Raaz Dwivedi

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Academic appointments

FODSI Postdoctoral Fellow *2021—*

Harvard University, School of Engineering and Applied Sciences, Boston, USA
Massachusetts Institute of Technology, Department of EECS, Cambridge, USA

- Advisors: *Prof. Susan Murphy & Prof. Devavrat Shah*

Education

Ph.D., Electrical Engineering and Computer Sciences *2015—2021*

University of California, Berkeley, USA

- Advisors: *Prof. Martin Wainwright & Prof. Bin Yu*
- Thesis title: *Principled statistical approaches for sampling and inference in high dimensions*
- Thesis committee members: *Prof. David Aldous & Prof. Peter Bartlett*

B. Tech., Electrical Engineering *2010—2014*

Indian Institute of Technology, Bombay, India

- Advisor: *Prof. Vivek Borkar*
- Graduated with Honors in EE and Minors in Mathematics
- Secured Institute Rank 1 (amongst a thousand)

Research Interests

Theoretical and applied aspects of statistical machine learning and data science with a focus on causal inference, reinforcement learning, and theory of MCMC methods

Achievements & Awards

Institute of Mathematical Statistics (IMS) New Researcher Travel Award *London, 2022*

Best Presentation Award, Machine Learning and Statistics Session, Laboratory of Information and Decision Systems (LIDS) Student Conference, MIT *USA, 2022*

Best Student Paper Award, Sections on Statistical Computing and Statistical Graphics, American Statistical Association (ASA) *USA, 2022*

Outstanding Graduate Student Instructor Award, UC Berkeley *Berkeley, 2020*

Berkeley Student Travel Grant, Jerusalem Joint Statistical Event *Israel, 2018*

Student Travel Award, NeurIPS 2018 *Canada, 2018*

Oberwolfach Leibniz Graduate Students Travel Award *Germany, 2017*

Student Travel Award, SAMSI QMC Workshop 2017, Raleigh-Durham *USA, 2017*

Berkeley Fellowship, the most prestigious fellowship for incoming students *Berkeley, 2015*

President of India Gold Medal, IIT Bombay, for the highest GPA in the institute *India, 2014*

Institute Silver Medal, IIT Bombay, for the highest Honors GPA (EE department) *India, 2014*

Best B. Tech. Project (undergraduate thesis) Award, IIT Bombay *India, 2014*

Manjula Bagmal Parikh Foundation Trust Prize, IIT Bombay *India, 2014*

Dilip R. Limaye Academic Excellence Award, IIT Bombay *India, 2014*

Prof. K. C. Mukherji Award, IIT Bombay *India, 2014*

Urvish Medh Memorial Prize for excellent academic performance in the EE department in first through senior year, IIT Bombay *India, 2011—2014*

Institute Academic Excellence Prize for excellent institute wide academic performance in first through senior year, IIT Bombay *India, 2011—2014*

Aditya Choubey Prize for the best academic performance in the institute across the first year students, IIT Bombay *India, 2011*

All India Rank 10 (amongst half a million), IIT Joint Entrance Exam (IIT-JEE) *India, 2010*

All India Rank 46 (amongst a million), All India Engineering Entrance Exam *India, 2010*

Work Experience

Microsoft Research, Research Intern (with Lester Mackey), New England, USA *Summer 2019*

Mist Systems (Juniper Networks), Data Science Intern, Cupertino, USA *Summer 2017*

WorldQuant Research, Senior Quantitative Researcher, Mumbai, India *Jul 2014—Jul 2015*

Stanford University, Research intern (with Prof. Balaji Prabhakar), USA *Summer 2013*

Ivy Mobility, Data Science Intern, Chennai, India *Winter 2012*

Journal Publications

(⋆ denotes equal contribution, and † denotes alphabetical ordering; title is hyperlinked to the online pdf of the paper)

J1. **Raaz Dwivedi***, Yan Shuo Tan*, Briton Park, Mian Wei, Kevin Horgan, David Madigan, and Bin Yu, "Stable discovery of interpretable subgroups via calibration in causal studies", *International Statistical Review (ISR), 2020.*

J2. Nick Altieri†, Rebecca L. Barter, James Duncan, **Raaz Dwivedi**, Karl Kumbier, Xiao Li, Robert Netzorg, Briton Park, Chandan Singh, Yan Shuo Tan, Tiffany Tang, Yu Wang, Chao Zhang and Bin Yu, "Curating a COVID-19 data repository and forecasting county-level death counts in the United States", *Harvard Data Science Review (HDSR), 2020.*

J3. **Raaz Dwivedi***, Nhat Ho*, Koulik Khamaru*, Martin J. Wainwright, Michael I. Jordan and Bin Yu, "Singularity, misspecification, and the convergence rate of EM", *Annals of Statistics (AoS), 2020.*

J4. Yuansi Chen, **Raaz Dwivedi**, Martin J. Wainwright and Bin Yu, "Fast mixing of Metropolized Hamiltonian Monte Carlo: Benefits of multi-step gradients", *Journal of Machine Learning Research (JMLR), 2020.*

J5. **Raaz Dwivedi***, Yuansi Chen*, Martin J. Wainwright and Bin Yu, "Log-concave sampling: Metropolis-Hastings algorithms are fast", *Journal of Machine Learning Research (JMLR), 2019.*

J6. **Raaz Dwivedi**†, Ohad N. Feldheim, Ori Gurel-Gurevich and Aaditya Ramdas, "The power of online thinning in reducing discrepancy", *Probability Theory and Related Fields (PTRF), 2019.*

J7. Yuansi Chen*, **Raaz Dwivedi***, Martin J. Wainwright and Bin Yu, "Fast MCMC sampling algorithms on polytopes", *Journal of Machine Learning Research (JMLR), 2018.*

J8. Vivek Borkar†, **Raaz Dwivedi** and Neeraja Sahasrabudhe, "Gaussian approximations in high dimensional estimation", *Systems & Control Letters, 2016.*

Conference Publications

C1. **Raaz Dwivedi** and Lester Mackey, "Generalized kernel thinning", To appear in *International Conference on Learning Representations (ICLR), 2022.*

C2. Abhishek Shetty, **Raaz Dwivedi** and Lester Mackey, "Distribution compression in near-linear time", To appear in *International Conference on Learning Representations (ICLR), 2022.*

C3. **Raaz Dwivedi** and Lester Mackey, "Kernel thinning", Extended abstract in *Conference on Learning Theory (COLT), 2021.*

C4. **Raaz Dwivedi***, Nhat Ho*, Koulik Khamaru*, Martin J. Wainwright, Michael I. Jordan and Bin Yu, "Sharp analysis of Expectation-Maximization for weakly identifiable models", *The 23rd International Conference on Artificial Intelligence and Statistics (AISTATS), 2020.*

C5. **Raaz Dwivedi***, Nhat Ho*, Koulik Khamaru*, Martin J. Wainwright and Michael I. Jordan, "Theoretical guarantees for EM under misspecified Gaussian mixture models", *Advances in Neural Information Processing Systems (NeurIPS), Montreál, 2018.*

C6. **Raaz Dwivedi***, Yuansi Chen*, Martin J. Wainwright and Bin Yu, "Log-concave sampling: Metropolis-Hastings algorithms are fast", Extended abstract in *Conference on Learning Theory (COLT), Stockholm, 2018.*

C7. Yuansi Chen*, **Raaz Dwivedi***, Martin J. Wainwright and Bin Yu, "Vaidya walk: A sampling algorithm based on the volumetric barrier", *Communication, Control, and Computing (Allerton), 55th Annual Allerton Conference, 2017.*

C8. **Raaz Dwivedi** and Vivek Borkar, "Removing sampling bias in networked stochastic approximation", *International Conference on Signal Processing and Communications (SPCOM), Bangalore, 2014.*

Pre-Prints

P1. **Raaz Dwivedi**, Susan Murphy, and Devavrat Shah, "Counterfactual inference in sequential experimental design", *arXiv preprint.*

P2. **Raaz Dwivedi***, Chandan Singh*, Bin Yu and Martin J. Wainwright, "Revisiting minimum description length complexity in overparameterized models", *arXiv preprint (in journal submission).*

P3. Nhat Ho*, Koulik Khamaru*, **Raaz Dwivedi***, Martin J. Wainwright, Michael I. Jordan and Bin Yu, "Instability, computational efficiency, and statistical accuracy", *arXiv preprint (in journal submission).*

Research Talks

T1. Counterfactual inference in sequential experimental design. *MIT Statistics and Data Science Conference (SDSCon) 2022, MIT.* *April 2022*

T2. Counterfactual inference in sequential experimental design. *Econometrics Lunch, MIT.* *Mar 2022*

T3. Near-optimal compression in near-linear time. *Hot topics workshop on Foundations of Stable, Generalizable and Transferable Statistical Learning, Mathematical Sciences Research Institute (MSRI), Berkeley.* (Invited talk) *Mar 2022*

T4. Counterfactual inference in sequential experimental design. *Tea Talk, Laboratory for Information & Decision Systems (LIDS), MIT.* *Mar 2022*

T5. Counterfactual inference in sequential experimental design. *Stat 300, Harvard University.* *Feb 2022*

T6. Counterfactual inference in sequential experimental design. *Learning from Interventions Workshop, Simons Institute, Berkeley.* (Invited talk) *Feb 2022*

T7. Near-optimal compression in near-linear time. *27th Annual Laboratory for Information & Decision Systems (LIDS) Student Conference, MIT.* (Contributed talk) *Jan 2022*

T8. Imputation using nearest neighbors for adaptively collected data. *Foundations of Data Science Institute (FODSI) Retreat.* (Invited talk) *Jan 2022*

T9. Revisiting Minimum Description Length Complexity in Overparameterized Models. *Collaborations on the Theoretical Foundations of Deep Learning.* (Invited talk) *Nov 2021*

T10. Non-asymptotic Guarantees for MCMC and Kernel Thinning. *Finale Doshi-Velez Group Meeting, Harvard University.* (Invited talk) *Oct 2021*

T11. Kernel Thinning. *The Data-Centric Engineering Reading Group (DCE), Alan Turing Institute.* (Invited talk) *Sep 2021*

T12. Kernel Thinning. *Stat 300, Harvard University.* *Sep 2021*

T13. Kernel Thinning. *Monte Carlo Methods & Applications (MCM).* (Contributed talk) *Sep 2021*

T14. Kernel Thinning. *2021 World Meeting of the International Society for Bayesian Analysis (ISBA).* (Contributed talk) *Aug 2021*

T15. Kernel Thinning. *The Bayesian Young Statisticians Meeting (BAYSM) 2021.* (Contributed talk) *Aug 2021*

T16. Kernel Thinning. *Conference on Learning Theory (COLT).* (Contributed talk) *Aug 2021*

T17. Kernel Thinning. *Subset Selection in Machine Learning Workshop, International Conference on Machine Learning (Subset ML, ICML).* (Contributed talk) *Jul 2021*

T18. Revisiting Complexity and the Bias-Variance Tradeoff: Using Minimum Description Length. *North American School of Information Theory (NASIT).* (Contributed poster) *Jun 2021*

T19. Revisiting Complexity and the Bias-Variance Tradeoff: Using Minimum Description Length. *Workshop on the Theory of Overparameterized Machine Learning (TOPML).* (Contributed talk) *Apr 2021*

T20. Revisiting Complexity and the Bias-Variance Tradeoff: Using Minimum Description Length. *Stat 212, UC Berkeley.* (Guest Lecture) *Apr 2021*

T21. Subgroup Discovery in Randomized Experiments & Markov Chain Monte Carlo Sampling. *Research Seminar, USC Marshall School of Business.* (Invited talk) *Feb 2021*

T22. Subgroup Discovery in Randomized Experiments & Markov Chain Monte Carlo Sampling. *Statistics Seminar, University of Toronto.* (Invited talk) *Feb 2021*

T23. Subgroup Discovery in Randomized Experiments & Markov Chain Monte Carlo Sampling. *MINDS Symposium on the Foundations of Data Science, John Hopkins University.* (Invited talk) *Feb 2021*

T24. Subgroup Discovery in Randomized Experiments & Markov Chain Monte Carlo Sampling. *Devavrat Shah and Susan Murphy Group Meetings, MIT and Harvard University.* (Invited talk) *Feb 2021*

T25. Subgroup Discovery in Randomized Experiments & Markov Chain Monte Carlo Sampling. *Research Seminar, Microsoft Research New England.* (Invited talk) *Jan 2021*

T26. Non-asymptotic Guarantees for Markov Chain Monte Carlo. *Flatiron Institute Seminar.* (Invited talk) *Jan 2021*

T27. Subgroup Discovery in Randomized Experiments & Markov Chain Monte Carlo Sampling. *Statistics Seminar, University of Washington.* (Invited talk) *Jan 2021*

T28. Subgroup Discovery in Randomized Experiments & Markov Chain Monte Carlo Sampling. *Operations Research and Statistics Group Seminar, MIT Sloan.* (Invited talk) *Jan 2021*

T29. New Perspectives on Old Problems in Causal Inference and MCMC Sampling. *Statistics Seminar, UC Irvine.* (Invited talk) *Jan 2021*

T30. StaDISC: Stable discovery of interpretable subgroups via calibration. *Young Data Scientist Research Seminar, ETH Zurich.* (Invited talk) *Sep 2020*

T31. Veridical Data Science and the PCS Framework. *ASA Annual Symposium on Data Science and Statistics (SDSS).* (Invited talk) *Jun 2020*

T32. Statistics Meets Optimization: Two Vignettes on The Intersection, *Department of Mathematics and Statistics, IIT Kanpur, India.* (Invited talk) *Jan 2020*

T33. Singularity, misspecification and the convergence rate of Expectation-Maximization. *Fall Western Sectional Meeting of the AMS, UC Riverside.* (Invited talk) *Nov 2019*

T34. Power of gradients and accept-reject step in MCMC algorithms. *BIDS Statistics and Machine Learning Forum, UC Berkeley.* (Invited Talk) *Mar 2019*

T35. Log-concave sampling: Metropolis Hastings algorithms are fast. *Conference on Learning Theory (COLT) 2018, Stockholm, Sweden.* (Conference Poster) *Dec 2018*

T36. Log-concave sampling: Metropolis Hastings algorithms are fast. *Jerusalem Joint Statistical Event, Israel.* (Contributed talk) *Dec 2018*

T37. Theoretical guarantees for EM under misspecified Gaussian mixture models. *Neural Information Processing Systems (NeurIPS) 2018, Montreál, Canada.* (Conference Poster) *Dec 2018*

T38. Theoretical Guarantees for MCMC Algorithms, *Department of Electrical Engineering, IIT Bombay, India.* (Invited talk) *Jan 2018*

T39. Theoretical Guarantees for MCMC Algorithms, *School of Technology and Computer Science Seminar, TIFR Bombay, India.* (Invited talk) *Jan 2018*

T40. The power to two choices in reducing discrepancy, *SAMSI QMC Opening Workshop, Raleigh-Durham, Duke University.* (Contributed Poster) *Aug 2017*

Teaching Experience

Teaching Fellow, Harvard University *2022–*

- *Sequential Decision Making*: STAT 234, Spring 2022, Taught by Prof. Susan Murphy.

Graduate Student Instructor, UC Berkeley *2018—2019*

- *Introduction to Machine Learning*: EECS 189, Spring 2018, Taught by Prof. Anant Sahai and Prof. Jennifer Listgarten. *Co-led* the content development (homeworks, discussions and exams) in a team of 20+ TAs in a class of 350+ students.
- *Modern Statistical Prediction and Machine Learning*: STAT 154, Spring 2019, Taught by Prof. Bin Yu. Helped in *redesigning* the class along with one other TA, Yuansi Chen, for a class of 140+ students.

Teaching Assistant, IIT Bombay and Government of India *2011—2014*

Responsible for weekly discussions (40 students) besides exam grading, and (optional) help sessions for larger groups (up to 200 students)

- *Calculus*: MA 105, Fall 2011, Fall 2012 (Intensive Program for Entrants)
- *Linear Algebra*: MA 106, Spring 2012, Spring 2013, Spring 2014 (Online course for Ministry of Human Resource Development, by Government of India for 400 undergraduate colleges)
- *Ordinary Differential Equations*: MA 108, Spring 2012, Spring 2013
- *Electromagnetism*: PH 103, Fall 2011
- *Partial Differential Equations*: MA 207, Summer 2012

Guest lectures

- *STAT 234, Harvard University*: "Offline off-policy reinforcement learning" *Feb 2022*
- *EECS 189, UC Berkeley*: "An Introduction to Ensemble Methods" *Oct 2019*
- *STAT 154, UC Berkeley*: "Boosting" *Apr 2019*

Academic Services

Workshop

- Mentoring in the 2020-21 Summer Institute on "Building Just-in-Time Adaptive Interventions Using Micro-Randomized Trial Designs" for behavioral scientists (online) *Oct 2021*

Mentoring Activities

- Institute for Data, Systems and Society (IDSS) Postdoc Mentoring Program for *PhD students*, MIT *2022—*
- Berkeley Artificial Intelligence Research (BAIR) PhD Buddy Program for *incoming graduate students*, UC Berkeley *2020—2021*
- Berkeley Artificial Intelligence Research (BAIR) UG Mentoring Program for *undergraduate students*, UC Berkeley *2017—2021*
- Institute Student Mentoring Program (ISMP) for *incoming undergraduate students*, IIT Bombay *2013—2014*
- EE Department Academic Mentoring Program (DAMP) for *sophomores and juniors*, IIT Bombay *2012—2014*
- Intensive Program for Entrants (IPE) for *incoming undergraduates*, IIT Bombay *2012—2013*

Reviewing Activities

- *Journals*: Journal of Machine Learning Research (JMLR) (4 Papers), IEEE Transactions on Information Theory (4 Papers), Bernoulli (2 Papers), Mathematics of Operations Research (1 paper), Statistics and Computing (1 paper),
- *Conferences*: Conference on Learning Theory (COLT), International Conference on Machine Learning (ICML), Neural Information Processing Systems (NeurIPS), Foundations of Computer Science (FOCS), Symposium on Discrete Algorithms (SODA), AAAI Conference on Artificial Intelligence

Graduate Admissions

- EECS Graduate Admissions Committee, UC Berkeley *2018—2020*
- EECS Graduate Admissions Committee, MIT *2021*