

**Lora Billings**  
**January 2008**

Associate Professor  
Department of Mathematical Sciences  
Montclair State University  
Montclair, NJ 07043 U.S.A.

Office Phone: 973-655-7812  
Office Fax: 973-655-7686  
E-mail:billingsl@mail.montclair.edu

**EDUCATION**

PhD	Applied Mathematics	University of Colorado, at Boulder	1998
MS	Applied Mathematics	University of Colorado at Boulder	1996
BS	Mathematics	Lafayette College	1993

**PROFESSIONAL EXPERIENCE**

Associate Professor  
Assistant Professor  
Montclair State University  
Department of Mathematical Sciences

September 2005 – present  
September 2001 – 2005

ONR/ASEE Postdoctoral Fellowship  
U.S. Naval Research Laboratory  
Washington, DC

January 2000 - August 2001

Assistant Professor (non-tenure track)  
University of Delaware  
Department of Mathematical Sciences

September 1998 - December 1999

**TEACHING EXPERIENCE**

**Undergraduate Courses**

Applied Prealculus, Precalculus, Calculus A, Calculus I, Calculus III, Linear Algebra, Differential Equations, Mathematical Modeling, Topics for Undergraduates: Mathematical Biology

**Graduate Courses**

Applied Math: Discrete, Applied Mathematics: Continuous

## **STUDENT RESEARCH**

### **M.S. THESES Advisor**

- Amy Fiorillo, MS, Dynamics of a Two Serotype Disease with Antibody Dependent Enhancement, May 2006
- Nancy Picinic-Riccia, MS, A Survey of the Methods to Find Probability Density Functions, May 2006
- Kirsten Viz, MS, Disease Outbreaks in Coupled Populations: An Application of Measles Spread in Cameroon, May 2005

### **M.S. THESES Committee member**

Lucas Shaw, MS in Computer Science from University of Wyoming,  
Advisor: Dr. William Spears, A Computational Framework for Modeling the Spread of Pathogens and Generating Effective Containment Strategies in Weakly Connected Island Models, May 2007

### **GRADUATE INDEPENDENT STUDIES**

David Burger (thesis in progress), Marie McCrary (thesis in progress), Nick Senedzuk, Karin Weule

### **UNDERGRADUATE INDEPENDENT STUDIES**

Stephanie Haupin, Kristina Oriente, Erica Heine, David Burger, Jason Long, Marie McCrary, Julian Montefusco, Carmen Piccolo, Rajni Jain

## **PUBLICATIONS and PRESENTATIONS**

### **REFEREED PUBLICATIONS**

1. Lora Billings, Amy Fiorillo, and Ira B. Schwartz, "Vaccinations in disease models with antibody-dependent enhancement," *Mathematical Biosciences*, 211 (2008) pp. 265-281.
2. Leah B. Shaw, Lora Billings, and Ira B. Schwartz, "Predictions and dimension reduction in a multistrain disease model" *Journal of Mathematical Biology* 55 (2007) pp. 1-19.
3. Lora Billings, Ira B. Schwartz, Leah B. Shaw, Marie McCrary, Donald S. Burke, and Derek A. T. Cummings, "Instabilities in multiserotype disease models with antibody-dependent enhancement," *Journal of Theoretical Biology* 246 (2007) pp. 18-27.
4. I. B. Schwartz, L. B. Shaw, D.A.T. Cummings, L. Billings, M. McCrary, and D. Burke, "Chaotic desynchronization of multi-strain diseases," *Physical Review E* 72, 066201 (2005).
5. D.A.T. Cummings, I. B. Schwartz, L. Billings, L. B. Shaw, and D. S. Burke, "Dynamic Effects of Antibody Dependent Enhancement on the Fitness of Viruses," *Proceedings of the National Academy of Sciences* 102 (2005), pp. 15259-15264.
6. Carmen Piccolo and Lora Billings, "The Effect of Vaccinations in an Immigrant Model," *Mathematical and Computer Modelling* 42 (2005), pp. 291-299.

7. W.-w. Tung, Y. Qi, J.B. Gao, Y. Cao, L. Billings, "Direct characterization of chaotic and stochastic dynamics in a population model with strong periodicity," *Chaos, Solitons and Fractals* 24 (2005), pp. 645–652.
8. L. Billings, I. B. Schwartz, D. S. Morgan, E. M. Bollt, R. Meucci, and E. Allaria, "Stochastic bifurcation in a driven laser system: Experiment and theory," *Physical Review E* 70, 026220 (2004).
9. I. B. Schwartz, L. Billings, and E. M. Bollt, "Dynamical Epidemic Suppression Using Stochastic Prediction and Control," *Physical Review E* 70, 046220 (2004).
10. I. B. Schwartz, D. S. Morgan, L. Billings, and Y.-C. Lai, "Multi-scale continuum mechanics: From global bifurcations to noise induced high dimensional chaos," *CHAOS* 14:2 (2004), pp. 373-386.
11. R. Meucci, D. Cinotti, E. Allaria, I. Triandaf, L. Billings, D. Morgan, and I.B. Schwartz, "Global manifold control in a driven laser: sustaining chaos and regular dynamics" *Physica D*, 189:1-2 (2004), pp. 70-80.
12. L. Billings, E. M. Bollt, D. Morgan, and I. B. Schwartz, "Stochastic global bifurcation in perturbed Hamiltonian systems," *Discrete and Continuous Dynamical Systems*, Proceedings of the Fourth International Conference on Dynamical Systems and Differential Equations, May 24-27, 2002, Wilmington, NC, USA, (2003), pp. 123-132.
13. Y.-C. Lai, Z. Liu, L. Billings, and I. B. Schwartz, "Noise-induced unstable dimension variability and transition to chaos in random dynamical systems," *Physical Review E* 67, 026210 (2003).
14. L. Billings, E. M. Bollt, and I. B. Schwartz, "Phase-Space Transport of Stochastic Chaos in Population Dynamics of Virus Spread," *Physical Review Letters* 88, 234101 (2002).
15. E. M. Bollt, L. Billings, and I. B. Schwartz, "A manifold independent approach to understanding transport in stochastic dynamical systems," *Physica D* 173 (2002), pp. 153-177.
16. L. Billings, W. M. Spears, and I. B. Schwartz, "A Unified Prediction of Computer Virus Spread in Connected Networks," *Physics Letters A* 297 (2002), pp. 261-266.
17. Z. Liu, Y.-C. Lai, L. Billings, and I. B. Schwartz, "Transition to chaos in continuous-time random dynamical systems," *Physical Review Letters* 88, 124101 (2002).
18. L. Billings and I. B. Schwartz, "Exciting chaos with noise: unexpected dynamics in epidemic outbreaks," *Journal of Mathematical Biology* 44 (2002), pp. 31-48.
19. I. B. Schwartz, L. Billings, J. J. Pancrazio, and J. M. Schnur, "Methods for short time series analysis of cell-based biosensor data," *Biosensors & Bioelectronics* 16 (2001), pp. 503-512.
20. L. Billings and E. M. Bollt, "Probability density functions of some skew tent maps," *Chaos, Solitons and Fractals*, 12 (2001), pp. 365-376.
21. L. Billings, I. B. Schwartz, J. J. Pancrazio, and J. M. Schnur, "Dynamic and geometric analysis of short time series: a new comparative approach to cell-based biosensors," *Physics Letters A*, 286 (2001), pp. 217–224.
22. T. W. Carr, L. Billings, I. B. Schwartz and I. Triandaf, "Bi-instability and the global role of unstable resonant orbits in a driven laser," *Physica D*, 147 (2000), pp. 59-82.
23. L. Billings, J. H. Curry and V. Robins, "Chaos in Relaxed Newton's Method: The Quadratic Case," *Contemporary Mathematics*, 252 (1999), pp. 63-70.

24. L. Billings, J. H. Curry and E. Phipps, "Symmetric Functions and Exact Lyapunov Exponents," *Physica D*, 121 (1998), pp. 44-64.
25. L. Billings, J. H. Curry and E. Phipps, "Lyapunov Exponents, Singularities and a Riddling Bifurcation," *Physical Review Letters*, 79 (1997), pp. 1018-1021.
26. L. Billings and J. H. Curry, "On Noninvertible Mappings of the Plane: Eruptions," *CHAOS*, 6(1996), pp. 108-120.

#### **PROCEEDINGS/TECHNICAL REPORTS - not refereed**

1. Ira B. Schwartz and Lora Billings, "Fluctuation Induced Almost Invariant Sets," Naval Research Laboratory Memo Report NRL/MR/6790--0609012 (2006).
2. I. B. Schwartz, L. Billings, D. S. Morgan, and Y.-C. Lai, "Noise induced dimension changing bifurcations," Proceedings from SPIE: Noise in Complex Systems and Stochastic Dynamics held in Austin, TX (2005).
3. I. B. Schwartz and L. Billings, "Stochastic Epidemic Outbreaks: Why Epidemics Are Like Lasers," Proceedings from SPIE: Noise in Complex Systems and Stochastic Dynamics held in Maspalaomas Gran Canaria Island (2004).
4. L. Billings and G. Weinstein, "Survey Of Multimedia Enhancements For Calculus" Proceedings of the Fifteenth Annual International Conference on Technology in Collegiate Mathematics (ICTCM), held in Orlando, FL (2003).
5. W. M. Spears, L. Billings, and I. B. Schwartz, Modeling Viral Epidemiology, Naval Research Laboratory Memo Report, NRL/MR/6700--01-8537 (2001).
6. L. Billings and J. H. Curry, Bifurcations in a Class of Noninvertible Mappings of the Plane. Proceedings from CESA '96 IMACS Multiconference: Computational Engineering in Systems Applications held in Lille, France. 2 (1996), pp. 625-629.

#### **BOOKS AND CHAPTERS**

Ira B. Schwartz, Lora Billings, David Holt, and Ioana Triandaf, "Chemical and Biological Sensing -- Modeling and Analysis from the Real World," Chapter 3 of "SIAM Homeland Security," edited by Carlos Castillo-Chavez and published by SIAM (2003), pp. 55-86.

#### **PROFESSIONAL PRESENTATIONS/ABSTRACTS**

1. November 14, 2007, Invited seminar speaker, "Antibody dependent enhancement: Complex dynamics in the evolution of diseases," Institute for Urban Ecosystem Studies (IUES), Kean University, NJ.
2. July 16, 2007, Minisymposium organizer, ICIAM 2007 6th International Congress on Industrial and Applied Mathematics, "Multi-strain diseases: from predictive modeling to vaccine control," co-organized with Ira Schwartz and Derek Cummings, Zurich, Switzerland.
3. June 23, 2007, Plenary speaker, "Multi-strain disease models with antibody dependent enhancement," Workshop on Dynamical Systems and Applications at Banff International Research Station, Alberta, Canada. June 22-24, 2007. Conference organizers: Bernard Brooks (Rochester Institute of Technology), Harold Hastings (Hofstra University), Herbert Kunze (Guelph University), Michael A. Radin (Rochester Institute of Technology).

4. November 4, 2006, Plenary speaker, "Antibody dependent enhancement: Complex dynamics in the evolution of diseases," Mathematical Association Of America New Jersey Section - Fall Meeting, Seton Hall University, South Orange, NJ.
5. October 24, 2006, Mathematical Biology Seminar Lecture, "Multi-strain disease models with antibody-dependent enhancement," Center for Applied Mathematics and Statistics, NJIT, Newark, NJ.
6. October 10, 2006, Invited Lecture, "Multi-strain disease models with antibody-dependent enhancement" DIMACS workshop on Models of Co-Evolution of Hosts and Pathogens, Rutgers University, New Brunswick, NJ.
7. February 2, 2006, Seminar speaker, "Antibody dependent enhancement in multi-strain diseases," Dept. of Mathematical Sciences, Montclair State University, NJ.
8. August 20, 2005, Plenary speaker, "Antibody dependent enhancement in multi-strain diseases," Mathematical Epidemiology Workshop at Banff International Research Station, Alberta, Canada. August 20-25, 2005.
9. August 3, 2005, Invited speaker, "Analyzing the effects of noise," George Washington University Summer Program for Women in Mathematics, at the Naval Research Laboratory, Washington, DC.
10. May 24, 2005, Invited Minisymposium speaker, "Noise Induced Dimension Changing Bifurcations," at the SIAM Conference of Applications of Dynamical Systems, Snowbird, UT.
11. May 14, 2005, Invited Minisymposium speaker, "Chaotic Desynchronization of Multi-Strain Diseases," Frontiers in Applied and Computational Mathematics (FACM '05), New Jersey Institute of Technology, Newark, NJ.
12. March 22, 2005, Invited Colloquium Lecture, "Epidemic Models and the Pattern of Outbreaks," Dept. of Theoretical and Applied Mathematics, University of Akron, OH.
13. December 11, 2004, Invited Minisymposium speaker, "Stochastic Epidemic Outbreaks: Why Epidemics Are Like Lasers," Canadian Mathematical Society National Meeting, Montreal, Canada.
14. July 13, 2004, Minisymposium organizer and speaker, SIAM 2004 Annual Meeting, "New Problems in Stochastic Dynamics of Multi-Potentials," co-organized with Ira Schwartz, Portland, OR. My talk: "Stochastic Bifurcations to Chaos."
15. July 11, 2004, Contributed talk, SIAM Conference on the Life Sciences 2004, "Multi-Strain Disease Dynamics," Portland, OR.
16. June 18, 2004, Invited Minisymposium speaker, AIMS' Fifth International Conference on Dynamical Systems and Differential Equations, Special Session "Low-dimensional Structures, Reduced Description and Stochastic Processes in Atmosphere/ocean Dynamics," California State Polytechnic University, Pomona, CA. My talk: "Noisy chaotic dynamics."
17. February 23, 2004, Invited Lecture, "Analysis of the spread of email viruses," Networks and Power Laws Conference, NRL, Washington, DC.
18. February 2, 2004, Invited Lecture, "Stochastic and deterministic bifurcations in lasers – Universal characteristics in single and coupled systems with delay" Michigan State University, East Lansing, MI.
19. January 4, 2004, Contributed Poster, "Analysis of the spread of email viruses," Dynamics Days 2004, Chapel Hill, NC.

20. January 8, 2003, Plenary Speaker, "Phase-Space Transport of Stochastic Chaos," Dynamics Days 2003, Scottsdale, Arizona.
21. September 10, 2002, Mathematical Biology Seminar Lecture, "Noise Induced Chaos in the SEIR Model," Center for Applied Mathematics and Statistics, NJIT, Newark, NJ.
22. July 11, 2002, Contributed Lecture, "Phase Space Transport of Stochastic Chaos in Population Dynamics of Virus Spread," 2002 SIAM Annual Meeting, Philadelphia, PA.
23. July 1, 2002, Invited Lecture, "Chaotic Epidemic Outbreaks: Deterministic or Random?" DIMACS International Conference on Computational and Mathematical Epidemiology, Rutgers University, New Brunswick, NJ.
24. June 10-13, 2002, Organizer and Speaker, DIMACS Working Group on Analogies Between Computer Viruses and Immune Systems and Biological Viruses and Immune Systems, Rutgers University, New Brunswick, NJ. The title of the talk on June 11, 2002 was "Stochastic Modeling and Chaotic Epidemic Outbreaks."
25. May 26, 2002, Invited Lecture, "Noise induced chaos," in the session on Invariant Manifolds and Their Applications, Fourth International Conference on Dynamical Systems and Differential Equations, Wilmington, NC.
26. May 15, 2002, Theoretical Ecology Lab Tea Lecture, "Noise Induced Chaos in the SEIR model," Department of Ecology and Evolutionary Biology, Princeton University, Princeton, NJ.
27. March 11, 2002, Dynamical Systems Seminar Lecture, "Noise Induced Chaos," Mathematics Department, Boston University, Boston, MA.
28. March 7, 2002, Invited Lecture in the minisymposium "Patterns, Persistence, and Environment in Population Dynamics: Theory and Data" at the SIAM Conference on the Life Sciences, Boston, MA. The talk was titled "Unexpected Nonlinear Dynamics in Stochastic Epidemic Models."
29. January 4, 2002, Contributed Lecture, "Noise induced chaos in population models," Dynamics Days 2002, Baltimore, MD.

## **GRANT AWARDS**

1. 07/2006–07/2009. Controlling interacting systems in noisy environments. PI: Lora Billings, ARO Mathematical Sciences Research Area of Cooperative Systems (\$133,426).
2. 09/2004–09/2008. RUI: An analysis of infectious disease dynamics. PI: Lora Billings, NSF Applied Mathematics Program, Award number DMS-0414087 (\$129,969).
3. 06/2003-08/2004. Analysis and Control of Emergent Dynamics in Epidemiology. PI: Lora Billings, DARPA, Award Number: DAAD19-03-1-0134 (\$79,191).
4. 2004. Epidemic Models with Seasonal Variations PI: Lora Billings, Student Faculty Research Award from MSU (\$2000).
5. 08/2002-07/2003 Analysis and Control of Disease Propagation. PI: Lora Billings, Office of Naval Research, Contract Grant No. N00173-02-1-G909 (\$49,995).
6. 08/2001-07/2002. Dynamics of Information Distribution under IO Attacks. PI: Lora Billings, Office of Naval Research, Contract Grant No. N00173-01-1-G911 (\$49,421).

## PROFESSIONAL SERVICE

### UNIVERSITY-BASED

#### University service

1. ORSP Director Search Committee, 2007-present
2. Provost Search Committee, 2007
3. Honorary Degree Committee, 2005

#### College service

1. CSAM Interdisciplinary Council, 2007-present
2. College Research Committee, 2007
3. College Graduation Committee, 2003
4. College Committee on PR & Retention of Students, 2002

#### Department service

1. GK-12 Fellows in the Middle: Partnerships for Inquiry and Interdisciplinary Middle School Science and Mathematics Mentor, 2006-present
2. Proposed PhD in Applied Mathematics committee, 2005-present
3. Chair of Special Interest Group in Pure and Applied Math, 2004-2007
4. Faculty Search Committee, Applied Math, 2004, 2005
5. Scheduling Committee, 2004-present
6. Department Website Committee, 2001-present
7. Department Newsletter Committee, 2001-2004

### DISCIPLINE-BASED

Reviewed grant proposals for Jeffress Trust (VA), 2007

Reviewed grant proposals for Qatar National Research Fund, 2007

Reviewed book: *Differential Equations* by Blanchard, Devaney, Hall, 3ed, 2007

Reviewed grant proposals on NSF panels, 2005 (2 panels), 2007

Reviewed ASEE/ONR fellowship applications, 2003

#### Refereed manuscripts

*Applied Mathematical Modelling, Physical Review Letters, Europhysics, Physical Review E, Physica D, Physics Letters A, Proceedings of the Royal Society: Biological Sciences, Theoretical Population Biology, PLoS Computational Biology, Chaos, The Journal of Biomathematics, The Canadian Applied Mathematics Quarterly, Multiscale Modeling and Simulation, Scholarpedia.*

### PROFESSIONAL MEMBERSHIPS

American Mathematical Society

American Physical Society

Society for Industrial and Applied Mathematics