

# Julia Gaudio

## Curriculum Vitae

MIT Department of Mathematics  
Cambridge, MA 02139  
✉ [jgaudio@mit.edu](mailto:jgaudio@mit.edu)

🌐 <http://web.mit.edu/jgaudio/www/index.html>

### Current Position

2020+ **Applied Mathematics Instructor**, *Massachusetts Institute of Technology*.  
Host: Elchanan Mossel

### Education

- 2016–2020 **PhD Operations Research**, *Massachusetts Institute of Technology*, *GPA: 5.0/5.0*.  
Thesis: Topics in High-Dimensional Probability and Statistics  
Advised by David Gamarnik and Patrick Jaillet  
Microsoft Research PhD Fellow
- 2015–2016 **MS Computer Science**, *Brown University*, *GPA: 3.88/4.0*.  
Thesis: Algorithms for Large-Scale Prescriptive Evacuations  
Advised by Pascal Van Hentenryck  
Degree completed concurrently with BS in Applied Mathematics
- 2012–2016 **BS Applied Mathematics**, *Brown University*, *GPA: 3.94/4.0*.

### Research Areas

My research focuses on the analysis of high-dimensional models in probability and statistics.

#### **Shotgun Assembly of Erdős–Rényi Random Graphs**, with Elchanan Mossel.

Shotgun assembly of graphs is the problem of assembling a graph from local neighborhoods. The name comes from DNA shotgun assembly, which is the problem of reconstructing a DNA sequence from short segments. We study the problem of reconstructing Erdős–Rényi random graphs in the regime  $G(n, n^{-\alpha})$ , where  $\alpha \in (0, 1)$ .

#### **Large Deviations for Stochastic Block Models**, with Christian Borgs, Jennifer Chayes, Samantha Petti, and Subhabrata Sen.

We derived a large deviation principle (LDP) for stochastic block models. Using the LDP, we analyzed the conditional distribution over block models, given that a large deviations event has occurred. Our focus was on large deviations in subgraph counts. The results are derived using the theory of *graphons*, which are limiting objects for graphs.

#### **Isotonic Regression**, with David Gamarnik.

In our first paper, we considered the problem of estimating an unknown coordinate-wise monotone function given noisy measurements in high dimensions. Further, we introduced the sparse isotonic regression problem, where the monotonicity of the unknown function is dictated by an unknown subset of the coordinates. In subsequent work, we analyzed monotone multi-index models. In a monotone multi-index model, the input  $X$  is a vector. The output  $Y$  is given by  $Y = f(\beta X) + Z$ , where  $Z$  is noise,  $\beta$  is a matrix, and  $f$  is a coordinate-wise monotone function.

### **Attracting Random Walks**, with Yury Polyanskiy.

We introduced the Attracting Random Walks model, which is a Markov chain that describes the movements of particles on a graph. The degree of attracting of the particles is dictated by a parameter  $\beta$ . We showed that as  $\beta$  is varied, there is a phase transition in mixing time; for small enough  $\beta$ , the mixing time is polynomial, but for  $\beta$  large enough the mixing time is exponential.

### **Random Instance TSP**, with Patrick Jaillet.

Suppose  $n$  points are placed uniformly at random in the unit square. It is known that the optimal TSP tour length normalized by  $\sqrt{n}$  converges to a constant almost surely. Determining the value of the constant is an open problem. Our work improved the lower bound on the constant.

### **Convergence for Stochastically Ordered Markov Processes**, with Saurabh Amin and Patrick Jaillet.

Consider an M/M/1 queue that is in equilibrium at time zero. Suppose its arrival and/or service rate changes at time zero. How long will it be until the queue converges to the new stationary distribution? We gave bounds on convergence to stationarity under perturbation, for queues and other stochastically ordered Markov processes.

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## Publications

### Accepted Papers

Julia Gaudio and Yury Polyanskiy. Attracting Random Walks. *Electronic Journal of Probability* 25(73). 2020.

Julia Gaudio and Patrick Jaillet. An Improved Lower Bound for the Traveling Salesman Constant. *Operations Research Letters*. 48(1) 67-70. 2020.

David Gamarnik and Julia Gaudio. Sparse High-Dimensional Isotonic Regression. *Thirty-third Conference on Neural Information Processing Systems (NeurIPS)*. 2019.

Julia Gaudio, Saurabh Amin, and Patrick Jaillet. 2019. Exponential Convergence Rates for Stochastically Ordered Markov Processes with Random Initial Conditions. *Systems and Control Letters*. Vol 133.

Julia Romanski and Pascal Van Hentenryck. Benders Decomposition for Large-Scale Prescriptive Evacuations. 2016. *Thirtieth AAAI Conference on Artificial Intelligence (AAAI-16)*, Phoenix, AZ.

Kunal Kumar, Julia Romanski, and Pascal Van Hentenryck. Optimizing Infrastructure Enhancements for Evacuation Planning. 2016. *Thirtieth AAAI Conference on Artificial Intelligence (AAAI-16)*, Phoenix, AZ.

### Preprints

Christian Borgs, Jennifer Chayes, Julia Gaudio, Samantha Petti, and Subhabrata Sen. A large deviation principle for block models. 2020.

David Gamarnik and Julia Gaudio. Estimation of Monotone Multi-Index Models. 2020.

### Working Papers

Julia Gaudio and Elchanan Mossel. Shotgun Assembly of Erdős–Rényi Random Graphs. 2020+.

## Patent Applications

Julia Romanski and Pascal Van Hentenryck. Benders Decomposition For Large-Scale Prescriptive Evacuations. US Provisional Application No. 62/456,890

Kunal Kumar, Julia Romanski, and Pascal Van Hentenryck. Optimizing Infrastructure Enhancements for Evacuation Planning. PCT/US17/65530

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## Awards and Honors

- 2018-2020 Microsoft Research PhD Fellowship
- 2019 Runner-up, MIT ORC Best Student Paper Competition for *Attracting Random Walks*
- 2016 Rohn Truell Prize for Undergraduate Excellence, Brown University Division of Applied Mathematics
- 2016 Winner, Brown University Computer Science Symposium
- 2016 Honorable mention in Mathematical Contest in Modeling
- 2015 Phi Beta Kappa, inducted as a junior
- 2015 Shoman Scholarship (Brown University)

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## Industry Experience

- Summer **Research Intern**, MICROSOFT RESEARCH, Cambridge, MA.
  - 2019 Worked with Jennifer Chayes, Christian Borgs, Samantha Petti, and Subhabrata Sen on large deviations for stochastic block models.
- Summer **Research Intern**, MICROSOFT RESEARCH, Redmond, WA.
  - 2018 Worked with Ishai Menache, Luke Marshall, and Ece Kamar to develop an optimization method for real-time shared mobility.
- Summer **Software Engineering Intern**, GOOGLE, Mountain View, CA.
  - 2016 As an intern in the Speech Team (part of Google Research and Machine Intelligence), I implemented algorithms for mixed speech separation in reverberant environments.
- Summer **Research Intern**, NATIONAL INFORMATION AND COMMUNICATIONS TECHNOLOGY AUSTRALIA, Canberra, Australia.
  - 2015 Working with Pascal Van Hentenryck, I improved NICTA's evacuation planning algorithms, leading to a substantial increase in the number of people who could be evacuated in the event of a major flood.

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## Talks

### Upcoming Talks.

- INFORMS Annual Meeting (November 2020)
- Southeastern Probability Conference, Duke University (TBD)
- Minisymposium speaker at the SIAM Conference on Discrete Mathematics (TBD)

### **Sparse High-Dimensional Isotonic Regression**, (With David Gamarnik).

- Invited talk at MIT-IBM Watson AI Lab (Cambridge, MA)

**Attracting Random Walks**, (With Y. Polyanskiy).

- Brown University Probability Seminar (February 2020)
- Random Structures and Algorithms, held at ETH Zurich (2019)
- Stochastic Processes and their Applications (SPA), held at Northwestern University (2019)
- Northeast Probability Seminar, held at the Courant Institute, NYU (2018)
- MIT LIDS Student Conference (2018)

**Exponential Convergence Rates for Stochastically Ordered Markov Processes with Random Initial Conditions**, (With S. Amin and P. Jaillet).

- INFORMS Annual Meeting, Houston TX (2017)
- Stochastic Processes and their Applications (SPA), held in Moscow (2017)

**Benders Decomposition for Large-Scale Prescriptive Evacuations**, (With P. Van Hentenryck).

- Thirtieth AAAI Conference on Artificial Intelligence (AAAI-16), Phoenix, AZ

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## Teaching and Mentoring

2020 **Instructor**, *18.434 Topics in Theoretical Computer Science*.

This is a communication-intensive undergraduate seminar with 16 students. As the seminar instructor, I designed the course. The topic of the class is randomized algorithms and probabilistic analysis, following the book “Probability and Computing” by Eli Upfal and Michael Mitzenmacher.

2018 **Teaching Assistant**, *6.265 Advanced Stochastic Processes*.

*Advanced Stochastic Processes* is an advanced graduate-level discrete probability class. Topics include random graphs, concentration inequalities, large deviations, and graphical models. My responsibilities included hosting weekly office hours and grading problem sets. I gave one of the course lectures.

2013-2016 **Swearer Tutoring and Enrichment in Math and Science (STEMS)**.

STEMS is a Brown University organization that provides tutoring to students at a nearby high school. From 2013 to 2016 I was an in-class and after school math tutor. I was a co-coordinator of the organization from 2015 to 2016, which involved training a group of 70+ tutors and holding weekly discussions regarding tutoring skills and effective mentorship.

2014-2016 **Brown University Meiklejohn Program**.

Individual peer advisor for ten first-year students

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## Service

2020+ **Reviewer**.

*Journal of the Operational Research Society* and *IEEE Control Systems Letters (L-CSS)*

2019-2020 **LIDS and Statistics Tea Talk Committee**.

Hosted informal research talks at the MIT Laboratory for Information and Decision Systems.

2018-2019 **LIDS Student Conference Committee**.

Co-organizer of the 2019 LIDS Student Conference, a two-day conference featuring student presentations, four plenary talks by external speakers, and a banquet.

2018 **MIT IDSS Visiting Committee Meeting**.

Participated on a student panel for members of the IDSS visiting committee and presented a research poster.

2016-2017 **Leadership team of MIT INFORMS chapter**.