Daniel W. Cunningham

Contact Information

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Website

Research Interests

Set Theory, Mathematical Logic,
Axiom of Determinacy

Education

University of California, Los Angeles, CA

Ph.D., **Mathematics**, June 1990.

- Passed Four Ph.D. Qualifying Examinations: (1) Real Analysis; (2) Algebra; (3) Complex Analysis; (4) Set Theory & Logic.
- Thesis Title: *The Real Core Model*
- Advisor: **John R. Steel**, U.C. Berkeley

Professional Experience

Professor of Mathematics
Department of Mathematics
SUNY Buffalo State
1991–2020

Lecturer of Mathematics
Department of Mathematics
California State University, Fresno
2020–Present

Scholarship

Articles, Books, and Research Papers – (Sole Author)

- ***On forcing over*** $L(\mathbb{R})$, **Archive for Mathematical Logic**, to appear.
- ***Real Analysis: With Proof Strategies***, CRC Press, (2021), 281 p.
- ***A diamond-plus principle consistent with AD***, **Archive for Mathematical Logic**, vol. 59 (2020), no. 5-6, pp. 755-775.
- ***Set Theory***, **Internet Encyclopedia of Philosophy**, 2019.
- ***Why does trigonometric substitution work?***, **International Journal of Mathematical Education in Science and Technology**, vol. 49 (2018), no. 4, pp. 588-593.[1]
- ***A diamond principle consistent with AD***, **Notre Dame Journal for Formal Logic**, vol. 58 (2017), no. 3, pp. 397-407.
- ***A strong partition cardinal above*** Θ, **Archive for Mathematical Logic**, vol. 56 (2017), no. 3-4, pp. 403-421.
- ***Set Theory: A First Course***, Cambridge University Press, (2016), 262 p. **Citations**
- ***Strong partition cardinals and determinacy in*** $K(\mathbb{R})$, **Archive for Mathematical Logic**, vol. 54 (2015), pp. 173-192.
- ***A Logical Introduction to Proof***, New York, NY: Springer, (2013), 356 p. **Citations**
- ***Scales of minimal complexity in*** $K(\mathbb{R})$, **Archive for Mathematical Logic**, 51 (2012), no. 3-4, pp. 319-351.
- ***A covering lemma for*** HOD ***of*** $K(\mathbb{R})$, **Notre Dame Journal for Formal Logic**, vol. 51, no. 4 (2010), pp. 427-442.

[1] Identified, under the section Notable Writings, in the anthology *The Best Writing on Mathematics* (edited by Mircea Pitici, Princeton University Press, 2019).

- ***A covering lemma for*** $K(\mathbb{R})$, **Archive for Mathematical Logic**, vol. 46 (2007), pp. 197–221.
- ***Scales and the fine structure of*** $K(\mathbb{R})$***. Part I. Acceptability above the reals***, **Mathematics ArXiv**, (2006), 40 pages.
- ***Scales and the fine structure of*** $K(\mathbb{R})$***. Part II. Weak real mice and their scales***, **Mathematics ArXiv**, (2006), 27 pages.
- ***Scales and the fine structure of*** $K(\mathbb{R})$***. Part III. Scales of minimal complexity***, **Mathematics ArXiv**, (2006), 23 pages.
- ***A covering lemma for*** $L(\mathbb{R})$, **Archive for Mathematical Logic**, vol. 1 (2002), pp. 49–54.
- ***Is there a set of reals not in*** $K(\mathbb{R})$***?***, **Annals of Pure and Applied Logic**, vol. 92 (1998), pp. 161-210.
- ***The fine structure of real mice***, **The Journal of Symbolic Logic**, vol. 63 (1998), pp. 937-994.
- ***The real core model and its scales***, **Annals of Pure and Applied Logic**, vol. 72 (1995), pp. 213-289.

zbMATH Reviewer

- In 2012, invited by Professor Gert-Martin Greuel (Editor-in-Chief) to be a reviewer for zbMATH (formerly Zentralblatt MATH), a major international reviewing service produced in cooperation with the European Mathematical Society. **Link**.

MathSciNet Reviewer

- In 2015, invited by Professor Andres Caicedo (Editor) to review the chapter *Structural consequences of AD*, by Steve Jackson, in the Handbook of Set Theory, Springer, Dordrecht, 2010. **Link**. In 2019, invited to review the paper *An analysis of the models* $L[T_{2n}]$, by Rachid Atmai. **Link**.

Referee Work

- Refereed papers in mathematics for the **Journal of Symbolic Logic**, the **Annals of Pure and Applied Logic**, the **American Mathematical Monthly**, and the **International Journal of Mathematical Education in Science and Technology**. I have also reviewed a book proposal for Cambridge University Press.

Presentations

- *Why does trigonometric substitution work?*, MAA, SUNY Broome — Oct 2017
- *The Schröder-Bernstein Theorem*, SUNY Buffalo State — Sep 2017
- *Set Theory: An intersection of mathematics and philosophy*, University at Buffalo — Apr 2014
- *Zorn's Lemma – its history, its use, and a proof*, SUNY Buffalo State — Oct 2012
- *A Calculus Problem: Do infinitesimals exist?*, SUNY Buffalo State — Apr 2009
- *What is Mathematical Logic?*, SUNY Buffalo State — Apr 2002
- *Proof Diagrams*, MAA Sectional Meeting, Brock University, Canada — Nov 2001
- *Covering Lemmas for* $L(\mathbb{R})$ *and* $K(\mathbb{R})$, AMS, University of Nevada, LV — Apr 1999
- *Using MATLAB to Visualize N-Space*, Joint Meetings, Cincinnati, Ohio — Jan 1994
- *Group Discovery and Communication*, ICTCM, Parsippany, NJ — Nov 1993

NSF Grant Proposals

- Instrumentation & Laboratory Improvement: *Group discovery and communication: a computer laboratory approach to lower division mathematics* (funded) May 1993

  The NSF agreed with the reviewers and stated that this "highly meritorious" and "wonderful" proposal shall be funded. As a result, the Mathematics Department and SUNY Buffalo State created our current Mathematics Computer Laboratory.

- Research in Undergraduate Institutions: *Descriptive Set Theory,* (unfunded with positive reviews) Nov 1995

  ⋆ "This is a very exciting proposal with potential for leading to results of great importance in modern set theory. It is a wonderful idea that Cunningham is developing here, to combine core model theory with the theory of $L(\mathbb{R})$."

  ⋆ "The investigations outlined in this proposal are in a central area at the frontiers of set theory and if successful could well lead to important advances in our understanding of inner models, large cardinals and determinacy."

- ⋆ "Cunningham has developed the theory of these models and has proved some very nice results about them. This is a rich field for potential research, as Cunningham in his well-written proposal shows."

- Research in Undergraduate Institutions: *Determinacy, Inner Models and Covering Properties* (unfunded with positive reviews) Nov 1999
  - ⋆ "Cunningham has a coherent and well-motivate program: to adapt the theory of core models for large cardinals to core models for the axiom of determinacy plus large cardinals. He has made significant progress, and he is likely to make more progress."
  - ⋆ "His work on the covering lemma is striking and I believe that this proposal warrants funding."
  - ⋆ "The investigator has done some very nice work generalizing the Covering Lemma to $L(\mathbb{R})$ and $K(\mathbb{R})$. He now proposes to generalize this to other real core models. This is a good project, which I would like to see the NSF support."

Education Grant

- Undergraduate Research at Buffalo State: *An undergraduate research course in mathematics* (funded) Jun 2004

Awards/Honors

- UUP Discretionary Awards in 2018, 2017, 2016, 2015, 2014, 2013, 2009, 2008, 2005, 2002, 1999, 1998, 1995 in recognition of effective teaching and scholarship.
- Mentor of Honor Students – Honors Convocation (2013, 2008, 2005, 2004, 1997, 1996, 1995).
- *Recognition of Contribution Award* – From the Center for the Enhancement of Learning and Teaching, and the Office of Academic Affairs Jun 1996
- *Recognition of Contribution to the Focus on Learning and Teaching Conference* – From the Provost and Vice President, Center for the Enhancement of Learning and Teaching, and the Office of Academic Affairs Mar 1996
- Term Faculty Development Award – Professional Development and Quality of Life Committee approved my funding application to attend the following workshops:
  - *Augment the Teaching of Linear Algebra via the use of Software Tools* Jul 1993
  - *Interactive Mathematics Text Project* Jul 1993
- While on sabbatical leave, I spent the Fall Semester 2000 as a *Visiting Scholar* at the UC Berkeley Mathematics Department.

Courses Taught

Lebesgue Measure	Techniques of Proof	Real Analysis I, II
Probability	Abstract Algebra I, II	Calculus I, II, III
Topology	Set Theory	*Mathematica* Labs
Differential Equations I, II	Mathematical Logic	Calculus (non-majors)
Discrete Mathematics	Computability Theory	Linear Algebra
Number Theory	Foundations of Mathematics	History of Mathematics

Course Development at Buffalo State

- *Set Theory*. Designed and created MAT 430. This course covers the fundamental facts about abstract sets–relations, functions, natural numbers, order, cardinality, transfinite recursion, the axiom of choice, Zorn's lemma, ordinal numbers, and cardinal numbers, within the framework of axiomatic set theory.
- *Calculus III*. Revised MAT 263, which was previously a 3-credit course, to align its content with the topics covered in the revised prerequisite MAT 162 and to align the teaching approach with that used in MAT 161 and MAT162. I clearly identified the topics that must be covered making the course compatible with the comparable course at other institutions. In order to cover these new topics, the number of class and credit hours was increased to 4. The vast majority of SUNY mathematics departments teach Calculus III as a 4-credit course.
- *Techniques of Proof*. Designed and created the course MAT 300 to ease the transition from lower division mathematics to more theoretical courses such as abstract algebra and real analysis. This course acts as a gateway to upper division mathematics with an emphasis on the techniques of proof, and the effective written and oral communication of mathematical ideas.
- *Capstone Research in Mathematics*. Designed and created MAT 491, our research course in undergraduate mathematics. The primary goal of the senior level course is to allow our students to successfully experience mathematical research on their own and to effectively communicate the results of their research.

- *Discrete Mathematics and the Foundations of Computer Science*. Designed the course MAT 670 to give our graduate mathematics education students the knowledge, skills, and tools required to be proficient teachers of discrete mathematics.

Program Development

- Julian Cole (Philosophy Department) and myself designed and proposed the new program: **Undergraduate Certificate in Mathematical Logic**. This program was approved in 2018 by the SUNY System Administration and the New York State Education Department.

Courseware Activities

- **ATLAST Workshop** (1993) – a project to *Augment the Teaching of Linear Algebra* through the use of Software Tools, conceived by the International Linear Algebra Society and was funded through the National Science Foundation. Participants were trained in the use of the MATLAB software package and learned how to effectively incorporate computer exercises into undergraduate linear algebra courses. (University of Houston, Texas, July, 1993.)
- **IMTP Workshop** (1993) – The *Interactive Mathematics Text Project* was funded by the Mathematical Association of America and IBM to improve student learning.
- **Mathematica Conference for Advanced Users** (1994) – workshops and sessions dedicated to help users create *Mathematica* packages and interactive texts. (University of Illinois, Urbana-Champaign, April, 1994.)
- **ATLAST Developers Workshop** (1996) – I was invited to participate in this workshop that brought together 30 experts in the use of software for teaching Linear Algebra. Developers produced high-quality classroom lessons based on materials in the ATLAST Book of Computer Exercises and the MATLAB files that accompany the book. (University of Washington, Seattle, WA, August, 1996.)

Service

- *Organizing Committee* – Member of the local organizing committee for the 2008 International Workshop in Combinatorial Image Analysis (IWCIA '08) which took place in Buffalo, NY, April 7-9, 2008.
- *SUNY Mathematics Education Task Force* (2003) – Peter D. Salins, SUNY Provost and Vice Chancellor for Academic Affairs, announced the creation of this task force as "It is essential that we include on this Task Force both mathematics education faculty and mathematics faculty." I was invited to be a member of this task force.
- *Personnel Committee* (2017-18), (2016), (2012-13), (2013-15), (2009-11), (2001-04) – Evaluate faculty applying for promotion or renewal, and assess faculty applicants.
- *Curriculum Committee* (2012-13) (2008-09), (2006-08), (2001-02) – Review, update, and create undergraduate courses in mathematics.
- *Mathematics Search Subcommittee* (2006-07) – Review and evaluate applications for the position of Assistant Professor in Mathematics.
- *Chair Evaluation Committee* (2003-04) – Expedite the evaluation and the election of the Chair of the Mathematics Department.
- *Associate Chair* (1999-00) – Serve as coordinator of student advisement and assist the Chair with teaching assignments.
- *MAA Liaison* (1996-00) – Responsible for communicating with the MAA on issues of collegiate mathematics.
- *SNSS Personnel Committee* (2003-06) – Participate in the review and evaluation of faculty, in the School of Natural and Social Sciences, applying for promotion.
- *SNSS Agenda, By-Laws, and Elections Committee* (1992-94) – Schedule meetings, determine rules, and evaluate elections.
- *Probation Appeals Board* (Spring, 1996) – Provide a fair hearing and constructive advisement to those students on probation who are attempting to return to good academic standing.
- *Buffalo State Mathematics Seminar* – organizer of series of semester seminars.
- *Mathematics Awards* – I regularly participated in the department's annual awards ceremony by congratulating and presenting awards to our best mathematics students.