ANNA SEIGAL

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Employment

2023-	Assistant Professor of Applied Mathematics School of Engineering and Applied Sciences, Harvard University
2023-	Affiliate, Department of Statistics, Harvard University
2021-2023	Junior Fellow, Society of Fellows, Harvard University
2019-2021	Hooke Research Fellow and Junior Research Fellow Mathematical Institute and The Queen's College, University of Oxford

Education

2014-2019	Mathematics PhD, University of California, Berkeley Dissertation: Structured Tensors and the Geometry of Data Advisor: Bernd Sturmfels
2013-2014	Master of Mathematics, Part III of Mathematical Tripos Emmanuel College, University of Cambridge Honours pass with distinction
2010-2013	BA (Hons) Mathematical Tripos Emmanuel College, University of Cambridge 1st class, top 10

Research Interests

Applied algebra, tensors and multilinear algebra, applied algebraic geometry, algebraic statistics.

Publications

C. Améndola, L. Gustafsson, K. Kohn, O. Marigliano, A. Seigal: *Differential equations for Gaussian statistical models with rational maximum likelihood estimator* 8 (2024) no. 3.

P. Friz, T. Lyons, A. Seigal: *Rectifiable paths with polynomial log-signature are straight lines*, Bulletin of the London Mathematical Society (2024) 1-13.

V. Makam, P. Reichenbach, A. Seigal: *Symmetries in directed Gaussian graphical models*, Electronic Journal of Statistics 17 (2023) no. 2, 3969-4010.

C. Squires, A. Seigal, S. Bhate, C. Uhler: *Linear causal disentanglement via interventions*, Proceedings of the 40th International Conference on Machine Learning, PMLR 202 (2023).

K. Wang, A. Seigal: *Lower bounds on the rank and symmetric rank of real tensors*, Journal of Symbolic Computation 118 (2023) 69–92.

A. Seigal, H. Harrington, V. Nanda: *Principal Components along Quiver Representations*, Foundations of Computational Mathematics 23 (2023) 1129–1165.

Covid-19 Multi-omics Blood Atlas (COMBAT) Consortium (100+ authors): *A blood atlas of COVID-19 defines hallmarks of disease severity and specificity*, Cell 185 (2022) 916–938.

C. Améndola, K. Kohn, P. Reichenbach, A. Seigal: *Toric Invariant Theory for Maximum Likelihood Estimation in Log-linear Models*, Algebraic Statistics 12 (2021) no. 2, 187-211.

C. Améndola, L. Gustafsson, K. Kohn, O. Marigliano, A. Seigal: *The Maximum Likelihood Degree of Linear Spaces of Symmetric Matrices*, Le Matematiche 76 (2021) no. 2, 535-557.

C. Améndola, K. Kohn, P. Reichenbach, A. Seigal: *Invariant Theory and Scaling Algorithms for Maximum Likelihood Estimation*, SIAM Journal on Applied Algebra and Geometry 5 (2021) no. 2, 304-337.

A. Seigal, E. Sukarto: *Ranks and Singularities of Cubic Surfaces*, Le Matematiche 75 (2020) no. 2, 575–594.

A. Seigal: *Ranks and Symmetric Ranks of Cubic Surfaces*, Journal of Symbolic Computation 101 (2020) 304-317.

M. Pfeffer, A. Seigal, B. Sturmfels: *Learning Paths from Signature Tensors*, SIAM Journal on Matrix Analysis and Applications 40 (2019) no. 2, 394–416.

A. Seigal, M. Beguerisse-Díaz, B. Schoeberl, M. Niepel, H. Harrington: *Tensor clustering with algebraic constraints gives interpretable groups of crosstalk mechanisms in breast cancer*, Journal of the Royal Society Interface 16 (2019) no. 151, 20180661.

A. Seigal, G. Montúfar: *Mixtures and Products in Two Graphical Models*, Journal of Algebraic Statistics 9 (2018) no. 1, 1–20.

E. Robeva, A. Seigal: *Duality of Graphical Models and Tensor Networks*, Information and Inference: a Journal of the IMA, iay009, https://doi.org/10.1093/imaiai/iay009.

A. Seigal: *Gram Determinants of Real Binary Tensors*, Linear Algebra and its Applications 544 (2018) 350–369.

A. Seigal, B. Sturmfels: *Real Rank Two Geometry*, Journal of Algebra 484 (2017) 310–333.

A. Seigal, P. Mira, B. Sturmfels, M. Barlow: *Does Antibiotic Resistance Evolve in Hospitals?*, Bulletin of Mathematical Biology 79 (2017) 191–208.

E. Robeva, A. Seigal: *Singular Vectors of Orthogonally Decomposable Tensors*, Linear and Multilinear Algebra 65 (2017) no. 12, 2457–2471.

H. Abo, A. Seigal, B. Sturmfels: *Eigenconfigurations of Tensors*, Algebraic and Geometric Methods in Discrete Mathematics, Contemporary Mathematics 685, American Mathematical Society (2017) 1–25.

A. Seigal, S. Yakovenko: *Local Dynamics of Intersections: V. I. Arnold's Theorem Revisited*, Israel Journal of Mathematics 201 (2014) no. 2, 813–833.

Preprints

P. Leyes Carreno, C. Meroni, A. Seigal: *Linear causal disentanglement via higher-order cumulants*, arXiv:2407.04605.

K. Wang, A. Maraj A. Seigal: *Contrastive independent component analysis*, arXiv:2407.02357.

K. Wang, A. Seigal: *Identifiability of overcomplete independent component analysis*, arXiv:2401.14709.

G. Bérczi, E. Hamilton, P. Reichenbach, A. Seigal: *Complete collineations for maximum likelihood estimation*, arXiv:2311.03329.

R. Sonthalia, A. Seigal, G. Montúfar: *Supermodular rank: set function decomposition and optimization*, arXiv:2305.14632.

T. Muller, V. Nanda, A. Seigal: *Multilinear hyperquiver representations*, arXiv:2305.05622.

S. Bhate, A. Seigal, J. Caicedo: *Deciphering causal genomic templates of complex molecular phenotypes*, bioRxiv, https://doi.org/10.1101/2022.08.15.503769.

Awards and Funding

2021	University of British Columbia Early Career Scholar Award
2020	SIAM Richard C. DiPrima Prize
2019	Friedman Memorial Prize, UC Berkeley
2018	Outstanding Graduate Student Instructor Award, UC Berkeley
2017	Best Poster Prize, SIAM conference on Applied Algebraic Geometry
2014	Fulbright Postgraduate Student Award from the US-UK Fulbright Commission
2014	M. T. Dodds Prize, Emmanuel College, University of Cambridge
2013	Herman Peries Prize, Emmanuel College, University of Cambridge
2011,'12,'13	Braithwaite Batty Senior Scholarship for top mathematics result in Emmanuel College

Colloquia and Plenary Talks

10/2023	Colloquium in Applied Mathematics, University of Chicago.
7/2023	Plenary talk: *Factorising data*, SIAM Conference on Applied Algebraic Geometry TU Eindhoven.
10/2022	Mathematics Colloquium: *Ranks of tensors and connections to data analysis*, IISER Pune, India.
11/2021	Mathematics Colloquium: *Groups and symmetries in statistical models*, Michigan State University.
4/2021	Faculty of Science Early Career Invited Lecture and Math Colloquium: *Algebraic methods in statistics and data analysis*, University of British Columbia.
3/2021	Tensor Methods and Emerging Applications to the Physical and Data Sciences Tutorials: *(i) From linear algebra to multi-linear algebra (ii) Tensors in statistics and data analysis*, Institute for Pure and Applied Mathematics (IPAM), UCLA.
11/2020	Division of Applied Math Colloquium: *Algebraic methods in statistics and data analysis*, Brown University, RI.
11/2020	Public Lecture: *Ideas for a complex world*, Mathematical Institute, University of Oxford.
6/2020	General Mathematics Colloquium: *Structured tensors and the geometry of data* Korteweg-de Vries Institute for Mathematics, University of Amsterdam.
9/2018	Math Colloquium: *Structured tensors and the geometry of data*, Santa Clara University.

Other Invited Talks

10/2024	(scheduled) Algebraic Geometry and Machine Learning minisymposium, SIAM Conference on Mathematics of Data Science, Atlanta.
4/2024	Geometry-Algebra-Singularity-Combinatorics seminar, Northeastern University.
2/2024	Computational and Applied Mathematics Seminar, Tufts University.
2/2024	AI for Science workshop, Harvard.
1/2024	Workshop on Connecting Higher-Order Statistics and Symmetric Tensors, ICERM, Providence, Rhode Island.
7/2023	Algebraic Methods in Graphical Models minisymposium, SIAM Conference on Applied Algebraic Geometry, TU Eindhoven.
5/2023	Analysis Seminar, University of Potsdam.
5/2023	Workshop on Computations and Data in Algebraic Statistics, Casa Matemática Oaxaca, Mexico
4/2023	Discrete Math Seminar, UMass Amherst.
1/2023	Heidelberg Math and ML Seminar.

1/2023	Applications of Tensors in Computer Science Session, Joint Mathematics Meeting, Boston.
1/2023	Topology, Algebra, and Geometry in the Mathematics of Data Science Session, Joint Mathematics Meeting, Boston.
12/2022	Algebraic Structures in Statistical Methodology Workshop, Oberwolfach.
11/2022	MIT-Harvard-MSR Combinatorics Seminar.
9/2022	Boise State TATERS (Topics in Algebra, Topology, Etc. Research Seminar).
8/2022	Data Science Seminar, Mars Petcare.
6/2022	Combinatorial, Computational, and Applied Algebraic Geometry (CCAAGS-22), University of Washington, Seattle.
5/2022	Pacific Northwest Seminar on Topology, Algebra, and Geometry in Data Science.
4/2022	Nonlinear Algebra and Combinatorics from Physics Center of Mathematical Sciences and Applications (CMSA), Harvard University.
3/2022	Open Neighborhood Seminar, Harvard University Math Department.
2/2022	Theory of Computation Seminar, Harvard University.
2/2022	Combinatorics, Physics and Probability Seminar Center of Mathematical Sciences and Applications (CMSA), Harvard University.
1/2022	AlToGeLiS seminar, online.
12/2021	Statistics and Data Science Seminar, Queen Mary University of London.
11/2021	Optimization under Symmetry Workshop, Program on Geometric Methods in Sampling and Optimization, Simons Institute for the Theory of Computing, Berkeley.
11/2021	One World YoungStatS webinar: "Novel Algebraic Approaches to Maximum Likelihood Estimation".
10/2021	Geometry and Learning from Data Workshop, Casa Matemática Oaxaca, Banff International Research Station, Mexico.
10/2021	Applied CATS Seminar, KTH Royal Institute of Technology, Stockholm.
8/2021	Algebraic Geometry of Data minisymposium, SIAM Conference on Applied Algebraic Geometry, Texas A&M University.
7/2021	Applications of Rough Paths: Computational Signatures and Data Science, ICERM, Providence, Rhode Island.
7/2021	Complexity Theory Seminar and Konstanz Women in Mathematics Series, Universität Konstanz, Germany.
6/2021	Real algebraic geometry and algorithms for geometric constraint systems workshop Fields Institute, Toronto.
5/2021	Tensor Methods and Emerging Applications to the Physical and Data Sciences, Efficient Tensor Representations for Learning and Computational Complexity Workshop IPAM, UCLA.
5/2021	Applied Algebra Seminar, University of Wisconsin, Madison.
2/2021	Applied Mathematics Seminar, University of Warwick.
12/2020	MAD+ (math and data plus) seminar, NYU and ETH Zürich.
11/2020	Oxford/Swansea/Liverpool Topological Data Analysis centre meeting.
8/2020	Geometry Seminar, Texas A&M University.
7/2020	Rough Paths Interest Group, Alan Turing Institute, London.
7/2020	Algebraic Statistics Online Seminar.
5/2020	Computational Maths and Applications Seminar, University of Oxford.

4/2020	Geometric Complexity Theory Seminar Online, Chennai Mathematical Institute, India.
4/2020	Nonlinear Algebra Seminar Online, MPI MiS, Leipzig, Germany.
2/2020	Mathematical Biology and Ecology Seminar, University of Oxford.
2/2020	Algebraic Geometry Seminar, University of Oxford.
1/2020	Geometry and Topology Seminar, University of Glasgow.
1/2020	Algebra Seminar, University of York.
1/2020	DataSig meeting, Alan Turing Institute, London.
12/2019	12th International Conference of the ERCIM Working Group on Computational and Methodological Statistics, London.
12/2019	Algebra and Number Theory Seminar, Queen Mary University of London.
12/2019	London Mathematical Society Applied Algebra and Geometry Seminar, University of Oxford.
11/2019	Queen's College Symposium, University of Oxford.
10/2019	OCIAM Seminar, University of Oxford.
9/2019	Real Applied Algebraic Geometry Conference, Technische Universität Berlin, Germany.
7/2019	The Algebra and Geometry of Tensors mini-symposium, SIAM Conference on Applied Algebraic Geometry, Bern, Switzerland.
4/2019	Mathematics for Data Science and Decision Making Seminar, UC Davis.
2/2019	Serkan Hoşten's 50th Birthday Conference, San Francisco State University.
1-5/2019	Speaker and Organizer of *Applied Invariant Theory Seminar*, UC Berkeley.
1/2019	Applied Math Seminar, Stanford.
12/2018	Advances in Applied Algebraic Geometry Conference, Bristol.
11/2018	Talks in Theoretical Sciences, Institute for Theoretical Studies, ETH Zürich, Switzerland.
11/2018	Mathematics, Information and Computation Seminar, NYU.
10/2018	Workshop on Real Algebraic Geometry and Optimization, Non-linear Algebra program, ICERM, Providence, RI.
10/2018	Geometry and Topology Seminar, San Francisco State University.
9/2018	Workshop on Boltzmann machines, American Institute of Mathematics, San Jose.
7/2018	Geometry of Tensors minisymposium, SIAM Annual Meeting, Portland, Oregon.
6/2018	Math of Data Seminar, Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany.
6/2018	Berlin-Oxford Young Researchers Meeting on Applied Stochastic Analysis, Berlin, Germany.
5/2018	SIAM Conference on Applied Linear Algebra, Hong Kong.
4/2018	Seminar on Applied Algebra and Geometry, MIT.
4/2018	AMS Special Session on Algebraic Statistics, Northeastern University.
1/2018	Tensors! Mathematical Challenges and Opportunities minisymposium, Joint Mathematics Meetings, San Diego.
11/2017	Optimization and Data Science Seminar, University of California, San Diego.
8/2017	Biological Algebraic Statistics mini-symposium, SIAM Conference on Applied Algebraic Geometry, Atlanta.
7/2017	Speaker and discussion leader, Conference Board of the Mathematical Sciences conference, 'Tensors and their uses in approximation theory, quantum information theory and geometry', Auburn, Alabama
4/2017	Algebraic Statistics Workshop in Oberwolfach.
2/2017	Commutative Algebra and Algebraic Geometry Seminar, UC Berkeley.

12/2016	Tensors: Algebra meets Numerics workshop, Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany.
11/2016	Math Research Seminar, San Jose State University.
8-12/2016	Speaker and Organizer of *Foundational Tensor Theory Seminar*, UC Berkeley.
9/2016	Applied Algebra Seminar, UC Berkeley.
7/2016	Structured polynomial equations and applications mini-symposium, SIAM Annual Meeting, Boston.
5/2016	Biomathematics Seminar, Imperial College, London.
4/2016	Algebra, Geometry, Combinatorics Seminar, San Francisco State University.
4/2016	Algebra and Discrete Mathematics Seminar, University of California, Davis.
4/2016	Applied Algebra Seminar, UC Berkeley.
4/2016	Session on Combinatorial and Computational Commutative Algebra and Algebraic Geometry, Salt Lake City.
1/2016	Session on Non-Linear Algebra, Joint Mathematics Meetings, Seattle.
12/2015	Algorithms and Complexity in Algebraic Geometry Reunion, Simons Institute, Berkeley.
9/2015	Applied Algebra Seminar, UC Berkeley.
5/2015	Geometry Seminar, Texas A&M University.
3/2015	Commutative Algebra and Algebraic Geometry Seminar, UC Berkeley.
1/2015	Computational Algebraic Geometry Seminar, UC Berkeley.
11/2012	12th Forum of Young Mathematicians, Institut Henri Poincaré, Paris, France.

Outreach

2021	Emmy Noether Society talk, University of Cambridge.
2020	Berkeley Womxn in Math talk, UC Berkeley.
2020	Plenary talk: *The geometry of partial observations*, 'It All Adds Up' conference for 250 school girls, University of Oxford.
2019	Guest Lecture, PROMYS Europe: summer school for high school students, University of Oxford.
2017	Expository article: *The Algebraic Statistics of an Oberwolfach Workshop*, Snapshots of modern mathematics from Oberwolfach (2018) no. 1.
2016	Expository article: *Applied Algebra and Geometry: A SIAGA of Seven Pictures*, arXiv:1603.08546. Published in three instalments for SIAM News.
2015-2021	Blog writer: *Picture this Maths* https://picturethismaths.wordpress.com/ Convey mathematical ideas, pictures and research to wide audience.
2013	Documentary director: *What do you think about, when you think about maths?* Exploration of how visualisations are used to understand mathematical concepts http://imaginingthings-blr.tumblr.com/
2011-2013	Founder and President of *The Emmy Noether Society*, the student society for women in mathematics at the University of Cambridge.

Activities

2024	Workshop co-organiser: *Applied and computational algebraic geometry* Isaac Newton Institute, Cambridge, UK.
2023	Applied Algebra and Geometry Seminar co-organiser, Harvard University.
2022	Co-organiser of mini-workshop on Algebraic Statistics, Harvard University.
2021	Mini-symposium co-organiser: *Applied Invariant Theory: Statistics and Algorithms*, SIAM Conference on Applied Algebraic Geometry, Texas A&M University.

2021	Senior Fellow: Tensor Methods and Emerging Applications to the Physical and Data Sciences, Institute for Pure and Applied Mathematics, UCLA.
2021	Workshop co-organiser: *Mathematical Foundations and Algorithms for Tensor Computations.* Institute for Pure and Applied Mathematics, UCLA.
2020-2021	Data Science seminar co-organiser, University of Oxford.
2019	Undergraduate Maths Admissions Interviews, The Queen's College, University of Oxford.
2019	North-meets-South colloquium co-organiser, University of Oxford
2019	Mini-symposium co-organiser: *Signature tensors of paths*, SIAM Conference on Applied Algebraic Geometry, Bern, Switzerland.
2018	Mini-symposium co-organiser: *Theoretical challenges in tensor decomposition*, SIAM Annual Meeting, Portland, Oregon.
2018	Mini-symposium co-organiser: *Tensors and multilinear algebra*, SIAM Conference on Applied Linear Algebra, Hong Kong.
2017	Mini-symposium co-organiser: *Tensors from algebra to applications*, SIAM Conference on Applied Algebraic Geometry, Atlanta.
2017	Workshop co-organiser: *Interactions between algebra and the sciences*, Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany.