

Lorin Crawford

1 Memorial Dr, Cambridge, MA 02474, USA
lcrawford@microsoft.com • +1 (857) 453-6156 • www.lorincrawford.com

- EDUCATION**
- Duke University**, Durham, North Carolina, USA Aug 2013 – May 2017
Ph.D. in Statistical Science
Co-Advisors: Sayan Mukherjee, Ph.D. and Kris C. Wood, Ph.D.
Thesis: Bayesian Kernel Models for Statistical Genetics and Cancer Genomics
- Clark Atlanta University**, Atlanta, Georgia, USA Aug 2009 – May 2013
B.S. in Mathematics
Advisor: Fisseha Abebe, Ph.D.
Valedictorian/*Summa Cum Laude* (Cumulative GPA: 4.0/4.0)
- PROFESSIONAL EXPERIENCE**
- Microsoft Research New England**, Cambridge, Massachusetts, USA Sep 2020 – Present
Senior Researcher
- Brown University**, Providence, Rhode Island, USA Jul 2019 – Present
RGSS Assistant Professor of Biostatistics, Department of Biostatistics
Assistant Professor of Biostatistics, Department of Biostatistics Jul 2017 – Jun 2019
- PUBLICATIONS**
- REFEREED PAPERS (*CO-FIRST AUTHORS; †CO-SENIOR AUTHORS; #CORRESPONDING AUTHOR(S); ADVISEE)**
- [1] **L. Crawford**, V. Ponomarenko#, J. Steinberg, and M. Williams (2014). Accepted elasticity in local arithmetic congruence monoids. *Results in Mathematics*. **66**: 227-245.
 - [2] G.R. Anderson, S.E. Wardell, M. Cakir, **L. Crawford**, J.C. Leeds, D.P. Nussbaum, P.S. Shankar, R.S. Soderquist, E.M. Stein, J.P. Tingley, P.S. Winter, E.K. Zeiser-Misenheimer, H.M. Alley, A. Yllanes, V. Haney, K.L. Blackwell, S.J. McCall, D.P. McDonnell, and K.C. Wood# (2016). PIK3CA mutations enable selective targeting of a breast tumor lineage survival dependency through MTOR-mediated control of MCL-1 translation. *Science Translational Medicine*. **8**: 369ra175.
 - [3] G.R. Anderson*, P.S. Winter*, K.H. Lin, D.P. Nussbaum, M. Cakir, E.M. Stein, R. Soderquist, **L. Crawford**, J.C. Leeds, R. Newcomb, P. Stepp, C. Yip, S.E. Wardell, J.P. Tingley, M. Ali, M. Xu, M. Ryan, S.J. McCall, A. McRee, C.M. Counter, C.J. Der, and K.C. Wood# (2017). A landscape of therapeutic cooperativity in KRAS mutant cancers reveals principles for controlling tumor evolution. *Cell Reports*. **20**(4): 999-1015.
 - [4] **L. Crawford**#, P. Zeng, S. Mukherjee, and X. Zhou# (2017). Detecting epistasis with the marginal epistasis test in genetic mapping studies of quantitative traits. *PLOS Genetics*. **13**(7): e1006869.
 - [5] K.R. Singleton*, **L. Crawford***, E. Tsui, H.E. Manchester, O. Maertens, X. Liu, M.V. Liberti, A.N. Magpusao, E.M. Stein, J.P. Tingley, D.T. Frederick, G.M. Boland, K.T. Flaherty, S.J. McCall, C. Krepler, K. Sproesser, M. Herlyn, D.J. Adams, J.W. Locasale, K. Cichowski, S. Mukherjee, and K.C. Wood# (2017). Melanoma therapeutic strategies that select against resistance by exploiting MYC-driven evolutionary convergence. *Cell Reports*. **21**(10): 2796-2812.
 - [6] R. Soderquist, **L. Crawford**, E. Liu, M. Lu, A. Agarwal, G.R. Anderson, K.H. Lin, P.S. Winter, M. Cakir, and K.C. Wood# (2018). Systematic mapping of BCL-2 gene dependencies in cancer reveals molecular determinants of BH3 mimetic sensitivity. *Nature Communications*. **9**(1): 3513.
 - [7] **L. Crawford**#, K.C. Wood, X. Zhou#, and S. Mukherjee# (2018). Bayesian approximate kernel regression with variable selection. *Journal of the American Statistical Association*. **113**(524): 1710-1721.
 - [8] D.E. Runcie# and **L. Crawford** (2019). Fast and general-purpose linear mixed models for genome-wide genetics. *PLOS Genetics*. **15**(2): e1007978.

- [9] A. Monod#, S. Kališnik, J.Á. Patiño-Galindo, and **L. Crawford** (2019). Tropical sufficient statistics for persistent homology with a parametric application to infectious viral disease. *SIAM Journal on Applied Algebra and Geometry*. **3**(2): 337-371.
- [10] **L. Crawford**#, S.R. Flaxman, D.E. Runcie, and M. West (2019). Variable prioritization in nonlinear black box methods: a genetic association case study. *Annals of Applied Statistics*. **13**(2): 958-989.
- [11] T. Borgovan#, **L. Crawford**, C. Nwizu, and P. Quesenberry (2019). Stem cells and extracellular vesicles: biological regulators of physiology and disease. *American Journal of Physiology-Cell Physiology*. **317**(2): C155-C166.
- [12] K.H. Lin, J.C. Rutter, A. Xie, E.T. Winn, B. Pardieu, R. Dal Bello, Y.R. Ahn, Z. Dai, R.T. Sobhan, G.R. Anderson, K.R. Singleton, A.E. Decker, P.S. Winter, J.W. Locasale, **L. Crawford**, A. Puissant#, and K.C. Wood# (2020). Using antagonistic pleiotropy to design a chemotherapy-induced evolutionary trap. *Nature Genetics*. **52**: 408-417.
- [13] W. Cheng, S. Ramachandran#, and **L. Crawford**# (2020). Estimation of non-null SNP effect size distributions enables the detection of enriched genes underlying complex traits. *PLOS Genetics*. **16**(6): e1008855.
- [14] J.S. Sadick, **L. Crawford**, H.C. Cramer, C. Franck, S.A. Liddelow, and E.M. Darling# (2020). Generating cell type-specific protein signatures from non-symptomatic and diseased tissues. *Annals of Biomedical Engineering*. **48**: 2218-2232.
- [15] **L. Crawford**#, A. Monod#, A.X. Chen, S. Mukherjee, and R. Rabadán (2020). Predicting clinical outcomes in glioblastoma: an application of topological and functional data analysis. *Journal of the American Statistical Association*. **115**(531): 1139-1150.
- [16] B.A. Borden, Y. Baca, J. Xiu, F. Tavora, I. Winer, B.A. Weinberg, A.M. VanderWalde, S. Darabi, W.M. Korn, A.P. Mazar, F.J. Giles, **L. Crawford**, H. Safran, W.S. El-Deiry, and B.A. Carneiro# (2021). The landscape of glycogen synthase kinase-3 beta (GSK-3b) genomic alterations in cancer. *Molecular Cancer Therapeutics*. **20**(1): 183-190.
- [17] A.N. Spierer#, J.A. Mossman, S.P. Smith, **L. Crawford**, S. Ramachandran, and D.M. Rand# (2021). Natural variation in the regulation of neurodevelopmental genes modifies flight performance in *Drosophila*. *PLOS Genetics*. **17**(3): e1008887.
- [18] B. Wang*, T. Sudijono*, H. Kirveslahti*, T. Gao, D.M. Boyer, S. Mukherjee#, and **L. Crawford**# (2021). A statistical pipeline for identifying physical features that differentiate classes of 3D shapes. *Annals of Applied Statistics*. In Press.

PREPRINTS (*CO-FIRST AUTHORS; †CO-SENIOR AUTHORS; #CORRESPONDING AUTHOR(S); ADVISEE)

- [1] **L. Crawford**# and X. Zhou#. Genome-wide marginal epistatic association mapping in case-control studies. *bioRxiv*. 374983.
- [2] J. Ish-Horowicz*, D. Udwin*, S.R. Flaxman, S.L. Filippi#, and **L. Crawford**#. Interpreting deep neural networks through variable importance. *arXiv*. 1901.09839.
- [3] K.E. Ware, S. Gupta, J. Eng, G. Kemeny, B.J. Puvindran, W.C. Foo, **L. Crawford**, R.G. Almquist, D. Runyambo, B.C. Thomas, M.U. Sheth, A. Agarwal, M. Pierobon, E.F. Petricoin, D.L. Corcoran, J. Freedman, S.R. Patierno, T. Zhang, S. Gregory, Z. Sychev, J.M. Drake, A.J. Armstrong#, J.A. Somarelli#. Convergent evolution of p38/MAPK activation in hormone resistant prostate cancer mediates pro-survival, immune evasive, and metastatic phenotypes. *bioRxiv*. 2020.04.22.050385.
- [4] D.E. Runcie#, J. Qu, H. Cheng, and **L. Crawford**. Mega-scale linear mixed models for genomic predictions with thousands of traits. *bioRxiv*. 2020.05.26.116814.
- [5] P. Demetci*, W. Cheng*, G. Darnell, X. Zhou, S. Ramachandran, and **L. Crawford**#. Multi-scale inference of genetic architecture using biologically annotated neural networks. *bioRxiv*. 2020.07.02.184465.
- [6] W. Cheng, G. Darnell, S. Ramachandran, and **L. Crawford**#. Generalizing variational autoencoders with hierarchical empirical Bayes. *arXiv*. 2007.10389.

- [7] S. Raghavan*, P.S. Winter*#, A.W. Navia*, H.L. Williams*, A. DenAdel, R.L. Kalekar, J. Galvez-Reyes, K.E. Lowder, N. Mulugeta, M.S. Raghavan, A.A. Borah, K.S. Kapner, S.A. Väyrynen, A. Dias Costa, R. W.S. Ng, J. Wang, E. Reilly, D.Y. Ragon, L.K. Brais, A.M. Jaeger, L.F. Spurr, Y.Y. Li, A.D. Cherniack, I. Wakiro, A. Rotem, B.E. Johnson, J.M. McFarland, E.T. Sicinska, T.E. Jacks, T.E. Clancy, K. Perez, D.A. Rubinson, K. Ng, J.M. Cleary, **L. Crawford**, S.R. Manalis, J.A. Nowak, B.R. Wolpin†, W.C. Hahn†, A.J. Aguirre†#, A.K. Shalek†#. The tumor microenvironment drives transcriptional phenotypes and their plasticity in metastatic pancreatic cancer. *bioRxiv*. 2020.08.25.256214.
- [8] M.C. Turchin#, G. Darnell, **L. Crawford**#, and S. Ramachandran#. Pathway analysis within multiple human ancestries reveals novel signals for epistasis in complex traits. *bioRxiv*. 2020.09.24.312421.
- [9] S.P. Smith, S. Shahamatdar, W. Cheng, S. Zhang, J. Paik, M. Graff, C. Haiman, T.C. Matise, K.E. North, U. Peters, E. Kenny, C. Gignoux, G. Wojcik, **L. Crawford**†, and S. Ramachandran†#. Redefining replication in multi-ancestry genome-wide association studies. *bioRxiv*. 2021.04.20.440612.

SOFTWARE

- [1] **BAKR**: Bayesian Approximate Kernel Regression
- [2] **BANNs**: Biologically Annotated Neural Networks
- [3] **gene-ε**: A Recalibrated Hypothesis Test for Sets of SNP-Level Summary Statistics
- [4] **Grid-LMM**: Fast and Flexible Linear Mixed Models for Genetic Association Studies
- [5] **HEBAE**: Hierarchical Empirical Bayes Autoencoder
- [6] **MAPIT**: MArginal ePIstasis Test
- [7] **MAPIT-R**: MArginal ePIstasis Test for Regions and SNP-Sets
- [8] **MegaLMM**: Mega-scale Linear Mixed Models for Multivariate Genomic Prediction
- [9] **RATE**: RelATive cEntrality Measures for Variable Prioritization
- [10] **SECT**: The Smooth Euler Characteristic Transform
- [11] **SINATRA**: Pipeline for Sub-Image Analysis and Feature Selection on 3D Shapes
- [12] **Tropix**: Tropical Sufficient Statistics for Persistent Homology

AWARDS & FELLOWSHIPS

Cell Press: 1000 Inspiring Black Scientists in America	2021
David & Lucille Packard Foundation Fellowship for Science and Engineering	2020
Mathematically Gifted & Black: Black History Month Honoree	2020
The Root: 100 Most Influential African Americans in 2019	2019
Endowed Named Assistant Professorship	2019
Alfred P. Sloan Research Fellowship	2019
Forbes 30 Under 30 Class of 2019: Science	2019
Leonard J. Savage Thesis Award in Applied Methodology	2018
National Science Foundation (NSF) Graduate Research Fellowship	2015
Duke University Dean Graduate Fellowship	2013
Isabella T. Jenkins Outstanding Academic Achievement Award	2013
J.J. Dennis Endowed Undergraduate Fellowship	2012
Clark Atlanta University Provost Scholarship	2009

SPONSORED RESEARCH

P20GM103645 (PI Sanes)	09/01/18 – 09/08/20
NIH/NIGMS	
Title: <i>COBRE Center for Central Nervous System Function</i>	
Role: Core B Co-Investigator	

2U10CA180794 (PIs Gray and Gatsonis) 03/01/19 – 09/08/20
NIH/NCI/Dana Farber Cancer Institute
Title: *ECOG-ACRIN Network Group Statistics and Data Management Center*
Role: Biostatistician

W81XWH-18-1-018 (PI Somarelli) 09/01/18 – 08/31/21
DoD/PCRP
Title: *Targeting the p38/Snail/PD-L1 axis in Hormone-therapy Resistance and Metastasis*
Role: Co-Investigator

P20GM109035 (PI Rand) 03/01/19 – 02/28/21
NIH/NIGMS
Title: *COBRE Center for Computational Biology of Human Disease*
Project Title: *Deep learning Methods for Fine Mapping and Discovery in Genomic Association Studies*
Role: Principal Investigator of Project

FG-2019-11622 (PI Crawford) 09/15/19 – 09/14/21
Alfred P. Sloan Foundation Research Fellowship
Title: *Interpretable Machine Learning Methods for Genome-wide Association Mapping*
Role: Principal Investigator

2020-71387 (PI Crawford) 10/15/20 – 10/14/25
David & Lucille Packard Foundation Fellowship for Science and Engineering
Role: Principal Investigator

**INVITED
TALKS**

AS ASSISTANT PROFESSOR / SENIOR RESEARCHER

University of Chicago, Department of Statistics Colloquium, Chicago, IL 2021
Joint Statistical Meetings, Biometrics Invited Session, Virtual Meeting 2021
SMB, Data-Driven Modeling and Analysis in Mathematical Biology, Virtual Meeting 2021
Great Lakes Bioinformatics Conference, Keynote Speaker, Virtual Meeting 2021
ICLR, Geometrical and Topological Representation Learning Workshop, Virtual Meeting 2021
IMSI, Topological Data Analysis Workshop, Chicago, IL 2021
New York University and ETH Zürich, Math and Data (MAD+) Seminar, Virtual Meeting 2021
Columbia University, DSI Distinguished Speaker Series, New York, NY 2021
ProbGen, Quantitative Genetics and Association Mapping Session, Cold Spring Harbor, NY 2021
University of Michigan, Dept. of Biostatistics Seminar, Ann Arbor, MI 2021
Princeton University, Quantitative and Computational Biology Seminar Series, Princeton, NJ 2021
Johns Hopkins University, Dept. of Biostatistics Seminar Series, Baltimore, MD 2021

NeurIPS, Topological Data Analysis and Beyond Workshop, Virtual Meeting 2020
University of Colorado, Biostatistics Seminar Series, Aurora, CO 2020
University of Wisconsin-Madison, Dept. of Statistics Seminar, Madison, WI 2020
University of North Carolina, Dept. of Biostatistics Seminar, Chapel Hill, NC 2020
University of Pennsylvania, The Wharton School Statistics Seminar, Philadelphia, PA 2020
Rochester Institute of Technology, Mathematical Modeling Seminar, Rochester, NY 2020
The Black Women in Computational Biology Network, Seminar Series, Virtual Meeting 2020
Joint Statistical Meetings, Biometrics Invited Session, Philadelphia, PA 2020
Stanford University, Statistics Department Seminar, Palo Alto, CA 2020
Brown University, Rhode Island IDeA Symposium (Invited Science Talk), Providence, RI 2020
University of Arkansas for Medical Sciences, Biomedical Informatics Seminar, Little Rock, AR 2020
Microsoft Research New England, Seminar Series, Cambridge, MA 2020
ENAR Spring Meeting, Invited Session, Nashville, TN 2020
Brown University and Lifespan, Populations Science Group Meeting, Providence, RI 2020
Duke University, Sloan Research Summit (Keynote Speaker), Durham, NC 2020
University of Massachusetts Amherst, Statistics and Probability Seminar, Amherst, MA 2020

NES/MAA Fall Meeting, Plenary Talk, Wellesley, MA 2019

Broad Institute of MIT and Harvard, Models, Inference & Algorithms Seminar, Cambridge, MA	2019
Duke University, Computational Biology Seminar, Durham, NC	2019
Joint Statistical Meetings, IMS Invited Session, Denver, CO	2019
WNAR/IMS/JR Meeting, IMS Invited Session, Portland, OR	2019
33rd New England Statistics Symposium (NESS), Hartford, CT	2019
UC Irvine, Dept. of Statistics Seminar, Irvine, CA	2019
Brown University, Center for Computational Biology of Human Disease Seminar, Providence, RI	2019
ENAR Spring Meeting, IMS Invited Session, Philadelphia, PA	2019
University of Connecticut, Dept. of Statistics Seminar, Storrs, CT	2018
University of Michigan, Dept. of Biostatistics Seminar, Ann Arbor, MI	2018
Harvard University, Data Science Initiative Conference, Cambridge, MA	2018
Brown University, Pattern Theory Seminar Series, Providence, RI	2018
ISBA World Meeting, Edinburgh, Scotland, UK	2018
College of the Holy Cross, Pi Mu Epsilon (PME) Colloquium, Worcester, MA	2018
ENAR Spring Meeting, Geometry and Topology in Statistical Inference Workshop, Atlanta, GA	2018
42nd SIAM-SEAS, Statistical Topological Data Analysis Mini Symposium, Chapel Hill, NC	2018
ICERM, NSF TRIPODS: Geometry and Topology of Data Workshop, Providence, RI	2017
NeurIPS, Synergies in Geometric Data Analysis Workshop, Long Beach, CA	2017
Brown University, Data Science Initiative Seminar, Providence, RI	2017
Brown University, Center for Computational Molecular Biology Seminar, Providence, RI	2017
Brown University, Applied Topology and Geometry Seminar, Providence, RI	2017
SIAM AG'17, Statistics and Applied Algebraic Topology Workshop, Atlanta, GA	2017

PROFESSIONAL AFFILIATIONS American Statistical Association (ASA); Genetics Society of America (GSA); International Biometric Society Eastern North American Region (IBS ENAR); International Society for Bayesian Analysis (ISBA)

SERVICE ACTIVITIES

EDITORIAL SERVICE

<i>Biostatistics</i> (Associate Editor)	2021 – Present
<i>Journal of the American Statistical Association</i> (AE of Reproducibility for A&CS)	2018 – Present

EXTERNAL SERVICE

ISBA Section on Biostats and Pharma (Treasurer)	2021 – Present
IBS ENAR Regional Advisory Board	2020 – Present

PROFESSIONAL SERVICE

Probabilistic Modeling in Genomics (ProbGen), Virtual Meeting Session: Quantitative Genetics and Association Mapping (Co-Chair)	2021
--	------

Intelligent Systems for Molecular Biology (ISMB), Virtual Meeting European Conference on Computational Biology (ECCB), Virtual Meeting Proceedings Program Committee	2021
--	------

REVIEWER SERVICE

American Journal of Human Genetics; Annals of Applied Statistics; Bioinformatics; Biostatistics; BMC Bioinformatics; Conference on Neural Information Processing Systems (NeurIPS); Genes; International Conference on Artificial Intelligence and Statistics (AISTATS); International Conference on Machine Learning (ICML); Journal of the American Statistical Association; Journal of Animal Science; Journal of Computational and Graphical Statistics; Journal of Machine Learning Research; Journal of Multivariate Analysis; New England Journal of Medicine; PLOS Genetics

INSTITUTIONAL SERVICE (BROWN UNIVERSITY)

Brown University: DSI Campus Advisory Board	2021 – Present
Brown University: Goldwater Scholarship Nomination Committee	2019 – 2020
School of Public Health: Operational Planning Committee	2019 – 2020

Department of Biostatistics: PhD Admissions Committee	2018 – 2020
Department of Biostatistics: Seminar Series Organizer	2018 – 2020
Department of Biostatistics: Communications Committee	2017 – 2020
Department of Biostatistics: Academic Programs Committee	2017 – 2020
Center for Computational Molecular Biology: PhD Admissions Committee	2017 – 2020

**MENTORSHIP
ACTIVITIES**

POSTDOCTORAL FELLOWS

Greg Darnell (Co-advised by Sohini Ramachandran)	2019 – 2020
--	-------------

DOCTORAL STUDENTS

Wei Cheng (Computational Biology; Co-advised by Sohini Ramachandran)	Present
Alan DenAdel (Computational Biology)	Present
Chibuikem Nwizu (Warren Alpert Medical School/Computational Biology)	Present
Wai Shing Tang (Physics)	Present
Dana Udwin (Biostatistics)	Present
Emily Winn (Applied Mathematics)	Present

DOCTORAL DISSERTATION COMMITTEES

Dilum Aluthge (Warren Alpert Medical School/Computational Biology)	Present
Ashley Conard (Computational Biology)	Present
Pinar Demetci (Computational Biology)	Present
Kun Meng (Biostatistics)	Present
David M. Morgan (Ecology and Evolutionary Biology)	Present
Adrienne Parsons (Molecular Pharmacology, Physiology, and Biotechnology)	Present
Samuel Smith (Computational Biology)	Present
Qing Wu (Computational Biology)	Present
Haobo Yang (Chemistry)	Present

Dhananjay Bhaskar (Biomedical Engineering)	2021
Sahar Shahamatdar (Computational Biology)	2021

MASTERS THESIS ADVISING

Alexander Li (Biostatistics)	2021
Isaac Zhao (Biostatistics)	2019
Bruce Wang (Data Science Initiative)	2018

UNDERGRADUATE HONORS THESIS ADVISING

Erin Bugbee (Statistics)	2020
Gabrielle Ferra (Applied Math-Biology)	2020
Kayla Scharfstein (Applied Math-Computer Science)	2020
Zachary Kaplan (Applied Math)	2019
Timothy Sudijono (Applied Math)	2019

**COURSES
TAUGHT**

- PHP0100 - First Year Seminar: Statistics is Everywhere
- PHP2601 - Linear Models
- PHP2605 - Generalized Linear Models
- PHP2950 - Doctoral Seminar in Public Health

[CV compiled on 2021-05-05]