MARGARET DOIG

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TABLE OF CONTENTS

SUMMARY

Note: Please see the dedicated folder on my website for an up-to-date record of publications, CV, etc.: http://doigmath.maderak.com/site/.

EDUCATION

PhD	Princeton University, Mathematics (terminal degree) Dissertation: "Spherical Seifert fibered spaces, knot surgeries, and Heegaard Floer homology" Advisor: Zoltán Szabó	2005-2010
BS	University of Notre Dame, Mathematics Dissertation: "Stellar braid groups" Advisor: Francis Connolly	2001-2005
BA	University of Notre Dame, Philosophy Dissertation: "Thomas Aquinas's account of will (with special attention to *liberum arbitrium*)" Advisor: Alfred Freddoso	2001-2005

FIELDS OF INTEREST

Research Interests: Mathematics, primarily low-dimensional topology with some work in other areas informed by this background, including: experimental topology; graph theory and its applications; fuzzy math; history and pedagogy of math; social choice theory.

Teaching Interests: Mathematics, most notably upper division (400 level) majors' courses and Honors Program interdisciplinary SAMS courses, as well as quantitative reasoning for non-STEM majors. Significant teaching experience also in calculus and related service courses.

PROFESSIONAL EMPLOYMENT

Assistant Professor, Creighton University	2016—
Postdoctoral Fellow, Syracuse University	2013-2016
Postdoctoral Fellow, Indiana University, Bloomington	2010-2013

PROFESSIONAL AFFILIATIONS

Association of Women in Mathematics	2004—
American Mathematical Society	2005—

FELLOWSHIPS AND HONORS

Philip T. Church Postdoctoral Fellowship, Syracuse University 2013-2016

Zorn Postdoctoral Fellowship, Indiana University, Bloomington 2010-2013

National Science Foundation Graduate Research Fellowship 2009-2010

National Defense Science and Engineering Graduate Fellowship 2005-2008

President's Fellowship, Princeton University 2005-2010

Goldwater Fellowship 2004-2005

William F. Reilly Merit Scholarship, University of Notre Dame 2001-2005

GRANTS

Workshop Participation, NSF/NSERC/ASRA/CONAHCYT-BIRS – *funded* 2024
Will attend April 2024 workshop on probabilistic knot theory at Banff International Research Station for Mathematical Innovation and Discovery (BIRS), which is funded by the National Science Foundation (NSF), National Sciences and Engineering Research Council (NSERC) of Canada, Alberta Science and Research Authority (ASRA), and the Consejo Nacional de Humanidades, Ciencias y Tecnologías (CONAHCYT) of Mexico. BIRS provides room and board. 1735.30CAD

Travel Grant, NSF-AWM – *funded* 2024
NSF grant administered by the Association for Women in Mathematics (AWM); enables women mathematicians to attend conferences and research events in their fields to advance their research activities and improve their visibility in the research community. Would be used for travel to April 2024 BIRS workshop. $985

Summer Faculty Research Fellowship, Creighton University – *funded* 2018
"The combinatorics of grid Floer homology." PI, supervising two undergraduate students (one funded, one unfunded). Supported a summer research program. $10,000

Travel Grant, NSF-AWM – *funded* 2015
Used to travel to and present at special session of an AWM Research Symposium, San Jose, CA, 2014. $725

Research Grant, NSF – *not funded* 2013
"Applications of Heegaard Floer Homology to Traditional Questions of Low-Dimensional Topology." PI. To support summer research and travel. $85,890

SCHOLARSHIP

I have published 5 articles in peer-reviewed journals since 2014 and have 3 appearing soon. There are 3 more currently undergoing the peer review process or being prepared for submission, along with several projects in earlier stages. Most preprints may be found on the arXiv, although several were interdisciplinary and did not fit any available category. All preprints (and their status) may be found at http://doigmath.maderak.com/site/tenure.html.

The Australian Mathematical Society (AMC) maintains a rating of journals internationally. Where available, I have included their ratings below.

PEER-REVIEWED PUBLICATIONS AND ACCEPTED PREPRINTS

Condorcet in Math Class: How an Eighteenth Century Philosophe Enriches the Modern Undergraduate Experience. *XVIII New Perspectives on the Eighteenth Century* 20:1 (2023).

NPEC is a peer-reviewed journal published annually by a regional professional association. It is multidisciplinary and publishes work in literature, history, history of science, history of ideas, and cultural history relating to the eighteenth century.

A fuzzy approach to sustainability I: A time-series analysis of the Sustainable Development Goals (with D. S. Malik). Accepted; to appear Nov 2024, *New Mathematics and Natural Computation.*

NMNC is a peer-reviewed journal which focuses on the mathematics of uncertainty and its applications to the social sciences. Dr. Malik performed the initial data analysis; I completed the analysis, created the visualizations, and wrote the article.

A fuzzy approach to sustainability II: The 2030 Agenda for Sustainable Development (with D. S. Malik). Accepted; to appear Nov 2024, *New Mathematics and Natural Computation.*

This is a companion article to "A fuzzy approach to sustainability I." Dr. Malik performed the initial data analysis; I completed the analysis, created the visualizations, and wrote the article.

Essential extensions and injective hulls of fuzzy modules (with D. S. Malik). Accepted (publication not yet scheduled), *New Mathematics and Natural Computation.*

Dr. Malik designed the project and wrote most of the article; I assisted with the proofs.

On the intersection ring of graph manifolds (with Peter Horn). *Transactions of the American Mathematical Society 369* (2017), 1185-1203. arXiv:1412.3990. (3 citations in peer-reviewed publications, 3 in preprints)

Trans. Amer. Math. Soc. is a very selective internationally-recognized peer-reviewed journal which is a monthly scientific journal of the American Mathematical Society that publishes longer articles in all areas of pure and applied mathematics (rated A+ by the AMC). Each author contributed equally to the proofs and the writing.

On the number of finite p/q-surgeries. *Proceedings of the American Mathematical Society 144* (2016), 2205-2215. arXiv:1302.6130. (5 citations in peer-reviewed publications, 1 in a preprint)

Proc. Amer. Math. Soc. is an internationally-recognized peer-reviewed journal which is a monthly scientific journal of the American Mathematical Society that publishes shorter articles in all areas of pure and applied mathematics (rated A by the AMC).

Finite knot surgeries and Heegaard Floer homology. *Algebraic & Geometric Topology 15-2* (2015), 667-690. arXiv:1201.4187. (13 citations in peer-reviewed publications, 2 in peer-reviewed survey articles, 1 in a Ph.D thesis, 3 in preprints)

Algebraic & Geometric Topology is a well-recognized peer-reviewed journal that publishes in topology with special attention to low-dimensional and differential topology (rated A by the AMC).

On braid groups and right-angled Artin groups (with Francis Connolly). *Geometriae Dedicata 172* (2014), 179-190. arXiv:math.GT/0411368. (11 citations in peer-reviewed publications, 2 in Pd.D theses, 3 in preprints)

Geom. Ded. is a peer-reviewed journal publishing articles on geometry and its connections to topology, group theory, and dynamical systems (rated B by the AMC). I was responsible for most of the proof. Each author contributed equally to the writing.

SUBMITTED PUBLICATIONS

A combinatorial proof of the homology cobordism classification of lens spaces (with Stephan Wehrli). With a referee, *New York Journal of Mathematics.* arXiv.org:1505.06970. (5 citations in peer-reviewed publications, 1 in a preprint)

The New York J. Math. is a peer-reviewed journal focusing on open access to new research in algebra, analysis, geometry, and topology (rated B by the AMC). I designed most of the proof. Each author contributed equally to the writing.

Graph blocks, radius and diameter, and an application to the Randić index. Submitted. arXiv:2107.00071.

PUBLICATIONS IN PREPARATION

Typical knots: Size, link component count, and writhe. Being prepared for submission; preprint available at arXiv:2004.07730. (2 citations in preprints)

Maximum run length in a toroidal grid graph. Being prepared for submission; preprint available at arXiv:math.CO/0412530. (2 citations in peer-reviewed publications)

The probability space of grid graphs. Being written.

OTHER SCHOLARSHIP PRODUCTS

"Honey, you show me your article, I'll show you mine": A missed opportunity for risk analysis. Being prepared for submission.

Intended for a medical journal in an editorial column (editor- but not peer-reviewed) on personal experiences with the practice of medicine in the modern era (2022).

DMT: A math toolkit for low-dimensional topology and related areas.
http://doigmath.maderak.com/

- Heegaard Floer d-invariants for lens spaces, L-space surgeries, spherical space forms, plumbed manifolds (2010).
- Casson-Walker invariants, miscellaneous invariants (2016).
- Knot genus (via Knot Floer Homology), fiberedness calculations; knot drawer (2019).
- Random knot generator, additional knot invariants (2020).
- Randić index and graph theory invariant calculations (2020).

STUDENT RESEARCH SUPERVISED

Tucker Knaak. *Western states power grid* 2022
This project grew out of Tucker's midterm for a graph theory course. Paper under preparation.

Josh Eason. *Randić index – behavior at infinity* 2022
Josh worked on this project for a semester. It was an outgrowth of methods covered in a Graph Theory course. Paper under preparation.

Jenna Royce. *More explorations in persistent homology* 2021
Jenna worked on this project for a semester; it was a continuation of Kiley's project.

Kiley Junker. *Explorations in persistent homology* 2020
(co-supervised with Nathan Pennington)

Parker Johnson. *An implementation of Heegaard Floer calculations* 2018
Parker worked on a CURAS SURF grant over the summer. Produced user interface in php, including a sophisticated knot drawer, and contributed to core c++ code of DMT, available for public use at http://doigmathtoolkit.maderak.com/.

Billy Duckworth. *Randić index and average path length* 2018-2019
Billy worked on this project over two semesters. Presented at the CURAS research fair, Creighton University, and AMS/MAA Joint Math Meetings, Baltimore, MD (2019).

Anna Rossini. *Randić and Wiener indices* 2017
Anna worked on this project over a summer. Presented a poster at AMS/MAA Joint Math Meetings, San Diego, CA (2018).

RESEARCH PRESENTATIONS

Presentations are marked as SEM (external departmental colloquia and seminars), CON (special sessions and other invited presentations at conferences, as well as invited workshops), CON(U) (uninvited presentations at conferences), INT (internal colloquia and seminars), or EXP (expository and outreach).

All the external presentations were funded, conferences by travel allowance (except AWM 2014, by an NSF-AWM travel grant) and department visits by the institution.

Knot Theory and Random Models Informed by Experimental Data Workshop CON 2024 (planned)
(Participant) Banff International Research Station for Mathematical Innovation and Discovery

Condorcet in math class CON(U) 2023
MAA Sectional, Peru State College

A story about math (and me) EXP 2021
STEM Fellows Seminar, Benedictine College

Typical knots: A story about your shoelaces (and DNA and quantum cryptography) SEM 2021
Mathematics Department Colloquium, Benedictine College, Atchison, KS

Typical knots: A story about your shoelaces (and DNA and quantum cryptography) SEM 2021
Mathematics Department Colloquium, University of Nebraska at Omaha

Typical knots: Explorations of the normal behavior of knot and link invariants SEM 2020
Groups-Semigroups-Topology Seminar, University of Nebraska-Lincoln

Typical knots: Explorations of component count, genus, and crossing change CON 2020
Special Session on Women in Topology, AMS/MAA Joint Meetings, Denver, CO

A feasible algorithm to find genus SEM 2018
Groups-Semigroups-Topology Seminar, University of Nebraska-Lincoln

Heegaard Floer theory and knot surgery SEM 2018
Topology Seminar, Chinese University of Hong Kong

Finite surgeries – an application of Heegaard Floer homology to a traditional knot theory question SEM 2018
Groups-Semigroups-Topology Seminar, University of Nebraska-Lincoln

A gentle introduction to grid homology and fibered knots INT 2018

Department Colloquium, Creighton University

A brief introduction to topology; and an application of Heegaard Floer theory to the finite surgery question SEM 2016
Colloquium, Creighton University

Combinatorial methods in Heegaard Floer theory SEM 2015
Topology Seminar, Wesleyan University

A combinatorial proof of the homology cobordism classification of lens spaces CON 2015
Moab Topology Conference, Utah State University

A combinatorial proof of the homology cobordism classification of lens spaces SEM 2015
Topology Seminar, Boston College

A combinatorial proof of the homology cobordism classification of lens spaces CON 2015
Special Session on Low-dimensional Topology, AWM Research Symposium, University of Maryland-College Park

Neumann-Siebenmann invariants and surgery on algebraic knots CON 2015
Special Session on Knot theory and Floer-type invariants, AMS Sectional, Michigan State University

Knot Floer homology, grid diagrams, and combinatorial methods INT 2015
Topology and Geometry Seminar, Syracuse University

Rational homology cobordism classification of spherical manifolds CON 2014
Special Session on Knot Concordance and 4-Manifolds, AMS Sectional, University of Wisconsin, Eau Claire

A combinatorial investigation of the integral homology cobordism classification of spherical manifolds INT 2014
Topology and Geometry Seminar, Syracuse University

Finite surgeries – an application of Heegaard Floer homology to a traditional knot theory question SEM 2014
Geometry and Topology Seminar, University of Buffalo

Homology cobordism classification of lens spaces CON 2014
Special Session on Invariants in Low-Dimensional Topology, AMS Sectional, University of Maryland-Baltimore

Eta invariants and ribbon obstructions INT 2014

Topology and Geometry Seminar, Syracuse University

Surgery obstructions from Heegaard Floer theory CON 2014
Special Session on Homological Invariants in Low-Dimensional Topology, AMS Sectional, Boston College

Pursuing polygonal privacy: The opaque square problem EXP 2014
Invited lecturer, NY Regional Graduate Mathematics Conference, Syracuse University

On the intersection ring of graph manifolds INT 2014
Topology and Geometry Seminar, Syracuse University

Morse theory (or: where the multivariable 2nd derivative test comes from) EXP 2013
Graduate Seminar, Syracuse University

Heegaard Floer theory and surgery INT 2013
Topology and Geometry Seminar, Syracuse University

Obstructing finite surgery SEM 2013
Virtual Topology Seminar, Louisiana State University

Obstructing finite surgery CON 2013
Special Session on Low-Dimensional Topology, AWM Research Symposium, Santa Clara University

Heegaard Floer homology and finite surgeries CON 2013
Special Session on Knots, Links, and Three-Manifolds, AMS/MAA Joint Meetings, San Diego, CA

Applications of Heegaard Floer theory to knot surgery CON 2012
Seminar for Undergraduate Mathematical Research Reunion Conference (a conference honoring Frank Connolly), University of Notre Dame

An introduction to Heegaard Floer theory and applications to knot surgery CON 2012
Invited lecturer, Graduate Student Topology Conference, Indiana University, Bloomington

A gentle introduction to Heegaard Floer theory EXP 2012
Graduate Student Topology Seminar, Indiana University, Bloomington

Finite Surgery SEM 2012
Topology Seminar, University of Virginia

Heegaard Floer homology and finite surgeries SEM 2011
Geometry Seminar, California Institute of Technology

Heegaard Floer homology and knot surgery SEM 2011
Geometry Seminar, Purdue University

Heegaard Floer homology and knot surgery SEM 2010
Topology Seminar, University of Notre Dame

Heegaard Floer theory and surgery CON(U) 2010
AMS/MAA Joint Meetings, San Francisco, CA

Finite surgeries – applications of Heegaard Floer homology to a traditional knot theory question INT 2010
Topology Seminar, Indiana University, Bloomington

Heegaard Floer homology and knot surgery INT 2010
Topology Seminar, Indiana University, Bloomington

Heegaard Floer homology and knot surgeries SEM 2010
Geometry and Topology Seminar, University of Pennsylvania

Obstructing finite surgery INT 2010
Topology Seminar, Princeton University

The Jones polynomial EXP 2008
Program for Women in Mathematics, Institute for Advanced Study

Fibered knots EXP 2008
Graduate Seminar, Princeton University

What everyone should know about topology (but I had to look up) EXP 2007
Graduate Seminar, Princeton University

The Jones polynomial (and other cool facts about knot theory) EXP 2006
Graduate Seminar, Princeton University

Braid groups EXP 2006
Graduate Seminar, Princeton University

Stellar braiding CON(U) 2005
AMS/MAA Joint Meetings, Atlanta, GA

Maximum run length in a toroidal grid graph CON(U) 2004
AMS/MAA Joint Meetings, Phoenix, AZ

TEACHING

COURSES TAUGHT AT CREIGHTON

As of spring 2024, I will have taught 73 sections of 22 courses. Math for the Modern World is Creighton University's core class for humanities, nursing, and some social science students. I have extensively taught the early calculus sequence, Calculus I/II and their applied versions, which are requirements for many STEM majors. I have also frequently taught in the intermediate sequence, the required courses for hard science majors (Calculus III and Differential Equations) and the bridge courses for math and (in spring 2024) for data science majors. I have specialized at Creighton University in teaching the upper division courses with approximately a quarter of these courses (although we have 9 tenure lines in the department) along with the only honors interdisciplinary courses we have recently offered.

Title	Credits	Sections	Notes
Math for the Modern World	2	23	quantitative reasoning
Finite Mathematics	3	1	
Calculus I	4	5	
Applied/Bio Calculus I	3	2	
Calculus II	4	8	
Applied/Bio Calculus II	3	4	
Calculus III	4/3	9	
Differential Equations	3	1	
Introduction to Proofs	3	2	
Data Science	3	1	
Analysis I	3	3	
Algebra I	3	1	
Combinatorics	3	1	
Applied Graph Theory	3	1	
Differential Geometry	3	1	
Topology	3	1	
History of Geometry	3	1	math/history
Voting Theory	3	1	math/political science
Independent Study	1-3	6	miscellaneous topics
Math/Data Science Capstone	1	1	ethics capstone for majors
Graduate Topology I	3	1	graduate course
Culture of Collegiate Life	0.5	2	freshmen advising seminar

OTHER CONTRIBUTIONS TO TEACHING

Course development.
I designed the two interdisciplinary honors courses from scratch and assembled the materials from multiple sources. I redesigned the upper division courses Combinatorics, Graph Theory, and Topology and sourced their material from multiple standard textbooks. I redesigned Math for the Modern World completely and created course materials for department use.

Materials for Undergraduate Liberal Arts Math.
Materials prepared for MTH 205. Shared with other Creighton and external faculty. Emphasize inquiry-based learning in the classroom – motivated by a project, students work through materials in small groups. See
http://doigmath.maderak.com/site/tenure.html.

SERVICE

SERVICE TO INSTITUTION

Hiring Committees

- Statistics/Data Science Assistant Professor 2023-2024
- Statistics/Data Science Assistant Professor 2022-2023
- Statistics Assistant Professor 2021-2022
- Applied Mathematics Assistant Professor 2021-2022
- Humanities Research Assistant Professor, Honors Program 2021
- Statistics/Data Science Assistant Professors (2 positions) 2020-2021
- Science Research Assistant Professor, Honors Program 2019
- Statistics Assistant Professor 2017-2018

Advising/RSP

- 1 major / 1 honors Fall 2023
- 1 major / 3 honors Spring 2023
- 1 major / 3 honors Fall 2022
- 6 majors / 3 honors Spring 2022
- 4 majors / 3 honors Fall 2021
- 4 majors / 1 honors Spring 2021
- 3 majors / 1 honors / 1 RSP Fall 2020
- 5 majors / 1 honors / 6 RSP Spring 2020
- 4 majors / 1 honors / 10 RSP Fall 2019
- 4 majors / 14 RSP Spring 2019
- 3 majors / 14 RSP Fall 2018
- 2 majors Spring 2018
- 2 majors Fall 2017

Goldwater Selection Committee 2021, 2022
Reviewed applications, assisted with selection of nominees; mentored one applicant, who was successful.

Advisory Board

- Creighton University Honors Program 2018—
- University of Notre Dame Honors Program 2009-2014

Interview Applicants

- Honors Program 2023
- Honors Program 2022
- Honors Program 2021
- Honors Program 2020
- Honors Program 2019

- Dean's Fellows 2018

Review Applicants
- Phi Beta Kappa 2018, 2022, 2023
- CURAS Summer Undergraduate Research Fellowships 2018, 2021
- Clare Booth Luce Fellowships 2018, 2020

Visiting Scholars/Colloquia
- Phi Beta Kappa Visiting Scholar Committee 2021—
- Creighton contact for Great Plains Alliance 2017—
- Assist with sourcing Math department colloquium speakers 2017—

SERVICE TO PROFESSION

Local Coordinator, Fall Meeting, North Central Section, AMS 2023
Assisted with meeting coordination and management for conference with 21 sessions attended by approximately 400 people.

Organizer, Special Session 2021
"Developments in knot theory and low-dimensional topology", Fall 2021 Central Section Meeting, American Math Society

Chaperone students to meetings
- AMS/MAA Joint Meetings, San Francisco, CA 2024
- AMS/MAA Joint Meetings, Denver, CO 2020
- Nebraska Conference for Undergraduate Women in Mathematics, Lincoln, NE 2017
- AMS/MAA Joint Meetings, Atlanta, GA 2017

Reading group mentor
Independent study aside from registered courses; see also MTH 495 sections taught.
- Graduate Reading Group in Topology, Syracuse University 2015
- Undergraduate Reading Group, Creighton University 2017-2020

Coach, Putnam Competition
Meeting weekly in fall with undergraduates preparing for national math competition.
- Creighton University 2019
- Syracuse University 2013-2015

Peer Review Process
- *Transactions of the American Mathematical Society* (expert evaluation) 2023
- Elsevier (textbook reviewer) 2020
- *Journal of Knot Theory and Its Ramifications* (referee) 2017
- *Geometry and Topology* (referee) 2015

- *Algebraic and Geometric Topology* (referee) 2015

SERVICE TO COMMUNITY

Civil Air Patrol 2007—
Nationwide 64,000-person aviation-related volunteer service organization involved with aerospace education, youth development, and emergency services. Have held more than 15 different Emergency Services and Pilot qualifications, including:

- **Mission Observer/Mission Pilot** 2008—/2011—
  Aircrew member or pilot for aviation search and rescue, disaster assessment, and other aerial missions, including the responses to two Presidentially-declared disasters.
- **Mission Check Pilot/Mission Check Pilot Examiner** 2017—
  Train and evaluate mission pilots and mission pilot evaluators, support mission effectiveness and safety of individual pilots, ensure quality and standardization of training and evaluations, promote communal culture of safety and effectiveness.
- **Instructor/Check Pilot/Check Pilot Examiner** 2014-2016, 2019—
  Train and evaluate pilots, instructors, and evaluators, support flight safety, ensure quality and standardization of training and evaluations, foster culture of continuing education and improvement.

Have held more than 20 duty assignments, including:

- **Director of Operations,** Indiana Wing 2012-2013
  Oversaw flight operations for 1300 members, approximately 1800 flight hours per year; managed staff of 7, including standardization and evaluation (flight safety and education for approximately 35 pilots / 25 Mission Pilots), aircrew training (approximately 75 total Aircrew Members), maintenance (9 aircraft with acquisition value of approximately $5,000,000), and assorted mission-specific personnel.
- **Assistant Deputy Chief of Staff - Operations,** Great Lakes Region 2020-2022
  Assisted as needed with overhead management of flight operations for Wisconsin, Illinois, Indiana, Ohio, Michigan, and Kentucky.
- **Standardization/Evaluation Officer,** Mission Aircrew School, National Emergency Services Academy Aug 2022—
  Oversee standardization and quality assurance of aircrew training and evaluation for an academy which develops new emergency services training and operational techniques and promulgates them to trainers from around the nation.