Jacob Calvert

Education

University of California, Berkeley, USA
Ph.D. Statistics, starting fall 2017

University of Oxford, Oxford, UK
M.Sc. Mathematical and Theoretical Physics, July 2017
Thesis: *Integrable probability and KPZ universality* with Ben Hambly

University of Bristol, Bristol, UK
M.Sc. Mathematical Sciences with distinction, September 2016
Thesis: *Interacting particle system models of hillslope formation* with Márton Balázs

University of Illinois at Urbana-Champaign, USA
B.S. Bioengineering with highest honors, May 2015

Funding & Awards

National Funding

2017 NIH SBIR Phase I Grant (awarded via Dascena, Inc.)
2016 NSF STTR Phase I Grant (also via Dascena, Inc.)
2015 NSF Graduate Research Fellowship (declined for Marshall Scholarship)
2015 Marshall Scholarship
2014 Barry M. Goldwater Scholarship
2014 NSF Center for the Physics of Living Cells $10k Pilot Grant

University of Illinois Awards

2015 Outstanding Science & Math Presentation, Undergrad Research Symposium
2015 Senior 100 Honorary
2014 Riverside Research Innovation Award
2014 Office of Undergraduate Research Travel Grant (for 2015)
2014 Undergraduate Research Certificate
2014 Office of Undergraduate Research Travel Grant (for 2014)
2013 Imagine the Impossible Award, Engineering Open House
2013 Spirit of Illini Engineering Award, Engineering Open House
2012 Best Presentation of Society, Engineering Open House
2011 Edmund J. James Scholar, Illinois Honors Program
2011 Helen Lohmeyer Memorial Scholarship

Papers

1. Hwang H, Kreig A, **Calvert J**, Lormand J, Kwon Y, Daley J, Sung P, Opresko P, Myong S. Telomere overhang accessibility to telomerase and ALT associated proteins depends on telomeric repeat number. *Structure*. 2014; 22(6): 842-853. (**Featured article**)
2. Kreig A, **Calvert J**, Sanoica J, Cullum E, Tipanna R, & Myong S. G-quadruplex formation in double strand DNA probed by NMM and CV fluorescence. *Nucleic Acids Research*. 2015; 43(16): 7961-7970.
3. **Calvert J**, Price D, Barton C, Chettipally U, Das R. Discharge recommendation based on a novel technique of homeostatic analysis. *Journal of the American Medical Informatics Association*. 2016; ocw014.
4. Kim M, Kreig A, Lee CY, Rube HT, **Calvert J**, Song J, Myong S. Quantitative analysis and prediction of G-quadruplex forming sequences in double-stranded DNA. *Nucleic Acids Research*. 2016; 44(10): 4807-4817.
5. **Calvert J**, Desautels T, Chettipally U, Barton C, Hoffman J, Jay M, Mao Q, Mohamadlou H, Das R. High-performance detection and early prediction of Septic shock for alcohol-use disorder patients. *Annals of Medicine and Surgery*. 2016; 8: 50-55.

6. **Calvert J**, Price D, Chettipally U, Barton C, Feldman M, Hoffman J, Das R. A computational approach to early sepsis detection. *Computers in Biology and Medicine*. 2016; 74: 69-73. (**Ranked by reviewers and editorial board as one of the top 16 papers published in CBM in 2016.**)
7. **Calvert J**, Mao Q, Rogers A, Barton C, Jay M, Desautels T, Mohamadlou H, Jan J, Das R. A computational approach to mortality prediction of alcohol use disorder inpatients. *Computers in Biology and Medicine*. 2016; 75: 74-79.
8. **Calvert J**, Mao Q, Hoffman J, Jay M, Desautels T, Mohamadlou H, Chettipally U, Das R. Using electronic health record collected clinical variables to predict medical intensive care unit mortality. *Annals of Medicine and Surgery*. 2016; 11: 52-57.
9. Desautels T, **Calvert J**, Hoffman J, Jay M, Kerem Y, Shieh L, Shimabukuro D, Chettipally U, Feldman MD, Barton C, Wales DJ, Das R. Prediction of sepsis in the Intensive Care Unit with minimal electronic health record data: a machine learning approach. *JMIR Medical Informatics*. 2016; 4(3): e28.
10. **Calvert J**, Hoffman J, Barton C, Shimabukuro D, Ries M, Chettipally U, Kerem Y, Jay M, Mataraso S, Das R. Cost and mortality impact of an algorithm-driven sepsis prediction system. *Journal of Medical Economics*. 2017.
11. Desautels T, **Calvert J**, Hoffman J, Mao Q, Jay M, Fletcher G, Barton C, Chettipally U, Kerem Y, Das R. Using transfer learning for high accuracy mortality prediction in a data-scarce hospital setting. *Biomedical Informatics Insights*. 2017; 9: 1-8.
12. Desautels T, Das R, **Calvert J**, Trivedi M, Summers C, Wales D, Ercole A. Predicting early unplanned intensive care unit readmission in a tertiary-care hospital: a cross-sectional machine learning approach *BMJ Open* (accepted). 2017.

Submitted

1. Mao Q, Jay M, Hoffman J, **Calvert J**, Barton C, Shimabukuro D, Shieh L, Chettipally U, Fletcher G, Kerem Y, Zhou Y, Das R. Validation of a sepsis prediction algorithm using only vital sign data in the emergency department, general ward and ICU.

In prep

1. **Calvert J**, Balázs M. Hydrodynamics of a weakly asymmetric zero-range process with closed boundaries.
2. **Calvert J**, Michaelides K, Balázs M. Connecting microscopic and macroscopic descriptions of hillslope evolution.
3. **Calvert J**, Kreig A, Tippana R, Sinha S, Myong S. Computational prediction of G-quadruplex formation in double-stranded DNA.

National talks

1. **Calvert J**, Kreig A, Sinha S, Myong S. Computational Prediction of G-quadruplex Formation. *Biophysical Society Annual Meeting,* Baltimore, MD. February, 2015.
2. **Calvert J**, Kreig A, Sinha S, Myong S. Computational Prediction of G-quadruplex Formation. *Biomedical Engineering Society Annual Meeting,* San Antonio, TX. October, 2014.
3. **Calvert J**, Hwang H, Kreig A, Myong S. Telomere Overhang Accessibility Depends on Telomeric Repeat Number. *Biomedical Engineering Society Annual Meeting,* Seattle, WA. September, 2013.

Posters

1. **Calvert J**, Kreig A, Saurabh S, Myong S. Predicting G-quadruplex Formation. *8th Annual Undergraduate Research Symposium,* Champaign, IL. April, 2015.
2. Sanoica J, **Calvert J**, Kreig A, Tipanna R, Myong S. Rapid Characterization of G-quadruplexes in Double-Stranded DNA. *Biomedical Engineering Society Annual Meeting,* San Antonio, TX. October, 2014.
3. **Calvert J**, Kreig A, Myong S. Computational Modeling and Prediction of G-quadruplex Formation. *Graduate Cancer Community Symposium,* Champaign, IL. September, 2014.
4. **Calvert J**, Kreig A, Saurabh S, Myong S. Computational Modeling and Prediction of G-quadruplex Formation. *7th Annual Undergraduate Research Symposium,* Champaign, IL. May, 2014.
5. Kreig A, **Calvert J**, Tippana R, Myong S. G-quadruplex DNA Folding and Dynamics within Duplex DNA. *Biophysical Society Annual Meeting,* San Francisco, CA. February, 2014.

6. **Calvert J**, Kreig A, Sinha S, Myong S. Probabilistic Modeling of G-quadruplex Formation. *Illinois Bioengineering 10th Anniversary Symposium,* Champaign, IL. November, 2013.
7. **Calvert J**, Hwang H, Kreig A, Myong S. Regulation of Human Telomere Accessibility by G-quadruplex DNA. *Illinois Bioengineering 10th Anniversary Symposium,* Champaign, IL. November, 2013.
8. **Calvert J**, Kreig A, Myong S. Computational Modeling and Prediction of G-quadruplex Formation. *Biomedical Engineering Society Annual Meeting,* Seattle, WA. September, 2013.
9. **Calvert J**, Hwang H, Kreig A, Myong S. G-quadruplex DNA and the Regulation of Human Telomere Accessibility. *6th Annual Undergraduate Research Symposium,* Champaign, IL. April, 2013.

Research Experience

University of Oxford, Oxford, UK. March 2017 to June 2017.

I wrote a thesis detailing the development of the Schur and Macdonald measures, beginning with their representation-theoretic underpinnings and leading to their use in analyzing integrable systems, particularly in the context of the Kardar-Parisi-Zhang universality class. I was advised by Ben Hambly.

University of Bristol, Bristol, UK. May 2016 to Sep 2016.

I wrote a thesis on interacting particle systems and applied my results to a fundamental problem in geomorphology–hillslope evolution. In particular, I solved a gradient zero-range process with novel boundary conditions, which was motivated by the application, and identified its scaling limit. This work is being split into two manuscripts, one focused on the use of such techniques in geomorphology and a second on the rigorous proof of the scaling limit. I worked with Márton Balázs and Katerina Michaelides.

Dascena, Inc, Hayward, California. Jun 2015 to Jun 2016.

As chief technical officer, I led a team of seven (including four Ph.D. scientists) in the application of machine learning techniques to disease prediction. During this time, I oversaw the development of our core technology from the prototype stage through to its implementation in a Midwestern hospital system. I communicated our work through 7 papers and authored several grants, two of which have been funded.

University of Illinois at Urbana-Champaign, Champaign, Illinois. Jan 2012 to Sep 2015.

Project 9. May 2013 to Sep 2015. I developed a simple probabilistic model of the formation of DNA structures called G-quadruplexes (GQs) and implemented a learning algorithm to fit the model's parameters using *in vivo* experimental data. My results challenge a longstanding view that GQs broadly influence genomic regulatory processes and suggest an evolutionary mechanism by which GQs are used to suppress tumor formation. I worked with Saurabh Sinha and Sua Myong.

Project 8. Sep 2014 to Sep 2015. For my senior design project, I designed and built a low-cost glucose detection device, which had a 300-fold improvement in sensitivity over the industry standard and was an order of magnitude cheaper. I worked with the company GlucoSentient.

Project 7. Dec 2014 to Jan 2015. I calculated information-theoretic surprisal for 3-grams, based on a corpus of books and magazine articles, and used the results to compare the language used in a personal essay of mine with the concluding passages of James Joyce's *Ulysses*. This was independent work.

Project 6. Sep 2014 to Dec 2014. I performed the first molecular dynamics simulation of a GQ in double-stranded DNA, which demonstrated that nearby stretches of DNA could interact with and destabilize it. I worked with Zaida Luthey-Schulten.

Project 5. Jan 2014 to Dec 2014. I simulated the forces exerted by liquids on mixtures of grains in materials like adobe, to better understand the properties of naturally self-healing materials. I worked with Alfred Hübler.

Project 4. Dec 2013 to Jan 2014. I programmed simulations of cardiac sync and avalanches, based on the biological oscillator work of Strogatz and the sandpile model of Bak, Tang, and Wiesenfeld. This

was independent work.

Project 3. May 2013 to Sep 2013. I developed a rapid, chemical mix-and-measure GQ characterization method, which relied on the specificity of two drugs to different conformations of GQ structure. This test is orders of magnitude cheaper and faster than other GQ characterization methods, and enables the parallelization of GQ experiments. I worked with Sua Myong.

Project 2. May 2012 to May 2013. I developed a biophysical assay for testing the stability of DNA secondary structures, the application of which led to the discovery of a natural anticancer mechanism. I worked with Sua Myong.

Project 1. Jan 2012 to May 2012. I wrote scripts in Perl to sift through genomes and find the coordinates of non-overlapping intergenic regions. I worked with Jian Ma.

Teaching & Service

Peer Reviewer, Sep 2016 to present.
Reviewing manuscripts for Journal of Medical Internet Research, Annals of Medicine and Surgery, Biomedical Informatics Insights.

Course Representative, School of Mathematics, University of Bristol. Sep 2015 to Sep 2016.
Served as the liaison between the taught-course graduate math students and the science faculty.

Teaching Assistant (BIOE 310), Dept. of Bioengineering, UIUC. Jan 2015 to May 2015.
Graded and held office hours for a biological data analysis course.

Course Developer, Dept. of Bioengineering, UIUC. May 2014 to May 2015.
Developed a new biostatistics lab course, designed/tested all lab modules.

Consultant, Student Consultants on Teaching, UIUC. Aug 2013 to May 2015.
Evaluated lecturer performance, reviewed educational grants.

Engineering Ambassador, College of Engineering, UIUC. Feb 2013 to May 2015.
Presented engineering concepts to K-12 students.

Outreach Instructor, Middle School Science Outreach Program. Aug 2012 to May 2015.
Organized lecture series on quantitative biology for middle school students.

Director of Information, Biomedical Engineering Society, UIUC. Aug 2011 to May 2015.
Oversaw the development of web-based resources for members.

Course Grader (BIOE 476), Dept. of Bioengineering, UIUC Aug 2014 to Dec 2014.
Graded for a senior-level tissue engineering course.

Dean's Student Advisory Committee, Engineering Council, UIUC. May 2013 to May 2014.
Met monthly with College of Engineering Deans, organized student focus groups.

Course Assistant (BIOE 206), Dept. of Bioengineering, UIUC Aug 2013 to Dec 2013.
Guest-lectured, graded, advised final projects, and hosted review sessions.

Course Assistant (BIOE 220), Dept. of Bioengineering, UIUC. Aug 2013 to Dec 2013.
Created statistical thermodynamics problem sets.

Project Leader, Engineering Open House, UIUC. Jan 2012 to May 2013.
Led a team in the development of a device for magnet control with muscle potential.

Other Info

- Languages: Expertise in MATLAB; proficiency in LaTeX; familiar with Perl, Python, C, SQL
- Web dev: HTML, CSS, Dreamweaver, cPanel
- Hobbies: Recreational programming, thriller-genre films, tennis, electric blues guitar