SHUOTAO DIAO

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EDUCATION

University of Southern California, Los Angeles, CA *August 2016 - August 2022*
Ph.D. in Industrial and Systems Engineering *GPA: 3.97/4.00*

- **Honor:** Provost PhD Fellowship
- **Dissertation:** On the Interplay between Stochastic Programming, Non-parametric Statistics, and Nonconvex Optimization
- **Advisor:** Dr. Suvrajeet Sen
- **Dissertation Committee:** Dr. John Carlsson, Dr. Phebe Vayanos, Dr. Rahul Jain

University of Southern California, Los Angeles, CA *June 2017 - May 2021*
M.S. in Computer Science *GPA: 4.00/4.00*

Lehigh University, Bethlehem, PA *August 2014 - May 2016*
M.S. in Statistics *GPA: 3.96/4.00*

Shandong University, Jinan, Shandong, China *September 2010 - June 2014*
B.S. in Physics *GPA: 90.47/100.00*

WORK EXPERIENCE

Postdoctoral Scholar, Northwestern University *March 2023 - Present*

- **Advisor:** Dr. David P. Morton
- Use SEIR compartmental model and optimization methods to detect and mitigate future surges of the pandemic.
- Study graph clustering problems and design column generation algorithms with heuristics.
- Study multistage stochastic program with infinite horizons and design associated cutting plane algorithms.

Research Scientist Intern, Amazon.com *May 2020 - August 2020*

- Cooperated with Reverse Logistics (RL) team to design a Mixed Integer Programming (MIP) model to optimize capacity plan on RL related screening activities.
- Implemented the capacity planning model by using Xpress Mosel programming language and launched the software package on the internal online platform.
- Built an analysis tool to analyze the qualities of the input data and output solutions for internal use.
- Provided with a return offer based on the outstanding performance during the internship.

RESEARCH DISSEMINATION

Peer Reviewed Journals

- Diao, Shuotao, and Suvrajeet Sen. "Distribution-free algorithms for predictive stochastic programming in the presence of streaming data." Computational Optimization and Applications 87.2 (2024): 355-395.
- Eisenberg, Bennett, and Shuotao Diao. "Properties of the Kelly bets for pairs of binary wagers." Statistics & probability letters 125 (2017): 215-219.

Under Review at Peer Reviewed Journals

- Diao, Shuotao, and Suvrajeet Sen. "A Reliability Theory of Compromise Decisions for Large-Scale Stochastic Programs", arXiv preprint arXiv:2405.10414 (2024). (Link to the paper)
  - Submitted to Mathematical Programming on May 15, 2024

Peer Reviewed Conferences

- Proceedings of INFORMS Optimization Society Conference *Houston, TX, March 2024*
"A Unifying Theory for Improving Reliability of Stochastic Programming Solutions using Compromise Decisions", with Suvrajeet Sen. (Link to the paper)

Non-Peer Reviewed Conference Presentations

• INFORMS Annual Meeting *Phoenix, AZ, October 2023*
"Comparisons Between Bagging And Compromise Decisions", with Suvrajeet Sen.
• International Conference on Stochastic Programming XVI *Davis, CA, July 2023*
"Non-parametric Stochastic Decomposition for Predictive Stochastic Programming in the Presence of Streaming Data", with Suvrajeet Sen.
• INFORMS Annual Meeting *Anaheim, CA, October 2021*
"Non-parametric Stochastic Decomposition for Two-stage Predictive Stochastic Programming", with Suvrajeet Sen.
• INFORMS Annual Meeting *Seattle, WA, October 2019*
"Non-parametric Stochastic Quasi-gradient method in Stochastic Programming", with Suvrajeet Sen.
• International Conference on Stochastic Programming XV *Trondheim, Norway, August 2019*
"Learning Enabled Optimization with Non-parametric Estimation", with Suvrajeet Sen.
• INFORMS Annual Meeting *Phoenix, AZ, November 2018*
"Stochastic Algorithms for Conditional Stochastic Optimization", with Suvrajeet Sen.

Pre-Print Papers

• Diao, Shuotao, and Suvrajeet Sen. "Online Non-parametric Estimation for Nonconvex Stochastic Decomposition with Majorization-Minimization" (Link to the paper) *2022*

RESEARCH EXPERIENCE

Design of Staged Alert System with a Wastewater Signal (Postdoc) *2023 - Present*

• Incorporated daily viral load as a state variable into the SEIR compartmental model to study the correlation between wastewater signal and hospital census.
• Designed a wastewater-based risk awareness tool for the staged alert system.

Finding All Pareto Optimal Solutions to a Graph Clustering Problem (Postdoc) *2023 - Present*

• Use matroid and totally dual integrality to understand the pattern of the Pareto optimal solutions to the graph clustering problem.
• Designed heuristic cuts and regularization in the column generation method to reduce the upper bound of the optimal cost.

A Reliability Theory of Compromise Decisions for Large-Scale Stochastic Programs *2023 - 2024*

• Adopted a stochastic programming variance reduction framework known as "compromise decision".
• Studied the reliability of the stochastic programming solutions from the "compromise decision" process.
• Used Rademacher average of instances to bound the sample complexity of the compromise decision.

Online Non-parametric Estimation for Nonconvex Stochastic Decomposition with Majorization-Minimization *2022*

• Designed a fusion of k nearest neighbors (k-NN) estimation, Stochastic Decomposition (SD) algorithm, and Majorization-Minimization (MM) algorithm to solve a class of two-stage stochastic programs where the first-stage objective is a difference-of-convex function and second-stage objective is the minimum of a linear program.

Learning Enabled Optimization with Non-parametric Approximation *2016 - 2022*

• Merged concepts of stochastic programming and non-parametric statistical learning (e.g., k-NN estimation and kernel estimation).
• Designed a first-order method using non-parametric stochastic quasi-gradients to solve a predictive stochastic programming problem.
• "Predictive" means that the objective function is a conditional expectation of the random cost function with respect to the observed predictor.
• Designed a non-parametric extension of Stochastic Decomposition algorithm to solve two-stage predictive stochastic linear programming and two-stage predictive stochastic quadratic programming problems.

A Unifying View on Decomposition Based Methods for MSLP *2020 - 2021*

• Studied the sample complexity of Dynamic Programming (DP) formulation of MSLP based on the concept of uniform normalized convergence.

• Made connections among various versions of Stochastic Dual Dynamic Programming (SDDP) and Stochastic Dynamic Linear Programming (SDLP).
• Showed that SDDP with a proximal mapping in the root node of the scenario tree can produce an optimal solution in a finite number of iterations with probability one.

PROJECTS

Non-parametric Stochastic Decomposition Solver *May 2021 - Sep 2023*

• Implemented SD-kNN, SD-kNN-Batch and SD-kNN-QQ algorithms in C++. CPLEX solver, as a base solver, is used to compute Lagrange multipliers and solve quadratic programming problems (e.g., proximal mapping process). Link to the codes.

Learning Embedded Stochastic Approximation *August 2020 - December 2020*

• Built a deep neural network to learn the value function in two-stage stochastic linear programming problems.
• Used model-agnostic meta-learning (MAML) model to meta learn the value function.

LEONA Solver *June 2019 - April 2021*

• Implemented LEON algorithm in C++. CPLEX solver, as a base solver, is used to provide Lagrange multipliers for non-parametric stochastic quasi-gradient calculation. Link to the codes.
• Designed the data file, model file and stochastic file in XML format.

A Contest fORged by Amazon Web Services and cORe *October 2019*

• Modeled inventory management problem by a predictive two-stage stochastic linear programming, where the random quantities are modeled by a time series.

SKILLS

Languages	C++, Python, C, Java, Matlab, SQL, Xpress Mosel
Software & Tools	CPLEX, Gurobi, AMPL, SCiPy, Numpy, Pandas, Sklearn, PyTorch, TensorFlow, Latex

PROFESSIONAL SERVICE

Referee for INFORMS Journal on Computing *2024*
Referee for Operations Research *2023*
Referee for INFORMS Journal on Optimization *2022*
Referee for SIAM J. of Optimization *2021*

TEACHING EXPERIENCE

Lecturer

• IEMS 351 Optimization Methods in Data Science at Northwestern University *Fall 2024*

Lecture (ISE 638 Stochastic Optimization, USC) *Spring 2022*

• Held an 80-minute lecture for an introduction to first-order stochastic programming algorithms and proof of almost sure convergence of Stochastic Approximation algorithm.

Lecture (ISE 330 Introduction to Operations Research: Deterministic Models, USC) *Fall 2019*

• Held four 80-minute lectures for the review on linear algebra, an introduction to AMPL, an introduction to simplex algorithm, and an introduction to Dijkstra's Algorithm.

OTHER EXPERIENCE

WBE Seminar Series *March 2024*

• "Design of a Staged Alert System with a Wastewater Signal" with Guyi Chen and David P. Morton.

Teaching Assistant *2018 - 2022*

• Undergraduate Courses: ISE 225 Engineering Statistics I, ISE 220 Probability Concepts in Engineering, ISE 330 Introductions to Operations Research: Deterministic Models
• Graduate Courses: ISE 630 Foundations of Optimization

• Gained gratitude from the instructors for helping them organize the coursework and grade the homework and exams.
• Good at answering the questions from the students by considering their personal specific needs and backgrounds.

Research Assistant *2018 - 2022*

• Designed algorithms to merge stochastic programming algorithms and non-parametric statistical estimation.
• Designed stochastic programming algorithms for solving nonconvex stochastic programming problems.

INFORMS Doctoral Student Colloquium *October 2017*

• Invited to attend doctoral student colloquium and shared personal experience in PhD education with peers.