The 66th Meeting of the

Alabama Association of College Teachers of Mathematics

Auburn University at Montgomery, Montgomery, AL
February 13, 2016

The 2016 Lewis-Parker Lecture

Dynamical Issues in Dispersal Population Models

Wenxian Shen, Auburn University

ABSTRACT

Dispersal evolution equations have been widely used to investigate the dynamics of many evolution systems in applied sciences. In the current talk, I will focus on the dynamics of dispersal evolution equations/systems arising from population models. First, I will introduce such evolution equations/systems and fundamental dynamical issues. Then I will present some existing results and ongoing research on population persistence and spread. The talk will end with some open problems.

Alabama Journal of Mathematics

Editor in Chief: Tin-Yau Tam, Auburn University
Managing Editor: Jim Gleason, The University of Alabama
`http://ajmonline.org`

The Alabama Journal of Mathematics 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

The AACTM would particularly like to thank Auburn University at Montgomery for graciously hosting this year's conference and Jerome Goddard II for his very hard and diligent work as the local organizer.
Thank you so much for your efforts to make this conference a success.

AACTM SCHEDULE

8:15–9:00 Registration

9:00–9:10 Welcome

9:10–9:25 **Khalid Said, Jaedeok Kim**, Jacksonville State University
Numerical Range of Sum of Two Orthogonal Projections

9:30–9:45 **Anneliese H. Spaeth**, Huntingdon College
Using Reading Journals in Calculus

9:50–10:05 **Eze R. Nwaeze**, Tuskegee University
Growth of Polynomials not Vanishing inside a Circle

10:10–10:25 **David Turner**, Faulkner University
Bernoulli, Euler, and Induction

10:25–10:45 Break

10:45–11:45 **LEWIS-PARKER LECTURE**
Wenxian Shen, Auburn University
Dynamical Issues in Dispersal Population Models

11:45–1:00 Lunch

1:00–1:15 **Pat Rossi**, Troy University
Surprises that Should NOT have Been Surprises

1:20–1:35 **Zekeriya Y. Karatas**, Tuskegee University
A Novel Cryptosystem Based on Lower Triangular Matrices

1:40–1:55 **Cornelius Pillen**, University of South Alabama
The Mobile Math Circle and the Mobile Math Teachers Circle

2:00–2:20 Panel Discussion on methods (old and new) for teaching calculus

2:20–2:40 Break

2:40–2:55 **Luke Smith**, Auburn University Montgomery
Reactions to Reform Mathematics Pedagogy from Students in a Postsecondary Remedial Mathematics Course

3:00–3:15 **Vasiliy Prokhorov**, University of South Alabama
On Asymptotics of Singular Numbers of Hankel Matrices

3:20–3:35 **Li Huang, Lauretta Garrett**,Tuskegee University
Bringing Authenticity into the College Mathematics Classroom

3:40 Business meeting

ABSTRACTS
(in alphabetic order by speaker surname)

Speaker: **Li Huang, Lauretta Garrett**,Tuskegee University
Title: *Bringing Authenticity into the College Mathematics Classroom*
Abstract: Authenticity is a popular "buzz" word in education, but what does it really mean? We will define authenticity as it relates to mathematics education and describe practical ways that authenticity can be brought into the college mathematics classroom. Examples used in pre-calculus and statistics will be presented along with suggestions for calculus. Participants will have the opportunity to judge tasks for authenticity and consider ways that authenticity could be increased.

Speaker: **Zekeriya Y. Karatas**, Tuskegee University
Title: *A Novel Cryptosystem Based on Lower Triangular Matrices*
Abstract: In this talk, a novel public key cryptosystem based on a subgroup of the general linear group will be introduced. Two random elements of an abelian subgroup of lower triangular matrices in $\mathrm{GL}(k, \mathbb{Z}_n)$ will be chosen to define automorphisms for encryption. The encryption and decryption will be given explicitly, and an example will be given in conclusion. This work is a generalization of the cryptosystem introduced by M. Khan and T. Shah in 2015. Also, it is a joint work with Erkam Luy from Erciyes University, Turkey.

Speaker: **Eze R. Nwaeze** , Tuskegee University
Title: *Growth of Polynomials not Vanishing inside a Circle*
Abstract: Let $p(z) = a_0 + a_1 z + a_2 z^2 + a_3 z^3 + \cdots + a_n z^n$ be a polynomial of degree n, where the coefficients a_k may be complex. A well-known theorem of Rivlin states that if $p(z) \neq 0$ for $|z| < 1$, then

$$\max_{|z|=r} |p(z)| \geq \left(\frac{1+r}{2}\right)^n \max_{|z|=1} |p(z)| \text{ for } r \leq 1.$$

We improve on this result and give also analogous inequality for polynomials with gaps. A special case of our result amounts to the above result due to Rivlin.

Speaker: **Cornelius Pillen**, University of South Alabama
Title: *The Mobile Math Circle and the Mobile Math Teachers Circle*
Abstract: The Mobile Math Circle, a weekly gathering of high school and middle school students with professional mathematicians, has been in existence more than 16 years. Out of the Math Circle grew a teachers circle for middle school math teachers. In this talk we will share some of our experiences in running the circles. We will also give a brief introduction to the many resources that are available to anyone who might be interested in organizing a math circle or teachers circle.

Speaker: **Vasiliy Prokhorov**, University of South Alabama
Title: *On Asymptotics of Singular Numbers of Hankel Matrices*
Abstract: Let $E = [a, b] \subset (-1, 1)$ and let μ be a positive Borel measure with support E and $d\mu/dx > 0$ a.e. on E. Denote by D_n the Hankel matrix constructed by moments $c_k = \int_E x^k d\mu(x)$ of μ:

$$D_n = \begin{bmatrix} c_0 & \dots & c_n \\ \dots & \dots & \dots \\ c_n & \dots & c_{2n} \end{bmatrix}.$$

We present results related to asymptotics behavior of singular numbers $\sigma_{k_n,n}$ of the Hankel matrix D_n, where $k_n/n \to \theta \in (0, 1]$ as $n \to \infty$.

Speaker: **Pat Rossi**, Troy University
Title: *Surprises that Should NOT have Been Surprises*
Abstract: As instructors, we are always in search of exercises (in particular test exercises) that are *original* (in the sense of having solutions that differ somewhat from "standard" exercises), *unique* (in the sense that their solutions defy predictability), and finally, *not too difficult*. In this talk, we look at some of these exercises whose solutions turned out to be somewhat surprising and consider why that should not have been the case. Finally, we consider lessons learned.

Speaker: **Khalid Said, Jaedeok Kim**, Jacksonville State University
Title: *Numerical range of sum of two orthogonal projections*
Abstract: We show that two pairs of subspaces (M, N) and $M^\perp$, $N^\perp$ are unitarily equivalent if M and N are subspaces of $\mathbb{C}^n$ in generic position by constructing a unitary operator. The relationships between two sets of

the principal angles, the principal angles between M and N, and the principal angles between $M^\perp$ and $N^\perp$, are established. We use the relationships to compute the numerical range of the sum of two orthogonal projections onto M and N.

Speaker: **Luke Smith**, Auburn University Montgomery
Title: *Reactions to Reform Mathematics Pedagogy from Students in a Postsecondary Remedial Mathematics Course*
Abstract: The presentation would be based on a study in which students who were enrolled in a remedial mathematics course at a small 4-year university were taught according to the reform pedagogical principles advocated by NCTM, AMATYC, and MAA. Since most of the students had not been previously exposed to these teaching methods, this study obtained students' reactions ($n = 22$) to the course through an anonymous, free-response (not multiple choice) survey at the end of the course. Surveys from students in two equivalent "traditional" lecture courses ($n = 44$) were also analyzed and served as a baseline by which to gauge students' responses from the reform group. The surveys asked for general likes and dislikes regarding the pedagogical practices that were employed in their respective courses. The findings from the surveys were that students in the reform course generally liked its key features (group work, student presentations, and graphing calculators), but roughly half of the class wished that the instructor spent more time doing many more example problems on the board as opposed to giving the class time to explore the mathematical principles underlying the example problems. The reactions by students in the reform course are interesting since these students scored higher on word problem (and equivalently on other measures) than did the students who were enrolled in "traditional" lecture courses. Teachers who wish to use reform pedagogical practices need to be aware of student expectations as they plan their lessons.

Speaker: **Anneliese H. Spaeth**, Huntingdon College
Title: *Using Reading Journals in Calculus*
Abstract: In parallel studies during the Fall 2015 semester, we examined the effects of assigning reading journals in a first semester calculus course. At the beginning of the semester, students were given instructions about how to read the textbook. On alternating weeks, students were asked to complete journal assignments - these included taking reading notes, responding to a prompt question, and reflecting upon any confusing portions of the reading. A comparison between student quiz scores from weeks during which journals were assigned and quiz scores from weeks during which no journals were assigned will be given, and implications for teaching will be discussed. This is joint work with Tara C. Davis.

Speaker: **David Turner**, Faulkner University
Title: *Bernoulli, Euler, and Induction*
Abstract: Math majors moving into their junior-level classes are expected to understand and construct mathematical proof. They are often introduced to mathematical proof with a technique called mathematical induction. The first such problems encountered include the formulas

$$1 + 2 + 3 + \cdots + n = \frac{n(n+1)}{2}$$

and

$$1 + 3 + 5 + \cdots + (2n-1) = n^2.$$

A question may come to mind: given the sum on the left, how does one find the formula on the right? This presentation shows how to find the formula on the right when the sum on the left is generated by a polynomial. An analogous result is obtained when the generator is an alternating polynomial. Converses are also obtained.