

# Caroline L. Turnage-Butterbaugh

---

Department of Mathematics and Statistics  
Carleton College  
Northfield, MN 57707 USA

+1 (507) 222-4785  
cturnageb@carleton.edu  
<https://www.carleton.edu/directory/cturnageb/>

## PROFESSIONAL APPOINTMENTS

|   |                |
|---|----------------|
| <b>Carleton College:</b> Associate Professor of Mathematics                 | 2024 – present |
| Assistant Professor of Mathematics  | 2018 – 2024    |
| <b>Duke University:</b> William W. Elliott Assistant Research Professor     | 2015 – 2018    |
| <b>Mathematical Sciences Research Institute (MSRI):</b> Postdoctoral Fellow | Spring 2017    |
| <b>North Dakota State University:</b> Postdoctoral Research Fellow          | 2014 – 2015    |
| <b>Williams College:</b> Postdoctoral Undergraduate Research Mentor         | Summer 2014    |

## EDUCATION

|  |          |
|--|----------|
| <b>University of Mississippi:</b> Ph.D. in Mathematics                       | May 2014 |
| <b>Wake Forest University:</b> M.A. in Mathematics                           | May 2008 |
| <b>Wofford College:</b> B.A. in Mathematics & French, <i>magna cum laude</i> | May 2006 |

## RESEARCH INTERESTS

analytic number theory – moments of  $L$ -functions, zeros of  $L$ -functions, and class groups of number fields

## RESEARCH GRANTS

|  |             |
|--|-------------|
| NSF CAREER Grant (P.I.), DMS-2239681                     | 2023 – 2029 |
| NSF Grant (P.I.), DMS-1902193                            | 2019 – 2023 |
| NSF FRG Grant (Senior Scientist Consultant), DMS-1854398 | 2019 – 2023 |

## PREPRINTS

1. Short mollifiers of the Riemann zeta-function (with J.B. Conrey, D.W. Farmer, C-H Kwan, and Y. Lin), preprint, 2025, <https://arxiv.org/abs/2508.11108>
2. The Alternative Hypothesis for zeros of the Riemann zeta-function (with S. Baluyot, D.A. Goldston, and A.I. Suriajaya), preprint, 2025, <https://arxiv.org/abs/2508.10857>
3. A guide to Tauberian theorems for arithmetic applications (with L.B. Pierce and A. Zaman), preprint, 2025, <https://arxiv.org/abs/2504.16233>
4. Pair correlation of zeros of the Riemann zeta function I: Proportions of simple zeros and critical zeros (with S. Baluyot, D.A. Goldston, and A.I. Suriajaya), preprint, 2025, <https://arxiv.org/abs/2501.14545>

## PUBLICATIONS

1. A Mean value theorem for Dirichlet polynomials associated with primitive Dirichlet  $L$ -functions (with S. Baluyot), *International Mathematics Research Notices* **2025(3)** (2025), 1–39.
  - This article is the streamlined version of a longer preprint: Twisted  $2k$ th moments of primitive Dirichlet  $L$ -functions: beyond the diagonal, (with S. Baluyot), <https://arxiv.org/abs/2205.00641>

2. An unconditional Montgomery Theorem for pair correlation of zeros of the Riemann zeta function (with S. Baluyot, D.A. Goldston, and A. I. Suriajaya), *Acta Arithmetica* **214** (2024), 357–376.
3. On the Montgomery-Odlyzko method regarding gaps between zeros of the zeta-function (with D. A. Goldston and T.S. Trudgian), *Journal of Mathematical Analysis and Applications* **527** (2023), no. 2, Paper No. 127548.
4. Some explicit and unconditional results on gaps between zeroes of the Riemann zeta-function (with T. Trudgian and A. Simonic), *Transactions of the American Mathematical Society*, **375**, no. 3 (2022), 3239–3265.
5. Hilbert transforms and the equidistribution of zeros of polynomials (with E. Carneiro, M. K. Das, A. Florea, A. V. Kumchev, A. Malik, M. B. Milinovich, and J. Wang) *Journal of Functional Analysis* **281** (2021), no. 9, Paper No. 109199, 25 pp.
6. On a conjecture for  $\ell$ -torsion in class groups of number fields: from the perspective of moments (with L. B. Pierce and M. Matchett Wood), *Mathematical Research Letters* **28**, no. 2 (2021), 575–621.
7. An effective Chebotarev density theorem for families of number fields with an application to  $\ell$ -torsion in class groups (with L. B. Pierce and M. Matchett Wood), *Inventiones Mathematicae* **219** (2020), no. 2, 701–778.
8. Extremal primes of elliptic curves without complex multiplication (with C. David, A. Gafni, A. Malik, and N. Prabhu) *Proceedings of the America Mathematics Society* **148** (2020), no. 3, 929–943.
9. On  $r$ -gaps between zeros of the Riemann zeta-function (with J. B. Conrey), *Bulletin of the London Mathematical Society* **50** (2018), no. 2, 349–356.
10. Gaps between zeros of Dedekind zeta-functions of quadratic number fields. II (with H. M. Bui and W. P. Heap), *Quarterly Journal of Mathematics* **67** (2016) no. 3, 467–482.
11. \*Gaussian distribution of the number of summands in generalized Zeckendorf decompositions (with A. Best, P. Dynes, X. Edelsbrunner, B. McDonald, S. J. Miller, K. Tor, and M. Weinstein), *INTEGERS* **16** (2016), #A6
12. \*Gaps between zeros of  $GL(2)$   $L$ -functions (with O. Barrett, B. McDonald, S. J. Miller, P. Ryan, and K. Winsor), *Journal of Mathematical Analysis and Applications* **429** (2015), 204–232.
13. Consecutive primes in tuples (with W. D. Banks and T. Freiberg), *Acta Arithmetica* **167**, (2015), 261–266.
14. \*Gaussian behavior of the number of summands in Zeckendorf decompositions in small intervals (with A. Best, P. Dynes, X. Edelsbrunner, B. McDonald, S. J. Miller, K. Tor, and M. Weinstein), *Fibonacci Quarterly* **52** (2014), no. 5, 35–46.
15. \*Benford behavior of Zeckendorf decompositions (with A. Best, P. Dynes, X. Edelsbrunner, B. McDonald, S. J. Miller, K. Tor, and M. Weinstein), *Fibonacci Quarterly* **52** (2014), no. 5, 47–53.
16. Gaps between zeros of Dedekind zeta-functions of quadratic number fields, *Journal of Mathematical Analysis and Applications* **418** (2014), no. 1, 100–107.
17. *Moments of products of automorphic  $L$ -functions* (with M. B. Milinovich), *Journal of Number Theory*, **139** (2014), 175–204.

\* Undergraduate co-authors from the 2014 SMALL REU

**CONFERENCE PROCEEDINGS AND BOOK CONTRIBUTIONS (SMALL 2014 REU)**

1. Benford behavior of generalized Zeckendorf decompositions (with A. Best, P. Dynes, X. Edelsbrunner, B. McDonald, S. J. Miller, and M. Weinstein), *Combinatorial and Additive Number Theory II: CANT*, New York, NY, USA, 2015 and 2016, Springer, New York, 2017.
2. From Quantum Systems to  $L$ -Functions: Pair Correlation Statistics and Beyond (with O. Barrett, F. W. K. Firk, and S. J. Miller), *Open Problems in Mathematics* (editors John Nash Jr. and Michael Th. Rassias), Springer-Verlag (2016).
3. Some Results in the Theory of Low-lying Zeros (with B. Mackall, S. J. Miller, C. Rapti, and K. Winstor), in *Families of automorphic forms and the trace formula* (editors Werner Müller, Sug Woo Shin, and Nicolas Templier), Simons Symposia Series, Springer-Verlag.
4. Benfordness of the Cauchy Distribution and Generalizations (with X. Edelsbrunner, K. Huan, B. Mackall, J. Powell, and M. Weinstein), Section 3.6, an appendix to *Theory and Applications of Benford's Law*, (S. J. Miller, editor), Princeton University Press, 2015.

**FELLOWSHIPS AND GRANTS**

|   |                  |
|---|------------------|
| Carleton College Curricular Bridge Grant                                    | 2025             |
| Carleton College Hewlett Mellon Fellowship                                  | 2020             |
| Carleton College Curriculum Development Grant                               | 2020             |
| US Junior Oberwolfach Fellow  | 2019             |
| Carleton College Curriculum Innovation Grant                                | 2019             |
| MAA Project NExT Fellow – Silver'19 cohort                                  | 2019             |
| AMS-Simons travel grant, declined   | 2019 – 2020      |
| AMS-Simons travel grant   | 2018 – 2019      |
| NSA conference grant (Co-P.I.), re:boot Number Theory 2016, Duke University | 2016             |
| AWM/ NSF travel grant, DMS-1153905  | 2014             |
| GAANN summer research grants, University of Mississippi                     | 2010, 2012, 2013 |
| GAANN graduate studies fellowship, University of Mississippi                | 2009 – 2014      |

**AWARDS**

|  |      |
|--|------|
| Top 5% Teaching Evaluations, Trinity College of Arts & Sciences, Duke University | 2018 |
| University of Mississippi Class Marshal  | 2014 |
| Graduate Instructor Excellence in Teaching Award                                 | 2013 |
| Graduate Student Research Achievement Award in Mathematics                       | 2013 |

**RESEARCH VISITS****Invited Visits for Collaboration**

- Duke University – April 2025, December 2022, September 2022, December 2019, January 2015
- École Polytechnique Fédérale de Lausanne (EPFL), September 26 - 30, 2022

- NSF Focused Research Group, American Institute of Mathematics (AIM) – February-March 2022, August 2021, August/September 2019
- Department of Mathematics, University of New South Wales - Canberra – March 2018
- Institute for Advanced Study (IAS) – May 2018
- Max Planck Institute of Mathematics (MPIM) – July 2018
- Institute for Computational and Experimental Research in Mathematics (ICERM) – November 2015
- Department of Mathematics, University of Missouri – November 2013

### **Invited Conference and Workshop Participation**

- Analytic Number Theory, Institut Mittag-Leffer – March 2024
- Delta Symbols and the Subconvexity Problem, AIM – October 2023
- Arithmetic, Algebra, and Algorithms, International Centre for Mathematical Sciences – April 2023
- 50 Years of Number Theory & Random Matrix Theory Conference, IAS – June 2022
- Automorphic Forms and Arithmetic, Oberwolfach – August/September 2020
- Analytic Number Theory, Oberwolfach – November 2019
- Women in Numbers 4 (WIN4), Banff International Research Station – August 2017
- Moments of Zeta and Correlations of Divisor Sums, AIM – August/September , 2016
- Bounded Gaps Between Primes, AIM – November 2014

### **INVITED RESEARCH LECTURES AND PRESENTATIONS**

#### **Plenary Talks**

- AMS Current Events Bulletin Lecture, Joint Mathematics Meetings – January 2026
- INTEGERS, In Honor of the 80th Birthdays of Melvyn Nathanson and Carl Pomerance, University of Georgia – May 2025
- 47th Annual New York Regional Graduate Mathematics Conference, Syracuse University – April 2022

#### **Department Colloquia**

- University of Illinois Urbana-Champaign, December 2023
- Vanderbilt University, November 2023
- University of New South Wales Canberra – March 2018
- Oberlin College – November 2017
- Wake Forest University – April 2016
- Williams College – January 2015, June 2014
- Wofford College – April 2014

#### **Summer Programs for Graduate Students and Postdocs**

- ANTeater, University of California Irvine – August 2022
- $L$ -functions: Open Questions and Current Methods, Summer school on  $L$ -functions, Hausdorff Center for Mathematics – June 2018 (3 lectures)
- New Trends in Analytic Number Theory, LMS-CMI Research School, University of Exeter – August 2018

**REU Talks**

- PRiME (Pomona Research in Mathematics Experience) Colloquium – July 2022
- Summer Research Seminar, Wofford College – June 2021
- Bridging Theoretical and Applied Mathematics REU, Winthrop University – June 2016
- WADE Into Research REU, Wake Forest University – June 2016

**Seminar Talks**

- Number Theory Seminar, Kansas State University – April 2024
- Number Theory Seminar, University of Illinois Urbana-Champaign, December 2023
- Algebra and Number Theory Seminar, University of Rochester, March 15, 2023
- Number Theory Seminar, Duke University, December 7, 2022
- Number Theory Seminar, École Polytechnique Fédérale de Lausanne, September 28, 2022
- Algebraic Geometry and Number Theory Seminar, Chalmers University of Technology / University of Gothenburg – October 2021
- Number Theory Seminar, Vanderbilt University – May 2021
- Quebec-Maine Number Theory Seminar, University of Montreal – April 2021
- Number Theory Seminar, University of Virginia – April 2021
- Analytic Number Theory and Harmonic Analysis Seminar, Purdue University – March 2021
- Focused Research Group Seminar, American Institute of Mathematics – March 2021
- Number Theory Seminar, Kansas State University – March 2021
- ViBrANT Seminar (Virtual Brazilian Analytic Number Theory) – February 2021
- Number Theory Seminar, University of Mississippi – February 2021
- VaNTAGe (Virtual seminar on open conjectures in Number Theory & Arithmetic Geometry) – February 2020
- Number Theory Seminar, University of Minnesota – December 2018
- Number Theory Seminar, University of New South Wales Sydney – March 2018
- Pure Maths Seminar, University of New South Wales Sydney – March 2018
- Number Theory Seminar, MPIM – July 2018
- PLeaSANTS, MPIM – July 2018
- Algebra and Number Theory Seminar, University of Cologne – July 2018
- Algebra, Geometry, and Number Theory Seminar, Tufts University – November 2017
- Algebraic Geometry and Number Theory Seminar, Rice University – April 2017
- Number Theory Seminar, University of South Carolina – November 2016
- Number Theory Seminar, University of Illinois Urbana-Champaign – April 2016
- UNC-Duke Number Theory Seminar, Duke University – January 2015

**Invited Conference/Workshop Talks**

- Analytic Number Theory and Arithmetic Statistics, CRM, Quebec – August 2024
- International Conference on L-functions and Automorphic Forms, Vanderbilt University – May 2024
- Analytic Number Theory Workshop, Institut Mittag-Leffler – March 2024
- AMS Special Session on Analytic Number Theory and Related Fields, Omaha, October 2023
- Number Theory Days, EPFL, September 30-October 1, 2022
- AMS Special Session Analytic Theory of Automorphic Forms &  $L$ -Functions, JMM – January 2020
- Analytic Number Theory Workshop, Oberwolfach Research Institute for Mathematics – November 2019
- NSF-CBMS Conference:  $L$ -functions & Multiplicative Number Theory, U. of Mississippi – May 2019
- Analytic Aspects of Automorphic Forms, Université de Lille – April 2019
- Value Distribution of Zeta and L-functions and Related Topics, RIKEN Institute – March 2019
- CMS Special Session, CMS Winter Meeting, Vancouver – December 2018
- AMS Special Session, AMS Sectional Meeting Washington State University – March 2017
- Connections for Women, Analytic Number Theory Workshop, MSRI – February 2017
- AMS Special Session on Analytic number theory and arithmetic, JMM – January 2017
- 30th Automorphic Forms Workshop, Wake Forest University – March 2016
- Computational aspects of  $L$ -functions, ICERM – November 2015
- Elementary, analytic, and algorithmic number theory: Research inspired by the mathematics of Carl Pomerance, University of Georgia – June 2015
- AMS Special Session on Analytic Methods in Elementary Number Theory, AMS Spring Southeastern Sectional Meeting, University of Alabama – March 2015
- Exciting New Faces in Analytic Number Theory (ENFANT), Hausdorff Center for Mathematics, Bonn – July 2014
- AMS Special Session on Modern Methods in Analytic Number Theory, AMS Sectional Meeting, University of Mississippi – March 2013

**TALKS FOR HIGH SCHOOL STUDENTS**

- Summer Workshop in Mathematics (SWIM) (2 week course instructor), Duke University – June 2017
- Harkness Table Series, Spartanburg Day School – October 2016
- Summer Workshop in Mathematics (SWIM), Duke University – June 2016

**PEDAGOGICAL TALKS**

- *Understanding X: Contextualizing Formulas*, Faculty Development Workshop Series, Center for Excellence in Teaching and Learning, University of Mississippi – November 2013
- *Understanding X: Contextualizing Formulas*, Graduate Student Seminar, Center for Excellence in Teaching and Learning, University of Mississippi – November 2013
- *Engaging Student Learners*, Graduate Instructor Workshop, Center for Excellence in Teaching and Learning, University of Mississippi – August 2013

**SERVICE****Professional Service**

- AMS-Simons Travel Grants Selection Committee – February 2024 – present
- Co-organizer (with M. Rubinstein and N. Snaith), AIM Workshop, *Moments of the derivative of characteristic polynomials and L-functions*, American Institute of Mathematics – December 2025
- SLMath NSF Reverse Site Visit Team – October 2024
- Application Reviewer, Women and Mathematics (WAM), Institute for Advanced Study – Spring 2023
- NFS Review Panelist – 2020, 2021, 2023
- Referee – Algebra & Number Theory, Algorithmic Number Theory Symposium Proceedings, American Mathematical Monthly, Bulletin of the London Mathematical Society, Cambridge Philosophical Society, Crelle’s Journal (Journal für die reine und angewandte Mathematik), Indagationes Mathematicae, INTEGERS, International Mathematical Research Notices, International Journal of Number Theory, Journal of the European Mathematical Society, Journal of Number Theory, Mathematics of Computation, Mathematika, Quarterly Journal of Mathematics, Transactions of the AMS, Women in Numbers Proceedings
- Co-organizer (with H. Tran and Y. Tang), AWM Research Symposium Special Session *Number Theory*, Institute for Mathematics and its Applications, Minneapolis, Minnesota – 2022
- External PhD Thesis Committee, Quanli Shen, University of Lethbridge – 2021
- Co-organizer (with A. Malik and G. Martin), MCA Special Session *Advances in algebraic and analytic number theory*, MCA, Montreal, Quebec – 2017
- Co-director (with A. Alvarado, J. Fuselier, H. Hahn, and L. Pierce), re:boot Number Theory 2017, Duke University – June 6-9, 2017 [www.math.duke.edu/~pierce/Reboot2016.shtml](http://www.math.duke.edu/~pierce/Reboot2016.shtml)
- Co-organizer (with M. Nastasescu), MAA Invited Paper Session *L-functions and other animals*, JMM in Atlanta, Georgia – 2017
- Co-director (with A. Bucur, H. Hahn, P. Paaajanen, and L. Pierce), re:boot Number Theory 2016, Duke University – March 17-20, 2016 [www.math.duke.edu/~pierce/Reboot2016.shtml](http://www.math.duke.edu/~pierce/Reboot2016.shtml)

**Institutional Service (Carleton College)**

- Budget Committee, elected faculty committee member, 2025-present
- Committee on Convocation and Common Conversation, faculty member – 2024-2025
- College Council, untenured-when-elected faculty committee member – 2022-2024
- Campus Recreation Advisory Committee, faculty member – 2019-2021
- FOCUS, colloquium speaker – Fall 2019
- Inside Carleton Alumni Magazine *For the Love of Teaching*, cover – Spring 2019

**Departmental Service (Carleton College)**

- Department of Mathematics & Statistics Colloquium, co-organizer – 2020-2021, 2022-2023, 2024-present
- Math VAP Hiring Committee, member – 2024-2025
- Math Across the Cannon, co-organizer – 2024-2025
- Graduate School Panel, co-organizer (Fall 2024), panelist (Fall 2018)
- Hiring Committee, 2023-2024 VAP Mathematics search, member – Winter/Spring 2023

- NUMS (Northfield Undergraduate Mathematics Symposium), co-organizer – Fall 2018, Fall 2019, Fall 2020, Fall 2021, Fall 2022, Fall 2023
- SWiMS+ (Society for Women in Mathematics & Statistics), faculty co-organizer – 2018-2020
- Math Skills Center Tutor Training, faculty liaison – 2019-2020

### Departmental and Institutional Service (Previous Institutions)

- ONTO-Math, committee member, Duke University – Fall 2016
- Summer Workshop in Mathematics (SWIM), faculty advisory committee, Duke University – June 2016
- Graduate Student Seminar, Department of Mathematics, U. of Mississippi – founder and organizer
- Allies @ Ole Miss, Ally, Fall 2012 – Spring 2014 - member of network of faculty who are visibly supportive of students from the LGBTQ+ community
- Graduate Women's Group, U. of Mississippi – Committee member, Fall 2012 – Spring 2013

### OUTREACH

- Career Conversations, invited speaker – University of Mississippi AWM Chapter (November 2024, February 2025)
- Letters to a Pre-Scientist, penpal – 2019-2020
- Science Question from a Toddler, fivethirtyeight.com – October 2017  
– consultant for the article *What Would Happen If There Were No Number 6?* [link]
- SWIM (Summer Workshop in Mathematics), Duke University – June 2017  
– course instructor for workshop for female high school students [link]
- Southeastern Conference for Undergraduate Women in Mathematics, Duke University – Nov. 2016
- Dinner for 8, Duke University – October 2016
- Harkness Series Lecture, Spartanburg Day School – October 2016
- SWIM Lecture, Duke University – June 2016
- Fargo, ND Elementary School Demonstration (Tic-tac-toe on a torus)– April 2015
- Nebraska Conference for Undergraduate Women in Mathematics (graduate panelist)– January 2012
- Gear Up Mississippi Summer College Lecture – July 2009, July 2010

### TRAINING AND WORKSHOP PARTICIPATION

- Mental Health First Aid Training, Carleton College – May 2019
- Structuring the Classroom for Inclusive Teaching, CIT, Duke University – October 2016
- Center for Instructional Technology (CIT) Showcase, Duke University – October 2016
- P.R.I.D.E Training, Center for Sexual and Gender Diversity, Duke University – April 2016

### PROFESSIONAL ORGANIZATION MEMBERSHIP

- American Mathematical Society
- Association for Women in Mathematics
- National Association of Mathematicians
- Math Alliance
- Mathematical Association of America