we will speculate about possible implications for the frequent use of the phrase "[God] stretched out the heavens."

We conclude by summarizing the results and recognizing that as we study mathematics and science, along with Gods Word, we can know the truth. In fact, God's plan for each of us is to know Him Who is the Truth.

Designing a New Sequence of Three Seminars on Math and Faith at Azusa Pacific University

Bryant Matthews

Three years ago, the Azusa Pacific University math faculty began collaborating on a new sequence of seminars intended to help our majors to integrate their mathematical studies with their faith development. The first seminar considers the influence of Christian belief on the historical development of math and physics as well as the strengths and limitations of mathematical and scientific reasoning in our attempts to learn about the world around us. The second seminar looks at the purpose of life, of work, of cultural work, and of mathematical work while supporting students in developing their own sense of vocation. The final seminar helps students to design pathways for missional application of their mathematical training and to plan for intentional growth in character along the way. In this talk, I will share about our design process as well as lessons learned thus far in the implementation phase.

Number Patterns and Insights for the Mathematically Apprehensive

Mandi Maxwell

In the general public, math tends to get a bad reputation; it's misunderstood. It is all too often characterized as just a bunch of rules and procedures, but we know that this a limited and stale view. Mathematics can be beautiful. Fundamentally, it is a study of patterns with intriguing and unexpected connections. It describes and reveals the structure of God's creation and its imagery can deepen our appreciation of our Lord and Savior. My purpose in this talk is to share how some of the connections and beauty that I see in the realm of numerical sequences might enable those outside the mathematical community to gain a deeper appreciation of mathematics.

Reflections Upon the Relationship Between Mathematical and Biblical Truth

Dale McIntyre

And he who talked with me had a gold reed to measure the city [Jerusalem], its gates, and its wall. The city is laid out as a square; its length is as great as its breadth. And he measured the city with the reed: twelve thousand furlongs. Its length, breadth, and height are equal.

(Rev. 21:15-16)

This paper seeks to explore the relationship between mathematical and biblical truth in a number of ways. Pursuit of mathematical truth parallels theology; mathematics reflects the divine nature; mathematical concepts pervade Scripture; and biblical arguments follow the same rules of logic that are foundational to mathematics. It is hoped that reflection upon these connections will encourage the Christian mathematician to serve the Lord through his/her vocation with increased vitality and devotion.

Mathematics as Sub-Creation

Chris Micklewright

As with so many debatable topics today, discussions of mathematical philosophy too often focus on the polarized alternatives of Platonism and nominalism. In these discussions, mathematicians are either discovering eternal truths that could not be otherwise (Platonism), or they are playing meaningless games according to arbitrary rules (nominalism). Faced with these alternatives, Christians have naturally favored Platonism, and there is a well-known joke that all mathematicians are Platonists except on Sundays. However, both perspectives tend toward abstraction, neglecting the created world around us. I will explore a middle way between these alternatives, seeing mathematics as a form of sub-creation (to borrow the term from Tolkien). Like Adam, mathematicians study the created world, identifying patterns and structures, naming and classifying them. However, we are also created in God's image and given the freedom to go beyond what we see in creation, to create new concepts and to forge new connections. I will also explore the implications of this perspective for our understanding of mathematical beauty, and for our work as educators. These ideas been developed with the support of a grant given by Bridging the Two Cultures of Science and the Humanities II, a project run by Scholarship and Christianity in Oxford, the UK subsidiary of the Council for Christian Colleges and Universities, with funding by Templeton Religion Trust and The Blankemeyer Foundation.

Towards Non-Violent and Christian Video Games

Benjamin Mood

Video games have become more prevalent in our society since their spread during the last quarter of the 20th century. Unfortunately, most of the games that are successful are violent and non-Christian. For example, in the popular version of Fortnite, the rules are essentially be the last one left standing by killing all your opponents. The overall goal of this project is to explore how to create alternative games, which are non-violent and Christian. This talk will focus on the progress of the first part this project, which will examine why humans perceive some aspects of games as violent and others as not.

Math, Magic, and More!

Andrew Mosteller

In this talk, we will briefly discus the history of math, magic, and how they interact. We will also explore two very powerful, self-working (relying fully on mathematics, no sleight of hand required) card tricks. In addition, we will reveal the underlying mathematics and method behind these tricks which use key concepts from Group Theory and Number Theory. We will also go over how generalizations of this method can be used to create new possibilities of self-working card tricks.

Team Work and Evaluation: Finding the Missing Link

Sarah A. Nelson

As I learn more about inquiry based learning, I find myself increasingly drawn to finding the most effective ways to facilitate team work during class time. Working together helps level the playing field for all of my students while encouraging them to all learn the material in a deeper way. There are so many benefits to working together. Historically, though, assessments come in the form of exams during which students are completely isolated. As a result, these traditional exams undermine my teaching practices and send mixed messages to my students. There should be a link between the learning process and how we assess students. On the other hand, having students complete all their assessments together presents too many opportunities for individual students to slip between the cracks. In this talk, we will share the process of finding common ground between our teaching and assessment practices. We will share our observations and what we have learned along the way.

A Conversation About Health Insurance

Emily Sprague Pardee

One evening I found myself explaining Medicare to a new recipient about to undergo a much-needed hip replacement. My Christian friend, long an opponent of the Affordable Care Act, thought of this access to his necessary treatment as a miracle. I pulled out Galatians 6:2, "Bear ye one another's burdens and so fulfill the law of Christ," as a gateway to introduce health insurance simply, perhaps even to regard insurance premiums as tangible expressions of charity. This talk builds on those simple beginnings to provide a quick overview of the Affordable Care Act with a spotlight on the mathematics behind its provisions. We continue by honing in on California's particular implementation of the ACA and attempt to sort out the mathematical choices behind differences of opinion about costs and benefits. We end with a few remarks about how this Christian bridges the gap between density curves and spreadsheets to speak to the hearts of concerned citizens.

Glimpses of God Through a Mathematician's Eyes

Doug Phillippy

The ability of mathematics to describe the world around us has long been of interest to mathematicians. I share this interest and my training as an applied mathematician has allowed me to gain insight into the world through the modeling process. Nevertheless, my understanding of the modeling process was limited by a secular education. This talk will describe my journey from secular education to Christian educator and how that journey has expanded my understanding of the modeling process. In particular, I will highlight several mathematical models that have strengthened my understanding of God and my faith.

Random Walk on Three "Half-Cubes"

Michael R. Pilla

In this talk, we will study random walks on some interesting graphs including a clock, a cube, and three "half-cubes." Random walks are ubiquitous in applications, appearing everywhere from animal movements to Google search algorithms. In our case, take a cube of cheese and slice it with a knife through its center of gravity. It turns out there are three topologically distinct way of doing this, leaving a "half-cube." Starting from a designated origin, we will place a cookie at each vertex of the half-cube. Each step will be taken from one vertex to an adjacent vertex with equal probability, independently of all previous steps. Every time we reach a vertex for the first time, we will eat the cookie and move on (the cookies are not replaced). We will find the expected time to eat a given cookie, the probability a given cookie is eaten last, and the time it takes to eat all of the cookies.

Less Volume, More Creativity: R for Busy Humans

Randall Pruim

R is a general purpose programming language. R is also a data analysis tool with a vast array of statistical procedures available to its users. Although a core team develops R, it is also community-supported software with thousands of package authors. While these features make R powerful and useful, they can also make it overwhelming. We will present an introduction to a "Less Volume, More Creativity" approach to using R that makes R more hospitable to its human users and helps optimize our scarcest resource: analyst (including faculty and student) time.

Clean Water for Liberia

Randall Pruim, Stacy DeRuiter, Matthew Bone

A team of Calvin faculty and students from statistics, sociology, and GIS are partnering with Sawyer (a manufacturer of water filters) and NGOs in Liberia in a project to bring clean water to everyone in that country by 2022. This summer will mark the mid-point of this five-year effort. We will present some of the results so far and discuss the benefits and challenges of working in such a large and varied team.

Celebrity Politicians

Ray Rosentrater

We all know of celebrities who have gone on to hold high political office. Do celebrities have a significant advantage over seasoned and amateur (those having not held office previously) politicians? Initial results seem to give a resounding "yes," but a closer analysis indicates that things might not be as simple as they first appear.

Specifications Grading in a Math for Liberal Arts Course

Lauren Sager

Concepts of Mathematics is a quantitative reasoning core course with a dual audience: non-mathematics majors looking for core credit, and elementary education majors. After watching students, who are often self-proclaimed "not math people," panic before exams, I turned to specifications grading to try to ease some mathematics anxiety in the classroom. In this talk, I will give a brief overview of the course and of specifications grading. I will also talk a bit about both student and grading outcomes.

Transhumanism, Faith, and the Human Future

Derek Schuurman

The adage that "we shape our tools, and thereafter our tools shape us" takes on a new meaning with transhumanism. Transhumanism is a movement that seeks to enhance humans using technology far beyond the limits of their current physical and intellectual capacities to evolve into something better.

Technology like glasses, pacemakers and artificial limbs already augment human capabilities, but the goal of these technologies is to restore normal human capacities that have been lost or damaged due to disease or accidents. In contrast, the goal of transhumanism is for humanity to take control of its evolutionary destiny and move towards a "posthuman" future.

The longings of transhumanists point, in part, to a recognition of our fallen condition, and that things are not the way they are supposed to be with disease, suffering, and death. The issue is that they look to technology as savior of the human condition instead of God (or in addition to God).

The notion of disembodied existence in certain transhumanist ideals reflects some themes in Gnosticism. We need to recall that the incarnation reveals the value God places on our physicality and humanity. We need to remember how Christ, "the Word who became flesh" (1 John 3:2), models what it means to be truly human. Furthermore, the importance of valuing bodies should inform our current technology use and design by encouraging embodied experiences and practices.

Addressing Challenges in Creating Math Presentations

David Schweitzer

When it comes to composing presentation slides with extensive mathematical content, each of the slide creation platforms has at least one significant drawback. Whether it is Beamer and its steep learning curve, PowerPoint and its relative inefficiency with math, Google Slides and its complete lack of math capabilities, or some other platform, no one tool single-handedly offers an ideal solution. Additionally, if users desire creative flexibility, such as the ability to easily change fonts or colors, the platforms' respective limitations can become even more pronounced.

In a project that has been well suited for undergraduate research, the presenter and his team are actively developing new tools and enhancing existing ones to address these issues. This talk will discuss two such tools for PowerPoint. By using a new VBA macro and a modified version of a pre-existing, open source VBA add-in, users can have math creation and rendering capabilities largely on par with TEX's, all while maintaining PowerPoint's simplicity for all other tasks. These tools consequently greatly reduce the amount of time necessary to create slides with mathematical content. Time-permitting, the talk will also include brief discussion of long-term project goals, such as the team's early inroads for web platforms and efforts to improve educators' ability to meet the accessibility needs of students with visual impairments.

Small is Beautiful: Leveraging the Small Size of Departments to Make Rapid Cultural Changes

Daniel Showalter

Several faculty in our mathematical sciences and biochemistry departments received an NSF grant to transform our culture and make it a more welcoming home for underrepresented minority and first generation college students. Within two years, over 90% of our full-time math and science faculty had gone through a one-year Diversity Response Training course, and many continued on to conduct related studies in their classrooms. This talk will present some of the challenges, failures, and successes of our attempt to impact some of the more invisible parts of our journey as Christian professors to see beyond how students are performing by conventional academic standards.

A Unifying Project for a TEX/CAS course

Andrew Simoson

We describe a CAS and TEX usage course for mathematics majors. As a unifying project, each student selects two primes p and q with $pq < 100$, explores mathematical pq ideas, and generates associated graphs, figures, tables for a final TEX paper. We summarize several pq explorations: students render page pq from Schwartz's picture book about primes, *You Can Count on Monsters*, via Mathematica and TEX's picture environment; students generate fractal images of pq; and students discover the primes of the ring $\mathbb{Z}\left[\sqrt{pq}\right]$.

Does Harvard Discriminate Against Asian Americans in Admission Decisions?

Michael Stob

The organization Students for Fair Admissions sued Harvard University alleging that Harvard discriminates against Asian-American applicants in its undergraduate admissions decisions. At the trial, each side featured an expert witness presenting statistical analyses supporting their respective cases. In this talk, we look at these analyses not to resolve the title question but to highlight some of the difficulties in using such statistical models to resolve discrimination cases.

Is Mathematical Truth Time Dependent? Some Thoughts Related to a Paper from Judith Grabiner

Richard Stout

Judith Grabiner, a renowned historian of mathematics, has written many papers related to significant changes in the content and nature of analysis, from the 17th through the 19th century. In her paper "Is Mathematical Truth Time Dependent?" Professor Grabiner gives several reasons for the changing nature and requirements in rigor that occurred over this period of two hundred years. In this talk I will briefly summarize her conclusions, particularly in light of how they might influence a Christian perspective on mathematics.

Charles Babbage and Mathematical Aspects of the Miraculous

Courtney K. Taylor

Charles Babbage is widely known as the father of the computer, but he is lesser known for his contributions to natural theology and apologetics. In 1837 Babbage wrote the Ninth Bridgewater Treatise in response to a series of writings concerning faith and science that had been commissioned by the Royal Society. Among the remarkable features of the Ninth Bridgewater are mathematical analogies concerning the miraculous. We will explore these ideas, which range from the difference engine to a family of fourth degree curves, illustrating that for Babbage, miracles are not exceptions to natural law, but rather instances of a larger pattern. In addition we will see how Babbage employed probability to refute Hume's argument against miracles.

Analyzing Retention and Graduation Rates at Bethel University

Deborah Thomas

Academic institutions such as ours are always looking for ways to increase retention rates. Being able to describe successful students and learn how to better cater to all students is a key goal of universities. Two such markers are the percentage of returning students between the freshman and sophomore year as well as the graduation rate for a particular class after four years. Two years ago, I presented initial results. However, at that stage, I had mainly focused on data cleaning. Here, will present more robust results, looking at the effect of participation in sports, dorm choice and first generation college student status on the retention of students between their first and second year and also at graduation rates. We will also make recommendations based on our results to increase retention rates.

Computer Science: Sub-Creation in a Fallen World

Russ Tuck

When God created people in his image, he gave us the gift of sub-creation. One of the great joys of Computer Science is exercising that gift to create tools : software and computer systems that serve people and solve problems. Like all God's gifts, he charges us to exercise the gift of sub-creation wisely and for good. While there are many obvious implications and challenges, being good stewardship of users' time and reducing discrimination are particularly relevant and perhaps less obvious examples.

Although computer scientists exercise the gift of sub-creation, we do so as fallen people in a fallen world. This affects not only what we build but, more fundamentally, how we build it. First, we are inherently imperfect and mistake-prone, which means our software inevitably contains bugs (mistakes). So we have to test software to find the bugs, then figure out how to fix them.

More fundamentally, but less obviously, our knowledge and understanding are imperfect, so we don't even know exactly what to build. The modern practice of "agile" software development can be understood as addressing this problem. Its focus on incremental development and immediate testing seeks to explore and better understand the requirements and to refine the design. It also helps find mistakes quickly in order to fix them more easily. This is a productive response to human imperfection in both knowledge and action.

Ways of Thinking Beautifully about Mathematics

James M. Turner

At Calvin College, First Year Students are required to take a section of our Discovering the Christian Mind course during our January term. For the past 3 years, I have taught a section of this course titled *Thinking Beautifully about Mathematics*. In it, I explored, with the students, various areas of mathematics, as well as how mathematicians have explored them, while addressing such questions as "Is mathematics invented or discovered?" and "Why is mathematics unreasonably effective?" Ultimately, we look to identify ways and characterizations for how beauty displays itself in mathematics and how and it what ways beauty is seen by mathematicians. In this talk, I will report on some of the questions, observations, and speculations that arose from teaching this course.

Replacing Remedial Mathematics with Corequisites in General Education Mathematics Courses

Alana Unfried

Many colleges and universities offer courses, such as Remedial Mathematics or Elementary Algebra, that underprepared students must complete before they can take a college-level mathematics course. However, nationally there is a push to replace remedial mathematics courses with corequisite courses instead. This design allows students to enter directly into their general education mathematics course instead of first overcoming the barrier of a remedial course. Corequisite mathematics courses were implemented across the 23-campus California State University system during the 2018-19 academic year. I will discuss the design and implementation of a corequisite structure at California State University, Monterey Bay, in particular focusing on the redesign of our Introductory Statistics course and corresponding corequisite course. I will discuss the rationale for moving to this structure, the logistics of making this change, the design and pedagogy used for Introductory Statistics and its corequisite, as well as preliminary findings about student success in our first year implementation.

A Metaphor from Competitive Gaming: the Crown that will Last Forever

James Vanderhyde

David Sirlin, competitive video game tournament champion, wrote a book (2005) that explains how to win at games. Sirlin begins the book by describing a "mountain" of competitive gaming: a few gamers are already "on the journey" to the mountain peak, but most only think they are. "They got stuck at a chasm at the mountain's base," and "they are imprisoned in their own mental constructs of made-up game rules. ... 'Playing to win' is largely the process of shedding the mental constructs that trap players in the chasm who would be happier at the mountain peak."

This is how I see the Christian life, or more broadly the spiritual or moral life. When a person has not come to terms with the sinful nature and accepted the grace of God and the saving work of Jesus, "they are imprisoned in their own mental constructs." All they have to work with are the moral codes they either come up with on their own or inherit from their parents and peers. Paul (Col. 2:21 NIV) writes, "Such regulations indeed have an appearance of wisdom, with their self-imposed worship, their false humility and their harsh treatment of the body, but they lack any value in restraining sensual indulgence." This way of living sounds just like what Sirlin calls the "scrub" mentality. Life is not a game, but let's see how far the analogy takes us, and what we need to do to win.

Approaching History with Graph Theory – A Review

Kevin Vander Meulen

The book *The Square and the Tower: Networks and Power, from the Freemasons to Facebook* by Niall Ferguson is a 2017 popular history book that has a leading role for mathematics. The book notes that the subject of history tends to focus on institutions and leaders of institutions. Ferguson proposes that the significant impact of social networks has been overlooked. He explores many historical events, including the Enlightenment and the Reformation, as well as more current events. Ferguson uses mathematical tools, especially graph theory, to make his point. I will review and critique what the book offers.

A Modeling-Driven Approach to Teaching Differential Equations

Mary Vanderschoot

Wheaton College uses a modeling-driven approach in teaching Differential Equations by incorporating several modeling projects throughout the course. I'll share several creative variations on canonical models (solution flowing into a tank, mass on a spring, predator-prey) that cater to students majoring in economics, physics, environmental science, and social science. These projects not only promote understanding, but also increase students' ability to work in groups and to communicate assumptions and results in written form with clarity and professionalism as a scientific report.

TENZI: A Fun Introduction to Markov Chains and Decisions

Michael Veatch

TENZI, "The world's fastest game," sounds simple: roll 10 dice until they all match, setting aside the dice you want to keep. On average how many rolls does it take to get 10 matches? Answering this question, for both the optimal and a naive policy, requires combinatorics, order statistics, and Markov chains. The proof that the strategy is optimal is more advanced, using dynamic programming. The mathematical framework of Markov chains often gets little or no treatment in the undergraduate curriculum, but is now essential in machine learning and dynamic pricing, for example. General dynamic programming approximation schemes make it possible to handle larger models with decisions. The TENZI problem could be used to introduce probability students to these important ideas.

An APOS Analysis of Calculus Student Comprehension of Continuity and Related Topics

Jayleen Wangle

This study concerns Calculus I students' comprehension of the concepts of function, limit, and continuity. Items were designed to inquire about participant depth of understanding of function, limit, and continuity. Participant responses were viewed through the lens of the constructs depicted by Dubinsky's (1991) Action-Process-Object-Schema (APOS) theory. APOS theory was developed by Dubinsky and his colleagues as a means of measuring perceived student depth of understanding. The theory purports that one's schema consists of the constructs of actions, processes, and objects (Asiala et al., 1996). For example, one demonstrates a strong schema of the concept of function when one shows that one is able to think about a function as a process or an object as appropriate to the task. Even though quantitative and qualitative methods were used in this study, this talk will center on results from participant interviews. A prominent finding was that participants who demonstrated a stronger conception of the notion of function displayed a more in-depth understanding of continuity.

Maximal Elements of Ordered Sets and the Ontological Argument

Doug Ward

I will present a simple theorem concerning maximal elements of a set T endowed with an ordering "$>$" that is antisymmetric, i.e., if A and B are elements of T, we cannot have both $A > B$ and $B > A$. A special case of this theorem is a simple version of the ontological argument, one of the classical proofs for the existence of God.

Math is _____

Josh Wilkerson

Many discussions of mathematics from a Christian perspective focus on presenting math as true, good, and beautiful. While this is undoubtedly an integral conversation to bring into the math classroom, if the conversation stops there, at true, good, and beautiful, then we are painting an incomplete picture of mathematics. If the conversation stops there then we are analyzing an abstract discipline with abstract language and many students leave our doors feeling as if they have had an intellectual exchange but they remain ultimately unchanged in how they practice and understand mathematics.

This presentation will challenge educators on how to complete the sentence "Math is _____" with language that remains faithful to the true, good, and beautiful but also considers the practical experience students are having of mathematics. How do we understand not only the philosophy of mathematics but the practice of mathematics from a Christian perspective? How do the practices and liturgies of the math classroom impact the mathematical affections of students?

This presentation will end by offering some practical examples that math teachers can implement in their own classroom.

Making Stuff Up: A Model for Undergraduate Research in Mathematics

Rebekah Yates

In order to introduce our students to mathematical research, several years ago we began offering a 1-credit Math Research Seminar each spring for any students who have completed our Introduction to Proofs course. In this talk, I will describe the structure of the course, research problems we have explored, and our experiences with the course, including how the course broadens students' perspectives on mathematics as a creative, active discipline.

Image Data: A Project-Based Exploration of Computer Vision

Ryan Yates

Computer vision systems appear in many well-known cutting-edge domains such as self-driving cars, augmented reality, and facial recognition. There are also many lesser-known applications throughout industry and scientific domains. Our Image Data class is a special topics course in Data Science at Houghton College where we attempt to demystify tools for building computer vision though hands-on projects including building practical vision systems out of low cost components and using standard open source software tools for computer scientists and data scientists.

Practical Examples of Bin Packing and Critical Path Scheduling

Maria Zack, Greg Crow

In the process of designing and implementing the gut remodel of a post-Sputnik science building, we created a host of examples for quantitative literacy classes that are rooted in real world problems. How many cubicles can you fit in a construction trailer? What are the prerequisite constraints on furniture installation in the building? Why are the painters still here? How can you number rooms so that it is intuitive to professors and high school student visitors and yet allows sufficient flexibility that the rooms could be sub-divided later?

Outreach Activities to Attract Majors

Valorie L. Zonnefeld

The demand for graduates with mathematical and statistical skills remains high. In education, the National Science Foundation (2014) reported that 27% of high school math teachers in the US did not possess a degree in mathematics. The need for mathematics and statistics graduates is evident, but the students are not always available. This presentation will share outreach activities that have and have not worked for recruiting more majors at Dordt University.

How do we add more students to the quantitative sciences pipeline? One strategy is to reach out to students prior to college. Dordt has used multiple approaches to share the joys and opportunities in mathematics with Kindergarten through 12th grade students. These strategies include math competitions, a March Madness Data Analytics Battle, classroom visits, postcards, game nights, and week-long camps. Outreach for current students has included a mini-internship, a booth at the campus fair, game nights, club activities, and the addition of new programs.

This presentation and many of the outreach opportunities are funded by a NSF Noyce grant [DUE 1660632]

Discussion Abstracts

Discussion on Student Mentoring

Ryan Botts, Lori Carter, Catherine Crockett, Mike Leih

College professors wear many hats in addition to teaching and research. One of the most daunting tasks can be mentoring. Whether it be about academic trajectory, career options, life issues, or research, most of us have no shortage of students lining up at our doors for advice. More recently we've found that those we are advising have even more specialized needs. They may have disabilities about which we have little information, may be a first generation student finding it difficult to navigate current and future requirements, or be someone of an ethnicity or gender who feels different from the rest of the students in the class. At Point Loma Nazarene University we have been working together to find good ways to support these sometimes challenging students. We believe that as Christians, this is a part of our calling. We'd like to share what we have learned, and hear about how others have helped their most challenging students.

What New Collegiate Faith/Integration Resources Can ACMS Provide?

Bob Brabenec

Over the years, the ACMS organization has supported the integration of mathematics and the Christian faith in a variety of ways. These include many talks at the biennial conferences which are in the conference Proceedings, along with the writing and publication of two books: *Mathematics in the Postmodern Age: A Christian Perspective* in 2001 and *Mathematics Through the Eyes of Faith* in 2010. The purpose of this informal discussion session will be to ascertain what kind of additional materials are desired, and some ways in which these can be provided. Content will be shared from my *Mathematics and its Foundations* manual used for my math capstone course at Wheaton.

Advising Students for Government and Industry Job Searches

Stephen McCarty

I am an operations research analyst and work for the US Army. This topic discussion will consist of a short presentation on working for the federal government and applying for jobs on the US government job website https://www.usajobs.gov/ followed by Q&A. The session will then be open for discussion and presentations from other audience members with tips to share on helping students with job searches.

New Evangelical Statement of Principles on AI

Derek Schuurman

The Southern Baptist Convention issued a statement titled "Artificial Intelligence: An Evangelical Statement of Principles" (click here). Christianity Today has a report on this as well (click here). I am curious to hear from others: what do you think of the statement? I am glad to see the church responding to this issue with a voice that is "biblical and relevant" – but much more remains to be done in this rapidly evolving field!

ACMS Resources for K-12 Christian Educators

Josh Wilkerson

What role might ACMS play in K-12 Christian education? How can ACMS help to develop resources for math educators in Christian schools—or at least engage educators in critiquing available resources for integrating faith and mathematics?
