Suvrajeet Sen (Overview)

- B.E. (Hons.) Mech. Eng., Birla Institute of Technology and Science, Pilani, 1977
- Ph.D. Industrial Engineering & Operations Research, Virginia Tech, 1982
- **Field: Operations Research, and Infrastructure Systems** (with focus below)
  - *Optimization:* Large Scale, Stochastic and Integer Optimization
  - *Modeling for Infrastructures*: Electricity, transportation, communications
- **Appointments** (over the past 39 years)
  - *Professor*, Epstein Dept. of ISE, Viterbi School of Engineering, Univ. of Southern Calif., (2012 – date); and Ming-Hseih Dept. of ECE (Courtesy).
  - *Professor*, Ohio State Univ. (2006 - 2012), Univ. of Arizona (1982-2006)
  - *Director,* Center for Energy, Sustainability and Environment (2007- 2010)
  - *Program Director*, NSF/ENG (2003-2005)
- **Awards and Honors**
  - *Fellow*, INFORMS (Inst. for Oper. Res./Mgmt. Sc.), 2005 (1% of membership)
  - *Co-Winner*, INFORMS *Computing Society Award,* 2015 ("for seminal work on Stochastic Mixed Integer Programming"),
  - INFORMS *Distinguished Service*, 2017; *Sigma Xi*- Scientific Research Hon.Soc.
  - *Virginia Tech. Academy of Distinguished Alumni,* 2018.
  - *Recent Plenary Lectures (past 5 years):* INFORMS Annual Conference (2016), INFORMS Computing Society Conference, (2015), Operations Research Society of India (ORSI, 2018 Opening Lecture, Mumbai).
  - *Previous Plenary/Keynote Lectures* at INFORMS Optimization Conference (2012), International Conference on Stochastic Programming (Berlin, 2001 and Vienna 2007), ORSI (2006, Bangalore), Service Systems (Bejing, 2005).
  - *Tutorial speaker* at many INFORMS Conferences (2018, 2017, 2001, 2000, 1996) and International Winter Schools in Europe (2013, 2012).
  - *Distinguished Lectures*, Arizona State, Penn State, Texas A&M, and invited speaker at over 75 universities world-wide. *Invited speaker* at Oberwolfach, 2018 (German Mathematics) and Dagstuhl (German Computing) Workshops
- **Professional Service**
  - *Editorial Boards:* Current *INFORMS J. on Optimization*, *SIAM J. of Optimization. Member* of several editorial boards in the past (*INFORMS J. on Computing, Telecom Systems*, *Operations Research,* and *Math. Programming B*), as well as as Optimization Area Editor of *Operations Research.*
  - *Founder*, INFORMS Optimization Society (1995), Chair (2015-2016)
  - *Conference Leadership: INFORMS 2021 (Plenary/Keynote Speakers)* ISMP (*Program Committee*, 2015, 2022), ICSP (*Program Committee*, 2019, *General Chair*, 2004), *Chair*, INFORMS Telecommunications Section (1995), *Program Co-Chair* (ORSA, 1993)
  - *Recent Prize Committees: Chair,* INFORMS Computing Prize (2020*) Chair,* Khachiyan Prize (2018)*, Member,* INFORMS Fellows Selection (2017-2019)
- **Research Grants**
  - *Principal Investigator*: Federal grants exceed $10 million.
  - Current Projects $1.2 million from – a) NSF: Cyberinfrastructure for OR; b) AFOSR: Predictive Stochastic Programming (PSP); c) ONR: Oracle-Driven Stochastic Integer Programming
- **Publications**
  - Published 116 papers. Google Scholar h-index: 36. Papers with more than100 citations (i-100) are split between Optimization (9) and Models for Networked Infrastructures (6) (i.e., power systems, telecommunications and transportation).

Suvrajeet Sen
(Orcid: 0000-0002-6285-8833)

Education

B.E.(Hons.) Mechanical Engineering, Birla Inst. of Tech. and Sci. Pilani, India, 1977
M.E. Engineering Management, University of Louisville, Louisville, KY, 1979
Thesis: "Design of a multicommodity distribution network"
(Advisor: S.M. Alexander).
Ph.D. Industrial Engineering and Operations Research, VPI & SU, 1982
Dissertation: "The extreme point mathematical programming problem"
(Advisor: H.D. Sherali).

Major Field

Operations Research and Infrastructure Systems (with focus below)

Optimization: Large scale, stochastic and integer optimization.
Modeling for Infrastructures: electricity, transportation, and communications

Employment

1981 - 1982 *Research Associate*,
Dept. of IMSE, Pennsylvania State University
1982 - 1987 *Assistant Professor*,
SIE Dept. University of Arizona
1987 - 1994 *Associate Professor*,
SIE Dept. University of Arizona
1994 - 2006 *Professor*,
SIE Dept. University of Arizona
2006 - 2012 *Professor, Director of Data-Driven Decisions (3D) Lab, and OR-Ohio*
ISE Dept. Ohio State University
2007 - 2010 *Director*, Center for Energy, Sustainability & Environment, OSU
2012 – 2013 *Research Professor*, ISE Dept. Ohio State University
2012 – date *Professor of ISE, University of Southern California (also, ECE, Courtesy)*
Other Appointments
Sabbaticals 1987-88 (Bellcore, Stanford Univ.)
1995-96 (Oak Ridge Nat. Labs., Univ. of Zurich)
2003 (EPSRC (U.K.) Funded Visitor to Brunel University, London)
2017-2018 (Visits to numerous universities in Europe and U.S.)
2003 - 2005 *Program Director*, OR and SEE
Div. of Design, Manufacture and Industrial Innovation
National Science Foundation
2004 - 2005 *Chair*, NSF/Engineering Cyberinfrastructure Working Group
National Science Foundation (See also Honors in 2005)

Honors and Awards

Fellow, (2005) Inst. for Oper. Res. and Mgmt. Sci. (INFORMS) (1% of members)
The 2015 ICS Prize awarded annually for best English-language paper(s) at the interface of OR and Computing: citation to Suvrajeet Sen et al for seminal work on stochastic mixed integer programming. (Awarded papers in publications list)
2016 Plenary Speaker, INFORMS Annual Meeting, Nashville, TN.
2017 INFORMS Distinguished Service Award
2017 Distinguished Speaker at Texas A&M Department of Industrial Engineering
2018 Virginia Tech. Academy of Distinguished Alumni
2018 Inaugural Speaker, Operations Research Society of India (ORSI) Conference, Mumbai.
2019 Distinguished Speaker at Arizona State University, Tempe, AZ
2006 Meritorious Service Award, Operations Research (INFORMS flagship journal)
2005 Outstanding Leadership and Service, NSF-Engineering Directorate
2004 Distinguished Speaker, Penn State University
2001 Distinguished Alumnus, University of Louisville
Who's Who in Science and Engineering
Honor Societies: Alpha Pi Mu (IE), Sigma Xi (Scientific Res.)
Past Plenary/Keynote Lectures at INFORMS Optimization Conference (Miami) 2012, International Conferences on Stochastic Programming (Vienna, Austria (2007) and Berlin, Germany (2001)), Service Science Conference 2005 (China), Inaugural speaker at ORSI (2006).
Tutorial speaker at many INFORMS Conferences (1996, 2000, 2001, 2017, 2018) and International Workshops (2012, 2013). Invited Speaker at Oberwolfach and Dagstuhl, Germany.

Awards Committees

INFORMS Computing Society (ICS) Prize Chair: 2020. Member: 2021.
Chair, Khachiyan Award (INFORMS Optimization Soc. Lifetime Achievement, 2018)
INFORMS Fellows Selection Committee 2017 - 2019
Junior Researcher Award (INFORMS Optimization Society, 2017)
Nicholson Prize (INFORMS Student Paper Prize), 2015-2016
COSP (Committee on Stochastic Programming) Awards Committee, 2013, 2016

Extramural Service

Chair, NSF Committee for *"OR as a Catalyst for Engineering Grand Challenges"*
Area Editor (Optimization), *Operations Research* (1996 - 2000)
Associate Editor, INFORMS J. on Optimization (2017 – current)
Associate Editor, SIAM J. on Optimization (2019 – current)
Associate Editor, Mathematical Programming B (2015 – 2017)
Associate Editor, *Operations Research* (1991 - 1995), (2001 - 2012)
Associate Editor, *ORSA Journal on Computing*, (1995 - 2001)

Associate Editor, *J. of Telecommunications Systems*, (1996 - 2001)
Advisory Editor, *Journal of Service Science and Informatics* (2004 - ongoing)
Advisory Editor, *Asia Pacific Journal of Operations Research* (2003 – ongoing)
Guest Editorships: special issues of *Interfaces*, *Annals of Operations Research*, *IIE Transactions*, *Computational Optimization and Applications*.
General Chair, NSF Tutorials on Stochastic Programming, 1996.
General Chair, IFIP Workshop on Stochastic Programming, 1996.
Program Chair, INFORMS Telecommunications Conference, Boca Raton, FL, 1998.
General Chair, Tenth International Conference on Stochastic Programming, October 2004.
General Chair, INFORMS Midwest Conference, Columbus, OH 43210.
Founder, INFORMS Optimization Section, 1995.
Chair-Elect, INFORMS Optimization Society 2014.
Chair, INFORMS Optimization Society, 2015-2016
Chair INFORMS (formerly ORSA/TIMS) Telecommunications Technical Section, 1995-96. (Chair-Elect: 1994-95).
Member, INFORMS Strategic Planning Committee, 2004
Member, Committee on Stochastic Programming (COSP) (by invitation), 2000-2004.
Member, Committee on Stochastic Programming (COSP) Awards, 2013, 2016.
Member, INFORMS Nicholson Student Paper Prize, 2005, 2015, 2016.
Member, IFIP Working Group 7.7 (by invitation)
Program Co-Chair, ORSA/TIMS Meeting, Phoenix, 1993.
Member of Program Committee for ORSA Telecommunications Conference, 1995.
Member of International Program Committee for International Conferences on Stochastic Programming, Israel (1995), Vancouver (1998), Berlin (2001), ISMP 2015, Trondheim (2019), ISMP 2021.
Tutorials Chair, International Conference on Stochastic Programming, Halifax (2010)
External Examiner, University of South Africa (1991), Massey University, New Zealand (1994), University of Zurich, Switzerland (1995), University of Copenhagen, Denmark (1998), University of Rome (2001-2002), Brunel University (2006).

Referee

National Science Foundation (Panelist), National Research Council (National Academy of Eng.), Office of Naval Research, Australian Research Council, NSERC (Canada), International Science Foundation (for former Eastern Block nations) and the following journals. *Annals of Operations Research, Computational Optimization and Applications, Discrete Optimization, Energy Systems, European Journal of Operations Research, IEEE Transactions on Automatic Control, IIE Transactions, Interfaces, Journal of Design and Manufacturing, Journal of Global Optimization, Journal of Network and Systems Management, Journal of Economic Dynamics and Control Large Scale Systems, Management Science, Mathematical Programming, Mathematics of Operations Research, Naval Research Logistics, Networks, INFORMS Journal on Computing, Operations Research, Optimal Control Applications and Methods, Production Planning and Control, Power Systems Computing, SIAM Journal on Control and Optimization, SIAM Journal on Optimization, Telecommunications Systems.*

Invited Speaker at the following Universities:
Arizona, Arizona State, Auburn, Auckland (New Zealand), Bergen (Norway), British Columbia (Vancouver, Canada), Brunel (U.K), Univ.at Buffalo (SUNY Buffalo), UC-Berkeley, UC-Davis, Cambridge (U.K), Charles Univ. (Prague,Czech), Carnegie Mellon University, Copenhagen (Denmark), Florida, George Mason University, George Washington University, Guelph University (Canada), Humboldt University (Berlin, Germany), IIT Mumbai (India), IIT Delhi (India), IISc Bangalore (India), Illinois, Johns Hopkins, Lancaster (U.K), Lehigh, Louisville, Maryland, Michigan, Milan (Italy), Missouri-Rolla, Naval Postgraduate School, Northern Arizona, NC State, U. North Carolina, Northwestern, Oklahoma State Univ., Oslo (Norway), Rome (Italy), St. Gallen (Switzerland), Norwegian University of Economics (Bergen, Norway), Norwegian Univ. of Science and Tech. (Trondheim, Norway), Ohio State University, Penn State, Pittsburgh, Princeton, Purdue, Sabanci (Turkey), U. of Southern California, Stanford, Stevens, Texas A&M, Tennessee, Virginia Tech, VCU, Wisconsin, Zurich (Switzerland).

Service at Univ. of Southern California

Member, Appointments, Promotion and Tenure Committee, VSoE (2012-2014)
Member, Engineering Faculty Council, VSoE (Fall 2012)
Member, Graduate Studies Committee, Epstein Dept (2012-2013)
Chair, Faculty Recruitment Committee, Epstein Dept (2014 – 2016)
Member, Promotion and Tenure Committee, Epstein (2015-2017)

Service at Ohio State University

Chair, OR-Ohio (a consortium of universities in the State of Ohio promoting OR at the graduate level), 2008 – 2012
Director, Center for Energy and Sustainability (School of Engineering, 2007-2010)
Director, 3D-Lab (2006 - 2012)
Member, Promotion and Tenure Committee, 2010 - 2012

Service at Univ. of Arizona (most significant)

Member, SIE Peer Review Committee, (1994 - 98)
Leader, ELITE Project Team (1996 - 1998)
Member, SIE Undergraduate Committee (1996 - 2000)
Chair, Arizona Software Institute, 1998 - 99.
Chair, of the SIE Search Committee, 1997 - 2001
Organizer, SIE Seminar Series, 1999-2002, 2005-2006
Member, College Promotion and Tenure Committee (2000 - 2002)
Member, Program Assessment and Instructional Priorities Team.
Affiliate Member, Program in Applied Mathematics (1989 -)
Member, Search Committee for Digital Arts Director, Fine Arts College (1998-2000)

Member, Committee for Information Technology Initiative (Prop. 301)

(A) Publications[1] (In this section the integer [n] is in reverse chronological order).

- *Research Focus: Optimization (large scale, stochastic and integer optimization) and Modeling for Infrastructures (electricity, transportation, communications).*
- *Impact Balance: Of journal papers with **100 or more citations**[2] (i-100 on Google Scholar is 15), 3/5 are in Optimization, and 2/5 are in Modeling for Infrastructures. See papers denoted* **[n↑]**
- *The 2015 INFORMS Computing Society Award was given for "seminal work on Stochastic Mixed-Integer Programming." see papers* **[n*]**

[116] S. Atakan, H. Gangammanavar, and S. Sen, "Towards a Sustainable Power Grid: Stochastic Hierarchical Planning for High Renewable Integration" accepted in *European Journal of Operational Research.*

[115] J. Xu and S. Sen, "Decision Intelligence for Nationwide Ventilator Allocation during the COVID-19 Pandemic," *Springer Nature – Computer Science*, accepted in the *Special Issue on Combatting COVID-19*, 2021.

[114] H. Gangammanavar and S. Sen, "Stochastic Dynamic Linear Programming: A Sequential Sampling-Based Multi-Stage Stochastic Programming Algorithm," *SIAM J. on Optimization*, vol. 31#3, pp. 2111-2140, 2021.

[113] J. Liu, G. Li, and S. Sen, "Coupled Learning Enabled Stochastic Programming with Endogenous Uncertainty," accepted in *Mathematics of Operations Research*, 2021

[112] Y. Deng and S. Sen, "Predictive Stochastic Programming" *Computational Management Science* , Special Issue of 15th ICSP), July 2021, DOI: 10.1007/s10287-021-00400-0.

[111] J. Liu, N. Cui, J-S. Pang and S. Sen, "Two-stage Stochastic Programming, with Linearly Bi-parametrized Quadratic Recourse," *SIAM J. on Optimization* vol. 30#3, 2530–2558, 2020.

[110] H. Gangammanavar, Y. Liu and S. Sen, "Stochastic Decomposition for Two-Stage Stochastic Linear Programs with Random Cost Coefficients," *INFORMS Journal on Computing,* 33(1), 51-71, 2020, DOI: 10.1287/ijoc.2019.0929

[109] J.Liu and S. Sen, "Asymptotic Results on Two-stage Stochastic Quadratic Programming" *SIAM J. on Optimization,* vol. 30#1, pp. 823-854, 2020.

[108] J. Lei, U. Shanbhag, J-S. Pang and S. Sen, "On Synchronous, Asynchronous, and Randomized Best-Response schemes for Stochastic Nash games" *Mathematics of Operations Research,* Vol. 45 (1): 34, Feb. 2020.

[107] Y. Deng, J. Xu, C. Kesselman, and S. Sen, "Computational Operations Research Exchange (core): a Cyber-infrastructure for Analytics" in *Winter Simulation Conference,* Dec. 2019 (N. Mustafee et al (eds)).

[106] Y. Deng, J.Liu and S. Sen, "Coalescing Data and Decision Sciences for Analytics" *INFORMS TutORials pp. 20-49, 2018.*

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[1] *As a general rule, all authors are listed alphabetically for publications, unless there were special circumstances (e.g. graduate student) to warrant an alternate author sequence.*

[2] In my field, 100 citations marks a deep contribution. I consider this similar to scoring a century in cricket.

[105] S. Atakan and S. Sen, "A Progressive Hedging-based Branch and Bound Algorithm for Stochastic Mixed Integer Programming" *Computational Management Science*, vol. 15, pp. 501-540, 2018.

[104] H. Gangammanavar, and S. Sen, "Two-scale Stochastic Optimization Framework for Controlling Distributed Storage Devices" *IEEE Transactions on Smart Grid*, vol. 9, pp. 2691-2702, 2018.

[103] A. Atakan, G. Lulli, and S. Sen, "A State-Transition MIP Formulation for the Unit Commitment Problem," *IEEE Transactions on Power Systems*, Vol. 33 (1), pp. 736-748, 2018.

[102] S. Küçükyavuz and S. Sen, "Introduction to Two-stage Stochastic Mixed Integer Programming" in *INFORMS TutORials*, pp. 1-27, 2017.

[101] J-S. Pang, S. Sen and U.V. Shanbhag, "Two-stage Non-cooperative Games with Risk Averse Players," *Mathematical Programming B*, (special issue on *Stochastic Variational Inequalities*), vol. 165, pp.235-290, 2017.

[100] Y. Qi and S. Sen, "Ancestral Benders' Cuts and Multi-term Disjunctions for Mixed-Integer Recourse Decisions in Stochastic Programming," *Mathematical Programming* January 2017, Volume 161, pp 193–235.

[99] S. Sen and Y. Liu, "Mitigating Uncertainty via Compromise Decisions in Stochastic Linear Programming: Variance Reduction" *Operations Research,* 64(6):1422-1437, August 2016.

[98] D.P. Morton, and S. Sen, "OR – A Catalyst for Engineering Grand Challenges: Opportunities in Security" *OR/MS Today,* pp. 28-32, February 2016.

[97] H. Gangammanavar, S. Sen and V. Zavala, "Stochastic Optimization of Sub-hourly Economic Dispatch with Wind Energy" *IEEE Transactions on Power Systems,* Vol. 31 (2), pp. 949-959, 2015.

[96] S. Sen, C. Barnhart, J.R. Birge, W.B. Powell, C.A. Shoemaker, "OR – A Catalyst for Engineering Grand Challenges: Opportunities in Sustainability" *OR/MS Today,* pp. 22-26, December 2015.

[95] S. Sen, C. Barnhart, J.R. Birge, E.A. Boyd, M.C. Fu, D.S. Hochbaum, D.P. Morton, G.L. Nemhauser, B.L. Nelson, W.B. Powell, C.A. Shoemaker, D.D. Yao, S. Zenios, "Operations Research – A Catalyst for Engineering Grand Challenges" *OR/MS Today,* pp. 44-47, August 2015.

[94] S. Sen and Z. Zhou, "Multi-stage Stochastic Decomposition: A Bridge Between Stochastic Programming and Approximate Dynamic Programming" *SIAM Journal on Optimization* , Vol. 24, pp. 127-153, 2014.

[93*] D. Gade, S. Küçükyavuz, and S. Sen, "Decomposition algorithms with parametric Gomory cuts for two-stage stochastic integer programs," *Mathematical Programming*, vol. 144, pp. 39-64, 2014.

[92] P.V.S Aketi and S. Sen, "Modeling Demand Response and Economic Impact of Advanced and Smart Metering," *Energy Systems*, vol. 5, pp. 583-606, 2013.

[91] S. Sen, "Stochastic Programming," *Encyclopedia of Operations Research and Management Science* (S. Gass and M. Fu, eds.), Springer, pp. 1486 – 1497, 2013.

[90] K. Huang, S. Sen, and F. Szidarovszky, "Connections among Decision Field Theory models of Cognition," *Journal of Mathematical Psychology*, Vol. 56, pp. 287 – 296, 2012.

[89] B. Chen, S. Küçükyavuz, and S. Sen, "A Computational Study of the Cutting Plane Tree Algorithm for General Mixed-Integer Linear Programs," *Operations Research Letters*, Vol. 40, pp. 15-19, 2012.

[88] S. Sen and Z. Zhou, "Optimization Simulation: The case of multi-stage stochastic decision models," *Proceedings of the Winter Simulation Conference* (S. Jain et al, eds.), 2011.

[87] B. Chen, S. Küçükyavuz, and S. Sen, "Finite Disjunctive Programming Characterizations for General Mixed-Integer Linear Programs," *Operations Research*, Vol. 59, pp. 202–210, 2011.

[86] S. Sen, "Stochastic Integer Programming Algorithms: Beyond Benders' Decomposition," *Wiley Encyclopedia on Operations Research and Management Science*, 2010

[85] J. Desai and S. Sen, "A global optimization algorithm for reliable network design," *European J. of Operational Research* pp. 1 – 8, 2010.

[84] S. Sen, Z. Zhou and K. Huang, "Enhancements of Two-Stage Stochastic Decomposition, *Computers and Operations Research*, pp. 2434 – 2439, 2009. An abbreviated version entitled "Stochastic Decomposition and Extensions," appeared in "*Stochastic Programming: The State of the Art,*" in honor of George Dantzig, edited by G. Infanger, 2011.

[83] Y. Yuan and S. Sen, "Enhanced cut generation methods for decomposition-based branch-and-cut algorithms for two-stage stochastic mixed-integer programs," *INFORMS Journal on Computing*, pp. 480 – 487, 2009.

[82] S. Sen, S. Kang, Y. Qi, "Dashboard for Intelligent Collaborative Engineering: An Architectural Overview," Proceedings of the Industrial Engineering Research Conference, Vancouver, BC, Canada, 2008.

[81] J.L. Higle, B. Rayco, and S. Sen, "Stochastic Scenario Decomposition for Multi-stage Stochastic Programs," *IMA Journal of Management Mathematics,* pp 1-28, 2009.

[80] T. Genc and S. Sen, "An analysis of capacity and price trajectories for the Ontario Electricity Market using dynamic Nash Equilibrium under uncertainty," *Energy Economics*, 30, pp. 173-191, 2008.

[**79*] L. Ntaimo and S. Sen**, "A Comparative Study of Decomposition Algorithms for Stochastic Combinatorial Optimization," *Computational Optimization and Applications*, vol. 40, pp. 299-319, 2008.

[78] L. Ntaimo and S. Sen, "A branch-and-cut algorithm for two-stage stochastic mixed-binary programs with continuous first-stage variables," *Int. J. of Computational Science and Engineering*, 3, pp. 232-241, 2007.

[77] L. Zhao and S. Sen, "A comparison of sample-path based simulation-optimization and stochastic decomposition for multi-location transshipment problems," *Winter Simulation Conference 2006* (L.F. Perrone et al, eds.).

[76] S. Sen "On Bridging the Gap between Academe and Industry in OR/MS," *OR/MS Today,* pp. 31-33, 2006.

[75] T. Genc, S. Reynolds, and S. Sen, "Dynamic Oligopolistic Games Under Uncertainty: A Stochastic Programming Approach," *Journal of Economic Dynamics and Control*, 31, pp. 55-80, 2007.

[74] G. Mitra, C. Poojari and S. Sen, "Strategic and Tactical Planning Models for Supply Chain: An Application of Stochastic Mixed Integer Programming," *Handbook on Modelling for Discrete Optimization* Springer International Series in Operations Research and Management Science, pp. 227-264, 2006.

[73] Y. Xu and S. Sen, "A Distributed Computing Architecture for Simulation and Optimization," *Winter Simulation Conference 2005* (M.E. Kuhl, N.M. Steiger, F.B. Armstrong, J.A. Jones, eds.).

[72↑*] S. Sen and H.D. Sherali, "Decomposition with Branch-and- Cut Approaches for Two Stage Stochastic Integer Programming," *Mathematical Programming*, 106, pp. 203-223, 2006.

[71↑*] S. Sen and J.L. Higle, "The C3 Theorem and a D2 Algorithm for Large Scale Stochastic Integer Programming," *Mathematical Programming*, 104, pp. 1-20, 2005.

[70] G. Lulli and S. Sen, "A Heuristic Algorithm for Stochastic Integer Programming with Complete Recourse," *European J. of Operations Research*, 171, pp. 879-890, 2006.

[69↑] M. Casey and S. Sen, "The Scenario Generation Algorithm for Multi-stage Stochastic Linear Programming," *Mathematics of Operations Research*, 30, pp. 615-631, 2005.

[68↑] S. Sen, L. Yu, and T. Genc, "A Stochastic Programming Approach to Power Portfolio Optimization," *Operations Research*, 54, pp. 55-72, 2006.

[67↑*] L. Ntaimo and S. Sen, "The Million Variable "March" for Stochastic Combinatorial Optimization," *Journal of Global Optimization*, 32, no. 3, pp. 385-400, 2005.

[66↑] S. Sen, "Algorithms for Stochastic Mixed-Integer Programming Models," *Handbook of Discrete Optimization*, (K. Aardal, G.L. Nemhauser, and R. Weismantel eds.), North-Holland Publishing Co., pp. 515-558, 2005.

[65] J.L. Higle and S. Sen "Duality for Multistage Convex Stochastic Programs," *Annals of Operations Research*, 142, pp. 129-146, 2006.

[64] Y. Xu, S. Sen and F. Ciarallo, "An Agent-based Approach for Distributed Simulation," *International Journal of Modeling and Simulation*, 24, no. 2, pp. 55-64, 2004.

[63↑] G. Lulli and S. Sen, "A Branch and Price Algorithm for Multi-stage Stochastic Integer Programs with Applications to Stochastic Lot Sizing Problems," *Management Science*, 50, pp. 786-796, 2004.

[62] S. Sen, J.L. Higle and L. Ntaimo, "A Summary and Illustration of Disjunctive Decomposition with Set Convexification," *Stochastic Integer Programming and Network Interdiction Models* (D.L. Woodruff ed.), pp. 105 - 125, Kluwer Academic Press, 2002.

[61] G. Lulli and S. Sen, "Stochastic Batch Sizing Problems: Models and Algorithms," *Stochastic Integer Programming and Network Interdiction Models* (D.L. Woodruff ed.), pp. 85 - 103, Kluwer Academic Press, 2002.

[60] S. Sen, L. Yu and T. Genc, "Decision Aids for Scheduling and Hedging in Deregulated Electricity Markets: A Stochastic Programming Approach to Power Portfolio Optimization," (invited paper), *Proceedings of the 2002 Winter Simulation Conference*, San Diego, CA.

[59] J.L. Higle and S. Sen, "A Stochastic Programming Model for Network Resource Utilization in the Presence of Multi-Class Demand Uncertainty," *Applications of Stochastic Programming* (eds. S.W. Wallace and W.T. Ziemba), 2005.

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[56] J.L. Higle and S. Sen, "Stochastic Linear Programming: Decomposition and Cutting Planes," *Encyclopedia of Optimization*, (C.A. Floudas and P.M. Pardalos, eds.), Kluwer Academic Publishers, Dordrecht, 2001.

[55] S. Sen, A. Dixit, Y. Xu, A.L. Barath and F. Ciarallo, "The Open Bit Mine: A Laboratory Test-bed for Studying Parallel Realities," *Proceedings of IE Research Conference*, May 2001.

[54] F.H. Murphy and S. Sen, "Qualitative Implications of Uncertainty in Economic Equilibrium Models," *Decision-Making Under Uncertainty: Energy and Power*, (C. Greengard and A. Ruszczynski, eds.), The IMA Volumes in Mathematics and its Applications, vol. 128, Springer, New York, 2002.

[53] J. Wu and S. Sen, "A Stochastic Programming Model for Currency Option Hedging," *Annals of Operations Research*, 100, pp. 227-250, 2000.

[52↑] S. Sen, R. Pillai, S. Joshi, A. Rathi, "A Mean-Variance Model for Route Guidance in Advanced Traveller Information Systems," *Transportation Science*, 35, pp. 37-49, 2001.

[51] Y.K. Cho, B.P. Zeigler, H.J. Cho, H.S. Sarjoughian and S. Sen, "Design Considerations for Distributed Real-time DEVS," *Proceedings of AIS 2000*.

[50] S. Sen, J.L. Higle and J.R. Birge, "Duality Gaps in Stochastic Integer Programming," *Journal of Global Optimization*, 18, pp. 189-194, 2000.

[49] J.L. Higle and S. Sen, "Algorithmic Implications of Duality in Stochastic Programs," *Proceedings of the IFIP Conference*, 1999.

[48] J.L. Higle and S. Sen, "Statistical approximations for stochastic linear programming problems," *Annals of Operations Research*, 85, pp. 173-192, 1999.

[47↑] S. Sen and J.L. Higle, "An Introductory Tutorial on Stochastic Linear Programming: Modeling," *Interfaces*, 29, pp. 33-61, 1999.

[46] H.D. Sherali, G. Choi and S. Sen, "An exterior-point polytope sliding method for linear programming," *Informatica*, 8, pp. 559-582, 1997.

[45↑] S. Sen and K.L. Head "Controlled Optimization of Phases (COP) at an Intersection," *Transportation Science*, 31, pp. 5-17, 1997.

[44] S. Sen, J.B. Goldberg, J.L. Higle and W.R. Ferrell, "Bachelor of Arts in Engineering: Endless Possibilities," *Proceedings of the ASEE-PSW Conference*, San Luis Obispo, CA, 1997.

[43] S. Sen, J.L. Higle, J.B. Goldberg and W.R. Ferrell, "Engineering with a Liberal and Technical Education (ELITE)," *Proceedings of Frontiers in Education Conference*, Salt Lake City, UT, 1996.

[42] J.L. Higle and S. Sen, "Tutorial: Modeling Two Stage Stochastic Linear

Programs," *Proceedings of the Industrial Engineering Research Conference*, pp. 311-320, 1996.

[41] S.W. Wallace, J.L. Higle and S.Sen (eds). *Stochastic Programming, Algorithms and Models*, special issue of *Annals of Operations Research*, 64, 1996.

[40↑] J.L. Higle and S. Sen, *Stochastic Decomposition: A Statistical Method for Large Scale Stochastic Linear Programming*, Kluwer Academic Publishers, Dordrecht, 1996.

[39] J.L. Higle and S. Sen, "Duality and Statistical Tests of Optimality for Two Stage Stochastic Programs," *Mathematical Programming*, 75, pp. 257-275, 1996.

[38] J.L. Higle and S. Sen, "Statistical Approximations for Recourse Constrained Stochastic Programs," *Annals of Operations Research*, 56, pp. 157-175, 1995.

[37] J.L. Higle and S. Sen, "Finite master programs in stochastic decomposition," *Mathematical Programming*, 67, pp. 143-168, 1994.

[36] M.S. Sodhi, R.A. Askin and S. Sen, "A hierarchical model for flexible manufacturing systems control," *Journal of Operational Research*, 45, pp. 1185-1196, 1994.

[35] J.L. Higle and S. Sen, "Epigraphical Nesting: a unifying theory for the convergence of algorithms," *Journal of Optimization Theory and Applications*, 84, pp. 339-360, 1995.

[34↑] S. Sen, R.D. Doverspike and S. Cosares, "Network Planning with Random Demand," *Telecommunication Systems*, 3, pp. 11-30, 1994.

[33] S. Sen, J. Mai and J.L. Higle, "Solution of Large Scale Stochastic Programs with Stochastic Decomposition Algorithms," Book Chapter for *Large Scale Optimization: The State of the Art*, W. Hager, D. Hearn and P. Pardalos (eds.), 1994

[32] M.S. Sodhi, R.A. Askin, S. Sen, "Multiperiod tool and production assignment in Flexible Manufacturing Systems," *Int. J. of Prod. Research*, 32, pp. 1281-1294, 1994.

[31] K.T. Au, J.L. Higle and S. Sen, "Inexact subgradient methods with applications in stochastic programming," *Mathematical Programming*, 63, pp. 65-82, 1994.

[30] J.L. Higle and S. Sen, "Stochastic Decomposition: A Statistical Approach to Activity Analysis Under Uncertainty," *Proceedings of the IFIP/Daimler-Benz Workshop on* "Statistical Methods for Decision Processes," (G. Hellwig, P. Abel and P. Kall eds.) pp. 64-77, 1993.

[29] S. Sen and L. Mahajan, "A Model for Multiplexing and Cable Sizing in Local Access Telephone Networks," *Annual Communications Review*, 47, pp. 530-537, 1993.

[28] S. Sen, "Subgradient decomposition and the differentiability of the recourse function of a two stage stochastic LP with recourse," *Operations Research Letters*, 13, pp. 143-148, 1993.

[27↑] S. Sen, "Relaxations for probabilistically constrained programs with discrete random variables," *Operations Research Letters*, 11, pp. 81-86, 1992.

[26] J.L. Higle and S. Sen, "On the convergence of algorithms with implications

for stochastic and nondifferentiable optimization," *Math. of Operations Research*, 17, pp. 112-131, 1992.

[25] J.L. Higle and S. Sen, "Statistical verification of optimality conditions for stochastic programs with recourse," *Annals of Operations Research*, 30, pp. 215-240, 1991.

[24↑] J.L. Higle and S. Sen, "Stochastic Decomposition: An algorithm for two stage stochastic linear programs with recourse," *Math. of Operations Research*, 16, pp. 650-669, 1991.

[23] A. Rakshit and S. Sen, "Sequential rank-one/rank-two updates for quasi-Newton differential dynamic programming," *Optimal Control Applications and Methods*, 11, pp. 95-101, 1990.

[22] A. Vakharia, R.G. Askin and S. Sen, "Cell Formation in Group Technology: A Mathematical Programming Approach," *Proceedings of the Decision Sciences Institute Annual Meeting*, 1989.

[21] S. Sen, R.D. Doverspike and S.I. Vohnout, "Diverse Routing in the Unified Facilities Optimizer," *Proceedings of Global Telecommunications Conference (Globe-com)*, 1989.

[20] A. Rakshit, S. Sen and L. Duckstein, "A Stagewise Compromise Programming Framework for Multi-stage Multiple Objective Decision Making Problems," *Control Theory and Advanced Technology*, special issue on Multi-objective Discrete Dynamic Systems (Y. Haimes, editor), 5, pp. 413-441, 1989.

[19] S. Sen and S.J. Yakowitz, "A Quasi-Newton algorithm for discrete-time optimal control," *Automatica*, 23, pp. 749-752, 1987.

[18] S. Sen and H.D. Sherali, "Nondifferentiable reverse convex programs and facetial cuts via a disjunctive characterization," *Mathematical Programming*, 37,

[17] F.H. Murphy, S. Sen and A.L.Soyster, "Electric utility expansion planning in the presence of existing capacity: a nondifferentiable convex programming approach," *Computers and Operations Research*, 14, pp. 19-31, 1987. pp. 169-183, 1987.

[16] S. Sen and D. Yakowitz, "A primal-dual subgradient method for time staged capacity expansion," *European Journal of Operational Research*, 27, pp. 301-312, 1986.

[15] S. Sen and D.N. Contractor, "Reduction of pressure surges by minimax optimization," *Applied Mathematical Modelling*, 10, pp. 271-277, 1986.

[14] S. Sen, "A class of algorithms for large scale nonlinear minimax optimization," *Applied Mathematics and Computation*, 18, pp. 355-361, 1986.

[13] S. Sen and H.D. Sherali, "A class of convergent primal-dual subgradient algorithms for nondifferentiable optimization," *Mathematical Programming*, 35, pp. 279-297, 1986.

[12] S. Sen and H.D. Sherali, "Facet inequalities from simple disjunctions in cutting plane theory," *Mathematical Programming*, 34, pp. 72-83, 1986.

[11] S. Sen and A. Whiteson, "A cone splitting algorithm for reverse convex programming," *Proceedings of IEEE Conference on Systems Man and Cybernetics*, Tucson, AZ, pp. 656-660, 1985.

[10] S. Sen and D.N. Contractor, "Reduction of fluid transients by minimax

optimization," *Forum on Unsteady Flow*, ASME Winter Meeting, November 1985.

[9] H.D. Sherali and S. Sen, "On generating cutting planes from combinatorial disjunctions," *Operations Research*, 33, pp. 928-933, 1985.

[8] S. Sen and H.D. Sherali, "A branch and bound algorithm for extreme point mathematical programming," *Discrete Applied Mathematics*, 11, pp. 265-280, 1985.

[7] S. Sen and H.D. Sherali, "A disjunctive cutting plane algorithm for the extreme point mathematical programming problem," *Opsearch*, 22, pp. 83-94, 1985.

[6] S. Sen and H.D. Sherali, "On the convergence of cutting plane algorithms for a class of nonconvex mathematical programs," *Mathematical Programming*, 31, pp. 42-56, 1985.

[5] S. Sen, S.K. Saraf, A.L. Soyster, F.H. Murphy, "The capital supply curve in models of capacity expansion: some economic and algorithmic aspects," *Naval Research Logistics Quarterly*, 31, pp. 199-212, 1984.

[4] H.D. Sherali, A.L. Soyster, F.H. Murphy and S. Sen, "Allocation of capital costs in electric utility capacity expansion planning under uncertainty," *Management Science* 30, pp. 1-19. 1984.

[3] H.D. Sherali, A.L. Soyster, F.H. Murphy and S. Sen, "Linear programming based analysis of marginal cost pricing in electric utility capacity expansion," *European Journal of Operations Research*, 11, pp. 349-360, 1982.

[2↑] F.H. Murphy, S. Sen and A.L. Soyster, "Electric utility capacity expansion planning with uncertain load forecasts," *AIIE Transaction*, (*Currently IISE Transactions)* 14, pp. 52-59, 1982.

[1] F.H. Murphy, S. Sen and A.L. Soyster, "Accounting for uncertain load forecasts in electric utility capacity expansion: a deterministic equivalence," *Proceedings of Energy Modeling III*, Institute of Gas Technology, Chicago, Il. pp. 71-98, 1980.

Papers under review *(in Reverse Chronological Order)*

[3] D. Zhang and S. Sen, "A Stochastic Conjugate Subgradient Algorithm for Kernelized Support Vector Machines" submitted to *Computational Optimization and Applications.*

[2] J. Xu and S. Sen, "Ensemble Variance Reduction Methods for Stochastic Combinatorial Optimization and their Application to Stochastic Facility Location Problem" submitted to *INFORMS J. on Computing.*

[1] S. Diao and S. Sen, "Distribution-free Algorithms for Learning Enabled Optimization with Non-parametric Approximations," revised and submitted to *SIAM J. on Optimization.*

(B) Scholarly Presentations

Plenary, Keynote and Featured Lectures (in Reverse Chronological Order)

[14] Plenary Lecture, 'Big Data and Big Decisions' INFORMS Annual Conference, Nashville, TN, Nov. 2016
[13] "Are Stochastic Programs Solvable? Retrospective on Stochastic Programming,'' International Conference on Stochastc Programming, Buzios, Brazil, June 2016.
[12] Advanced Tutorial Lecture 'Conceptual v Computational Stochastic Programming: Perspectives as SP turns 60!' INFORMS Computing Society Conference, Richmond, VA, Jan. 2015.
[11] STOR-i Lectures 'Stochastic Programming" for EPSRC (U.K.) Program at University of Lancaster, Statistics and Operations Research.
[10] Featured Lecture 'Stochastic Mixed Integer Programming,' INFORMS Optimization Conference, Miami, Florida, February 2012.
[9] Plenary Lecture 'New Directions in Stochastic Decomposition,' Eleventh International Conference on Stochastic Programming, Vienna, Austria , August 2007.
[8] Opening Keynote Lecture 'Operations Research: The Glue for Infrastructure Systems,' Operations Research Society of India National Meeting, Bangalore, India, December 2005.
[7] Keynote Lecture 'Service Enterprise Engineering,' IEEE-Service Operations, Logistics and Transportation Conf. Beijing, China, August 11, 2005.
[6] Report on 'Structuring Cyberinfrastructure for the Engineering Directorate,' presented as Chair of the Engineering Cyberinfrastructure Working Group, August 2005.
[5] Distinguished Lecture at Penn State University, September 2004.
[4] Distinguished Lecture on 'The SPEED-CS Project,' Speed Scientific School, Univ. of Louisville, Nov. 2001.
[3] Plenary Lecture on 'Algorithmic Challenges in Stochastic Programming,' Ninth International Conference on Stochastic Programming, August 2001.
[2] Featured Lecture on 'Advances in Stochastic Programming,' Twenty-Fifth Dutch Operations Research Conference, January 2000. (This is a series of 3 lectures at the conference.)
[1] Semi-plenary Lecture on 'Stochastic Decomposition algorithms for stochastic linear programming,' International Conference on Operations Research, Berlin, 1994.

Research Tutorials (in Reverse Chronological Order)

[12] Tutorial on 'Coalescing Data and Decision Sciences for Analytics,' INFORMS, Phoenix, November 2018
[11] Tutorial on 'Stochsatic Mixed-Integer Programming,' INFORMS, Houston, October 2017
[10] Winter School on Stochastic Programming 2013: Lecture to 80 Ph.D. students in Europe, hosted in Tignes, France, April, 2013.
[9] Winter School on Stochastic Programming 2013: Lecture to 40 Ph.D. students in

Europe, hosted in Oppdal, Norway April, 2012.

[8] Master Class on Stochastic Programming: Series of 3 lectures to Ph.D. students in Northern England, hosted by the University of Lancaster, March 2012.

[7] Winter School on Stochastic Programming 2011: Lecture to about 80 Ph.D. Students in Europe, hosted in Norway by the Norwegian University of Science and Technology, March, 2011

[6] Tutorial on 'Stochastic Integer Programming,' INFORMS Conference, Maui, Hawaii, June 2001.

[5] Tutorial on 'Stochastic Integer Programming,' INFORMS Conference, Salt Lake City, UT, May 2000.

[4] Tutorial on 'Scenario Generation in Stochastic Programming,' INFORMS Conference, Cincinnati, OH, May 1999.

[3] Tutorial on 'Algorithms for Large Scale Stochastic Programming,' INFORMS Computer Science Technical Section Meeting, Monterey, CA, 1998.

[2] Tutorial on 'Algorithms for Stochastic Programming,' INFORMS (formerly ORSA/TIMS) Conference, New Orleans, 1995.

[1] Tutorial on 'Large Scale Optimization Under Uncertainty,' ORSA/TIMS Conference, Boston, 1994.

Lectures at Academic Institutions and Industry (These are unordered)

[1] 'Multiplexing considerations in network planning,' *Bell Communications Research*, May 1989.

[2] 'Stochastic Decomposition: A new algorithmic concept for stochastic programming,' March 1987, presented at:
- (a) *RPI*, Decision Sciences and Systems Engineering Dept.
- (b) *Penn State*, IE Dept.
- (c) *Bell Communications Research*.

[3] 'Primal-Dual methods in Lagrangian Relaxation,' *Martin Marietta Information and Communications Systems*, June 1987.

[4] 'Algorithms for the Unified Facilities Optimizer,' presented at:
- (a) *Purdue*, IE Dept., March 1988.
- (b) *Univ. of Ariz.* Elect. and Comp. Eng. Dept, Nov. 1989.

[5] 'Planning CIM Systems,' *Diversified Engineering*, October, 1989.

[6] 'Integrating Dynamic Routing in Link Sizing,' *Deutsche Bundespost*, Darmstadt, Germany, July 1991.

[7] 'Progress on Stochastic Decomposition Algorithms,' presented at:
- (a) *Stanford Optimization Laboratory*, Feb. 1989.
- (b) *Pacific Gas and Electric Co.*, March, 1989.
- (c) *Bell Communications Research*, April 1989.
- (d) *Southern Methodist University*, November 1989.
- (e) *Nat. Institute of Standards and Tech.*, November 1990
- (f) *Bell Communications Research*, March 1991.
- (g) Minisymposium at *Humboldt University*, Berlin, Germany, January 1994.
- (h) *University of British Columbia*, Vancouver, B.C, February 1994.
- (i) *Naval Postgraduate School*, Monterey, February, 1994.

(j) *The University at Buffalo*, April 2001.

[8] 'Activity Analysis Under Uncertainty,' presented at:
(a) *Systems Science Seminar, Arizona State University*, April, 1992.
(b) *Bell Communications Research*, May, 1992.
(c) *Daimler Benz*, Stuttgart, Germany, June 1992.
(d) *AT & T Bell Laboratories*, August 1992.
(e) *U.S. West Advanced Technologies*, December 1992.

[9] 'Computational considerations in the solution of large scale stochastic programs using Stochastic Decomposition algorithms,' presented at:
(a) 24th Optimization Conf. organized by *Charles University*, Prague, Czech., Sept. 1992.
(b) Conference on Large Scale Optimization, organized by *The University of Florida*, February 1993.
(c) *Pacific Gas and Electric Co.*, March, 1993.

[10] 'Verification of Optimality in Sampling-based Algorithms,' presented at
(a) Workshop at the *Intl. Inst. for Appl. Systems Analysis (IIASA)*, Laxenburg, Austria, July 1993.
(b) *Bell Communications Research*, May 1994.

[11] 'Multi-stage Stochastic Decomposition Algorithms,' presented at:
(a) *University of California, Davis*, March 1995.
(b) *Humboldt University, Berlin, Germany*, March 1996.

[12] 'Controlled Optimization of Phases (COP) at an Intersection,' presented at:
(a) *Univ. of Tennessee, Knoxville, TN,* Sept. 1995.
(b) *Univ. of Louisville, Louisville, KY,* Oct. 1995.
(c) *Charles University, Prague, Czech Rep.,* Feb. 1996.
(d) *University of Copenhagen, Denmark,* March, 1996.

[13] 'A Mean-Variance Approach in Advanced Traveller Information Systems,'
(a) *Cambridge University*, Cambridge, England

[14] 'On connections between stochastic programming, simulation optimization and design optimization,' *NASA Langley*, Hampton, VA, July 1998.

[15] 'A Scenario Generation Algorithm for Stochastic Programming,' presented at:
(a) *University of Florida*, February 1999.
(b) *University of British Columbia*, March 1999.
(c) *Texas A & M University*, April 1999.
(d) *University of Oslo, Norway*, March 2001.

[16] 'Qualitative Implications of Uncertainty in Economic Equilibrium Models,'
(a) *Univ. of Copenhagen*, November 1998.
(b) *Univ. of California, Riverside*, May 1999.
(c) *Electric Power Research Inst.*, July 1999.

[17] 'The SPEED-CS Project'
(a) *Univ. of Louisville*, November 2001.
(b) *NSF Workshop, University of Texas*, March 2002.

[18] 'Algorithmic Challenges in Stochastic Programming'
(a) *Arizona State University*, February 2002.
(b) *Penn State University*, February 2002.
(c) *Georgia Tech.*, April 2002.

[19] 'The Scenario Generation Algorithm for Multi-stage SLP'
(a) *Johns Hopkins University*, October 2002.
(b) *CGDO Conference*, Blacksburg, August, 2005.
[20] 'Research Trails in Operations Research,'
(a) *National Science Foundation*, February 2003.
(b) *Brunel University*, March 2003.
[21] 'Two stage SMIP with Continuous First-Stage Variables in Both Stages,' Econometrics Department, University of Groningen, Netherlands, May 2004.
[22] 'Stochastic Mixed-Integer Programming,'
(a) IE Symposium, University of Wisconsin, Madison, April 2006.
(b) OR Colloquium, Carnegie Mellon University, February, 2009
(c) OR-Ohio Tutorials, May 2009
[23] `Non-negative start-up prices and uniqueness of shadow prices in the presence of indivisibilities,"
(a) MURI Workshop, University of Arizona, Tucson, AZ, March 2008.
(b) University of Cincinnati, Cincinnati, OH, .May 2008
(c) Sabanci University, Istanbul, Turkey, July 2008
[24] 'Mixed-Integer Programming in Natural Language Processing'
(a) University of Arizona (December 2008)
(b) Arizona State University (January 2009)
(c) University of Pittsburgh (February, 2009)
[25] 'Overview of Stochastic Mixed-Integer Programming,' Banff International Research Station (BIRS), Banff, Canada, 2009, Univ. of Miami, February 2010, University of Texas, El-Paso, April 2011.
[26] 'Multi-stage Stochastic Decomposition and connections to Dynamic Programming,' Princeton University, April 2010.
[27] 'Does Moore's Law Apply to Stochastic Programming', USC, May 2014.
[28] 'Learning Enabled Optimization,' University of Arizona (September 2016), Oklahoma State University (March, 2017), Texas A&M University (October 2017), George Washington Univ. (Sept. 2018), Johns Hopkins Univ (Oct. 2018), VCU (2018), George Mason (Oct. 2018), Univ. of Bergen (Oct. 2018), ASU (March 2019), Uber (May 2019)
[29] 'Stochastic Decomposition Revival,' Univ. of Arizona (Sept. 2018) Univ. of Maryland (Oct. 2018), Univ. of California – Davis (March 2019)
[30] `Stochastic Hierarchical Planning: A Win-Win Paradigm for Power System Operations,' Univ. of Michigan, (Oct. 2019)
[31] `Stochastic Facility Location,' Amazon, (Dec. 2019)
[32] (COVID Period Lcetures). Three Decades of Stochastic Decomposition, SUNY-Stonybrook, Nov. 2020

(D) Invited Conference Presentations (Last Five Years)
(Approx. 4 – 5 invited presentations a year over the career)

[1] S. Sen and Y. Qi, "Ancestral Benders' Cuts and Multi-term Disjunctions for Mixed Integer Recourse Decisions in Stochastic Programming," International Conference on Stochastic Programming, Bergamo, Italy, July 2013.

[2] S. Sen, "Stochastic Dynamic Decision Simulation," INFORMS Applied Probability Conference, San Juan, Costa Rica, July 2013

[3] H. Gangammanavar and S. Sen and V. Zavala, "Simulation and Optimization of Wind Energy for Sub-hourly Economic Dispatch" INFORMS Annual Conference, Minneapolis, October 2013

[4] S. Sen and Y. Liu, "Proprocessing Stochastic Mixed-Integer Programs using Stochastic Decomposition," INFORMS Annual Conference, Minneapolis, October 2013

[6] S. Atakan, G. Lulli and S. Sen, "Improved Formulations for the Unit Commitment Problem," INFORMS Annual Conference, San Francisco, Nov. 2014

[7] H. Gangammanavar and S. Sen, "Multiple Timescale Stochastic Optimization for Integrating Renewable Recources," INFORMS Annual Conference, San Francisco, Nov. 2014.

[8] H. Gangammanavar and S. Sen, "Simulation and Optimization of Wind Energy for Sub-hourly Economic Dispatch," INFORMS Annual Conference, San Francisco, Nov. 2014.

[9] H. Gangammanavar, and S. Sen, "Economic Dispatch using Stochastic Decomposition," Energy Modeling workshop, Univ. of California – Davis, November, 2014.

[10] S. Sen, and Y. Liu "Mitigating Uncertainty via Compromise Decisions in Stochastic Linear Programming," invited speaker, IFORS, Barcelona, Spain, July 2014, and also at INFORMS Annual Conference, Nov. 2014.

[11] S. Sen, " Is there further evidence of Moore's Law for Algorithms/Software" Lecture at ISE Department, Ohio State University March 2014.

[12] S. Sen, "Conceptual v Computational Stochastic Programming: Perspectives as SP turns 60!" INFORMS Computing Society Conference, Richmond, VA, Jan. 2015 (https://sites.google.com/site/2015icsconference/home/plenary-speakers)

[13] S. Atakan, and S. Sen, "Progressive Hedging for Stochastic Mixed-Integer Programming," International Symposium on Mathematical Programming, Pittsburgh, PA, July 2015

[14] S. Sen "On the Role of Regularization in Stochastic Programming," iSIM Workshop, Purdue University, July 2015 (Also presented at the USC Workshop in October, 2015)

[15] H. Gangammanavar and S. Sen, "Time-staged Stochastic Decomposition, and Applications in Energy Planning" International Symposium on Mathematical Programming, Pittsburgh, PA, July 2015

[16] H. Gangammanavar and S. Sen, "Multistage Stochastic Optimization with Application in Energy Storage Control" INFORMS Annual Conference, Philadelphia, PA Nov. 2015.

[16] S. Atakan and S. Sen, "Decomposition Framework for Stochastic Mixed-Integer Programming Algorithms" INFORMS Annual Conference, Philadelphia, PA. Nov. 2015

[17] S. Atakan and S. Sen, "Decomposition for Two-stage Unit Commitment Models" INFORMS Optimization Conference, Princeton University, March 2016.

[18] H. Gangammanvar and S. Sen, "Stochastic Dynamic Linear Programming" INFORMS Optimization Conference, Princeton University, March 2016.

[19] S. Sen, "Are Stochastic Programs Solvable? Retrospective on Stochastic Programming,'' International Conference on Stochastc Programming, Buzios, Brazil, June 2016.
[20] S. Sen, "Big Data and Big Decisions" INFORMS Annual Conference, Nashville, TN, Nov. 2016
[21] H. Gangammanavar and S. Sen, "Impact of Wind Models on Economic Dispatch," WINDFARMS2017, Madrid, Spain, May 2017.
[22] S. Sen, Session on "Learning Enabled Optimization", International Conference on Stochastic Programming, Trondheim, Norway, 2019.

Grants and Contracts (S. Sen is the lead PI unless otherwise stated)

I have served as the lead PI for grants totaling approximately $9.1 million. While most of the funds are from federal agencies, some industrial grants were also obtained. Internal grants from the university are not listed below.

Completed Externally Funded Projects

Bell Communications Research
Project: Intra-LATA network design with multiplexing considerations
Duration: Jan. 1984 - Dec. 1985 ($75,000); Summer 1986.
Responsibility: 100%

AT&T
Distributed Algorithms ($27,000 from AT&T).
Responsibility: 100%
Manufacturing Laboratory Development (Co-PI: R. Askin, $26,000 from AT&T).
Responsibility: 50%

Bell Communications Research
Project: Unified Facilities Optimizer.
Duration: September 1986 - May 1989 ($126,000).
Responsibility: 100%

U.S. West
Project: Network Planning under Uncertainty
Duration: June 1991-August 1992 ($17,200)
Responsibility: 60%

Arizona Department of Transportation
Project: RHODES for Real-Time Tra±c Control (PI: P. Mirchandani)
Involvement: May 1991-Feb 1992.
Responsibility: 15% of $200,000.

National Science Foundation

Project: Mathematical Programming Under Uncertainty: Risk and Recourse Revisited. (Co-PI: J.L. Higle)
Duration: October 1991 - September 1994 ($245,000).
Responsibility: 50%

NATO
Project: Cellular Decomposition (Co-PI's: J.L. Higle and S.W. Wallace)
Duration: January 1993 - August 1994 ($4,000)
Responsibility: 33%

National Science Foundation
Project: Research Experience for Undergraduates. This grant is intended to supplement an earlier NSF grant.
Duration: December 1992 - August 1994 ($5,000).
Responsibility: 100%

Federal Highway Administration
Project: Real-Time Traffic Control (PI: P. Mirchandani)
Duration: June 1994 - December 1995
Responsibility: 15% of $375,000

National Science Foundation
Project: Integrated Planning Under Uncertainty: Statistical Methods in Mathematical Programming. (Co-PI: J.L. Higle)
Duration: November 1994 - October 1997 ($301,921).
Responsibility: 50%

National Science Foundation
Project: Tutorials on Stochastic Optimization.
Duration: July 1995 - July 1996 ($20,000).
Responsibility: 50%

Department of Education
Project: Graduate Assistance in Areas of National Need (GAANN, PI: P. Mirchandani)
Duration: September 1995 - July 2000 ($500,000).
Responsibility: 20%

National Science Foundation
Project: ELITE: Engineering with Liberal and Technical Education. (Co-PIs: W.R. Ferrell, J.B. Goldberg, J.L. Higle)
Duration: June 1996 - June 2001 ($700,000).
Responsibility: 40%

National Science Foundation
Project: SPEED-CS: A Simulation Platform for Experimetation and Evaluation of

Distributed-Computing Systems. (Co-PIs: F. Ciarallo, H. Sarjoughian, R. Schlichting and B. Zeigler)
Duration: August 1999 - July 2003 ($1 million).
Responsibility: 55%

National Science Foundation
Project: Performance Models with Data Evolution (Co-PI: J.L. Higle)
Duration: August 1999 - July 2002 ($416,000).
Responsibility: 50%

Lockheed Martin
Project: Network Design and Simulation (Co-PI: J.C. Smith)
Duration: December 2000 - December 2001 ($10,000).
Responsibility: 50%

Air Force Office of Scientific Research
Project: MURI for Human Decision Making (PI: J.C. Smith, 2003-2005), (PI: S. Sen, 2005 - 2008)
Duration: August 2003 - August 2008 ($4,200,000).
Responsibility: 20%

Air Force Office of Scientific Research
Project: Decomposition Algorithms for Very Large Scale Stochastic Integer Programs
Duration: May 2007 - December 2007 ($75,000).
Responsibility: 100%

National Science Foundation
Project: Workshop for Cyber-Enabled Discovery
Duration: Nov. 2007 – June 2008 ($10,000).
Responsibility: 100%

Honda of America Manufacturing
Project: Dashboard for Intelligent Collaborative Engineering
Duration: January 2008 - December 2008 ($152,000), includes $30,000 matching from Honda-OSU Partnership.
Responsibility: 100%
Contination: September 2009 – August 2010 ($110,000).

Public Utility Commission of Ohio
Project: Impact of Advanced Metering on demand and prices
Duration: June 2008 - May 2010 ($125,000).
Responsibility: 100%

Air Force Office of Scientific Research

Project: Models and Algorithms involving Very Large Scale Stochastic Integer Programs
Duration: February 2008 - December 2010 ($421,000).
Responsibility: 100%

DARPA-AT&T (CORONET Project)
Project: Stochastic Network Design (Subcontract from AT&T)
Duration: January 2008 - July 2011 ($68,000 – Phase II).
Responsibility: 100%

Air Force Office of Scientific Research
Project: Dynamic Stochastic Mixed-Integer Programming
Duration: February 2012 - 2013 ($110,000).
Responsibility: 100%

National Science Foundation
Project: Stochastic Multi-scale Optimization for Energy Resource Planning
Duration: July 2009 - June 2013 ($245,999).
Responsibility: 100%

National Science Foundation
Project: Stochastic mixed-integer optimization: Polyhedral theory, large-scale algorithms and computations (Co-PI: S. Küçükyavuz)
Duration: July 2011 - June 2014 ($230,000).
Responsibility: 50%

National Science Foundation
Project: OR as a Catalyst for NAE Grand Challenges
Duration: August 2012 - July 2013 ($25,000).
Responsibility: 100%

Air Force Office of Scientific Research
Project: Dynamic Stochastic Mixed-Integer Programming
Duration: February 2013- Dec. 2014 ($310,000).
Responsibility: 100%

National Science Foundation
Project: Stochastic Nash Equilibrium Problems
Duration: August 2015 - July 2018 ($300,000).
PI: Jong-Shi Pang
Responsibility: 50%

National Science Foundation
Project: Stochastic Unit Commitment with Topology Control Recourse for Networks with High Penetration of Distributed Renewable Resources
Duration: August 2015 – July 2017 ($150,000).

Responsibility: 100%

Air Force Office of Scientific Research
Project: Statistical Optimality and Algorithms for Resilience
Duration: August 2015- Dec. 2018 ($450,000).
Responsibility: 100%

Current Funded Projects

National Science Foundation
Project: EAGER (Computational Operations Research Exchange). Co-PI: Carl Kesselman
Duration: Apr. 2018 – Apr. 2021 ($350,000).
Responsibility: 50%

Air Force Office of Scientific Research
Project: Predictive Stochastic Programming
Duration: Oct. 1, 2019 – Sept. 30, 2022 ($491, 544).
Responsibility: 100%

Office of Naval Research
Project: Oracle-Driven Stochastic Integer Programming
Duration: Oct. 1, 2019 – Sept. 30, 2022 ($416,238).
Responsibility: 100%

Consulting and Software

Consultant to *AT&T, Bellcore, Diversified Engineering Inc., Frontline Systems, Honda, Modular Mining*, *Pinnacle West Capital Corporation, Public Utility Commission of Ohio*, *U.S. West Communications*, *United Airlines*.

Teaching

List of Courses (USC)

Graduate Courses (Book used in parenthesis)
(1) Foundations of Optimization (Bazaara, Sherali and Shetty, Boyd and Vandenberghe, Bertsekas, Nedic, Ozdaglar)
(2) Linear Optimization (Bertsimas and Tsitsiklis)
(3) Numerical Optimization (Nocedal and Wright)
(4) Stochastic Programming (Notes)
(5) Integrative Analytics (Notes)

Undergraduate Courses (USC)
(1) Deterministic Operations Research (Hillier and Lieberman, 10th Edition)

List of Courses (Ohio State)

Undergraduate Courses (Book used in parenthesis)
(1) Integrated Systems Engineering (Scheinerman).

Graduate Courses (Book used in parenthesis)
(2) Linear Programming (Bertsimas)
(3) Foundations of Optimization (Bazaara, Sherali and Shetty)
(4) Nonlinear Programming Algorithms (Bertsekas)
(5) Stochastic Programming (Notes).

List of Courses (Arizona)

Undergraduate Courses (Book used in parenthesis)
(1) Computer Methods for Engineering (Yakowitz/Szidarovszky).
(2) Deterministic Operations Research (Winston).
(3) A Survey of Optimization Methods (Winston).
(4) Concepts in Communications Systems (Kurose/Ross, Bertsekas/Gallagher).
(5) Dynamical Systems Modeling (Scheinerman)

Graduate Courses (Book used in parenthesis)
(1) Linear Programming (Bertsimas)
(2) Foundations of Optimization (Bazaara, Sherali and Shetty)
(3) Nonlinear Programming Algorithms (Bertsekas)
(4) Distributed Algorithms (Lynch)
(5) Topics in Optimization (Boyd and Vandenberghe)
(6) Large Scale Optimization (Notes).

Contributions to University Teaching (Arizona)
(1) Applied Mathematics Brown Bag Lunch, 1990, 1994.
(2) ATRP Brown Bag Lunch, 1991.
(3) Applied Mathematics Case Studies Seminar, 1991, 1994, 1998.
(4) MIS Seminar, 1999.
(5) Statistics Seminar, 2002

Undergraduate Research Supervision
[1] J. Mai (funded thru NSF grant) 'Implementation of Stochastic Decomposition algorithms' (Sept. 1991 - 1993)
[2] C. Tomkins (ELITE student) 'Water Resources Case Study' (May 2001)

Graduate Research Supervision
My research program has involved a number of graduate students. As a measure of the quality of my students, it may be noted that several of my students (Sonia Vohnout, Jason Mai and Claire Tomkins) have been awarded NSF Graduate Fellowships. In addition, two students have been funded by European Governments to conduct graduate research under

my supervision at Arizona.

Supervision of Exchange Students

[1] T.S. Sund (funded by Norwegian Govt.) (1993-94).
[2] G. Lulli (funded by Italian Govt.) (2001-2002).

M.S. Theses and Reports

[1] D.S. Yakowitz, 'Subgradient optimization methods for capacity expansion planning,' December 1983. (proceeded to finish a Ph.D at UA).
[2] A. Whiteson, 'A cone splitting algorithm for reverse convex programming,' July 1985. (proceeded to join Sandia Labs.)
[3] S. Bradley, `Multiplexing considerations in the design of intra-LATA networks,' August 1985. (proceeded to join AT&T Bell Labs.)
[4] F. Burstrom, 'Approximate methods for large scale fixed charge network flow problems,' August 1985. (proceeded to join AT&T Bell Labs)
[5] M.S. Dunatunga, `Successive two segment separable programming for large scale nonlinear minimax optimization,' December 1985. (proceeded to finish a Ph.D at UA)
[6] J. Gunn, 'Stochastic Decomposition,' May 1986. (proceeded to join Hughes)
[7] D. Rushall, 'Heuristics for 3-Dimensional Collision Avoidance,' May 1989. (proceeded to join General Dynamics)
[8] S.I. Vohnout, 'Heuristics for diverse routing in telecommunications networks,' May 1990. (proceeded to join IBM)
[9] L. Murthy, 'A Multiplexing and Cable Sizing Model for Tree Networks,' (June 1993). (employed with a software firm in Seattle)
[10] G. Cameron, 'A stochastic programming approach to network planning,' (Co-directed with J.L. Higle), December 1993.
[11] J. Mai (M.S.) 'Cellular Decomposition,' 1994. (joined Microsoft)
[12] R. Balasubramaniam (M.S.) 'Statistical Tests of Optimality for Stochastic Linear Programming,' 1996. (joined U.S. Air)
[13] I. Hapugoda (M.S.) 'Dynamic Interactive Planning and Simulation,' (2002).

Ph.D. Dissertations

[1] A. Rakshit (Ph.D) 'A Framework For Discrete-Time Dynamic Programming with Multiple Objectives,' October 1988. (Co-directed with L.D. Duckstein). United Airlines.
[2] M.S. Dunatunga, (Ph.D) 'Stagewise methods for nondifferentiable dynamic optimization problems,' May 1990. (joined *Univ. of Arizona*)
[3] D.S. Yakowitz, (Ph.D) 'Stochastic Decomposition for Some Nonlinear Stochastic Programs,' Dec. 1990, (Co-directed with J.L. Higle). (joined U.S. Geological Service)
[4] M.S. Sodhi, (Ph.D.) 'Hierarchical Methods for Manufacturing Systems Design,' Feb.1991. (Co-directed with Ron Askin. Was Dept. Chair, *Univ. of Rhode Island*)

[5] K.T. Au, (Ph.D.) 'Inexact Subgradient Methods,' March 1992, (joined Reliant Energy)
[6] J. Wu (Ph.D) 'A Sampling Based Stochastic Programming Algorithm and Its Application to Currency Option Hedging,' October 1996. (joined Fannie Mae)
[7] S. Shelby (Ph.D) 'Distributed Traffic Control,' December 2001. (joined Gardner Transportation Systems)
[8] G. Lulli (Ph.D) (Univ. of Rome), (S. Sen is the technical advisor.) (December 2002) *Lancaster Univ*. England, Senior Lecturer
[9] T. Genc (Ph.D, Economics) 'Economics of Restructuring in Electricity Markets,' (co-advised by S. Reynolds), December 2003. at *Univ. of Guelph, Canada,*, Full Professor.
[10] L. Yu (Ph.D) 'Stochastic Optimization in Competitive Markets,' May 2004. (joined PPL Inc.)
[11] N. Lewis (Ph.D) 'Stochastic Combinatorial Optimization,' July 2004. *Texas A&M,* Full Professor
[12] Y. Xu (Ph.D) 'Distributed Systems Simulation,' August 2005. *University of California*
[13] Y. Yang (Ph.D) 'Algorithms for Very Large Scale Stochastic Combinatorial Optimization,' March 2010, Vice President, J.P. Morgan-Chase, North Carolina
[14] Z. Zhou (Ph.D) 'Multi-stage Stochastic Decomposition Algorithms' (May 2012)
[15] B.Y. Chen (Ph.D) 'Cutting Plane Trees and Extensions,' (May 2011, joined Cisco).
[16] Y. Qi (Ph.D) 'Stochastic Mixed-Integer Programming,' (August 2012, at Alibaba).
[17] D. Gade (Ph.D) 'Algorithms and Reformulations for Large Scale Integer and Stochastic Integer Programs," (Co-advised by S. Kucukyavuz. August 2012, Saber Technologies).
[18] H. Gangammannavar (Ph.D) 'Multi Time-scale Stochastic Optimization with Application to Integrating Renewable Resources into the Power Grid' (August 2013, *Southern Methodist University*, Assistant Professor.
[19] AVS. Praneeth (Ph.D) 'Prices in Wholesale Electricity Markets and Demand Response' January 2014, Edison Mission Energy.
[20] Y. Liu (Ph.D) "Statistical Aspects of Stochastic Decomposition," At 85.41, a Data Science subsidiary of Kroger.
[21] S. Atakan (Ph.D) "Advances in Stochastic Mixed-Integer Programming with Applications in Power Systems Planning," May 2018. OR Analyst at Amazon
[22] Y. Deng (Ph.D.) "Learning Enabled Optimization and Applications", May 2019, joined Google in December, 2018.
[23] J. Liu (Ph.D.) "The Fusion of Predictive and Prescriptive Analytics via Stochastic Programming" June 2019.
[24] S. Diao (Current Ph.D. Student) "Non-parametric Learning Enabled Optimization and Applications" (ongoing)
[25] J. Xu (Current Ph.D. Student) "Deep Learning with Stochastic Optimization" (ongoing)
[26] D. Zhang (Current Ph.D. Student) "Beyond First-order Methods in Machine Learning"

Post-doctoral/Visiting Scholar Supervision

[1] B. Rayco (Ph.D in ISE, Univ. of Florida), “Stochastic Scenario Decomposition," (1997-98). Currently at Modular Mining Systems.
[2] M. Casey (Ph.D in Math. Univ. of California-Davis), “Scenario Generation Algorithms," (2001-2002). Currently at Raytheon.
[3] J. Desai (Ph.D. in ISE, Virginia Tech.), “Survivable Network Design," (2005-2006). Currently at National University of Singapore
[4] K. Huang (Ph.D. in ISyE, Georgia Tech. “Re-sampling in Stochastic Programming," (2005-2006). Currently at McMaster University
[5] K. Shugang (Ph.D. in IE, Hong Kong University), “Dashboard for Intelligent Collaborative Engineering,” (2007-2012).