Xuancheng Shao Curriculum Vitae

Contact Information

Department of Mathematics
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Employment

2022–present **University of Kentucky**
Associate Professor

2017–2022 **University of Kentucky**
Assistant Professor

2014–2017 **University of Oxford**
Glasstone Research Fellow

Education

2009–2014 **Stanford University**
PhD in Mathematics
Advisor: K. Soundararajan
Dissertation: *Dichotomy between structure and randomness in combinatorial number theory*

2006–2009 **Massachusetts Institute of Technology**
Bachelor of Science in Mathematics, minor in Economics
Bachelor of Science in Computer Science

2005–2006 **Beijing University**

Research interests

- Analytic and combinatorial number theory: distribution of primes, exponential sums, sieve theory.
- Additive combinatorics: Gowers norms and applications to primes, nilsequences, structure theory of sumsets.

Preprints and publications

27. (with K. Matomäki, T. Tao, J. Teräväinen) "Higher uniformity of arithmetic functions in short intervals I. All intervals."

    arXiv:2204.03754. Submitted. 90 pages.

26. (with A. Alsetri) "On Hilbert cubes and primitive roots in finite fields."

    Arch. Math. (Basel) 118 (2022), no. 1, 49-56.

25. (with P.Y. Bienvenu, J. Teräväinen) "A transference principle for systems of linear equations, and applications to almost twin primes."

    Algebra Number Theory 17 (2023), no. 2, 497-539.

24. (with K. Matomäki, M. Radziwiłł, T. Tao, J. Teräväinen) "Singmaster's conjecture in the interior of Pascal's triangle."

    Q. J. Math. 73 (2022), no. 3, 1137-1177.

23. (with J. Teräväinen) "The Bombieri-Vinogradov theorem for nilsequences."

    Discrete Anal. 2021, Paper No. 21, 55 pp.

22. (with K. Matomäki) "Discorrelation between primes in short intervals and polynomial phases."

    Int. Math. Res. Not. IMRN 2021, no. 16, 12330-12355.

21. "On an almost all version of the Balog-Szemeredi-Gowers theorem."

    Discrete Anal. 2019, Paper No. 12, 18 pp.

20. (with W. Xu) "A robust version of Freiman's $3k-4$ Theorem and applications."

    Math. Proc. Cambridge Philos. Soc. 166 (2019), no. 3, 567—581.

19. (with A. Granville) "When does the Bombieri-Vinogradov theorem hold for a given multiplicative function?"

    Forum Math. Sigma 6 (2018), e15, 23 pp.

18. (with S. Drappeau, A. Granville) "Smooth-supported multiplicative functions in arithmetic progressions beyond the $x^{1/2}$-barrier."

    Mathematika 63 (2017), no. 3, 895–918.

17. (with A. Granville) "Bombieri-Vinogradov for multiplicative functions, and beyond the $x^{1/2}$-barrier."

    Adv. Math. 350 (2019), 304—358.

16. (with B. Bhattacharya, S. Ganguly, Y. Zhao) "Upper tails for arithmetic progressions in a random set".

    Int. Math. Res. Not. IMRN 2020, no. 1, 167–213.

15. (with K. Matomäki) "When the sieve works II".

    J. Reine Angew. Math. 763 (2020), 1–24.

14. (with K. Matomäki, J. Maynard) "Vinogradov's theorem with almost equal summands."

    Proc. Lond. Math. Soc. (3) 115 (2017), no. 2, 323-347.

13. "Gowers norms of multiplicative functions in progressions on average".

    Algebra Number Theory 11 (2017), no. 4, 961-982.

12. (with S. Drappeau) "Weyl sums, mean value estimates, and Waring's problem with friable numbers".

    Acta Arith. 176 (2016), no. 3, 249-299.

11. (with K. Matomäki) "Vinogradov's three primes theorem with almost twin primes".

    Compos. Math. 153 (2017), no. 6, 1220-1256.

10. "Narrow arithmetic progressions in the primes".

    Int. Math. Res. Not. IMRN 2017, no. 2, 391-428.

9. "Polynomial values modulo primes on average and sharpness of the larger sieve".

    Algebra Number Theory 9 (2015), no. 10, 2325-2346.

8. "On an inverse ternary Goldbach problem".

    Amer. J. Math. 138 (2016), no. 5, 1167-1191.

7. "Finding linear patterns of complexity one"

    Int. Math. Res. Not. IMRN 2015, no. 9, 2311-2327.

6. (with P. Diaconis, K. Soundararajan) "Carries, group theory, and additive combinatorics".

    Amer. Math. Monthly 121 (2014), no. 8, 674-688.

5. "Large values of the additive energy in $\mathbb{R}^d$ and $\mathbb{Z}^d$".

    Math. Proc. Cambridge Philos. Soc. (2014) 156: 327-341.

4. "An L-function-free proof of Vinogradov's three primes theorem".

    Forum Math. Sigma 2 (2014), e27, 26 pp.

3. "Character sums over unions of intervals".
   Forum Math. 27 (2015), no. 5, 3017-3026.

2. "A density version of the Vinogradov three primes theorem".
   Duke Math. J. 163 (2014), no. 3, 489-512.

1. "On character sums and exponential sums over generalized arithmetic progressions".
   Bull. London Math. Soc. (2013) 45 (3): 541-550.

Academic Honors and Grants

- NSF DMS-2200565, Topics in Analytic Number Theory and Additive Combinatorics, 2022-2025.
- NSF DMS-1802224, Topics in Analytic Number Theory and Additive Combinatorics, 2018-2022.
- Pölya teaching fellow award, Stanford, 2014.
- ACM-ICPC World Finals: Second Place Team (North America Champions), 2008.
- William Lowell Putnam Mathematical Competition: Putnam Fellow, 2007; Top 25 Individuals, 2006.
- International Mathematical Olympiad: Gold Medal, 2005.
- Chinese National Olympiad in Informatics: Gold Medal, 2003.

Selected Talks

Invited Conference and Workshop Talks

- Oct 2023: Special session on number theory and friends, AMS Sectional Meeting, University of South Alabama.
- Oct 2023: Special session on analytic number theory and related fields, AMS Sectional Meeting, Creighton University.
- Sep 2022: Analytic number theory conference in honor of Andrew Granville, Montreal.
- Jun 2022: SIAM conference on discrete mathematics (DM22).
- Mar 2022: Special session on the interface of harmonic analysis and number theory, AMS Sectional Meeting, Purdue (online).

- Dec 2020: Special session on discrete analysis, CMS winter meeting, Montreal (online).
- Jan 2019: Special session on counting methods in number theory, Joint AMS/MAA Meeting, Baltimore.
- Sep 2018: Arithmetic Ramsey theory, University of Manchester.
- Aug 2018: Additive combinatorics and its applications, AIM.
- May 2018: International Conference on Mathematics and Statistics (ICOMAS 2018), University of Memphis.
- Oct 2017: Workshop on additive combinatorics, CMSA, Harvard.
- May 2017: Recent developments in analytic number theory, MSRI, Berkeley.
- Jan 2017: Pseudorandomness boot camp, Simons Institute for the Theory of Computing, Berkeley.
- Apr 2015: One-day meeting in additive combinatorics, Oxford.
- Oct 2014: New horizons in additive combinatorics, CRM, Montreal.
- Sep 2014: Analytic number theory workshop, Clay Mathematical Institute, Oxford.

Seminar Talks

- Mar 2022: Stanford analytic number theoy reading seminar (delivered online).
- Mar 2022: Nancy-Metz number theory seminar (delivered online).
- Oct 2021: Algebra seminar, University of Kentucky.
- Jul 2020: Webinar in additive combinatorics (online).
- Jun 2020: Number theory seminar, Shandong University (delivered online).
- Apr 2020: Number theory seminar, Kansas State University (delivered online).
- Jul 2019: Colloquium Series for REU Program, University of Tennessee Chattanooga.
- Nov 2018: Discrete CATS seminar, University of Kentucky.
- Oct 2018: Number theory seminar, University of Georgia.
- Oct 2018: Number theory seminar, University of Manchester.
- Sep 2018: Analysis seminar, University of Kentucky.

- Jun 2018: Seminaire d'Algebre et de Theorie des Nombres, EPFL.
- Mar 2018: Number theory seminar, UIUC.
- Feb 2018: Harmonic analysis and automorphic form, Ohio State University.
- Sep 2017: Algebra and number theory seminar, University of Kentucky.
- Oct 2016: Number theory seminar, University of Warwick.
- Apr 2016: London number theory seminar, King's College London.
- Feb 2016: Number theory seminar, University of Manchester.
- Oct 2015: Heibronn seminar, University of Bristol.
- May 2015: Seminaire d'Algebre et de Theorie des Nombres, EPFL.
- Feb 2015: Number theory seminar, University of Oxford.
- Oct 2014: Analytic number theory seminar, CRM, Montreal.
- Mar 2014: Québec-Vermont Number Theory Seminar, Montreal.
- Oct 2013: Number theory seminar, Stanford University.

Lecture series

- Jun 2022: Fourier methods in additive combinatorics, Shandong University (3 lectures, delivered online).
- May 2019: Shandong University, China (3 lectures).
- Jan 2017: Pseudorandomness boot camp, Simons Institute for the Theory of Computing, Berkeley (2 lectures).

Teaching

University of Kentucky

- MA113 (Calculus I), Fall 2019, 2023.
- MA213 (Calculus III), Fall 2017.
- MA322 (Matrix algebra), Spring 2018.
- MA327 (Game theory), Fall 2020.

- MA361 (Undergraduate abstract algebra I), Fall 2021, 2023.
- MA362 (Undergraduate abstract algebra II), Spring 2022, 2023.
- MA433 (Undergraduate complex analysis), Spring 2019.
- MA565 (Graduate linear algebra), Fall 2022.
- MA561 (Graduate abstract algebra I), Fall 2019.
- MA661 (Graduate abstract algebra II), Spring 2020.
- MA671 (Graduate complex analysis), Spring 2018, 2019, 2022.
- MA765 (Graduate topic class), Fall 2018, 2020, Spring 2023.

University of Oxford

- Consultation sessions for C3.8 Analytic Number Theory, Trinity Term 2015.

Stanford University

- Teaching assistant for Math 21 Calculus, Spring 2014.
- Teaching assistant for Math 42 Calculus (Accelerated), Fall 2013.
- Teaching assistant for Math 51 Linear Algebra and Differential Calculus of Several Variables, Spring 2011, Winter 2012, Fall 2012.

Massachusetts Institute of Technology

- Math tutor for the Office of Minority Education, 2007-2009.

Students supervised

- Graduate student (current): Ali Alsetri.
- Mengdi Wang (2019-2020): Visiting PhD student from Shandong University.
- Sean Grate (Fall 2019): Undergraduate independent study.
- Tibor Burdette (Fall 2019): Undergraduate independent study.
- Wenqiang Xu (Summer 2017): Undergraduate research, Oxford.
- James Herring (2016): Mathematics Part B Dissertation, Oxford (co-supervised with J. Andrade).

Service

- Organizer for the special session on recent progress in analytic number theory, AMS Spring Central Sectional Meeting, 2021.
- Preliminary examination committee member, University of Kentucky, 2018-2020 (analysis), 2020-2021 (algebra).
- Alumni Day co-organizer, University of Kentucky, 2021.
- Faculty adviser for the Putnam competition, University of Kentucky, 2020-present.
- Faculty adviser for the Virginia Tech regional math competition, University of Kentucky, 2022.
- Salary committee, University of Kentucky, 2022-2024.
- Hiring committee member, University of Kentucky, 2022-2023.
- Graduate program committee member, University of Kentucky, 2021-2022.
- Graduate recruiting committee member, University of Kentucky, 2019-2020, 2022-2023.
- Postdoc search committee member, University of Kentucky, 2019-2020.
- Julia Robinson Math Festival volunteer, Lexington, KY, Nov 2019.
- Organizer, Number Theory Seminar, Oxford, 2015-2016.
- Assessor, Part B/C dissertations, Oxford, 2016.
- Examiner, Confirmation of status viva of Freddie Manners, Oxford, 2015.
- Examiner, Transfer of status viva of Sofia Lindqvist, Oxford, 2016.
- Journal refereeing: *Compositio Mathematica*, *Journal of the European Mathematical Society*, *Advances in Mathematics*, *Mathematische Annalen*, *IMRN*, *Proceedings of the LMS*, *Journal of the LMS*, *Algebra Number Theory*, *Acta Arithmetica*, *Mathematika*, *Journal of Number Theory*, *Discrete Analysis*, etc.
- Reviewer for AMS Mathematical Reviews.