

# DANIEL LACKER

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## ACADEMIC POSITIONS

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- 2024– **Associate Professor with tenure**, Columbia University, Industrial Engineering & Operations Research
- 2022–2024 **Associate Professor without tenure**, Columbia University, Industrial Engineering & Operations Research
- 2017–2022 **Assistant Professor**, Columbia University, Industrial Engineering & Operations Research
- 2015–2017 **NSF Postdoctoral Fellow**, Brown University, Division of Applied Mathematics  
Sponsor: Kavita Ramanan

## EDUCATION

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- 2010–2015 **Ph.D., Operations research and financial engineering**, Princeton University  
Adviser: René Carmona  
Thesis title: Stochastic differential mean field game theory
- 2006–2010 **B.S., Computational finance**, Carnegie Mellon University  
Graduated Summa Cum Laude

## AWARDS, HONORS, AND GRANTS

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- 2024–2026 Sloan Research Fellowship, \$150,000
- 2021–2026 NSF CAREER award DMS-2045328, \$426,563
- 2019–2022 AFOSR Grant FA9550-19-1-0291, \$150,000
- 2019 Early Career Prize, SIAM Activity Group on Financial Mathematics and Engineering.
- 2015–2017 NSF Postdoctoral Fellowship, DMS 1502980, \$150,000
- 2015 Invited Fellow, Institute for Pure and Applied Mathematics (IPAM) Program on Broad Perspectives and New Directions in Financial Mathematics
- 2014 SIAG/FME Conference Paper Prize.
- 2014 Wu Prize for Excellence, Princeton University.
- 2009 Moore Award for Excellence in Mathematics, Carnegie Mellon University.

## PUBLICATIONS, SUBMISSIONS AND PREPRINTS

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Underlined names are Ph.D. students whom I advised or co-advised. Authors are listed alphabetically.

1. “Independent projections of diffusions: Gradient flows for variational inference and optimal mean field approximations.” D. Lacker. (2023) Preprint.
2. “Projected Langevin dynamics for entropic optimal transport.” G. Conforti, D. Lacker, S. Pal. (2023) Preprint.
3. “Approximately optimal distributed stochastic controls beyond the mean field setting.” J. Jackson, D. Lacker. (2023) Preprint.
4. “Mean field approximations via log-concavity.” D. Lacker, S. Mukherjee, and L.C. Yeung. (2023) *International Mathematics Research Notices*.
5. “Sharp uniform-in-time propagation of chaos.” D. Lacker, L. Le Flem. (2023) To appear in *Probability Theory and Related Fields*.

6. “A label-state formulation of stochastic graphon games and approximate equilibria on large networks.” D. Lacker, A. Soret. (2022) To appear in *Mathematics of Operations Research*.
7. “Stationary solutions and local equations for interacting diffusions on regular trees.” D. Lacker, J. Zhang. (2023) *Electronic Journal of Probability* **28** (4), 1–37.
8. “Closed-loop convergence for mean field games with common noise.” D. Lacker, L. Le Flem. (2023) *Annals of Applied Probability* **34** (4), 2681–2733.
9. “Hierarchies, entropy, and quantitative propagation of chaos for mean field diffusions.” D. Lacker. (2023) *Probability and Mathematical Physics* **4** (2), 377–432.
10. “Quantitative approximate independence for continuous mean field Gibbs measures.” D. Lacker. (2022) *Electronic Journal of Probability* **27** (15), 1–21.
11. “A characterization of transportation-information inequalities for Markov processes in terms of dimension-free concentration.” D. Lacker, L.C. Yeung. (2020) *Annales de l’Institut Henri Poincaré Probabilités et Statistiques* **59** (1), 364–377.
12. “Marginal dynamics of interacting diffusions on unimodular Galton-Watson trees.” D. Lacker, K. Ramanan, and R. Wu. (2020) To appear in *Probability Theory and Related Fields*.
13. “Local weak convergence for sparse networks of interacting processes.” D. Lacker, K. Ramanan, and R. Wu. (2023) *Annals of Applied Probability* **33** (2), 643–688.
14. “A case study on stochastic games on large graphs in mean field and sparse regimes.” D. Lacker and A. Soret. (2022) *Mathematics of Operations Research* **47** (2), 1530–1565.
15. “Denseness of adapted processes among causal couplings.” M. Beiglböck and D. Lacker. (2020) Preprint.
16. “Superposition and mimicking theorems for conditional McKean-Vlasov equations.” D. Lacker, M. Shkolnikov, and J. Zhang. (2020) To appear in *Journal of the European Mathematical Society*.
17. “Locally interacting diffusions as Markov random fields on path space.” D. Lacker, K. Ramanan, and R. Wu. (2021) *Stochastic Processes and their Applications* **140**, 81–114.
18. “Many-player games of optimal consumption and investment under relative performance criteria.” D. Lacker, A. Soret. (2020) *Mathematics and Financial Economics* **14**, 263–281.
19. “Inverting the Markovian projection, with an application to local stochastic volatility models.” D. Lacker, M. Shkolnikov, and J. Zhang. (2020) *Annals of Probability* **48** (5), 2189–2211.
20. “Non-exponential Sanov and Schilder theorems on Wiener space: BSDEs, Schrödinger problems and control.” J. Backhoff Veraguas, D. Lacker, and L. Tangpi. (2020) *Annals of Applied Probability* **30** (3), 1321–1367.
21. “On the convergence of closed-loop Nash equilibria to the mean field game limit.” D. Lacker. (2020) *Annals of Applied Probability* **30** (4) 1693–1761.
22. “On a strong form of propagation of chaos for McKean-Vlasov equations.” D. Lacker. (2018) *Electronic Communications in Probability* **23** (45), 1–11.
23. “From the master equation to mean field game limit theory: Large deviations and concentration of measure.” F. Delarue, D. Lacker, and K. Ramanan. (2020) *Annals of Probability* **48** (1), 211–263.
24. “From the master equation to mean field game limit theory: A central limit theorem.” F. Delarue, D. Lacker, and K. Ramanan. (2018) *Electronic Journal of Probability* **24** (51), 1–54.
25. “Mean field and n-agent games for optimal investment under relative performance criteria.” D. Lacker and T. Zariphopoulou. (2017) *Mathematical Finance* **29** (4) 1003–1038.
26. “Rare Nash equilibria and the price of anarchy in large static games.” D. Lacker and K. Ramanan. (2019) *Mathematics of Operations Research* **44** (2), 400–422.
27. “Limit theory for controlled McKean-Vlasov dynamics.” D. Lacker. (2017) *SIAM Journal on Control and Optimization* **55** (3), 1641–1672.
28. “A non-exponential extension of Sanov’s theorem via convex duality.” D. Lacker. (2020) *Advances in Applied Probability* **52** (1), 61–101.
29. “Mean field games of timing and models for bank runs.” R. Carmona, F. Delarue, and D. Lacker. (2017) *Applied Mathematics & Optimization* **76** (1), 217–260.

30. “Novel covariance-based neutrality test of time-series data reveals asymmetries in ecological and economic systems.” A. Washburne, J. Burby, and D. Lacker. (2016) *PLoS Computational Biology* **12** (9), 3740–3803.
31. “Liquidity, risk measures, and concentration of measure.” D. Lacker. (2018) *Mathematics of Operations Research* **43** 3, 813–837.
32. “Law invariant risk measures and information divergences.” D. Lacker. (2018) *Dependence Modeling* **6** 1, 228–258.
33. “Translation invariant mean field games with common noise.” D. Lacker and K. Webster. (2015) *Electronic Communications in Probability* **20** (42), 1–13.
34. “A general characterization of the mean field limit for stochastic differential games.” D. Lacker. (2016) *Probability Theory and Related Fields* **165** (3), 581–648. Winner of the SIAG/FME Conference Paper Prize, 2014.
35. “Mean field games with common noise.” R. Carmona, F. Delarue, and D. Lacker. (2016) *The Annals of Probability* **44** (6), 3740–3803.
36. “Mean field games via controlled martingale problems: Existence of Markovian equilibria.” D. Lacker. (2015) *Stochastic Processes and their Applications* **125** (7), 2856–2894.
37. “A probabilistic weak formulation of mean field games and applications.” R. Carmona and D. Lacker. (2015) *The Annals of Applied Probability* **25** (3), 1189–1231 .

**Google Scholar:** <https://scholar.google.com/citations?user=Zyb6vdAAAAAJ&hl=en&oi=ao>

**arXiv:** [http://arxiv.org/find/math/1/au:+Lacker\\_D/0/1/0/all/0/1](http://arxiv.org/find/math/1/au:+Lacker_D/0/1/0/all/0/1)

## PROFESSIONAL ACTIVITIES

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- Associate editor, *Mathematics of Operations Research*, 2020–present
- Associate editor, *Mathematics and Financial Economics*, 2019–present
- Faculty Affiliate, Financial and Business Analytics Center, Data Science Institute, Columbia University
- Member, Institute for Operations Research and the Management Sciences (INFORMS)
- Member, Society for Industrial and Applied Mathematics (SIAM) and Activity Group on Financial Mathematics and Engineering
- Short course on Propagation of Chaos at the 9th International Colloquium on Backward Stochastic Differential Equations and Mean Field Systems. June 26, 2022.
- IMSI short course on Mean Field Games and Applications. June 7–11, 2021.
- American Mathematical Society Short Course on mean field games, January 13–14, 2020.
- Mini-course at ICMS workshop on mean field games, energy systems, and other applications, April 2019.
- Mini-course at IPAM Graduate Summer School on Mean Field Games and Applications, June 2018.
- Co-organizer of the Applied Probability and Risk Seminar, Columbia University, 2018–present.
- Co-organizer of the Probability Seminar, Brown University, Division of Applied Mathematics, 2016–2017.
- Math CoOp (outreach program), Brown University, 2015–2017.
- Organizer of the student-led Stochastic Analysis Seminar, Princeton University, 2012–2013.

## INVITED TALKS

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1. Centre International de Rencontres Mathématiques (CIRM), conference on PDE & Probability in interaction. January 22–26, 2024.
2. Clay Mathematics Institute workshop, About Entropy in Large Classical Particle Systems. September 25–29, 2023.
3. Princeton workshop on Stochastic Control & Financial Engineering. June 20–23, 2023.
4. SIAM Conference on Financial Mathematics & Engineering. June 1–4, 2023.
5. Carnegie Mellon Probability/Math Finance Seminar. April 24, 2023.
6. Workshop on Kinetic and hydrodynamic descriptions in collective behavior. Granada, Spain, 7–9 November 2022.

7. Invited speaker, 9th International Colloquium on Backward Stochastic Differential Equations and Mean Field Systems. Annecy, France, June 27 to July 2, 2022.
8. **Plenary speaker**, Bachelier World Congress. June 17, 2022.
9. Centre de Recherches Mathématiques, Workshop on Mean Field Games, Montreal. April 11, 2022.
10. Banff International Research Station, workshop on Stochastic Mass Transports. March 24, 2022.
11. King's College Probability Seminar. February 21, 2022.
12. University of Washington Probability Seminar. January 31, 2022.
13. SIAG/FME virtual seminar series. January 13, 2022.
14. IMSI program on Distributed Solutions to Complex Societal Problems. December 6–17, 2021.
15. Statistics and Probability Seminar, TU Delft. November 22, 2021.
16. Courant Analysis Seminar. November 18, 2021.
17. UNC-Duke Probability Seminar. November 4, 2021.
18. PIMS workshop, Mean Field Games on Networks Workshop. October 26–29, 2021.
19. CIRM workshop, Advances in Stochastic Analysis for Handling Risks in Finance and Insurance. September 13–17, 2021.
20. Peking University PDE/Analysis Seminar. June 15, 2021.
21. SIAM Conference on Financial Mathematics & Engineering. June 1–4, 2021.
22. Financial Mathematics/ Engineering Seminar Series, Hong Kong Consortium of Quantitative Finance. April 28, 2021.
23. Paris Bachelier Seminar. December 4, 2020.
24. Warwick Stochastic Finance Seminar. November 13, 2020.
25. Princeton University Mathematical Finance Seminar. October 14, 2020.
26. Questrom Finance Seminar, Boston University. October 2, 2020.
27. Virtual Informal Systems Seminar, McGill University. September 29, 2020.
28. Workshop on Mean Field Games: Recent Progress at the University of Chicago. February 6, 2020.
29. University of Michigan Financial/Actuarial Mathematics Seminar. January 29, 2020. Ann Arbor, MI.
30. AMS Short Course on Mean Field Games. January 13–14, 2020.
31. Eurandom workshop on Heavy Tails. December 17, 2019. Eindhoven, Netherlands.
32. Carnegie Mellon Probability and Computational Finance Seminar. November 25, 2019.
33. Rutgers Mathematical Finance and Probability Seminar. October 8, 2019.
34. SIAM Conference on Financial Mathematics & Engineering. June 4–7, 2019. Toronto, Canada.
35. Humboldt University of Berlin Mathematical Finance Seminar. May 23, 2019.
36. Paris Bachelier Seminar. May 17, 2019.
37. ICMS workshop on mean-field games, energy systems, and other applications. April 1–5, 2019. Edinburgh, UK.
38. USC joint Probability / Mathematical Finance seminar. March 8, 2019.
39. UC Berkeley IEOR Colloquium. February 11, 2019.
40. INFORMS Annual Meeting. November 6, 2018. Phoenix, AZ.
41. Third Eastern Conference on Mathematical Finance. October 26, 2018. Chicago, IL.
42. ETH Zurich Mathematical Finance Seminar. May 31, 2018.
43. Workshop on Stochastic Analysis and its Applications. May 13–18, 2018. Oaxaca, Mexico.

44. Berkeley-Columbia Meeting in Engineering and Statistics. April 6, 2018.
45. Workshop on stochastic analysis applied to economics, finance, and insurance. March 19-23, 2018. Santiago, Chile.
46. Duke Probability Seminar. February 8, 2018.
47. Princeton University Mathematical Finance Seminar. December 6, 2017.
48. Columbia Probability Seminar. December 1, 2017.
49. ICERM Workshop on Robust Methods in Probability & Finance. June 19, 2017. Providence, RI.
50. Fourth Conference on Mean Field Games and Related Topics. June 16, 2017. Rome, Italy.
51. Vienna Seminar in Mathematical Finance and Probability. June 1, 2017.
52. University of Konstanz. May 30, 2017.
53. Imperial College London Stochastic Analysis Seminar. May 24, 2017.
54. 8th Western Conference in Mathematical Finance. March 24, 2017. Seattle, WA.
55. University of Michigan Financial/Actuarial Mathematics Seminar. February 15, 2017.
56. Carnegie Mellon Probability and Computational Finance Seminar. February 13, 2017.
57. SIAM Conference on Financial Mathematics & Engineering. November 17-19, 2016. Austin, TX.
58. Worcester Polytechnic Institute Financial Mathematics and Stochastic Analysis Seminar. November 14, 2016.
59. University of Texas at Austin Financial Mathematics Seminar. September 23, 2016.
60. Byrne Workshop on Stochastic Analysis in Finance and Insurance. June 6-10, 2016. Ann Arbor, MI.
61. Workshop on Stochastic Analysis and Mathematical Finance. May 22-27, 2016. Oaxaca, Mexico.
62. Courant Institute Probability Seminar. April 22, 2016.
63. University of Connecticut Analysis and Probability Seminar. April 15, 2016.
64. Columbia Mathematical Finance Seminar. March 3, 2016.
65. Columbia University, Industrial Engineering and Operations Research Colloquium. January 12, 2016.
66. University of California, Santa Barbara, Statistics and Applied Probability Seminar. December 9, 2015.
67. University of North Carolina, Chapel Hill, Statistics and Operations Research Colloquium. December 4, 2015.
68. University of Michigan Financial/Actuarial Mathematics Seminar. November 17 & 18, 2015.
69. University of Texas at Austin Financial Mathematics Seminar. November 9, 2015.
70. Brown University Probability Seminar. November 3, 2015.
71. IPAM Broad Perspectives and New Directions in Financial Mathematics Seminar. April 6, 2015. Los Angeles, CA.
72. Workshop on Interacting Agents in Constrained Financial Markets. January 31, 2015. Austin, TX.
73. University of Southern California Math Finance Colloquium. January 26, 2015.
74. Carnegie Mellon Probability and Computational Finance Seminar. January 12, 2015.
75. SIAM Conference on Financial Mathematics & Engineering. November 13-15, 2014. Chicago, IL.
76. Columbia Mathematical Finance Seminar. October 9, 2014.
77. Rutgers Mathematical Finance and Probability Seminar. October 7, 2014.
78. Institute of Mathematical Statistics Annual Meeting / Australian Statistical Conference. July 7-10, 2014. Sydney, Australia.
79. MFO Workshop on Stochastic Analysis in Finance and Insurance. May 4-10, 2014. Oberwolfach, Germany.
80. 8th Oxford-Princeton Workshop on Financial Mathematics and Stochastic Analysis. March 21-22, 2014. Oxford, UK.
81. Workshop on Stochastic Games, Equilibrium, and Applications to Energy & Commodities Markets. August 27-29, 2013. Toronto, Canada.
82. 2nd Princeton-Lausanne Workshop on Quantitative Finance & Economics. May 3-4, 2013. Princeton, NJ.
83. Young Researcher's Meeting on BSDEs, Numerics and Finance. July 2-4, 2012. Oxford, UK.

## PHD STUDENT ADVISEES

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**Jiacheng Zhang** (coadvised with Mykhaylo Shkolnikov at Princeton), graduated May 2021, now a postdoc at Berkeley

**Agathe Soret**, graduated May 2022, now at Two Sigma

**Luc Le Flem**, graduated January 2023, now at Hudson River Trading

**Lane Chun Yeung** (coadvised with Ioannis Karatzas), graduated May 2023, now a postdoc at Carnegie Mellon

**Fuzhong Zhou**, expected to graduate in May 2026

**Manuel Arnese**, expected to graduate in May 2027

## TEACHING

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- 2018– **Instructor**, *Columbia University*, IEOR E3658, Probability for Engineers
- 2017– **Instructor**, *Columbia University*, IEOR E4701, Stochastic Models for Financial Engineering
- 2018 **Instructor**, *Columbia University*, IEOR E8100, Mean field games and interacting particle systems
- 2014 **Instructor**, *Princeton University*, Masters in Finance Math Camp