Curriculum Vitae
Tudor A. Manole

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Research Areas

Theory: Statistical optimal transport, latent variable models, statistical machine learning, non-parametric hypothesis testing, distribution-free inference.

Applications: Quantum computing, high energy physics.

Employment

Norbert Wiener Postdoctoral Associate *7/2024–Present*
Massachusetts Institute of Technology
Institute for Data, Systems, and Society
Statistics and Data Science Center

Education

Ph.D. Statistics *8/2018–5/2024*
Carnegie Mellon University
Advisors: Larry Wasserman & Sivaraman Balakrishnan

M.Sc. Statistics *8/2018–5/2019*
Carnegie Mellon University

B.Sc. Honours Mathematics *9/2014–5/2018*
McGill University
Minor Computer Science
Distinction, First Class Honours in Mathematics

Awards

Umesh K. Gavaskar Memorial PhD Thesis Award, *Carnegie Mellon University* *2024*
ASA Student of the Year, *American Stat. Assoc., Pittsburgh Chapter* *2024*
Lawrence D. Brown Ph.D. Student Award, *Institute of Mathematical Statistics* *2023*
Hannan Graduate Student Travel Award, *Institute of Mathematical Statistics* *2022*
Statistical Learning and Data Science Student Paper Award, *American Stat. Assoc.* *2021*
Student Presentation Award, *Statistical Society of Canada* *2021*
Ph.D. Research Fellowship Runner-Up, *Two Sigma* *2021*
Graduate Presidential Fellowship, *Carnegie Mellon University* *2020*
Canadian Postgraduate Scholarship, *NSERC* *2020*
Undergraduate Research Award, *NSERC* *2017*
Undergraduate Research Award, *NSERC* *2016*

Publications

(*Equal contribution.)

Journal Publications

1. Ramdas, A., T. **Manole**. (2024). Randomized and Exchangeable Improvements of Markov's, Chebyshev's and Chernoff's Inequalities. *Statistical Science. (To appear.)*.
2. **Manole**, T., P. Bryant, J. Alison, M. Kuusela, L. Wasserman. (2024). Background Modeling for Double Higgs Boson Production: Density Ratios and Optimal Transport. *The Annals of Applied Statistics 18(4), 2950-2978.*
3. **Manole**, T., S. Balakrishnan, J. Niles-Weed, L. Wasserman. (2024). Plugin Estimation of Smooth Optimal Transport Maps. *The Annals of Statistics 52(3), 966-998.*
4. **Manole**, T., J. Niles-Weed. (2024). Sharp Convergence Rates for Empirical Optimal Transport with Smooth Costs. *The Annals of Applied Probability 34(1), 1108-1135.*
5. **Manole**, T., A. Ramdas. (2023). Sequential Estimation of Convex Functionals and Divergences. *IEEE Transactions on Information Theory 69(7), 4641-4658.*
6. **Manole**, T., S. Balakrishnan, L. Wasserman. (2022). Minimax Confidence Intervals for the Sliced Wasserstein Distance. *Electronic Journal of Statistics 16(1), 2252–2345.*
7. **Manole**, T., A. Khalili. (2021). Estimating the Number of Components in Finite Mixture Models via the Group-Sort-Fuse Procedure. *The Annals of Statistics 49(6), 3043–3069.*

Peer-Reviewed Conference Publications

8. **Manole**, T., N. Ho (2022). Refined Convergence Rates for Maximum Likelihood Estimation in Finite Mixtures Models. *Proceedings of the 39th International Conference on Machine Learning, PMLR 162:14979-15006. (Selected for Long Presentation.)*

Papers Under Revision

9. **Manole**, T., S. Balakrishnan, J. Niles-Weed, L. Wasserman. (2023+). Central Limit Theorems for Smooth Optimal Transport Maps. *Major Revision, The Annals of Applied Probability. arXiv:2312.12407.*
10. Balakrishnan, S., T. **Manole**. (2025). Stability Bounds for Smooth Optimal Transport Maps and their Statistical Implications. *Major Revision, Electronic Journal of Statistics. arXiv:2502.12326.*

Preprints

11. **Manole**, T., D. Mark, W. Gong, B. Ye, Y. Polyanskiy, S. Choi. (2025). How Much Can We Learn from Quantum Random Circuit Sampling? *Preprint available upon request.*
12. Hundrieser*, S., T. **Manole***, D. Litskevich, A. Munk. (2025). Local Poisson Deconvolution for Discrete Signals. *arXiv:2508.00482.*
13. Balakrishnan, S., T. **Manole**, L. Wasserman. (2025). Statistical Inference for Optimal Transport Maps: Recent Advances and Perspectives. *arXiv:2506.19025.*
14. **Manole***, T., N. Ho*. (2020). "Uniform Convergence Rates for Maximum Likelihood Estimation under Two-Component Finite Mixture Models". *arXiv:2006.00704.*

Patents

1. Advanced Methods to Benchmark Noisy Quantum Devices.
   Inventors: Manole, T., D. Mark, W. Gong, B. Ye, Y. Polyanskiy, S. Choi.
   United States Provisional Patent Application No. 63/866,172. *Filed 8/2025.*

Presentations

Invited Talks at International Conferences and Workshops

1. Sharp Deconvolution of Optimal Transport Matchings. *12/2025*
   IMS International Conference on Statistics and Data Science, Seville, Spain
2. Quantitative Stability of Smooth Optimal Transport Maps. *11/2025*
   Workshop on Optimal Transport, Fields Institute, Toronto, Canada
3. Statistical Methods for Benchmarking Quantum Random Circuits. *10/2025*
   INFORMS Annual Meeting, Atlanta, GA.
4. How Much Can We Learn from Quantum Random Circuit Sampling? *10/2025*
   Math. of Computation and Algorithms Workshop, IBM Research, Cambridge, MA.
   (Co-speaker: Daniel K. Mark.)
5. Sharp Deconvolution of Optimal Transport Matchings. *8/2025*
   Joint Statistical Meetings, Nashville, TN.
6. Sharp Deconvolution of Optimal Transport Matchings. *7/2025*
   SIAM Annual Meeting, Montreal, Canada.
   (Canceled due to visa travel restriction.)
7. Sharp Deconvolution of Optimal Transport Matchings. *5/2025*
   Institute for Pure & Applied Mathematics, Los Angeles, CA.
8. Sharp Deconvolution of Optimal Transport Matchings. *3/2025*
   Statistics and Optimal Transport Workshop, Columbia University.
9. Central Limit Theorems for Smooth Optimal Transport Maps. *11/2024*
   NA-NM-AT Conference, Tiberiu Popoviciu Institute of Numerical Analysis, Virtual.
10. Efficient Inference for the Quadratic Wasserstein Distance. *8/2024*
    11th World Congress in Probability and Statistics, Bochum, Germany.
11. Central Limit Theorems for Smooth Optimal Transport Maps. *7/2024*
    International Conference on Robust Statistics, Fairfax VA, United States.
12. Central Limit Theorems for Smooth Optimal Transport Maps. *6/2024*
    Mathematisches Forshungsinstitut Oberwolfach, Oberwolfach, Germany.
13. Central Limit Theorems for Smooth Optimal Transport Maps. *12/2023*
    IMS International Conference on Statistics and Data Science, Lisbon, Portugal.
14. Central Limit Theorems for Smooth Optimal Transport Maps. *12/2023*
    CMStatistics Conference, Berlin, Germany.
15. Plugin Estimation of Smooth Optimal Transport Maps. *8/2023*
    Joint Statistical Meetings, Toronto, Canada.
16. Homogeneity Testing in the Search for Pairs of Higgs Bosons at the LHC. *5/2023*
    Statistical Society of Canada Annual Meeting, Ottawa, Canada.
17. Optimal Transport in High-Energy Physics. *4/2023*
    Banff International Research Station, Banff, Canada.
    (Co-speaker: Philipp Windischhofer.)
18. Order Selection for Finite Mixture of Regression Models. *5/2022*
    Statistical Society of Canada Annual Meeting, Virtual.
19. Transfer Learning for Data-Driven Background Modelling. *11/2021*
    PhyStat–Systematics Workshop, Virtual.
20. Uniform Convergence Rates for the MLE under Two-Component Gaussian Mixtures. *5/2021*
    Fourth International Conference of Econometrics and Statistics, Virtual.

Invited Talks at University Seminars

21. How Much Can We Learn from Quantum Random Circuit Sampling? *12/2025*
Stochastics Colloquium, University of Göttingen, Germany.

22. How Much Can We Learn from Quantum Random Circuit Sampling? *10/2025*
Penn State–Purdue–Maryland Mathematical Data Science Seminar.

23. Central Limit Theorems for Smooth Optimal Transport Maps. *3/2025*
Computational and Applied Mathematics Seminar, Tufts University.

24. Central Limit Theorems for Smooth Optimal Transport Maps. *10/2024*
Statistics and Stochastics Seminar, Massachusetts Institute of Technology.

25. Central Limit Theorems for Smooth Optimal Transport Maps. *9/2024*
CRM Applied Mathematics Seminar, McGill University, Canada.

26. Central Limit Theorems for Smooth Optimal Transport Maps. *9/2024*
Statistics Seminar, Cornell University.

27. Minimax Nonparametric Testing in Wasserstein Distance. *6/2024*
Stochastics Colloquium, University of Göttingen, Germany.

28. Statistical Inference for Multivariate Optimal Transport. *1/2024*
Monthly Seminar of the University of Freiburg Research Unit "Mathematical Statistics in the Information Age—Statistical Efficiency and Computational Tractability".

29. Statistical Inference for Multivariate Optimal Transport. *1/2024*
Institute for Foundations of Data Science Seminar Series, Yale University.
(Postdoc job talk.)

30. Optimal Transport with Applications to Data-Driven Background Modeling. *2/2023*
McWilliams Center for Cosmology, Carnegie Mellon University.

31. Statistical Inference for Optimal Transport via Density Estimation. *11/2022*
Stochastics Colloquium, University of Göttingen, Germany.

32. Order Selection in Multidimensional Finite Mixture Models. *1/2017*
Statistics Seminar, McGill University, Canada.

Invited Lectures

33. Three Lectures on Estimating the Wasserstein Distance. *7/2025*
Summer School on Optimal Transport (invited by Katy Craig), UC Santa Barbara.

34. Plugin Estimation of Smooth Optimal Transport Maps. *4/2025*
Guest Lecture (invited by Andrew Nobel), UNC Chapel Hill.

35. Statistical Inference for Optimal Transport. *3/2024*
Guest Lecture (invited by Johannes Wiesel), Carnegie Mellon University.

36. Inference for Optimal Transport via Linearization of Monge-Ampère. *12/2024*
Guest Lecture (invited by Axel Munk), University of Göttingen, Germany.

37. Reverse Martingales and their uses in Sequential Analysis. *5/2021*
Three-Hour Guest Lecture (invited by Aaditya Ramdas), Carnegie Mellon University.

Invited Talks at Peer-Reviewed Conferences

38. Refined Convergence Rates for the MLE under Finite Mixture Models. *7/2022*
Long Presentation, International Conference on Machine Learning, Virtual.

39. Minimax Confidence Intervals for the Sliced Wasserstein Distance. *12/2019*
Spotlight, Optimal Transport and ML Workshop, NeurIPS, Vancouver, Canada.

Contributed Talks at International Conferences

40. Plugin Estimation of Smooth Optimal Transport Maps and Wasserstein Distances. *8/2022*
Joint Statistical Meetings, Washington, DC.

41. Plugin Estimation of Smooth Optimal Transport Maps. *6/2022*
Institute of Mathematical Statistics Annual Meeting, London, UK.

42. Order Estimation in Finite Mixture Models via the Group-Sort-Fuse Procedure. *8/2021*
Joint Statistical Meetings, Virtual.

43. Sequential Estimation of Convex Divergences. *6/2021*
Statistical Society of Canada Annual Meeting, Virtual.

Poster Presentations

44. Sample Complexity of Error Characterization in Quantum Random Circuit Sampling. *1/2025*
QSEC Annual Research Conference, Carroll, NH.

Short-Term Research Visits

1. Institute for Mathematical Stochastics, Georg August University of Göttingen.
Hosted by Axel Munk, 11/7–20/2022; 12/4–15/2023; 6/9–23/2024; 12/18–23/2025.

2. Department of Statistics and Data Science, Cornell University.
Hosted by Florentina Bunea, 9/24–27/2024.

3. Department of Statistics and Operations Research, UNC Chapel Hill.
Hosted by Andrew Nobel, 4/23–25/2025.

Professional Service

Journal Reviewing

Annals of Applied Probability, Annals of Statistics (x10), Bayesian Analysis, Bernoulli, Biometrika, Electronic Communications in Probability, Electronic Journal of Statistics (x2), Information and Inference, Journal of Applied Probability, Journal of Machine Learning Research (x2), Journal of the American Statistical Association, Journal of the Royal Statistical Society, Series B (x2), IEEE Transactions on Pattern Analysis and Machine Intelligence, Statistica Sinica, Statistical Science, Statistical Theory and Related Fields, Transactions on Machine Learning Research.

Conference Reviewing

International Conference on Machine Learning (2020; Top 33% Reviewer), Neural Information Processing Systems (2020; Top 10% Reviewer), NeurIPS Optimal Transport and Machine Learning Workshop (2023), Conference on Learning Theory (2025)

Miscellaneous

Co-organizer of the Statistical Machine Learning Reading Group *9/2022–8/2023*
Carnegie Mellon University.

Teaching Experience

Teaching (as Sole Instructor)

Carnegie Mellon University, Department of Statistics and Data Science

36-225	Introduction to Probability Theory (Undegraduate, 47 students)	*Summer 2023*

Teaching Assistantships

Carnegie Mellon University, Department of Statistics and Data Science

36-709	Advanced Statistical Theory I (Graduate)	*Spring 2024*
36-705	Intermediate Statistics (Graduate)	*Fall 2021*
36-219	Probability Theory and Random Processes (Undergraduate)	*Spring 2021*
36-705	Intermediate Statistics (Graduate)	*Fall 2020*
36-662	Data Mining (Undergraduate/Graduate)	*Spring 2020*
36-700	Probability and Mathematical Statistics (Graduate)	*Fall 2019*
36-350	Statistical Computing (Undergraduate)	*Summer 2019*
36-217	Probability Theory and Random Processes (Undergraduate)	*Fall 2018–Spring 2019*

Professional Memberships

Institute of Mathematical Statistics
American Statistical Association
Institute for Operations Research and the Management Sciences