

David Rushing Dewhurst

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Education

University of Vermont

Burlington, VT

Ph.D. Complex Systems and Data Science (GPA 4.0/4.0)

May 2018 - May 2020

- Ph.D. dissertation: "Essays on modeling and analysis of dynamic sociotechnical systems"
- Fully funded by the MITRE Corporation through DARPA award #W56KGU-17-C-0010 from May 2018 through September 2019; fully funded by MassMutual Center of Excellence in Complex Systems and Data Science from September 2019 through completion.
- Co-founder of UVM - MITRE Computational Finance Laboratory

University of Vermont

Burlington, VT

M.S. Mathematics (GPA 4.0/4.0)

September 2016 - May 2018

- M.S. thesis in functional analysis: "Some results on a class of functional optimization problems"
- Received J. Kenney award as the top mathematics graduate student
- Fully funded by graduate teaching fellowship, taught Calculus I

Mathematical Sciences Research Institute / University of Montreal

Montreal, PQ, Canada

Séminaire de Mathématiques Supérieures: Contemporary Dynamical Systems

July 2017

- Full financial support from MSRI

University of Vermont

Burlington, VT

B.A. Economics, Mathematics, and Political Science (GPA 3.3/4.0)

September 2011 - May 2016

- Member of Omicron Delta Epsilon (economics international honor society)

Experience

Charles River Analytics

Cambridge, MA

Scientist, probabilistic modeling and machine learning

August 2020 - present

Innovation leader in artificial intelligence and machine learning methods for real-time system monitoring

- Develop nonparametric and deep learning methods for cybersecurity threat detection
- Research Bayesian time series representations and invent new modeling frameworks
- Lead agile software engineering teams, implement dev-ops best practices, and develop metrics to track team performance

UVM - MassMutual Center of Excellence in Complex Systems and Data Science

Burlington, VT

Research fellow

September 2019 - present

Design research initiatives in sociotechnical time series data mining, analysis, and modeling

- Conduct analytical and computational research in financial markets, social media dynamics, and game theory
- Supervise graduate and undergraduate researchers

MassMutual

Boston, MA

Lead data scientist

February 2020 - July 2020

Serve as knowledge leader in nonparametric and Bayesian time series analysis and modeling

- Lead software development team automating economic capital risk management analysis pipeline
- Architect and develop comprehensive Bayesian structural time series software leveraging cutting-edge machine learning and probabilistic programming research
- Consult as economic and machine learning knowledge resource across data science organization, peer-review project designs and writeups, and mentor junior data scientists

The MITRE Corporation

Burlington, VT

Computer science graduate fellow

June 2017 - September 2019

Design research in computational finance, create DARPA deliverables, and write scientific publications.

- Leverage nonparametric statistical procedures and design new signal processing algorithms to analyze petabytes of high-frequency financial data
- Lead-authored empirical studies of U.S. equities market microstructure, led to extensive press coverage and creation of new DARPA program
- Coordinate and execute financial market resilience strategy exercises as member of white-cell team, summarize strategies and generate insights for DARPA program managers

Papers

Listed in reverse chronological order (time ordering is first appearance on arXiv.org)

19. **Dewhurst, D.R.**, 2020. Structural time series grammar over variable blocks. arXiv preprint arXiv:2009.06865. Accepted at ProbProg 2020.
18. Dodds, P.S., Minot, J.R., Arnold, M.V., Alshaabi, T., Adams, J.L., **Dewhurst, D.R.**, Reagan, A.J., and Danforth, C.M., 2020. Probability-turbulence divergence: A tunable allotaxonomic instrument for comparing heavy-tailed categorical distributions. arXiv preprint arXiv:2008.13078. (Submitted for publication.)
17. Dodds, P.S., Minot, J.R., Arnold, M.V., Alshaabi, T., Adams, J.L., **Dewhurst, D.R.**, Reagan, A.J., and Danforth, C.M., 2020. Long-term word frequency dynamics derived from Twitter are corrupted: A bespoke approach to detecting and removing pathologies in ensembles of time series. arXiv preprint arXiv:2008.11305.
16. Alshaabi, T., Adams, J.L., Arnold, M.V., Minot, J.R., **Dewhurst, D.R.**, Reagan, A.J., Danforth, C.M. and Dodds, P.S., 2020. Storywrangler: A massive exploratorium for sociolinguistic, cultural, socioeconomic, and political timelines using Twitter. arXiv preprint arXiv:2007.12988. (Submitted for publication.)
15. Alshaabi, T., **Dewhurst, D.R.**, Bagrow, J.P., Dodds, P.S. and Danforth, C.M., 2020. The sociospatial factors of death: Analyzing effects of geospatially-distributed variables in a Bayesian mortality model for Hong Kong. arXiv preprint arXiv:2006.08527. (Submitted for publication.)
14. **Dewhurst, D.R.**, Alshaabi, T., Arnold, M.V., Minot, J.R., Danforth, C.M. and Dodds, P.S., 2020. Divergent modes of online collective attention to the COVID-19 pandemic are associated with future caseload variance. arXiv preprint arXiv:2004.03516.
13. Arnold, M.V., **Dewhurst, D.R.**, Alshaabi, T., Minot, J.R., Adams, J.L., Danforth, C.M., and Dodds, P.S., 2020. Hurricanes and hashtags: Characterizing online collective attention for natural disasters. arXiv preprint arXiv:2003.14291. (Submitted for publication.)
12. Alshaabi, T., Arnold, M.V., Minot, J.R., Adams, J.L., **Dewhurst, D.R.**, Reagan, A.J., Muhamad, R., Danforth, C.M., and Dodds, P.S., 2020. How the world's collective attention is being paid to a pandemic: COVID-19 related 1-gram time series for 24 languages on Twitter. arXiv preprint arXiv:2003.12614.
11. Alshaabi, T., **Dewhurst, D.R.**, Minot, J.R., Arnold, M.V., Adams, J.L., Danforth, C.M. and Dodds, P.S., 2020. The growing echo chamber of social media: Measuring temporal and social contagion dynamics for over 150 languages on Twitter for 2009–2020. arXiv preprint arXiv:2003.03667. (Submitted for publication.)
10. Dodds, P.S., Minot, J.R., Arnold, M.V., Alshaabi, T., Adams, J.L., **Dewhurst, D.R.**, Gray, T.J., Frank, M.R., Reagan, A.J. and Danforth, C.M., 2020. Allotaxonomy and rank-turbulence divergence: A universal instrument for comparing complex systems. arXiv preprint arXiv:2002.09770. (Submitted for publication.)
9. **Dewhurst, D.R.**, Li, Y., Bogdan, A. and Geng, J., 2020, July. Evolving *ab initio* trading strategies in heterogeneous environments. In Proceedings of the 2020 Genetic and Evolutionary Computation Conference (pp. 76-84).
8. Dodds, P.S., Minot, J.R., Arnold, M.V., Alshaabi, T., Adams, J.L., **Dewhurst, D.R.**, Reagan, A.J. and Danforth, C.M., 2019. Fame and Ultrafame: Measuring and comparing daily levels of being “talked about” for United States’ presidents, their rivals, God, countries, and K-pop. arXiv preprint arXiv:1910.00149. (Submitted for publication.)
7. **Dewhurst, D.R.**, Danforth, C.M. and Dodds, P.S., 2020. Noncooperative dynamics in election interference. Physical Review E, 101(2), p.022307.
6. **Dewhurst, D.R.**, Alshaabi, T., Kiley, D., Arnold, M.V., Minot, J.R., Danforth, C.M. and Dodds, P.S., 2020. The shocklet transform: a decomposition method for the identification of local, mechanism-driven dynamics in sociotechnical time series. EPJ Data Science, 9(1), p.3.
5. **Dewhurst, D.R.**, Arnold, M.V. and Van Oort, C.M., 2019, July. Selection mechanisms affect volatility in evolving markets. In Proceedings of the Genetic and Evolutionary Computation Conference (pp. 90-98). ACM.
4. **Dewhurst, D.R.**, Van Oort, C.M., Ring IV, J.H., Gray, T.J., Danforth, C.M. and Tivnan, B.F., 2019. Scaling of inefficiencies in the US equity markets: Evidence from three market indices and more than 2900 securities. arXiv preprint arXiv:1902.04691. (Submitted for publication.)
3. Tivnan, B.F., **Dewhurst, D.R.**, Van Oort, C.M., Ring IV, J.H., Gray, T.J., Tivnan, B.F., Koehler, M.T., McMahon, M.T., Slater, D.M., Veneman, J.G. and Danforth, C.M., 2020. Fragmentation and inefficiencies in US equity markets: Evidence from the Dow 30. PLoS one, 15(1), p.e0226968.
2. **Dewhurst, D.R.**, Danforth, C.M. and Dodds, P.S., 2018. Continuum rich-get-richer processes: Mean field analysis with an application to firm size. Physical Review E, 97(6), p.062317.
1. Dodds, P.S., **Dewhurst, D.R.**, Hazlehurst, F.F., Van Oort, C.M., Mitchell, L., Reagan, A.J., Williams, J.R. and Danforth, C.M., 2017. Simon's fundamental rich-get-richer model entails a dominant first-mover advantage. Physical Review E, 95(5), p.052301.

Contributed talks

4. **Dewhurst, D.R.** (July, 2020). Evolving *ab initio* trading strategies in heterogeneous environments. Presented at the Genetic and Evolutionary Computational Conference (GECCO 2020), Remote.
3. **Dewhurst, D.R.** (January, 2020). The shocklet transform and STAR algorithm: A decomposition method for the identification of local, mechanism-driven dynamics in sociotechnical time series. Presented at Dynamics Days 2020, Hartford, CT, USA.
2. **Dewhurst, D.R.** (July, 2019). Selection mechanisms affect volatility in a market of evolving agents. Presented at the Genetic and Evolutionary Computation Conference (GECCO 2019), Prague, Czech Republic.
1. **Dewhurst, D.R.** (May, 2019). Fragmentation and inefficiencies in US equities markets: A network perspective. Presented at the 4th workshop on Statistical Physics for Financial and Economic Networks at NetSci 2019, Burlington, VT, USA.

Technical skills

I design complex research programs that leverage massive datasets subject to flexible project requirements in dynamic solution spaces.

- **Analytical:** ordinary and partial differential equations; real, complex, and functional analysis; continuous and global optimization; nonparametric and Bayesian statistics; probability theory and stochastic processes; noncooperative and evolutionary game theory; panel data econometrics
- **Computational:** Object-oriented and functional programming; petabyte-scale data analysis using distributed computing techniques and resources (e.g., MapReduce, Spark, Dask); agent-based modeling (financial and other domains); Monte Carlo methods for options pricing, simulation, search, and optimization; machine learning, deep learning, and reinforcement learning methods; complex network analysis; linear and nonlinear time series analysis; signal processing algorithm design; numerical PDE solver design
- **Programming languages and software:** Python, Julia, R, C, Stan, MATLAB/Octave, *T_EX, Bash, RHEL, Torque/PBS, Git

Academic service

- **Journal reviewer:** Cognitive Science, The Computer Journal (Section C), Journal of Open Source Software
- **Conference reviewer:** International Conference on Computational Social Science (2020)
- **M.S. advisor:**
 - Nathaniel Shenton, University of Vermont, M.S. Complex Systems and Data Science (2020). Project title: “Two essays on celebrities’ influence on Twitter: Characterizing fame and modeling exogenous events after death”

Professional service

- **UMass Center for Data Science:** Industry advisor, Data Science for the Common Good