






RAAZ DWIVEDI

 Harvard/MIT

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ACADEMIC APPOINTMENTS

Postdoctoral Fellow, Computer Science & Statistics, Harvard University and Electrical Engineering (EE) & Computer Sciences (CS), Massachusetts Institute of Technology (MIT) 2021—
Advisors: *Prof. Susan Murphy & Prof. Devavrat Shah*

EDUCATION

Ph. D., EECS, University of California (UC), Berkeley 2015—2021
Advisors: *Prof. Martin Wainwright & Prof. Bin Yu*
Thesis title: *Principled statistical approaches for sampling and inference in high dimensions*
B. Tech., EE, Indian Institute of Technology (IIT), Bombay, India 2010—2014
Minors in mathematics, Institute Rank 1

RESEARCH INTERESTS

My research involves a multi-disciplinary approach to data science and brings together ideas from computer science, electrical engineering, and statistics in collaboration with domain experts. I develop statistical machine learning approaches for data-driven personalized decision-making with research across *causal inference, reinforcement learning, Bayesian inference, random sampling, and high-dimensional statistics*.

SELECTED ACHIEVEMENTS & AWARDS

- Best Student Paper Award, Statistical Computing & Graphics, American Statistical Association 2022
- Best Presentation Award, Laboratory of Information & Decision Systems (LIDS) Conference, MIT 2022
- Certificate of Distinction and Excellence in Teaching (Q Award), Harvard University 2022
- Foundations of Data Science (FODSI) Postdoctoral Fellowship 2021
- Outstanding Graduate Student Instructor Award, UC Berkeley 2020
- Berkeley Fellowship, the most prestigious fellowship for incoming Ph. D. students 2015
- President of India Gold Medal, IIT Bombay, for the highest GPA in the graduating class 2014
- All India Rank 10 amongst half a million, IIT Joint Entrance Exam 2010

CONFERENCE PUBLICATIONS

(\star denotes equal contribution and \dagger denotes alphabetical ordering; title is hyperlinked to the online pdf of the paper)

- C1. **Raaz Dwivedi**, Lester Mackey. “Generalized kernel thinning”, *International Conference on Learning Representations (ICLR)*. 2022
- C2. Abhishek Shetty, **Raaz Dwivedi**, Lester Mackey. “Distribution compression in near-linear time”, *International Conference on Learning Representations (ICLR)*, **Best Student Paper Award, JSM**. 2022
- C3. **Raaz Dwivedi**, Lester Mackey, “Kernel thinning”, Extended abstract in *Conference on Learning Theory (COLT)*. Full version under review in *JMLR*. 2021
- C4. **Raaz Dwivedi** \star , Nhat Ho \star , Koulik Khamaru \star , Martin J. Wainwright, Michael I. Jordan, 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** \star , Nhat Ho \star , Koulik Khamaru \star , Martin J. Wainwright, Michael I. Jordan, “Theoretical guarantees for EM under misspecified Gaussian mixture models”, *Advances in Neural Information Processing Systems (NeurIPS)*. 2018
- C6. **Raaz Dwivedi** \star , Yuansi Chen \star , Martin J. Wainwright, Bin Yu, “Log-concave sampling: Metropolis-Hastings algorithms are fast”, Extended abstract in *Conference on Learning Theory (COLT)*. 2018
- C7. Yuansi Chen \star , **Raaz Dwivedi** \star , Martin J. Wainwright, Bin Yu, “Vaidya walk: A sampling algorithm based on the volumetric barrier”, *Allerton Conference*. 2017

JOURNAL
PUBLICATIONS

- C8. **Raaz Dwivedi**, Vivek Borkar, “Removing sampling bias in networked stochastic approximation”, *International Conference on Signal Processing and Communications (SPCOM)*. 2014
- J1. Nhat Ho^{*}, Koulik Khamaru^{*}, **Raaz Dwivedi**^{*}, Martin J. Wainwright, Michael I. Jordan, Bin Yu, “Instability, computational efficiency, and statistical accuracy”, *accepted with minor revision at JMLR*. 2022+
- J2. **Raaz Dwivedi**^{*}, Chandan Singh^{*}, Bin Yu, Martin J. Wainwright, “Revisiting minimum description length complexity in overparameterized models”, *accepted with minor revision at JMLR*. 2022+
- J3. 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, Bin Yu, “Curating a COVID-19 data repository and forecasting county-level death counts in the United States”, *Harvard Data Science Review (HDSR)*. 2021
- J4. **Raaz Dwivedi**^{*}, Yan Shuo Tan^{*}, Briton Park, Mian Wei, Kevin Horgan, David Madigan, Bin Yu, “Stable discovery of interpretable subgroups via calibration in causal studies”, *Int. Statistical Review*. 2020
- J5. **Raaz Dwivedi**^{*}, Nhat Ho^{*}, Koulik Khamaru^{*}, Martin J. Wainwright, Michael I. Jordan, Bin Yu, “Singularity, misspecification, and the convergence rate of EM”, *Annals of Statistics (AoS)*. 2020
- J6. Yuansi Chen, **Raaz Dwivedi**, Martin J. Wainwright, Bin Yu, “Fast mixing of Metropolized Hamiltonian Monte Carlo: Benefits of multi-step gradients”, *Journal of Machine Learning Research (JMLR)*. 2020
- J7. **Raaz Dwivedi**^{*}, Yuansi Chen^{*}, Martin J. Wainwright, Bin Yu, “Log-concave sampling: Metropolis-Hastings algorithms are fast”, *Journal of Machine Learning Research (JMLR)*. 2019
- J8. **Raaz Dwivedi**[†], Ohad N. Feldheim, Ori Gurel-Gurevich, Aaditya Ramdas. “The power of online thinning in reducing discrepancy”, *Probability Theory and Related Fields (PTRF)*. 2019
- J9. Yuansi Chen^{*}, **Raaz Dwivedi**^{*}, Martin J. Wainwright, Bin Yu. “Fast MCMC sampling algorithms on polytopes”, *Journal of Machine Learning Research (JMLR)*. 2018
- J10. Vivek Borkar[†], **Raaz Dwivedi**, Neeraja Sahasrabudhe. “Gaussian approximations in high dimensional estimation”, *Systems & Control Letters*. 2016

PRE-PRINTS &
WORKING PAPERS

- P1. **Raaz Dwivedi**, Katherine Tian, Sabina Tomkins, Predrag Klasnja, Susan Murphy, Devavrat Shah, “Counterfactual inference in sequential experimental design”, *arxiv, to be submitted to Annals of Statistics (AoS)*. 2022
- P2. **Raaz Dwivedi**, Katherine Tian, Sabina Tomkins, Predrag Klasnja, Susan Murphy, Devavrat Shah, “Doubly robust nearest neighbors in factor models”, *preliminary version on arxiv*. 2022
- P3. Abhin Shah, **Raaz Dwivedi**, Devavrat Shah, Greg Wornell, “On counterfactual inference with unobserved confounding”, *NeurIPS workshop, full version to be submitted to AoS*. 2022
- P4. Carles Domingo-Enrich, **Raaz Dwivedi**, Lester Mackey, “Compress then test: Powerful kernel testing in near-linear time”, *in conference submission*. 2022
- P5. **Raaz Dwivedi**^{*}, Kelly Zhang^{*}, Prasidh Chhabria, Predrag Klasnja, Susan Murphy, “Assessing personalization by a reinforcement learning algorithm”, *Working paper*. 2022+

SOFTWARES &
METHODOLOGIES

- S1. Carles Domingo-Enrich, **Raaz Dwivedi**, Lester Mackey. Python package “Compress then test” ([🔗 link](#)).
- S2. Abhishek Shetty^{*}, **Raaz Dwivedi**^{*}, Lester Mackey. Python package “Compress++” ([🔗 link](#)).
- S3. **Raaz Dwivedi**, Lester Mackey. Python package “Kernel Thinning” ([🔗 link](#)).
- S4. **Raaz Dwivedi**^{*}, Yan Shuo Tan^{*}, Briton Park, Mian Wei, Kevin Horgan, David Madigan, Bin Yu. Python repository “StaDISC” ([🔗 link](#)).
- S5. Yuansi Chen^{*}, **Raaz Dwivedi**^{*}, Martin Wainwright, Bin Yu. Python package (with C++ implementation) “Vaidya and John walks” ([🔗 link](#)).

SELECTED INVITED
TALKS

From HeartSteps to HeartBeats: Personalized Decision-making

- Operations, Information, and Technology Seminar, GSB, Stanford University *scheduled Jan 2023*
- Statistics and Data Science Seminar, Wharton, University of Pennsylvania *scheduled Jan 2023*
- Statistics Seminar, University of Chicago *scheduled Jan 2023*
- Statistics and Operation Research Seminar, UNC Chapel Hill *scheduled Jan 2023*
- Statistics Seminar, UCLA *scheduled Jan 2023*
- ML Ideas Seminar, Microsoft Research New England *scheduled Jan 2023*
- Operation Research and Industrial Engineering Seminar, Cornell University *Dec 2022*
- Operation Research and Industrial Engineering Seminar, Cornell Tech *Dec 2022*
- Statistics Seminar, Rutgers University *Nov 2022*
- ISL Colloquium, EE, Stanford University *Nov 2022*
- BLISS Seminar, EECS, UC Berkeley *Nov 2022*

Counterfactual inference in sequential experiments

- Informs Annual Meeting, Indianapolis *Oct 2022*
- Institute of Mathematical Statistics (IMS) Annual Meeting, London *Jun 2022*
- Learning from Interventions Workshop, Simons Institute, Berkeley *Feb 2022*

Near-optimal compression in near-linear time

- SIAM Conference on Uncertainty Quantification, Atlanta *Apr 2022*
- Statistical learning Workshop, Mathematical Sciences Research Institute, Berkeley *Mar 2022*

Kernel thinning

- Data-Centric Engineering Group, Alan Turing Institute, Virtual *Sep 2021*

Revisiting minimum description length complexity in overparameterized models

- Alg. Info Theory & Machine Learning Symp., Alan Turing Institute, London *Jul 2022*
- Collaborations on the Theoretical Foundations of Deep Learning, Virtual *Nov 2021*

StaDISC: Stable discovery of interpretable subgroups via calibration

- Young Data Scientist Research Seminar, ETH Zurich, Virtual *Sep 2020*
- ASA Annual Symposium on Data Science & Statistics, Virtual *Jun 2020*

Singularity, misspecification, & the convergence rate of EM

- Math & Statistics Seminar, IIT Kanpur *Jan 2020*
- AMS Special Sections Meeting, UC Riverside *Nov 2019*

Theoretical guarantees for MCMC algorithms

- BIDS Seminar, UC Berkeley *Mar 2019*
- EE Seminar, IIT Bombay *Jan 2018*
- STCS Seminar, TIFR Bombay *Jan 2018*

CONTRIBUTED
& OTHER RESEARCH
TALKS

Counterfactual inference in sequential experiments

- Statistics and data science conference (SDSCON), MIT *Apr 2022*
- Econometrics Lunch, MIT *Mar 2022*

Near-optimal compression in near-linear time

- LIDS Student Conference, MIT, **Best presentation award** *Jan 2022*

Generalized kernel thinning

- Joint Statistical Meeting (JSM), Washington DC *Aug 2022*

Kernel thinning

- Monte Carlo Methods & Applications (MCM), Virtual *Sep 2021*
- International Society for Bayesian Analysis (ISBA) World Meeting, Virtual *Aug 2021*
- The Bayesian Young Statisticians Meeting (BAYSM), Virtual *Aug 2021*
- Joint Statistical Meeting (JSM), Virtual *Aug 2021*
- Conference on Learning Theory (COLT), Virtual *Aug 2021*
- Subset Selection, International Conference on Machine Learning (ICML), Virtual *Jul 2021*

Revisiting complexity and the bias-variance tradeoff: Using minimum description length

- Theory of Overparameterized Machine Learning (TOPML) Workshop, Virtual *Apr 2021*

Converging fast and slow: Statistics vs optimization

- BAIR and BDD Retreat, Berkeley, Virtual *Aug 2020*

Log-concave sampling: Metropolis Hastings algorithms are fast

- Joint Statistical Meeting (JSM), Washington DC *Dec 2018*

Vaidya walk: A sampling algorithm based on the volumetric barrier

- Allerton Conference *Oct 2017*

CONTRIBUTED POSTER
PRESENTATIONS**On counterfactual inference with unobserved confounding**

- NeurIPS Causality for Real world impact workshop, New Orleans *Nov 2022*

Counterfactual inference in sequential experiments

- Cornell ORIE Young Researchers Workshop, Ithaca *Oct 2022*
- Royal Statistical Society (RSS) Conference, Aberdeen, Scotland *Sep 2022*
- Synthetic Control Methods Workshop, Data X, Princeton University *Jun 2022*
- American Causal Inference Conference (ACIC), UC Berkeley *May 2022*
- Symposium for Mathematical Sciences (SMaSH), Harvard University *May 2022*
- Statistics and data science conference (SDSCON), MIT *Apr 2022*

Near-optimal compression in near-linear time

- Royal Statistical Society (RSS) Conference, Aberdeen, Scotland *Sep 2022*

Generalized kernel thinning

- Advances in Approximate Bayesian Inference (AABI), Virtual *Feb 2022*

Revisiting minimum description length complexity in overparameterized models

- North American School of Information Theory (NASIT), Virtual *Jun 2021*

Theoretical guarantees for EM under misspecified Gaussian mixture models

- Neural Information Processing Systems (NeurIPS), Montréal, Canada *Dec 2018*

Log-concave sampling: Metropolis Hastings algorithms are fast

- Conference on Learning Theory (COLT), Stockholm, Sweden *Jul 2018*

On power of two choices in reducing discrepancy

- SAMSI Workshop, Duke University, Raleigh *Aug 2017*

TEACHING (TASHP)
EXPERIENCE

- T1. Sequential Decision Making (STAT 234), *Harvard University*. Gave four guest lectures and supervised several half-semester long research projects. *2022*

	<p>T2. Modern Statistical Prediction and Machine Learning (STAT 154), <i>UC Berkeley</i>. Gave one guest lecture, helped redesign the class, and developed new discussion sections, homeworks, and exams. 2019</p> <p>T3. Introduction to Machine Learning (EECS 189), <i>UC Berkeley</i>. Co-head for the content developments in team of 10+ TAs, helped design discussion sections, homeworks, and exams. 2018</p> <p>T4. Linear Algebra, Calculus, Differential equations (MA 105, 106, 108, 207), <i>IIT Bombay</i>. Taught teaching sections and several voluntary help sessions that were often attended by 200+ students. 2011–2014</p>
GUEST LECTURES	<p>L1. Regret analysis of posterior sampling (3 lectures, STAT 234), <i>Harvard University</i> Apr 2022</p> <p>L2. Offline off-policy reinforcement learning (STAT 234) <i>Harvard University</i>. Feb 2022</p> <p>L3. Revisiting complexity and the bias-variance tradeoff (STAT 212) <i>UC Berkeley</i>. Apr 2021</p> <p>L4. Introduction to ensemble methods in machine learning (EECS 189), <i>UC Berkeley</i>. Oct 2019</p> <p>L5. Introduction to boosting methods (STAT 154), <i>UC Berkeley</i>. Apr 2019</p>
ACADEMIC SERVICES	<p>Undergraduate Research Mentoring</p> <ul style="list-style-type: none"> • UC Berkeley, One student that led to a co-authored journal publication 2020–2021 • Harvard, Two students with three co-authored submissions in preparation 2022– <p>Institutional Mentoring</p> <ul style="list-style-type: none"> • MIT Institute for Data, Systems, & Society (IDSS) Postdoc Mentors for two <i>PhD</i> students 2022– • UC Berkeley Artificial Intelligence Research (BAIR) Buddies for two <i>incoming PhD</i> students 2020–2021 • UC Berkeley BAIR Mentoring Program for five <i>undergraduates</i> 2017–2021 • IIT Bombay Student Mentoring Program (ISMP) for twelve <i>incoming undergraduates</i> 2013–2014 • IIT Bombay Academic Mentoring Program (DAMP) for four <i>sophomores & juniors</i> 2012–2014 • IIT Bombay Intensive Mentoring Program for thirty <i>undergraduates</i> 2012–2013 <p>Committees</p> <ul style="list-style-type: none"> • Member, Committee on Equality and Diversity, IMS 2022– <p>Scientific Meetings</p> <ul style="list-style-type: none"> • Chair, New Researchers Group Session, IMS Annual Meeting 2022 • Chair, Statistical Machine Learning Session, IMS Annual Meeting 2022 • Mentor, Summer Institute on Just-in-Time Adaptive Interventions via MRTs 2021 <p>Graduate Admissions</p> <ul style="list-style-type: none"> • EECS Graduate Admissions Committee, MIT 2021 • EECS Graduate Admissions Committee, UC Berkeley 2018–2020 <p>Reviewing Activities</p> <ul style="list-style-type: none"> • <i>Journals</i>: JMLR, IEEE-IT, JRSSB, Bernoulli, HDSR, Stats & Comp., SIAM, MOR, Jour. of Causal Inference • <i>Conferences</i>: COLT, ICML, NeurIPS, AISTATS, FOCS, STOC, SODA, AAAI

WORK EXPERIENCE	Microsoft Research , Research Intern with Lester Mackey, New England, USA			2019
	Mist Systems, Juniper Networks, Data Science Intern, Cupertino, USA			2017
	WorldQuant Research, Senior Quantitative Researcher, Mumbai, India			2014–2015
	Stanford University , Research Intern with Prof. Balaji Prabhakar, USA			2013
	Ivy Mobility, Data Science Intern, Chennai, India			2012
REFERENCES				
	<div>SUSAN MURPHY Professor, CS & Statistics Harvard University (Postdoc Advisor) ✉ samurphy@fas.harvard.edu 🏠 people.seas.harvard.edu/~samurphy</div>	<div>DEVAVRAT SHAH Professor, EECS MIT (Postdoc Advisor) ✉ devavrat@mit.edu 🏠 devavrat.mit.edu</div>	<div>LESTER MACKEY Principal Researcher Microsoft Research New England Adjunct Professor, Stanford University ✉ lmackey@stanford.edu 🏠 web.stanford.edu/~lmackey</div>	
	<div>MARTIN WAINWRIGHT Professor, EECS MIT (Ph. D. Advisor) ✉ mjwain@mit.edu 🏠 people.eecs.berkeley.edu/~wainwrig</div>	<div>BIN YU Professor, EECS & Statistics UC Berkeley (Ph. D. Advisor) ✉ binyu@berkeley.edu 🏠 binyu.stat.berkeley.edu</div>		