Abstracts of Presentations

Brian Beasley (Presbyterian College)
Where, Oh Waring? The Classic Problem and its Extensions

In 1770, Edward Waring published his famous conjecture that every positive integer may be expressed as the sum of four squares, nine cubes, nineteen fourth powers, etc. Ever since, mathematicians have tackled not only Waring's original problem but also a wide variety of generalizations. This talk will sketch brief outlines of Waring's life and the history behind the eventual solution to his problem. In addition, it will present some of the related questions currently being studied, such as expressing sufficiently large integers as sums of powers, sums of powers of primes, and sums of unlike powers.

Arthur Benjamin (Harvey Mudd College)
Mathemagics!

In this fast-paced performance, I will demonstrate and explain how to mentally add and multiply numbers faster than a calculator, how to memorize 100 digits of pi, how to figure out the day of the week of any date in history, and other amazing feats of mind. I have presented his mixture of math and magic to audiences all over the world.

Combinatorial Trigonometry (and a method to DIE for)!

Many trigonometric identities, including the Pythagorean theorem, have combinatorial proofs. Furthermore, some combinatorial problems have trigonometric solutions. All of these problems can be reduced to alternating sums, and are attacked by a technique we call D.I.E. (Description, Involution, Exception). This technique offers new insights to identities involving binomial coefficients, Fibonacci numbers, derangements, and Chebyshev polynomials.

Ryan Botts and Lori Carter (Point Loma Nazarene University)
Lessons Learned: A Journey in Computational Science

Inspired by work on building a computational science program and student questions about modeling, we aim to discuss some of our experiences with computational science. We will first clarify what computational science is, why it is a legitimate science, why it is worth our students' time, and what makes it a challenging field. We will also discuss how computer scientists, mathematicians, and laboratory scientists each have something different to contribute to the field.

Robert Brabenec (Wheaton College)
Thinking Philosophically about Mathematics

I will present a broad overview of the important periods throughout history, from the time of the ancient Greeks until the present day, when mathematicians were encouraged to think

philosophically about their discipline. While the three major philosophies of mathematics—logicism, intuitionism, and formalism—were proposed and developed during the period roughly from 1880 to 1930, there are several other distinct times when philosophical concerns influenced mathematics.

It is instructive to be aware of the mathematical developments during the nineteenth century that led to this emergence of formal philosophies after 1880. These include such items as the discovery of non-Euclidean geometry, the bringing of rigor into calculus, the development of abstract algebraic structures, the definition and construction of real numbers, and Cantor's theory of infinite sets. An understanding of the overall development of these major concepts in their historical context can help both faculty and students to better understand and enjoy the discipline of mathematics.

Kristin Camenga (Houghton College)
Asking and Answering Questions: Developing Independence in a Capstone Course

This talk will share ideas and reflections on a senior capstone course with a focus on helping students develop skills for lifelong mathematical learning by asking questions and seeking answers. Classroom activities and assignments will be shared that aim to help students learn to research, read a variety of sources, respond to speakers, and extend problems.

Jeremy Case (Taylor University)
Preacher-Kid Mathematicians

Euler, Abel, and Riemann were all children of ministers. Euler's and Riemann's fathers hoped their sons would go into the ministry, but mathematical potential won out. This talk will examine how mathematical historians portray these shifts away from clergy life towards mathematics. Furthermore, we will provide a survey of other interesting mathematicians who were pastor's kids, or PK's.

Loredana Ciurdariu (Polytechnic University of Timisora)
On the Beauty of Some of Pascal's Thoughts Seen in the Light of the Holy Scriptures

It is better to study Pascal's character from a different perspective as well, more precisely by his writings, by that which defines him. There are assumptions that his health might have deteriorated following the experiments he had done using mercury. He talks in his Pensées about faith, grace and purity of the heart, about the peoples and the way in which God leads them, about wisdom, dreams and hopes, and that which lies in the human heart. If statistics were gathered concerning the most used books and verses from the Bible in the Pensées, these would be: Ecclesiastes, Proverbs, Matthew, Mark, Jeremiah, Hebrews, Romans, Luke, Isaiah, Psalms. But those which occupy a central position are, of course, the ones used by Lord Jesus Christ, such as: John 3:16, when he speaks about faith, Luke 17:33, when speaking about the the wager, and Matthew 16:26, when talking about the thinking reed. For Pascal there is no antagonism between science and faith.

Mark Colgan (Taylor University)
Encouraging Students to Connect topics in Calculus with Biblical Ideas

My goals for the students in my Calculus I class go beyond learning the standard content of pre-calculus and calculus. Particularly since this is also a general education course, I also want them to learn to work in groups, to experience real-world applications, to learn to communicate effectively, and to understand mathematical life lessons, many of which are supported by Scripture. To help students explore these ideas, I ask them to write short reflection papers on topics such as working in groups, the fourth dimension, things we should maximize and minimize, financial stewardship as it relates to exponential growth, etc. I will share how I design these assignments, some sample reflections, and how students have responded to this approach.

Eric Gossett (Bethel University)
The Search for Hamilton

In the summer of 2009, my wife and I were in Dublin. I decided we should visit the bridge (location) where Hamilton scratched the quaternion equations. This turned out to be quite difficult. I will present a photo journal of that (eventually successful) search, as well as discuss the annual walk to the bridge sponsored by the mathematics department of the National University of Ireland, Maynooth.

Nathan Gossett (Bethel University)
The Need for Graphics in Computer Science

This talk will focus on the benefits of offering a course on programming Computer Graphics in an undergraduate Computer Science curriculum. A sample course outline will be provided, as well as a discussion of ways to conduct lectures, labs and a list of suggested assignments. A discussion of "dos and dont's" will also be presented, including a list of required prerequisite courses and skills that students would need in order for the course to be a success.

Wayne Iba (Westmont College)
Real Simulations and Simulated Reality

Movies such as *The Matrix* have stimulated popular interest in "brain in a vat" scenarios. Amidst the traditional questions of mind, we tend to overlook an integral enabling component—the world simulation—which merits consideration in its own right. When facing the simulations in these imagined scenarios, we struggle with conceptual muddles regarding what's real and not. In this paper, I argue that simulated worlds are every bit as real as the one we inhabit. This turns out to be important when considering the possibility, as suggested by Nick Bostrom, that the world we experience as "real" is actually a simulation. Can such a prospect be reconciled with an Orthodox Christian perspective? While the metaphysical status of simulations that I posit moves us towards an integration, significant obstacles remain to be addressed. I consider some of these remaining challenges and explore the associated stakes.

Jonathan Leech (Westmont College)
Skew Lattices in Algebra and Computer Science

Noncommutative variations of lattices have been studied since the physicist Pascual Jordan introduced the subject in 1949. The talk will survey recent developments, indicating connections to structural aspects of idempotents in rings, as well as to some research in computer science.

Stephen Lovett (Wheaton College)
Bringing REU into the Classroom

Mathematics graduate programs and companies that employ math majors often want to ascertain an applicant's potential for research. However, in many undergraduate courses, assessments consist only of regular exercise sets, quizzes, and in-class tests. Without doing a senior research thesis or landing an official REUs, students do not regularly gain experience in or an appreciation for research. Courses in the humanities regularly require students to write in the discipline, progressively preparing them methodologically for "writing in the field." This begs the question: could math departments do a little more to prepare students to use mathematics beyond college? In this talk, we explore options for incorporating undergraduate mathematical research and writing into regular course assignments. The speaker will present some investigative project questions he has used in a variety of courses and illustrate the results with actual student work.

Justin Marks (Colorado State University)
Pattern Recognition in Large Data Sets

Pattern recognition in large data sets, such as a collection of digital images or videos, is often achieved through considering the data as residing on a matrix manifold. We illustrate using digital images of human faces collected at Colorado State University. Building on recently established geometric properties of the Stiefel and Grassmann manifolds, we propose a new approach for computing retractions, i.e., maps from the matrix manifold's tangent space to the manifold. The result is a family of new algorithms that can be used for geometric optimization.

Bryant Mathews (Azusa Pacific University)
Tropical Mathematics

Tropical mathematics is an alternate version of mathematics, obtained by appending the number infinity to the real numbers, replacing addition with minimum, and replacing multiplication with addition. Many theorems in linear algebra and algebraic geometry have analogues in the tropical context. My students and I have been working on the tropical version of the minimal rank problem, which asks for the minimal rank of a matrix subject to certain constraints imposed by a graph. I will introduce the problem and report on preliminary results.

Nathan Moyer (Whitworth University)
Connecting Students with Philosophy, History, Faith

This talk describes a class project that helps students wrestle with the deep philosophical questions of mathematics in a relevant way. Through article readings and group discussions,

various historical views of mathematical philosophy are examined and critiqued. An emphasis is placed upon students making meaningful connections between their own views of mathematics and their personal Christian faith or worldview.

Judith Palagallo (University of Akron)
Calculus Communication Circles

A Calculus Communication Circle is a communication network for Advanced Placement Calculus teachers. In northeast Ohio the Circle provides a forum where teachers meet to share ideas about mathematics and the teaching of calculus. In addition, faculty members from area colleges conduct workshops for the Circle two or three times per academic year. I will discuss the creation of the Circle and progress it has made over its three year existence. Perhaps you will want to start a Calculus Circle in your area!

Doug Phillippy (Messiah College)
What Mathematics has Taught me about God and Running

This talk will focus on the third draft of my text: The Study of Mathematics: Developing a mature understanding of mathematical thought with consideration of Christian faith and Vocation, a text targeting first-year mathematics majors attending Christian institutions of higher education. The talk will give an overview of the development of this text which has taken place over a seven-year period, but it will focus on the work done to complete the third draft of the text, work that was completed while on my sabbatical during the spring of 2011. Unlike the previous two drafts of this text, the third draft, which is more than double the size of the second draft, will mark the completion of this project and be a product ready for publication. This talk will describe the three-fold nature of the text, which is intended to tell some of my own journey (hence the title of the talk), to introduce mathematical topics that are both of interest and importance to first-year mathematics majors, and to help students understand what it means to consider their studies and future careers from a Christian perspective.

Donna Pierce (Whitworth University)
Math History Study Abroad Program: Worldview Perspectives

In January 2011 fifteen Whitworth University students participated in a program where they studied math history in a historical context on-site in Italy, Germany and England. Walking amongst the Roman engineering wonders, experiencing the mathematical beauty of Renaissance art and architecture, seeing the inventions, original papers and instruments of Galileo, DaVinci, Euler, Newton and others, and learning from experts about the effects of war and oppression on society, gave the students new insights into the worldview perspectives of men and women responsible for major developments in mathematics. In this presentation we will share some of the highlights of that trip, focusing on what the students learned about the faith and worldview perspectives of these mathematicians.

Michael Rempe (Whitworth University)
The 25 Billion Dollar Linear Algebra Problem

Soon after its debut in 1997, Google quickly became the most popular search engine on the web, largely because of its fast response rate and the quality of its search results. Compared to other tools, Google seemed to do a better job of placing the most relevant results near the top of the results list. In this talk I will present an overview of PageRank, one of the factors Google uses to arrange its search results. This surprisingly simple and intuitive algorithm is based on a familiar linear algebra topic, and therefore can be used as a motivating example or an instructional module in a Linear Algebra course.

Gene Rohrbaugh (Messiah College)
From Augustine and Aquinas to Asimov: The Moral Status Of Intelligent Machines

The recent victory of IBM's Watson over human Jeopardy champions is but one sign of the progress that is being made in the field of artificial intelligence. Intelligent machines are not only growing in their cognitive capabilities; they are also being given greater autonomy to act in the real world. Autonomous machine agents are being deployed in areas such as vehicle navigation, military reconnaissance, health care, space exploration, and even weapons systems. Secular and Christian computer scientists likely agree that actions in such domains are ethically consequential; however they may not agree on the prospects of building machine agents that can be expected to act ethically over the long run. Whether ethical behavior is possible, let alone likely, depends in part on one's view on the nature of ethical behavior as well as its source.

This paper juxtaposes the ideas of Augustine and Aquinas, representing traditional Christian thought, with those of Asimov, representing modern secularism. A self- identified atheist and open critic of evangelical Christianity, Asimov might be expected to have little in common with a fourth century Catholic Bishop and a thirteenth century Dominican priest, yet on many points they find agreement. Even more surprising, in some ways, the two Church fathers seem to grant such machine agents a higher moral status than did Asimov. Even though they obviously did not write about robots per se, Augustine and Aquinas articulate clear principles on the moral status of beings both human and non-human. After beginning with a brief introduction establishing the moral import of machine agents, the paper is structured around two central questions: (1) Are such agents morally considerable, either directly or indirectly? and (2) Are they truly moral agents? The paper closes by making a connection to student learning, describing how these and other engaging philosophical questions can be used to stimulate student interest in grand challenges in computing.

The Place of Computing in the Liberal Arts Curriculum

Modern liberal arts curricula, designed to promote the development of a broad knowledge base and critical thinking skills, commonly include requirements in literature, languages, philosophy, history, mathematics, and science, all of which have had a longstanding presence in western education. In contrast, computer and information science, a relative newcomer to the academic table, is often marginalized as having only professional or technical merit, of value primarily to specialists. But the chronological happenstance of a field's discovery should not be the sole measure of its value in educating liberally. Instead, each field should be evaluated in terms of

how it can contribute to meeting the foundational objectives that drive an institution's academic programs.

In this paper, I explore the place of computing in the contemporary liberal arts curriculum. I begin by reporting the results of an exploratory poll of computing educators conducted earlier this year among participants of the CS-CHRISTIANITY mailing list. Participants were asked a series of questions designed to elicit their descriptions of how computing fits into the curricula at their respective institutions. The stories gathered in response were grouped into four distinct categories: (1) no computing requirement; (2) a requirement that can be fulfilled by computing courses as well as other courses; (3) a general distribution requirement taught by faculty in a variety of disciplines; and (4) an explicit computing requirement developed and taught by faculty in computing. The remainder of the paper outlines some challenges one might face in advocating for incorporation of computing into the curriculum, as well as strategies and approaches one might take to do so.

Michael Stob (Calvin College)
R on the Cloud

The program R is a system for statistical computations and graphics. It is quickly becoming the system of choice both for professional statisticians and classroom instruction. We use it at Calvin for statistical instruction at all levels because it is free, easily user-extensible, professional quality, and relatively easy to learn. During this past semester four classes at different levels used R on the cloud—that is R was accessed via the web from a remote server. The web interface to R, called RStudio, made R simple to learn and use for our students. In this talk I will demonstrate how, through RStudio, R can easily be used in an introductory statistics course.

David Stucki (Otterbein University)
Teaching Infinity, and Beyond!

Otterbein University, as a part of its transition to a semester calendar for the academic year 2011-12, has redesigned it general education Integrative Studies program from the ground up. A signature feature of the new program is a freshman year seminar (FYS) that is structured to meet common learning objectives for entering students that are independent of specific content. This allows faculty from any discipline to propose "passion" courses that will engage students in ways they are unlikely to have encountered in high school. In the autumn of this past year I piloted a course, offered to sophomores as a religion/philosophy credit, that will be packaged as an FYS this fall as one of our inaugural FYS offerings. Taking its title from the catch-phrase from Toy Story, the course *To Infinity and Beyond* is open to students from any major and carries no prerequisite.

I will present the course design, along with a bibliography of resources, and talk about adapting the course to various audiences. I would also like to report some of the anecdotal evidence of its impact on students (and on me).

Gordon Swain (Ashland University)
History of the Area Between a Line and a Parabola

The quadrature of the region bounded by a line and a parabola was first accomplished by Archimedes. But many mathematicians since then have also solved this area problem, using it as a "test case" for their methods. We will survey the math, the historical development, and the people themselves.

Glen Van Brummelen (Quest University)
Mathematics Across Cultures: How Can Worldview Affect Mathematics?

As Christians we often assert that worldview affects and informs every aspect of our lives. Within mathematics this is usually explored on a philosophical level. But broader cultural assumptions about the structure of knowledge have had surprisingly deep effects on the nature and practice of mathematics. Concentrating mostly on ancient Greece and pre-modern China, we shall compare practices to witness the effect of societal practices on beliefs concerning the nature of mathematics.

Trigonometry, Ancient Astronomy, and the Birth of Applied Mathematics

Trigonometry, one of the oldest of the mathematical sciences, was born in ancient Greece from the need to predict the positions of the heavenly bodies. The arrival of an efficient place value number system from Babylon allowed geometry to become quantitative, changing the astronomical game entirely. Astronomers and geographers in Greece, and later in India and medieval Islam, now had unprecedented powers to describe mathematically the world they observed around them. Not least among trigonometry's accomplishments was its role in one of the most successful predictive theories in the history of science: Ptolemy's epicyclic model of planetary motion. The fact that this model was completely wrong, yet its mathematics proved fundamental to the growth of science for at least two millennia, leads to some interesting speculations on Wigner's observation of the "unreasonable effectiveness of mathematics in the natural sciences."

Mary Walkins (Lee University)
History of Mathematics: An Exercise in Strengths

As a leader in strengths-based education, Lee University encourages all new students, since fall 2003, to take the Gallup StrengthsFinder to determine their top 5 signature themes (out of a possible 34). At Lee, the syllabus for the History of Mathematics course calls for students to write a paper on a mathematician. As an added dimension, students were asked to think critically about—and incorporate—the strengths they believe that mathematician may have. Each student was required to compare and contrast his or her strengths with those of a mathematician. This was done with the hope that, as aspiring mathematicians, students may be inspired to persevere to make their mark in the history of mathematics, since math is still evolving. In this presentation, through an exercise in strengths, I will share examples of how students were inspired by each mathematician selected.

Samuel Wilcock (Messiah College)
A Bayesian Secondary Analysis in an Asthma Study

A recent study published in the New England Journal of Medicine by the Asthma Clinical Research Network (ACRN) compared three different treatments for their effectiveness in treating adults with uncontrolled asthma. This talk will briefly describe the study design and its results, then detail the beginnings of a secondary analysis using Bayesian methods to estimate the parameters of interest. The methods will be explained, and the preliminary estimates given and contextualized. The talk will conclude with a discussion of the next steps and the goals for further analysis of the data in this study.

Josh Wilkerson (Texas A&M University)
What We Can Learn from Process Theology: Integrating Faith and Mathematics

There are numerous examples of great thinkers attempting to harmonize mathematical advances with the canons of the historical Christian faith in an attempt to make Christianity relevant to modern, intellectual society. Process theology arose because its adherents believed it to be the best of such attempts. Upon close inspection, however, process theology can only be labeled as a departure from Christian Orthodoxy. Yet the process perspective still has something to offer for the construction of a framework within which a distinctly Christian perspective of mathematics might be developed. As contemporary Christian mathematicians wrestle with integrating their faith and their discipline, it is the contention of this paper that they will benefit greatly from studying process theology and, in particular, from critically examining the ways in which it departs from orthodoxy.

In the first section of this paper I will summarize the tenets of process theology and examine the deep interplay between this school of thought and developments in the field of mathematics. Process theology will be presented as a clear historical example of how theological foundations have significant impact on the practice mathematics.

In the next section, I will critique the tenets of process theology in light of scripture and the historical teaching of the Christian church. This critique will focus specifically on the doctrines of divine revelation, God as Trinity, and the person and work of Jesus Christ. From this analysis the paper will conclude that process theology radically departs from Christian orthodoxy and therefore its proposal for integrating orthodox Christian faith and mathematics cannot be accepted.

Jason Wilson (Biola University)
Natural Law in the Secular vs. Biblical Mind

The scientific community agrees that there are "laws" in nature, for example, the "law of gravity." Scientists also agree that mathematics is the language within which these laws are written. Differences arise in the understanding of the nature of natural laws. This presentation will briefly consider some secular viewpoints. The majority of the time will reflect on biblical texts leading to a proposed model of the nature of natural laws. The model centers on Jesus Christ as the pre-existent creator who is the source of life (Proverbs 8:22–35; John 1:1–4). What are the implications of this model for having, and living, the life of Christ as a professional

mathematician / scientist (John 17:3, 21–23)? The presentation will close with remarks on this question.

Talithia Williams (Harvey Mudd College)
The Misapplication of Statistics in American life

H.G. Wells once said, "Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write." The widespread use of statistics plays an influential role in persuading public opinion. As such, statistical literacy is necessary for members of society to critically evaluate the bombardment of charts, polls, graphs, and data that are presented on a daily basis. However, what often passes for "statistical" calculations and discoveries are often meant to be manipulative. This talk will examine applications of statistics in American media and give examples of where statistics has been grossly misused.

Nicholas Willis (George Fox University)
Two Integration of Faith and Mathematics Projects for Freshman Mathematics Majors

Two projects will be presented that integrate faith and Mathematics in a freshman Introduction to Proofs class at George Fox University. The first project asks students to look at the life of a Christian Mathematician. The focus of this project is to show students that many great mathematicians also had immense faith. The second project asks students to take a close look at their own life. How do they plan to live a life of Christian faith in their chosen profession? Both projects are designed to encourage students to look at their careers in Mathematics as a vocation.

Rebekah Yates (Houghton College)
A Second Course in Linear Algebra, or Teaching Students to Read and Speak Mathematics

In this talk I will describe my experience in teaching a second course in linear algebra as a discussion class. Students read the text and presented both material from the text and assigned problems each day. I'll share the successes and failures of this experiment, including the structure of the course, how the course was graded, and student responses to the class.

Maria Zack (Point Loma Nazarene University)
Using Original Historical Mathematics Texts in the Classroom

Like many mathematicians who teach courses in the history of mathematics, my degree is in mathematics and not the history or philosophy of mathematics. For the last fifteen years, as part of our institution's commitment to the liberal arts, I have been teaching courses in the history of mathematics as well as incorporating historical topics into a wide variety of mathematics courses in our curriculum.

This incorporation of historical material into mathematics classes has been a way to help students make connections between their general education courses and their major course work. In the last three years I have experimented with using original historical texts (in translation if needed) in four classes: number theory, linear algebra, history of mathematics, and a course on

mathematics, art and architecture. These experiments have included pilot testing some existing material that is part of an NSF sponsored program and well as developing materials of my own.

This talk discusses the successes, failures and lessons learned from a "non-expert" working with original texts in a number of settings. It also provides some practical information about resources, translation and the development of student activities.

Nicholas Zoller (Southern Nazarene University)
The Mathematics of Cubic Sudoku

In the last decade the Sudoku puzzle has fixed itself in America's puzzle consciousness. Sudoku puzzles share space with crossword puzzles and word finds in newspaper puzzle sections, and several books have been written for the Sudoku playing community. Mathematicians are among the most dedicated Sudoku players. Although some are content with simply solving puzzle after puzzle, others have used tools from combinatorics and algebra to study its important properties. The popularity of Sudoku has spawned several variants. We examine one such variant called Cubic Sudoku. It is played on a board set up to look like three adjacent faces of a cube. The regular Sudoku rules apply, and a new rule is added. Following the lead of other Sudoku researchers, we use Gröbner bases to attempt to count the number of distinct puzzles. We also show how to use the rules of Cubic Sudoku to deduce strategies for solving puzzles efficiently.