SPECIAL SUMMER MATHEMATICS COLLOQUIUM SERIES

2019 REU MATHEMATICS PROGRAM

Note: All talks will take place in room EMCS 422.

Thursday, August 1

9:45 – 10:00	**Welcoming Remarks** Joe Wilferth, Interim Dean College of Arts and Sciences
10:00 – 10:30	Emily Eckels, Steven Jin, and Brian Tobin *Lower Bounds for the L^1 Norm of Exponential Sums*
10:40 – 11:10	Margaret Brown and Shan (Miko) Jiang *Modeling Cholera Transmission with Disease Control*
11:20 – 11:50	S. Blake Allan, Justin Kim, Greg Michajlyszyn, and Don Rung *Explicit Krein Resolvent Identities for Singular Sturm–Liouville Operators with Applications to Bessel Operators*
12:00 – 12:30	Nafisa Tabassum and Carolyn Valenti *A Multi-Scale Model for Cholera Dynamics*

NSF REU Site: Research Training for Undergraduates in Mathematical Analysis with Applications in Allied Fields. Preprints will be available on the REU website and arXiv.org, and submitted for publication in peer-reviewed journals.

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ABSTRACTS

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Emily Eckels, Emory University
Steven Jin, University of Maryland, College Park
Brian Tobin, Harvard University

Lower Bounds for the L^1 Norm of Exponential Sums

We employ the method of Balog and Ruzsa and the large sieve to investigate the behaviour of the L^1 norm of a wide class of exponential sums over the square-free integers and the primes. Moreover, we provide a new proof of a lower bound due to Vaughan for the L^1 norm of an exponential sum with the von Mangoldt Λ function over the primes.

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Margaret Brown, University of Maryland, College Park
Shan (Miko) Jiang, Mount Holyoke College

Modeling Cholera Transmission with Disease Control

We construct a new mathematical model to investigate the transmission dynamics of cholera under the impact of disease control measures, particularly with awareness programs and water sanitation. The model incorporates the impact of awareness programs into the disease transmission rates, and that of water sanitation into the description of the environmental pathogen evolution. We conduct a careful mathematical analysis to the model and establish the local and global stabilities, characterized by the basic reproduction number, for the disease-free and endemic equilibria. In addition, an optimal control study is in progress to explore effective prevention and intervention strategies for cholera epidemics.

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S. Blake Allan, Baylor University
Justin Kim, Vanderbilt University
Gregory Michajlyszyn, University of Rochester
Donald Rung, Sewanee: The University of the South

Explicit Krein Resolvent Identities for Singular Sturm–Liouville Operators with Applications to Bessel Operators

We derive explicit Krein resolvent identities for generally singular Sturm–Liouville operators in terms of boundary condition bases and the Lagrange bracket. As an application of the resolvent identities obtained, we compute the trace of the resolvent difference of a pair of self-adjoint realizations of the Bessel differential expression. The resulting trace formula is then used to determine the spectral shift function for the pair.

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Nafisa Tabassum, York College, City University of New York
Carolyn Valenti, Bucknell University

A Multi-Scale Model for Cholera Dynamics

A multi-scale mathematical model for cholera dynamics is developed and analyzed. The model links the within-host and between-host disease dynamics and their interaction with the pathogen in the aquatic environment. The within-host, between-host and environmental sub-systems are on the fast, intermediate, and slow time scales, respectively. A study based on separation of scales is first performed for each of the three sub-systems. Properties of the trivial and non-trivial equilibria are thoroughly investigated and threshold-type results are established. The analysis is then extended to the full system coupling the three time scales.

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REU Mentors

Andrew Ledoan
Jin Wang
Roger Nichols