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 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

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

Benny Cohen, USC, December 2021–May 2023. Next position: MechE PhD, USC

Sam Zhang, USC, May 2023–

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–, Statistics Graduate Qualifying Exam, 2020–, RTPC Merit Review, 2019–2020, 2021– (Co-Chair), Postdoctoral Appointments, 2018–2019, Various PhD 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. AMS MR Reviewer 2014–2018

Refereed research articles for: Acta Mathematica, Duke Math Journal, Annals of Applied Probability, Communications in Mathematical Physics, IEEE Transactions on Information Theory, Annales de l'Institut Henri Poincaré (B) Probabilités et Statistiques, 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 (2018–2023):

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, IU Bloomington, February 19, 2015
Southern California Probability Symposium, IPAM, UCLA, December 6, 2014
Probability Seminar, UC Berkeley, April 9, 2014
Discrete Math Seminar, Brown University, March 6, 2014
Analysis Seminar, Cornell University, March 3, 2014

Preprints

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

Sphere Valued Noise Stability and Quantum MAX-CUT Hardness, arXiv:2306.03912.

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.

Independent Sets of Random Trees and of Sparse Random Graphs, arXiv:2006.04756.

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

Publications

Dimension-Free Noninteractive Simulation from Gaussian Sources (with Alex Tarter), arXiv:2202.09309, to appear, IEEE Transactions on Information Theory.

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

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.