Steven M. Heilman
Curriculum Vitae

USC Mathematics Department
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Employment

Assistant Professor RTPC of Mathematics, USC, 7/2018–present (on leave Spring 2024)

Assistant Professor of Mathematics (Tenure Track), University of Notre Dame, 1/2018–7/2018

Assistant Adjunct Professor of Mathematics, UCLA, 7/2014–12/2017

Education

Ph.D. in Mathematics, Courant Institute of Mathematical Sciences, NYU, 9/2009–4/2014
Thesis: Gaussian Isoperimetry for Multiple Sets
Thesis advisor: Professor Assaf Naor

B.A. in Mathematics, Cornell University, 8/2005–5/2009
Summa Cum Laude with Distinction in all Subjects
Undergraduate thesis: Homotopies of Eigenfunctions and the Spectrum of the Laplacian on the Sierpinski Carpet
Undergraduate thesis advisor: Professor Robert S. Strichartz

Research interests

Probability, Analysis, Geometry, Theoretical Computer Science, Statistics

Awards, Grants, and Honors

NSF Grant CCF 2448108, 2025–2028, $199,000
NSF Grant CCF 1911216, 2019–2022, $90,294
NSF Grant DMS 1708908 (transferred to 1829383, 1839406), 2017–2020, $96,465
AMS Simons Travel Grant, 2015–2017
Simons-Berkeley Graduate Research Fellowship, Fall 2013
NSF Graduate Research Fellowship, 2011–2014
Harry S. Kieval Prize in Mathematics, Cornell University, 2009

Technical Skills

Python, Matlab, LaTeX, Java, Linux

Advising

Mathematics Ph.D. Student: Alex Tarter, USC, October 2019–May 2022.
    Next position: Mathematical Statistician/Data Scientist at USDA NASS
    Thesis: Dimension Reduction Techniques for Noise Stability Theorems

Mathematics Masters Students:
Xingyun Zhou, USC, December 2019–December 2020.
    Thesis: Max-3-Cut Performance of graph neural networks on random graphs
Chuhuan Huang, USC, March 2022–May 2023. Next position: Math PhD, Johns Hopkins
    Thesis: Computational hardness of linear-structured Markov Decision Processes

Mathematics Undergraduates (supported by USC URAP Fund, Summer 2022):
Jake Freeman, USC, December 2021–May 2023. Next position: ORFE PhD, Princeton
    Research Topic: Maximum Gaussian Perimeter of Convex Sets in the Plane
Benny Cohen, USC, December 2021–May 2023. Next position: MechE PhD, USC
    Research Topic: Neural Networks and Graph Cut Problems
Sam Zhang, USC, May 2023–December 2023. Next position: Math Masters, Johns Hopkins
    Research Topic: Noise Stability of Ranked Voting Methods
Rabbi Hou, USC, September 2024–
    Research Topic: Reinforcement Learning for Counterexamples in Combinatorics

Activities/ Professional Service

HIM Workshop Organizer, Information Theory, Boolean Functions and Lattice Problems. Part of trimester program: Boolean Analysis in Computer Science. November 18–22, 2024

IPAM Workshop Organizer, Calculus of Variations in Probability and Geometry, February 7–11, 2022

USC Committee Involvement: Undergraduate Curriculum, 2022–, Data Science Course (Math 446), 2022–2023, Statistics Graduate Qualifying Exam, 2020–2023, RTPC Merit Review, 2019–2020, 2021–2023 (Co-Chair), Postdoctoral Appointments, 2018–2019, Various PhD and Masters Theses

Co-Organizer, USC Probability and Statistics Seminar, 2018–

cSplash Outreach Program at NYU, Co-President 2010–2011, President 2011–2012

Reviewed grant proposals for: NSF (2018 and 2024).   AMS MR Reviewer 2014–2018

Refereed research articles for: Acta Mathematica, Duke Math Journal, International Mathematics Research Notices, Annals of Applied Probability, Communications in Mathematical Physics, IEEE Transactions on Information Theory, Annales de l'Institut Henri Poincaré (B) Probabilités et Statistiques, Pacific Journal of Mathematics, Revista Matemática Iberoamericana, Annali di Matematica Pura ed Applicata, Proceedings of the AMS, Proceedings of the Edinburgh Mathematical Society, Experimental Mathematics, Theory of Computing, SIAM Journal on Discrete Mathematics, FOCS, Discussiones Mathematicae Graph Theory

Teaching

Instructor at USC for (2018–2024):

      446 Data Science with Python, 547 Statistical Learning Theory (twice)
      541A Graduate Statistics (thrice), 541B Graduate Statistics, 545 Graduate Time Series
      507A Graduate Probability, 505B Graduate Applied Probability
      408 Mathematical Statistics (twice), 407 Probability Theory (twice), 458 Numerical Methods
      126 Calculus 2 (also course coordinator), 118 Calculus for Business Students (two sections)

Instructor at Notre Dame for: 60850 Graduate Probability, and Independent Reading in Probability

Instructor at UCLA for the following undergraduate courses (2014–2017):

      174E Financial Mathematics, 171 Stochastic Processes (twice)
      170A Probability Theory 1 (thrice), 170B Probability Theory 2 (twice)
      167 Game Theory (twice), 164 Optimization
      131A Analysis 1, 131B Analysis 2, 115A Linear Algebra (twice)
      31A Calculus 1, 31B Calculus 2, 32A Calculus 3 differentiation, 32B Calculus 3 integration

Recitation Leader at NYU for: Analysis 2 and Calculus 1
Teaching Assistant at NYU for: Introduction to Mathematical Proofs

Instructor work included lecturing, creating lecture notes, homeworks and exams, grading exams, and holding office hours. Recitation leader work included holding weekly recitations, grading quizzes and exams, writing homework solutions and holding office hours. Teaching assistant work included grading homework, writing homework solutions and holding office hours.

Presentations

      Mathematics Colloquium, University of Georgia, April 4, 2024
      Analysis Seminar, University of Denver, May 12, 2023
      Algebra/Number Theory/Combinatorics Seminar, Claremont Mckenna, April 4, 2023
      AMS Eastern Section Meeting, March 18, 2023
      Mathematics Colloquium, USC, January 23, 2023
      LA Probability Forum, Caltech, June 2, 2022
      JMM Special Session on Decisions, Elections, and Games, April 8, 2022
      Probability Seminar, UCI, March 2, 2022
      IPAM Conference, Calculus of Variations in Probability and Geometry, February 11, 2022
      Probability and Analysis (PAW) Webinar, March 15, 2021
      Probability Seminar, UCI, March 3, 2020
      Probability Seminar, UCSD, February 27, 2020
      Research Visit, Università degli Studi di Napoli Federico II, December 13-22, 2019
      Analysis Seminar, Georgia Tech, February 20, 2019
      High-Dimensional Probability Seminar, Georgia Tech, February 20, 2019
      Probability Seminar, UCI, January 15, 2019
      Southern California Probability Symposium, USC, December 8, 2018
      Probability Seminar, UCLA, November 15, 2018
      Applied Math Seminar, Claremont Mckenna, October 29, 2018

Probability Seminar, USC, October 26, 2018

AMS Eastern Section Meeting, Special Session on Convex Geometry and Functional Inequalities, September 30, 2018

Algebra/Number Theory/Combinatorics Seminar, Claremont Mckenna, December 5, 2017

Joint UCLA/Caltech Analysis and PDE seminar, May 19, 2017

Probability Seminar, Harvard University, April 5, 2017

Mathematics Colloquium, Cal State Northridge, February 21, 2017

Mathematics Colloquium, University of Delaware, January 28, 2017

Mathematics Colloquium, Notre Dame, January 26, 2017

Mathematics Colloquium, UC Irvine, January 10, 2017

Probability Seminar, Texas A&M, December 5, 2016

Probability Seminar, UC Irvine, November 29, 2016

Mathematics Colloquium, Temple University, November 28, 2016

Probability Seminar, UCLA, November 17, 2016

Joint UCLA/Caltech Analysis and PDE seminar, June 3, 2016

Probability Seminar, USC, January 15, 2016

Combinatorial Number Theory Seminar, UC Riverside, December 1, 2015

Probability Seminar, UC Irvine, November 24, 2015

Probability Seminar, UCSD, November 5, 2015

Probability Seminar, University of Pennsylvania, September 24, 2015

Workshop on Analytic Tools in Probability and Applications, Institute for Mathematics and its Applications, University of Minnesota, April 28, 2015

Probability Seminar, UC Berkeley, April 9, 2014

Preprints

Maximum Gaussian Perimeter of Convex Sets in the Plane and PAC Learning Bounds, in preparation.

Three Candidate Plurality is Stablest for Correlations at Most 1/10, arXiv:2306.03312.

Hyperstable Sets with Voting and Algorithmic Hardness Applications, arXiv:2209.11216.

Noise Stability of Ranked Choice Voting, arXiv:2209.11183.

Convex Cylinders and the Symmetric Gaussian Isoperimetric Problem, arXiv:2204.12003.

A Variational Proof of Robust Gaussian Noise Stability, arXiv:2108.04950.

A Moment Majorization principle for random matrix ensembles, arXiv:1603.05620.

Publications

Sphere Valued Noise Stability and Quantum MAX-CUT Hardness, arXiv:2306.03912, to appear, Annals of Probability.

Stable Gaussian Minimal Bubbles, arXiv:1901.03934, to appear, Calculus of Variations and PDE.

Independent Sets of Random Trees and of Sparse Random Graphs, arXiv:2006.04756, to appear, Journal of Graph Theory.

Dimension-Free Noninteractive Simulation from Gaussian Sources (with Alex Tarter), IEEE Transactions on Information Theory, **70** (2024), no. 8, 5516–5532. 10.1109/TIT.2024.3396736.

Tree/Endofunction Bijections and Concentration Inequalities, Electronic Journal of Combinatorics, **29** (2022), no. 2, P2.33. 10.37236/10560.

Three Candidate Plurality is Stablest for Small Correlations (with Alex Tarter), Forum of Mathematics Sigma **9** (2021), E65. 10.1017/fms.2021.56

Designing Stable Elections: a Survey, Notices of the AMS **68** (2021), no. 4, 516–527. 10.1090/noti2251. A shorter news-style article entitled "The Electoral College is surprisingly vulnerable to popular vote changes" appeared in The Conversation, 16 July 2020. Discussed Voting on the Data Skeptic podcast, 31 August, 2020.

The Structure of Gaussian Minimal Bubbles, Journal of Geometric Analysis. **31** (2021), no. 6, 6307–6348. 10.1007/s12220-020-00531-x.

Symmetric Convex Sets with Minimal Gaussian Surface Area, American Journal of Mathematics. **143** (2021), no. 1, 53–94. 10.1353/ajm.2021.0000.

A Periodic Isoperimetric Problem Related to the Unique Games Conjecture, Random Structures Algorithms. **56** (2020), no. 1, 154–168. 10.1002/rsa.20877.

Strong Contraction and Influences in Tail Spaces, (with Elchanan Mossel and Krzysztof Oleszkiewicz), Transactions of the AMS. **369** (2017), no. 7, 4843–4863. 10.1090/tran/6916.

Standard Simplices and Pluralities are Not the Most Noise Stable, (with Elchanan Mossel and Joe Neeman), Israel Journal of Mathematics. **213** (2016), no. 1, 33–53. 10.1007/s11856-016-1320-y. An abstract appeared in ITCS 2015.

Low Correlation Noise Stability of Symmetric Sets, Journal of Theoretical Probability. **34** (2021), 2192–2240. 10.1007/s10959-020-01031-y.

Euclidean Partitions Optimizing Noise Stability, Electronic Journal of Probability. **19** (2014), no. 71, 1-37. 10.1214/EJP.v19-3083.

Solution of the propeller conjecture in $\mathbb{R}^3$ (with Aukosh Jagannath and Assaf Naor), Discrete & Computational Geometry. **50** (2013), no. 2, 263–305. 10.1007/s00454-013-9530-0. An extended abstract appeared in STOC 2012.

Orthogonal Polynomials with Respect to Self-Similar Measures (with Philip Owrutsky and Robert S. Strichartz), Experiment. Math. **20** (2011), no. 3, 238–259. 10.1080/10586458.2011.564966.

Localized Eigenfunctions: Here You See Them, There You Don't (with Robert S. Strichartz), Notices Amer. Math. Soc. **57** (2010), no. 5, 624–629. arXiv:0909.0783.

Homotopies of Eigenfunctions and the Spectrum of the Laplacian on the Sierpinski Carpet (with Robert S. Strichartz), Fractals **18** (2010), no. 1, 1–34. 10.1142/S0218348X10004750.

Outer Approximation of the Spectrum of a Fractal Laplacian (with Tyrus Berry and Robert S. Strichartz), Experiment. Math. **18** (2009), no. 4, 449–480. 10.1080/10586458.2009.10129061.

A hydrogel-based microfluidic device for the studies of directed cell migration. Shing-Yi Cheng, Steven Heilman, Max Wasserman, Shivaun Archer, Michael L. Shuler and Mingming Wu, Lab Chip **7** (2007), 763–769. 10.1039/b618463d.

A three-channel microfluidic device for generating static linear gradients and its application to the quantitative analysis of bacterial chemotaxis. Jinpian Diao, Lincoln Young, Sue Kim, Elizabeth A. Fogarty, Steven M. Heilman, Peng Zhou, Michael L. Shuler, Mingming Wu and Matthew P. DeLisa, Lab Chip **6** (2006), 381–388. 10.1039/B511958H.