DANIEL SOLOW

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EDUCATION

Ph.D.   Operations Research, Stanford University, 1978
Thesis Title: Decomposability in Fixed Point Computation.

M.S.   Operations Research, University of California at Berkeley, 1972.
Thesis Title: An Algorithm for Computing Fixed Points to
Continuous Mappings.

B.S.   Math and Computer Science, Carnegie-Mellon University, 1970.

RESEARCH INTEREST

I use mathematical models, analysis, and computer simulations to study how properties emerge in complex adaptive systems, with applications to teams and leadership in organizations. I also do basic research in linear, combinatorial, and nonlinear optimization.

PERMANENT ACADEMIC POSITIONS

Professor, Department of Operations, Weatherhead School of Management, Case Western Reserve University, 2009-present.

Associate Professor, Department of Operations, Weatherhead School of Management, Case Western Reserve University, 1982-2009.

Assistant Professor, Department of Operations Research, Weatherhead School of Management, Case Western Reserve University, 1978-1982.

TEACHING (Average rating of approximately 4.7 out of 5.0 over 32 years)

<u>MBA Courses</u>—Statistics and Decision Modeling for full-time and part-time MBA students (descriptive statistics, confidence intervals, hypothesis testing, simple and multiple regression, deterministic model building, linear programming, project management, simulation).

Mathematics and Statistics Courses—calculus, differential equations, graph theory, mathematics foundations for advanced studies (proofs and mathematical thinking for research-related work), undergraduate statistics for business majors.

Operations Research Courses—linear programming, nonlinear programming, topics in mathematical programming, network flow theory.

Computer Science Courses—computer programming, computer methods in operations research (I developed this course on data structures and numerical analysis using C++ with object-oriented programming for the MS program in Operations Research).

Teaching Ratings—averaging about 4.7 (out of 5.0) over all courses taught in the category of "appraisal of the instructor." Given the Teaching Excellence Award by the Weatherhead School of Management in 1981, 2010, 2-15, and 2018. In 2007, I was a semi-finalist for the university-wide Diekhoff Award for excellence in graduate teaching.

VISITING POSITIONS

Visiting Researcher, Department of Operations Research, Naval Postgraduate School, Monterey, CA, every year for about one month from 2008 – present.

Adjunct Professor, Department of Industrial Engineering, Kasetsart University, Bangkok, Thailand, 1997 – present.

Visiting Scholar, Department of Computer Science, University of California at Berkeley, Berkeley, CA, January 13 - May 10, 1994.

Visiting Professor, Toshiba Chair, Department of Industrial Engineering and Management, Waseda University, Tokyo, Japan, September 2, 1993 - December 31, 1993.

Visiting Scholar, Chengdu University of Science and Technology, by invitation of the People's Republic of China, March 1987 - April 1987.

Visiting Professor, Department of Computing Sciences, The University of Wollongong, Australia, July 1986 - December 1986.

Visiting Professor, Department of Applied Mathematics, University of the Witwatersrand, Johannesburg, South Africa, February 1984 - June 1984.

Visiting Research Scholar, College of Engineering, Hosei University, Tokyo, Japan, August 1983 - February 1984.

FUNDED RESEARCH

"A Constrained Optimization Approach to Solving Certain Systems of Equations," National Science Foundation, May 1981 - May 1983.

AWARDS

Teaching Excellence Award, Weatherhead School of Management, for excellence in graduate teaching, 2018.

Teaching Excellence Award, Weatherhead School of Management, for excellence in graduate teaching, 2015.

Teaching Excellence Award, Weatherhead School of Management, for excellence in graduate teaching, 2010.

Semi-finalist for the Diekhoff Award for outstanding graduate teaching at Case Western Reserve University, April 5, 2007.

2001 McGuffey Textbook Longevity Award from the Text and Academic Authors Association for my book *How to Read and Do Proofs*, March 21, 2001.

Toshiba Chair, Department of Industrial Engineering and Management, Waseda University, Tokyo, Japan, 1993.

Fulbright Nominee, Council for International Exchange of Scholars, 1986.

Hosei International Fund Foreign Scholars' Fellowship, Hosei University, Tokyo, Japan, 1983.

Fulbright Fellowship Nominee, *CIES*, 1982.

Teaching Excellence Award, Weatherhead School of Management, for excellence in graduate teaching, 1981.

SERVICE

Departmental Committees:
- Graudate Programs (chair)
- Admissions and Financial Aid Committee (chair)
- Open House Coordinator—developed an innovative format for this annual event for attracting potential students to graduate studies in operations research. I have run this program from 1989 until 2000.

School Committees:
- Dean Search Committee—elected as a member by the faculty
- Council—elected as a member of this committee that advised the dean on academic issue

University Committees:
   Sexual Harrasment Committee (by special appointment of ex-president
   Agnar Pytte.)

   Ad Hod Committee (scheduling a series of university-wide events to
   honor the life and times of Charles Darwin.)

PROFESSIONAL ACTIVITIES

Member of: The editorial board of the *International Journal of
                   Operational Research* (Jan. 2006 – present).

Member of: Institute for Operations Research and Management Science
                   Mathematical Association of America

Member of: INFORMS Education COMAP Subcommittee
                   I judge papers for the Mathematics Competition in
                   Modeling, an international competition for undergraduate
                   students sponsored by COMAP (Mar. 12, 2000—present).

Have Refereed for: *Organization Science*; *Computational and Mathematical
                   Organization Theory*; *Mathematical Programming*;
                   Operations Research; *Mathematics Research Society*;
                   Management Science; *Applied Mathematics and
                   Optimization*; *Naval Logistics Research Quarterly*; *The
                   International Journal of Math and Math Sciences*;
                   Transportation Sciences; *IEE Transactions, Academy of
                   Management Review*

                   Member of an NSF Proposal Review Panel (Feb. 21 – May
                   3, 2013)

Chairman for:

                   Organization Theory Session, INFORMS International
                   Meeting, Maui, HA, June, 2001

                   Computer Science Applications Session, INFORMS
                   National Meeting, Seattle, WA, October, 1998

                   Heuristics in Combinatorial Optimization Session,
                   INFORMS National Meeting, San Diego, CA, May, 1997.

                   Nonlinear Programming Session, ORSA/TIMS National
                   Meeting, San Francisco, CA, Nov., 1992.

                   Mathematical Programming Session, ORSA/TIMS
                   National Meeting, Nashville, TN, May, 1991.

	Linear Complementarity Session, 13th International Symposium on Mathematical Programming, Tokyo, August 1988.
	Nonlinear Programming Session, ORSA/TIMS National Meeting, San Diego, October 1982.
Representative for:	Committee for evaluating and recommending funding proposals for the Joint AMS-SIAM-IMS Summer Conference Series, 1995.
	Speakers Program of the Institute for Operations Research and Management Science (INFORMS), 1989 - 2000.
	The Mathematical Association of America, 1980 - 1985.
Workshops:	
	Conducted a four-day workshop on "Mathematical Proofs" for faculty and Ph. D. students in June 2013 at INSEAD in Fontainebleau, France.
	Conducted a four-week workshop on "Mathematical Proofs" for students at the Naval Postgraduate School, Monterey, CA,every year from 2008 to t he present.
	Conducted a two-week workshop on "Mathematical Thinking Processes" for gifted high school students, held at the University of Toronto, Toronto, Canada, July, 1995.
	Presented an invited workshop on "A Systematic Approach to Optimization Modeling and Algorithm Development," Roadway Package System, Pittsburgh, PA, Aug., 1992.

INVITED TALKS

Some examples of invited talks:

"What makes a Combinatorial Optimization Problem Easy or Hard to Solve?" Department of Operations Research, Naval Postgraduate School, Monterey, CA, Jan. 24, 2012.

"Visionary vs. Charismatic Leadership: Insights from a Mathematical Model," Military Applications Conference (INFORMS), Monterey, CA, March 27, 2012.

 "Prove It! Who Says Theoretical Math is Hard?" Science Café, Cleveland, OH, June 11, 2012.

"Factors that Affect the Optimal Amount of Central Control in Complex Systems", Department of Operations Research, Naval Postgraduate School, Monterey, CA, March 20, 2008.

"Central Organization in Complex Systems: A Step Beyond Self-Organization," Santa Fe Institute, Santa Fe, NM, June 25, 2007.

"Mathematical Models for Studying the Value of Leadership in Team Replacement," Department of Industrial Engineering, University of Pittsburgh, Pittsburgh, PA, Oct. 19, 2006.

"Mathematical Models for Explaining the Emergence of Specialization in Performing Tasks", International Conference on Complex Systems (*ICCS2004*), Boston, MA, May 19, 2004 and the Understanding Complex Systems 2005 Symposium, University of Illinois, Champaign-Urbana, May 16-19, 2005.

"Kauffman's *NK* Model: New Results and Applications," presented at Center for Complex Systems, University of Michigan, Ann Arbor, Michigan, Oct. 19, 2000 and also at the Santa Fe Institute, Santa Fe, New Mexico, Nov. 3, 2000.

"What Should Students Learn From Advanced Mathematics and How Should We Teach It To Them", Ohio Sectional Meeting of the Mathematical Association of America, Findley, OH, October 28, 1994 (invited keynote speaker).

"A Systematic Method for Teaching Deductive Reasoning and Mathematical Proofs", presented at:

> ICMI-JCME Regional Conference on Mathematical Education, Tokyo, Japan, October 13, 1983.

> 61st Annual Meeting of the National Council of Teachers of Mathematics, Detroit, Michigan, April 15, 1983.

> 89th Annual Meeting of the Mathematical Association of America, Denver, Colorado, January 8, 1983.

> 60th Annual Meeting of the National Council of Teachers of Mathematics, Toronto, Canada, April 14, 1982.

> Numerous universities in the U.S., Japan, Hong Kong, Australia, Thailand, China, and South Africa, 1983 - present.

> Numerous universities in the U.S., New Zealand, Australia, Singapore, Hong Kong, China, Japan, and South Africa, 1983 - present.

PUBLICATIONS

BOOKS

Linear Programming: An Introduction to Finite Improvement Algorithms, 2nd ed., Dover Publications, July 2014.

How to Read and Do Proofs, 6th Edition, John Wiley & Sons, Inc., New York, 2013. (Includes 15 videotaped lectures.)

How to Read and Do Proofs, 5th Edition, John Wiley and Sons, Inc., New York, 2010. (Includes Solutions Manual and Web Solutions.)

How to Read and Do Proofs, 4th Edition, John Wiley and Sons, Inc., New York, 2004. (Includes Solutions Manual and Web Solutions.)

How to Read and Do Proofs, (Thai Translation), Top Publishing Company, Bangkok, Thailand, 2004.

How to Read and Do Proofs, 3rd Edition, John Wiley and Sons, Inc., New York, 2001. (Includes Solutions Manual and Web Solutions.)

The Keys to Linear Algebra, Books Unlimited, Cleveland, OH, 1998. This undergraduate text is driven by applications to illustrate the basic topics in a first-semester course. In addition to the theory, this book explains the underlying thinking processes as they arise in the context of linear algebra. A 189-page *Solutions Manual* was also developed.

The Keys to Advanced Mathematics: Recurrent Themes in Abstract Reasoning, Books Unlimited, Cleveland, OH, 1995. This unique book teaches the underlying thinking processes involved in learning advanced mathematics courses such as linear algebra, discrete mathematics, abstract algebra, and real analysis. A 74-page *Solutions Manual* was also developed.

Management Science, The Art of Decision Making, (with Kamlesh Mathur), Prentice Hall Publishing Company, Englewood Cliffs, NJ, 1994. An 850-page book for undergraduate and MBA students that focuses on model building and problem solving in management. Supporting materials include: (a) an Instructors' Manual, (b) a Student Resource Manual (300 pages), and (c) Video Cases.

Solutions Manual for How to Read and Do Proofs, 2nd Edition, John Wiley and Sons, Inc., New York, 1991.

How to Read and Do Proofs, 2nd Edition, John Wiley and Sons, Inc., New York, 1990.

How to Read and Do Proofs, (Chinese Translation), New Wave Publishing Co., Taipei, Taiwan, 1989.

Thinking in Pascal, Addison-Wesley Publishing Co., Reading, MA, 1988. This textbook provides a systematic approach for teaching the computer problem-solving process to students taking a first course in programming. Emphasis is given primarily to the translation of word problems into algorithms and to the debugging aspects. The approach is to identify problem solving techniques that can be used on virtually all problems. Complete coverage of Pascal is included.

Como Entender y Hacer Demonstraciones en Matematicas, (Spanish Translation of How to Read and Do Proofs), Editorial Limusa, S.A., Mexico City, Mexico, 1987.

Reasoning with a Computer in Pascal, Addison-Wesley Publishing Co., Reading, MA, 1986.

How to Read and Do Proofs, (Japanese Translation), Kyoritsu Publishing Co., Tokyo, Japan, 1985.

Linear Programming: An Introduction to Finite Improvement Algorithms, Elsevier Science Publishing Co., New York, 1984.

Reading, Writing and Doing Mathematical Proofs: Proof Techniques for Geometry, Dale Seymour Publications, Palo Alto, CA, 1984.

Reading, Writing, and Doing Mathematical Proofs: Proof Techniques for Advanced Mathematics, Dale Seymour Publications, Palo Alto, CA, 1984. (This and the previous book are the high school version of How to Read and Do Proofs, described below.)

How to Read and Do Proofs, John Wiley and Sons, Inc., New York, 1982. This book is the first systematic approach for teaching students how to read, think about, understand, and "do" mathematical proofs. The approach is currently being taught at universities throughout the world. Through the coordinated effort of over 25 students, the manuscript has been simultaneously translated and submitted to John Wiley in:

  Spanish   Japanese   Chinese   French   Korean

Numerous invited talks regarding the teaching method have been presented to universities and other organizations, as listed in this vita.

REFEREED RESEARCH PAPERS

Complex Systems and Leadership Papers

"Validation of Mathematica Models," Daniel Solow, *American Scientist*, Accepted May 23, 2022.

"An Evolutionary Justification of the Emergence of Leadership Using Mathematical Models," Daniel Solow, Joseph Szmerekovsky, and Sukumarakaru Krishnakuma, *Mathematics*,Special Issue on Mathematical Modeling and Optimization, **9(2271)**, 2021.
https://www.mdpi.com/2227-7390/9/18/2271/pdf

"Improved Heuristics for Finding Balanced Teams," Daniel Solow, Jie Ning, Jieying Zhu, Yishen Cai, *IISE Transactions*, **52(12**), 1312-1323, September 2020.

"Setting Leadership Goals and Getting Those Goals Accomplished: Insights from a Mathematical Model", Daniel Solow and Joseph Szmerekovsky, *Computational and Mathematical Organization Theory*, **20 (1)**, 36-51, 2014.

"Understanding the Role of Worker Interdependence in Team Selection," Will Millhiser, Corinne Coen and Daniel Solow**,** *Organization Science*, **22(3)**, 772-787, May – June, 2011.

"Factors that Affect the Optimal Amount of Central Control in Complex Systems," Daniel Solow and Joseph Szmerekovsky, *Naval Research Logistics*, **55**(5), 478-491, August, 2008.

"Mathematical and Computational Models of Leadership: Past and Future," J. K. Hazy, W. Millhiser, and D. Solow, in J. K. Hazy, J. Goldstein & B. B. Lichtenstein (Eds.), *Complex Systems Leadership Theory* (Chapter 9). Mansfield, MA: ISCE Publishing Company, Mansfield, MA, 2007. (Book Chapter)

"How Large Should a Complex System Be? An Application in Organizational Teams," *Complexity*, Will Millhiser and Daniel Solow, **12(4)**, 54 – 70, March/April 2007.

"The Role of Leadership: What Management Science Can Give Back to the Study of Complex Systems," Daniel Solow and Joe Szmerekovsky, *Emergence: Complexity and Organization,* **8(4)**, 52 – 60, December, 2006.

"Mathematical Models for Studying the Value of Motivational Leadership in Teams," Daniel Solow, Apostolos Burnetas, Sandy Kristen Piderit, and Chartchai Leenawong, *Computational and Mathematical Organization Theory*, **11(1)**, 5-36, May, 2005.

"Mathematical Models for Explaining the Emergence of Specialization in Performing Tasks," Daniel Solow and Joe Szmerekovsky, *Complexity*, **10(1)**, 37-48, September/October, 2004.

"Mathematical Models for Studying the Value of Cooperational Leadership in Team Replacement," Daniel Solow and Chartchai Leenawong, *Computational and Mathematical Organization Theory,* **9(1)**, 61-81, May, 2003.

"Managerial Insights into the Effects of Interactions on Replacing Members of a Team," Daniel Solow, George Vairaktarakis, Sandy Kristen Piderit, Ming-chi Tsai, *Management Science*, **48(8),** 1060-1073, 2002.

"On the Expected Performance of Systems with Complex Interactions Among Components," Daniel Solow, Apostolos Burnetas, Ming-chi Tsai, and Neil Greenspan, *Complex Systems*, **12(4)**, 423-456, 2000.

"On the Challenge of Developing a Formal Mathematical Theory for Establishing Emergence in Complex Systems," *Complexity*, **6(1)**, 49-52, 2000.

"Understanding and Attenuating the Complexity Catastrophe in Kauffman's *NK* Model of Genome Evolution," (with Apostolos Burnetas, Ming-chi Tsai, and Neil Greenspan), *Complexity*, **5(1)**, 53-66, 1999.

"Evolutionary Consequences of Selected Locus-Specific Variations in Epistasis and Fitness Contributions in Kauffman's *NK* Model," (with Apostolos Burnetas, Theresa Roeder , and Neil Greenspan), *Journal of Theoretical Biology*, **196**, 181-196, 1999.

Deterministic Optimization Papers

"An application of integer programming to producing aircraft engine parts", Daniel Solow, Qiong Wu, and Dan Magri, *Int. J. Applied Management Science*, Vol. 13, No. 1, .1 – 14, 2021.

"Improved Heuristics for Finding Balanced Teams," Daniel Solow, Jie Ning, Jieying Zhu, Yishen Cai, *IISE Transactions*, Volume 52(12), September 2020.

"Novel Approaches to Feasibility Determination", Daniel Solow, Roberto Szechtman, and Enver Yucesan, to *Transactions on Modeling and Computer Simulation*, **31(1)**, 1 – 25, January 2021.

"Emergency relocation of items using single trips: Special cases of the Multiple Knapsack Assignment Problem," Daniel Solow, N.B. Dimitrov, Joseph Szmerekovsky, Jia Guo, *European Journal of Operational Research*, **258(3)**, 938 - 942, May 2017.

N.B. Dimitrov et al., Emergency relocation of items using single trips: Special cases of the Multiple Knapsack Assignment Problem, European Journal of Operational Research (2016), http://dx.doi.org/10.1016/j.ejor.2016.09.004.

"Improving the Efficiency of the Simplex Algorithm Based on a Geometric Explanation of Phase 1," Daniel Solow and Hans Halim, *International Journal of Operational Research*, **5(4)**, 408 - 428, 2009.

"Linear and Nonlinear Programming," in Encyclopedia of Computer Science and Engineering (Benjamin Wah, ed.) Hoboken: John Wiley & Sons, Inc., **3**, 1744-1748, January, 2009.

"A Constrained Optimization Approach to Solving Certain Systems of Convex Equations," Daniel Solow and Hantao Li, *European Journal of Operational Research*, **176(3)**, 1334 – 1347, February, 2007.

"Vehicle Routing and Scheduling with Full Truck Loads," S. Arunapuram, Kamlesh Mathur, and Daniel Solow, *Transportation Science* **37(2)**, 170-182, May 2003.

"An Analysis and Implementation of an Efficient In-Place Bucket Sort," (with Apostolos Burnetas and Rishi Agarwal), *ACTA Informatica* **34**, 687-700, 1997.

"The Effectiveness of Finite Improvement Algorithms for Finding Global Optima," with S. Jacobson, *ZOR: Methods and Models of Operations Research,* **37(3)**, 1993.

"A Finite Improvement Algorithm for the Linear Complementarity Problem," with K. Paparrizos, *European Journal of Operations Research*, **3**, 305-324, 1989.

"A Finite Descent Theory for Linear Programming, Piecewise Linear Convex Minimization and the Linear Complementarity Problem," with P. Sengupta, *Naval Research Logistics Quarterly*, **32**, 417-431, 1985.

"Finite Search Procedures in Operations Research and Combinatorial Optimization," Proceedings of the 4th Mathematical Programming Symposium of Japan, November 1983.

"Homeomorphisms of Triangulations with Applications to Computing Fixed Points," *Mathematical Programming*, **20**(2), 213-224, 1981.

"Comparative Computer Results of a New Complementary Pivot Algorithm for Solving Equality Constrained Optimization Problems," *Mathematical Programming*, **18**(2), 168-185, 1980.

"Decomposability in Fixed Point Computation with Applications and Acceleration Techniques," *Journal of Mathematical Analysis and Applications*, **71**(2), 558-579, 1979.

BOOK REVIEWS

The Science of Decision Making: A Problem-Based Approach Using Excel, Eric V. Denardo, review appeared in *Interfaces* **33**(1), 92-94, 2003.

REFERENCES (Available on Request)