Patrick T. Davis

http://patrickdavis.info

Mailing Address:
Illinois Mathematics & Science Academy
1500 Sullivan Road
Aurora, IL 60506-1000

Email:
pdavis@imsa.edu
Office Phone:
(630) 907-5492

Education

PhD in Mathematics Central Michigan University (CMU) December 2017

Concentration: Teaching College Mathematics

Qualifying Exams: Algebra, Analysis, Applied Mathematics

Dissertation: *Delay Differential Equations in Epidemiological Modeling*

Advisor: Dr. Thomas Gilsdorf, Professor & Department Chair

MA in Mathematics CMU May 2017

Qualifying Exams: Algebra and Analysis

BS Eastern Michigan University (EMU) April 2011

Majors: Mathematics, General Science

Minor: Economics

Recognitions: *summa cum laude*, University Honors, Department Honors

Advisor: Dr. Andrew M. Ross, Associate Professor

Academic Positions

Mathematics Faculty August 2018 – present

Illinois Mathematics & Science Academy (IMSA)

Full-time faculty member of the Mathematics Team at IMSA – a residential state-funded high school for extremely high-performing students.

Accelerate Mathematics Instructor August 2017 – June 2018
South Carolina Governor's School for Science & Mathematics (SCGSSM)
Full-time faculty member of the Accelerate program at SCGSSM – which provides an engineering-focused curriculum to students across the state of South Carolina via an online platform. Daily instruction is given in real-time via a video conferencing system.

Graduate Student Assistant August 2011 – May 2017
Central Michigan University
Full-time graduate student in the Department of Mathematics. Held teaching assistantships, research assistantships, and doctoral fellowships at various times.

Teaching Experience

As an instructor at the Illinois Mathematics & Science Academy:

BC Calculus 1 Fall 2018, Spring 2019
This course is the first in a three course sequence designed to prepare students to take the AP Calculus BC exam given by The College Board. The primary focus is differential calculus and its applications.

Multivariable Calculus Fall 2018
Vector calculus, as it would be covered in a standard university-level Calculus III course. Topics include vectors, limits, differentiation, and integration – with a focus on three dimensions but including extensions to n variables where applicable.

Differential Equations Spring 2019
Analytic and numerical solutions to ordinary differential equations (including linear, nonlinear, and systems).

As an instructor at the South Carolina Governor's School for Science & Mathematics:

Honors Pre-Calculus August 2017 – June 2018
This course is designed to prepare students to take the calculus series. Topics include polynomial functions, rational functions, exponential functions, logarithmic functions, and trigonometric functions.

Calculus BC August 2017 – June 2018
This course is designed to prepare students to take the AP Calculus BC exam given by The College Board. Topics include most of the content from the standard university-level Calculus I and Calculus II courses (differential & integral calculus, infinite series, etc.).

As a graduate student at Central Michigan University:

Business Calculus (MTH 217) Fall 2014, Spring 2014, Fall 2016
Differentiation and integration of algebraic, exponential, and logarithmic functions, applications of differentiation and integration, partial derivatives.
Independent Instructor. Course Coordinator: Dr. Leela Rakesh

Intermediate Algebra (MTH 105) Fall 2012, Spring 2013

Algebraic expressions, functions, factoring, graphing, linear and quadratic equations, linear inequalities, systems of linear equations, rational expressions, radicals, negative and rational exponents. Successful completion of this course satisfies the University Mathematics Competency requirement.

Semi-Independent Instructor. Course Coordinator: Julia Burch

Teaching Internships

As part of the PhD program at CMU, students are required to complete two teaching internships – during which they serve as the independent instructor of an upper-level mathematics course under the mentorship of a faculty member.

My teaching internships were in:

Differential Equations (MTH 334) Fall 2015

Definition and solution of first, second, and higher order differential equations.

Mentor: Dr. Leela Rakesh

Linear Algebra & Matrix Theory (MTH 223) Spring 2015

Systems of linear equations, matrices, determinants, vectors, vector spaces, eigenvalues, linear transformations, applications and numerical methods.

Mentor: Dr. Meera Mainkar

Research Interests

Topic Summary:

Mathematical Epidemiology. Delayed Differential Equations (DDEs). Dynamical Systems. Numerical analysis. Stochastic Modeling.

MSC2010 Classifications: 34C60, 34K, 37M, 92D25, 92D30

Current/Recent Investigations:

- Instantaneous & Delayed Dispersal on Disease Dynamics in a Metapopulation

  Researching how standard epidemiological models may be adapted to reflect the spread of a disease through a metapopulation when movement between the subpopulations is delayed.

- Spatial Disease Dynamics

  Researching how infectious disease spreads through a population modeled in continuous space where there is some sort of embedded spatial population structure.

Directions for Future Investigations:

- Cellular Automaton Models of Disease Spread
- Plant Epidemiology
- Numerical Algorithms for Solving Delayed Differential Equations
- Delayed Self-Quarantine Behavior in Epidemics
- Stochastic Delayed Differential Equations

Presentations & Posters

Mu Alpha Induction Ceremony (IMSA) Nov 2018
The Mathematics of Disease: An Introduction to Compartmental Modeling

Student Seminar (Winthrop University) Oct 2017
The Mathematics of Disease: An Introduction to Compartmental Modeling

Graduate Student Seminar (CMU) Sept 2016, Jan 2017
A Practical Introduction to LaTeX

Joint Mathematics Meetings (Atlanta, GA) Jan 2017
Modeling an Infectious Disease in a Continuous Region with an Embedded Metapopulation
Preliminary results on the spread of disease through a continuous region, using PDEs to model dispersal paths through a metapopulation. AMS Contributed Paper Session on Mathematical Biology, III.

Graduate Student Seminar (CMU) Nov 2016
Lessons from SMS: Infectious Disease Modeling
Results from the 2016 SMS summer graduate school, Dynamics of Biological Systems.

MAA MathFest (Columbus, OH) Aug 2016
Using Python in an Introductory ODE Course
Anecdotal evidence on incorporating Python projects in an undergraduate course on ordinary differential equations. Themed Contributed Session on Programming in Mathematics Classes and Mathematics for Programming.

SIAM Annual Meeting (Boston, MA) Jul 2016
A General Framework for the Analysis of Infectious Disease Models with Delayed Differential Equations
General results on how to study infectious disease models making use of delay differential equations – including analysis of equilibria, stability, etc. Motivated by an example in metapopulations.

Student Research and Creative Endeavors Exhibition (SRCEE) (CMU) Apr 2015
Wavelet Based Methods for Artifact Removal for Physiological Signals
Analysis of electroencephalogram (EEG) signals using multiresolution analysis. Determined the optimal combination of wavelet type, thresholding rules, and decomposition level to best denoises the given contaminated biosignal data.
With Oluremi Abayomi, Keshab Dahal, and Nonhle Channon Mdziniso. Faculty Advisor: Dr. En-Bing Lin

On Generalizing the Basic Reproduction Number ($\mathcal{R}_0$) for Delayed Infectious Disease Models
Studied previously formulated methods to determine the basic reproduction number of ODE systems, and then worked to understand simlar methods for systems of DDEs.
Faculty Advisor: Dr. Leela Rakesh

AMS Graduate Student Chapter (CMU) Feb 2016
An Introduction to Stochastic Processes: Deriving Brownian Motion From Random Walk

Graduate Student Seminar (CMU) Jan 2016, Sept 2015, Jan 2015, Sept 2014
A Practical Introduction to LaTeX
With Pin-Hung Kao.

Joint Mathematics Meetings (Seattle, WA) Jan 2016
Effect of Delayed Dispersal in an Infectious Disease Model of a Large Metapopulation
Results similar to SRCEE 2015. AMS Session on Mathematical Biology and Related Fields.

Graduate Student Seminar (CMU) Sept 2015
Lessons from MSRI: An Introduction to Systems Biology
Results from the MSRI 2015 summer graduate school, Mathematical Topics in Systems Biology.

AMS Graduate Student Chapter (CMU) Sept 2015
The Mathematics of Disease: An Introduction to Compartmental Modeling
Motivation and analysis of the well-known Kermack-McKendrick (or SIR) model in which the population is divided into various compartments relating to the disease dynamics.

Student Research and Creative Endeavors Exhibition (SRCEE) (CMU) Apr 2015
Migration Delays in an Infectious Disease Model
Using DDEs to infectious disease in a metapopulation, where delays are caused by movement between the geographically (or otherwise) distinct subpopulations.
Faculty Advisor: Dr. Leela Rakesh

Application of a Fixed Point Method for Infectious Disease
Establishing the existence of a stable equilibrium point using a fixed point method on a system of integral equations based on the standard Kermack-McKendrick model for SIR dynamics.
With Mutaz Mohammad, Daniel Ntimoah, and Yifan Zhang. Faculty Advisor: Dr. En-Bing Lin

Graduate Student Seminar (CMU) Nov 2014
An Introduction to Delay Differential Equations
Basic theory of DDEs with discrete delays, including the Method of Steps and key differences from ordinary differential equations.

Student Research and Creative Endeavors Exhibition (SRCEE) (CMU) Apr 2014
An Exploration of Delay Differential Equations
Expository work examining various aspects of DDEs including the existence and uniqueness of solutions, the Method of Steps, and tactics for analyzing the delay.

SIAM Annual Meeting (San Diego, CA) Jul 2013
An Exploration of Dynamical Systems with an Application in Cancer Growth
Results from 2013 SRCEE project.

Great Lakes SIAM Sectional Meeting (Mount Pleasant, MI) Apr 2013
An Exploration of Dynamical Systems with an Application in Cancer Growth
Results from 2013 SRCEE project.

Student Research and Creative Endeavors Exhibition (SRCEE) (CMU) Apr 2013
An Exploration of Dynamical Systems with an Application in Cancer Growth
Using a system of differential equations to model the competition for nutrients between cancer cells and normal body cells.
Faculty Advisor: Dr. Leela Rakesh

Joint Mathematics Meetings (Boston, MA) Jan 2012
Modeling the Spread of a Ug99-Type Wheat Pathogen in the United States of America
Results from the 2012 URSP at EMU. AMS Session on Mathematical Biology and Related Fields, III.

Michigan MAA and MichMATYC Meeting (Ypsilanti, MI) May 2011
Modeling the Spread of a Wheat Pathogen in the United States
Results from my Senior Honors Thesis.

Undergraduate Research Symposium (EMU) Mar 2011
Modeling the Effects of Cannibalistic Behavior in Zebra Mussel (Dreissena polymorpha) Populations
Results from participation in the 2010 REU Program at TAMU.

Modeling the Spread of a Wheat Pathogen in the United States
Preliminary results from my Senior Honors Thesis.

Joint Mathematics Meetings (New Orleans, LA) Jan 2011
Modeling the Effects of Cannibalistic Behavior in Zebra Mussel (Dreissena polymorpha) Populations
Results from participation in the 2010 REU Program at TAMU. AMS Session on Mathematical Biology and Ecology, IV.

MAA Undergraduate Mathematics Conference (Grand Rapids, MI) Oct 2010
Modeling the Effects of Cannibalistic Behavior in Zebra Mussel (Dreissena polymorpha) Populations
Results from participation in the 2010 REU Program at TAMU.

EMU Undergraduate Research Symposium Mar 2010
A City of Ypsilanti Job Training Program: A Cost-Benefit Analysis
Results of a cost-benefit analysis performed on a potential job training program in the city of Ypsilanti, MI.
Advisor: Dr. Kemper Moreland (EMU Department of Economics).

Graduate Summer Schools

Séminaire de Mathématiques Supérieures (Edmonton, Canada) May-Jun 2016
Dynamics of Biological Systems
Participated in the summer graduate school held at the University of Alberta. The program included lectures on biological waves/invasions, complex bio-networks, disease dynamics, multiscale biological dynamics, and the nonlinear dynamics of pattern formation.
Organizers: Dr. Mark Lewis, Dr. Thomas Hillen, and Dr. Yingfei Yi

Mathematical Sciences Research Institute (Berkeley, CA) Jun-Jul 2015
Mathematical Topics in Systems Biology
Participated in the summer graduate school which explored the use of mathematics in biology through projects dealing with origin of mutation, cell polarity, lab image analysis, and determining causation.
Organizers: Dr. Steven Altschuler and Dr. Lani Wu

Undergraduate Research Experiences

Undergraduate Research Stimulus Program May-Aug 2011
Modeling the Spread of a Wheat Pathogen in the United States of America
Furthered work done for my Senior Honors Thesis.
Faculty Sponsor: Dr. Andrew Ross.

Senior Honors Thesis Aug 2010 – May 2011
Modeling the Spread of a Wheat Pathogen in the United States of America
Explored techniques to model the path of a hypothetical outbreak of a Ug99-variety stem rust in the United States of America and its effect on wheat production through a discrete deterministic model run via computer simulation. The model adapts a standard SEIR model for a single region of wheat and then extends it to consider the interactions between multiple regions, and finally throughout the entire country.
Advisor: Dr. Andrew Ross

COMAP Mathematical Contest in Modeling Feb 2011
Say That Again? A Discussion of the Repeater Coordination Problem
Received an Honorable Mention ranking.
Collaborators: Shannon Bourke and Michael Ludke. Faculty Sponsor: Dr. Andrew Ross

Research Experiences for Undergraduates (REU) Jun-Jul 2010
Modeling the Effects of Cannibalistic Behavior in Zebra Mussel (Dreissena polymorpha) Populations
Spent the summer doing an individual mathematical research project at Texas A&M University in College Station, TX on local zebra mussel population dynamics.
Advisors: Dr. Jay Walton and Dr. May Boggess

COMAP Mathematical Contest in Modeling Feb 2010
Modeling the Sweet Spot of a Baseball Bat
Received a Meritorious ranking.
Collaborators: Donald Ellison and Xiaoai Chai. Faculty Sponsor: Dr. Andrew Ross

Professional Organizations

American Mathematical Society (AMS) 2010 – present

Mathematical Association of America (MAA) 2015 – present

Society of Industrial and Applied Mathematics (SIAM) 2013 – present

The National Consortium of Secondary STEM Schools (NCSSS) 2017 – present

Selected Awards & Recognition

2015	Outstanding Tutoring Honorable Mention
2014	Outstanding Teaching Assistant
2011	Doctoral Research Fellowship (CMU) Undergraduate Research Stimulus Program Highest Honors (University Honors & Departmental Honors in Mathematics) *summa cum laude* Dean's List for Outstanding Academics
2010	Honors Undergraduate Fellowship (Mathematics) 25th Anniversary Scholarship Recipient (EMU Undergraduate Symposium) Dean's List for Outstanding Academics Bruce C. Gockerman Award for Economics
2009	Dean's List for Outstanding Academics Hilton G. Falahee Scholarship for Mathematics
2008	Benjamin A. Gilman International Scholarship Dean's List for Outstanding Academics
2007	EMU Presidential Scholarship EMU Honors College Membership Dean's List for Outstanding Academics

Mathematics-Related Student Organizations

AMS Graduate Student Chapter Feb 2015 – May 2017

President (Aug 2015 – May 2017), Treasurer (Feb 2015 – Aug 2015)

Helped to found the student organization as Treasurer and then elected President for the 2015-16 and 2016-17 school years. Organized regular meetings with talks on various topics and ran social events. Collaborated with similar undergraduate student organizations to run assorted events on campus.

Faculty Advisor: Dr. Meera Mainkar

Mathematics Club at EMU Sept 2009 – Apr 2011

President (Jan 2010 – May 2011), Vice President (Sept 2009 – Jan 2010)

Helped to found the student organization as Vice President and went on to become the President for the remainder of the academic year. Reelected to serve as President for the 2010-2011 school year. Worked closely with the Department of Mathematics to provide a rounded experience on campus for students interested in the field of mathematics.

Selected Technical Skills

GeoGebra Moderately proficient.
Used during instruction of a linear algebra course, business calculus, and pre-calculus courses.

HTML & CSS Moderately proficient
Used to create and maintain my personal website.

LaTeX Highly proficient.
Currently used on a daily basis as my primary document preparation system.

MATLAB Highly proficient.
Used for numerous completed projects. Currently used on a weekly basis for research.

Mathematica Highly proficient.
Used for numerous completed projects. Currently used on a weekly basis for research.

Python Moderately proficient.
Used during instruction of an ODE course.

Selected Service Activities

Physics Search Committee Nov 2017 – present
Served as a general member of the recommending committee in the hiring of a new Physics Instructor for the SCGSSM Accelerate program.

Math-A-Palooza End of Each Semester from 2015 – May 2017
Served as a tutor. The event provides last minute help for undergraduate students studying for finals.

OP4 Search Committee Mar 2017
Served as the graduate student representative in the hiring of a new OP4 (Office Professional, level 4) for the CMU Department of Mathematics.

LaTeX Files Jan 2016 – May 2017
Created a Beamer theme for Central Michigan University, managed a small team to create `cmuthesis.cls` file to properly format Masters Theses and doctoral dissertations at CMU, and put together `cmuposter.cls` to make CMU-themed academic/technical posters.

Kappa Mu Epsilon Oct 2015
Graduate School in Mathematics
Presented at a meeting of CMU's Kappa Mu Epsilon chapter, educating undergraduate students on math graduate school and encouraging them to consider it.
With Pin-Hung Kao and Dr. Sivaram Narayan.

New Teaching Assistant Workshop Aug 2014
Helped to facilitate discussions, presented on how to balance skills and concepts while using online homework, and provided feedback during mini-teaching sessions.

McNair Scholarship Program GRE Tutor Summers from 2012-14
Organized and ran sessions to prepare the McNair Scholars at CMU to take the quantitative portion of the GRE.

EMU Honors College Assistant Director Search Fall 2010
Helped with the search to find a new Assistant Director for the Honors College at EMU.

Campus Life Orientation Assistant Sept 2009, Sept 2010
Served for two years as a New Student Orientation Assistant for FUSION (EMU's four-day orientation for incoming freshman, international, and transfer students).

EMU Honors Orientation Assistant Aug 2009, Aug 2010
Helped to welcome and direct students for the Honors College Orientation during summer 2009 and 2010. Assisted in running the discussion over the general reading assignment, and presented in the Honors Experience workshop.

Alternative Spring Break Feb 2010
Winter 2010 participant in the Special Needs Education trip to work with the Damar Services in Indianapolis, IN – an organization committed to helping children with autism and their families.

Selected Extracurricular Pursuits

Central Harmony A Cappella Fall 2011 – Spring 2014
Active member of the premiere co-ed a cappella group at CMU. Elected to serve as Business Director for the 2012-13 and 2013-14 academic years.

Beneath the Trapdoor Productions Jun 2009 – Dec 2011
Cast member in three separate musical theater productions put on by the Beneath the Trapdoor Productions company in Clinton Township, MI.

EMU University and Chamber Choirs Sept 2007 – Apr 2011
Six-semester member of University Choir and three-semester member of Chamber Choir. Both under the direction of Professor Trey Jacobs, Director of Choral Activities.

EMU Vocal Jazz Ensemble Oct 2007 – Apr 2010
Founding five-semester member of the ensemble started under the direction of Professor Trey Jacobs and then continued under Dr. Wendy vanGent.

Study Abroad (University of Derby, U.K.) Jan-Jun 2009
Spent the Winter 2009 semester at the University of Derby in the city of Derby, UK. Studied as a Joint Honours student.

Boy Scouts of America Jan 2000 – Dec 2006
Became an Eagle Scout in November 2006.