KARTIK PATEKAR

PhD Applicant

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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.

Other Academic Achievements

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

PHYSICS 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.

WORKSHOPS AND CONFERENCES ATTENDED

Jul 2023 **Summer School - Wage Determination & Difference-in-Differences** **Barcelona School of Economics**
Prof. Derek Neal & Prof. Jeffrey Wooldridge
- Obtained average grade 8.25/10 (Excellent category) in the cohort of mostly junior Ph.D. candidates.
- Attended a week-long research presentation workshop.

Feb 2023 **RISE-IIMA Conference on Education Economics** **IIM-Ahmedabad**
- Attended research talks on Education and Development Economics focused on India.

Dec 2022 **Global Conference for Giftedness and Creativity 2022** **Jeddah, Saudi Arabia**
- Among 100 invitees from top schools to conference on cutting-edge science and technology research.
- Presented my work on quantum technology. Collaborated with peers to ideate a Global Talent Platform.

WORK EXPERIENCE

Feb 2023 – Present **Research Associate - Education Economics Projects** **J-PAL South Asia**
Prof. Abhijeet Singh, Prof. Mauricio Romero & Prof. Karthik Muralidharan
- Executed endline data collection for evaluation of a national NGO's **technology-based intervention** providing teaching resources to underprivileged parents to supplement pre-school learning (*Project 1*).
- Managed a 64-member field team to survey 6500+ households in 345 villages of Maharashtra state with **three different instruments** - teacher survey, parents survey, and child assessment (age 4-6).
- Gained hands-on experience in instrument design, survey piloting, enumerator training, project finance management, field planning, stakeholder engagement, data cleaning, and exploratory analysis.
- Performed preliminary analysis using administrative data in a study aiming to address application constraints in a government scheme that sponsors private schooling for disadvantaged students (*Project 2*).
- Applied **GIS techniques** to integrate gridded spatial data with national survey datasets using R, obtaining village-level aggregates to analyze the variation in application rates. Visualized geographical variation by plotting using **R and QGIS**. Presented my results to inform sampling decisions.
- Piloted 400 phone-based parent surveys and child assessments (age 3-7) in Chhattisgarh state for *Project 2*.

Sep 2021 – Jan 2023 **Quantitative Trader** **DRW Holdings, London**
- Specialized in cross-exchange high-frequency trading strategies for Equities and Futures. Attained Sharpe ratio of 1.7 while managing a substantial daily trading volume of approximately $1 billion.
- Conducted **time-series analysis** to discern leading and lagging variables, subsequently integrating them in predictive machine learning models, such as neural networks or constrained regressions.

UNDERGRADUATE PROJECTS

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

- Worked in 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.

Jul 2018 – Nov 2018 **Dimer Model** **IIT-Bombay**
Prof. Sumiran Pujari

- Studied the dimer model (on 2-dimensional lattice) using **probability theory and mean field theory**.
- Approximated the discrete model using continuum field (under mean field theory), and showed that the results match with exact solutions in simple cases.

Some Other Projects

4. **Automation of deal entry process from Courthouse documents |** *Industry Project, firm "Enverus"*: Used Machine Learning techniques (Image Processing, Optical Character Recognition, Natural Language Processing) to automate the task of extracting required information from unstructured court-house documents.
5. **Quantum Chaos in many-body systems |** *Prof. Gautam Mandal, TIFR*: Studied and characterized quantum chaos in many-body systems (such as atoms in strong electromagnetic fields) using techniques from the random matrix theory.
6. **Superconducting Quantum Circuits |** *Prof. Steven Girvin, Yale University*: Designed a superconducting three-wave mixing circuit to split one electric signal into two signals. Successfully obtained exact analytical solutions.
7. **Chaos in Special Relativistic Dynamics |** *Prof. Punit Parmananda, IIT-Bombay*: Worked out the partial differential equations describing a two-body relativistic system and simulated the dynamics to show chaotic behavior.
8. **Gesture Mouse |** *Prof. Pradeep Sarin, IIT-Bombay*: Developed a glove that controls computer pointer using hand gestures.

VOLUNTEERING EXPERIENCE

Aug 2023 – Present **Secondary school teaching volunteer** **Teach for India (NGO)**
Volunteering at a local public school under the supervision of a "Teach for India" fellow. Performed teaching and administrative tasks for grade 7 classrooms.

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 and QGIS
- 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

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