

Daniel Russo

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Field of Specialization

Broad Area: Algorithms that drive sequential decision making under uncertainty in fast-paced digital systems.

Keywords: Reinforcement learning; Multi-armed bandits; Recommender systems

Education

2011 - 2015 **Stanford University, Stanford, CA.**

PhD in Management Science and Engineering

Concentration area: Operations Research

Advisor: Benjamin Van Roy

Dissertation title: *Efficient Learning in Sequential Optimization*

2007 - 2011 **University of Michigan, Ann Arbor, MI.**

Bachelor of Science in Economics (*with highest honors*) and Mathematics (*with honors*)

Academic Appointments

Columbia University, Graduate School of Business, New York, NY.

Decision Risk & Operations Division

2022-Present Philip H. Geier Jr. Associate Professor

2021-2022 Associate Professor

2017-2021 Assistant Professor

Northwestern University, Kellogg School of Management, Evanston, IL.

Operations Department

2016-2017 Assistant Professor

Professional Experience

2020-Present **Spotify, New York, NY.**

Consultant, Staff Machine Learning Engineer.

2015-2016 **Microsoft Research, Cambridge, MA.**

Postdoctoral Research Scientist

2013 **oDesk (now Upwork), Redwood City, CA.**

Intern - developed automated skills testing system for job market candidates

2011 **Charles River Associates, Boston, MA.**

Summer Analyst – Competition and Antitrust practice

Honors and Awards

2023 Full Oral presentation at machine learning conference ICML (2.2% of submissions)

- 2022 Frederick W. Lanchester Prize: *Awarded for a paper, a book, or a group of books or papers that represent the “best contribution to operations research and the management sciences published in English in the past five years”*
- 2016 First place, INFORMS 2016 Junior Faculty Interest Group (JFIG) paper competition
- 2014 First place in INFORMS George Nicholson student paper competition
- 2014 Accel Graduate Fellowship
- 2013 Oral presentation at machine learning conference NeurIPS (1.4% of submissions)
- 2011-2014 Stanford Graduate Fellowship
- 2011 Ferrando Honors Prize: *“Awarded annually to the best senior pursuing honors in Economics” at the University of Michigan.*

Peer Reviewed Journal Papers

1. J. Bhandari and D. Russo, *Global Convergence Guarantees for Policy Gradient Methods*. Operations Research, 2024.
2. D. Russo, *Approximation Benefits of Policy Gradient Methods with Aggregated States*. Management Science, Vol. 69, No. 11, pp. 6898-6911, 2023.
3. D. Russo and B. Van Roy, *Satisficing in Time Sensitive Bandit Learning*. Mathematics of Operations Research, Vol. 47, No. 4, pp. 2815-2839, 2022.
4. A. Kim, S. Balserio, D. Russo, *On the Futility of Dynamics in Robust Mechanism Design*. Operations Research, Vol. 69, No. 6, pp. 1767-1783, 2021.
5. J. Bhandari, D. Russo, and R. Singal, *A Finite Time Analysis of Temporal Difference Learning with Linear Function Approximation*. Operations Research, Vol. 69, No. 3, pp. 950-973, 2021.
6. D. Russo, *A Note on the Equivalence of Upper Confidence Bounds and Gittins Indices for Patient Agents*. Operations Research, Vol. 69, No. 1, pp. 273-278, 2021.
7. D. Russo, *Simple Bayesian Algorithms for Best Arm Identification*. Operations Research, Vol. 68, No. 6, pp. 1625-1647, 2020.
 - First place, INFORMS 2016 JFIG paper competition.
8. D. Russo and J. Zou, *How Much Does Your Data Exploration Overfit? Controlling Bias via Information Usage*. IEEE Transactions on Information Theory, Vol. 66, No. 1, pp. 302-323, 2020.
9. I. Osband, B. Van Roy, D. Russo, and Z. Wen, *Deep Exploration via Randomized Value Functions*. Journal of Machine Learning Research, Vol. 20, No. 124, pp. 1-62, 2019
10. D. Russo, B. Van Roy, A. Kazerouni, I. Osband, and Z. Wen, *A Tutorial on Thompson Sampling*. Foundations and Trends in Machine Learning, Vol. 11, No. 1, pp. 1-96, 2018.
11. D. Russo and B. Van Roy, *Learning to Optimize via Information-Directed Sampling*. Operations Research, Vol. 66, No. 1, pp. 230-252, 2018.
 - First place, INFORMS George Nicholson 2014 student paper competition.
12. D. Russo and B. Van Roy, *An Information Theoretic Analysis of Thompson Sampling*. Journal of Machine Learning Research Vol. 17, pp. 1-30, 2016.
13. D. Russo and B. Van Roy, *Learning to Optimize via Posterior Sampling*. Mathematics of Operations Research. Vol. 39, No. 4, pp. 1221-1243, 2014.

Peer Reviewed Conference Proceedings

*Papers displayed in gray are superseded by published journal papers listed elsewhere.

1. D. Cheikhi, and D. Russo, *On The Statistical Benefits of Temporal Difference Learning*. International Conference on Machine Learning (ICML), 2023
 - Full oral presentation; top 2.2% of submissions.
 - Finalist for the INFORMS Applied Probability Society best student paper award.
2. S. Min and D. Russo, *An Information-Theoretic Analysis of Nonstationary Bandit Learning*. International Conference on Machine Learning (ICML), 2023.
3. T. McDonald, L. Maystre, M. Lalmas, D. Russo, and K. Ciosek, *Impatient Bandits: Optimizing Recommendations for the Long-Term Without Delay*. Conference on Knowledge Discovery and Data Mining (KDD), 2023.
4. L. Maystre and D. Russo, *Temporally-Consistent Survival Analysis*, Advances in Neural Information Processing Systems (NeurIPS), 2022.
5. T. Zhang, D. Russo, A. Zeevi, *Learning to Stop with Surprisingly Few Samples*, Conference on Learning Theory (COLT), 2021.
6. J. Bhandari and D. Russo, *On the Linear Convergence of Policy Gradient Methods for Finite MDPs*. Artificial Intelligence and Statistics (AISTATS), 2021.
7. D. Russo, *Worst-Case Regret Bounds for Exploration via Randomized Value Functions*. Advances in Neural Information Processing Systems (NeurIPS), 2019.
8. J. Bhandari, D. Russo, and R. Singal, *A Finite Time Analysis of Temporal Difference Learning with Linear Function Approximation*. Conference on Learning Theory (COLT), 2018..
9. C. Qin, D. Klabjan and D. Russo, *Improving the Expected-Improvement Algorithm*. Advances in Neural Information Processing Systems (NeurIPS), 2017.
10. D. Russo and J. Zou, *Controlling Bias from Data Exploration via Information Usage*. Artificial Intelligence and Statistics (AISTATS), 2016.
 - Full oral presentation; top 7% of submissions
11. D. Russo, *Simple Bayesian Algorithms for Best Arm Identification*. Conference on Learning Theory (COLT), 2016.
12. D. Russo and B. Van Roy, *Eluder Dimension and the Sample Complexity of Optimistic Exploration*. Advances in Neural Information Processing Systems (NeurIPS), 2013.
 - Full oral presentation; top 1.4% of submissions.
13. I. Osband, D. Russo and B. Van Roy, *(More) Efficient Reinforcement Learning Via Posterior Sampling*. Advances in Neural Information Processing Systems (NeurIPS), 2013.
14. N. Arnosti and D. Russo, *Welfare-Improving Cascades and the Effect of Noisy Reviews*. Workshop on Internet & Network Economics (WINE), 2013.

Papers under review.

1. C. Qin and D. Russo, *Adaptive Experimentation in the Presence of Exogenous Nonstationary Variation*. Major revision at Management Science.
2. L. Maystre, D. Russo, and Y. Zhao, *Optimizing Audio Recommendations for the Long-Term: A Reinforcement Learning Perspective*. Major revision at Management Science.
3. M. Alvo, D. Russo, and Y. Kanoria, *Neural Inventory Control in Networks via Hindsight Differentiable Policy Optimization*. Submitted.
4. C. Qin and D. Russo, *Optimizing Adaptive Experiments: A Unified Approach to Regret Minimization and Best-Arm Identification*. Submitted.
5. S. Min, and D. Russo, *An Information-Theoretic Analysis of Nonstationary Bandit Learning*. Submitted.
6. K. W. Zhang, T. Cai, H. Namkoong, and D. Russo, *Posterior Sampling via Autoregressive Generation*. Submitted.

Other work in progress.

1. D. Cheikhi and D. Russo, *On the Limited Representational Power of Value Functions and its Links to Statistical (In) Efficiency*.
2. K. W. Zhang, T. McDonald, L. Maystre, M. Lalmas, D. Russo, and K. Ciosek, *Impatient Bandits: Optimizing Recommendations for the Long-Term Without Delay*.
- A full-length paper that greatly expands an earlier conference publication.
3. C. Qin and D. Russo, *Best-arm Identification with Contexts: the Optimality of Context-Independent Experimentation*.

Patents

1. Maystre, L., Russo, D., Zhao, Y., Cantrell, S., Ghael, S.P., and Jebara, T. Systems and methods for training a natural language model. U.S. Patent Application, filed April 5, 2024. Patent Pending.
2. Maystre, L., Baldwin-McDonald, T., Lalmas-Roelleke, M., Russo, D., Ciosek, K.A., Wu, T., and Tanguy, G., Spotify AB. Optimizing selection of media content for long-term outcomes. U.S. Patent Application 18/627,301, filed April 4, 2024. Patent Pending.
3. Russo, D., Zhao, Y., Maystre, L., Bansal, S., Bhaskar, S., Wu, T., Gustafsson, D., Bredeisen, D., Ojeda, R.S., and Jebara, T., Spotify AB. Systems and methods for providing content to users. U.S. Patent Application 18/472,919, filed September 22, 2023. Patent Pending.

Teaching

- Columbia Managerial Statistics (MBA Core), 2017-present
- Dynamic Programming (PhD), 2017-present
- Northwestern Operations Management (MBA), 2016
- Learning in Sequential Decision Making (PhD), 2016

Professional Activities

Editorial Service

- Associate Editor, *Management Science*, 2022-present.

- Associate Editor, *Operations Research*, 2024-present.
- Associate Editor, *Stochastic Systems*, 2021-present.
- Ad-hoc Reviewer (Journals): *Operations Research*; *Management Science*; *Journal of Machine Learning Research*; *Stochastic Systems*; *Electronic Journal of Statistics*; *Journal of Applied Probability*; *Computational Optimization and Applications*; *Production and Operations Management*; *IEEE Transaction on Information Theory*; *Annals of Statistics*
- Reviewer (Conferences): *NeurIPS*; *ICML*; *COLT*; *AISTATS*; *ALT*; *ICLR* (area chair in 2023)

Other Service for the Professional Community

- Council Member, INFORMS Applied Probability, 2024-2025.
- Organizer, Workshop on Strategic and Utility-aware REcommendation, ACM Conference on Recommender Systems, 2024.
- Prize Committee, INFORMS George Nicholson Paper Competition, 2022-2023.
- Host, Virtual RL Theory Seminar, 2020.

Internal Service

- DRO PhD program director, 2024-present.
- Digital Future Initiative postdoc search committee, 2024.
- DRO admission committee, 2017-present.
- DRO qualifying exam committee, 2017-present.
- DRO faculty search committee, 2019-2020 and 2022-2023.
- Co-organizer, machine learning reading group, 2021, 2023-present.

Invited Talks

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| 2023-2024 | Marshall School of Business, University of Southern California
Data Science Lab, MIT
Kellogg School of Management, Northwestern University
Reinforcement Learning Symposium, Boston University
Deming Center Supply Chain Innovation Network, Columbia Business School |
| 2022-2023 | Simons Institute for the Theory of Computing, UC Berkeley
Consequences & Reveal Workshop, ACM Conference on Recommender Systems
Conference on Digital Experimentation, MIT
Business School, Hong Kong University of Science and Technology
Tepper School of Business, Carnegie Mellon University
Data Science Institute, Columbia University
Utah Winter Operations Conference
McCombs School of Business, University of Texas Austin
Booth School of Business, University of Chicago |
| 2021-2022 | Technology and Operations Management Seminar, INSEAD |

Operations Research Colloquium, Penn State
 Young Mathematicians Lecture Series, National University of Singapore
 Industrial and Systems Engineering, University of Minnesota
 Information Systems Laboratory, Stanford University
 Stochastic Networks, Applied Probability, and Performance (SNAPP) Seminar
 Cornell Tech
 Graduate School of Business, Stanford University
 Reinforcement Learning Theory Online Seminar
 Machine Learning Seminar, University of Washington
 Data Science Seminar, LinkedIn

2020-2021 Simons Institute for the Theory of Computing, UC Berkeley
 Institute for Data Science and Dynamical Systems, University of Illinois
 Operation Research Center Colloquium, MIT
 Data Science Lab, MIT
 Machine Learning Seminar, Georgia Institute of Technology
 Cornell Tech
 Reinforcement Learning Theory Seminar

2019-2020 Department of Operations Research and Industrial Engineering, Cornell University
 ADSI Workshop on Learning and Control, University of Washington
 Mostly OM workshop, Chinese University of Hong Kong
 Microsoft Research New York

2018-2019 Economic Theory Seminar, Columbia University
 Two Sigma
 Electrical and Computer Engineering, University of Michigan
 Institute for Mathematics and its Applications, University of Minnesota
 Electrical and Computer Engineering, Princeton University

2017-2018 Laboratory for Information and Decision Systems, MIT
 Columbia Business School, Columbia University
 Netflix Research

2016-2017 Business School, National University of Singapore
 Google Deep Mind
 Uber Data Science
 Reinforcement Learning Forum, Stanford University

2015-2016 Fuqua School of Business, Duke University
 Microsoft Research, New York
 Chulalongkorn University
 Graduate School of Business, Stanford University
 School of Engineering and Applied Sciences, Harvard University
 Industrial and Operations Engineering, University of Michigan
 Industrial and Systems Engineering, Georgia Tech
 Booth School of Business, University of Chicago

Marshall School of Business, University of Southern California
Electrical and Computer Engineering, University of Texas Austin
Microsoft Research, New England
Industrial Engineering and Operations Research, Columbia University
Columbia Business School, Columbia University
Stern School of Business, New York University
2014-2015 Kellogg School of Management, Northwestern University
Microsoft Research, Redmond
Information Theory Forum, Stanford University
Allerton Conference—invited session showcasing the “Class of 2014”
NeurIPS Bayesian Optimization Workshop - speaker and panelist
2013-2014 NeurIPS Oral Presentation