

**Frederick “Forrest” Isadore Miller**  
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## EDUCATION

**Worcester Polytechnic Institute (WPI)**, Worcester, MA Expected Graduation: May 2023  
Bachelor of Science, Mathematical Sciences: GPA: 3.97 (as of 6/9/2022)  
Bachelor of Science, Data Science; GPA: 3.97 (as of 6/9/2022)  
Major Quality Project (Honors Thesis): *Deep Learning for Reflected Backwards Stochastic Differential Equations*, Advisor: Professor Stephan Sturm (WPI)

### *Relevant Coursework*

**Computer Science** - Accelerated Introduction to Program Design, Object Oriented Design Concepts, Database Systems I, Analysis of Algorithms, Machine Learning\*

**Mathematics** - Matrices and Linear Algebra II, Combinatorics, Linear Programming, Applied Statistics I & II, Probability Theory, Convex Optimization, Top Algorithms in Applied Mathematics, Numerical Methods for Linear and Nonlinear Systems, Data Analytics and Statistical Learning, Computational Optimization, Portfolio Valuation and Risk Management (Graduate), Lebesgue Measure and Integration (Graduate)\*, Linear Algebra (Graduate)\*

**Data Science** - Introduction to Data Science, Data Science II: Modeling and Data Analysis, Data III: Computational Data Intelligence\*, Advanced Prescriptive Analytics

\* = To be completed by Summer 2023

**2022 Gene Golub SIAM Summer School**, L'Aquila - Italy August 2022  
Topics: Quantitative Risk Management in Finance, Energy and Commodities Markets, Machine Learning and Financial Technology, Mean Field Games.  
- Selected among competitive pool of applicants to be funded to attend the program

## RESEARCH EXPERIENCE:

**Undergraduate Researcher**, WPI (November 2021 - Present)

**Advisor:** Professor Andrew Trapp (WPI)

**Project title:** Optimizing the Benefit-to-Cost Ratio for Deployment of New York City Shelter Resources REU

- Using Python, Gurobi, and high performance computing to maximize the benefit to cost ratio for resource allocation for New York City runaway and homeless youth
- Applying techniques from fractional programming, mixed integer optimization, and data engineering to develop the optimization model

**Advisor:** Professor Stephan Sturm (WPI), Professor Rohini Kumar (Wayne State University), Dr. Hussein Nasrallah (University of Michigan - Dearborn)

**Project title:** Deep Learning to approximate RBSDEs to price American Options

- Applying neural networks to approximate solutions to reflected backwards stochastic differential equations (RBSDEs).
- Performing parameter selection for the neural network and RBSDEs to generate smile curves of the American Put Options and verify solutions are consistent with theory
- Reporting the solutions to be written for scientific publication

**NSF REU Student**, University of Wisconsin - La Crosse (UWL) (June 2021 - August 2021)

**Advisors:** Dr. Wako Bungula (UWL), Dr. Danelle Larson (United States Geological Survey)

**Project title:** Topological Data Analysis (TDA) of Upper Mississippi River System

- Utilized R and Python libraries to apply the TDA mapper algorithm to generate a large simplicial complex from the dataset
- Apply density algorithms to topologically define different ecological states within the data.
- Presented weekly progress updates to all the REU students and created a research poster to bring to conferences (a research poster that was accepted at JMM 2022)

**Research Assistant Intern,** Yale School of Medicine (June 2020 - August 2020)

**Advisors:** Dr. Steven Kleinstein, Dr. Kenneth Hoehn

**Project title:** B Cell Repertoire data set curation

- Developed parts of a data pipeline for analysis of longitudinal studies in the Observed Antibody Space and the iReceptor data sets
- Performed analysis on gene sequence data to find evidence of somatic hyper evolution
- Publication in eLife Sciences

## PUBLICATIONS

1. In preparation, to be submitted to Management Science: **Miller F**, Bilge Kaya Y, Dimas G, Konrad R, Lee Maass K, Trapp A, *Optimizing the Benefit to Cost Ratio for Public Sector Decision Making*
2. Larson DM, Bungula W, Stockdill A, McKean C, Lee A, **Miller F**, Davis K., in review, U.S. Geological Survey. *Quantifying ecosystem states and state transitions of the Upper Mississippi River using topological data analysis.*
3. Larson DM, Bungula W, Lee A, Stockdill A, McKean C, **Miller F**, Davis K, Erickson R, Hlavecek E. in review, U.S. Geological Survey and Limnology and Oceanography: Methods. *Reconstructing missing data by comparing common interpolation techniques: applications for long-term water quality data and beyond.*
4. Hoehn, K. B., Turner, J. S., **Miller, F. I.**, Jiang, R., Pybus, O. G., Ellebedy, A. H., & Kleinstein, S. H. (2021). *Human B cell lineages associated with germinal centers following influenza vaccination are measurably evolving.* ELife, 10, e70873. <https://doi.org/10.7554/eLife.70873>

## PROJECTS

1. MA 574 Portfolio Valuation and Risk Management Project: *Markowitz Portfolio Optimization*. Applied Markowitz Portfolio theory to trade assets throughout the semester. Produced report on the success of the account with weekly rebalances.
2. MA 4635 Data Analytics and Statistical Learning Final Project: Applied several statistical learning algorithms to best predict weather using a Kaggle dataset.
3. MA 3231 Linear Programming Final Project: *L<sup>1</sup> Regression Analysis*: Presented a theoretical study of L1 regression and its interpretation as a linear programming problem.

## HONORS AND AWARDS:

INFORMS Scholarship to attend INFORMS Annual Meeting 2022

WPI Presidential Scholarship (2019- Present)

Dean's List, WPI, All Semesters

Babbage Level, Kryptos: A Series in Cryptanalysis, 2/3 challenges solved (April 2021)

NSF I-Corps New England Regional Innovation Node @ MIT, Participant, WPI (Fall 2020)

## TEACHING EXPERIENCE

**Peer Learning Assistant (PLA)**, WPI Math Department (August 2020 - Present)

- Manage a section of 20 to 35 students in mathematical sciences courses at WPI
- Run a weekly discussion section reviewing lecture content.
- Grade Homework & exams for the section working with a Professor and other PLAs and Teaching Assistants.

*Courses Taught:*

MA 1023 - Calculus III, A Term 2020, A Term 2021, D Term 2022

MA 2071 - Matrices & Linear Algebra I - B Term 2020, D Term 2021

MA 2621 - Probability for Applications, C Term 2022

MA 3231 - Linear Programming, A Term 2022

## CONFERENCES / TALKS

- 2022 INFORMS Annual Meeting, October 2022
  - Optimizing The Benefit-to-Cost Ratio For Effective Capacity Deployment For New York City's Homeless Youth Shelter System
  - Awarded INFORMS Scholarship to be funded and attend the conference and attend special sessions
- WPI PhD Student Seminar @ WPI, February 2022
  - A brief survey of operations research and optimization
- Math REU Poster Session @ University of Wisconsin - La Crosse (UWL), August 2021
  - Research poster to members of UWL Math & Biology Departments
- WPI Math Club Sunday Night Seminar - April 2020
  - Introductory combinatorics to members of WPI Math club
- WPI Math Department Open House - April 2021, October 2021, April 2022
  - Mathematical Sciences undergraduate program at WPI with prospective students

## LEADERSHIP / SERVICE

**President**, WPI Math Club (April 2020 - Present)

Prepare meetings for WPI's math club by finding an activity for our weekly math hour. Normally this consists of a fun puzzle with a mathematical bend that the club discusses and tries to solve.

**President**, WPI Pi Mu Epsilon Massachusetts Alpha Math Honors Society (May 2022 - Present)

Vice President January 2022 - May 2022, Member April 2021 - January 2022

## SKILLS

Programming Languages: Python, SQL, R, Java

Applications: Microsoft Office, Google Suite, LaTeX, Docker, Github, pandas, numpy, scikit, gurobi, tensorflow, Bloomberg Market Concepts (Certified), slurm  
Interpersonal Skills: Leadership, Teamwork, Public speaking, Conflict resolution

## PROFESSIONAL EXPERIENCE

**Analytics Intern**, Heritage Capital LLC, Woodbridge, CT

May 2019 - June 2019

- Examined and condensed market data to be coherent for client use
- Utilized Java to take data on various market indexes and oscillators to show market performance over time