

Justin Sirignano

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Appointments

Assistant Professor (tenure track), University of Illinois at Urbana-Champaign
Department of Industrial & Systems Engineering Aug. 2016-

Chapman Fellow, Imperial College London
Department of Mathematics 2015-2016

Education

Stanford University, PhD 2010-2015

Princeton University, B.S.E. 2006-2010
Graduated *summa cum laude*
Elected to Phi Beta Kappa, Tau Beta Pi, and Sigma Xi

Research Interests

Machine learning, deep learning, stochastic analysis, financial math and engineering applications.

Research Publications

1. “DGM: A Deep Learning Algorithm for solving Partial Differential Equations” (with K. Spiliopoulos). *Journal of Computational Physics*, forthcoming 2018. arXiv:1708.07469
2. “Stochastic Gradient Descent in Continuous Time” (with K. Spiliopoulos). *SIAM Journal on Financial Mathematics*, 8(1), 933-961, 2017.
3. “Risk Analysis for Large Pools of Loans” (with K. Giesecke). **Winner of the inaugural SIAM Financial Mathematics & Engineering Conference Paper Prize.** *Management Science*, 2018.
4. “Large-scale Loan Portfolio Selection” (with K. Giesecke and G. Tsoukalas). *Operations Research*, 64(6), 1239-1255, 2016.
5. “Large Portfolio Asymptotics for Loss from Default” (with K. Giesecke, K. Spiliopoulos, and R. Sowers). *Mathematical Finance*, 25(1), 77-114, 2015.
6. “Fluctuation Analysis for the Loss from Default” (with K. Giesecke and K. Spiliopoulos). *Stochastic Processes and their Applications*, 124(7), 2322-2362, 2014.
7. “Optimization of Secondary-Air Addition in a Continuous One-Dimensional Spray Combustor” (with L. Rodriguez, A. Siders, and W. Sirignano). *Journal of Propulsion and Power*, 26(2), 288-294, 2010.
8. “Deep Learning for Limit Order Books.” *Quantitative Finance*, forthcoming 2018. arXiv:1601.01987
9. “Inference for Large Financial Systems” (with G. Schwenkler and K. Giesecke). Minor Revision at *Mathematical Finance*. SSRN: 3012751

10. “Universal Price Formation in Financial Markets: Insights from Deep Learning” (with Rama Cont).
Invited Revision at *Quantitative Finance*. arXiv: 1803.06917
11. “Deep Learning for Mortgage Risk” (with K. Giesecke and A. Sadhwani).
In Review. arXiv:1607.02470
12. “Mean Field Analysis of Neural Networks” (with K. Spiliopoulos).
In Review. arXiv:1805.01053
13. “Mean Field Analysis of Neural Networks: A Central Limit Theorem” (with K. Spiliopoulos).
In Review. arXiv:1805.01053
14. “Stochastic Gradient Descent in Continuous Time: A Central Limit Theorem” (with K. Spiliopoulos).
In Review. arXiv:1710.04273
15. “Deep Learning: Mathematics and Computation.” Book to be published by Cambridge University Press. In preparation.

Other Publications

1. “Deep Learning Models in Finance.”
SIAM News, June 2017.
2. Book review of “Deep Learning” by Goodfellow, Bengio, and Courville.
SIAM Review, 2018.
3. “A Forward-Backward Algorithm for Stochastic Control Problems” (with S. Ludwig, R. Huang, and G. Papanicolaou).
Proceedings of the First International Conference on Operations Research and Enterprise Systems, February 2012.

Awards and Honors

1. Chapman Fellowship at Imperial College London
2. Winner of the inaugural SIAM Financial Mathematics & Engineering Conference Paper Prize.
3. Rose Hills Foundation Engineering Fellowship at Stanford University.
4. Lore von Jaskowsky Memorial Prize, School of Engineering and Applied Sciences at Princeton University, for senior thesis research.

Computational Grants on the Blue Waters national supercomputer

1. Blue Waters general allocation (115,000 node hours, 2017-2018)
2. Blue Waters general allocation (111,000 node hours, 2016-2017)
3. Blue Waters startup allocation “Deep Learning: Modeling Financial Data and Reinforcement Learning” (25,000 node hours, 2016)
4. Blue Waters education allocation (50,000 node hours, 2017)
5. Blue Waters education allocation (25,000 node hours, 2016)

Teaching

1. “Deep Learning” (Fall 2016, 2017, 2018). Graduate course.
2. “Deep Learning” (Spring 2018). Undergraduate course.
3. “Deep Learning II” (Spring 2018). Graduate course.
4. “Machine Learning” (Spring 2016). Graduate course.
5. “Analysis of Data” (Spring 2017, Spring 2018). Undergraduate course.

Current Students

3 PhD students, 4 masters students, and 1 undergraduate student.

Submitted Grant Proposals (currently under review)

1. NSF Applied Math (PIs: J. Sirignano and K. Spiliopoulos).
2. Air Force (\$3.7 million, PI: Dan Bodony, Co-PIs J. Sirignano, J. Freund, A. Goza, K. Stephani)
3. DoE/NNSA PSAAP III center (approximately \$18 million, I am a co-PI). This would replace the current PSAAP II center at UIUC.

Patents

1. US Patent Application 15/331,825
Title: Apparatus for Analyzing the Risk of a Large Loan Pool and Method of Using
Inventors: K. Giesecke and J. Sirignano
2. US Patent Application 15/613,256
Title: Apparatus for Optimizing a Loan Pool and Method of Using
Inventors: K. Giesecke and J. Sirignano

Professional Activities

1. Organized Minisymposiums and Sessions
 - (i) *Machine learning* minisymposium at SIAM Financial Math Meeting, Toronto, June 2018. 12 speakers.
 - (ii) *Machine learning in finance* session at INFORMS Annual Meeting, Houston, October 2017.
 - (iii) *Financial engineering* session at INFORMS Applied Probability Meeting, Northwestern University, July 2017.
 - (iv) *Machine learning for finance* minisymposium at SIAM Financial Mathematics Conference, Austin, November 2016.
 - (v) *Machine learning for finance* session at INFORMS Annual Meeting, Nashville, November 2016.
 - (vi) *Large-scale portfolio risk* session at INFORMS Annual Meeting, Philadelphia, November 2015.
2. Referee for *SIAM Journal on Financial Mathematics*, *Journal of Machine Learning Research*, *Quantitative Finance*, *Operations Research*, *Management Science*, and other journals.
3. Co-organizer of “Machine Learning” seminar series at University of Illinois at Urbana-Champaign.
4. Member of committee for the Masters of Financial Engineering program.
5. Campus collaborator for the Deep Learning Major Research Instrument Project (approx. \$2 million), which is developing a high-performance cluster specifically designed for deep learning and will provide unprecedented computational performance for deep learning applications.

Selected Presentations

1. Seminar at Oxford University, Dept. of Mathematics, Spring 2019.
2. Seminar at University of Michigan, Dept. of Mathematics, Spring 2019.
3. SIAM Financial Mathematics conference, June 2019.
4. SIAM Annual Meeting, July 2018.
5. London Quantitative Finance Seminar, May 2018.
6. Deep Learning Workshop, National Center for Supercomputing Applications, UIUC, October 2017.
7. Seminar at Princeton University, 2017.
8. INFORMS Applied Probability Society Conference, Northwestern University, July 2017. Invited.
9. Seminar at Northwestern University, April 2017.
10. J.P. Morgan, New York City, August 2017. Invited seminar.
11. Seminar at UIUC Business School, February 2017.
12. SIAM Financial Mathematics Conference, Austin, Texas, November 2016. Co-organized minisymposium on machine learning in finance.
13. Bank of England, London, May 2016. Invited seminar.
14. INFORMS Annual Meeting, Nashville, November 2016. Invited.
15. Seminar at London Business School, London, June 2016.
16. Seminar at Oxford University, May 2016.
17. London-Paris Bachelier Workshop on Mathematical Finance, London, September 2015. Invited.
18. Lending Club, San Francisco, June 2015.
19. IPAM Workshop on Systemic Risk and Financial Networks, Los Angeles, 2015.
20. SIAM Financial Mathematics and Engineering Meeting, Chicago, 2014. Invited.
21. INFORMS Annual Meeting, San Francisco, 2014. Invited.
22. Joint Mathematics Meeting, Baltimore, 2014. Invited.
23. INFORMS Annual Meeting, Phoenix, October, 2012. Invited.
24. SIAM Financial Mathematics and Engineering Meeting, Minneapolis, 2012. Chair of the *Credit Risk* session.
25. Annual Meeting of the Canadian Applied and Industrial Mathematics Society, Toronto, 2012. Invited.
26. 5th Financial Risks International Forum, Paris, France, 2012.

Other work experience

British Petroleum, Natural Gas and Power (NAGP), Summer 2013. Machine learning model for electric power market.

Citizenship

United States of America