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 probabilistic AI for mission-critical defense applications
- Develop nonparametric and deep learning methods for cybersecurity threat detection (NAVSEA, DEVCOM, DARPA SHEATH)
- Lead probabilistic modeling team on DARPA LogX program (DoD-wide logistics modeling)
- Design and implement innovative probabilistic programming language and structural time series analysis frameworks

University of Vermont   **Burlington, VT**
Adjunct assistant professor, mathematics and statistics   *June 2020 - present*
Research fellow   *September 2019 - June 2020*
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
- 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 effort
- Coordinate and execute financial market resilience strategy exercises as member of white-cell team
- Received Trailblazer award for leading new company initiative in computational finance

Papers

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

20. Gothard, K., **Dewhurst, D.R.**, Minot, J.R., Adams, J.L., Danforth, C.M. and Dodds, P.S., 2021. The incel lexicon: Deciphering the emergent cryptolect of a global misogynistic community. arXiv preprint arXiv:2105.12006.

19. **Dewhurst, D.R.**, 2020. Structural time series grammar over variable blocks. arXiv preprint arXiv:2009.06865. Presented 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 allotaxonometric 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., 2021. Storywrangler: A massive exploratorium for sociolinguistic, cultural, socioeconomic, and political timelines using Twitter. Science advances, 7(29), p.eabe6534.

15. Alshaabi, T., **Dewhurst, D.R.**, Bagrow, J.P., Dodds, P.S. and Danforth, C.M., 2021. The sociospatial factors of death: Analyzing effects of geospatially-distributed variables in a Bayesian mortality model for Hong Kong. Plos one, 16(3), p.e0247795.

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., 2021. Hurricanes and hashtags: Characterizing online collective attention for natural disasters. PLoS one, 16(5), p.e0251762.

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. PloS one 16, no. 1 (2021): e0244476.

11. Alshaabi, T., **Dewhurst, D.R.**, Minot, J.R., Arnold, M.V., Adams, J.L., Danforth, C.M. and Dodds, P.S., 2021. The growing amplification of social media: measuring temporal and social contagion dynamics for over 150 languages on Twitter for 2009–2020. EPJ data science, 10(1), pp.1-28. (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. Allotaxonometry 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

o **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
o **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
o **Programming languages and software:** Julia, Python, Nim, R, C, Stan, MATLAB/Octave, ∗TEX, Bash, RHEL, Torque/PBS, Git

Academic service

o **Journal reviewer:** Cognitive Science, The Computer Journal (Section C), Journal of Open Source Software, Scientific Reports
o **Conference reviewer:** International Conference on Computational Social Science (2020)
o **Advisor:**
  – Nathaniel Shenton, University of Vermont (2020, M.S.)

Professional service

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