# Undergraduate Research in Mathematics and Statistics

Rowan's Department of Mathematics

10/23/2024

# What is student research?

- Collaborate with a mentor (professor or industrial supervisor) on a research project to solve a mathematical/statistical problem of interest to the academic community or motivated by industry.
- Devote a certain number of hours/week to work on the project and meet regularly with their mentor.
- Different types of problems: theoretical, applied (industry), computational (programming)
- Different opportunities: internal/external to Rowan, paid/unpaid, internships, REUs.

# Why do research as an Undergrad?

- Educational Benefits
- Professional Benefits
- Personal Benefits

# Educational Benefits

- Enhance understanding and knowledge of your academic field.
- Apply what you learn in class to real-world projects.
- Learn new things that aren't covered in classes
- Earn academic credit
- Prepare for graduate study
- Improve/Acquire Skills:
  - communication (written and oral)
  - critical thinking & problem-solving
  - teamwork
  - time management

# Professional Benefits

- Explore your interests and clarify your career goals
- Strengthen your resume
- Develop strong relationships with faculty (think recommendation letters!!!)
- Network with experts in your field (potential future employers)
- Check out potential graduate school programs (off campus)

# Personal Benefits

- Build confidence in your skills
- Sharpen your critical and analytical thinking skills
- Travel to a new place (off campus research or conference presentation)
- Earn scholarships, stipends, and/or awards
- …and more

# Where can you find research opportunities?

- On Campus:
  - Work with our faculty members
  - Paid or Unpaid options
  - Semester long or Summer


Scan to see research faculty & opportunities at CSM (left) & SEE (right)

- Off campus
  - Usually over summer
  - Search internet (Key words: Summer undergrad research/internships)
  - Check out Local Businesses (Large companies: Banks, Pharmaceuticals, etc.)
  - National Science Foundation REU (Research Experience for Undergraduates) program: https://www.nsf.gov/crssprgm/reu/

# How do you start?

- Prepare yourself:
  - Think about the kind of research you want to do. Be open.
  - Strengthen your skill sets (Math department offers a Mathematics Research course in fall semesters (Math 01.390))
  - Plan early (deadlines may be in Dec-April)

- Talk to your professors (and other faculty):
  - To learn about different research topics
  - Ask about research opportunities with them
  - Ask for recommendation letters (for off campus opportunities)

# Math 01.390 – Mathematical Research

- Offered in fall semesters. To enroll, contact Dr. Thanh Nguyen (nguyent@rowan.edu)
- Provides appropriate research problems for you to do in one semester (and beyond if you want)
- Connects you with Math research faculty
- Strengthen:
  - Research skills (analytical, statistical, computational)
  - Writing skills (latex for math writing)
  - Presentation skills (present your research project)
- Should take it in sophomore/junior year.

# Preparing applications for off-campus opportunities

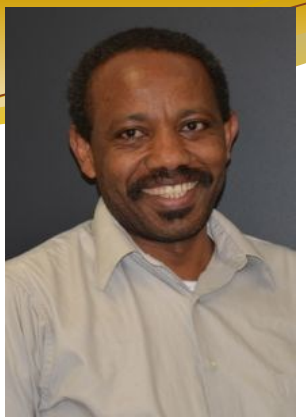
- Resume:
  - Write a good one (get help)
  - List of relevant coursework or transcripts
- Letter(s) of Recommendation
  - Don't wait until the last minute
- Personal Statement (important)
- Ask for a second opinion from advisor

# Mathematics Faculty Research Interests & potential research projects

# Dr. Nasrine Bendjilali

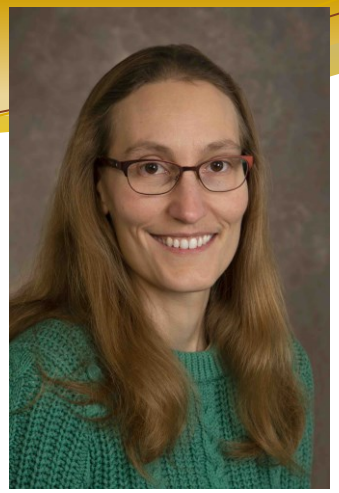
- Research Interests:
  - Machine learning, neural networks and analysis of big data.
  - Genetic risk factors contributing to development of complex human diseases
  - Statistical methods for genetic mapping of human traits
  - Multiple hypothesis testing procedures and their applications in biomedical sciences
- Potential Projects:
  - Machine learning, neural networks and analysis of big data.
- Time frame: contact for info
- Student Skills required:
  - Motivation to do research
  - Background in programming using Python or R.
- Contact Info:
  - bendjilali@rowan.edu , office: Robison Hall 229 C

# Dr. Abdul Hassen

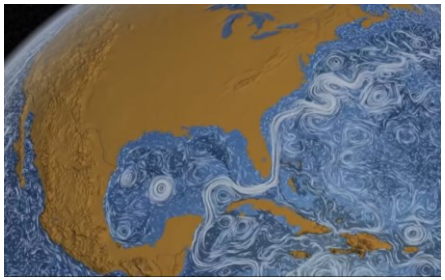


- Research Interests:
  - Analytic Number Theory
  - Partition Functions
  - Bernoulli and Euler Polynomials and Numbers
- Potential Projects:
  - Generalized Euler Numbers
  - Convolutions Properties of Generalized Euler Polynomials
  - Zeros of Generalized Euler Polynomials
- Time frame: contact for info
- Student Skills required:
  - Discrete math, Calculus III
- Contact Info:
  - hassen@rowan.edu, Robinson 229E

# Dr. Helga Huntley



- Research Interests:
  - Geophysical fluid dynamics.
  - Ocean, atmosphere, climate modeling.
  - State estimation and predictability.
- Potential Projects:
  - Extract flow properties from observed trajectories of drifters.
  - Stability analysis of differential equations describing ocean flows.
  - Analysis of local/regional climate data to identify signals of climate change.
  - Quantify ecosystem resilience to tropical storm stress



- Time frame: Summer 2025 and thereafter
- Student Skills required:
  - Curiosity about the ocean and the natural world.
  - Programming skills in Matlab.
  - Multivariable calculus; differential equations; statistics; numerical analysis a plus (depending on project)
- Contact Info:
  - huntleyh@rowan.edu.

# Dr. Ik Jae Lee

- Research Interests:
  - Drone AI, Topological machine learning, Knot theory
- Potential Projects:
  - Multiscale autonomous drone mapping: Developing a platform to create mosaic map from aerial drone images
  - Precision agriculture & Drone AI
  - Computing an example of an invariant of 4-Dimensional space (in Broda-Petit Construction), using a graded matrix algebra.
- Time frame: spring 2025 / summer 2025 semester
- Student Skills required:
  - Computer programming skills
  - Discrete math, Linear Algebra
- Contact Info:
  - leei@rowan.edu, Robinson 228J

# Dr. Hieu Nguyen

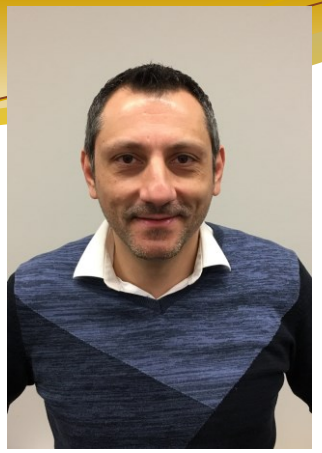

- Research Interests:
  - Drone AI
- Potential Projects:
  - Precision mapping: Program AI drones to fly intelligent missions to map agricultural fields using computer vision models
  - Obstacle avoidance: Develop novel obstacle detection algorithms for AI drones to intelligently navigate cluttered rainforest environments.
  - Applications of autonomous robotic vehicles and drones working together
- Looking for up to 3 students (1st-year students are encouraged to apply)

- Time frame: Start ASAP on volunteer basis to complete onboard training; transition to paid position when funding is available
- Funding: potentially available for Spring-Summer 2025 to support 2 students
- Student Skills required:
  - Strong math ability and computer programming skills
  - Able to learn and work both independently and collaboratively
  - Enjoy solving problems that utilize both math and computer science
- Contact Info:
  - nguyen@rowan.edu, Robinson 228N

# Dr. Thanh Nguyen

- Research Interests:
  - Differential equations, Numerical analysis, Optimization
  - Image Processing, Scientific machine learning, Deep learning
  - Applications in engineering and industry
- Potential projects:
  - Numerical methods for inverse scattering problems
  - Modeling of air pollution & pollution source identification
  - Detection of Carolina Redroot detection using Drone & Deep learning
- Looking for 2-3 students
- Time frame: Can start ASAP on volunteer basis for training, then transition to paid position when well prepared.
- Funding: Available for 2-3 students after training
- Student Skills required:
  - Linear algebra; differential equations (for modeling & inverse problems)
  - Strong programming skills (Python/Matlab)
- Contact Info:
  - nguyent@rowan.edu, Robinson 230C

# Dr. Babis Papachristou



- Research Interests:
  - Statistical Genetcis, Biostatistics (Analysis of Biological Data), Epidemiology, Statistical Computing (Writing Software Packages in R or C/C++)
- Potential Projects:
  - Data analysis
  - Statistical programming
- Time frame: contact for info
- Student Skills required:
  - At least an Intro Stat course (Required)
  - Experience in statistical programming (R, C/C++ desired)
- Contact Info:
  - papachristou@rowan.edu, Robinson 230D

# Dr. Uma Thayasivam

- Research Interests:
  - Statistical Learning, Predictive Modeling, Data Science
    Explainable AI (XAI), Recommender Systems & Quantum Computing Data Science,
    AI in healthcare , Educational Data Mining
- Potential Projects:
  - Student predictive modeling
  - Healthcare -Statistical learning
  - Interpretable AI for Data Science
  - Robust methods for high dimensional data
  - Open to student driven projects on statistical/data mining
- Looking for interesting students who are willing to gain experience
- Time frame: Spring 2025 and beyond!
- Funding: Initially unfunded with potential for future funding support including summer funding.
- Student Skills required:
  - Basic Statistics course
  - Some experience in computing programming
  - Desire to learn and willing to commit some quality time
- Contact Info:
  - thayasivam@rowan.edu, Robinson 228 H

# Dr. Hung Tong

- Research Interests:
  - Cluster Analysis and Model-based Clustering
  - Mixture Models and EM Algorithms
  - Missing Data Analysis
- Potential Projects:
  - Clustering Skewed Data with Missing Values
  - Cluster-Weighted Models with Missing Values
  - C++ Integration into the R Package **MixtureMissing**
- Time frame: I am hoping to have well-defined projects and funding information in late Spring 2025. In the meantime, I am happy to chat and learn about your interests.
- Student Skills required:
  - Linear Algebra: trace, inverse, determinant, matrix algebra
  - Probability: expected values, joint, marginal, and conditional distributions
  - R Programming: vector, matrix, array, data frame, if-else statements, loops, apply() functions
  - Familiarity with the multivariate normal distribution and/or maximum likelihood estimation is a plus, but we can have a crash course together!
- Contact Info:
  - tong@rowan.edu, Robinson 228K

# Questions?