

Professor of Mathematics
Oberlin College

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<http://www.oberlin.edu/faculty/kwoods/>

Education and Employment

Professor of Mathematics, Oberlin College, 2018-present.

Chair of Mathematics, Oberlin College, 2017-2019, 2020-2022.

Associate Professor of Mathematics, Oberlin College, 2012-2018.

Assistant Professor of Mathematics, Oberlin College, 2006-2012.

Visiting Assistant Professor, University of California, Berkeley, 2005-2006.

NSF Postdoctoral Fellow in Mathematics, University of California, Berkeley, 2004-2006.

Ph.D. in Mathematics, University of Michigan, Alexander Barvinok, advisor, 2004.

B.S., Summa cum Laude, with Honors in Mathematics, Wake Forest University, 2000.

Publications (available at <http://www.oberlin.edu/faculty/kwoods/papers.html>)

Numerical semigroups via projections and via quotients (with Tristram Bogart and Christopher O'Neill), *Discrete & Computational Geometry* (2024), to appear.

The generalized Frobenius problem via restricted partition functions, *The Electronic Journal of Combinatorics* 30 (2023).

When is a numerical semigroup a quotient? (with Tristram Bogart and Christopher O'Neill), *Bulletin of the Australian Mathematical Society* 109 (2024), 67-76.

A plethora of polynomials: a toolbox for counting problems (with Tristram Bogart), *The American Mathematical Monthly* 129 (2022), 203-222. Winner of the MAA Ford-Halmos award.

Periodic behavior in families of numerical and affine semigroups via parametric Presburger arithmetic (with Tristram Bogart, John Goodrick), *Semigroup Forum* 102 (2021), 340-356.

A parametric version of LLL and some consequences: parametric shortest and closest vector problems (with Tristram Bogart, John Goodrick), *SIAM Journal on Discrete Mathematics* 34 (2020), 2363-2387.

Parametric Presburger arithmetic: complexity of counting and quantifier elimination (with Tristram Bogart, John Goodrick, and Danny Nyguyen), *Mathematical Logic Quarterly* 65 (2019), 237-250.

The danger of testing by selecting controlled subsets, with applications to spoken-word recognition (with David Liben-Nowell, Julia Strand, Alexa Sharp, and Tom Wexler), *Journal of Cognition* 2 (2019).

AdaM and GrahaM Play the Stock Market, *The American Mathematical Monthly* 125 (2018), p:257.

Parametric Presburger arithmetic: logic, combinatorics, and quasi-polynomial behavior (with Tristram Bogart and John Goodrick), *Discrete Analysis* (2017), #4.

- The parametric Frobenius problem (with Bjarke Hammersholt Roune), *Electronic Journal of Combinatorics* 22 (2015).
- Presburger arithmetic, rational generating functions, and quasi-polynomials, *Journal of Symbolic Logic* 80 (2015), 433-449. Extended abstract in Proceedings of ICALP '13, the *International Colloquium on Automata, Languages and Programming*.
- The unreasonable ubiquitousness of quasi-polynomials, *Electronic Journal of Combinatorics* 21 (2014). Extended abstract in Proceedings of FPSAC '13, the *International Conference on Formal Power Series and Algebraic Combinatorics*.
- Book review of *Symmetry: A Mathematical Exploration*, by Kristopher Tapp. In *The American Mathematical Monthly* 120 (2013), 477-481.
- Computing Shapley value in supermodular coalitional games (with David Liben-Nowell, Alexa Sharp, and Tom Wexler), Proceedings of COCOON '12, the *International Computing and Combinatorics Conference* (2012).
- The price of civil society (with Russell Buehler, Zachary Goldman, David Liben-Nowell, Yuechao Pei, Jamie Quadri, Alexa Sharp, Sam Taggart, and Tom Wexler), Proceedings of WINE, the *Workshop on Internet and Network Economics* (2011).
- A finite calculus approach to Ehrhart polynomials (with Steven Sam), *The Electronic Journal of Combinatorics*, 17 (2010).
- An implementation of the Barvinok-Woods integer projection algorithm (with Matthias Koeppel and Sven Verdoolaege), Proceedings of the *International Conference on Information Theory and Statistical Learning* (2008), 53-59.
- Maximal periods of (Ehrhart) quasi-polynomials (with Matthias Beck and Steven Sam), *Journal of Combinatorial Theory, Series A*, 115 (2008), 517-525.
- Counting with generating functions (with Sven Verdoolaege), *Journal of Symbolic Computation* 43 (2008), 75-91.
- The probability of choosing primitive sets (with Sergi Elizalde), *Journal of Number Theory*, 125 (2007), 39-49.
- Bounds on the number of inference functions of a graphical model (with Sergi Elizalde), *Statistica Sinica*, 17 (2007), 1395-1415. Also in Proceedings of FPSAC, the *International Conference on Formal Power Series and Algebraic Combinatorics* (2006).
- Parametric alignment of Drosophila genomes (with Colin Dewey, Peter Huggins, Bernd Sturmfels, and Lior Pachter), *PLoS Computational Biology*, 2 (2006), 606-614.
- Neighborhood complexes and generating functions for affine semigroups (with Herbert Scarf), *Discrete and Computational Geometry*, 35 (2006), 385 - 403.
- Computing the period of an Ehrhart quasi-polynomial, *The Electronic Journal of Combinatorics*, 12 (2005).
- Short rational generating functions and their applications to integer programming (with Ruriko Yoshida), *SIAG/OPT Views and News*, 16 (2005), 15-19.
- Parametric Sequence Alignment (with Colin Dewey). In *Algebraic Statistics for Computational Biology*, Lior Pachter and Bernd Sturmfels, eds, Cambridge University Press (2005), 193-205.

The minimum period of the Ehrhart quasi-polynomial of a rational polytope (with Tyrell McAllister), *Journal of Combinatorial Theory, Series A*, 109 (2005), 345-352.

Rational Generating Functions and Lattice Point Sets, Ph.D. thesis, University of Michigan (2004).

Short rational generating functions for lattice point problems (with Alexander Barvinok). *Journal of the American Mathematical Society*, 16 (2003), 957-979.

Parametric inference of HIV recombinant genomes (with Niko Beerenwinkel and Colin Dewey), unpublished manuscript.

Teaching

At Oberlin College:

STAT 113, Introduction to Statistics, Fall 2006, Spring 2007, Fall 2007, Fall 2011 (2 sections), Spring 2013, Fall 2013 (2 sections), Spring 2015, Fall 2016 (2 sections), Spring 2018 (2 sections), Fall 2018, Summer 2021 (2 sections).

MATH 131, Calculus Ia, Fall 2006.

MATH 133, Calculus I, Spring 2014, Spring 2023.

MATH 220, Discrete Mathematics, Spring 2008 (2 sections), Fall 2008 (2 sections), Spring 2011 (2 sections), Fall 2015, Spring 2021.

MATH 231, Multivariable Calculus, Spring 2012, Spring 2016 (2 sections).

MATH 301, Foundations of Analysis, Fall 2022.

MATH 318, Cryptography, Spring 2019, Summer 2021, Spring 2023.

MATH 328, Computational Algebra and Algebraic Geometry, Fall 2010.

MATH 329, Rings and Fields, Fall 2021.

MATH 335, Probability, Fall 2007, Fall 2014, Fall 2015, Fall 2018.

MATH 342, The Mathematics of Social Choice, Spring 2012, Spring 2014, Spring 2016, Fall 2017.

MATH 343, Combinatorics, Spring 2009.

MATH 345, Information Theory, Spring 2007, Spring 2009, Spring 2011, Spring 2013, Spring 2015, Spring 2017.

MATH 348, Graphical Models, Spring 2008.

FYSP 079, Agreeing to Disagree: The Mathematics and Philosophy of Cooperation, Fall 2013, Fall 2014, Fall 2016, Fall 2022.

FYSP 179, Symmetry in Science, Art, and Life (First Year Seminar), Fall 2008, Fall 2010.

At the University of California, Berkeley:

MATH 113, Abstract Algebra, Spring 2006.

MATH 172, Combinatorics, Fall 2005.

At the University of Michigan:

MATH 115, Calculus I, Winter 2001.

MATH 105, Data, Functions, and Graphs, Fall 2001.

Honors Students and Research Students

Auggie Fisher, *The Minimal Generating Set of an Integer Cone*, 2022-2023.
Riley Chinburg, Chromatic Symmetric Functions, 2021-2022.
Oliver Meldrum, *Dedekind Sums*, 2018-2019.
Bobby Dorward, *Combinatorial statistics on restricted growth functions containing a pattern exactly k times*, 2016.
Sam Rossin, *Steiner Tree Games*, 2015-2016 (CS Honors Student).
Ryo Kimura (with Bob Bosch), *Quantum Computing: An Undergraduate's Guide to Shor's Algorithm*, 2013-2014.
James Foust, *Payment Schemes and Moral Hazard*, 2012-2013.
Eli Bixby, Pat Haggerty, Whit Schorn (with Alexa Sharp and Tom Wexler, Oberlin College), *Topics in Algorithmic Game Theory*, Summer 2012.
Shahab Raza, *The Probabilistic Method*, 2011-12.
Liam Solus, *Triangulations and Toric Ideals*, 2010-11.
Fifteen students (with Alexa Sharp and Tom Wexler, Oberlin College; and David Liben-Nowell, Carlton College), *Topics in Algorithmic Game Theory*, Summer 2010.
Sam Cole, David Leibovic, Elara Willett, Jamie Quadri (with Alexa Sharp, Oberlin College), *Topics in Algorithmic Game Theory*, Summer 2009.
Nicholas Lowery, *Topology and Infinite Graphs*, 2008.
Steven Sam, University of California, Berkeley, *Ehrhart Theory*, 2005-2007.

Research Interests

Discrete and Computational Geometry.
Algorithms, generating functions, lattice points in polyhedra, integer programming (including test sets), geometry of numbers, complexity theory.
Applications in combinatorics, commutative algebra, logic, theoretical computer science.

Professional Activities

Associate Editor, *American Mathematical Monthly*, 2017-present.
Member AWM, MAA.
AIM SQuaRE organizer/participant, 2023-2025.
Affiliate Scholar, Institute for Mathematics and Democracy, 2021-present.
Author of 20 Mathematical Reviews (the primary journal and database containing written summaries/reviews of mathematical articles, see <http://www.ams.org/mathscinet>).
External evaluator for one tenure case and two promotion to full professor cases.
Co-organizer and Program Co-chair, Midstates Conference for Undergraduate Research in Computer Science and Mathematics, Oberlin College, November 2009.
Co-organizer, Special Session on the Linear Diophantine Problem of Frobenius, AMS-MAA Joint Meetings, January 2008.

Journals/Conferences/Grants refereed for:

Involve (2020, 2024)
Combinatorial Theory (2023 – quick opinion)
Discrete and Computational Geometry (2003, 2007, 2008, 2019, 2020, 2023)
European Journal of Combinatorics (2016, 2023)
International Mathematics Research Notices (2022)
PUMP Journal of Undergraduate Research (2021)
AMS, Student Mathematical Library book series (2021)
College Mathematics Journal (2008, 2009, 2010, 2011, 2013, 2020)
American Mathematical Monthly (2010, 2018, 2020)
Journal of the Korean Mathematical Society (2020)
Proceedings of the AMS (2016, 2020)
Discrete Mathematics (2004, 2011, 2019)
Combinatorica (2003, 2014, 2019)
Algebraic Combinatorics (2018)
Journal of Integer Sequences (2017)
FOCS: Symposium on Foundations of Computer Science (2017)
CCC: Computational Complexity Conference (2017)
SIAM Journal on Discrete Mathematics (2013, 2014, 2017)
Electronic Journal of Combinatorics (2016, 2017, 2017)
Journal of Number Theory (2006, 2017)
IPCO: Conference on Integer Programming and Combinatorial Optimization (2013, 2016)
Annals of Combinatorics (2016)
FPSAC: International Conference on Formal Power Series and Algebraic Combinatorics (2016)
Mathematics of Operations Research (2003, 2007, 2009, 2011, 2013, 2015)
Journal of Algebraic Combinatorics (2014)
NSA Mathematical Sciences Grant Program (2014, 2014).
Random Structures and Algorithms (2013)
ACM Symposium on Parallelism in Algorithms and Architectures (2013)
Journal of Combinatorial Theory – Series A (2005, 2007, 2008, 2012)
Transactions of the AMS (2011)
INTEGERS (2010)
Discrete Optimization (2010)
IMA Volumes in Mathematics and its Applications (2009)
Bulletin of Mathematical Biology (2009)
Journal of Pure and Applied Algebra (2008)
Communications in Algebra (2008)
Linear Algebra and its Applications (2008)
Snowbird Research Conference Proceedings (2007)
Algorithmica (2005, 2006)
Australasian Journal of Combinatorics (2004)
Discrete Applied Mathematics (2003)

Major Institutional Service

Chair, Department of Mathematics, 2017-2019, 2020-2022.

Elected member, College Faculty Council, 2021-2023.

Elected member, Educational Plans and Policies Committee, 2013-2015, 2017-2019.

Member, Strategic Plan Implementation – Governance Committee, 2016-2020.

Presentations

Quasi-polynomial Behavior in Factorizations via Presburger Arithmetic

AMS Special Session on Ideal and Factorization Theory in Rings and Semigroups,
Joint Mathematics Meetings, January 2024.

A Plethora of Polynomials: A Toolbox for Counting Problems

Colloquium, University of Kansas, March 2023.

The Banach-Tarski Paradox

Student / Faculty Lunch, Oberlin College, November 2022.

Student / Faculty Lunch, Oberlin College, February 2015.

Quotients of Numerical Semigroups

Faculty Seminar, Oberlin College, November 2022.

The Restricted Partition Function

Faculty Seminar, Oberlin College, November 2020.

The Yumminess of Chicken Tenders (the Frobenius Problem)

Math Favorites Talk, Oberlin College, September 2020.

What is a “Nice” Formula, and Where Do I Get One?

Faculty Seminar, Oberlin College, March 2018.

The Complexity of Presburger Arithmetic in Fixed Dimension

ISMP, the International Symposium on Mathematical Programming, July 2018.

Faculty Seminar, Oberlin College, February 2019.

Untangling Escher through complex analysis

Student / Faculty Lunch, Oberlin College, April 2018.

Science Friday, Oberlin College, October 2011.

Student / Faculty Lunch, Oberlin College, October 2011.

Counting with Rational Generating Functions

Faculty Seminar, Oberlin College, November 2017.

Geometric Combinatorics minisymposium, SIAM Conference on Discrete
Mathematics, June 2010.

Workshop on Dedekind sums in geometry, topology, and arithmetic, BIRS, Banff,
October 2009.

Discrete Mathematics and Representation Theory Seminar, University of California,

Davis, April 2005.
Algebra-Geometry-Combinatorics Seminar, San Francisco State University, April 2005.

MSRI post-doc seminar, November 2004.

Cubing the Pyramid: or, Why We Need Calculus (and Measure Theory)

Student / Faculty Lunch, Oberlin College, February 2019.
Colloquium, College of Wooster, February 2017.
Colloquium, Ohio Wesleyan, October 2014.
Colloquium, Kenyon College, October 2012.
Colloquium, Gettysburg College, January 2012.
Colloquium, Carleton College, January 2012.
Colloquium, Denison University, November 2011.
Undergraduate Colloquium, Colorado College, February 2010.
Student Research Colloquium, Oberlin College, July 2009.
Undergraduate Colloquium, Kent State University, July 2009.
Student / Faculty Lunch, Oberlin College, March 2007.

Counting with Colombians

Faculty Seminar, Oberlin College, September 2016.

Counting with Quasi-polynomials

Colloquium, Universidad de los Andes, August 2015.

Decidability and Quantifier Elimination

Faculty Seminar, Oberlin College, April 2015.

The Banach-Tarski Paradox

Student / Faculty Lunch, Oberlin College, February 2015.

The Parametric Frobenius Problem

Faculty Seminar, Oberlin College, February 2014.

Presburger arithmetic, rational generating functions, and quasi-polynomials

ICALP, the International Colloquium on Automata, Languages and Programming, July 2013.

The Unreasonable Ubiquitousness of Quasi-polynomials

FPSAC, the International Conference on Formal Power Series and Algebraic Combinatorics, June 2013 (poster).
Faculty Seminar, Oberlin College, December 2012.
Special Session on Toric Algebraic Geometry and Beyond, AMS Central Sectional, October 2012.

Generating Functions and the Two Stamp Problem

Colloquium, College of Wooster, October 2012.
Colloquium, Niagara University, February 2012.
Colloquium, Loyola University Maryland, February 2012.
Colloquium, James Madison University, January 2012.

Colloquium, Vassar College, January 2012.
Colloquium, Drake University, December 2011.
Colloquium, Claremont Colleges, December 2009.
Departmental Spring Banquet, Ohio Wesleyan University, April 2009.
Colloquium, Denison University, March 2009.
Colloquium, Franklin and Marshall College, January 2009.
Colloquium, Ursinus College, December 2008.
Undergraduate Colloquium, Kent State University, November 2007.
Colloquium, Kenyon College, March 2007.
Colloquium, Bard College, January 2006.
Colloquium, Oberlin College, December 2005.
Colloquium, Carleton College, February 2005.
Colloquium, Bucknell University, February 2005.
Colloquium, Washington and Lee University, January 2005.
Session on Combinatorics, AMS-MAA Joint Meetings, January 2005.
Colloquium, Wake Forest University, January 2005.

Computing Shapley Value in Supermodular Coalitional Games

COCOON, the International Computing and Combinatorics Conference, Sydney,
August 2012.
Faculty Seminar, Oberlin College, February 2011.

The price of civil society

Faculty Seminar, Oberlin College, November 2011.

Solving Lattice Point Problems Using Rational Generating Functions

Discrete CATS Seminar, University of Kentucky, April 2010.
Research Seminar, Colorado College, February 2010.
Combinatorics Seminar, IPAM, UCLA, November 2009.
Combinatorics Seminar, University of California, San Diego, November 2009.
Faculty Seminar, Oberlin College, May 2009.
Colloquium, Case Western Reserve University, October 2008.
Colloquium, Cleveland State University, November 2007.
Colloquium, Kent State University, November 2007.
BAD (Bay Area Discrete) Math Day, October 2004.
Geometry Seminar, Georgia Institute of Technology, February 2004.
Microsoft Research, Redmond, WA, January 2004.
Workshop on Combinatorial and Discrete Geometry, MSRI, November 2003.
Combinatorics Seminar, Massachusetts Institute of Technology, October 2003.
Integer points in Polyhedra, AMS-IMS-SIAM Joint Summer Research Conference,
Snowbird, Utah, July 2003.
Combinatorics/Geometry Seminar, University of Washington, Seattle, April 2003.
Cowles Foundation, Yale University, March 2003.
Discrete Mathematics Seminar, University of California, Davis, January 2003.
Miniworkshop on Algebraic Statistics, University of California, Berkeley, January
2003.
Combinatorics Seminar. University of Michigan, January 2003.

VIGRE Seminar, University of Michigan, September 2003.

Neighborhood Complexes and Rational Generating Functions

Faculty Seminar, Oberlin College, March 2010.

Algebra / Number Theory / Combinatorics Seminar, the Claremont Colleges, November 2009.

Session on Combinatorics, AMS-MAA Joint Meetings, January 2006.

A Finite Calculus Approach to Ehrhart Polynomials

Special Session on Algebra and Number Theory with Polyhedra, AMS Western Sectional, April 2009.

Combinatorics and Graphical Models: investigating inference functions

Special Session on Applications of Algebraic and Geometric Combinatorics, AMS Southeastern Sectional, April 2009.

Squooshing the Cube

Student/Faculty Lunch, Oberlin College, March 2008.

Parametric Inference for Graphical Models

Algebraic Statistics Seminar, Ohio State University, November 2007.

Periods of Ehrhart quasi-polynomials

Integer points in Polyhedra, AMS-IMS-SIAM Joint Summer Research Conference, Snowbird, Utah, August 2006.

Special Session on Enumerative Aspects of Polytopes, AMS Western Sectional, April 2006.

Computing the Period of an Ehrhart Quasi-polynomial

Mini-workshop on Ehrhart Quasipolynomials, Mathematisches Forschungsinstitut Oberwolfach, August 2004.

Various topics:

Mathematics Undergraduate Student Association Lecture Series, University of California, Berkeley, May 2005.

Student Combinatorics Seminar, University of Michigan, November 2001, November 2002, October 2003.

Student Theoretical Computer Science Seminar, University of Michigan, October 2003.

Mathematics Awareness Day. North Carolina A&T State University. April 2000.

Special Session on Undergraduate Research, Joint Meetings, Washington DC, January 2000 (with J. DeBlois, N. Boethe, L. Powell).

Poster Presented. Poster Session on Undergraduate Research, Joint Meetings, Washington DC, January 2000.

Grants, Fellowships, and Scholarships

Research Status (competitive across Oberlin College), 2009-2010.

Project NeXT Fellowship, 2006-2007.

NSF Postdoctoral Fellowship, 2004-2007.

Clay Liftoff Fellowship, August 2004.

NSF Graduate Research Fellowship, 2000-2004.

VIGRE Graduate Fellowship, University of Michigan, 2000-2004.

Honors and Awards

MAA Ford-Halmos Award (with Tristram Bogart) for *A plethora of polynomials: a toolbox for counting problems*.

Horace H. Rackham Distinguished Dissertation Award (given to eight theses university-wide), University of Michigan, 2005.

Sumner Myers Prize (“for the best Ph.D. dissertation in mathematics”), University of Michigan, 2004.

Wirt and Mary Cornwell Award (“to a student who, during the four previous years, has demonstrated the greatest intellectual curiosity and has given the most promise of original study and creative work in mathematics”), University of Michigan, 2004.

William and Ruth Archie Award (“for the student who best exemplifies the ideals of a liberal arts education”), Wake Forest University, 2000.