Jason Karl Davis

PhD Candidate, Applied Mathematics

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▬▬▬ Research Statement

I am interested in quantitatively understanding the dynamics of prion protein aggregation and propagation. Much of this biology is rooted in inherently stochastic processes, though probabilistic models have hitherto been avoided in the literature due to the intractability that comes with the enormous state-spaces that arise from complex Markov chain models. I am developing stochastic theory, tools, and models that accurately capture important biology while remaining grounded in a computationally feasible framework.

▬▬▬ Education

2012–present	**PhD, Applied Mathematics (Expected 2017)**, *Univ. of California, Merced*, Merced, CA. *Advisor:* Prof. Suzanne S. Sindi. *Dissertation Title:* Mathematical Models of Prions in *S. cerevisiae*.
2009–2011	**MS, Mathematics and Statistics**, *Georgetown University*, Washington, DC.
2004-2008	**ScB, Mathematics and AB, Education Studies**, *Brown University*, Providence, RI.

▬▬▬ Publications

○ Vinson, David W., Davis, Jason K., Sindi, Suzanne S., and Dale, Rick. "Efficient n-gram analysis in R with cmscu." Behavior research methods 48.3 (2016): 909-921.

○ Davis, Jason K., and Sindi, Suzanne S. "Initial condition of stochastic self-assembly." *Physical Review E* 93.2 (2016): 022109.

○ Davis, Jason K., and Sindi, Suzanne S. "A mathematical model of the dynamics of prion aggregates with chaperone-mediated fragmentation." *Journal of Mathematical Biology* (2015): 1-24.

○ Davis, Jason K., and Sindi, Suzanne S. "A study in nucleated polymerization models of protein aggregation." *Applied Mathematics Letters* 40 (2015): 97-101.

▬▬▬ Manuscripts in Progress

○ Davis, Jason K. and Sindi, Suzanne S. "A Stochastic Model of *in vivo* Prion Loss in *S. cerevisiae*."
We derive general theory for the sojurn time of a semi-Markov jump process with transitions on two time-scales, where the fast scale has only Markovian jumps and the slow scale has Gamma-distributed jumps.

○ Davis, Jason K. and Sindi, Suzanne S. "Characterizing the Stability of Prion Strains."
S. cerevisiae has many prion proteins, each admitting multiple, distinct misfoldings with different "phenotypes." We present a stochastic model for the immediate dynamics following the initial misfolding of the protein, explore its implications on what traits are favored in prion strains, and validate our analysis against experimental data.

○ Serio, Tricia, Sindi, Suzanne S., Davis, Jason K, et al. "Utilizing Interdisciplinary Multiscale Methods to Reveal the Mechanisms of PSI Induction."
This paper follows biological experimentation inspired by mathematical modeling and concludes distinct prion strains emerge from distinct nucleation processes. These differences provide an elegant explanation for the observed stability of various strains *in vivo* and agree with experiments where this stability is perturbed via gene regulation.

Conference Presentations and Workshops

July 2016	**SIAMLS 2016**, *Boston, MA*, "A Stochastic Two-Hit Model of Prion Disease".
Jan 2016	**JMM 2016**, *Seattle, WA*, "Better Initial Conditions for Homogeneous Self-Assembly Problems".
Nov 2015	**SCiP 2015**, *Chicago, IL*, "Computation, Collaboration, and n-grams".
July 2015	**SMB 2015**, *Atlanta, GA*, "An Enzyme-Limited, Nucleated Polymerization Model of Prion Aggregates".
Jan 2015	**JMM 2015**, *San Antonio, TX*, "Solution of a Recurrence Relation Governing Prion Aggregation and Fragmentation".
June 2014	**ECMTB 2014**, *Gothenburg, Sweden*, "Enzyme-Limited Prion Fragmentation".
Jan 2014	**JMM 2014**, *Baltimore, MD*, "Enzyme-Limited Prion Fragmentation".
Oct 2013	**ICMA IV**, *Lubbock, TX*, "Enzyme-Limited Prion Fragmentation".
July 2010	**IMSM 2010**, *Raleigh, NC*. Industrial Math/Stat Modeling Workshop for Graduate Students, hosted by SAMSI.

Honors and Awards

2013	**Applied Mathematics Summer Fellowship**. Awarded via competitive application in order to conduct research during the summer term.
2013	**Applied Mathematics Academic Term Research Award**. Awarded via competitive application for TA-relief in order to focus on my research.

Teaching Experience

2013 Teaching Associate, *University of California*, Merced, CA.
- Instructor of Record for MATH32: Probability and Statistics (Summer).
- Received overwhelmingly positive feedback from the students for my take on the introductory material and its integration with data-analysis lab assignments in R.

2012–2013 Graduate Teaching Assistant, *University of California*, Merced, CA.
- Teaching Assistant for MATH141: Linear Analysis (Fall, both 2012 and 2013).
- Nominated for "Teaching Assistant of the Year" by the students (2012).

2007–2008 Undergraduate Teaching Assistant, *Brown University*, Providence, RI.
- Teaching Assistant for CS22: Introduction to Discrete Structures and Probability (Spring 2008).
- Teaching Assistant for ED101: The Craft of Teaching (Fall 2006 and 2007).

Professional Experience

2008–2012 Assistant Program Manager, *Air Force Office of Scientific Research*, Arlington, VA.
- Assisted in the management and execution of over $80 million annually of basic research funds in applied mathematics and computer science.
- Coordinated with business functionals and grant/contract awardees to ensure performance milestones and deliverables were met.
- Managed 2 small business research (STTR) programs in quantum nanowires and nanoparticle tethers.

Leadership and Service

2015–2016 **Graduate Student Association**, President.

As president of the graduate student body, I
- managed a council of executive officers,
- interfaced with UC Merced administration to represent and advocate for graduate student needs,
- and participated in numerous high-level committee meetings regarding hires, university growth, and graduate school policies.

2014–2015 **Quantitative, Analytic, and Computational Consulting**, Founding Member.

As a founding member of QACC, I
- helped identify a campus opportunity to share quantitative knowledge and expertise across disciplines and departments,
- started a GPU-programming working group for graduate students to participate in,
- and co-organized a "scientific computing boot-camp" for incoming graduate students to get rapidly acquainted to UNIX environments and cluster computing.

2013–2015 **SIAM UC Merced Chapter**, President.

As president of the local SIAM chapter, I
- restarted the inactive chapter,
- broadened its membership,
- and initiated a recurring, student-led seminar series.

2013–2014 **Graduate Student Association**, External Vice President.

As external vice president of the graduate student body, I
- participated in monthly, University of California system-wide meetings of elected student body leaders,
- helped identify and organize grassroots initiatives sponsored by the UC Student Association,
- and lobbied in Sacramento on behalf of UC Merced.