Tengyuan Liang

curriculum vitae

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Academic Appointment

2017– **The University of Chicago**, *Booth School of Business*, United States.
Professor of Econometrics and Statistics, 2022 –
Associate Professor, 2021 – 2022
Assistant Professor, 2017 – 2021

Becker Friedman Institute, *Big Data Initiative*.
Affiliated Scholar, 2018 –

The Center for Applied Artificial Intelligence.
Faculty Affiliates, 2022 –

2024 **The University of Chicago Campus in Hong Kong**, Hong Kong.
Raymond Hung Global Faculty in Residence

Education

2012–2017 **University of Pennsylvania**, *The Wharton School*, United States.
Ph.D. in Statistics

2008–2012 **Peking University**, China.
B.S. in Mathematics

Visiting Positions

2019 Yale University, *Cowles Foundation for Research in Economics*.
Visiting Assistant Professor in Econometrics

2016 Yahoo Research New York, *Online Learning and Optimization Group*.
Summer Research Scientist

Fellowships & Awards

2022– William Ladany Faculty Fellow

2021–2026 NSF CAREER Grant
DMS - 2042473 "New Statistical Paradigms Reconciling Empirical Surprises in Modern Machine Learning", by National Science Foundation, Division of Mathematical Sciences

2021–2022 William S. Fishman Faculty Scholar

2017–2021 George C. Tiao Faculty Fellow
research fellowship for computational and data science awarded by the Booth School

2014–2017 Winkelman Fellowship
highest honorific fellowship awarded by the Wharton School

2016 J. Parker Memorial Bursk Award
awarded by the Statistics Department at the Wharton School for excellence in research

2014 US Junior Oberwolfach Fellow

Research

Research Interests

Fields: Learning, Inference, Optimization, Econometrics.

Working Papers

- T. Liang, B. Recht.
"Randomization Inference When N Equals One."
arXiv:2310.16989 [v1]

- M. H. Farrell, T. Liang, S. Misra.
"Deep Learning for Individual Heterogeneity: An Automatic Inference Framework."
arXiv:2010.14694 [v2]

- T. Liang.
"Estimating Certain Integral Probability Metrics (IPMs) Is as Hard as Estimating under the IPMs."
arXiv:1911.00730 [v1]

Peer-Reviewed Publications

- T. Liang.
"Blessings and Curses of Covariate Shifts: Adversarial Learning Dynamics, Directional Convergence, and Equilibria."
Journal of Machine Learning Research, conditionally accepted, 2024.

- Y. Hur, T. Liang.
"Detecting Weak Distribution Shifts via Displacement Interpolation."
Journal of Business & Economic Statistics, forthcoming, 2024.

- Y. Hur, W. Guo, T. Liang.
"Reversible Gromov-Monge Sampler for Simulation-Based Inference."
SIAM Journal on Mathematics of Data Science, 6(2):283-310, 2024.

- T. Liang, S. Sen, P. Sur.
"High-Dimensional Asymptotics of Langevin Dynamics in Spiked Matrix Models."
Information and Inference: A Journal of the IMA, 12(4):2720-2752, 2023.

- T. Liang, B. Recht.
"Interpolating Classifiers Make Few Mistakes."
Journal of Machine Learning Research, 24(20):1-27, 2023.

- W. Guo, Y. Hur, T. Liang, C. Ryan.
"Online Learning to Transport via the Minimal Selection Principle."
Conference on Learning Theory, pmlr 178:4085-4109, 2022.

- T. Liang.
"Universal Prediction Band via Semi-Definite Programming."
Journal of the Royal Statistical Society: Series B (Statistical Methodology), 84(4):1558–1580, 2022.

- T. Liang, P. Sur.
"A Precise High-Dimensional Asymptotic Theory for Boosting and Minimum-ℓ_1-Norm Interpolated Classifiers."
The Annals of Statistics, 50(3):1669-1695, 2022.

- T. Liang, H. Tran-Bach.
"Mehler's Formula, Branching Process, and Compositional Kernels of Deep Neural Networks."
Journal of the American Statistical Association (Theory and Methods), 117:539, 1324-1337, 2022.

- T. Liang.
"How Well Generative Adversarial Networks Learn Distributions."
Journal of Machine Learning Research, 22(228):1-41, 2021.

- M. H. Farrell, T. Liang, S. Misra.
"Deep Neural Networks for Estimation and Inference."
Econometrica, 89(1):181-213, 2021.

- X. Dou, T. Liang.
"Training Neural Networks as Learning Data-adaptive Kernels: Provable Representation and Approximation Benefits."
Journal of the American Statistical Association (Theory and Methods), 116:535, 1507-1520, 2021.

- T. Liang, A. Rakhlin, X. Zhai.
"On the Multiple Descent of Minimum-Norm Interpolants and Restricted Lower Isometry of Kernels."
Conference on Learning Theory, pmlr 125:2683-2711, 2020.

- T. Liang, A. Rakhlin.
"Just Interpolate: Kernel "Ridgeless" Regression Can Generalize."
The Annals of Statistics, 48(3):1329-1347, 2020.

- T. T. Cai, T. Liang, A. Rakhlin.
"Weighted Message Passing and Minimum Energy Flow for Heterogeneous Stochastic Block Models with Side Information."
Journal of Machine Learning Research, 21(11):1-34, 2020.

- T. Liang, W. J. Su.
"Statistical Inference for the Population Landscape via Moment Adjusted Stochastic Gradients."
Journal of the Royal Statistical Society: Series B (Statistical Methodology), 81(2):431-456, 2019.

- T. Liang, J. Stokes.
"Interaction Matters: A Note on Non-asymptotic Local Convergence of Generative Adversarial Networks."
International Conference on Artificial Intelligence and Statistics, pmlr 89:907-915, 2019.

- T. Liang, T. Poggio, A. Rakhlin, J. Stokes.
"Fisher-Rao Metric, Geometry, and Complexity of Neural Networks."
International Conference on Artificial Intelligence and Statistics, pmlr 89:888-896, 2019.

- B. Tzen, T. Liang, M. Raginsky.
"Local Optimality and Generalization Guarantees for the Langevin Algorithm via Empirical Metastability."
Conference on Learning Theory, pmlr 75:857-875, 2018.

- S. Kale, Z. Karnin, T. Liang, D. Pál.
"Adaptive Feature Selection: Computationally Efficient Online Sparse Linear Regression under RIP."
International Conference on Machine Learning, pmlr 70:1780-1788, 2017.

- T. T. Cai, T. Liang, A. Rakhlin.
  "Computational and Statistical Boundaries for Submatrix Localization in a Large Noisy Matrix."
  The Annals of Statistics, 45(4):1403-1430, 2017.

- T. T. Cai, T. Liang, A. Rakhlin.
  "On Detection and Structural Reconstruction of Small-World Random Networks."
  IEEE Transactions on Network Science and Engineering, 4(3):165-176, 2017.

- T. T. Cai, T. Liang, A. Rakhlin.
  "Geometric Inference for General High-Dimensional Linear Inverse Problems."
  The Annals of Statistics, 44(4):1536-1563, 2016.

- T. Liang, A. Rakhlin, K. Sridharan.
  "Learning with Square Loss: Localization through Offset Rademacher Complexity."
  Conference on Learning Theory, pmlr 40:1260-1285, 2015.
  nominated for the best paper award

- A. Belloni, T. Liang, H. Narayanan, A. Rakhlin.
  "Escaping the Local Minima via Simulated Annealing: Optimization of Approximately Convex Functions."
  Conference on Learning Theory, pmlr 40:240-265, 2015.

- T. T. Cai, T. Liang, H. H. Zhou.
  "Law of Log Determinant of Sample Covariance Matrix and Optimal Estimation of Differential Entropy for High-Dimensional Gaussian Distributions."
  Journal of Multivariate Analysis, 137:161-172, 2015.

Professional Activities

2023– **Associate Editor**, *Operations Research*.

2020– **Editorial Board**, *Journal of Machine Learning Research*.

2020– **Senior Program Committee**, *Conference on Learning Theory (COLT)*.

2014– **Journal and Conference Referee**.

- **Probability and Statistics**: *Annals of Statistics, Journal of the Royal Statistical Society Series B (Statistical Methodology), Journal of the American Statistical Association (Theory and Methods), Biometrika, Bernoulli Journal, Statistica Sinica, Latin American Journal of Probability and Mathematical Statistics, Statistical Science, Probability Theory and Related Fields.*
- **Learning Theory**: *Journal of Machine Learning Research, Conference on Learning Theory (COLT), Symposium on the Theory of Computing (STOC), International Conference for Learning Representations (ICLR).*
- **Economics**: *Review of Economic Studies, Econometrica, Journal of Econometrics, Review of Economics and Statistics.*
- **Information Theory**: *IEEE Transactions on Information Theory, IEEE International Symposium on Information Theory (ISIT).*
- **Operations Research**: *Mathematics of Operations Research.*
- **Applied Mathematics**: *SIAM Journal on Mathematics of Data Science, Mathematical Statistics and Learning.*

Invited Presentations

2023–2024
- Warwick [Econometrics and Statistics Seminar Series, joint between Dept. of Economics and Dept. of Statistics]
- LSE [Data Science Seminar, Dept. of Statistics]
- Academia Sinica [Statistics Seminar, Institute of Statistical Science]
- HKUST [Data Science Seminar, Business School]

2022–2023
- Cornell [Statistics Seminar, Dept. of Statistics and Data Science]
- UCSD [Econometrics Seminar, Dept. of Economics]
- Princeton [Wilks Seminar Series, ORFE]
- UPenn [Statistics Seminar, Wharton School of Business]
- UW Madison [Statistics Seminar, Dept. of Statistics]
- UCLA [Econometrics Seminar, Dept. of Economics]
- UC Irvine [Econometrics Seminar, Dept. of Economics]

2021–2022
- UBC [Operations Research Seminar, Sauder School of Business]
- UCL [Econometrics Seminar, Dept. of Economics]
- UIUC [Statistics Seminar, Dept. of Statistics]
- MSR New England [Machine Learning Seminar]

2020–2021
- NSF-Simons Research Collaborations [Mathematics of Deep Learning Workshop, 60 mins talk]
- UMass Amherst [Statistics and Probability Seminar, Dept. of Mathematics and Statistics]
- Rutgers [Statistics Seminer, Dept. of Statistics]
- Durham [Econometrics Seminar at Business School]
- LSE [Econometrics Seminar, Dept. of Economics]

2019–2020
- MIT [Statistics and Stochastics Seminar Series, IDSS]
- Yale [Econometrics Seminar, Dept. of Economics]
- Harvard [Statistics Colloquium, Dept. of Statistics]
- MIT [MIFODS Workshop "Learning with a complex structure," 45 mins talk]
- Duke [TRIPODS Workshop "Theory and modeling of deep learning," 50 mins talk]
- Google Research NYC [Learning Theory Seminar]

2018–2019
- Duke [Decision Sciences Seminar, Fuqua School of Business]
- ENSAE-CREST [Center for Research in Economics and Statistics Seminar]
- UChicago [Joint U Chicago and TTIC Machine Learning Seminar]

2017–2018
- UIUC [Machine Learning Seminar, ECE Dept.]
- UChicago [Statistics Colloquium, Dept. of Statistics]
- HKUST [Joint Statistics Seminar, Business School and Dept. of Mathematics]

2016–2017
- Stanford [Statistics Seminar, Dept. of Statistics]
- Princeton [Colloquia, Operation Research and Financial Engineering]
- MIT [Operations Research and Statistics Seminar, Sloan School of Management]
- UChicago [Econometrics and Statistics Seminar, Booth School of Business]
- Cambridge [Statistical Laboratory Seminar, Dept. of Mathematics]
- Georgia Tech [Statistics Seminar, Dept. of Mathematics]
- UCSD [Statistics Seminar, Dept. of Mathematics]
- UVA [Statistics Seminar, Dept. of Statistics]
- UIUC [Statistics Seminar, Dept. of Statistics]
- Rutgers [Statistics Seminar, Dept. of Statistics, cancelled]
- Imperial College London [Operations Management Seminar, Business School]
- Yahoo Labs [Machine Learning Seminar]

Conferences CIRM [New Challenges in High-dimensional Statistics], MFO [Statistics and Learning Theory in the Era of Artificial Intelligence], BIRS [Statistical Aspects of Trustworthy Machine Learning], PolyU [Workshop on Mathematical Foundations of Data Science and AI], NBER [Big Data and Securities Markets Conference], CAS AMSS-PolyU [Joint Laboratory of Applied Mathematics Workshop], COLT 2022 , IMS-COLT Workshop 2022 , FIMI 2022 [Invited Speaker, Workshop on Functional Inference and Machine Intelligence, Japan], CIRM [Meeting in Mathematical Statistics: Machine Learning and Nonparametric Statistics, Luminy, France], IMS Annual Meeting 2022 [Invited Session, "Prediction and Sampling with Deep Neural Networks"], ICML 2021 [Invited Speaker, Workshop "Over-parameterization: Pitfalls and Opportunities"], JSM 2020 [IMS Invited Session, "Theory of Deep Learning"], ICCOPT 2019 [Generalization and Optimization Invited Session], JSM 2019 [Invited Session on "Modern Nonparametrics"], AISTATS 2019 [Present Two Papers], DALI 2019 [Machine Learning Theory Invited Session, George, South Africa], Econometric Conference on Big Data [Invited Talk at "Factor Models" Session, Tsinghua Univ.], COLT 2018 [Stochastic Optimization Session, KTH], Issac Newton Institute [Workshop on Future Challenges in Statistical Scalability, Cambridge], EcoSta 2018 [Frontiers in Financial Statistics Invited Session, CityU Hong Kong], CISS 2018 [Statistical Learning Invited Session, Princeton], ICML 2017 [Online Learning Session, Sydney], COLT 2015 [University Pierre and Marie Curie, Two Long Talks], Yale [NSF Workshop for Empirical Process and Modern Statistical Decision Theory], CIRM [Meeting in Mathematical Statistics: New Procedures for New Data, Luminy, France], CRM [Workshop on the Mathematical Foundations of Learning Theory, Barcelona, Spain], MFO [Workshop on Adaptive Statistical Inference, Oberwolfach, Germany].

Teaching Experience

2017– **University of Chicago Booth School of Business**, *Instructor*.
- Winter 23: Data, Learning and Algorithms
- Winter 23: Business Statistics
- Winter 22: Business Statistics
- Fall 21: Business Statistics
- Fall 20: Business Statistics
- Fall 19: Business Statistics
- Fall 18: Business Statistics
- Spring 18: Business Statistics

2012–2017 **Wharton School at University of Pennsylvania**, *Recitation Instructor and Teaching Assistant*.
- Spring 17: Stochastic Processes
- Spring 15: Concentration Inequalities
- Spring 14, Spring 15: Advanced Quantitative Modeling
- Fall 13: Introductory Statistics
- Spring 13: Statistical Inference
- Fall 12, Fall 15, Fall 16: Probability

University Service

2020–2022 **Organizer**, *Econometrics and Statistics Colloquium*, Chicago Booth.

Mentoring & Advising

2018– **Doctoral Students**.
Wenxuan Guo [2026, PhD, Chicago Booth], YoonHaeng Hur [2024, PhD, UChicago Stat], Hai Tran-Bach [2023, PhD, UChicago Stat], Xialiang Dou [2021, PhD, UChicago Stat → Two Sigma].

2018– **Dissertation Committee**.
Sen Na [2021, PhD, UChicago Stat → Postdoc, Berkeley], Shihao Gu [2021, PhD, Chicago Booth], Jingyu He [2020, PhD, Chicago Booth → Assistant Professor, CityU Hong Kong], Ming Yu [2020, PhD, Chicago Booth → Citadel], Qi An [2019, PhD, Chicago Booth]

2018– **Organizer**, *Data Science Reading Group*, UChicago.
mentoring PhD students from Statistics and Computational and Applied Mathematics