

# Art Duval

January 9, 2019

## Research Interests

Algebraic and topological combinatorics, including simplicial complexes, combinatorial Laplacians, higher-dimensional trees, and shifting operations and shifted complexes

## Education

### Massachusetts Institute of Technology

September 1986–February 1991.

Ph.D. in Mathematics, 1991

Thesis advisor: Professor Richard P. Stanley

Thesis title: *Simplicial Posets: f-vectors and Free Resolutions*

### California Institute of Technology

September 1982–June 1986.

B.S. in Mathematics, 1986, Honors

Thesis advisor: Professor Richard M. Wilson

Thesis title: *A Directed Graph Version of Strongly Regular Graphs*

## Academic experience

### University of Texas at El Paso

Professor

September 2008–present.

Associate Professor

September 1997–August 2008.

Assistant Professor

September 1991–August 1997.

## Honors

### University of Texas System

Spring 2009.

Regents' Outstanding Teaching Award

### UTEP

Spring 2006.

Chancellor's Council Teaching Excellence Award

### Mathematical Association of America Southwestern Section

Spring 2005.

Award for Distinguished College or University Teaching of Mathematics  
(Southwestern section covers Arizona, New Mexico, and El Paso)

### College of Science, UTEP

Spring 2002.

John R. Bristol Award for Teaching Excellence

## Other significant experience

### **On Teaching and Learning Mathematics (AMS blog)** Summer 2014–Summer 2019.

Contributing editor. Solicit and edit, or write myself, four articles per year. Serve as second editor on an additional four articles per year. Participate in periodic editorial board teleconferences.

### **Item Review Panels, NAEP** 2007–present.

Panels consist of three to six mathematicians and educators from across the country. We conduct an in-depth review of items in the National Assessment of Educational Progress’ (the “nation’s report card”) 4th, 8th, and/or 12th grade math tests for mathematical accuracy, clarity, and general item quality.

### **El Paso T-STEM Center** Fall 2006–Summer 2010.

Center was sponsored by the El Paso Collaborative for Academic Excellence, and sought to improve the teaching of STEM fields throughout El Paso, with an emphasis on middle and high school. I presented in-service activities for middle school math “coaches”, and was one of three leaders on a team writing middle school curriculum. I was also involved with training teachers on this curriculum.

### **Mathematics Alignment Initiative** Spring 2000–Spring 2007.

Initiative was sponsored by the El Paso Collaborative for Academic Excellence, and sought to align the content and “levels of cognitive demand” of mathematics in K-12 schools across El Paso, with each other and with UTEP and EPCC. I was a member of the Working Group, which produced the “frameworks” describing this alignment, and the Assessment Group, which produced an end-of-course Algebra II exam to encourage the alignment to happen. I have also presented workshops for K-12 teachers and UTEP faculty to help implement this plan.

### **Ysleta Independent School District, El Paso** Fall 2007–Spring 2009.

I helped the district implement the Algebra II end-of-course exam developed by the Mathematics Alignment Initiative. This included helping run several 3-hour workshops, and coordinating grading sessions.

### **Center for Effective Teaching and Learning, UTEP** Fall 2001–Spring 2004.

Fellow. As a Fellow, I presented workshops on college-level teaching and learning, served (with the other Fellows) as an advisor to the CETaL director, and publicized CETaL events and services within my department.

## Graduate students supervised

**Dmitri Iourinski** M.S., 1999.  
Thesis title: Directed Strongly Regular Graphs

**Jonathan Gamez** M.S., 2012.  
Thesis title: Dihedral Cayley Directed Strongly Regular Graphs

## Undergraduate student research supervised

- Enrique Salcido** Fall 2016–Spring 2018.  
Project title: “Directed Strongly Regular Graphs”  
(Enrique was sponsored by the NSF-funded Achieve Career Success in Science through Excellence program)
- Carolina Jacquez** Summer 2016.  
Project title: “Directed Strongly Regular Graphs”  
(Carolina was sponsored by the UT System Louis Stokes Alliance for Minority Participation)
- Jaime Ramos** Fall 2007–Spring 2008.  
Senior Thesis: “Rank Dependence”  
(Jaime was sponsored by Minority Access to Research Careers grant)
- Erika Esparza** Fall 2002–Spring 2003.  
Honors Thesis: “Directed Strongly Regular Graphs”  
(Erika was sponsored by the McNair Scholars grant)
- Cora Seidler** Fall 1999–Spring 2000.  
(Cora was sponsored by the Model Institutions for Excellence grant)
- Irene Ybarra** Fall 1994–Summer 1995.  
Project title: Combinatorics  
(Irene was sponsored by the Research Careers for Minority Scholars grant)

## Conference organization

- Southwest Local Algebra Meeting (SLAM)** February 2019.  
University of Texas at El Paso,  
Host organizer, annual regional meeting.
- Southwestern Undergraduate Mathematics Research Conference** March 2010.  
University of Texas at El Paso,  
Lead organizer, annual regional meeting.
- CombinaTexas** April 2009.  
University of Houston,  
Organizing committee, annual regional combinatorics meeting.
- CombinaTexas** April 2008.  
University of Texas at El Paso,  
Chair, organizing committee, annual regional combinatorics meeting.
- Mathematical Association of America Southwestern Section** April 2005.  
University of Texas at El Paso,  
Organizing committee, annual meeting.
- Formal Power Series and Algebraic Combinatorics** June 2003.  
Vadstena, Sweden,  
Organizing committee, fifteenth annual international conference.

## Research activities

### Extramural grants, as PI

*Southwest Local Algebra Meeting 2019*, \$16,544 requested from NSA, fully funded. (This grant supported hosting the conference at UTEP in February 2019.)

*Combinatorics of Simplicial and Cell Complexes*, \$42,000 requested from Simons Foundation, fully funded, September 2017–August 2022. (Research grant, primarily supporting travel.)

*Southwestern Undergraduate Mathematics Research Conference [SUnMaRC]*, \$4,000 requested from MAA (through NSF-funded Regional Undergraduate Mathematics Conferences [RUMC] program), \$2,500 funded. (This grant supported hosting the conference at UTEP in March 2010.)

*Formal Power Series and Algebraic Combinatorics: an International Combinatorics Conference (Vadstena, 2003)*, \$19,890 requested from NSF, fully funded. (This grant supported travel for United States-based graduate students and recent Ph.D.'s to the conference.)

*Formal Power Series and Algebraic Combinatorics: an International Combinatorics Conference (Melbourne, 2002)*, \$28,900 requested from NSF, \$15,000 funded. (This grant supported travel for United States-based graduate students and recent Ph.D.'s to the conference.)

*Formal Power Series and Algebraic Combinatorics: an International Combinatorics Conference*, \$19,890 requested from NSA, fully funded. (This grant supported travel for United States graduate students and recent Ph.D.'s to the conference, held in Vadstena, Sweden, in June, 2003.)

### Extramural grants, as co-PI

*Developing Evidence-Based Learning Communities in STEM Gateway Courses: Increasing Persistence and Timely Completion of STEM*, \$689,243 from U.S. Department of Education, October 2016–September 2019. (This grant supports efforts to improve precalculus courses.)

*CombinaTexas: A Combinatorics Conference for the South-Central U.S.*, \$14,607 requested from NSA, fully funded (C. Yan, Texas A & M University, PI. This grant supported the conference in 2008 and 2009, including hosting the conference at UTEP in April 2008.)

### Funded substantial visits

Hebrew University (Jerusalem, Israel), four weeks, May/June 1997.

Mathematical Sciences Research Institute (Berkeley, California), two weeks, March 1997.

Regional Geometry Institute, Smith College, four weeks, July 1993.

### Book chapter

“Simplicial and cellular trees” (with C. Klivans, J. Martin) in *Recent Trends in Combinatorics*, IMA Volumes in Mathematics and its Applications **159** (Springer, 2016), pp. 713–752.

### Refereed publications

“A weighted cellular matrix-tree theorem, with applications to complete colorful and cubical complexes” (with G. Aalipour, W. Kook, K.-J. Lee, J. Martin), *Journal of Combinatorial Theory (Series A)*, **158** (2018), 362–386.

“A non-partitionable Cohen-Macaulay simplicial complex” (with B. Goeckner, C. Klivans, J. Martin), *Advances in Mathematics*, **299** (2016), 381–395.

- “Cuts and flows of cell complexes” (with C. Klivans, J. Martin), *Journal of Algebraic Combinatorics*, **41** (2015), 969–999.
- “Critical groups of simplicial complexes” (with C. Klivans, J. Martin), *Annals of Combinatorics*, **17** (2013), 53–70.
- “Algorithms to determine the edges of a convex hull from its vertices” (with F. Lopez), *International Journal of Mathematical Modelling and Numerical Optimisation*, **3** (2012), 184–209.
- “Cellular spanning trees and Laplacians of cubical complexes” (with C. Klivans, J. Martin), *Advances in Applied Mathematics* **46** (2011), 247–274.
- “Simplicial Matrix-Tree Theorems” (with C. Klivans, J. Martin), *Transactions of the American Mathematical Society* **361** (2009), 6073–6114.
- “A Relative Laplacian spectral recursion,” *Electronic Journal of Combinatorics* **11(2)** (2006), #R26 (19 pp.).
- “A Common recursion for Laplacians of matroids and shifted simplicial complexes,” *Documenta Mathematica* **10** (2005), 583–618.
- “Semidirect product constructions of directed strongly regular graphs” (with D. Iourinski), *Journal of Combinatorial Theory (Series A)* **104** (2003), 157–167.
- “Shifted simplicial complexes are Laplacian integral” (with V. Reiner), *Transactions of the American Mathematical Society* **354** (2002), 4313–4344.
- “Algebraic shifting and spectral sequences,” *Advanced Studies in Pure Mathematics* **33** (2002), *Computational Commutative Algebra and Combinatorics*, pp. 53–64.
- “Iterated homology and decompositions of simplicial complexes” (with P. Zhang), *Israel Journal of Mathematics* **121** (2001), 313–331.
- “Iterated homology of simplicial complexes” (with L. Rose), *Journal of Algebraic Combinatorics* **12** (2000), 277–292.
- “Algebraic shifting increases relative homology,” *Discrete Mathematics* **225** (2000), 137–148.
- “Perron-Frobenius type results and discrete versions of nodal domain theorems” (with V. Reiner), *Linear Algebra and its Applications* **294** (1999), 259–268.
- “On  $f$ -vectors and relative homology,” *Journal of Algebraic Combinatorics* **9** (1999), 215–232.
- “Free resolutions of simplicial posets,” *Journal of Algebra* **188** (1997), 363–399.
- “Covering a circular string with substrings of a fixed length” (with W. F. Smyth), *International Journal of Foundations of Computer Science* **7** (1996), 87–93.
- “Algebraic shifting and sequentially Cohen-Macaulay simplicial complexes,” *Electronic Journal of Combinatorics* **3** (1996), #R21 (14 pp.).
- “Orderpotent  $f$ -rings” (with P. Wojciechowski), *Algebra Universalis* **34** (1995), 510–526.
- “A Combinatorial decomposition of simplicial complexes,” *Israel Journal of Mathematics* **87** (1994), 77–87.
- “A Directed graph version of strongly regular graphs,” *Journal of Combinatorial Theory (Series A)* **47** (1988), 71–100.

### Unrefereed publications

- “What Does Active Learning Mean for Mathematicians?” (with B. Braun, P. Bremser, E. Lockwood, D. White), *Notices of the American Mathematical Society* **64** (2017), 124–129; by invitation of the editors. Reprinted in *The Best Writing on Mathematics 2018*, pp. 169–178, Princeton Univ. Press, 2019.

“The partitionability conjecture” (with C. Klivans, J. Martin), *Notices of the American Mathematical Society* **64** (2017), 117–122; by invitation of the editors.

Entry on “Stanley-Reisner ring” in *Kluwer Encyclopaedia of Mathematics, Supplement III, 2002*, p. 382; by invitation of the editors.

### Conference proceedings

“Planting the seeds of computational thinking: An introduction to programming suitable for inclusion in STEM curricula” (with E. Freudenthal, S. Hug, A. Ogrey, K. Lim, C. Tabor, R. Gonzalez, A. Siegel), *Proceedings of the 118th American Society for Engineering Education Annual Conference & Exposition*, 12 pp.

### Invited presentations

“A non-partitionable Cohen-Macaulay simplicial complex”, *Discrete Geometry and Algebraic Combinatorics Conference*, Univ. of Texas Rio Grande Valley, 2016.

“A non-partitionable Cohen-Macaulay simplicial complex, and implications for Stanley depth”, *Southwest Local Algebra Meeting [SLAM]*, Texas St. Univ. (San Marcos), February 2016.

“The surprising similarity of shifted simplicial complexes and matroids” [open problem], *Stanley@70*, Massachusetts Inst. Tech. (Cambridge), June 2014.

“Combinatorial Laplacians,” *Southeast Texas Discrete Math & Applications Workshop*, Texas A & M Univ. at Galveston, October 2009.

“Counting Weighted Simplicial Spanning Trees of Shifted Complexes,” *CombinaTexas*, Texas A & M Univ. (College Station), February 2007.

“A Relative Laplacian spectral recursion,” *Richard Stanley 60th Birthday Conference*, Massachusetts Inst. Tech. (Cambridge), June 2004.

“Algebraic shifting and spectral sequences,” *Eighth Mathematical Society of Japan International Research Institute, on Computational commutative algebra and combinatorics*, Osaka Univ. (Japan), July 1999.

### Competitively selected presentations

“Critical Groups of Simplicial Complexes,” *Twenty-third International Conference on Formal Power Series and Algebraic Combinatorics*, Univ. of Iceland (Reykjavik), June 2011.

“Algebraic shifting increases relative homology,” *Tenth International Conference on Formal Power Series and Algebraic Combinatorics*, York Univ. (Toronto, Canada), June 1998.

“Algebraic shifting and sequentially Cohen-Macaulay simplicial complexes,” *Eighth International Conference on Formal Power Series and Algebraic Combinatorics*, Univ. of Minnesota (Minneapolis), June 1996.

“Iterated homology of simplicial complexes,” *Seventh International Conference on Formal Power Series and Algebraic Combinatorics*, Univ. de Marne-la-Vallée (Paris, France), May-June 1995.

### Contributed talks at conferences

“Matroids and statistical dependency”, *CombinaTexas*, Texas A & M Univ. (College Station), February 2018.

“Matroids and statistical dependency”, *Amer. Math. Soc. Annual Meeting*, Contributed Paper Session on *Matrices and Matroids*, San Diego, California, January 2018.

“Matroids and statistical dependency”, *Amer. Math. Soc. Central Section*, Special Session in *Geometric Combinatorics and Combinatorial Commutative Algebra*, Univ. of North Texas (Denton), September 2017.

“A non-partitionable Cohen-Macaulay simplicial complex, and implications for Stanley depth”, *Math. Congress of the Americas*, Special Session on *Combinatorial Commutative Algebra*, McGill University (Montreal, Canada), July 2017.

“A non-partitionable Cohen-Macaulay simplicial complex”, *Math. Congress of the Americas*, Special Session on *Geometry and Combinatorics of Cell Complexes*, McGill University (Montreal, Canada), July 2017.

“Metric polyhedral complexes” *Amer. Math. Soc. Central Section*, Special Session in *Chip-Firing and Divisors on Graphs and Complexes*, Univ. of St. Thomas (Minneapolis campus, Minnesota), October 2016.

“Weighted tree enumeration of cubical complexes”, *Amer. Math. Soc. Annual Meeting*, Special Session in *Algebraic and Topological Methods in Combinatorics*, Seattle, Washington, January 2016.

“Weighted spanning tree enumerators of color-shifted complexes”, *CombinaTexas*, Texas A & M Univ. (College Station), April 2014

“Weighted spanning tree enumerators of color-shifted complexes”, *Amer. Math. Soc. Central Section*, Special Session in *Topological Combinatorics*, Washington Univ. (St. Louis, Missouri), October 2013.

“Weighted spanning tree enumerators of complete colorful complexes”, *CombinaTexas*, Univ. of Houston–Downtown (Texas), April 2013.

“Weighted spanning tree enumerators of complete colorful complexes”, *13th Joint UTEP/NMSU Workshop on Mathematics, Computer Science, and Computational Sciences*, New Mexico St. Univ. (Las Cruces), April 2013.

“Weighted spanning tree enumerators of complete colorful complexes”, *Amer. Math. Soc. Southeastern Section*, Special Session in *Algebraic Combinatorics*, Univ. of Mississippi (Oxford), March 2013.

“Max flow min cut in higher dimensions”, *Amer. Math. Soc. Annual Meeting*, Special Session in *Topological Combinatorics*, San Diego, California, January 2013.

“Max flow min cut in higher dimensions”, *12th Joint UTEP/NMSU Workshop on Mathematics, Computer Science, and Computational Sciences*, UTEP, October 2012.

“Cuts and flows in cell complexes”, *CombinaTexas*, Southwestern Univ. (Georgetown, Texas), April 2012.

“Cuts and flows in cell complexes, I: Topology and vector space bases”, *Amer. Math. Soc. Central Section*, Special Session in *Enumerative and Geometric Combinatorics*, Univ. of Kansas (Lawrence), March 2012.

“The  $G$ -Shi arrangement, and its relation to  $G$ -parking functions”, *CombinaTexas*, Sam Houston St. Univ. (Huntsville, Texas), April 2011.

“The  $G$ -Shi arrangement, and its relation to  $G$ -parking functions”, *9th Joint UTEP/NMSU Workshop on Mathematics, Computer Science, and Computational Sciences*, New Mexico St. Univ. (Las Cruces), April 2011.

“The  $G$ -Shi arrangement, and its relation to  $G$ -parking functions”, *Amer. Math. Soc. Annual Meeting*, Special Session in *New Topics in Graph Theory*, New Orleans, Louisiana, January 2011.

“The Critical group of a simplicial complex”, *8th Joint UTEP/NMSU Workshop on Mathematics, Computer Science, and Computational Sciences*, UTEP, November 2010.

“The Critical group of a simplicial complex”, *Amer. Math. Soc. Central Section*, Special Session in *Algebraic and Topological Combinatorics*, Univ. of Notre Dame (South Bend, Indiana), November 2010.

“The Critical group of a simplicial complex”, *CombinaTexas*, Texas St. Univ. (San Marcos), April 2010.

“Spanning trees and Laplacians of cubical complexes”, *CombinaTexas*, Univ. of Houston (Texas), April 2009.

“Simplicial spanning trees”, *4th Joint UTEP/NMSU Workshop on Mathematics, Computer Science, and Computational Sciences*, UTEP, November 2008.

“A Simplicial matrix-tree theorem, II. Examples”, *Amer. Math. Soc. Central Section*, Special Session in *Geometric combinatorics*, DePaul Univ. (Chicago, Illinois), October 2007.

“Counting Weighted Simplicial Spanning Trees of Shifted Complexes”, *Amer. Math. Soc. South-eastern Section*, Special Session in *Algebraic and extremal combinatorics*, Davidson Coll. (Davidson, North Carolina), March 2007.

“Steiner complexes and the Laplacian spectral recursion”, *Amer. Math. Soc. Eastern Section*, Special Session in *Algebraic and geometric combinatorics*, Bard Coll. (Annandale-on-Hudson, New York), October 2005.

“Eigenvalues of combinatorial Laplacians”, *Math. Assoc. Amer. Southwestern Section*, UTEP, April 2005.

“A Relative Laplacian spectral recursion”, *CombinaTexas*, Texas State Univ. (San Marcos), February 2005.

“Port complexes and the Laplacian spectral recursion”, *CombinaTexas*, Texas A & M Univ. (College Station), April 2004.

“Shifted simplicial complexes and algebraic shifting”, *Amer. Math. Soc. Eastern Section*, Special Session in *Topological combinatorics*, Binghamton Univ. (New York), October 2003.

“Beyond Tutte-Grothendieck: A new recursion for matroids and shifted complexes”, *Amer. Math. Soc. Western Section*, Special Session in *Combinatorial commutative algebra and algebraic geometry*, San Francisco St. Univ. (California), May 2003.

“Obstructions to shifted families,” *Amer. Math. Soc. Central Section*, Special Session in *Algebraic combinatorics*, Univ. of Michigan (Ann Arbor), March 2002.

“Some surprising similarities between matroids and shifted simplicial complexes,” *Amer. Math. Soc. Western Section*, Special Session in *Algebraic and geometric combinatorics*, San Francisco St. Univ. (California), October 2000.

“Iterated homology and decompositions of simplicial complexes,” *Amer. Math. Soc. Northeast Section*, Special Session in *Algebraic and geometric combinatorics*, Providence Coll. (Rhode Island), October 1999.

“Eigenvalues of combinatorial Laplacians,” *Geometric and Topological Combinatorics*, Oberwolfach (Germany), April 1999.

“Eigenvalues of combinatorial Laplacians,” *Amer. Math. Soc. Annual Meeting*, Special Session in *Combinatorial Topology*, San Antonio, January 1999.



“Algebraic shifting increases relative homology,” *Amer. Math. Soc. Southeast Section*, Special session in *Algebraic combinatorics*, Univ. of Louisville (Kentucky), March 1998.

“Algebraic shifting increases relative homology,” *Combinatorial Convexity and Algebraic Geometry*, Oberwolfach (Germany), October 1997.

“Algebraic shifting and sequentially Cohen-Macaulay simplicial complexes,” *Amer. Math. Soc. Southeast Section*, Special session in *Algebraic combinatorics of posets and tableaux*, Univ. of North Carolina at Greensboro, November 1995.

“Decompositions and iterated homology,” *Algebraic and Geometric Combinatorics (informal session on Algebraic shifting)*, Oberwolfach (Germany), February 1995.

“Iterated homology of simplicial complexes,” at *Holiday Symposium*, New Mexico St. Univ. (Las Cruces), December, 1994.

“Combinatorial decompositions of simplicial complexes,” at *NSF Regional Geometry Institute*, Smith Coll. (Northampton, Massachusetts), July, 1993.

“The Exterior face-ring and a combinatorial decomposition of simplicial complexes,” at *Combinatorial Convexity and Algebraic Geometry*, Oberwolfach (Germany), March-April, 1993.

“A Combinatorial decomposition of simplicial complexes,” at *AMS Central Section, Special Session in Combinatorics and discrete geometry*, Southwest Missouri St. Univ. (Springfield), March, 1992.

#### **Departmental colloquia and seminars**

“Matroids and statistical dependency”, Texas St. Univ. (San Marcos), March 2018.

“Weighted enumeration of spanning trees of complete colorful complexes and skeletons of hypercubes”, Texas St. Univ. (San Marcos), March 2018.

“A non-partitionable Cohen-Macaulay simplicial complex”, New Mexico St. Univ. (Las Cruces), March 2017.

“A non-partitionable Cohen-Macaulay simplicial complex”, Univ. of Colorado Denver, March 2016.

“A non-partitionable Cohen-Macaulay simplicial complex”, UTEP, April 2015.

“Spanning trees and the critical group of simplicial complexes”, New Mexico St. Univ. (Las Cruces), October 2011.

“Spanning trees and the critical group of simplicial complexes”, Reed College (Portland, Oregon), April 2011.

“Spanning trees and the critical group of simplicial complexes”, Univ. of Kentucky (Lexington), March 2011.

“Variations on a  $G$ -theme: The  $G$ -Shi arrangement, and its relation to  $G$ -parking functions”, Texas A & M Univ. at Galveston, September 2010.

“Spanning trees and reduced Laplacians of simplicial complexes”, Arizona St. Univ. (Tempe), March 2010.

“Simplicial spanning trees”, Univ. of California, Davis, May 2008.

“Simplicial spanning trees”, UTEP, April 2008.

“Laplacians of simplicial complexes”, Univ. of Kansas (Lawrence), October 2006.

“An Introduction to Combinatorial Laplacians on Simplicial Complexes”, UTEP, September 2006.

“Steiner complexes (or: Why can you walk from Mexico to Canada, or swim from the Pacific to the Atlantic, but not both?)”, UTEP, October 2005.

“A common recursion for Laplacians of matroids and shifted simplicial complexes”, Univ. of Washington (Seattle), October 2002.

“Some surprising similarities between matroids and shifted simplicial complexes,” Texas A&M Univ. (College Station), September 2000.

“Eigenvalues of combinatorial Laplacians,” Univ. of Wisconsin (Madison), September 1999.

“Eigenvalues of combinatorial Laplacians,” UTEP, April 1999.

“Iterated homology and decompositions of simplicial complexes,” Univ. of Minnesota (Minneapolis), August 1998.

“ $f$ -vectors and homology of simplicial complexes,” Hebrew Univ. (Jerusalem, Israel), June 1997.

“ $f$ -vectors and homology of simplicial complexes,” Bar-Ilan Univ. (Ramat Gan, Israel), June 1997.

“Algebraic shifting and sequentially Cohen-Macaulay simplicial complexes,” New Mexico St. Univ. (Las Cruces), January 1997.

“Iterated homology of simplicial complexes,” National Security Agency (Ft. Meade, Maryland), June 1996.

“Covering a circular string with substrings of a fixed length,” UTEP, April 1995.

“Iterated homology of simplicial complexes,” UTEP, Spring 1995.

“Iterated homology of simplicial complexes,” New Mexico St. Univ. (Las Cruces), March 1995.

“A Combinatorial decomposition of simplicial complexes,” Massachusetts Inst. Tech. (Cambridge), January 1992.

“ $f$ -vectors of simplicial posets” Northeastern Univ. (Boston, Massachusetts), November 1990.

### **Contributed poster presentations at conferences**

“Beyond Tutte-Grothendieck: A new recursion for matroids and shifted complexes,” *Topological and Geometric Combinatorics*, Oberwolfach (Germany), April 2003.

“Obstructions to shifted families,” *Combinatorics*, Univ. of North Texas (Denton), March 2002.

“Some surprising similarities between matroids and shifted simplicial complexes,” *Combinatorics*, Texas A&M Univ. (College Station), March 2001.

“Some surprising similarities between matroids and shifted families,” *Combinatorial Convexity and Algebraic Geometry*, Oberwolfach (Germany), January 2001.

### **Session organizer** at conferences:

Contributed Paper Session on Discrete Mathematics in the Undergraduate Curriculum (with Elise Lockwood and John Caughman), Math. Assoc. Amer. Annual Meeting, San Diego, California, January 2018.

Contributed Paper Session on Discrete Mathematics in the Undergraduate Curriculum (with Elise Lockwood and John Caughman), Math. Assoc. Amer. Annual Meeting, Atlanta, Georgia, January 2017.

Special Session on Geometric Combinatorics (with Jeremy Martin), Amer. Math. Soc. Western Section Meeting, Univ. New Mexico (Albuquerque), April 2010

### **Referee** for the following journals and conferences:

Advances in Applied Mathematics  
 Algebraic Combinatorics  
 American Mathematical Monthly  
 Annals of Combinatorics  
 Applied Mathematics Letters  
 Canadian Mathematical Bulletin  
 Combinatorica  
 Discrete & Computational Geometry  
 Discrete Mathematics  
 Electronic Journal of Combinatorics  
 Electronic Journal of Linear Algebra  
 European Journal of Combinatorics  
 Graphs and Combinatorics  
 International Conference on Formal Power Series and Algebraic Combinatorics  
 Journal für die reine und angewandte Mathematik (Crelle's Journal)  
 Journal of Algebra  
 Journal of Algebraic Combinatorics  
 Journal of Combinatorial Theory (Series A)  
 Journal of Combinatorial Theory (Series B)  
 Linear Algebra and its Applications  
 manuscripta mathematica  
 Mathematische Annalen  
 Proceedings of the American Mathematical Society  
 Quarterly Journal of Mechanics and Applied Mathematics  
 SIAM Journal on Discrete Mathematics  
 Transactions of the American Mathematical Society  
 Topology and its Applications

**Program committee**

(supervise refereeing of about 8–12 potential contributed talks)

Twenty-Sixth International Conference on Formal Power Series and Algebraic Combinatorics (Chicago, Illinois, June/July 2014).

Fourteenth International Conference on Formal Power Series and Algebraic Combinatorics (Melbourne, Australia, July 2002).

Thirteenth International Conference on Formal Power Series and Algebraic Combinatorics (Tempe, Arizona, May 2001).

**Reviewer** for National Security Agency's Mathematical Sciences Program, and for National Science Foundation

## Teaching activities

### Courses taught

#### **Courses for non-science/engineering/math students**

Math 1319 Mathematics in the Modern World

Math 2301 Mathematics for Social Sciences II

#### **Courses primarily for pre-service elementary and middle school teachers**

Math 2303 Properties of the Real Numbers I

Math 3304 Fundamentals of Geometry from an Advanced Standpoint

Math 3308 Conceptual Algebra From Multiple Perspectives

Math 3309 Conceptual Mathematics From Multiple Perspectives II

#### **Courses primarily for science/engineering/math students**

Math 1508 Pre-Calculus

Math 1409 Pre-Calculus I

Math 1411 Calculus I

Math 2300 Discrete Mathematics

Math 2312 Calculus II

Math 2313 Calculus III

Math 2326 Differential Equations

Math 3323 Matrix Algebra

#### **Courses primarily for math majors**

Math 2325 Introduction to Higher Mathematics

Math 3319 Elementary Number Theory

Math 3325 Principles of Mathematics

Math 3328 Foundations of Mathematics

Math 3341 Introduction to Analysis

Math 4303 Fundamentals of Mathematics from an Advanced Standpoint

Math 4325 Modern Algebra

Math 4326 Linear Algebra

Math 4341 Real Analysis

Math 4370 Game Theory (topics course)

Math 4370 Combinatorics (topics course)

#### **Graduate courses**

Math 5311 Combinatorial Matrix Algorithms (topics course)

Math 5321 Principles of Analysis

Math 5341 Topology

Math 5370 Algebraic Structures

### New courses developed

**Engineering Pre-calculus and Calculus**    Math 1508 and 1411, Spring 2011–Fall 2014.  
Special sections for engineering majors, taught in conjunction with faculty from College of Engineering.

**Combinatorics** Math 4370, Fall 2010; Spring 2012.  
New course taught as topics course.

**Discrete Math** Math 2300, Spring–Fall 2010.  
Wrote projects on biology applications for discrete math, as part of S. Aley’s grant.

**Game Theory** Math 4370, Fall 2005.  
New course taught as topics course.

**Mathematics in the Modern World** Math 1319/1320, Spring–Fall 2005; Fall 2006.  
Piloted new Math 1319 course for liberal arts and education majors, initially as special sections of Math 1320.

**Introduction to Higher Mathematics** Math 2325, Spring 2003; Fall 2004–Spring 2005.  
Taught new course, a lab-based introduction to experimentation in mathematics, for first time, Spring 2003. Rewrote labs (supplied by authors), from Basic to Mathematica, Fall 2004–Spring 2005.

**Moore Method-based Analysis** Math 3341, Fall 2004.  
Along with H. Knaust (teaching the other section of this course), piloted his Analysis course notes using the Moore method (notes have no proofs; students provide proofs).

**Conceptual Mathematics II** Math 3309, Fall 2003–Spring 2004.  
Taught new course, focusing on the deeper mathematics that underlies middle school mathematics. Both semesters, I wrote projects based around the middle school curriculum the students (preservice teachers) were practicing teaching in the affiliated math methods course.

**Team-teaching field-based elementary education blocks** Math 2303, 3309,  
Fall 2000–Spring 2004.  
Participated in pilot of team-teaching field-based elementary education Block I (Math 2303; with ELED 3302 and ELED 3310), Fall 2000–Spring 2003; continued with new blocks (new degree plan, featuring Math 3309 with MSed 4310), Fall 2003–Spring 2004

**Visual Calculus** Summer 2002.  
Co-developed and co-taught summer course in “Visual Calculus” for pre-service and in-service middle school teachers, as part of M. Tchoshanov’s project to introduce concepts of single- and multi-variable calculus in middle school.

**Combinatorial Matrix Algorithms** Math 5311, Fall 1998.  
New course taught as topics course.

**Project-based Discrete Math** Math 2300, Summer 1996–Fall 1997.  
Developed and wrote projects around which entire course was based. Developed Summer 1996–Spring 1997, taught Fall 1996–Fall 1997.

**Reform Calculus** Math 1411, 1312, 2313, Fall 1994–Fall 1995.  
Part of a group attending and discussing pilot versions of all three semesters of Calculus, and among the first teaching each of the courses.

#### **Presentations on college-level teaching**

“Bioinformatics-themed projects in Discrete Mathematics” *Math. Assoc. Amer. Annual Meeting*, Session on *Discrete Mathematics in the Undergraduate Curriculum* San Diego, California, January 2018.

“Equivalence relations in mathematics, K-16+”, *Math. Assoc. Amer. Southwestern Section*, El Paso Comm. Coll. April 2015.

“Equivalence relations in mathematics, K-16+”, *Amer. Math. Soc. Southeastern Section*, Special Session on *the Work of Mathematicians and Mathematics Departments in Mathematics Education*, Univ. of Louisville (Kentucky), October 2013.

“Deepening Math and Science Understandings Through Integration of Computational Thinking” (with E. Freudenthal), at *Conference on Understanding Interventions that Broaden Participation in Research Careers*, Vanderbilt Univ. (Nashville, Tennessee), May 2011.

“The Importance of being Equivalent: The Ubiquity of equivalence relations in mathematics, K-16+”, Math Education Seminar, Univ. of Kentucky (Lexington), March 2011.

“Making an iMPaCT on precalculus: Using programming to propel a math course”, at *Sun Conference on Teaching and Learning*, UTEP, March 2011.

“Introduction to Math 1333, Our New Liberal Arts Math Course”, 3-hour workshop at El Paso Community Coll., August 2007.

“Walking to Win” (sample lesson), at *Preparing Mathematicians to Educate Teachers Workshop*, El Paso Community Coll., May 2006.

“Designing tasks at different levels of cognitive demand to improve students mathematical thinking” (with M. Tchoshanov), at departmental Teaching and Learning Seminar, November 2005.

“Mathematical literacy and your students” (with J. McClure, Metallurgical and Materials Engineering), workshop sponsored by CETaL, UTEP, April 2005.

“Developing pedagogical content knowledge through team-teaching” (with M. Tchoshanov), at departmental Teaching and Learning Seminar, February 2005.

“Student outcomes in mathematics” (with H. Knaust), at meeting for UTEP department chairs regarding SACS, February 2005.

“Technical texts and unruly readers”, workshop sponsored by CETaL, UTEP, November 2004.

“Mathematics as an experimental laboratory science” (with H. Knaust) at *Sun Conference on Teaching and Learning*, UTEP, March 2004.

“Constructive pedagogical cycle: Is learning a linear process?” (with M. Tchoshanov) at *Sun Conference on Teaching and Learning*, UTEP, March 2003.

“The Moore Method: A tradition of active student learning” (with H. Knaust) at *Sun Conference on Teaching and Learning*, UTEP, March 2002.

“Next steps: Piloting a field-based set of linked courses in mathematics education” (with M. Tchoshanov, S. Blake, C. Della-Piana, E. Perez) and “From K-16 Partnership to the classroom: Workshop on planning and implementing field-based courses in math and science” (with T. Brady, C. Della-Piana, M. Tchoshanov, S. Blake, S. Sanchez, E. Perez) at *CETP [Collaboratives for Excellence in Teacher Preparation] PI Meeting: Next Steps*, National Science Foundation (Arlington, Virginia), April 2001.

“A Project-based Discrete Math course,” *Mathematical Association of America Southwestern Section meeting*, Pima Community Coll. (Tucson, Arizona), April 1998.

“A Project-based Discrete Math course,” *Mathematical Association of America Texas Section meeting*, Southern Methodist Univ. (Dallas, Texas), March 1998.

## Training

Attended weeklong inquiry-based learning workshop, Univ. of Texas (Austin), June 2008.

Attended weeklong cooperative learning workshops, Cloudcroft NM, as part of Model Institutions for Excellence, Level I in Summer 1996, Level II in Summer 1998.

## Service activities

### Department of Mathematical Sciences

Advisory committee [evaluations, tenure, promotion], Fall 2000–Fall 2007.

Evaluation committee [annual evaluations], Spring 2017–Spring 2019.

Executive committee, Fall 2008–Spring 2009; Advisory committee, Fall 2009 [advise department chair].

Strategic planning committee, Spring–Fall 2004.

Hiring committee Fall 2000–Spring 2005, Fall 2008–Spring 2009 (chair math ed search Spring 2002–Spring 2003; chair pure math search Fall 2004–Spring 2005).

Undergraduate curriculum committee, Fall 1998–Spring 1999, Fall 2003–Spring 2004, Fall 2005–present (chair Fall 2005–Summer 2009, Fall 2014–present; co-chair Spring 2013–Summer 2014).

Club Zero (math club) advisor or co-advisor, Spring 1994–Summer 1997, Fall 2000–Summer 2009.

Ad hoc committee to develop new math courses for pre-service K-8 teachers, Spring–Fall 2002.

Ad hoc committee to develop new MAT program, under MSP umbrella, Spring 2003; also admissions committee for this program, Spring–Fall 2003.

Undergraduate advising, Fall 1993–Summer 1995.

Department newsletter, editor Fall 1997, Fall 1999, Fall 2000; co-editor Fall 2005–Fall 2018.

Bioinformatics colloquium committee, Fall 2008–Spring 2014.

Helped coordinate experimental midterm teaching evaluations for math department, with Tine Reimers of CETaL, Fall 2004–Spring 2005.

Chair, Calculus textbook selection committee, Fall 1997–Spring 1998.

Precalculus textbook selection committee, Spring 2000.

Precalculus committee, Spring–Summer 1998.

Graduate recruiting committee, Fall 1993–Spring 1997 (interim chair, Spring 1994).

Graduate studies committee, Fall 1997–Spring 1998.

Teaching effectiveness committee, Fall 1998.

Putnam exam committee, Fall 1991–Fall 1994.

Alumni relations committee, Fall 1994–Spring 1999.

Legacy committee [UTEP Endowment], Spring 1997.

### College of Science

Undergraduate curriculum committee, Spring 2006–Summer 2009, Spring 2013–present.

Bristol award committee, Spring 2004.

Awards committee, Fall 2004.

SACS committee, Fall 2004.

Ad Hoc Committee to ensure compliance of degree plans for pre-service teachers with new state guidelines, Fall 2002–Spring 2003.

“Science Prep” committee [planning new summer orientation for incoming science students], Spring–Summer 1995, Spring–Summer 1997

## **College of Education**

Ad Hoc committee to help College of Education develop (math portion of) new degree plans, and, in conjunction with these new degrees, new math courses, Spring–Fall 2001.

Department of Teacher Education, Hiring committee, Mathematics education position, Spring 1999, Spring 2001, Spring 2015.

Ad Hoc committee to develop new Master Math Teacher Certificate program (with Department of Teacher Education), Spring 2003.

## **University**

TNE Math Working Group, co-chair, Spring 2004–Summer 2006.

Foundations of Excellence [university-wide self-study], Fall 2007–Summer 2008.

Transitions Dimension subcommittee, chair

Steering committee

Hearing Officer, Office of Student Conduct and Conflict Resolution, Fall 2012–present.

Undergraduate curriculum committee, Fall 2018–Summer 2021.

Teacher Teaching Teachers (vertical and horizontal alignment of math courses for pre-service teachers, between UTEP and EPCC), Spring 2012–present.

Quality Enhancement Plan committee, Fall 2014–Fall 2015.

Hiring committee, Dean of the College of Science, Fall 2012.

Faculty Titles Advisory Group, Fall 2017–present.

Presenter team, “Practicing Kindness in Our University Community”, Fall Instructor Retreat, Fall 2017.

Meeple Board Game Society, faculty advisor, Fall 2015–present.

CAHSI-INCLUDES pilot project, Fall 2017–present.

Prudential Math/IT Task Force, Summer 2016–present.

Regents Outstanding Teaching Award selection committee, Fall 2013, Fall 2015, Fall 2016.

Ad hoc Core Curriculum Assessment Committee, Spring 2009–Spring 2010.

Mentor, Faculty Mentoring Program for Women (part of UTEP’s ADVANCE grant), Fall 2005–Spring 2007; Collaborative Faculty Mentoring Program, Fall 2008–Spring 2009.

Ad hoc committee on first-year math, Spring 2007.

Faculty Senate Teaching Effectiveness committee, Fall 2006–Spring 2008.

Teacher preparation advisory council, Fall 1998.

MIE Curriculum–Lower division science/engineering committee, Fall 1997.

MIE Cluster task force, Spring 1997.

Honors advisory council, Fall 1995–Spring 1997.

Student Enrichment Task Force, Fall 2006–Spring 2007.

Faculty Senate, Spring 1995–Summer 1996, Fall 2001–Spring 2003, Fall 2016–Spring 2018.

## **Service to the profession**

Faculty Mentor, Mathematical Association of America Project NExT, Fall 2015–Spring 2016  
[Red ’15 cohort]



Outside reference, candidate for tenure and/or promotion (names of universities available upon request), Fall 2013, Spring 2016, Fall 2017, Fall 2018.

Mathematical Association of America, Committee on Edyth May Sliffe Awards for Distinguished Mathematics Teaching in Middle School and High School, January 2018–January 2021.

### **Outreach service**

Invited speaker, Mu Alpha Theta induction ceremony, Transmountain Early College High School, October 2018.

100@100, radio interview KTEP-FM (100 researcher interviews to celebrate UTEP’s centennial), November 2014.

“Equivalence relations everywhere!”, talk at Greater El Paso Council of Teachers of Mathematics annual conference, El Paso Community Coll., October 2007.

Two presentations, sponsored by the El Paso Collaborative for Academic Excellence, to unpack “tools”, documents exploring difficulties in middle school mathematics topics, for staff developers, Fall 2006.

Part of K-16 Mathematics Panel presentation, El Paso Mathematics Summit, El Paso Community Coll. September 2006.

Several presentations, some with M. Tchoshanov, sponsored by the El Paso Collaborative for Academic Excellence, to introduce the “frameworks” for Algebra 2, Algebra 1, and K-8 mathematics developed by the K-16 Math Alignment Group, Spring–Fall 2003

Algebra 2 Summer Session and followup, Summer–Fall 2002. (Summer Session was two 1.5-day presentations, with M. Tchoshanov, as part of 2.5-day workshops sponsored by the El Paso Collaborative for Academic Excellence, to introduce the new “framework” for Algebra 2, developed by the K-16 Math Alignment Group; Fall was a half-day presentation, as part of a daylong followup to the Summer Session.)

Assisted S. Blake (College of Education) introduce weekly math projects at Wiggs Middle School, Spring 1998.

Science Night, (College of Science high school outreach), Spring 1997.

Undergraduate mathematics talks:

“Equivalence relations everywhere!”, *Club Zero (UTEP math club)*, November 2007.

“ $q$ -Calculus,” *Club Zero (UTEP math club)*, September 1996, September 2006.

“Combinatorics, algebra, topology – oh my!,” *Club Zero (UTEP math club)*, October 1995.

“Combinatorics, algebra, topology – oh my!,” *Sociedad Matematica L. Euler (undergraduate math club)*, Universidad Autonoma, Cd. Juárez, March 1995 (graduate recruiting trip).

Judge for Wiggs Middle School Math Fair, October 1997.

Judge on Hi-Q (high school quiz show on public station KCOS-TV), Fall 1992–Spring 1999.

### **Training**

Participated in Leadership Development Institute, UTEP, Fall 2011–Spring 2012.