

Robert G. Donnelly
Professor of Mathematics, Murray State University
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Education

Ph.D. in Mathematics, August 1997.

University of North Carolina at Chapel Hill
Advisor: Dr. Robert A. Proctor
Dissertation: *Explicit constructions of representations of semisimple Lie algebras*

B.S. in Mathematics, May 1991.

Liberty University, Lynchburg, Virginia
Advisor: Dr. Glyn K. Wooldridge (Chair)
Honors Thesis: *Exponents and sequences*

Positions Held

Department of Mathematics and Statistics, Murray State University

Professor, August 2008 to present; *Associate Professor*, August 2003 to August 2008; *Assistant Professor*, August 1997 to August 2003. See below for a more detailed description of teaching and service at Murray State.

School of Mathematics, University of New South Wales, Sydney, Australia

Visiting Research Fellow, July-August 2001. Invited to work with Norman J. Wildberger. Supported by UNSW and a grant obtained by Dr. Wildberger.

Department of Mathematics, University of North Carolina at Chapel Hill

Graduate Instructor, June 1994 to May 1997. Full responsibility for teaching one or two Calculus classes each semester. *Graduate Teaching Assistant*, August 1992 to May 1994. Assisted professors by grading homework, holding office hours, and conducting problem sessions for courses including Abstract Algebra, Real Analysis, Dynamical Systems, and Functional Analysis.

Norfolk Southern Corporation, Roanoke, Virginia

Programmer, June 1991 to August 1991. Worked with systems analysts and marketing systems management on a large file-maintenance project. Used the statistics software SAS to generate reports for product managers.

Teaching Experience and Service at Murray State

Teaching responsibilities have consisted of an average of three courses each semester, including Mathematical Concepts (a service-level course for non-science majors), College Algebra & Trigonometry, Business Calculus, all three semesters of the Calculus sequence, Intermediate Geometry (designed for future middle school teachers who have a math/science emphasis), Mathematical Reasoning (teaches concepts of proof-writing for mathematics majors transitioning to advanced mathematics coursework), Matrix and Linear Algebra, Introduction to Abstract Algebra, as well as some advanced undergraduate and graduate-level courses. Summer teaching has included Mathematics for Elementary and Middle School Teachers.

Advanced undergraduate and graduate-level teaching (excluding Master's thesis coursework) includes directing six+ independent study courses with graduate students on Representations of the Symmetric Group (twice: Spring 1998, Fall 2007), Enumerative Combinatorics, Topics in Algebra, Rational Trigonometry & Universal Geometry, Game Theory, and Coxeter Groups. Regular courses for graduate students and advanced undergraduates include Abstract Algebra, an advanced Linear Algebra course, Foundations of Geometry, Game Theory, and Combinatorics.

Research with students includes directing three Master's theses: Matthew Ross Gilliland, *Distributive Lattices and Weyl Characters of Exotic Type F_4* , defended April 2008. L. Wyatt Alverson II, *Distributive Lattices and*

Representations of the Rank Two Simple Lie Algebras, defended July 2003. Marti L. McClard, *Picturing Representations of Simple Lie Algebras of Rank Two*, defended April 2000. Also advised an advanced undergraduate honors project with John P. Eveland which used MAPLE to help study some combinatorial structures with connections to Lie theory; this two-year project (*Using Pictures to Classify Solutions to Certain Systems of Matrix Equations*) was defended in April 2001. Directed a multi-year undergraduate honors project on lattice theory with student Joshua Hyatt (*Markowsky's Poset of Irreducibles: Applications and New Results*), successfully defended April 2010. Results from these projects were presented by students at meetings of the Kentucky MAA in April 2000, April 2001, April 2003, March 2008, and March 2009. In academic year 2006-07, helped design and assisted another faculty member in directing a project with several undergraduate students studying pedagogical issues in first-year Calculus.

Teaching methods have included making use of student projects to teach applications and using technology: MAPLE for Calculus; TI-83 and -84 graphing calculators for Calculus and College Algebra; experimented with an on-line learning resource in College Algebra in Fall 2005; since Fall 2006 have used a Tablet PC as a primary medium for classroom instruction in many classes.

Extensive interaction with students includes serving as a faculty co-sponsor for the Murray State Math Club (Fall 1998 through Spring 2007) plus continuing support for the club — see my webpage for pictures and a summary of activities; serving as co-sponsor of the Murray State chapter of Pi Mu Epsilon, a national mathematics honor society (Fall 1998 through Spring 2000); and conducting the orientation seminar for freshman math majors each fall semester from 1999 through 2009.

Participation in course development includes chairing a committee which developed a successful proposal for a discrete mathematics course (MAT 508 *Introduction to Combinatorics and Graph Theory*) geared toward advanced undergraduate and graduate mathematics students at MSU. Initiated and helped develop a successful proposal for a game theory course (MAT 528 *Introduction to Game Theory*) for advanced undergraduate and graduate students. Worked with other Kentucky college mathematics educators to develop an online college algebra course as part of K-CORE (Kentucky Collaborative Online general education coRE). K-CORE is a project initiated by distance-learning administrators at CPE and KCTCS along with instructional technology specialists at several universities to make core curriculum available to Kentucky students on a large scale.

Participation in department research seminars includes organizing a seminar in August 1999 to investigate open questions in algebraic combinatorics. This helped lead to joint papers accepted by *Discrete Mathematics*, the *Electronic Journal of Combinatorics*, and the *SIAM Journal on Discrete Mathematics*. Gave four and a half 75-minute talks on “Coxeter Groups and Combinatorics” in a Coxeter Groups Seminar co-organized with MSU colleagues Dubravko Ivanšić and Tim Schroeder, October-November 2009. Participant in the department’s Pure Mathematics Seminar which began in Fall 2005 (gave a series of four fifty-minute talks on Combinatorial Lie Representation Theory in Spring 2006; attended talks in Fall 2005, Fall 2006, and Spring 2007). Gave four fifty-minute talks in the MSU Mathematics Colloquium (November 1997 – a joint talk with former MSU colleague Kay Moneyhun, February 1998, September 2000, and September 2004). Also gave five fifty-minute talks in the 1997-98 MSU Combinatorics Seminar organized by former MSU colleague Darla Kremer.

Other department and university service includes giving three fifty-minute lectures on “Game Theory and the Evolution of Social Norms” in the MSU cross-listed course ENG 300/HIS 390/PHI 340/SOC 305 *Peace, War, and Culture* (April 2002). Also gave a 50-minute presentation on “Applications of Game Theory to Biology” in the MSU cross-listed course BIO 460/MAT 460 *Biomathematics* (March 2008). Won an MSU Faculty Minigrant in the amount of \$636 for the departmental purchase of geometric manipulatives called Zome Tools (November 2007). Utilized these in presentations given to the MSU Euclidean Math Club (April 2008, October 2009), the Kentucky Governor’s Minority Student Conference (June 2009), the MSU chapter of the Association for Women in Mathematics (January 2010), and local students as part of a collegiate field day (May 2011). Besides committees for theses directed by me, have served on seven master’s thesis committees (including one at UNSW) and two undergraduate honor’s thesis committees. Initiated contact with math teachers at an area high school and gave 45-minute talks to their math classes on four separate occasions to aid in Murray State recruitment efforts. Topics for these talks included cryptography, probability, graph theory recreations, and voting theory. Regularly represent the department at student recruitment events. Served on a number of textbook selection committees (chair four times: Calculus twice, Mathematical Concepts, Transition to Advanced Mathematics)

and served eight times on the department curriculum committee (twice as chair). Chair of the Departmental Tenure Committee, 2005-06. Member of the Collegiate Tenure Committee, 2008-09 and 2009-10. Member of the Departmental Search Committee, 2008-09. Served as an editor for the 2007, 2008, 2009, and 2010 volumes of *Chrysalis*, the MSU journal of undergraduate research. Chair of the Departmental Screening Committee, 2010-2011.

Papers

Refereed publications: algebraic combinatorics, Lie representation theory, Coxeter/Weyl groups

- [1] “Root systems for asymmetric geometric representations of Coxeter groups,” *Communications in Algebra*, **39** (2011), pp. 1298–1314.
- [2] “Distributive lattices defined for representations of rank two semisimple Lie algebras,” with L. Wyatt Alverson II, Scott J. Lewis, Marti McClard, Robert Pervine, Robert A. Proctor, and N. J. Wildberger, *SIAM Journal on Discrete Mathematics*, **23** (2009), pp. 527–559.
- [3] “Eriksson’s numbers game and finite Coxeter groups,” *European Journal of Combinatorics*, **29** (2008), pp. 1764–1781. [Appeared online Nov. 2007, <http://dx.doi.org/10.1016/j.ejcb.2007.06.029>.]
- [4] “Constructions of representations of rank two semisimple Lie algebras with distributive lattices,” with L. Wyatt Alverson II, Scott J. Lewis, and Robert Pervine, *Electronic Journal of Combinatorics*, **13** (2006), #R109, 44 pp.
- [5] “Solitary and edge-minimal bases for representations of the simple Lie algebra G_2 ,” with Scott J. Lewis and Robert Pervine, *Discrete Mathematics*, **306** (2006), pp. 1285–1300.
- [6] “Extremal bases for the adjoint representations of the simple Lie algebras,” *Communications in Algebra*, **34** (2006), pp. 3705–3742.
- [7] “Constructions of representations of $\mathfrak{o}(2n + 1, \mathbb{C})$ that imply Molev and Reiner-Stanton lattices are strongly Sperner,” with Scott J. Lewis and Robert Pervine, *Discrete Mathematics*, **263** (2003), pp. 61–79.
- [8] “Extremal properties of bases for representations of semisimple Lie algebras,” *Journal of Algebraic Combinatorics*, **17** (2003), pp. 255–282.
- [9] “Explicit constructions of the fundamental representations of the symplectic Lie algebras,” *Journal of Algebra*, **233** (2000), pp. 37–64.
- [10] “Symplectic analogs of the distributive lattices $L(m, n)$,” *Journal of Combinatorial Theory, Series A*, **88** (1999), pp. 217–234.
- [11] “Solitary bases for irreducible representations of semisimple Lie algebras,” in: *Proceedings of the 10th Conference on Formal Power Series and Algebraic Combinatorics* (Program chair: I. Goulden), Fields Institute, Toronto, 1998, pp. 209–220. A refereed “extended abstract” submitted to the program committee of the 1998 international conference on Formal Power Series and Algebraic Combinatorics held at the Fields Institute and the Univ. of Toronto. The paper resulted in an invitation for a plenary session talk.

Refereed publications: mathematics for the classroom

- [12] “Powerball, expected value, and the law of (very) large numbers,” with Christopher J. Mecklin (primary author), *Journal of Statistics Education* [Online], **13** No. 2 (2005).
- [13] “Amortization: an application of calculus,” with Richard E. Klima (primary author), appeared as a Classroom Capsule in the *College Math Journal*, **30** (1999), pp. 388–391.

Submitted papers and other research manuscripts

Available at: <http://campus.murraystate.edu/academic/faculty/rob.donnelly/research.htm>

- [14] “The numbers game and Dynkin diagram classification results,” with Kimmo Eriksson, submitted. On the arXiv at <http://arXiv.org/pdf/0810.5371>, 20 pp.

- [15] “Eriksson’s numbers game on certain edge-weighted three-node cyclic graphs,” preprint. On the arXiv at <http://arXiv.org/pdf/0708.0880>, 5 pp. This paper provides details in support of [2] above.
- [16] “Convergent and divergent numbers games for certain collections of edge-weighted graphs,” preprint. On the arXiv at <http://arXiv.org/pdf/0810.5362>, 24 pp. This paper provides details in support of [14].
- [17] “A view of mathematics research productivity at U.S. regional public universities.” On the arXiv at <http://arXiv.org/pdf/0811.2759>, 26 pp.

Invited Talks

AMS Regional Meeting

University of Iowa, Iowa City, *March 2011*.
 Special Session on Algebraic Combinatorics.
 Title of talk: “Poset models for irreducible Weyl characters” (25 min)
 Invited by Mihai Ciucu (session organizer).

AMS Regional Meeting

Indiana University, Bloomington, *April 2008*.
 Special Session on Combinatorial Representation Theory, Topological Combinatorics,
 and Interactions Between Them.
 Title of talk: “The numbers game and Dynkin diagram classification results” (25 min)
 Invited by Patricia Hersh, Michelle Wachs, and Cristian Lenart (session organizers).

AMS Regional Meeting

Davidson College, Davidson, North Carolina, *March 2007*.
 Special Session on Algebraic and Extremal Combinatorics.
 Title of talk: “Extremal Posets Arising From Semisimple Lie Algebra Representations” (20 min)
 Invited by Gábor Hetyei and László Székely (session organizers).

Colloquium, S.U.N.Y. Albany, Albany, New York, *February 2007*.

Title of talk: “From Posets to Lie Algebras” (50 min)
 Invited/hosted by Cristian Lenart. Travel partially supported by SUNY Albany and Dr. Lenart’s grant.

17th Cumberland Conference on Graph Theory, Combinatorics, and Computing

Middle Tennessee State University, Murfreesboro, Tennessee, *May 2004*.
 Title of talk: “Uniqueness and Extremal Properties of Distributive Lattices in the Setting of Lie Algebra
 Representations” (20 min)
 Invited by Rong Luo (a conference organizer).

Colloquium, Appalachian State University, Boone, North Carolina, *October 2003*.

Title of talk: “Mars Attacks and The Domino Game” (50 min)
 Invited/hosted by Richard Klima.

Colloquium, Middle Tennessee State University, Murfreesboro, Tennessee, *October 2003*.

Title of talk: “Distributive Lattices and Representations of Semisimple Lie Algebras of Rank Two” (50 min)
 Invited/hosted by Xiaoya Zha. Travel partially supported by MTSU.

Colloquium, Rhodes College, Memphis, *October 2002*.

Title of talk: “Semisimple Lie Algebras Acting on Partially Ordered Sets.” (50 min)
 Invited/hosted by Kennan Shelton. Travel partially supported by Rhodes College.

Colloquium, Vanderbilt University, Nashville, *September 2002*.

Title of talk: “Semisimple Lie Algebras Acting on Partially Ordered Sets” (50 min)
 Invited/hosted by Mary Ann Horn and Paul Edleman. Travel partially supported by Vanderbilt.

AMS Regional Meeting

Georgia Institute of Technology, Atlanta, *March 2002*.
 Special Session on Algebraic Combinatorics.

Title of talk: “Distributive Lattices and Representations of Rank Two Simple Lie Algebras” (20 min)
Invited by Mihai Ciucu (session organizer).

Combinatorics Seminar, Massachusetts Institute of Technology, Boston, November 2001.

Title of talk: “On the Combinatorics of Rank Two Simple Lie Algebras” (50 min)
Invited/hosted by Sara Billey. Travel partially supported by MIT.

Joint Colloquium of the Univ. of New South Wales and the Univ. of Sydney, August 2001.

Title of talk: “Picturing Representations of Semisimple Lie Algebras” (50 min)
Invited/hosted by Norman Wildberger. Travel supported by UNSW and Dr. Wildberger’s grant.

Combinatorics Seminar, University of Wisconsin, Madison, November 2000.

Title of talk: “Solitary Bases for Representations of Semisimple Lie Algebras” (50 min)
Invited/hosted by Paul Terwilliger. Travel partially supported by the University of Wisconsin.

Combinatorics Seminar, University of Michigan, Ann Arbor, October 2000.

Title of talk: “Solitary Bases for Representations of Semisimple Lie Algebras” (50 min)
Invited/hosted by John Stembridge. Travel partially supported by the University of Michigan.

Combinatorics Seminar, Massachusetts Institute of Technology, Boston, September 1998.

Title of talk: “Representation Diagrams” (50 min)
Invited/hosted by Sara Billey. Travel partially supported by MIT.

Formal Power Series and Algebraic Combinatorics Conference

The Fields Institute and the University of Toronto, *June 1998.*

Title of plenary talk: “Solitary Bases” (30 min)

Invitations for plenary talks at this large annual combinatorics conference are competitive and are awarded on the basis of program committee reviews of extended abstracts submitted by prospective speakers.

Lie Algebras Seminar, North Carolina State University, Raleigh, April 1997.

Title of talk: “Explicit Constructions of Representations of Semisimple Lie Algebras” (50 min)
Invited by Kailash Misra.

Algebra Seminar, North Carolina State University, Raleigh, April 1996.

Title of talk: “Representations of Semisimple Lie Algebras on Posets” (50 min)
Invited by Kailash Misra.

Mid-Atlantic Algebra Conference

North Carolina State University, Raleigh, *March 1996.*

Title of talk: “Explicit Constructions of the Fundamental Representations of $\mathfrak{sp}(2n, \mathbb{C})$ ” (25 min)
Invited by Kailash Misra (a conference organizer).

AMS Regional Meeting

Greensboro, North Carolina, *November 1995.*

Special Session on Algebraic Combinatorics of Posets and Tableaux.

Title of talk: “Catalan Lattices” (20 min)

Invited by Lynne Butler and Curtis Greene (session organizers).

Awards, Fellowships, and Recognitions

Nominee for the Murray State University Distinguished Mentor Award

Twice nominated for this annual university award.

Murray State University Regents’ Teaching Award

Awarded this honor in 2010 representing the College of Science, Engineering, and Technology; nominated two other times.

Murray State University Presidential Research Fellowship

1999-2000 Academic year. One of two proposals accepted in a university-wide competition. The amount of the fellowship was \$6000. The project contributed to the completion of two papers and progress on two other papers. The project was part of an on-going research program in combinatorial Lie representation theory.

Linker Award

April 1997. One of two graduate teaching assistants to receive this University of North Carolina Mathematics Department teaching award for the 1996-97 academic year.

U.S. Department of Education GAANN Fellowship

Academic years 1991-92, 1992-93, 1993-94, 1996-97. Four-time recipient of this fellowship as a graduate student at the University of North Carolina. The fellowship paid for tuition and books and provided monies sufficient to cover living expenses for each of these academic years.

NSA Research Assistantship with Dr. Robert A. Proctor

Summer 1995, Spring and Summer 1996. Worked at the University of North Carolina under the direction of my thesis advisor Dr. Robert A. Proctor.

Contributed Talks and Other Conference Participation**Kentucky Section MAA Spring Conference**

Kentucky State University, Frankfort, Kentucky, *March 2009.*

Helped recruit MSU students to attend this conference (seven attended). One student working on a project under my direction gave a presentation.

Contributed talk (15 min), "Edge-colored distributive lattices from representation theory."

Western Kentucky University, Bowling Green, Kentucky, *March 2008.*

Helped recruit MSU students to attend this conference (eight attended), and served as moderator for a session of talks. One student working on a project under my direction gave a presentation.

Contributed talk (15 min), "The numbers game and Dynkin diagram classification results."

Centre College, Danville, Kentucky, *April 2006.*

Helped coordinate registration, travel, and room arrangements for one student and several faculty, and served as moderator for a session of talks.

Contributed talk (20 min), " 'Mars Attacks' and Some Classification Problems."

Morehead State University, Morehead, Kentucky, *April 2005.*

Helped coordinate registration, travel, and room arrangements for three students and three faculty.

Contributed talk (20 min), "Grid Posets."

Murray State University, *April 2004.*

Organized entertainment for the "Aftermath" event.

Bellarmine College, Louisville, Kentucky, *April 2003.*

Helped coordinate registration, travel, and room arrangements for five students and three faculty. Two students working on projects under my direction presented at this conference.

Georgetown College, Georgetown, Kentucky, *April 2002.*

Co-organized this trip for ten MSU students and five faculty.

University of Kentucky, Lexington, *April 2001.*

Two students working on projects under my direction presented at this conference.

Eastern Kentucky University, Richmond, Kentucky, *April 2000.*

Two students working on projects under my direction presented at this conference.

University of Louisville, *March 1999.*

Co-organized this trip for six MSU students and two faculty.

Joint Meetings of the AMS and MAA

New Orleans, *January 2011.*

Attended many special session talks; helped with department recruitment efforts.

Baltimore, *January 2003*.

Contributed talk (10 min), “Distributive Lattices and the Fundamental Representations of the Odd Orthogonal Lie Algebras.” Also served as moderator for a session of talks.

New Orleans, *January 2001*.

Contributed talk (10 min), “Reiner–Stanton Lattices are Rank Symmetric, Rank Unimodal, and Strongly Sperner.”

Washington, DC, *January 2000*.

Attended Special Session on Algebraic Combinatorics in honor of Gian-Carlo Rota.

San Antonio, *January 1999*.

Contributed talk (10 min), “Efficient Bases for Adjoint Representations.”

NSF/CBMS Conference on Algebraic Combinatorics

North Carolina State University, Raleigh, *June 2001*.

Invited participant at this workshop on symmetric functions. Travel partially supported by the conference organizers.

Combinatorics of Lie Type Conference

University of Wisconsin, Madison, *June 2000*.

Attended this conference honoring Lou Solomon.

31st Southeastern Conference on Combinatorics, Graph Theory, and Computing

Florida Atlantic University, Boca Raton, Florida, *March 2000*.

Contributed talk (15 min), “Rank Symmetry, Rank Unimodality, and the Strong Sperner Property.”

Workshop on Enumeration and Partially Ordered Sets

Mathematical Sciences Research Institute, Berkeley, California, *October 1996*.

Invited participant.

Formal Power Series and Algebraic Combinatorics Conference

University of Minnesota, Minneapolis, *June 1996*.

Refereed poster session talk, “Symplectic Analogs to $L(m, n)$.”

AMS Regional Meeting

Richmond, Virginia, *November 1994*.

Attended Special Session on Identities and Enumeration.