

LEONARD MUSHUNJE

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157W 123rd Street, Apt 4-H, New York 10027

EDUCATION

Columbia University in the city of New York

MA in Statistics

New York, USA

Aug 2022 - Dec 2023

University of Montevallo

Certificate in Mathematics-Exchange student

Montevallo, AL, USA

July 2021 - Jan 2022

Midlands State University

Bachelor of Science Honors in Mathematics (First Class)

Gweru, Zimbabwe

Feb 2017 - July 2021

RESEARCH AND TEACHING EXPERIENCE

University of Cambridge

Visiting Researcher-Mentored by Prof Mark Gross

Cambridge, UK

May 2022 –

- Computational Algebraic Geometry: Working on Maximum Likelihood degree estimation for exponential models with hidden variables using Toric Varieties.

New York University

Summer Graduate Researcher-Mentored by Prof Amine

NY, USA

Jun 2023 – Sep 2023

- Developed a Diffusion modelling framework to solve High dimensional PDEs in latent spaces.
- The architecture overcomes the weaknesses of spectral methods of slow convergence through automatic basis operator learning.

Columbia University, Zuckerman Institute

Research Intern- Mentored by Professor Liam Paninski

NY, USA

May 2023 –

- Working on animal point tracking using deep diffusion models and zero-one-shot learning in animal pose estimation

Columbia University, Department of Statistics

Summer Research Intern- Mentored by Professor Yuqi Gu

NY, USA

May 2023 –

- Working on Latent variable and graphical models with applications to market network analysis.

Columbia University

Course Grader

NY, USA

Sep 2022 – Dec 2022

- Assisted students and graded a full credit course in Probability Theory

Midlands State University

Research Assistant

Gweru, Zimbabwe

Feb 2018 – Nov 2021

- Researched topics on the intersection of Mathematical Modelling and Machine Learning with applications in Economic and Financial Modelling and published five peer reviewed articles as the first author.

Teaching Assistant

- Conducted classes and graded assignments for Number Theory, and Linear Algebra courses

PROFESSIONAL EXPERIENCE

JP Morgan Chase

Quantitative Research virtual internship, and mentorship

NY, USA

June 2023 – Sept 2023

- Pricing of put and call Options using Monte Carlo Simulations and Black Scholes Model in MATLAB.

- Application of the Long short term memory model (LSTM) to stock price prediction in Tensor flow and Pytorch.

Dura Capital Private Limited

Harare, Zimbabwe

Data Scientist – Mentored by Dr. Mudavanhu

April 2023 –

- Performing risk, and pricing model validation using VBA
- Collecting data and organizing data flow and pipeline from the FCC data centre in Zimbabwe
- Analysing web scrapped financial texts data using Natural language processing in Python

Quantitative Research Analyst- Mentored by Professor. Thomas Ho

Dec 2020 – March 2023

- Formulated research ideas, built and analyzed market data (stocks and derivatives), and implemented quantitative trading models
- Developed MATLAB algorithms based on the quasi newton and the trust-region methods to generate the optimal portfolios necessary for risk control and optima trades

Commercial Bank of Zimbabwe

Harare, Zimbabwe

Quantitative Risk Analyst-Group CEO's Office

Feb 2021 – March 2023

- Implemented logistic regression default model in R to identify significant factors for loan pricing
- Developed and launched the current CBZ multi-currency loan pricing model in Python

Fidelity Life Assurance of Zimbabwe

Harare, Zimbabwe

Actuarial Research and Risk Management Intern

April 2019 – March 2020

- Developed insurance pricing models and IFRS9 models for expected credit losses in VBA
- Produced Data Checks results, Performed Asset valuation (pensions and life insurance products), IBNR and UPR reserve calculations, and wrote clients' reports

African Actuarial Consultants

Harare, Zimbabwe

Actuarial Intern

Jan 2019 – April 2019

- Performed SVD and PCA for Economical IBNR and UPR reserve calculations using Python

SELECTED AWARDS AND HONORS

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- 10th Heidelberg Laureate Forum Fellow, Sept 2023 (*Awarded to 200/1000+ applicants across the World*)
 - Joint Statistical Meetings, Columbia Statistics Departmental Award, June 2023 (*Awarded to 4 students*)
 - SDSS student and Early Career Research Travel Award, May 2023
 - MA2PhD Fellowship, Department of Mathematics and Statistics, Columbia University, Aug 2022 (*awarded to top 1% students*)
 - Masters Graduate Teaching Assistantship, Indiana University of Pennsylvania, May 2022 (Declined)
 - Erasmus Mundus Scholarship Finalist, European Union Scholarships, April 2022.
 - SIAM Student Travel Award, Society for Industrial and Applied Mathematics, October 2019 and 2021.
 - Vice Chancellor's Book Prize for Best Student in Mathematics and Statistics, Midlands State University, November 2021
 - ECONET Wireless Group Award for Best Student in the Faculty of Science and Technology, Midlands State University, November 2021
 - CBZ Group Award for Best Student in the Faculty of Science and Technology, Midlands State University, November 2021
 - Selected International Mathematical Modelling Challenge (IMMC), National Representative, July 2021

- Invited Membership, Golden Key International Honor Society, March 2021.
- Global UGRAD Fulbright Scholarship for top 200 Undergraduates, US Department of State, May 2020.
- Outstanding Editorial Board Member, Journal of Economic Science Research, February 2021.
- Full Undergraduate Scholarship, ECONET Group, 2017-2021.
- National Mathematics Olympiad Finalist, Bindura University, October 2015.
- Full Advanced High School Scholarship, Capernaum Trust, 2010-2013 and 2014-2015.

SELECTED JOURNAL ARTICLES

- **Mushunje, L** and Allen, D (2023). “Modeling Trading Games in a stochastic non-life insurance market”, *Scientific African-Revise and Resubmit*
- **Mushunje, L**, Allen, D, & Peiris, S (2023). “Volatility and irregularity Capturing in stock price indices using time series Generative adversarial networks”, *Journal of Risk Financial Management- Accepted*
- **Mushunje, L** and Akhtar, S (2023). Non-banking sector role on Economic growth with Nighttime Lights data, *Cogent Journal of Economics and Finance, Revise and Resubmit*
- **Mushunje, L. (2021)**. “The health crisis of COVID-19: crisis and risk management”, *Africa Growth Agenda*
- **Mushunje, L.** and Mashasha, M. (2019). “Modelling the effects of variations in the corporate tax rate on revenue output in Zimbabwe”, *Undergraduate Economic Review*
- **Mushunje, L.** (2019). “A mathematical analysis of stock price oscillations within financial markets”, *Social Science research network*.
- Other projects available at: https://scholar.google.com/citations?user=Q5VI_EoAAAAJ&hl=en

SELECTED CONFERENCE PRESENTATIONS

- Algebraic Geometry for High dimensional data, Royal Statistical Society, Harrogate, UK, 5-7 Sep 2023
- Financial time series analysis with TimeGAN, JSM, Toronto, Canada, 5-10 August, 2023
- Workshop on Topological Moonshine, UIUC, 16-21 July, 2023
- 100 Years of Noetherian Rings, Princeton University, June 19-21, 2023
- Algebraic and topological interplay of algebraic varieties, Jaca, Spain, June 11-17, 2023
- Crowd Counting with NLP tools, Tom Ten Have Symposium, Harvard Medical School, June 8-9, 2023
- Workshop on Complex Lagrange and Integrable Systems, Oxford, UK, 5-8 June
- Algebraic Geometry, and Algebraic Graphs, University of Virginia, May, 24-28, 2023
- Nobel Prize Summit, Washington DC, 24-26 May, 2023
- Dimensionality Reduction for High Dimensional Functional Data, Workshop on GRAMSIA: Graphical Models, Statistical Inference, and Algorithms, Harvard University, May 16-19, 2023
- Great Plains Operator Theory Symposium (GPOTS), Ohio State University, Columbus, OH USA, May 16- 19, 2023
- Computations and Data in Algebraic Statistics, Banff International Research Station for Mathematical Innovation and Discovery, Mexico, 15-19 May, 2023 (*remote*)
- Summer workshop on Circuit Diameters and Augmentation: Recent Advances in Linear and Integer Optimization, University of Colorado Denver, May 15-16, 2023
- Function-On-Function Dimensionality reduction in real algebraic fields, 32nd Cumberland Conference on Combinatorics, Graph Theory and Computing, Middle Tennessee State University, May 13-14, 2023
- Topology Festival, Cornell University, 5-7 May, 2023
- Algebraic Geometry for Statistical Learning, Georgia Algebraic Geometry Symposium, Georgia, USA, 28-30 April, 2023
- AGNES, Stony Brook, NY, USA, 28-30 April, 2023
- High dimensional functional data analysis via Manifold Geometry, Combina Texas Conference, Texas, USA. 21-22 April, 2023

- Invited delegate, Fourth Annual Volatility Risk Institute Conference, New York Stern School of Business, NY, USA, 2023
- Modelling complex stochastic trading games, Joint Mathematical Meetings, Denver Co, USA, 2020
- Analyzing stock price oscillations within financial markets, Partial Differential equations (SIAM PD19), California, USA, 2019 (*Awarded a SIAM student Travel Award*).
- Theoretical game modeling in the insurance sector, Global Development Finance, South Africa, 2019
- The Physics of market prices for futures contracts, African Review of Economics and Finance, University of Witwatersrand, Johannesburg, South Africa, 2019

SELECTED GRANTS AND SUPPORT

- Summer school on Algebraic and topological interplay of algebraic varieties, NSF Grant (\$2000), 2023
- Summer workshop on homotopy theory, NSF Travel Grant (\$1000), 2023
- Workshop on Circuits and optimization, NSF Travel Grant (\$1000), 2023
- Workshop on Combinatorics, and graph theory, NSF Travel Grant (\$750), 2023
- Workshop on Topological Moonshine, UIUC student support Grant (\$350), 2023
- Lake-Michigan Combinatorics Workshop Graduate Grant (\$800), 2023
- Richmond Geometry Meeting Travel support grant (\$750)
- Annual Algebraic Geometry meeting graduate student support grant (\$400)
- American Physical Society Undergraduate student care grant (\$300), 2019
- Other small Conference Grants (Grant Total of \$1500), 2023

REVIEWER/REFeree ROLES

- Reviewer, Scientific African Journal, 2020-
- Session organizer on Financial Derivatives, Financial Management Association, Annual Meeting, 2023
- Reviewer and Program Committee, Financial Management Association, Annual Meeting, 2023
- Reviewer, and Program committee member, Joint Conference on Advances in Computational Intelligence, 2022
- Journal of Economic Science Research, Editorial board member, 2020-2022
- Lead Guest Editor, “The concept of econophysics and phynance at a broader base”, International Journal of Applied Mathematics and Theoretical Physics, 2019-2021
- Lead Guest Editor, “Wider thoughts on the application of data mining tools and predictive modeling in finance”, American Journal of Data mining and Knowledge Discovery, 2019-2021

OTHER POSITIONS AND LEADERSHIP ROLES

Columbia University, GSAS

Graduate Senate

NY, USA

October 2022 –

- Representing graduate students in Natural Sciences at the University level.

Columbia University, GSAS

PhD council member and external representative

NY, USA

Oct 2022 –

- Representing PhD graduate students in the faculty of Arts and Sciences.

Columbia University, Statistics Department

Masters student representative

NY, USA

Sept 2022 –

- Representing, and advocating for MA Statistics students in the department

World Mathematical Society

Founder and President

Harare, Zimbabwe

Jan 2020 –

- Participating in planning, decision-making, and organizing events.

SKILLS & CERTIFICATIONS

- **Programming:** Python, MATLAB, R, Macaulay2, LATEX, STATA, VBA, SPSS, MINITAB
- **Languages:** English (fluent and professional), Shona (native)

MEMBERSHIPS AND AFFILIATIONS

- American Finance Association
- American Risk and Insurance Association
- Society for Industrial and applied Mathematics, Algebraic Geometry Chapter
- American Mathematical Society
- American Statistical Association
- London Mathematical Society