Joseph Futoma

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EDUCATION

Duke University, Durham, NC

- **Ph.D. in Statistical Science** — Aug 2013 – May 2018
  - Advisor: Katherine Heller, Ph.D.
  - Dissertation: *Gaussian Process-Based Models for Clinical Time Series in Healthcare*
  - Focus: Bayesian statistics, machine learning, healthcare applications, data analysis of electronic health records.
  - Deep learning algorithm for early detection of sepsis currently implemented and used at Duke University Hospital.
- **M.S. in Statistical Science** — Aug 2013 – May 2016
  - GPA: 3.93 / 4.00
  - Coursework: Linear Models, Probability & Measure Theory, Bayesian & Modern Statistics, Advanced Machine Learning, Statistical Inference, Statistical Case Studies, Probability & Statistical Models, Spatial Statistics

Dartmouth College, Hanover, NH

- **A.B. with High Honors in Mathematics** — Sep 2010 – Jun 2013
  - Advisor: Daniel Rockmore, Ph.D.
  - Thesis: *Scalable Inference Algorithms for Clustering Large Networks*
  - *Summa Cum Laude*
  - GPA: 3.94 / 4.00 (3.96 in major)
  - Coursework: Abstract Algebra, {Real, Complex, Numerical} Analysis, Chaos, Probability, Quantum Mechanics, Networks, Topology, Measure Theory, Machine Learning, Mathematical Statistics, Intro to Applied Math

RESEARCH INTERESTS

Bayesian methods, big data, machine learning, data science, Bayesian deep learning, scalable inference, reinforcement learning & sequential decision making, healthcare, electronic health records, implementation & deployment of machine learning for healthcare.

ACADEMIC RESEARCH EXPERIENCE

School of Engineering & Applied Sciences, Harvard University

- **Postdoctoral Fellow, Center for Research on Computation & Society** — Jun 2018 – Present
  - Advisor: Finale Doshi-Velez, Ph.D.
  - Focus: Reinforcement learning & sequential decision-making in healthcare; analysis of intensive care unit (ICU) data.

Dept. of Statistical Science, Duke University

- **NDSEG Research Fellow** — Sep 2015 – May 2018
- **Statistical & Applied Mathematical Sciences Inst. (SAMSI) Research Fellow** — Aug 2014 – May 2015
  - Mentor: David Dunson, Ph.D.
  - Focus: Analysis of high-dimensional biological data from exercise physiology studies.
- **First Year Statistical Science Research Fellow** — Aug 2013 – May 2014

Dept. of Mathematics, Dartmouth College

- **Presidential Scholar Research Assistant,** — May 2012 – Aug 2013
  - Focus: Time-varying topic models, scalable network analysis.
  - Advisor: Daniel Rockmore, Ph.D.

INDUSTRY WORK EXPERIENCE

Quintiles Transnational, Predictive Analytics

- **Biostatistician Intern** — Jun 2014 – Sep 2014
  - Project: Develop statistical models to predict site adherence for risk-based monitoring of clinical trials.
  - Supervisors: Joseph Lucas, Ph.D. and Valerii Fedorov, Ph.D.

Amazon.com, Inc, Prime Music, Personalization

- **Research Intern** — May 2015 – Aug 2015
  - Project: Fit large-scale regressions with Apache Spark to solve the source appraisal problem in music recommendation. In online A/B testing, proposed algorithm increased overall music consumption by 1.2%.
  - Supervisor: Charles Thompson

Statistical Consulting — Jan 2017 – Present

- International Farming Corporation.
- Lab of Cynthia Toth, MD at Duke University: Predict disease progression in macular degeneration.

HONORS & AWARDS

- Center for Research on Computation & Society (CRCS) Postdoctoral Fellowship, Harvard — 2018
- Plenary Presentation (top 3/1540 of abstracts), Society for Hospital Medicine — 2018
- **National Defense Science and Engineering Graduate (NDSEG) Fellowship** — 2015

■ **Winner, LinkedIn Economic Graph Challenge**		2015
■ 2x Honorable Mention, NSF Graduate Research Fellowship Program		2014, 2015
■ First Year Statistical Science Research Fellowship, Duke University		2013 – 2014
■ Notable Paper Award (top 2.6% of submissions), AISTATS 2013		2013
■ Rufus Choate Scholar (GPA in top 5% of class), Dartmouth College		2010 – 2013

GRANTS

■ "Innovative Predictive Model to Anticipate Steroid Induced
Hyperglycemia and Guide Insulin Regimens," May 2018 - Apr 2019
- Co-Investigator (PI: Dr. Ann McGee).
- Duke Institute for Health Innovation.
- Total: $25,000.

■ "Early Identification of Cardiac Decompensation and Cardiogenic Shock," May 2018 - Apr 2019
- Co-Investigator (PI: Dr. Ajar Cochar).
- Duke Institute for Health Innovation.
- Total: $60,000.

■ "Implementation of a Duke-Specific Early Warning System," May 2016 - Apr 2017
- Collaborator (PI: Dr. Cara O'Brien).
- Duke Institute for Health Innovation.
- Total: $50,000.

■ "Improving Chronic Disease Management in Duke Primary Care:
Building a Virtual Medical Neighborhood for Chronic Kidney Disease," May 2016 - Apr 2017
- Collaborator (PI: Dr. Blake Cameron).
- Duke Institute for Health Innovation.
- Total: $40,000.

■ "Chronic Kidney Disease Population Management Tools," Jun 2015 - May 2016
- Collaborator (PI: Dr. Uptal Patel).
- Duke Translational Research Institute.
- Total: $50,000.

■ "Duke Connected Care Chronic Kidney Disease Care Improvement Project," May 2015 - Apr 2016
- Collaborator (PI: Dr. Dev Sangvai).
- Duke Institute for Health Innovation.
- Total: $65,000.

PUBLICATIONS

REFEREED JOURNAL PAPERS

[1] **J. Futoma**, J. Morris, and J. Lucas. "A Comparison of Models for Predicting Early Hospital Readmissions," *Journal of Biomedical Informatics*, vol. 56, pp. 229–238, Aug 2015.

REFEREED CONFERENCE PAPERS

[1] **J. Futoma**, S. Hariharan, M. Sendak, N. Brajer, M. Clement, A. Bedoya, C. O'Brien, and K. Heller. "An Improved Multi-Output Gaussian Process RNN with Real-Time Validation for Early Sepsis Detection," in *Proceedings of the 2nd Machine Learning for Healthcare Conference (MLHC)*, Boston, MA, Aug 2017.

[2] **J. Futoma**, S. Hariharan, and K. Heller. "Learning to Detect Sepsis with a Multitask Gaussian Process RNN Classifier," in *Proceedings of the 34th International Conference on Machine Learning (ICML)*, Sydney, Australia, Aug 2017.

[3] **J. Futoma**, M. Sendak, C. B. Cameron, and K. Heller. "Predicting Disease Progression with a Model for Multivariate Longitudinal Clinical Data," in *Proceedings of the 1st Machine Learning for Healthcare Conference (MLHC)*, Los Angeles, CA, Aug 2016.

[4] **J. Futoma**, M. Sendak, C. B. Cameron, and K. Heller. "Scalable Joint Modeling of Longitudinal and Point Process Data for Disease Trajectory Prediction and Improving Management of Chronic Kidney Disease," in *Proceedings of the 32nd Conference on Uncertainty in Artificial Intelligence (UAI)*, New York City, NY, Jun 2016.

[5] N. Foti, **J. Futoma**, D. Rockmore, and S. Williamson. "A Unifying Representation for a Class of Dependent Random Measures," in *Proceedings of the 16th Conference on Artificial Intelligence and Statistics (AISTATS)*, Scottsdale, AZ, May 2013.

REFEREED WORKSHOP PAPERS

[1] **J. Futoma**, M. Hughes, F. Doshi-Velez. "Prediction-Constrained POMDPs," in *NIPS 2018 Workshop on Reinforcement Learning under Partial Observability*, Montreal, Canada, Dec 2018.

[2] **J. Futoma**, A. Lin, M. Sendak, M. Clement, A. Bedoya, C. O'Brien, and K. Heller. "Learning to Treat Sepsis with Multi-Output Gaussian Process Deep Recurrent Q-Networks," in *NIPS 2017 Workshop on Machine Learning for Health*, Long Beach, CA, Dec 2017.

[3] **J. Futoma** and J. Lucas. "Predicting Early Hospital Readmissions using Electronic Health Records," in *NIPS 2014 Workshop on Machine Learning for Clinical Data, Healthcare and Genomics*, Montreal, Canada, Dec 2014.

OTHER PAPERS

[1] **J. Futoma**. "Scalable Inference Algorithms for Clustering Large Networks," *Dartmouth College Senior Thesis*, Jun 2013.

[2] **J. Futoma**. "Gaussian Process-Based Models for Clinical Time Series in Healthcare," *Duke University Ph.D. Dissertation*, May 2018.

PAPERS IN PREPARATION

[1] **J. Futoma**, M. Hughes, F. Doshi-Velez. "Prediction-Constrained POMDPs."

[2] **J. Futoma**, A. Lin, M. Sendak, M. Clement, A. Bedoya, C. O'Brien, and K. Heller. "Learning to Treat Sepsis with Multi-Output Gaussian Process Deep Recurrent Q-Networks."

[3] Z. Sun, O. Huang, E. Lorenzi, B. Chang, M. Turner, **J. Futoma**, T. Li, K. Heller, C. Mantyh, and E. Huang. "Validation and Implementation of Wide and Deep Learning for Surgical Risk Prediction At the Point-Of-Care."

[4] A. Lin, M. Sendak, A. Bedoya, M. Clement, N. Brajer, **J. Futoma**, H. Bosworth, K. Heller, C. O'Brien. "Improving Sepsis Care: Aligning Phenotype Selection with Program Design", under review at *Journal of Hospital Medicine*.

[5] A. Bedoya[*], **J. Futoma**[*], M. Clement, N. Brajer, A. Lin, M. Sendak, K. Heller, C. O'Brien. "Deeply Personalized Sepsis Care: Using Deep Learning to Improve Early Detection of Sepsis," in revision for *Critical Care Medicine*. (*: joint first author)

PRESENTATIONS & TALKS	▪ Invited Talk, NIPS 2018 Workshop: All of Bayesian Nonparametrics.	Dec 2018
	▪ Spotlight & Poster Presentation, NIPS 2018 Workshop on RL under Partial Observability.	Dec 2018
	▪ Poster Presentation, MLHC 2018.	Aug 2018
	• A. Lin, **J. Futoma**, A. Bedoya, N. Brajer, M. Sendak, F. Yashar, M. Nichols, M. Gao, M. Clement, K. Heller, C. O'Brien. "Leveraging Deep Learning and Rapid Response Team Nurses to Improve Sepsis Management" (Clinical Abstract).	
	▪ Poster Presentation, ISBA 2018 World Meeting.	Jun 2018
	▪ Poster Presentation, American Thoracic Society International Conference 2018.	May 2018
	• A. Lin, M. Sendak, A. Bedoya, M. Clement, **J. Futoma**, M. Nichols, M. Gao, K. Heller, C. O'Brien. "What Is Sepsis: Investigating the Heterogeneity of Patient Populations Captured by Different Sepsis Definitions".	
	▪ Plenary Presentation, Society for Hospital Medicine 2018.	Aug 2018
	• **Top 3 / 1540 submitted abstracts.**	
	• A. Lin, **J. Futoma**, M. Sendak, A. Bedoya, M. Clement, M. Gao, M. Nichols, K. Heller, C. O'Brien. "Deeply-Personalized Medicine: Bringing Deep Learning to Sepsis Care".	
	▪ Poster Presentation, NIPS 2017 Workshop on ML for Health.	Dec 2017
	▪ Invited Talk, Epic Data Science Forum (Madison, WI).	Oct 2017
	▪ Oral Presentation, Duke Dept. of Statistical Science, Seminar Series.	Sep 2017
	▪ Spotlight Presentation, MLHC 2017.	Aug 2017
	▪ Oral Presentation, ICML 2017.	Aug 2017
	▪ Oral Presentation, INFORMS Healthcare 2017.	Jul 2017
	▪ Spotlight Presentation, MLHC 2016.	Aug 2016
	▪ Invited Talk, UAI 2016 Workshop on Bayesian Applications.	Jun 2016

- Poster Presentation, UAI 2016.   Jun 2016
- Oral Presentation, Bayesian Young Statisticians Meeting.   Jun 2016
- Poster Presentation, ISBA 2016 World Meeting.   Jun 2016
- Poster Presentation, Society of General Internal Medicine.   May 2016
  - M. Sendak, C. B. Cameron, E. Komives, **J. Futoma**, E. Huang, K. Heller, D. Sangvai L. E. Boulware, and U.D.Patel. "Developing a Data-Driven Workflow for Population Health Rounding".
- Oral Presentation & Contributed 1 page paper, NIH-IEEE 2015 Strategic Conference on Healthcare Innovations and Point-of-Care Technologies for Precision Medicine.   Oct 2015
  - Z. Sun, **J. Futoma**, M. Sendak, E. Lorenzi, S. Brown, O. Huang, K. Heller, J. Thacker, C. Mantyh, and E. Huang. "Precision Medicine in Point-Of-Care Management of Surgical Complications."
- Poster Presentation, NIPS 2015 Workshop on ML for Clinical Data, Healthcare & Genomics. Dec 2014
- Invited Talk, Applied and Computational Mathematics Seminar Series, Dartmouth College.   Apr 2013

PROFESSIONAL SERVICE

Peer Reviewer   2015 – Present
- AISTATS {2018,2019}, {ICML 2017,2018}, MLHC {2016,2017,2018}, AMIA {2015}, NIPS Workshops {2015,2016,2017,2018}, IEEE TPAMI

SKILLS

Python (TensorFlow, PyTorch), MATLAB, R, BUGS/JAGS, Apache Spark, Scala, Julia, UNIX/Linux shell scripting, HTML/CSS, LaTeX, Mathematica, Microsoft Office.

REFERENCES

- **Finale Doshi-Velez, Ph.D.**
  Assistant Professor, Harvard: School of Engineering & Applied Sciences
  finale@seas.harvard.edu

- **Katherine Heller, Ph.D.**
  Assistant Professor, Duke: Dept. of Statistical Science, Center for Cognitive Neuroscience
  kheller@gmail.com

- **David Dunson, Ph.D.**
  Arts & Sciences Distinguished Professor, Duke: Depts. of Statistical Science, Math, ECE
  dunson@duke.edu

- **David Banks, Ph.D.**
  Professor of the Practice of Statistics
  dlbanks@duke.edu

- **Cara O'Brien, M.D.**
  Assistant Professor of Medicine; Associate Director of Clinical Operations, Duke University Hospital
  cara.obrien@duke.edu

- **Joseph Lucas, Ph.D.**
  Associate Research Professor, Duke: Social Science Research Institute, Duke Clinical Research Institute
  joseph.lucas@duke.edu

- **Suresh Balu, MBA**
  Program Director: Duke Institute for Health Innovation.
  suresh.balu@duke.edu

[*CV compiled on 2018-11-29*]