DANIEL IRVING BERNSTEIN

https://dibernstein.github.io

dibernst@mit.edu ⋄ bernstein.daniel@gmail.com

Research interests: Algebraic statistics, combinatorics, tropical geometry, applied algebraic geometry, phylogenetics, contingency tables, convex geometry

Teaching interests: Discrete mathematics, convex geometry, probability and statistics, algorithms, complexity theory, intro programming, abstract algebra, computational algebra, algebraic geometry, special topics courses related to my research interests

EDUCATION

2018 Ph.D. North Carolina State University, Mathematics (advisor: Seth Sullivant)
2015 M.S. North Carolina State University, Mathematics
2013 B.S. Davidson College, Mathematics (departmental honors, *magna cum laude*)

APPOINTMENTS

Massachusetts Institute of Technology:

- NSF Mathematical Sciences Postdoctoral Research Fellow (Mentor: Caroline Uhler): 2018-2020

Brown University:

- ICERM Postdoc: Fall 2018

Max Planck Institute for Mathematics in the Sciences (Leipzig, Saxony, Germany) :

- Visiting PhD Student in Bernd Sturmfels's group on nonlinear algebra: Summer 2017

North Carolina State University (Raleigh NC):

- Research Assistant: Summer 2014, Spring 2015, Summer 2015, Fall 2015, Summer 2016
- Instructor: Spring 2016, Fall 2016, Spring 2017, Fall 2017
- Recitation Leader: Spring 2014 and Fall 2014
- Lecture Assistant: Fall 2013, Spring 2018

GRANTS, HONORS, AND AWARDS

2018 – 2020	NSF Mathematical Sciences Postdoctoral Research Fellowship ($150,000)
2018	Winton-Rose Award (NC State Math Department, $1,000)
2013 – 2014	North Carolina State University Graduate Fellowship ($4,000)
2013	William G. McGavock Mathematics Award (Davidson College Math Department)
2013	Patterson Prize for talk given at the MAA Southeastern Section Spring Meeting

PAPERS

Submitted papers and preprints

11. The tropical Cayley-Menger variety (with Robert Krone). Submitted. arXiv:1812.09370
10. The algebraic matroid of the funtf variety (with Cameron Farnsworth and Jose Israel Rodriguez). arXiv:1812.10353
9. Typical and Generic Ranks in Matrix Completion (with Greg Blekherman and Rainer Sinn). Submitted. arXiv:1802.09513

8. L-infinity optimization to Bergman fans of matroids with an application to phylogenetics. Submitted. arXiv:1702.05141

Papers in press and print

7. Unimodular hierarchical models and their Graver bases (with Christopher O'Neill). To appear in *Journal of Algebraic Statistics*. arXiv:1704.09018
6. Completion of tree metrics and rank 2 matrices. *Linear Algebra and its Applications*. **533** (2017), pp. 1-13. arXiv:1612.06797
5. L-infinity optimization to linear spaces and phylogenetic trees (with Colby Long). *SIAM Journal on Discrete Mathematics*. **31** (2017) no. 2, pp. 875-889. arXiv:1702.05127
4. Unimodular binary hierarchical models (with Seth Sullivant). *Journal of Combinatorial Theory, Series B*. **123** (2017), pp. 97-125. arXiv:1502.06131
3. Normal binary hierarchical models (with Seth Sullivant). *Experimental Mathematics*. **26** (2017) no. 2 pp. 153-164. arXiv:1508.05461
2. Bounds on the expected size of the maximum agreement subtree (with Lam Si Tung Ho, Colby Long, Mike Steel, Katherine St. John and Seth Sullivant). *SIAM Journal on Discrete Mathematics*. **29** (2015) no. 4, pp. 2065-2074. arXiv:1411.7338
1. On three sets with nondecreasing diameter (with Carl Yerger and David J. Grynkiewicz). *Discrete Mathematics*. **338** (2015) no. 8, pp. 1328-1344. arXiv:1407.5122

TALKS

Invited conference talks

16. *Nonlinear algebra and matrix completion.* November 16, 2018. Nonlinear algebra in applications workshop at Brown University, ICERM.
15. *Using tropical geometry to characterize the algebraic matroid for rank-2 matrix completion.* July 13, 2018. SIAM Annual Meeting, Minisymposium on Distance Geometry. Portland, OR.
14. *Typical and generic ranks in low-rank matrix completion.* April 21, 2018. AMS Spring Eastern Sectional Meeting at Northeastern University. Special Session on Algebraic Statistics.
13. *Tropical linear spaces in phylogenetics.* September 23, 2017. AMS Fall Southeastern Sectional Meeting at University of Central Florida. Special Session on Mathematics of Biomolecules: Discrete, Algebraic, and Topological.
12. *Tropical Geometry for Rigidity Theory and Matrix Completion.* August 1, 2017. SIAM Conference on Applied Algebraic Geometry, Minisymposium on Algebraic Methods in Rigidity Theory. Atlanta, Georgia
11. *Tropical linear spaces in phylogenetics.* May 27, 2017. Interactions between algebra and the sciences. Max Planck Institute for Mathematics in the Sciences. Leipzig, Germany
10. *Combinatorial properties of hierarchical models.* July 11, 2016. SIAM Annual Meeting, minisymposium on algebraic statistics
9. *Toric Varieties in Statistics.* April 9, 2016. Meeting on Algebraic Geometry for Applications. Clemson University. Clemson, SC.
8. *Hierarchical Models: Normality and Related Properties.* Oct 3, 2015. 2015 AMS fall central sectional meeting, special session on algebraic statistics and its interactions with combinatorics, computation, and network science. Loyola University. Chicago, IL.

Seminar talks

7. Applied algebra and geometry seminar at Massachusetts Institute of Technology (Nov 21, 2017)
6. Algebra, geometry, and combinatorics seminar at San Francisco State University (Oct 19, 2016)
5. Combinatorics, algebra, convexity, algorithms and optimization seminar at UC Davis (Oct 17, 2016)

4. Graduate student algebra seminar, about once each semester

Contributed conference talks

3. *Unimodular Binary Hierarchical Models.* March 2, 2015. Forty-Sixth Southeastern International Conference on Combinatorics, Graph Theory, and Computing, Florida Atlantic University, Boca Raton, FL.
2. *A Strictly Increasing Function with Derivative Zero Almost Everywhere.* Spring, 2013. MAA Southeastern Section Spring Meeting, Winthrop University, Rock Hill, SC.
1. *Data Clustering and Movie Recommendations.* Spring, 2012. MAA Southeastern Section Spring Meeting, Clayton State University, Morrow, GA.

CONFERENCE ORGANIZING

3. *AMS Special Session on Algebraic Statistics (a Mathematics Research Communities Session)* at the Joint Mathematics Meetings. Atlanta GA, January 5, 2017
2. *Second Triangle Area Math Graduate Conference.* Raleigh NC, October 24, 2015.
1. *First Triangle Area Math Graduate Conference.* Raleigh NC, March 21, 2015.

CONFERENCES AND WORKSHOPS

30. *Bi-annual algebraic and tropical meetings of Brown and Yale* at Yale (November 29, 2018)
29. *Applied Algebra Day* at Massachusetts Institute of Technology (November 17, 2018)
28. *Nonlinear Algebra in Applications* at Brown University, ICERM (November 12-16, 2018)
27. *Real Algebraic Geometry and Optimization* at Brown University, ICERM (October 15-19, 2018)
26. *Algebraic Geometry Northeastern Series* at Brown University (September 21-23, 2018)
25. *Core Computational Methods* at Brown University, ICERM (September 17-21, 2018)
24. *Nonlinear Algebra Bootcamp* at Brown University, ICERM (September 5-12, 2018)
23. *SIAM Annual Meeting* in Portland, OR (July 9-13, 2018)
22. *AMS Spring Eastern Sectional Meeting* at Northeastern University (April 21-22, 2018)
21. *AMS Fall Southeastern Sectional Meeting* at University of Central Florida (September 23-24, 2017)
20. *SIAM Conference on Applied Algebraic Geometry* at Georgia Tech (July 31-August 4, 2017)
19. *NSF/CBMS Conference on Tensors and Their Uses in Approximation Theory, Quantum Information Theory and Geometry* at Auburn University (July 24-28, 2017)
18. *Algebraic and Combinatorial Phylogenetics* at Barcelona Graduate School of Mathematics (June 26-30, 2017)
17. *Interactions Between Algebra and the Sciences* at Max Planck Institute for Mathematics in the Sciences, Leipzig, Saxony, Germany (June 27, 2017)
16. *Computing in Tropical Geometry* at Zuse Institute Berlin (May 11-12, 2017)
15. *Joint Mathematics Meetings* (January 4 - 7, 2017)
14. *MSRI Summer School on Tropical Curves and Chip Firing* (July 25 - August 5, 2016).
13. *SIAM Annual Meeting* in Boston, MA (July 11 - 15, 2016).
12. *Summer School on Algebra, Statistics, and Combinatorics* at Aalto University, Helsinki, Finland (June 27 - July 2, 2016).
11. AMS *Mathematical Research Communities in Algebraic Statistics*, Snowbird UT (June 12-18, 2016).
10. *Meeting on Algebraic Geometry for Applications* at Clemson University, (April 9, 2016).
9. *AMS Fall Central Sectional Meeting* at Loyola University Chicago. (October 3-4, 2015).
8. Macaulay2 Workshop at Boise State University (May 27-30,2015)
7. *Forty-Sixth Southeastern International Conference on Combinatorics, Graph Theory, and Computing* at Florida Atlantic University (March 2-6, 2015)
6. *NSF/CBMS Conference on Mathematical Phylogeny* at Winthrop University (June 28 - July 22, 2014)

5. *Algebraic Statistics* at Illinois Institute of Technology (May 19-22, 2014)
4. *Joint Mathematics Meetings* (Jan 15-18, 2014)
3. *MAA Southeastern Section Spring Meeting* at Winthrop University (Spring 2013)
2. *MAA Southeastern Section Spring Meeting* at Clayton State University (Spring 2012)
1. Workshop in Epidemic Models at SAMSI and NCSU (May 16 - 20, 2011)

JOURNALS REFEREED

2. Forum of Mathematics, Sigma
1. Journal of Combinatorial Theory, Series B

OTHER PROFESSIONAL SERVICE AND OUTREACH

Massachusetts Institute of Technology, Institute for Data, Systems, and Society

2. LIDS social committee (Spring 2019-)
1. Co-organizer (with and Diego Cifuentes Elisa Perrone, and Elina Robeva) of the seminar in Algebra, Statistics and Optimization (Spring 2019-)

Brown University, Institute for Computational and Experimental Research in Mathematics

1. Co-organizer (with Greg Blekherman and Rainer Sinn) of a working group in matrix completion (Fall 2018)

North Carolina State University, Mathematics Department

5. Judge at the MAA poster session for undergraduate research at the 2017 JMM (January 6, 2017)
4. Co-organizer (with Emily Barnard) of NCSU's Graduate Student Algebra and Combinatorics Seminar (Fall 2014 - Spring 2017)
3. *Math Circle* (assistant), May 3, 2014
2. *AMS Graduate Student Chapter*, Fall 2013 - Spring 2016
   -Organize professional development and networking events for graduate students including a semesterly conference (see conference organizing)
   -President: Fall 2014 - Spring 2016, Treasurer: Fall 2013 - Fall 2014
1. *Math Doesn't Bug Me Team* (volunteer), Fall 2013 - Present
   -Outreach events for children in elementary and middle school

Davidson College, Mathematics Department

1. *Bernard Society* (officer), Fall 2012 - Spring 2013
   -Organize departmental events

TEACHING EXPERIENCE

North Carolina State University Mathematics Department

3. *Calculus III* (Main Instructor): Spring 2016, Fall 2016, Spring 2017, Fall 2017
2. *Calculus for Life and Management Sciences* (Recitation Leader): Spring 2014 and Fall 2014
1. *Applied Differential Equations* (Lecture Assistant): Fall 2013

Davidson College

2. *Center for Teaching and Learning* (math and computer science tutor), Fall 2011 - Spring 2013

1. *Programming and Problem Solving* (homework grader), Fall 2010

PROFESSIONAL DEVELOPMENT FOR TEACHING

2. NCSU graduate student teaching assistant spring workshop (May 7, 2014)
1. NCSU graduate student teaching assistant fall workshop (August 14-18, 2014)

MEMBERSHIPS

2. American Mathematical Society (AMS)
1. Society for Industrial and Applied Mathematics (SIAM)

PROGRAMMING LANGUAGES

Proficient in Java, C, C++, R, Python, Sage, Macaulay2, Mathematica

REFERENCES

Seth Sullivant (Ph.D. Advisor)
Professor of Mathematics
North Carolina State University
smsulli2@ncsu.edu

Jesús De Loera
Professor of Mathematics
University of California, Davis
deloera@math.ucdavis.edu

Cynthia Vinzant
Assistant Professor of Mathematics
North Carolina State University
clvinzan@ncsu.edu

Josephine Yu
Associate Professor of Mathematics
Georgia Institute of Technology
jyu@math.gatech.edu

Greg Blekherman
Georgia Institute of Technology
Associate Professor of Mathematics
greg@math.gatech.edu

Louis Theran
Lecturer in the School of Mathematics and Statistics
University of St. Andrews
lst6@st-andrews.ac.uk