Joshua Ducey

CONTACT INFORMATION

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EDUCATION

- Ph.D in Mathematics, University of Florida — 2011
  Dissertation Title: Problems in Algebraic Combinatorics
  Advisor: Peter Sin
- MS in Mathematics, University of Florida — 2007
- BA in Mathematics, University of Richmond — 2005

POSITIONS

- Professor, Department of Mathematics and Statistics — 2023 – Present
  James Madison University, Harrisonburg, VA
- Associate Professor, Department of Mathematics and Statistics — 2017 – 2023
  James Madison University, Harrisonburg, VA
- Assistant Professor, Department of Mathematics and Statistics — 2011– 2017
  James Madison University, Harrisonburg, VA
- Graduate Teaching Assistant — 2005 – 2011
  University of Florida, Gainesville, FL
- Dock Builder, Docks, Inc., St. Petersburg, FL — 2005
- Technician, Rain Room, Inc., Potomac, MD — 1997 – 2005

RESEARCH INTERESTS

- Algebra and combinatorics
- Diagonal forms and p-ranks of incidence matrices
- Applications of representation theory to combinatorial problems

PUBLICATIONS

*Note: Co-authors who were undergraduates at the time are indicated with an **

Peer-reviewed papers:

- A representation-theoretic computation of the rank of 1-intersection incidence matrices: 2-subsets vs. n-subsets.
  (with C. Sherwood*)
  To appear, Comm. Algebra
  https://arxiv.org/pdf/2205.04660.pdf
- Integer diagonal forms for subset intersection relations.
  (with L. Engelthaler*, J. Gathje*, B. Jones, I. Pfaff*, J. Plute*)
  Algebr. Comb., Vol. 8 (2025), no. 1, pp. 29-57
  https://arxiv.org/pdf/2310.09227.pdf
- Critical group structure from the parameters of a strongly regular graph.
  (with D. Duncan, W. Engelbrecht*, J. Madan*, E. Piato*, C. Shatford*, A.Vichitbandha*)
  J. Combin. Theory Ser. A, Vol. 180, 2021, 105424
  https://arxiv.org/pdf/1910.07686.pdf

- The critical group of the Kneser graph on 2-subsets of an n-element set.
(with I. Hill* and P. Sin)
Linear Algebra Appl. 546 (2018) 154-168
https://arxiv.org/pdf/1707.09115.pdf
- The Smith and critical group of the Grassmann graph of lines in finite projective space and of its complement.
(with P. Sin)
Bull. Inst. Math. Acad. Sin. (N.S.) 13 (4) (2018) 411-442
https://arxiv.org/pdf/1706.01294.pdf
- On the critical group of the missing Moore graph.
Discrete. Math. 340 (2017), no. 5, 1104-1109
http://arxiv.org/pdf/1509.00327v2.pdf
- Integer invariants of an incidence matrix related to Rota's basis conjecture.
(with S. Bittner*, X. Guo*, M. Oh, A. Zweber*.)
Missouri J. Math. Sci. 29 (2017), no. 1, 27-32
http://arxiv.org/pdf/1304.2005.pdf
- The Smith and critical groups of the square Rook's graph and its complement.
(with J. Gerhard* and N. Watson*.)
Electron. J. Combin. 23(4) (2016), #P4.9
http://arxiv.org/pdf/1507.06583v1.pdf
- Integer invariants of abelian Cayley graphs.
(with D. Jalil*.)
Linear Algebra Appl. 445 (2014) 316-325.
http://arxiv.org/pdf/1308.2335v2.pdf
- The elementary divisors of the incidence matrix of skew lines in PG$(3, q)$.
(with A. E. Brouwer and P. Sin.)
Proc. Amer. Math. Soc. 140 (2012) 2561-2573
http://arxiv.org/pdf/1103.0062v2.pdf
- Problems in algebraic combinatorics.
(Dissertation)
http://etd.fcla.edu/UF/UFE0042803/ducey_j.pdf

PRESENTATIONS

Conference Talks:

- AMS Spring Central Sectional Meeting — April 2024
University of Wisconsin-Milwaukee
Talk on Smith groups of integer matrices of the Johnson scheme.
(Special session on algebras and special functions around association schemes)
- AMS Spring Central Sectional Meeting — April 2023
University of Cincinnati
Talk on critical group of the n-cube graph.
(Special session on recent trends in graph theory)
- Series on Exploring Combinatorics and Number Theory — January 2021
(SECANT 3) Cedar Crest College (online)
Talk on abelian groups associated to strongly regular graphs.
- AMS Spring Central and Western Joint Sectional Meeting — March 2019
University of Hawaii at Manoa
Talk on critical groups of Grassmann and Kneser graphs.
(Special session on Algebraic and Geometric Combinatorics)

- Algebraic and Extremal Graph Theory August 2017
  Honoring Haemers, Lazebnik, Woldar
  University of Delaware
  Talk on Smith and critical groups of Grassmann graphs on lines in finite projective space.
- AMS Spring Southeastern Sectional Meeting, College of Charleston April 2017
  Talk on critical group of Kneser graph on 2-subsets of an n-element set.
  (Special session on graph theory)
- Japanese Conference for Combinatorics and its Applications May 2016
  (JCCA 2016) Kyoto University, Japan
  Talk on critical groups of strongly regular graphs.
- AMS Spring Southeastern Sectional Meeting, Univ. of Georgia Mar. 2016
  Talk on integer invariants of the $n \times n$ Rook's graph.
  (Special session on Theory and Applications of Graphs)
- AMS Spring Southeastern Sectional Meeting, Univ. of Georgia Mar. 2016
  On the critical group of a strongly regular graph.
  (Special session on Topics in Graph Theory)
- MAA MD-DC-VA Section Meeting, Roanoke Univ. Apr. 2015
  Finite abelian groups attached to graphs.
- AMS Western Sectional Meeting, University of Nevada-Las Vegas Apr. 2015.
  The critical group of the graph on skew lines in PG$(3, q)$.
- Joint Mathematics Meetings, San Diego, CA Jan. 2013
  A geometric proof of the structure theorem for finite abelian groups.
  (National meeting.)
- Algebraic Combinatorics: In Memory of Bob Liebler. Nov. 2011
  Colorado State University
  Talk on invariants of incidence matrices.
- Joint Mathematics Meetings, New Orleans, LA. Jan. 2011
  Talk on invariants of incident matrices.
  (National meeting.)
- Designs, Codes, and Geometries. University of Delaware Mar. 2010
  Talk on integer invariants of skew lines in PG$(3, q)$.

Seminar and Colloquium Talks:

- Algebra seminar, University of Florida Apr. 2024
  Talk on Smith groups of subset intersection matrices.
- Colloquium Talk, Dept. of Math and Stat. Oct. 2022
  James Madison University
  Some open problems in algebraic combinatorics.
- Combinatorics seminar, University of Wisconsin-Madison Oct. 2017
  Talk on critical groups of graphs.
- Algebra seminar, University of Florida Apr. 2016
  Talk on critical groups of strongly regular graphs.
- Discrete math seminar, University of Delaware Apr. 2016
  Talk on critical groups of strongly regular graphs.
- Combinatorics seminar, University of Florida Oct. 2012
  Integer invariants of an incidence matrix related
  to Rota's basis conjecture.

- Colloquium talk, Dept. of Math and Stat. Sept. 2012
  James Madison University
  The amazing Smith normal form.
- Colloquium talk, Dept. of Math and Comp. Sci. Nov. 2011
  University of Richmond
  Integer invariants of skew lines in PG$(3, q)$.
- Colloquium talk, Dept. of Math and Stat. Mar. 2011
  James Madison University
  Integer invariants of skew lines in PG$(3, q)$.

Other Conferences and Workshops attended:

- Graph Theory, Algebraic Combinatorics and Mathematical Physics Aug. 2022
  CRM, University of Montreal (online)
- Workshop on Algebraic Graph Theory and Quantum Information Aug. 2021
  The Fields Institute (online)
- Finite Geometry and Extremal Combinatorics Aug. 2019
  University of Delaware
- Southeast regional meeting on numbers (SERMON) Apr. 2016
  James Madison University
- Student Workshop on Quadratic Forms, Sums of Squares, Mar. 2009
  Theta Functions and Integral Lattices.
  University of Florida
- Conference on Group Representations and Combinatorics Sept. 2007
  University of Florida

GRANTS

- Recipient of CSM Scholarship Stimulus Program, JMU Summer 2025
  $6000
- Recipient of CSM Research Stimulus Program, JMU Summer 2021
  $4000
- University Programs, JMU Summer 2012 – Spring 2020
  Support for development and implementation of Math 199.
  Approximately $30000.
- College of Science and Mathematics Summer Research Grant, JMU 2016
  $4000
- Recipient of Tickle Fund, JMU 2015
  $4000
- College of Science and Mathematics Summer Research Grant, JMU 2013
  $4000

UNDERGRADUATES MENTORED

Research Students:

- JMU Internal REU Summer 2025 – Fall 2025
  Student: Jorge Menacho Paz
  Project title: Algebraic invariants of Hadamard matrices.
- Honors Capstone Summer 2024 – Fall 2025
  Student: Connor Phillips
  Project title: Algebraic invariants of ω-clique regular graphs.

- JMU Internal REU — Summer 2024
  Students: Robert Petro and Connor Phillips
  Project Title: Properties of ω-clique regular graphs.
- NSF REU (Co-mentored with Brant Jones of JMU) — Summer 2023
  Students: Lauren Engelthaler, Jacob Gathje, Izzy Pfaff, Jenna Plute
  Project Title: Integer diagonal forms of subset intersection relations.
- Honors Capstone — Spring 2022 – Spring 2023
  Student: Colby Sherwood
  Project title: Representation theory; p-ranks of subset incidence matrices; critical groups of the hypercube graphs.
- Math 485 Research Course, JMU — Fall 2021
  Students: Dominic Gammino, Michael Mitchniak, William Nettles, Colby Sherwood.
  Project Title: Integer invariants of strongly regular graphs, and other problems.
- NSF REU (Co-mentored with David Duncan of JMU) — Summer 2019
  Students: Wes Engelbrecht, Jawahar Madan, Eric Piato, Christina Shatford, Angela Vichitbandha.
  Project Title: Critical groups of strongly regular graphs.
- JMU Internal REU — Summer 2016 – Summer 2017
  Student: Ian Hill
  Project Title: The critical group of the Kneser graph $KG(n, 2)$.
- JMU Internal REU — Summer 2015
  Students: Jonathan Gerhard and Noah Watson
  Project Title: Integer invariants of the $n \times n$ rook's graph.
- JMU Internal REU — Summer 2013
  Student: Deelan Jalil
  Project Title: Integer invariants of abelian Cayley graphs.
- NSF REU (Co-mentored with Minah Oh of JMU) — Summer 2012
  Students: Stephanie Bittner, Michael Cheung, Xuyi Guo, and Adam Zweber.
  Project Title: Approaches to Rota's Basis Conjecture

Independent Study Students:

- Max Misterka — Spring 2023
  Learned about the algebraic graph theory perspective of some problems in quantum information.
- Ben Daniel — Fall 2016 – Fall 2017
  Studied Artin's 'Geometric Algebra'; worked on invariants of algebraically defined graphs.
- Chris Castillo — Fall 2014
  Learned about Lie algebras and their representations.

COURSES TAUGHT

James Madison University:

- MATH 103 The Nature of Mathematics (Lecture)
- MATH 167 Unsolved Problems in Mathematics (Lecture)
- MATH 199 Algebra/Precalculus Gateway (Coordinator)
- MATH 205 Introductory Calculus I (Lecture, Coordinator)
- MATH 231 Calculus with Functions I (Lecture)
- MATH 235 Calculus I (Lecture)

- MATH 236 Calculus II (Lecture)
- MATH 237 Calculus III (Lecture)
- MATH 238 Linear Algebra with Differential Equations (Lecture)
- MATH 245 Discrete Mathematics (Lecture)
- MATH 300 Linear Algebra (Lecture)
- MATH 310 Elementary Number Theory (Lecture)
- MATH 315 The Real Number System (Lecture)
- MATH 353 Graph Theory (Lecture)
- MATH 360 Complex Variables (Lecture)
- MATH 410 Advanced Calculus I (Lecture)
- MATH 411 Advanced Calculus II (Lecture)
- MATH 415 History of Mathematics (Lecture)
- MATH 430 Abstract Algebra I (Lecture)
- MATH 431 Abstract Algebra II (Lecture)
- MATH 434 Advanced Linear Algebra (Lecture)
- MATH 435 Introduction to Topology (Lecture)
- MATH 470 Connections in Mathematics (Lecture)
- MATH 475 Fundamental Concepts of Geometry (Lecture)
- MATH 485 Topics:
  - Lie Algebras and Representation Theory
  - Open Research Problems in Mathematics
- MATH 486 Indep. Study:
  - Studies in Geometric Algebra
- MATH 497 Undergrad. Research:
  - Critical groups of Kneser Graphs
  - Invariants of algebraically defined graphs
  - Representation theory of the symmetric group
  - Algebraic graph theory and quantum information
- MATH 499 Honors Capstone
  - Colby Sherwood (2023)
  - Connor Phillips (2025)

University of Florida:

- MAC1105 Basic College Algebra (AIM Program) (Lecture)
- MAC1140 Precalculus: Algebra (Large lecture of approx. 300 students)
- MAC1147 Precalculus: Algebra and Trigonometry (Lecture)
- MAC2233 Survey of Calculus (Discussion)
- MAC2311 Analytic Geometry and Calculus 1 (Lecture)
- MAC2312 Analytic Geometry and Calculus 2 (Lecture)
- MAC2313 Analytic Geometry and Calculus 3 (Discussion)

PROFESSIONAL SERVICE

Department, College, and University (JMU):

- Shenandoah Undergraduate Math and Stats (SUMS) Director — 2023 – present
- Colloquium Committee Chair — 2022 – present
- Reviewer for all JMU Math/Stat major graduation applications — 2020 – present
- Colloquium Committee member — 2021 – present
- RUME Hire Search Committee — Fall 2023
- RTA Hire Search Committee — Fall 2022
- Math 199 Developer and Coordinator — 2012 – 2020
- Facilitator for "High Impact Experience" Working Group — 2019 – 2020
- Member of "Service Courses" Working group — 2019 – 2020
- Member of committee to restructure JMU Math Placement Test — 2019 – 2020
- Tenure Track Hire Search Committee — Fall 2017
- Secretary for JMU Department of Math/Stat meetings — 2017 – 2018
- Title IX Faculty Panel Pool Member — 2015 – 2018
- Math 205 Course Coordinator — 2011 – 2020
- Math 205 Success Committee member — 2011 – 2016
- Math 205 Department PASS Leader coordinator — 2012 – 2020
- Calculus Committee member — 2011 – 2022
- Calculus Committee Chair — 2018 – 2022
- Shenandoah Undergraduate Math and Stats (SUMS) volunteer — 2011 and 2015
- Here-2-Help access point for students in distress or crisis — 2011 – present
- Session Leader at MD-DC-VA MAA Meeting at JMU — Apr. 2014
- Member of Academic Program Review subcommittee: Curriculum, Instruction, Advising (formerly APRISC) — 2016 – 2017
- Classroom observer of part-time mathematics faculty — Fall 2021

Professional:

- Journal Referee:
  - Algebraic Combinatorics (ALCO)
  - Communications in Algebra
  - Designs, Codes and Cryptography
  - Discrete Mathematics
  - Electronic Journal of Combinatorics
  - Linear Algebra and Its Applications
  - Linear and Multilinear Algebra
  - Mathematics Magazine
  - Theory and Applications of Graphs (TAG)
- MAA Project NExT consultant
- Reviewer of mathematics papers for Virginia Junior Academy of Sciences

Outreach:

- Volunteer Teacher 2010 – 2011
  Gainesville Correctional Institution, Gainesville, FL
  Individual tutoring for inmates preparing for the GED (high school equivalency) examination.
- Expanding Your Horizons (EYH) workshop leader 2012, 2015, 2017
  Magical numbers and card tricks

HONORS AND AWARDS

- Recipient of CSM Scholarship Stimulus Program 2025
  College of Science and Mathematics, James Madison University
- Recipient of CSM Research Stimulus Program 2021
  College of Science and Mathematics, James Madison University
- Department Research Award 2018
  Dept. of Mathematics and Statistics, James Madison University
- Keene Dissertation Fellowship Spring 2011
  University of Florida
  One of 12 dissertation fellowships awarded by the College of Liberal Arts and Sciences (approx. 30 departments). Given to graduate students whose dissertation projects are deemed by a selection committee to be highly meritorious. Carries a $5000 stipend and tuition waver.
- Chat Yin Ho Memorial Scholarship Fall 2010
  University of Florida
  Established in 2005 by colleagues and friends in memory of the late Dr. Chat Yin Ho. Includes a $2000 cash award, and is given to a graduate student demonstrating excellence in pure mathematics.
- Teaching Award: Certificate of Excellence March 2010
  Dept. of Mathematics, University of Florida.
- Teaching Award: Certificate of Merit March 2008
  Dept. of Mathematics, University of Florida.
- Graduate Travel Award Jan. 2011
  College of Liberal Arts and Sciences, University of Florida.
- Graduate Travel Award Apr. 2010
  College of Liberal Arts and Sciences, University of Florida.
- Steve Singleton Memorial Scholarship May 2001
  Meade Senior High School, Ft. Meade, MD
  Established in 1983 in memory of Steve Singleton, a student athlete who suffered from cystic fibrosis but still competed at varsity-level. Given annually to a student who excels in both academics and athletics.

COMPUTER SKILLS

Experienced with SAGE, Python, Linbox, Java, C++, LaTeX, and Unix-type operating systems.