

Lorin Crawford

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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; #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# (2020). The landscape of glycogen synthase kinase-3 beta (GSK-3b) genomic alterations in cancer. *Molecular Cancer Therapeutics*. In Press.

PREPRINTS (*CO-FIRST 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] B. Wang*, T. Sudijono*, H. Kirveslahti*, T. Gao, D.M. Boyer, S. Mukherjee, and **L. Crawford**#. A statistical pipeline for identifying physical features that differentiate classes of 3D shapes. *bioRxiv*. 701391.
- [4] 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.
- [5] A.N. Spierer#, J.A. Mossman, S.P. Smith, **L. Crawford**, S. Ramachandran, and D.M. Rand#. Natural variation in the regulation of neurodevelopmental genes modifies flight performance in *Drosophila*. *bioRxiv*. 2020.05.27.118604.
- [6] 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.
- [7] 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.
- [8] W. Cheng, G. Darnell, S. Ramachandran, and **L. Crawford**#. Generalizing variational autoencoders with hierarchical empirical Bayes. *arXiv*. 2007.10389.

- [9] 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, 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#. Transcriptional subtype-specific microenvironmental crosstalk and tumor cell plasticity in metastatic pancreatic cancer. *bioRxiv*. 2020.08.25.256214.
- [10] 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.

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

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: <i>ECOG-ACRIN Network Group Statistics and Data Management Center</i>	
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

**INVITED
TALKS**

AS ASSISTANT PROFESSOR / SENIOR RESEARCHER

IMSI, Topological Data Analysis Workshop, Chicago, IL	2021
NeurIPS, Topological Data Analysis and Beyond Workshop, Virtual Meeting	2020
University of Colorado, Biostatistics Seminar Series, Aurora, CO	2020
University of Wisconsin-Madison, Department of Statistics Seminar, Madison, WI	2020
University of North Carolina, Department 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

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>Journal of the American Statistical Association (AE of Reproducibility for A&CS)</i>	2018 – Present
	REVIEWER SERVICE	
	<i>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; PLOS Genetics</i>	
	EXTERNAL SERVICE	
	IBS ENAR Regional Advisory Board	2020 – Present
	INSTITUTIONAL SERVICE (BROWN UNIVERSITY)	
	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	
	Pinar Demetci (Computational Biology)	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) Advisor: Neil Sarkar	Present
	Dhananjay Bhaskar (Biomedical Engineering) Advisor: Ian Wong	Present
	Wei Cheng (Computational Biology) Advisor: Sohini Ramachandran	Present
	Ashley Conrad (Computational Biology) Advisor(s): Erica Larschan and Charles Lawrence	Present
	Kun Meng (Biostatistics) Advisor(s): Ani Eloyan	Present
	David M. Morgan (Ecology and Evolutionary Biology) Advisor: Daniel Weinreich	Present

Adrienne Parsons (Molecular Pharmacology, Physiology, and Biotechnology) Advisor: Eric Darling	Present
Sahar Shahamatdar (Computational Biology) Advisor: Sohini Ramachandran	Present
Samuel Smith (Computational Biology) Advisor: Sohini Ramachandran	Present
Haobo Yang (Chemistry) Advisor: Brenda Rubenstein	Present
MASTERS THESIS ADVISING	
Alexander Li (Biostatistics)	Present
Patricia Vera-González (Biostatistics)	Present
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 2020-10-01]