MUHAMMAD MAAZ

1 CONTACT INFORMATION

Institution	Mechanical and Industrial Engineering University of Toronto Toronto, ON Canada
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2 EDUCATION

Ph.D. Operations Research, University of Toronto `Sep 2022 - Aug 2025`

Supervisor. Timothy C.Y. Chan

Interests. optimization, machine learning, automated reasoning, computer algebra

GPA. 4.0/4.0

B.H.Sc., McMaster University `Sep 2016 - May 2020`

Honors. Summa cum laude (GPA 3.96/4.0)

Minor. Economics

Thesis. Matching with compatibility constraints: The case of the Medical Residency Matching Service

3 PROFESSIONAL EXPERIENCE

Applied Scientist (intern), Amazon `Jun 2022 - Sep 2022`

Contribution. Worked in natural language processing at Amazon Alexa, specifically outlier detection and unsupervised learning. Invented concept of order-isomorphisms of probability vectors to develop novel methods for unsupervised performance estimation.

4 PUBLICATIONS, PRESENTATIONS AND ABSTRACTS

4.1 In progress

1. **Maaz M**, Paschalidis P, Chairi I, McMahon S, Markarem A, McKay RG, Sutton T, Bertsimas D. Diagnosis and prognosis of aortic stenosis with multimodal machine learning. In preparation.

2. **Maaz M**, Strzeboński AW. A new method for reducing algebraic programs to polynomial programs. Under review.

3. **Maaz M**, Chan TCY. Formal verification of Markov processes with learned parameters.

   - Accompanying software package `markovml` at https://github.com/mmaaz-git/markovml

4. Chan TCY, **Maaz M**. Exact sensitivity analysis of Markov reward processes via algebraic geometry. Under review.

   - Accompanying software package `markovag` at https://github.com/mmaaz-git/markovag
   - Lee B Lusted Award for best student paper at 2024 Society for Medical Decision Making

4.2 Articles, Peer Reviewed

1. **Maaz M**. Abundant Neighborhoods, Two-Sided Markets, and Maximal Matchings. Naval Research Logistics. 2025 Apr 30

2. **Maaz M**, Leung KHB, Boutilier JJ, Suen S, Dorian P, Morrison LJ, Scales DC, Cheskes S, Chan TCY. Cost-Effectiveness of Drone-Delivered Automated External Defibrillators for Cardiac Arrest. Resuscitation. 2025;209:110552

3. **Maaz M**. Committees: An Alternative Financing Method from South Asia. Mathematics Magazine. Accepted.

4. Fabiano N, Gupta A, Bhambra N, Luu B, Wong S, **Maaz M**, Fiedorowicz JG, Smith AL, Solmi M. How to optimize the systematic review process using AI tools. JCPP Advances. 2024;e12234.

5. **Maaz M**, Qiao R, Zhou Y, Zhang R. On orderings of probability vectors and unsupervised performance estimation. Proceedings of 32nd International Joint Conference on Artificial Intelligence (IJCAI), Workshop on Generalizing from Limited Resources in the Open World. 2023.

6. Tahir T, Wong MM, **Maaz M**, Naufal R, Tahir R, Naidoo Y. Pharmacotherapy of impulse control disorders: A systematic review. Psychiatry Research. 2022 May;311:114499.

7. **Maaz M**. Saturating stable matchings. Operations Research Letters. 2021 Jun;49(4):597-601.

8. **Maaz M**, Papanastasiou A. Matching with compatibility constraints: The case of the Canadian medical residency match. Journal of Mechanism and Institution Design. 2020 Dec;5(1):99-117.

9. **Maaz M**, Papanastasiou A. Determining the optimal capacity and occupancy rate in a hospital: a theoretical model using queuing theory and marginal cost analysis. Managerial and Decision Economics. 2020 Oct;41(7):1305-1311.

10. **Maaz M**. A primer on the game theory behind the National Resident Matching Program for the medical educator and student. Medical Science Educator. 2020;30:965-969.

11. Kennedy C, Thabane L, Veroniki A A, Adachi R, Richardson J, Cameron I, Giangregorio A, Petropoulou M, Alsaad S, Alzahrani J, **Maaz M**, Ahmed MM, Kim E, Tehfe H, Dima R, Sabanayagam K, Hewston P, Alrob H, Papaioannou A. Management of frailty: A Systematic Review and Network Meta-analysis of Randomized Controlled Trials. Journal of the American Medical Directors Association. 2019;20(10):1190-8.

12. Li G, Abbade LP, Nwosu I, Jin Y, Leenus A, **Maaz M**, Wang M, Bhatt M, Zielinski L, Sanger N, Bantoto B. A systematic review of comparisons between protocols or registrations and full reports in primary biomedical research. BMC Medical Research Methodology. 2018 Dec;18(1):9.

13. Wang M, Sun G, Chang Y, Jin Y, Leenus A, **Maaz M**, Li G, Bhatt M, Abbade LP, Nwosu I, Zielinski L. A systematic survey of control groups in behavioral and social science trials. Research on Social Work Practice. 2018 Jul;28(5):538-45.

14. Jin Y, Sanger N, Shams I, Luo C, Shahid H, Li G, Bhatt M, Zielinski L, Bantoto B, Wang M, Abbade LP, Nwosu I, Leenus A, Mbuagbaw L, **Maaz M**, Chang Y, Sun G, Levine MA, Adachi JD, Thabane L, Samaan Z. Does the medical literature remain inadequately described despite having reporting guidelines for 21 years?–A systematic review of reviews: an update. Journal of multidisciplinary healthcare. 2018;11:495.

15. Li G, Abbade LP, Nwosu I, Jin Y, Leenus A, **Maaz M**, Wang M, Bhatt M, Zielinski L, Sanger N, Bantoto B. A scoping review of comparisons between abstracts and full reports in primary biomedical research. BMC Medical Research Methodology. 2017 Dec;17(1):181.

4.3 Abstracts and Presentations at Scientific Meetings, Peer Reviewed

1. Halawi Y, **Maaz M**. Siamese graph neural networks for drug discovery. Poster presentation at: Molecular Machine Learning, MILA. 2023 May 29; Montreal, QC.

2. **Maaz M**. An analysis of occupancy rates in hospitals: results from a cost-minimization model. Oral presentation at: Atlantic Canada Economics Association Conference, Université de Moncton. 2019 Oct 18; Moncton, NB.

4.4 Publications, Non Peer Reviewed

1. **Maaz M**, Papanastasiou A, Ruffle BJ, Zheng A. Heterogeneity in the support for mandatory masks unveiled. Canadian Centre for Health Economics. 2021 Jan 11.

2. **Maaz M**. Viability of machine learning to reduce workload in systematic review screenings in the health sciences: a working paper. arXiv preprint arXiv:1908.08610. 2019 Aug 22.

4.5 Abstracts and Presentations, Non Peer Reviewed

1. **Maaz M**. Abundant neighborhoods. Poster presented at: Simons Laufer Mathematical Sciences Institute Workshop on Algorithms, Approximation, and Learning in Market and Mechanism Design. 2023 Nov 6; Berkeley, CA.

2. **Maaz M**. Cost effectiveness of drone-delivered AEDs. Oral presentation at: INFORMS. 2023 Oct 15; Toronto, ON.

3. **Maaz M**. Cost effectiveness of drone-delivered AEDs. Oral presentation at: INFORMS Healthcare. 2023 Jul 26; Toronto, ON.

4. **Maaz M**. Reimagining residency matching for couples: a proposal. Poster presented at: International Congress on Academic Medicine. 2023 Apr 13; Quebec City, QC.

5. **Maaz M**. Many-to-one matching under varying preferences over students. Poster presented at: Medical Student Research Day, University of Toronto. 2022 Feb 23; Toronto, ON.

6. **Maaz M**. Addiction: integrating the medical and economic perspectives. Oral presentation at: Department of Economics workshop, McMaster University. 2020 Nov 11; virtual.

7. **Maaz M**. An analysis of occupancy rates in hospitals: results from a cost-minimization model. Poster presented at: Faculty of Health Sciences Poster Day, McMaster University. 2019 Apr 2; Hamilton, ON.

8. **Maaz M**. Modelling the hospital as a queuing problem. Oral presentation at: Department of Economics workshop, McMaster University. 2019 Jan 23; Hamilton, ON.

9. **Maaz M**. Incorporating marginal cost analysis with queuing theory. Oral presentation at: Department of Economics workshop, McMaster University. 2018 Nov 16; Hamilton, ON.

10. **Maaz M**, Tahir T, Muhammad M. Machine learning modelling in global health. Poster presented at: Canadian Global Health Students and Young Professionals Summit. 2017 Oct 28; Ottawa, ON.

5 HONORS, SCHOLARSHIPS AND AWARDS

5.1 Research

Best student presentation. $100. Atlantic Canada Economics Association `Oct 2019`

Lee B Lusted Award for best student paper. Society for Medical Decision Making `Oct 2024`

5.2 Academic

Vanier Scholarship (NSERC). $150000. `2023-2026`
Basis. Most prestigious PhD scholarship in Canada. Awarded to 55 students nationwide.

Canadian Graduate Scholarship (NSERC). $17500. `2022-2023`

Alex G. Climans Scholarship. $1525. University of Toronto `2021`
Basis. For high academic standing during premedical studies

Provost's Honour Roll. McMaster University `2020`
Basis. For obtaining a perfect GPA in an academic year

University Senate Scholarship. $800. McMaster University `2019`
Basis. Given to 800 students with highest GPAs

Edward Jenkins Award. $5000. McMaster University `2017`
Basis. One award for member of Canadian Forces with outstanding academic achievement

6 RESEARCH EXPERIENCE

Operations Research Center, Massachusetts Institute of Technology `Feb 2024 - Jul 2024`
Supervisor. Dimitris Bertsimas
Title. Multimodal artificial intelligence in healthcare
Contribution. Collaborated with Hartford Healthcare (Connecticut, USA) on projects to predict aortic stenosis and liver trauma grading. Developed data pipelines to gather different data modalities (images, notes, medical history). Trained models to integrate modalities, including XGBoost, TabNet, and 3-dimensional CNNs.

Department of Mathematics, University of Toronto `Mar 2021 - Aug 2021`
Supervisor. Robert McCann
Title. Continuum approximations of matching models
Contribution. Worked with a continuum approximation of a matching market to analyze how changing preferences affects the outcome of the match. The model formulated students as a distribution over a hypercube. Studied how different distributions of students affects the structure of the stable matching by using techniques from probability theory. Built simulations and visualizations in R to make dynamics concrete.

Department of Economics, McMaster University Apr 2020 - Oct 2020

Supervisor. Bradley Ruffle, Anastasios Papanastasiou, and Angela Zheng

Title. Economic incentives for social distancing and mask-wearing during COVID-19

Funding. McMaster COVID-19 Research Fund

Contribution. Contributed to development of economic model to project the use of fines versus subsidies in order to promote social distancing and mask-wearing during COVID-19. Helped with design and execution of large survey of Ontarians in order to test the hypotheses generates by the theoretical model. Performed statistical analyses in R, specifically building ordered logistic regression models, and generating marginal effects plots to present the results of the statistical models.

Department of Economics, McMaster University Jul 2018 - May 2020

Supervisor. Anastasios Papanastasiou

Title. Analyzing the Canadian Resident Matching Service (CaRMS)

Contribution. Bachelor's thesis. Self-studied matching theory literature to understand how the CaRMS worked. Published expository article on how the residency matching algorithm works for a medical audience. Independently formulated the novel matching with compatibility constraints model to study the two-pronged issue of unmatched students and unfilled positions in the CaRMS, thereby writing the first paper in the matching theory literature studying this issue.

Centre for Health Econ. and Policy Analysis, McMaster University Jan 2019 - Apr 2019

Supervisor. Graham Dobbs

Title. Predicting geriatric depression using longitudinal data

Contribution. Planned project to use data to predict geriatric depression. Obtained access to the SHARE data set, a longiudinal survery of elderly people in Europe. Cleaned and transformed the data. Built regression and machine learning models using socioeconomic factors as predictors. Wrote and submitted a manuscript.

Department of Economics, McMaster University Sep 2018 - Apr 2019

Supervisor. Anastasios Papanastasiou

Title. Applying queuing theory to hospital management

Contribution. Senior (3rd year) undergraduate project. Thought of idea to use queuing theory, a field of math that studies wait lines and wait times, to analyze the problem of "hallway medicine" in Ontario. Independently derived novel mathematical model incorporating queuing theory and marginal cost analysis. Applied model to predicting occupancy rates in hospitals. Presented work at the Atlantic Canada Economics Association Conference. Wrote and published a manuscript.

St. Peter's Hospital, Hamilton, ON Apr 2017 - Sep 2018

Supervisor. Ahmed Negm

Title. A systematic review of frailty interventions

Contribution. Screened thousands of abstracts and full text articles according to inclusion criteria. Performed data extraction on hundreds of full texts. Helped with drafting and proofreading.

Department of Health Evidence and Impact, McMaster University Feb 2017 - Aug 2017

Supervisor. Lehana Thabane

Title. Various projects related to evidence-based medicine

Contribution. Contributed to methodological design, search strategy, and inclusion criteria. Performed literature screening and data extraction. Involved in proofreading of manuscripts.

7 TEACHING EXPERIENCE

Private tutor, ECON 2GG3 Intermediate Micro II, McMaster Jan 2020 - Apr 2020
Teaching assistant, HTHSCI 1I06 Inquiry, McMaster Sept 2019 - Apr 2020
ESL tutor for newcomers to Canada, Hamilton Public Library Sept 2018 - Apr 2020
Private tutor, ECON 2G03 Intermediate Micro I, McMaster Jan 2019 - Apr 2019

8 SERVICE

8.1 Editorial

Chapter Editor, Public Health and Preventative Medicine, Toronto Notes Mar 2022 - Mar 2023
Trainee Editorial Board, Tropical Diseases, Travel Medicine and Vaccines Nov 2020 - Nov 2021
Section Editor, University of Toronto Medical Journal Sept 2020 - Aug 2021

8.2 Referee

Economic Modelling, PLoS Medicine, Yale Journal of Biology and Medicine, Psychology Research and Behaviour Management, Applied Economic Letters

8.3 Outreach

Founder & Leader, Mathematical Medicine Interest Group, U Toronto Sep 2021 - Sep 2022
Role. Organized popular public talks promoting the intersection of mathematics and medicine to a non-math audience.