The 74th Meeting of the Alabama Association of College Teachers of Mathematics

Samford University, Birmingham, AL
February 8, 2025

The 2025 Lewis-Parker Lecture

The Race Against the Machine: AI in Computational Mathematics
Dr. Carmeliza Navasca, University of Alabama at Birmingham

ABSTRACT: AI is now a household name. A specific type of AI is machine learning. In this talk, I will discuss machine learning in applied and computational math. I will include interesting applications in image processing used in self-driving cars, dental intraoral cameras and others.

Alabama Journal of Mathematics

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The Alabama Journal of Mathematics (AJM) is published under the auspices of the Alabama Council of Teachers of Mathematics (ACTM) and the Alabama Association of College Teachers of Mathematics (AACTM). The AJM is designed to meet a number of needs of the mathematics community in the State of Alabama. Specifically, the intent of the Journal is to knit together the various components of this mathematical community. As such, the journal includes research articles in mathematics and mathematics education appropriate for a general audience and activities and problems for K-16 mathematics teachers.

Acknowledgements

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AACTM Officers

AACTM 2025 SCHEDULE

Time	Event/Presenter
8:15am–8:50am	**Registration and Refreshments**
8:50am–9:00am	**Welcome remarks**
9:00am–9:15am	**Mingwei Sun**, Samford University *Penalized Poisson Regression with a Referee Index for Professional Soccer Performance Analysis*
9:20am–9:35am	**Laura Erin Watley**, University of Alabama *Navigating the Alabama Numeracy Act: How will mathematicians blend the study of content and pedagogy?*
9:40am–9:55am	**Marcus Shell*** **and Jaedeok Kim**, Jacksonville State University *A Look at The Symmetric Modular Group*
10:00am–10:15am	**Eze R. Nwaeze**, Alabama State University *Caputo–Fabrizio fractional Hermite–Hadamard type and associated results for strongly convex functions*
10:15am–10:30am	**Break**
10:30am–11:30am	**LEWIS-PARKER LECTURE:** **Carmeliza Navasca**, University of Alabama at Birmingham *The Race Against the Machine: AI in Computational Mathematics*
11:35am–12:35pm	**Lunch and Group Photo**
12:45pm–1:00pm	**Jim Gleason**, University of Alabama *Faculty Conceptions of Mathematics: Views of the Partner Disciplines*
1:05pm–1:20pm	**Janie Kennedy**, Samford University *Precalculus Problems to Enhance Understanding*
1:25pm–1:40pm	**Muhammad Mohebujjaman**, University of Alabama at Birmingham *Non-linearly coupled PDE based Stocking and Harvesting Models: Exploring Decoupled Algorithms and Analysis*
1:40pm–1:50pm	**Break**
1:50pm–2:10pm	**PANEL DISCUSSION:** *Bridging the Gap Between High School and College-Level Mathematics*
2:10pm–2:15pm	**Break**
2:15pm	**Business Meeting**

ABSTRACTS

(in alphabetical order by presenter's last name)

Jim Gleason University of Alabama

Faculty Conceptions of Mathematics: Views of the Partner Disciplines

Using a survey of faculty from Engineering, Economics, and Mathematics we see how different groups of faculty members prioritize different ways of defining and conceptualizing mathematics. We will then discuss how these different priorities impact the content and methods of teaching mathematics at the college level.

Janie Kennedy Samford University

Precalculus Problems to Enhance Understanding

We discuss nonroutine Precalculus problems that could lead to enhanced understanding in the Precalculus classroom.

Muhammad Mohebujjaman University of Alabama at Birmingham

Non-linearly coupled PDE based Stocking and Harvesting Models: Exploring Decoupled Algorithms and Analysis

We propose time-dependent non-linearly coupled Advection Reaction Diffusion (ARD) N-species competition models to investigate the Stocking and Harvesting (SH) effect on population dynamics in a heterogeneous environment. We also propose, analyze, and test two novel fully discrete decoupled linearized schemes for the coupled ARD-SH competition model. The time-stepping algorithms are first and second order accurate in time and optimally accurate in space. Stability and optimal convergence theorems of the decoupled schemes are proved rigorously. We verify the predicted convergence rates of our analysis and the efficacy of the algorithms using numerical experiments and synthetic data for analytical test problems. We also study the effect of harvesting or stocking and diffusion parameters on the evolution of species population density numerically and observe the coexistence scenario subject to optimal stocking or harvesting.

Eze R. Nwaeze Alabama State University

Caputo–Fabrizio fractional Hermite–Hadamard type and associated results for strongly convex functions

The study of fractional integral inequalities has attracted the interests of many researchers due to their potential applications in various fields. Estimates obtained via strongly convex functions produce better and sharper bounds when compared to convex functions. In this talk, I will discuss some new Hermite–Hadamard and Fejér types inequalities by means of the Caputo–Fabrizio fractional integral operators for strongly convex functions. In particular, we prove among other things that if $\omega : \mathfrak{I} \to \mathbb{R}$ is a strongly convex function with modulus $c > 0$ and $\alpha, \beta \in \mathfrak{I}$ with $\alpha < \beta$ then

$$\begin{aligned}\omega\left(\frac{\alpha+\beta}{2}\right) + \frac{c}{12}(\beta-\alpha)^2 &\leq \frac{B(\mu)}{\mu(\beta-\alpha)}\left[{}^{cf}\mathcal{I}^{\mu}_{\alpha}\omega(s) + {}^{cf}\mathcal{I}^{\mu}_{\beta}\omega(s) - \frac{2(1-\mu)}{B(\mu)}\omega(s)\right] \\ &\leq \frac{\omega(\alpha)+\omega(\beta)}{2} - \frac{c}{6}(\beta-\alpha)^2,\end{aligned}$$

where $\mu \in (0, 1]$, $s \in \mathfrak{I}$ and $B(\mu) > 0$ is a normalization function. Some applications to special means have also been investigated.

Marcus Shell* **and Jaedeok Kim** Jacksonville State University

A Look at The Symmetric Modular Group

The modular group $\mathrm{PSL}_2(\mathbb{Z})$ is the subcollection of

$$SL_2(\mathbb{Z}) = \left\{ \begin{bmatrix} a & b \\ c & d \end{bmatrix} \;\middle|\; a, b, c, d \in \mathbb{Z} \text{ and } ad - bc = 1 \right\}$$

wherein the two matrices A and $-A$ are considered identical. $\mathrm{PSL}_2(\mathbb{Z})$ is a group under matrix multiplication consisting of 2×2 matrices with integer entries and determinant 1. In this project, we study the subcollection

$$\mathrm{PSSL}_2(\mathbb{Z}) = \left\{ AA^T \;\middle|\; A \in \mathrm{PSL}_2(\mathbb{Z}) \right\}$$

consisting of all symmetric matrices in $\mathrm{PSL}_2(\mathbb{Z})$. A binary operation $*$ on $\mathrm{PSSL}_2(\mathbb{Z})$ is defined by $(AA^T) * (BB^T) = ABB^TA^T$. Then $(\mathrm{PSSL}_2(\mathbb{Z}), *)$ forms a group. We discuss interesting group-theoretic and number-theoretic properties of the new group.

Mingwei Sun Samford University

Penalized Poisson Regression with a Referee Index for Professional Soccer Performance Analysis

Understanding the factors that influence team performance is critical in sports analytics. In this study, we developed and implemented a penalized Poisson regression model capable of performing simultaneous variable selection and regression coefficient estimation. A novel referee index was introduced as a key variable to quantify the impact of referees on team performance. The model was applied to match data from Manchester City F.C. in the English Premier League to identify the essential predictors of the number of goals scored per game. Our results demonstrate that the proposed model outperforms standard linear regression in predictive accuracy, highlighting its robustness and utility. Furthermore, the framework is adaptable and can be generalized to analyze performance in other sports domains, providing a versatile tool for performance evaluation and decision-making in sports management.

Laura Erin Watley University of Alabama

Navigating the Alabama Numeracy Act: How will mathematicians blend the study of content and pedagogy?

In accordance with Act 2022- 249, the Alabama State Board of Education (ALSBE) modified the numeracy coursework standards relative to teaching of numeracy, including algebraic reasoning, cardinality, computational fluency, and conceptual understanding in the Educator Preparation Programs (EPPs). To ensure alignment with these standards, the Mathematics Department at the University of Alabama has collaborated with our College of Education to develop two mathematics for elementary education courses that integrated both content and pedagogy. During this discussion, I will illustrate how we have reimagined our mathematics for elementary education courses to meet the new numeracy coursework standards and pedagogy requirements with a focus on developing a deeper conceptual knowledge of mathematics for preservice teachers.

*Presenter: in joint authorship