Contributed Paper Schedule

Room 1

8:00 – 8:15 Constructing a Quadrilateral Inside Another One

Peter Ash, Cambridge College; J. Marshall Ash, DePaul University;*
Michael A.O. Ash, University of Massachusetts, Amherst

In a convex quadrilateral *ABCD*, join *A* to the midpoint of $\overline{BC}$, *B* to the midpoint of $\overline{CD}$, *C* to the midpoint of $\overline{DA}$ and *D* to the midpoint of $\overline{AB}$. The intersection of these segments forms a convex quadrilateral *EFGH*. An exercise in a projects book for Geometer's Sketchpad deliberately leads students to the incorrect conjecture that the ratio $r = \frac{Area(EFGH)}{Area(ABCD)}$ is a constant 1/5, independent of *ABCD*. This conjecture is true if *ABCD* is a parallelogram, but not in general. The proof for parallelograms is elementary, and quite nice. For the general case, we were able to prove that, in fact, $1/6 < r \le 1/5$, and the bounds are tight. We were also able to give a simple geometric characterization of the quadrilaterals on which the maximum possible value of 1/5 is attained.

We would not have been able to prove the general case without the help of a CAS, so this is a modern result in that it was suggested by Geometer's Sketchpad and was proved with the aid of Maple.

Actually we were able to prove a more general result where the midpoints are replaced by ρ-points, $(0 < \rho < 1)$ which are located a fraction ρ of the way from the first point in each segment to the second. In this case, it turns out that $\frac{(1-\rho)^3}{\rho^2 - \rho + 1} < r \le \frac{(1-\rho)^2}{\rho^2 + 1}$.

8:20 – 8:35 Dynamic geometry on sphere

Mohammed Salmassi, Framingham State College

We will look at the program *Spherical Easel* as the spherical counterpart of Geometer's Sketchpad. Using Easel, students can investigate geometric results on the sphere and compare them to plain geometry. Until the creation of Easel, students used physical models such as the Lenart sphere for investigations of this important Non-Euclidean geometry example. We will discuss several investigations carried out by students and us. Some of these results may be new and may have eluded the 18th century mathematicians.

8:40 – 8:55 Non-Euclidean Geometries in Art

Elizabeth Mathai, Norwich University

We look at how lines are defined in different geometries and how this affects our perception of parallel lines. In particular, two non-Euclidean geometries – hyperbolic and elliptic – are introduced. We then look at some art forms with applications of these.

Room 2

8:00 – 8:15 A simple model for intracranial hypertension and migraine

Scott Stevens, Champlain College

For years I have been working with a team of mathematicians, neurologists, and neurosurgeons on modeling intracranial fluid dynamics. Recently we proposed and supported a theory regarding the cause of idiopathic intracranial hypertension and migraine which is somewhat controversial. The original model used to justify our results was well received by the bioengineering and mathematical communities but was a bit too complex for publication in clinical journals. In an effort to break into this venue, the model has been stripped down to the bare necessities resulting in a single, first-order, governing differential equation. A simple, steady-state analysis of this equation produces results similar to those obtained from the more complex model. A manuscript has been submitted to the Journal of Neurosurgery with hopes of greater success. I will present this simplified model and discuss implications. I will also discuss the challenges involved in communicating mathematical results to those outside the field of mathematics.

8:20 – 8:35 Optimum Reproductive Numbers for a Campus Drinking Model

A.Y. Aidoo, Eastern Connecticut State University;*
J.L. Manthey, Saint Joseph's College;
K. Ward, Eastern Connecticut State University

Reproductive numbers are central to the epidemiological dynamics of any disease. They provide useful information that determine whether or not an endemic proportion of the target population can exist and be globally stable. However, estimating reproductive numbers have not been the explicit goal of college drinking researchers, since most of their research are not model driven. An epidemiological model capturing the dynamics of campus drinking is used to study how the "disease" of drinking is spread on campus. A simple optimization technique is used to estimate the reproductive numbers of the campus drinking model that is considered. The technique involves obtaining the reproductive numbers from the model and using known bounds for each parameter involved in the optimization process. A key theorem that establishes the condition under which an endemic steady state exists is proposed and proved, and the results are verified using values obtained directly from the model.

Room 3

8:00 – 8:15 How Can We Help Students Become More FIT (Fluent in Information Technology) for Mathematics?

Donna Beers, Simmons College

This presentation focuses on a new fluency in information technology requirement which many colleges and universities are adding to the competencies which they require of all baccalaureate candidates. The "FITness" requirement - concepts, skills, intellectual capabilities - is driven in part by the workplace, where students are expected to have IT fluencies as they enter their first careers or seek internship placements; the other driver is academic: Mathematics students need to be able to use information technology in order to communicate with their instructors and classmates, to manage their course work and track performance, and to access and analyze information needed for research projects, as well as to publish and communicate the results of their work.

The session will begin with (1) a review of the new IT fluency requirement that has been adopted at a small, private comprehensive university, (2) an outline of specific IT fluencies which the mathematics department at this institution has identified as needed by majors and non-majors, and (3) a proposal how these fluencies may be developed across the undergraduate mathematics curriculum. Then, participants will have the opportunity to share their experiences at their own institutions so that all may walk away with enriched understanding of the complexities of how to make this happen.

8:20 – 8:35 Popescu's Conjecture in Multiquadratic Extensions

Jay Price (Graduate Student), University of Vermont (Jonathan Sands, advisor)

Dirichlet's analytic class number formula states that if K is a number field then the first non-vanishing coefficient in the power series expansion of the Dedekind zeta function at $s = 0$ is given by the product of a ratio of integral invariants of K and a transcendental invariant. The integral invariants are the class number and the number of roots of unity of the field K. The transcendental invariant is the regulator of K. Popescu's Conjecture represents a generalization of this formula to the leading terms of Artin L-functions. In our talk we will provide a brief introduction to the elements of Popescu's conjecture. We will also reference some recent research which proves the truth of the conjecture in new settings.