Rahul Swamy, Ph.D.

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[Google Scholar](https://scholar.google.com/citations?user=skboI2kAAAAJ&hl=en) | [LinkedIn](http://www.linkedin.com/in/swamyrahul/) | [GitHub](http://github.com/rahul-swamy)

**Operations Research and Data Science Professional**

Expert in developing machine learning and mathematical optimization algorithms, with 8+ years of research experience and 4 years of industry practice. Skilled in designing creative, reusable, and scalable architectures.

**Summary of Work Experience**

* **Senior Data Scientist,** Walmart Centroid, New York, NY Oct 2023 – present (1 yr 5 mos)
* **Data Scientist,** Gurobi Optimization, Chicago, IL June 2022 – Aug 2023 (1 yr 3 mos)
* **Research Assistant,** University of Illinois at Urbana-Champaign, IL July 2016 – May 2022 (6 yrs)
* **Data Science Fellow**, Atlanta Data Science for Social Good, Atlanta, GA June 2015 – Aug 2015 (3 mos)
* **Optimization Analyst**, KPMG India, Business Consulting, Mumbai, India June 2013 – May 2014 (1 yr)

**Education**

* Ph.D. Operations Research, University of Illinois at Urbana-Champaign; GPA: 3.95/4 2023
* M.S. Operations Research, State University of New York at Buffalo; GPA: 3.89/4 2016
* B.Tech. Engineering Physics, Indian Institute of Technology Madras 2013

**Skills**

* **Analytics:** Reinforcement Learning, Machine Learning, Integer Programming, Graph Algorithms, Graph Neural Networks, Large Language Models, Recommendation Systems, A/B Testing
* **Programming languages:** Python (advanced), SQL (advanced), C++, R, MATLAB
* **Tools:** Google Cloud Platform, MongoDB, Tableau, DBeaver, Gurobi, CPLEX, Xpress Solver, OpenAI API
* **Libraries**: Gym, PyTorch, Pandas, TensorFlow, Seaborn, SciPy, Pyspark, Keras, Statsmodels, LightFm

**Relevant Projects**

* **Senior Data Scientist,** Walmart Centroid Oct 2023 – present

Network Optimization Data Science | Python, SQL, C++, Gurobi

* + Developed an **optimization** and **reinforcement learning** pipeline to reduce Walmart's transportation cost-to-serve through cost-optimal routing, staffing, and scheduling
  + Independently owned the yard space optimization workstream to initiate and develop an ML-based **simulation engine** to predict the future space needed for freight trucks at distribution centers
  + Interfaced with business partners, engineering, and finance teams to fine-tune prescriptive models within operational and business constraints, unlocking **6% savings** over 20 years
  + Formulated an optimization model to internalize freight from third parties, resulting in a **9%** reduction in cost-per-case-shipped
  + Engineered an **LLM chatbot** for stakeholders to interact with optimization outputs, thereby improving the explainability, interpretability and adaptability of the results
* **Data Scientist**, Gurobi Optimization June 2022 – Aug 2023

Integrating machine learning and optimization at Gurobi | Python, Gurobi, Sklearn

* Designed novel data science pipelines that integrate ML and mathematical optimization such as,
* **revenue optimization** with demand-elasticity via regression and quadratic program ([Link](https://www.gurobi.com/jupyter_models/avocado-price-optimization/))
* **recommendation system** with collaborative filtering and integer programming ([Link](https://www.gurobi.com/jupyter_models/diverse-music-recommendation-system/))
* **detecting text similarity** using linear programming ([Link](https://www.gurobi.com/jupyter_models/text-dissimilarity-using-linear-programming/))
* Contributed to **product development**: new tools that integrate ML functionalities into Gurobi such as modeling with Pandas integration, and regression functions as optimization inputs
* **Research Assistant**, University of Illinois at Urbana-Champaign July 2016 – May 2022

Multi-criteria optimization framework for fair political redistricting| Python, CPLEX, Gurobi

* + Formulated a **multi-objective** mixed integer linear program (MILP) to model *fair* political redistricting
  + Executed an efficient **graph-contraction** heuristic that solves MILPs using a branch-and-cut method to produce congressional redistricting maps that are Pareto-optimal to the parties and the voters
  + Provided **optimized district maps** to the Arizona Independent Redistricting Commission to assist in drawing Arizona’s 2023-2033 nine congressional districts affecting a population of 7+ million
  + Created **Optimap**: a publicly accessible **web application** using Streamlit+Python
* **Research Assistant**, State University of New York at Buffalo June 2015 – Aug 2015

Optimal location and routing of portable stations in a bike-sharing system | Python, Gurobi, C++

* + Formulated a MILP for optimizing the **location and routing** of portable stations with the objective to minimize the rebalancing load in a bike-sharing system
  + Accelerated the solution strategy with an efficient implementation of **Benders’ decomposition**
* **Data Science Fellow**, Data Science for Social Good, Georgia Tech. June 2015 – July 2015

Inferring mobility patterns using Wi-Fi logs | Python, SQL, Unix

* + Programmed a pipeline using Python and SQL to transform **large-scale Wi-Fi log data** (~1 TB) into spatial mobility patterns to obtain optimal location of commercial services

**Awards and Honors**

* **First Place** (out of 51 submissions), INFORMS Service Science Best Paper Award 2019
* **Finalist** (4 out of 39 submissions), INFORMS Public Sector Operations Research Best Paper Award 2018
* **First Place** (out of 30 posters), Poster Competition Award 2018, INFORMS Annual Meeting, Phoenix, AZ
* **Recipient**, UIUC ISE Graduate Service Awards for the years 2016-2017 and 2017-18
* **Recipient**, SUNY Buffalo Thomas-Drury Industrial Engineering Scholarship 2014 -15
* **Ranked** in the top 99.7% percentile in the Indian Institute of Technology Joint Entrance Exam 2009

**Select Journal Publications**

* **Swamy, R.,** King, D.M. and Jacobson, S.H., 2024. “[Highly Connected Graph Partitioning: Exact Formulation and A Cutting Planes Approach](https://arxiv.org/pdf/2406.08329),” *Naval Research Logistics.*
* **Swamy, R.,** King, D.M. and Jacobson, S.H., 2023. [“Multi-Objective Optimization for Politically Fair Districting: A Scalable Multilevel Approach.”](https://pubsonline.informs.org/doi/10.1287/opre.2022.2311) *Operations Research*.
* **Swamy, R.** andMurray, T., 2020. [“Computing Equilibrium in Network Utility-Sharing and Discrete Election Games.”](https://link.springer.com/article/10.1007/s10878-020-00554-8) *Journal of Combinatorial Optimization.*
* Dobbs, K., **Swamy, R.,** King, D.M., Ludden I.G., and Jacobson, S.H., 2023. “[An Optimization Case Study in Analyzing Missouri Redistricting](https://pubsonline.informs.org/doi/10.1287/inte.2022.0037).” *INFORMS Journal on Applied Analytics*.
* Ludden I., **Swamy, R.,** King, D.M. and Jacobson, S.H., 2022. [“A bisection protocol for political redistricting.”](https://pubsonline.informs.org/doi/epdf/10.1287/ijoo.2022.0084) *INFORMS Journal on Optimization*.
* **Swamy, R.,** King, D.M., Ludden, I., Dobbs, K., and Jacobson, S.H., 2024. “[A practical optimization framework for political redistricting: A case study in Arizona](https://www.sciencedirect.com/science/article/abs/pii/S0038012124000351).” *Socio-Economic Planning Sciences*.
* **Swamy, R.,** Kang, J.E., Batta, R. and Chung, Y., 2017. [“Hurricane Evacuation Planning Using Public Transportation.”](https://www.sciencedirect.com/science/article/abs/pii/S0038012116300210) *Socio-Economic Planning Sciences.*

**Press Releases and Media Articles**

* [INFORMS](https://www.informs.org/News-Room/INFORMS-Releases/News-Releases/New-Research-Develops-a-Model-for-Political-Redistricting-that-Optimizes-Political-Fairness)  (2022) “New research develops a model that optimizes political fairness for political redistricting”
* [UIUC](https://grainger.illinois.edu/news/stories/52711) (2022), “New political redistricting procedure prevent gerrymandering by forcing parties to act fairly”
* [INFORMS OR/MS Today](https://pubsonline.informs.org/do/10.1287/orms.2019.05.02/full/) (2019), “Political Redistricting and O.R.: A Map for the Future”