KARTIK PATEKAR

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EDUCATION

Oct 2020 – Jul 2021 **MASt in Applied Mathematics** **GPA - 78% (Distinction)**
University of Cambridge
Modules: Statistics and Probability

Aug 2016 – Apr 2020 **BTech in Engineering Physics with Honours and minor in Mathematics** **GPA - 9.89/10**
Indian Institute of Technology (IIT-Bombay)
Awarded Institute Silver medal and R.P. Memorial Award for academic achievements
Consistently ranked first among a cohort of 50 students in all 4 years

WORK EXPERIENCE

Feb 2023 – Present **Research Associate - Education Economics Projects** **J-PAL South Asia**
Professor(s) Abhijeet Singh, Mauricio Romero & Karthik Muralidharan

Project 1: *Addressing application constraints for an affirmative action policy that sponsors tuition fees in private schools for disadvantaged students*

- Analyzed survey data to estimate causal effects of information provision intervention and application support intervention on policy application rates in the 2x2 cross-randomized experiment
- Applied machine learning techniques on survey data to evaluate the possibility of estimating **Conditional ATE** and study heterogeneity in treatment effects across sample demographics
- Conducted literature review to create a comprehensive database of all **experimental EdTech studies** in developing countries since 2004 and organized them based on intervention type, treatment intensity, sample characteristics, and measured impact on learning outcomes
- Utilized GIS techniques to integrate gridded spatial population density data with administrative datasets; Created geographic variation maps using **R and QGIS** to aid sampling decisions

Project 2: *Evaluation of a tech-based education program that aims to improve learning levels of disadvantaged pre-primary children by sending at-home teaching resources to parents*

- Designed instruments (teacher survey, household survey and child assessment), conducted survey pilot, and **managed data collection** from 6,000+ households in 345 urban and rural low-income regions
- Ensured data quality through in-field monitoring and implementing high-frequency checks
- Handled data management and donor-related tasks (progress reports and documentation)

Jul 2024 – Present **Research Assistant (remote) - Spatial externalities**
Professor Gabriel Kreindler

- Developed an additive random utility discrete choice model to study local externalities and agent choices under general demand substitution patterns
- Quantified the impact of locally varying distributive effects on agent choices, including direct effects of charges and higher-order effects due to changes in externalities as agents reallocated across locations
- Determined socially optimal charges and the deadweight loss in unpriced equilibrium scenarios; established necessary and sufficient conditions for achieving social optima
- Showed how the model encompasses the classical case of global externality by deriving the demand and supply curve, and demonstrated that the deadweight loss reduces to the Harberger triangle's area
- Conducted numerical simulations to identify distinctive features arising in scenarios with localized externalities

Sep 2021 – Jan 2023 **Quantitative Trader** **DRW Holdings, London**

- Specialized in cross-exchange high-frequency trading strategies for Equities and Futures
- Performed **time-series analysis** to discern leading and lagging variables, subsequently integrating them in predictive **machine learning models** (neural networks and constrained regressors)

UNDERGRADUATE PROJECTS

Feb 2020 – May 2020 **Automation of deal entry process from Courthouse documents** **Firm: Enverus**
Machine Learning Internship

- Used **image localization and Optical Character Recognition (OCR)** techniques to convert scanned courthouse documents about US oil deals into unstructured textual data
- Fine-tuned Albert (Google's **natural language processing** model) to extract targeted information
- Improved accuracy by designing a deep learning model to understand out-of-vocabulary words using a **bi-directional Long-Short Term Memory (LSTM) Neural Network**

May 2019 – Jul 2019 **Gauge Theory of Doped Cuprates** **Harvard University**
Prof. Subir Sachdev

- Worked in a research group towards extending a partial differential equations model of doped cuprates (a semiconductor material), incorporating theoretical and experimental insights on phase transitions
- Converted these equations into a **Lagrangian optimization problem**. Used various analytical techniques to study system behavior (steady-state solution, saddle point approximation, and large-N approximation)
- Performed Monte-Carlo **simulations** in C++ to show that model results match the observed phase diagram

Nov 2018 – Dec 2018 **Quantum Measurement at Variable Strength** **Hiroshima University**
Prof. Hoffman Holger

- Worked to quantify the relation between decoherence (disturbance) and resolution in quantum measurements. Using theoretical motivations, quantified the measurement resolution in Quantum experiments using Hellinger distance, a metric commonly utilized in **information theory**
- Analytically showed that the decoherence is lower bounded by resolution, implying that a measurement will always disturb the quantum system more than the information obtained about system's initial state

PUBLICATIONS

- **Patekar, Kartik and Holger F Hofmann**, "The role of system–meter entanglement in controlling the resolution and decoherence of quantum measurements," *New Journal of Physics*, Oct 2019, *21* (10), 103006.
- **Scammell, Harley D., Kartik Patekar, Mathias S. Scheurer, and Subir Sachdev**, "Phases of SU(2) gauge theory with multiple adjoint Higgs fields in 2 + 1 dimensions," *Phys. Rev. B*, May 2020, *101*, 205124.

ACADEMIC AWARDS

- Represented India at the International Chemistry Olympiad 2016 in Tbilisi, Georgia, and secured the Silver medal
- **Ranked** 6^{th} in JEE-2016 among 1.1 million Indian students seeking admission to top engineering schools (IITs)
- Awarded S. N. Bose Fellowship in 2019 to undertake a summer research project at Harvard University
- Recipient of Narotam Sekhsaria Scholarship and Cambridge Trust Scholarship for study at the University of Cambridge

WORKSHOPS AND CONFERENCES ATTENDED

Jul 2023 **Summer School - Wage Determination & Difference-in-Differences** **Barcelona School of Economics**
Prof. Derek Neal & Prof. Jeffrey Wooldridge

Feb 2023 **RISE-IIMA Conference on Education Economics** **IIM-Ahmedabad**

Dec 2022 **Global Conference for Giftedness and Creativity (GCGC 2022)** **Jeddah, Saudi Arabia**

VOLUNTEERING EXPERIENCE

Oct 2022 – Jan 2023 **Research Associate** **Cambridge Development Initiative (NGO)**

- *Reviewed literature to identify the **challenges faced by Tanzanian students** in wake of COVID pandemic and proposed solutions that can be implemented by CDI as an international development organisation*
- *To address underlying challenges, designed an online **Education Resource Contributory Platform** (ERCP)*

Jul 2017 – Apr 2018 **Teaching Assistant** **Physics Department, IIT-Bombay**

- Teaching Assistant for courses "Thermal Physics" and "Quantum Mechanics I" for a class of 40 students

Apr 2018 – Mar 2019 **Institute Secretary, Maths and Physics Club** **IIT-Bombay**

- To foster Physics and Math enthusiasm, led a team of 8 to organize events throughout the year, such as research talks, science quizzes, lab visits, group discussions, and mentoring hobby projects

RELEVANT PROGRAMMING SKILLS

- *Proficient:* R, Python, Excel, and LaTeX. *Working knowledge:* Stata, QGIS and SurveyCTO
- Machine learning - neural networks, random forests, k-nearest neighbors, natural language processing models
- Data scraping, image processing, parallel computing, software development, large-scale simulations

RELEVANT COURSES

Undergraduate Math: Calculus, Linear Algebra, Differential Equations I & II, Data Analysis and Interpretation, Numerical Analysis, Real Analysis, Basic Algebra
Graduate Math: Modern Statistical Methods, Topics in Statistical Theory, Statistical Learning in Practice, Advanced Probability, Information Theory, Algebra II, Algebraic Topology
MITx[‡]**:** Foundations of Development Policy, Microeconomics, Data Analysis for Social Scientists, Political Economy and Economic Development, Designing and Running Randomized Evaluations
Miscellaneous: Economics, Psychology, Machine Learning, Environmental Studies, Renewable Energy Technologies

[‡] Online courses from MIT undergraduate program, evaluated through assignments and proctored exams.