Abstracts for ISMAA

General Session:

Title: *Three Muskeeters: All for One, One for All*
Author: Olcay Akman
Institution:

Abstract: *The NRC report BIO2010 recommends significant increases in computational and mathematical training for 21st century biologists. The resources necessary to achieve this goal are beyond the means of most institutions outside the Research I group of colleges. A reasonable way to bring these opportunities to our students and faculty is an organized collaborative consortium of colleges. In this talk we'll discuss such enterprise in Illinois, centered at the Illinois State University, called Intercollegiate Biomathematics Alliance.*

Title: *Is This the End of Facebook?*
Author: Anthony DeLegge (speaker) with Hannah Wangler
Institution: Benedictine University

Abstract: *In early 2014, a paper entitled "Epidemiological Modeling of Online Social Network Dynamics", written by Princeton University students John Cannarella and Joshua A. Spechler, went viral because of its interesting, yet somewhat startling conclusion. Using epidemic models, they concluded that Facebook was not only declining in user interest, but would eventually reach the point where it would essentially "die," or no longer be relevant, by the end of 2017! Although it does appear that Facebook may be declining a bit in popularity, and it faces a lot more competition today than before, this seemed like a startling conclusion to my research student and I, as both her and I are fairly active Facebook users, along with our friends and family! Thus, we set out taking the model from the paper, changing some aspects of it to try and make it more realistic, and testing it against search query data collected from Google Trends to see if we would reach a similar conclusion. This talk will go through the formulation of the model, analysis of the data, and overall conclusions to try and definitely answer the question: is this the end of Facebook?*

Title: *A Proof of a Lobachevsky Construction of the Limiting Parallel Ray*
Author: Gregory Galperin
Institution: Eastern Illinois University

Abstract: *Lobachevsky proposed a simple construction of the limiting parallel ray to a line through a point not on the line -- without reference to any model of the hyperbolic plane, H2. It is based on a special construction of Lambert's quadrilateral (a hyperbolic quadrilateral with exactly three right angles). However, Lobachevsky's proof is so difficult to understand that virtually no modern texts on hyperbolic geometry include it in any form. This talk will present a*

description of the construction in the Klein model, K2, of H2 along with a recent, simple and concise proof that the construction is correct,

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Title: *Oral and Mastery Based Testing in a Real Analysis Course*
Author: Amanda Harsy
Institution: Lewis University

Abstract: *In this talk we will discuss oral and mastery-based testing in an undergraduate Real Analysis course. The main goals of these alternate assessment methods are to decrease test anxiety and increase full understanding of the concepts of Analysis. In mastery-based testing, students are given problems in which they can only receive full credit on the problem after they demonstrate mastery of the concept being tested. Each test includes similar questions over the same concepts from previous tests which allows students who have not mastered an idea to retest and fully comprehend old concepts. Once a student receives full credit for a question, they need never attempt the question again. Students also met with the instructor to present proofs as an oral exam. This allowed the instructor to ask questions to determine whether a student fully understood the step by step process of the proof. It also provided students who were stuck a chance to be given a hint from the instructor and continue from that point. Both testing methods are designed so that test anxiety decreases since one bad exam grade or getting stuck on a proof will not necessarily tank their overall grade. This talk will discuss the benefits, shortcomings, and challenges of implementing these alternate assessment techniques.*

Title: *A STIELTJES TYPE EXTENSION OF THE Lr-PERRON INTEGRAL*
Author: Eyad Massarwi (speaker) with Paul Musial
Institution: Chicago State University

Abstract: *We explore properties of Lr-derivates with respect to a monotone increasing Lipschitz function. We then define Lr-ex-major and Lr-ex- minor functions with respect to a monotone increasing Lipschitz function and use these to define a Perron-Stieltjes type integral which extends the integral of L. Gordon.*

Title: *Maximal regular polygons inscribed in a triangle*
Author: Michael McAsey (speaker) with Libin Mou
Institution: Bradley University

Abstract: *In analogy with the incircle of a triangle, we consider maximal inscribed regular polygons in a triangle. The radius and center of such an n-gon are found. It is not surprising that as* $n \longrightarrow \infty$*, the inscribed polygons tend to the inscribed circle. Following a problem stated (and solved) by Calabi on squares in a triangle and work by Jerrard-Wetzel on equilateral triangles inscribed in a triangle, we consider triangles so that the maximal regular polygon can be*

inscribed in different ways inside its triangle. Jerrard-Wetzel and Calabi each found unique (non-equilateral) triangles for which the maximal equilateral triangle and square (respectively) can be inscribed in different ways. For regular n-gons with $n>6$, it turns out that there are increasingly many triangles having different ways to inscribe their maximal polygons. An example of the results is that the number of triangles with regular n-gons inscribed in different ways is bounded below by $\lfloor n/4 \rfloor$. So for n large, such triangles are far from unique.

Title: *Recalling Prerequisite Material in a Calculus II Course*
Author: Jeanette Mokry
Institution: Dominican University

Abstract: *While much new content is introduced in a Calculus II course, students must also call upon knowledge from prior courses when working through new material. Often class time needs to be spent discussing some of these prerequisite topics. In an effort to devote more class time to discussion of and practice with new concepts "preparation assignments" were created. These allow students to review necessary content outside of class just prior to when it will be built upon. In addition to sharing several examples, I will also discuss my own and student responses to their effectiveness.*

Title: *edTPA 101 and Academic Language*
Author: Todd Oberg
Institution: Illinois College

Abstract: *The edTPA is a teacher performance assessment that assesses a pre-service teacher candidate's ability to be a successful beginning teacher of record. Starting this fall passage of this assessment becomes a consequential requirement for earning a teaching license in Illinois. This session will provide an overview of the assessment for the Mathematics community and will focus on one part of it that Mathematics faculty can play a significant role in candidates' success, namely academic language. Thus part of this session will look at the concept of academic language, and ideas for how we can help our candidates with this important aspect of teaching.*

Title: *CCSSM and PARCC: Finding the Quality Mathematics (there's plenty)*
Author: Jim Olsen (speaker) with -
Institution: Western Illinois University

Abstract: *The PARCC test (which was administered this spring for the first time in grades 3-12 in Illinois and in many states across the country) has met much criticism (from parents, teachers, whiners, and policy makers) as an assessment tool and a way to measure student mathematical understanding. Granted, PARCC set too high of goals for themselves, and, as an assessment, the*

it has an uncertain future. However, the mathematical thinking that is expected of the CCSSM and PARCC is very good. Many of the items (which are available online) are useful as classroom problem solving, tasks, and explorations. In this session we will look at a number of questions which represent quality mathematical thinking. Millions of dollars were spent in the development of these questions. We can reap the benefits if we use them strategically in our classrooms (even if they don't work well on a standardized, nation-wide test). PARCC = Partnership for Assessment of Readiness for College and Careers CCSSM = Common Core State Standards for Mathematics

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Title: *Sunny with a chance of derivatives: How the heat equation relates to random walks on graphs*
Author: Melanie Pivarski
Institution: Roosevelt University

Abstract: *The heat equation is a partial differential equation describing the flow of heat in a space. A random walk on a graph moves from a vertex, $v0$, with neighbors to the next by picking a neighboring vertex, $v1$, uniformly at random (so each neighbor has probability $n1$ of being chosen). We'll describe how these two different ideas are beautifully related to one another using the idea of a discrete derivative.*

Title: *From Monge to Gauss: Engaging Applications in Differential Geometry using Maple*
Author: Kristen Schreck
Institution: Saint Xavier University

Abstract: *Differential geometry in three dimensions is one of the most intuitive areas of advanced mathematics. This rich subject follows naturally for students who have taken the calculus sequence, differential equations, and linear algebra. Mathematics majors become enthralled by the surprising and relevant applications that such a course may invoke in the world around them. Applied problems arise from a wide spectrum of interdisciplinary topics such as cartography, machine design, shape morphing, and worm holes, just to name a few. Maple is the perfect tool to bring the mathematics of differential geometry to life. As mathematics educators, we know that seeing the mathematics can often lead to a deeper understanding of it. In addition, students learn best by actually doing the mathematical explorations themselves. A course in differential geometry would not be complete without a strong emphasis on the compelling history of the subject. The Maple worksheets for this presentation will highlight beautiful, historical examples from Monge's work on space curves, evolutes, radius of curvature, and ruled and developable surfaces. These examples will lead us to examine new, applied problems involving surfaces and theories on normal, principal, and Gaussian curvatures.*

Title: *Tabulating Liars and Pseudoprimes*
Author: Andrew Shallue
Institution: Illinois Wesleyan University

Abstract: *Many primality tests rely on the choice of a base, and if a composite number passes the test we say it is a pseudoprime to that base, while the base is called a liar. A choice of base that reveals the number's compositeness is called a witness. Inspired by the search for reliable witnesses, I will describe new algorithms for tabulating all pseudoprimes to a given base, and for tabulating all liars of a given composite number.*

Title: *The Ubiquitous Pythagorean Theorem*
Author: Donald Sokol, PE

Abstract: *It's not widely recognized that circa 1800 B.C., the Babylonian algorithm for the integer triple, a squared plus b squared equals c squared, was constructed as a= 2(x+y)y; c=a + x^2 and b = square root of c squared - a squared and (later updated to b = c-2ysquared), (where x = 1, y = 1 then a = 4, c = 5 and b = 3).*

Euclid later circa 300 B.C., modified this algorithm to a = 2xy, c = x squared +y squared and b = x squared - y squared with appropriate caveats. (Where x=2, y=1 then a=4, c=5 and b=3).

At least six other algorithms using various combinations of +/-x, and +/-y in "a" are possible without redundancy. Other better known algorithms for integer triples in x and y include reciprocal pairs ala Robson and Sierpinski's number theory based algorithms.

The result is that one cannot easily determine which algorithm was used to produce a specific integer triple.

Title: *Random variables, independence and number theory: some examples*
Author: Wilfredo Urbina-Romero (speaker) with Elias Friedman
Institution: Roosevelt University

Abstract: *Sometimes it is difficult to motivate the notions of random variable and independence for the lack of concrete examples. The dyadic expansions of numbers in (0,1) and its regular continue fractions provide us of nice ad explicit examples of independent and asymptotically independent random variables.*

Undergraduate Students:

Title: *Fourier Transforms on Time Scales*
Author: Devin Akman
Institution:

Abstract: *We will use the theory of time scales to formalize the notion that transforms such as Fourier series and Fourier integrals are facets of a single, more general integral over closed subsets of R.*

Title: *Physicists vs. Mathematicians: Does 1+2+3+...=-1/12?*
Author: Laura Beitler
Institution: Augustana College

Abstract: *Physicists claim that 1+2+3+... =-1/12, while mathematicians say it diverges to infinity. The difference is a result of the rules you choose to play by. We will explore the differences between these two specific ways of reasoning and discuss an attempt to find commonalities between these approaches and find a plausible answer that fits within the rules of both disciplines.*

Title: *Hopf Bifurcations in the Parameter Space of a Continuous Model of a Four-Gene Regulatory Network*
Author: Mfoniso Ekong
Institution: Benedictine University

Abstract: *To compare the dynamic behavior of continuous and Boolean models for gene regulatory networks, it is necessary to understand the behavior of the dynamics of the continuous model. We consider small gene regulatory networks and demonstrate the existence of Hopf bifurcations in their parameter space. These Hopf bifurcations separate the parameter space into regions of oscillatory behavior and regions of stable behavior.*

Title: *Coefficients of cyclotomic polynomials*
Author: Brett Haines
Institution: Eastern Illinois University

Abstract: *Let S be the set of coefficients of cyclotomic polynomials. By Suzuki's theorem, $S=\mathbf{Z}$. Therefore, for any $m\in\mathbf{Z}$, there is the smallest positive integer $n=n(m)$ such that m occurs as a coefficient in the cyclotomic polynomial $\Phi n(x)$. After briefly reviewing the necessary background material, we will present some of the values of $n(m)$.*

Title: *An Integrated Pest Management Model with a Holling Type II Functional Response*
Author: Rachel Majerczyk
Institution: Benedictine University

Abstract: *We consider a stage-structured model for integrated pest management (IPM) with the impulsive effects of a birth pulse, the application of pesticide, and the periodic augmentation of a predator species. In particular, the model assumes a Holling Type II functional response for predation and a mixed Beverton-Holt type birth pulse. We determine the conditions for which the pest eradication solution is globally asymptotically stable.*

Title: *Persistence in A Pulse Vaccination SVEIR Model with a Half Saturation Incidence Rate*
Author: Maryam Moeed
Institution: Benedictine University

Abstract: *Pulse vaccination, which is a repeated, periodic application of vaccine, is a means by which infectious diseases can be eliminated. We consider an SVEIR epidemic model with pulse vaccination and a nonlinear half saturation incidence rate. In particular, we determine the conditions for global attractivity of the disease free periodic solution. That is, we determine conditions for which the disease will be eliminated. Additionally, we determine the conditions for which the diseases persists.*

Title: *A Stage Structured Integrated Pest Management Model with a Holling Type II Functional Response*
Author: Nwafor Nwoke
Institution: Benedictine University

Abstract: *We present an impulsive integrated pest management model utilizing a combination of pesticide, a predator species, and a disease in the prey species. The model incorporates stage structure for both the predator and prey species and assumes that the prey species reproduces according to birth a pulse. We use a full saturation incidence rate for the spread of the disease within the prey population and a Holling Type II functional response for the predation. We determine the conditions for which the pest (prey) free solution is globally asymptotically stable.*

Title: *An Agent Based Model for Integrated Pest Management*
Author: Elizabeth Rodriguez
Institution: Benedictine University

Abstract: *We consider an agent based model (ABM) for integrated pest management (IPM). The model incorporates stage structure for both the prey (pest) species and the predator species and the periodic application of pesticide and augmentation of the predator species. We explore*

conditions for which the pest species is eradicated and conditions for which both species persist at controlled levels in the system.

Title: *A Pulse Vaccination SVEIR Model with a Saturation Incidence Rate and Time Delay*
Author: Kelsey Zimmermann
Institution: Benedictine University

Abstract: *Pulse vaccination is an effective strategy for controlling or eradicating an infectious disease within a population. We consider an SVEIR epidemic model with pulse vaccination, a nonlinear saturation incidence rate, and a time delay for individuals moving from the exposed class to the infectious class. This model is a variation of the SIRVS pulse vaccination model due to Zhang et al., 2007. We determine the conditions for which the disease-free periodic solution is globally attractive and for which the solution is permanent*
