Mohammad Rafiqul Islam

Ph.D. Candidate in Mathematics
Florida State University

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Education

Ph.D. in Mathematics May, 2026 (Anticipated)
Department of Mathematics, Florida State University, Florida, USA
Advisor: Lingjiong Zhu, Ph.D.
Research: Theoretical Machine Learning - Distributed & constrained optimization techniques in Bayesian learning.

MS in Mathematics May, 2020
Department of Mathematics & Statistics, Youngstown State University, Ohio, USA

MS in Applied Mathematics March, 2016
Department of Mathematics, University of Dhaka, Dhaka, Bangladesh

BS in Mathematics March, 2014
Department of Mathematics, University of Dhaka, Dhaka, Bangladesh

Research interests

Algorithms and Optimization
Design and analysis of efficient scalable algorithms for collaborative learning under regularization and privacy constraints; empirical and analytical performance analysis of sampling algorithms; theory and implementation of optimization algorithms based on Langevin dynamics.

Financial Mathematics
Study the predictive modeling techniques for stock price movement using classical statistical and machine learning algorithms; pricing and portfolio risk management.

Research experience

Research Assistant Fall 2022 – Present

Working on the NSF-funded project *"The Heavy-Tailed Methods in Machine Learning"* (DMS-2208330), under the supervision of Dr. Lingjiong Zhu, Department of Mathematics, Florida State University. The project focuses on the development and theoretical analysis of advanced stochastic optimization and sampling algorithms.

Completed Project:

[1] **Generalized EXTRA** (Exact First-Order) **Stochastic Gradient Langevin Dynamics Algorithm**: Conducted numerical experiments to evaluate the performance of the algorithm on both synthetic and real-world datasets for Bayesian regression and classification problems.

Ongoing Projects:

[1] Development and analysis of the higher-order Langevin dynamics algorithms for improved convergence in sampling and optimization.

[2] **Reflected Underdamped Langevin Monte Carlo (RULMC)** algorithm for constrained domains.

[3] **Decentralized Projected Stochastic Gradient Langevin Dynamics** algorithm for collaborative Bayesian learning under projection constraints.

Publications

[1] Mert, Gurbuzbalaban; Islam, Mohammad Rafiqul; Wang, Xiaoyu; Zhu, Lingjiong (2024) "Generalized EXTRA stochastic gradient Langevin dynamics." arXiv preprint arXiv.2412.01993 (Submitted to *JMLR*).

[2] Mostafa, Fahad, Pritam Saha, Mohammad Rafiqul Islam, and Nguyet Nguyen. "GJR-GARCH volatility modeling under NIG and ANN for predicting top cryptocurrencies." Journal of Risk and Financial Management 14, no. 9 (2021): 421.

[3] Islam, Mohammad Rafiqul, and Nguyet Nguyen. "Comparison of financial models for stock price prediction." Journal of Risk and Financial Management 13.8 (2020): 181.

Presentations and talks

[1] The Heavy-Tail Phenomenon in Decentralized Stochastic Gradient Descent; Department of Mathematics, Florida State University; November 20, 2023.

[2] Decentralized Stochastic Gradient Langevin Dynamics and Hamiltonian Monte Carlo; Department of Mathematics, Florida State University; October 5, 2023.

[3] Asymptotics and calibration of local volatility models. Department of Mathematics, Florida State University; December 2, 2022.

[4] Sensitivity analysis for Monte Carlo and Quasi Monte Carlo option pricing; Department of Mathematics, Youngstown State University; April 28, 2020.

Selected course projects

[1] Option pricing techniques: A performance-based comparative study of the randomized quasi-Monte Carlo method and Fourier cosine method.

A term final project of a graduate-level data analysis course at FSU, where we conducted a comparative study of the COS and randomized quasi-Monte Carlo methods for pricing European options under the Black-Scholes model. RQMC yielded more accurate estimates with lower error, while COS was computationally faster but more sensitive to parameter choices.

[2] The Relationship Between Forced Sexual Activities And Suicidal Attempts Of The Victims.

A term final project of a graduate-level data analysis course at YSU, where we analyzed data from the 2017 Youth Risk Behavior Surveillance Survey to examine the link between forced sexual experiences and suicidal behavior in U.S. adolescents. Findings show a strong association with gender and assault frequency as significant predictors of suicide risk.

[3] Study of Runge-Kutta Method of Higher orders and its Applications.

Undergraduate project. We studied and implemented Runge-Kutta methods of second, fourth, and sixth order for solving ODEs and boundary value problems. Demonstrated improved accuracy of the sixth-order method through analytical derivations, numerical experiments, and FORTRAN simulations.

Teaching

[Spring 2025] **Instructor of Record** for MAC2311 Calculus with Analytic Geometry I; Department of Mathematics, Florida State University, Tallahassee, Florida.

[Fall 2024] **Grader and Admin TA** for MAP4170 Introduction to Actuarial Science; Department of Mathematics, Florida State University, Tallahassee, Florida.

[Spring 2024] **Instructor of Record** for MAP4170 Introduction to Actuarial Science; Department of Mathematics, Florida State University, Tallahassee, Florida.

[Fall 2023] **Grader** for MAP4170 Introduction to Actuarial Science; Department of Mathematics, Florida State University, Tallahassee, Florida.

[Spring 2023] **Instructor of Record** for MAC1140 Pre-calculus and Algebra; Department of Mathematics, Florida State University, Tallahassee, Florida.

[Fall 2022] **Recitation Instructor** for MAC2311 Calculus with Analytic Geometry I; Department of Mathematics, Florida State University, Tallahassee, Florida.

[Fall 2021 - Spring 2022] **Lab and Lecture TA** for MAC1114 Analytic Trigonometry and MAC1140 Pre-calculus and Algebra; Department of Mathematics, Florida State University, Tallahassee, Florida.

[Spring 2020] **Instructor of Record** for MATH 1511 Trigonometry; Department of Mathematics, Youngstown State University, Youngstown, Ohio.

[Fall 2019] **Instructor of Record** for MATH 1511 Trigonometry; Department of Mathematics, Youngstown State University, Youngstown, Ohio.

[Spring 2019] **Teaching Assistant** for MATH 1510 College Algebra; Department of Mathematics, Youngstown State University, Youngstown, Ohio.

[Fall 2018] **Instructor of Record** for MATH 1510 College Algebra; Department of Mathematics, Youngstown State University, Youngstown, Ohio

Conferences and seminars

[1] FSU Mathematics Industry Symposium 2024

[2] FSU Financial Mathematics Quant Symposium 2023

[3] 20^{th} International Mathematics Conference 2017 hosted by Bangladesh Mathematical Society, Dhaka, Bangladesh

[4] 6^{th} Annual Midwest Actuarial Student Conference hosted by the Society of Actuaries and the University of Wisconsin Milwaukee, WI, USA

[5] 1st SRU SAS Analytics Day hosted by Slippery Rock University and SAS Institute

Employments

Graduate Teaching Assistant Fall 2021 - Present	Department of Mathematics Florida State University, Tallahassee, Florida, USA
Graduate Teaching Assistant Fall 2020 - Spring 2021	Department of Mathematics University of Central Florida, Orlando, FL, USA
Graduate Assistant Fall 2018 - Spring 2020	Department of Mathematics & Statistics Youngstown State University, Youngstown, OH, USA
Advisor Summer 2019	Lakeland Tours LLC D.B.A Worldstrides ENVISION EMI, LLC; VIENNA, VIRGINIA, USA
Assistant Vice President September, 2017 - July, 2018	Actuarial & Reinsurance Department Delta Life Insurance Company Limited. Dhaka, Bangladesh
Actuarial Trainee September, 2016 - August, 2017	Actuarial & Technical Department Sandhani Life Insurance Company Limited; Dhaka, Bangladesh

Awards & scholarships

[2024] Bettye Anne Busbee Case Graduate Fellowship & Doctoral Mentorship Recognition 2024 ($1000.00).

[2020] Outstanding Graduate Student in Statistics Award for the 2019-2020 academic year ($150.00).

[2019] Society of Actuaries (SOA) travel grant to attend 6th Annual Midwest Actuarial Student Conference, University of Wisconsin, Milwaukee, WI ($125.00).

[2018] Graduate College Premiere Scholarship, Youngstown State University.

[2015] MetLife Bangladesh Actuarial Study Program 2015 Fellowship.

Memberships

[1] Bangladesh Mathematical Society: Life Member

[2] Society of Actuaries (SOA), USA: Student Member

[3] Society for Industrial and Applied Mathematics (SIAM), USA: Student Member

[4]American Mathematical Society-AMS: Student Member

[5] Graduate Student Council: FSU Mathematics Department

References

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