Alex Rice

Millsaps College, Department of Mathematics
Email: riceaj@millsaps.edu
Website: http://alexricemath.com

Education

- Ph.D., Mathematics, University of Georgia (2012)
  - ◊ Thesis Advisor: Neil Lyall
  - ◊ Teaching Mentor: Malcolm Adams
  - ◊ Thesis Title: Improvements and extensions of two theorems of Sárközy
- B.S., Mathematics, University of Georgia (2008), cum laude with Honors
- M.S., Computer Science, Georgia Institute of Technology (Expected Fall 2026)

Employment History

- Professor, Millsaps College (August 2023 – Present)
- Associate Professor, Millsaps College (August 2022 – August 2023)
- Assistant Professor, Millsaps College (August 2017 – August 2022)
- Visiting Assistant Professor, University of Rochester (September 2014 – May 2017)
- Visiting Assistant Professor, Bucknell University (August 2012 – May 2014)
- Graduate Assistant, University of Georgia (June 2009 – August 2012)
- Graduate Assistant, University of Wisconsin–Madison (August 2008 – May 2009)

Research Interests

My research interests lie primarily in the field of arithmetic combinatorics, a rapidly developing area with close connections to number theory, combinatorics, harmonic analysis, and ergodic theory. I am particularly interested in applying analytic and combinatorial methods to locate arithmetic structures in sets of integers. For a representative example, my thesis work and several ongoing projects concern quantitative improvements and extensions of two theorems of Sárközy, the qualitative versions of which state that any set of natural numbers of positive upper density necessarily contains two distinct elements that differ by a perfect square, as well as two elements that differ by one less than a prime number. While continuing my personal research program in arithmetic combinatorics, I have also expanded my umbrella to facilitate collaboration with undergraduate students and authored some semi-expository work for a broad mathematical audience.

Publications and Preprints

1. *The sum-product problem for small sets II* (w/ Phillip Antis, Holden Britt, Caleigh Chapman, Elizabeth Hawkins, Elyse Warren), preprint (2026).
2. *Notes and computations on forbidden differences* (w/ Christian Dean, Haley Havard, Elizabeth Hawkins, Patch Heard, Andrew Lott), PUMP Journal of Undergraduate Research 9 (2026), 124–138.
3. *The Furstenberg–Sárközy theorem for polynomials in prime variables* (w/ John R. Doyle), Ramanujan Journal 67, article 64 (2025), 33pp.
4. *Determinants of Seidel tournament matrices* (w/ Sarah Klanderman, MurphyKate Montee, Andrzej Piotrowski, Bryan Shader), Linear Algebra and Applications 707 (2025), 126–151.
5. *The sum-product problem for small sets* (w/ Ginny Ray Clevenger, Haley Havard, Patch Heard, Andrew Lott, Brittany Wilson), Involve 18 (2025), 165–180.
6. *A precise probability related to Simpson's paradox*, College Math. Jour. 55 (2024), 400–405.
7. *Computations and observations on congruence covering systems* (w/ Raj Agrawal, Prarthana Bhatia, Kratik Gupta, Powers Lamb, Andrew Lott, Christine Rose Ward), INTEGERS 24A (2024): Proceedings of the Integers 2023 Conference, A1.
8. *Schur's theorem in integer lattices* (w/ Vishal Balaji, Andrew Lott), INTEGERS 22 (2022), A62.
9. *The pigeonhole principle and multicolor Ramsey numbers* (w/ Vishal Balaji, Powers Lamb, Andrew Lott, Dhruv Patel, Sakshi Singh, Christine Rose Ward), Involve 15 (2022), 857–884.
10. *Multivariate polynomial values in difference sets* (w/ John R. Doyle), Discrete Analysis, 2021:11, 46pp.
11. *Reciprocal sums and counting functions*, Amer. Math. Monthly 129 (2022), 903–912.
12. *Sets in $\mathbb{R}^d$ determining k taxicab distances* (w/ Vajresh Balaji, Olivia Edwards, Anne Marie Loftin, Solomon Mcharo, Lo Phillips, Bineyam Tsegaye), Involve 13 (2020), 487–509.
13. *Lattice configurations determining few distances* (w/ Vajresh Balaji, Olivia Edwards, Anne Marie Loftin, Solomon Mcharo, Lo Phillips, Bineyam Tsegaye), INTEGERS 20 (2020), A86.
14. *Sets in $\mathbb{R}^d$ with slowly-decaying density that avoid an unbounded collection of distances*, Proceedings of the AMS 148 (2020), 523–526.
15. *Binary quadratic forms in difference sets*, Combinatorial and Additive Number Theory III, Springer Proceedings of Mathematics and Statistics vol. 297 (2020), 175-196.
16. *A maximal extension of the best-known bounds for the Furstenberg–Sárközy Theorem*, Acta Arithmetica 187 (2019), 1–41.
17. *Polynomials and primes in generalized arithmetic progressions* (w/ Ernie Croot, Neil Lyall), International Mathematics Research Notices (2015), no. 15, 6021–6043.
18. *A purely combinatorial approach to simultaneous polynomial recurrence modulo 1* (w/ Ernie Croot, Neil Lyall), Proceedings of the AMS 143 (2015), no. 8, 3231–3238
19. *A quantitative result on Diophantine approximation for intersective polynomials* (w/ Neil Lyall), INTEGERS 15A (2015), Proceedings of the Erdős Centennial Conference, A12.
20. *Sárközy's theorem for $\mathcal{P}$-intersective polynomials*, Acta Arithmetica 157 (2013), 69–89.
21. *Improved bounds on Sárközy's theorem for quadratic polynomials* (with Mariah Hamel, Neil Lyall), International Mathematics Research Notices (2013), 1761–1782.

22. *Polynomial differences in the primes* (w/ Neil Lyall), Combinatorial and Additive Number Theory 2011-2012, Springer Proc. of Mathematics and Statistics vol. 101 (2014), 129–146.
23. *Torsion points on elliptic curves with complex multiplication* (w/ Pete Clark, Brian Cook, James Stankewicz), International Journal of Number Theory 9 (2013), 447–479.
24. Computations on elliptic curves with complex multiplication (w/ Pete Clark, Patrick Corn, Jim Stankewicz), LMS Journal of Computation and Mathematics 17 (2014), 509–535.

Conference Presentations

- *Difference sets and exponential sums over polynomials in prime variables:* AMS Fall Southeastern Sectional Meeting, Tulane University (New Orleans), October 2025
- *Notes and computations on forbidden differences*
  - ◊ LA/MS MAA Sectional Meeting, Belhaven University, Jackson, MS, February 2025
  - ◊ Southern Regional Number Theory Conference, Louisiana State University, March 2025
  - ◊ INTEGERS, University of Georgia, May 2025
- T*he sum-product problem for small sets*
  - ◊ Southern Regional Number Theory Conference, Louisiana State University, March 2024
  - ◊ Louisiana/Mississippi MAA Sectional Meeting, New Orleans, March 2024
  - ◊ PANTS XXXVII, University of Georgia, December 2023
- *Reciprocal sums and counting functions*
  - ◊ Joint Mathematics Meetings, San Francisco, January 2024
  - ◊ Louisiana/Mississippi MAA Sectional Meeting, University of Mississippi, March 2023
- *New results on polynomials in difference sets*:
  - ◊ AMS Fall Southeastern Sectional Meeting, University of South Alabama, October 2023
  - ◊ INTEGERS, University of Georgia, May 2023
  - ◊ AMS Spring Southeastern Sectional Meeting, Georgia Tech, March 2023
  - ◊ Southern Regional Number Theory Conference, Louisiana State University, March 2022
- *A precise probability related to Simpson's paradox*
  - ◊ MAA MathFest, Tampa, August 2023
  - ◊ LA/MS MAA Sectional Meeting, Northwestern State University, March 2022
- *Generalized arithmetic progressions and diophantine approximation by polynomials*
  - ◊ Combinatorial and Additive Number Theory (CANT), virtual, May 2023
  - ◊ Southern Regional Number Theory Conference, Louisiana State University, March 2023
- *New results in classical and arithmetic Ramsey theory*: Combinatorial and Additive Number Theory (CANT), virtual, May 2022
- *Two constructions related to well-known distance problems*: Combinatorial and Additive Number Theory (CANT), virtual, May 2021
- *Sets with slow-decaying density and unbounded missing distances:* Louisiana/Mississippi MAA Sectional Meeting, Loyola University New Orleans, February 2020
- *Deligne polynomials in difference sets:* Combinatorial and Additive Number Theory (CANT), CUNY Graduate Center, May 2019

- *Extending the best-known bounds on the Furstenberg–Sárközy Theorem*
  - ◊ INTEGERS, Augusta State University, October 2018
  - ◊ Combinatorial and Additive Number Theory (CANT), CUNY Graduate Center, May 2018
  - ◊ CanaDAM Conference, Ryerson University, Toronto, June 2017
- *Difference sets and polynomials*
  - ◊ INTEGERS Conference, University of West Georgia, October 2016
  - ◊ Winter Meeting of the Canadian Mathematical Society, Montreal, December 2015
  - ◊ Combinatorial and Additive Number Theory (CANT), CUNY Graduate Center, May 2015
  - ◊ Southeastern Analysis Meeting (SEAM), University of Georgia, March 2015
- *Squares and primes in generalized arithmetic progressions*
  - ◊ INTEGERS, University of West Georgia, October 2013
  - ◊ Combinatorial and Additive Number Theory (CANT), CUNY Graduate Center, May 2013
- *Sárközy's theorem for $\mathcal{P}$-intersective Polynomials*: SEAM 28, Univ. of Alabama, March 2012
- Polynomial patterns in subsets of the integers:
  - ◊ INTEGERS, University of West Georgia, October 2011
  - ◊ PANTS XVI, Emory University, September 2011
- *Polynomial differences in the primes*
  - ◊ Additive Combinatorics Mini-Conference, Georgia Tech, June 2010
  - ◊ Combinatorial and Additive Number Theory (CANT), CUNY Graduate Center, May 2010

Research Seminar and Colloquium Talks

- *Some low-entry results in additive combinatorics*: Oklahoma State Number Theory Seminar, March 2025
- *Barriers and breakthroughs in undergraduate mathematics research*
  - ◊ Belhaven STEM Seminar, March 2024
  - ◊ Millsaps College Art of Research, October 2023
  - ◊ Millsaps College Board of Trustees Meeting, April 2023
- *Generalized arithmetic progressions and diophantine approximation by polynomials*
  - ◊ University of Georgia Analysis Seminar, March 2024
  - ◊ Oklahoma State Number Theory Seminar, February 2024
  - ◊ University of Mississippi Number Theory Seminar, October 2022
- *New results on polynomials in difference sets*
  - ◊ Oklahoma State Number Theory Seminar, October 2020
  - ◊ Louisiana Tech Algebra and Combinatorics Seminar, October 2019
  - ◊ University of Mississippi Number Theory Seminar, February 2019
- *Background and breakthroughs in density Ramsey theory*
  - ◊ Millsaps College Colloquium, February 2017
  - ◊ Wake Forest University Colloquium, February 2017
  - ◊ University of Rochester Number Theory Seminar, November 2016

- *Squares and primes in generalized arithmetic progressions*
  - ◊ University of Rochester Number Theory Seminar, February 2015
  - ◊ University of Georgia Analysis Seminar, January 2013
  - ◊ Bucknell University Algebra Seminar, October 2012
- *Difference sets and polynomials*: Univ. of Rochester Combinatorics Seminar, Sept. 2014
- *Diophantine approximation and polynomial configurations in sumsets*: Bucknell University Algebra Seminar, September 2013
- *Improvements and extensions of two theorems of Sárközy*: Penn State University Algebra and Number Theory Seminar, November 2012
- *Arithmetic patterns in dense sets of integers*:
  - ◊ West Chester University Colloquium, September 2012
  - ◊ Bucknell University Colloquium, March 2012
- *Polynomial patterns in subsets of the integers*
  - ◊ University of Georgia Number Theory Seminar, October 2011
  - ◊ Georgia Tech Combinatorics Seminar, September 2011
- *Polynomial differences in the primes:* University of Georgia Number Theory Seminar, September 2010

Selected Student-Targeted Presentations

- Math Isn't Done (MID) general interest lecture series, Millsaps College
  - ◊ *Primes, squares, and beyond: the integers then and now*, September 2018
  - ◊ *Too many pigeons, not enough holes*, October 2018
  - ◊ *Randomness, structure, and a card game*, February 2019
  - ◊ One person, one vote? The mathematics of elections and gerrymandering, Feb. 2020
  - ◊ Baseball, birthdays, and bank robbers: A survey of mathematical paradoxes, Nov. 2021
- Joyful Math Jamborees virtual lecture series, Texas State: *A cab ride with Erdős*, July 2020
- *Background and breakthroughs in density Ramsey theory*: University of Rochester Mathematics Club, March 2017
- Analysis and arithmetic combinatorics learning seminar (co-organizer with Neil Lyall), 2009–2012. Approximately 20 lectures on Waring's problem, Vinogradov's three primes theorem, Roth's theorem, Sárközy's theorem, and the Green–Tao theorem
- *Cantor's craziness*: University of Georgia Undergraduate Math Club, September 2009
- *An introduction to elliptic curves and L-p spaces and Lambda-p sets*: University of Georgia VIGRE Graduate Student Seminar, June and September 2009
- *Density and substance: investigating the size of integer subsets*
  - ◊ University of Wisconsin–Madison Math Club, September 2008
  - ◊ University of Georgia VIGRE Graduate Student Seminar, September 2007
  - ◊ University of Georgia Math Club, August 2007

Teaching Experience (ordered reverse chronologically by first preparation)

Millsaps College

- Mathematics for Data Science (MATH 2400): Spring 2025–27
- Directed Study in Calculus III (MATH 2240): Spring 2025
- Mathematical Statistics (MATH 4510): Fall 2024, Fall 2025
- Differential Equations (MATH 3540): Fall 2024–26
- Directed Study in Galois Theory and Number Fields (MATH 4750): Spring 2023
- Directed Study in Topology (MATH 4660): Fall 2022, Spring 2025
- Abstract Algebra (MATH 4620): Spring 2022, Fall 2023, Fall 2025
- Directed Study in Analytic Number Theory (MATH 4752): Fall 2021
- Senior Seminar (MATH 4902–4912): 2020–21, 2021–22, 2022–23, 2025–26, 2026–27
- Statistics for Behavioral Sciences (PSYC 2100): Fall 2020–23 (remote in 2020)
- Linear Algebra (MATH 3650): Spring 2020
- Number Theory (MATH 3620): Fall 2019, Fall 2021, Fall 2024, Spring 2027
- Real Analysis (MATH 4630): Spring 2019–21 (remote in 2021), Spring 2025
- Calculus II (MATH 2230): Spring 2019, Spring 2023
- Calculus I (MATH 1220): Fall 2018 (x3), Fall 2021–23 (x2 in 2022)
- Topics in Mathematics: How Not to Be Wrong (MATH 1000): Spring 2018–23 (remote in 2021), Spring 2025–27
- Elementary Statistics (MATH 1150): Spring 2018 (x2)
- Putnam Problem Solving Seminar (MATH 3751): Fall 2017–19, 2021, 2024–25
- Complex Variables (MATH 3580): Fall 2017, Spring 2022, Fall 2026
- Precalculus (MATH 1130): Fall 2017 (x2), Fall 2019 (x2), Fall 2020 (remote)

University of Rochester

- Number Theory (MTH 230): Fall 2016
- Introduction to Mathematical Modeling for Life Sciences (MTH 218): Spring 2016, 2017
- Independent Study with Writing Requirement (MTH 391W): Spring 2016 (Waring's problem), Fall 2016 (Chebyshev's prime estimates)
- Calculus II (MTH 142): Spring 2016, Spring 2017
- Combinatorics (MTH 238): Fall 2015
- Linear Algebra with Differential Equations (MTH 165): Spring 2015, Fall 2016 (Course Czar)
- Qualitative Theory of Ordinary Differential Equations (MTH 263): Fall 2014
- Calculus I (MTH 141): Fall 2014, Spring 2015, Fall 2015

Bucknell University

- Calculus III (MATH 211): Spring 2014
- Independent Study: Roth's Theorem on Arithmetic Progressions, Spring 2014
- Topics in Calculus (MATH 192): Spring 2014 (two sections)
- Calculus I (MATH 201): Spring 2013 (two sections), Fall 2013 (two sections)

- Differential Equations (MATH 212): Fall 2012, Fall 2013
- Calculus II (MATH 202): Fall 2012 (two sections), Spring 2013

University of Georgia

- Calculus with Analytic Geometry (MATH 2200): Spring 2011
- Precalculus (MATH 1113): Fall 2010

University of Wisconsin–Madison

- Calculus and Analytic Geometry II (MATH 222): Spring 2009
- Calculus and Analytic Geometry I (MATH 221): Fall 2008

Undergraduate Research Supervision

- Kinnaird Institute Research Experience (Millsaps): Annually supervise up to six Millsaps students in month-long internally-funded summer research program; produced multiple student presentations and seven published research articles (one additional under review).
- Andrew Lott (Millsaps): Honors thesis in Ramsey theory and arithmetic combinatorics (Spring 2022–Spring 2023); Phi Beta Kappa award for best thesis and presentation; Ford fellowship focused on Calculus I–II (Fall 2022–Spring 2023)
- Sergei Kolesnik (Millsaps): Soccer analytics (Spring 2022)
- Drew Hopkins (Millsaps): Probability and game theory (Spring 2021)
- Tim Tribone (University of Rochester): Generalized arithmetic progressions (2016–17)
- Research Experience for Undergraduates (REU) Instructor for *Structure and Randomness: An Invitation to Arithmetic Combinatorics*, University of Georgia, Summer 2010 (led by Neil Lyall and Mariah Hamel)

Awards and External Grants

- B.J. Ball Scholarship (University of Georgia): Outstanding graduate student, Spring 2012
- Outstanding Graduate Teaching Award (UGA, Departmental), Spring 2012
- Outstanding Teaching Assistant Award (UGA, University-wide), March 2012
- NSF VIGRE Fellowship ($25,000 / 11 months): 2009–2010, 2011–2012
- NSF VIGRE Summer Fellowship ($5,000 / 2 months): 2009, 2011
- Commendation for Excellence in Teaching (Millsaps): 2017–18 through 2022–23, 2024–25
- Commendation for Excellence in Scholarship (Millsaps): 2018–19 through 2024–25
- Commendation for Excellence in Service (Millsaps): 2018–19, 2021–22 through 2024–25
- Richard A. Smith Award for Excellence in Scholarship or Creative Work (Millsaps), May 2023
- Janet R. Langley Award for Excellence in Academic Advising (Millsaps), May 2023
- Paul R. Halmos–Lester R. Ford Award (MAA), MathFest 2023
- AMS–Simons Research Enhancement Grant for PUI Faculty: 2023–2026 ($10,800)
- Distinguished Professor Award (Millsaps), May 2025

Selected Additional Conferences and Workshops Attended

- REUF Continuation Meetings: AIM/ICERM, Pasadena CA/Providence RI, July 2023/June 2025
- Research Experience for Undergraduate Faculty (REUF), AIM in San Jose CA, August 2022
- ACS Social Justice Mathematics Symposium, Spelman College, June 2019
- Georgia Discrete Analysis Conference, University of Georgia, May 2018
- Spring Mini-Courses in Analysis and Geometry, Louisiana State University, February 2018
- IMA Workshop on Additive and Analytic Combinatorics, Minneapolis, Sept–Oct 2014
- IPAM Workshop on Kakeya, Restriction, and Sum-Product Theory, Los Angeles, May 2014
- Additive Combinatorics in Paris Summer School, Institut Henri Poincaré, July 2012
- Catalina Island Summer School in Harmonic Analysis, June 2012
- Oscillatory Integrals in Harmonic Analysis, ICMS, Edinburgh, June 2011
- Workshop on Discrete Methods in Ergodic Theory, Northwestern University, February 2011
- Southeastern Analysis Meeting (SEAM) 26, Georgia Tech, March 2010
- MAA MathFest: Madison (2008), Lexington (2011), Tampa (2023)
- Joint Mathematics Meetings: San Diego (2008), Washington D.C. (2009), New Orleans (2011), Boston (2012), Baltimore (2014), Atlanta (2017)
- NSF FRG Conference: New Developments in Harmonic Analysis, University of Georgia, October 2007

Millsaps College Committee Work

- Divisional Personnel Committee: Fall 2023–
- Faculty Grievance Committee: 2025–26
- Faculty Council: Sciences Division representative, Summer 2020–Spring 2022
- Faculty Assessment Committee: 2018–2024
- Curriculum Committee: Fall 2022–Spring 2025; temporary chair Fall 2023
- Honors Committee: Fall 2018–Spring 2021
- Honors Program Director: Fall 2021–Spring 2025
- STEM and Data Science Pathway Coordinator: Fall 2021–Spring 2024
- Recruitment/Enrollment and Cost Reduction Strategic Initiative Working Groups: Spring–Summer 2019
- Pathways Working Groups: Fall 2019
- All College Council and Athletics Committee: 2018-19

Additional Service

- Millsaps College High School Mathematics Competition: organizer, 2019, 2021–
- Louisiana/Mississippi MAA Sectional Meeting: student mentor and participant since 2019
- Putnam problem solving seminar (Millsaps): supervisor since 2017
- Putnam Exam grader and problem captain since 2021

- United States Mathematical Olympiad grader and problem captain, March 2024
- Mathematics Magazine Associate Editor since 2024
- PUMP Journal of Undergraduate Research editorial board member since 2026
- Mississippi Mu Alpha Theta: problem writer for state convention since 2021
- Referee: Proceedings of the AMS, Journal of Number Theory, Acta Arithmetica, American Mathematical Monthly, Involve: A Mathematics Journal, Compositio Mathematica, Annales Academiae Scientiarum Fennicae Mathematica, Communications in Algebra, Minnesota Journal of Undergraduate Mathematics, Rocky Mountain Journal of Mathematics, Ramanujan Journal, International Mathematics Research Notices, Integers, Electronic Journal of Combinatorics, College Mathematics Journal, Advances in Applied Mathematics, Mathematische Zeitschrift
- Reviewer for MathSciNet and zbMATH
- MATHCOUNTS Question Writing Committee: April 2016 – November 2018
- University of Georgia High School Math Tournament: Question writer and tournament volunteer 2006–2007, 2009–2011

Technical Skills

- Python, Java, SageMath, LaTeX