

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

Sampad Mohanty, USC, January 2026–

Thesis: Nonconvergence of Adam

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–May 2025. Next position: Finance (PhD offers declined)

Research Topic: Reinforcement Learning for Counterexamples in Combinatorics

Alina Du, USC, March 2025–

Research Topic: Reinforcement Learning for Counterexamples in Combinatorics

## Activities/ Professional Service

Seminar in Stochastic Processes, Local Lead Organizer, SSP 2027, March 17–20, 2027.

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, Dornsife Undergraduate Scholarship Interviews 2024, Approximately 10 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, Journal of the EMS,

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 (2018–2026):

446 Data Science with Python, 547 Statistical Learning Theory (twice)  
541A Graduate Statistics (thrice), 541B Graduate Statistics (twice), 545 Grad. Time Series  
507A Graduate Probability, 505B Graduate Applied Probability, 499 Game Theory (twice)  
408 Mathematical Statistics (twice), 407 Probability Theory (twice), 458 Numerical Methods  
126 Calculus 2 (also course coordinator), 118 Calculus for Business Students (twice)

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

Probability Seminar, MIT, May 2026  
Mathematics Colloquium, Cal State Long Beach, March 21, 2025  
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

A Lower Bound for Grothendieck's Constant, arXiv:2603.22616

Limit Theorems in Sequence Matching (with Richard Arratia), in preparation.

Trees and Graphs with Non Log concave Dominating Set Sequence via AI Tools (with Alina Du and Greta Panova), in preparation.

The Number of Independent Sets of Planar Graphs and Trees (with Swee Hong Chan and Greta Panova), in preparation.

A Fourier Approach to Levine's Hat Puzzle (with Omer Tamuz), arXiv:2503.09042

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.