

# Renee Dale, MS

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## Areas of specialization

Mathematical Biology • Computational Biology • Biostatistics • Bayesian Statistics • Mathematical Biology Education • Plant Biology • Parameter Estimation Techniques

## Education

- 2019 PhD in Biological Sciences, LSU  
*Dissertation: Dynamical Modeling in Cell Biology with Ordinary Differential Equations*
- 2019 MS in Experimental Statistics, LSU  
*Thesis: Parameter Estimation and Optimization for Mathematical Models using Bayesian Statistics*
- 2015 MS in Biological Sciences, LSU  
*Thesis: Mathematical Model of the Split Firefly Luciferase Assay*
- 2013 BS in Biological Sciences, LSU
- 2013 BA in Philosophy, LSU  
*Thesis: Empathy, Altruism, and Prosocial Behavior in Humans and Primates*

## Current position

*PhD Candidate*, Biological Sciences, Louisiana State University  
& *MS Candidate*, Experimental Statistics, Louisiana State University

## Teaching Experience

- 2013-2019 Teaching Assistant, LSU
- 2017 Guest Instructor, LSU Research Assistant, Biological Sciences, LSU
- 2017 Research Assistant, Mathematics, LSU

## Journal articles

SUBMITTED

- 11 **Dale, R.**, Kato, N., Wischusen, E. (2019) Modeling and analysis of the firefly luciferase reaction and the G-protein coupled receptor signaling pathway with ordinary differential equations increases self confidence in mathematical cell biology for novice graduate students. [Pre-print](#)

## IN PRESS

- 10 **Dale, R.**, Chen, Y., He, H. (2019) Hierarchical modeling of the effect of pre-exposure prophylaxis on HIV in the US. *Book Chapter*. Biostatistics and Computational Biology. Springer Press. [Pre-print](#)

## PUBLISHED

- 9 **Dale, R.**, Ohmuro, Y., Ueda, H., Kato, N. (2019) Non-Steady State Analysis of Enzyme Kinetics in Real Time Elucidates Substrate Association and Dissociation Rates: Demonstration with Analysis of Firefly Luciferase Mutants. *Biochemistry* 58, 2695–2702 (2019).
- 8 **Dale, R.**, Guo, B. (2018) Estimating epidemiological parameters of a stochastic differential model of HIV dynamics in the United States using hierarchical Bayesian statistics. *PLoS ONE* 13(7): e0200126. [Text](#)
- 7 Kumar, N., **Dale, R.**, Kemboi, D., Zeringue, E. A., Kato, N., Larkin, J. C. (2018) Functional Analysis of Short Linear Motifs in the Plant Cyclin-Dependent Kinase Inhibitor SIAMESE. *Plant Physiology*.
- 6 Chen, Y.C., **Dale, R.**, He, Hongyu, Le, Quoc-Anh T. (2017) Posterior Estimates of Dynamic Constants in HIV Transmission Modeling. *Computational and Mathematical Methods in Medicine*. [Text](#)
- 5 Brauer, E. K., Ahsan, N., **Dale, R.**, Kato, N., Coluccio, A. E., Piñeros, M. A., Kochian, L. V., Thelen, J. J., Popescu, S. C. (2016). The Raf-like kinase ILK1 and the high affinity K<sup>+</sup> transporter HAK5 are required for Innate Immunity and Abiotic Stress Response. *Plant Physiology*. pp.00035.2016. <http://dx.doi.org/10.1104/pp.16.00035>
- 4 **Dale, R.**, Kato, N. (2016). Truly quantitative analysis of the firefly luciferase complementation assay. *Current Plant Biology* 5(2016): 57-64.
- 3 **Dale, R.**, Ohmuro-Matsuyama, Y., Ueda, H., Kato, N. (2016). Mathematical Model of the Firefly Luciferase Complementation Assay Reveals a Non-Linear Relationship between the Detected Luminescence and the Affinity of the Protein Pair Being Analyzed. *PLoS ONE* 11(2): e0148256. [Text](#)
- 2 Kusmar, N., Harashima, H., Kalve, S., Bramsiepe, J., Wang, K., Sizani, B. L., Bertrand, L. L., Johnson, M. C., Faulk, C., **Dale, R.**, Simmons, L. A., Churchman, M. L., Sugimoto, K., Kato, N., Dasanayake, M., Beemster, G., Schnittger, A., Larkin, J. C. (2015). Functional Conservation in the SIAMESE-RELATED Family of Cyclin-Dependent Kinase Inhibitors in Land Plants. *Plant Cell* 27(11): 3065-3080
- 1 Fontenot, E. B., Ditusa, S. F., Kato, N., Olivier, D. M., **Dale, R.**, Lin, W. Y., Chiou, T. J., Macnaughtan, M. A., Smith, A. P. (2015). Increased phosphate transport of *Arabidopsis thaliana* Pht1;1 by site-directed mutagenesis of tyrosine 312 may be attributed to the disruption of homomeric interactions. *Plant Cell Environ* 38(10): 2012-2022.

## Honors & awards

- 2019 Midwest Dynamical Systems Travel Award, Early Career Conference
- 2019 Bath University Travel Award, 'Probability Meets Biology'
- 2019 Rice University Travel Award, AWM 2019
- 2018 European Student Council Symposium Travel Fellowship
- 2018 Finding Your Inner Modeler Year II Travel Award
- 2018 Parameter Estimation for Mechanistic Biological Models Workshop Travel award
- 2018 LSU McDaniel Scholarship

2018 SMB Landahl Travel Award  
 2018 Women in Math Networking Travel Award  
 2018 BAMM! Travel Award  
 2018 NextProf 2018 Workshop  
 2018 ASPB 2018 Travel Award  
 2017 CIRTl Associate  
 2017 *Plantae* Fellow  
 2017 International Conference on Health Policy and Statistics 2018 Travel Award  
 2017 Duke University *Geometry of Redistricting* Hackathon Travel Award  
 2017 International Society for Bayesian Analysis New Researcher Travel Award, O'Bayes  
 2017 Emory University *StatFest* Travel Award  
 2017 Women in Statistics and Data Science Travel Award  
 2017 SMB Subgroup on Immunology and Infection Travel Award  
 2017 NIMBioS *Pan-Microbial Trait Modeling* Travel Award  
 2017 LSU Graduate Student Travel Award  
 2017 Finding Your Inner Modeler Year I Travel Award  
 2017 Quantitative Cell Biology Network Workshop Travel Award  
 2013 Distinguished Communicator, Communication Across the Curriculum, LSU

## Grants

2018 SMB Education and Outreach Grant     *Video game for the promotion of plant biology and quantitative skill development in high school students*  
 2018 LSU Biograds     *Validation of a method to generate a system of differential equations from Boolean network models*  
 2018 LSU Libraries Open-Access Author Fund     *Estimating epidemiological parameters of a stochastic differential model of HIV dynamics in the United States using hierarchical Bayesian statistics*  
 2011 Sea Grant Undergraduate Research Grant     *Ideal CO<sub>2</sub> Concentration for Algal Growth*

## Talks

### INVITED TALKS

2019 Session Organizer, "Mathematical Plant Biology: A Collaborative Session", [Plant Biology 2019](#)  
 2019 Session Organizer, "Current Challenges in Mathematical Biology", Association for Women in Math [Research Symposium 2019](#).  
 2018 Session Chair, "Epidemiology Part B", Annual Meeting of the Society for Mathematical Biology, July 2018.

### CONTRIBUTED TALKS

2018 European Student Council Symposium     *Generation of nonlinear-differential-equations system from a model of Boolean relationships in Arabidopsis salt stress network*  
 2018 Finding Your Inner Modeler Year II     *Modeling red-light photoreceptor photobody formation in plants*  
 2018 Annual Meeting of the Society for Mathematical Biology     *Studying the effect of pre-exposure prophylaxis on the dynamics of different populations susceptible to HIV*

2018	CIRTL Teaching-As-Research Network	<i>Student gains in a graduate course on mathematical modeling in cell biology</i>
2018	2018 Sigma Xi Student Research Showcase	<i>Improved Mathematical Model Enhances Understanding of Endoreplication in Arabidopsis Trichomes with 4D Visualization</i>
2018	International Conference on Health Policy and Statistics 2018	<i>Bayesian Estimate of the Parameters of a Stochastic Differential Model of HIV Incidence in the United States</i>
2017	ULL Graduate Symposium	<i>Is the HIV epidemic over? Bayesian methodology to estimate epidemiological parameters for a system of stochastic differential equations</i>
2017	SCALA 2017: Scientific Computing Around Louisiana	<i>Posterior Estimates of Dynamic Constants in HIV Transmission Modeling</i>

## Posters

2019	Carnegie Junior Scientists Research Symposium	<i>Generation of nonlinear-differential-equations system from a model of Boolean relationships in Arabidopsis salt stress network</i>
2018	ASPB 2018	<i>Generation of nonlinear-differential-equations system from a model of Boolean relationships in Arabidopsis salt stress network</i>
2018	ASPB 2018	<i>Combating stereotypes of math and enhancing appreciation for plant biology in undergraduate students using video games</i>
2018	BAMM!	<i>Generation of nonlinear-differential-equations system from a model of Boolean relationships in Arabidopsis salt stress network</i>
2018	Southern Section ASPB 2018 Regional Meeting	<i>Improved Mathematical Model Enhances Understanding of Endoreplication in Arabidopsis Trichomes with 4D Visualization</i>
2018	Biograds Symposium	<i>Bayesian Estimate of the Parameters of a Stochastic Differential Model of HIV Incidence in the United States</i>
2018	AAAS 2018	<i>Improved Mathematical Model Enhances Understanding of Endoreplication in Arabidopsis Trichomes with 4D Visualization</i>
2018	SCALA 2018	<i>Hierarchical modeling of HIV prevention</i>
2017	Objective Bayes Workshop	<i>Bayesian Estimate of the Parameters of a Stochastic Differential Model of HIV Incidence in the United States</i>
2017	Emory University Stat Fest	<i>Bayesian Estimate of the Parameters of a Stochastic Differential Model of HIV Incidence in the United States</i>
2017	Annual Meeting of the Society for Mathematical Biology	<i>Bayesian Estimate of the Parameters of a Stochastic Differential Model of HIV Incidence in the United States</i>
2017	LSU Boyd Adventures in Research: A Pathway to Biomedical Research	<i>Posterior Estimates of Dynamic Constants in HIV Transmission Modeling</i>

## Education & Mentoring Activities

### MAJOR CONTRIBUTIONS

**Curriculum Development:** CURE lab for introductory biology involving modeling and programming techniques.

**Mentor** with *PlantingScience*: mentor elementary and high school science teams

**Developed web application** for undergraduate introductory biology students to enhance their understanding of traditionally difficult concepts, such as membrane potential & enzyme kinetics. [Current version](#) (2017).

**CIRTL Scholar:** The LSU Center for the Integration of Research, Teaching, and Learning (CIRTL) provides this certificate to graduate students who study STEM education, design

and carry out an experiment, and present or publish their findings. I took discipline-based education resource (DBER) courses, independently studied the literature, designed and carried out an experiment while guest instructor with BIOL 7800, and analyzed the data. I am currently writing up the results.

**Mentor with BIOS**, the Biology Intensive Orientation for Students at LSU.

**Curriculum Development:** BIOL 7800 Mathematical Modeling in Cellular Biology with Dr. Kato at LSU (2017). I assisted in conceptual course material development (differential equations, cell biology) and was completely responsible for the technical, programming materials for the course. My lecture materials are available at [my blog](#) and [my code examples here](#)

**Curriculum Development:** Helped develop a new coursework for use at LSU course BIOL 1005 Laboratory for non-science majors (2016). To help the students come up with independent research topics, I suggested the inclusion of a proposal presentation prior to their writeup.

**Developed web application** on Ecological Inference to include RxC analysis for assisting laywers to determine possible cases of gerrymandering using district data (2017). Currently the code is private and still under development.

**Volunteer statistical consultant** with Statistics Without Borders (2018)

#### MINOR CONTRIBUTIONS

**Mentor** with Association for Women in Mathematics Mentorship program

**Volunteer** with *Letters to a Future Scientist*

**Volunteer** with *Skype A Scientist*

**Judge:** Volunteer judge for local and regional Louisiana Science and Engineering Fair (LSEF) for both Junior and Senior levels (2014 – present)

**Judge:** American Statistical Association online poster competition for high school students (2018)

**Panelist**, Coaching Your Daughter for STEM (2018)

**Mentor:** Assisted local middle school students with their science fair projects (2014 & 2018)

## Scientific Outreach & Service to the Community

**Panelist**, Graduate Women in Science Careers panel (2019)

**Journal Reviewer**, International Journal of Molecular Sciences (2019)

**Journal Reviewer**, AIDS and Behavior (2018)

**Community network leader** of the Big Data and Cyberinfrastructure network on *Plantae*.

**Journal Reviewer**, Heliyon (2018)

**Guest editor**, [What we're reading](#). Collection of recent research on mathematical modeling in plant biology.(2018)

**Plantae Fellow:** scientific outreach with a focus on mathematical plant biology. [My profile](#) (2017-2018)

**Developed web application** in concert with Finding Your Inner Modeler workshop series to promote collaboration between experimentalists and computationalists. [Current version](#) (2017).

**Academic blogging** detailing computational procedures to help beginners in computational biology and the general computing public (2017)

**Academic Twitter** devoted to scientific breakthroughs, opportunities for graduate students, computational methodologies, and mental health related information; [#MathModelingMonday](#) for brief, weekly descriptions of computational methods in biology ([@bio\\_modeling](#)) (2017)

## Computational Skills

### COMPUTING LANGUAGES

Python, Matlab, Mathematica, R, Java, Comsol, C++, JMP, SAS, Spark

### MATHEMATICAL TECHNIQUES

Ordinary differential equations, stochastic differential equations, differential algebraic equations, mixed differential equations; Multivariate calculus, linear algebra

### COMPUTATIONAL TECHNIQUES

Flux balance analysis, flux variability analysis; Global and local optimization; Parameter estimation, kinetic modeling, population modeling, protein-protein interaction modeling, gene expression and control modeling; Algorithm development and design; Sensitivity analysis

### STATISTICAL TECHNIQUES

Bayesian statistics, Data mining, linear and nonlinear regression, parameter selection, categorization, clustering

### BIG DATA-RELATED SKILLS

Statistical techniques; Parallel computing (Matlab, R); GPU computing (CUDA in Matlab, R); Data sorting and large data set manipulation; Graphics (heat map, contour map, 3D graphics, 2D and 3D animation); Data mining; Matrix manipulation, High Performance Computing (Matlab); Database handling (Matlab, Python, Spark)

### ENGINEERING-RELATED SKILLS

Linux; Raspberry Pi setup and extension; RPi programming (including motors, automatic imaging); COMSOL microfluidic device design and fluids simulation

### APPLICATION DEVELOPMENT

Graphical user interface design and implementation (Matlab, R), web application development (R Shiny); Virtual machines

### OTHER SKILLS

Latex, vector graphics in Latex