

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 model and optimization methods to detect and mitigate future surges of a pandemic and flu.
- 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 a capacity planning model using Xpress Mosel programming language and launched the software package on an internal online platform.
- Built an analysis tool to analyze the quality of the input data and output solutions for internal use.
- Provided with a return offer based on 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 aagging 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 theory and total 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 a 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*, *Operations Research*, *INFORMS Journal on Optimization*, and *SIAM J. of Optimization*.

TEACHING EXPERIENCE

Lecture (IEMS 351 Optimization Methods in Data Science, Northwestern)

Fall 2024

- Serving as an instructor.
- Holding 50-minute lectures three times a week.
- Designing courses and projects, grading assignments and exams, and holding office hours.
- Managing a teaching assistant.

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

Hosted by the Discovery Partners Institute of the University of Illinois System

- "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 Ph.D. education with peers.