

**Susan E. Martonosi**  
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Department of Mathematics  
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### **Research Areas**

My research addresses the mathematical modeling of problems in homeland security to improve both the security and operational efficiency of the system. Currently, I am exploring the use of social network theory to determine how best to disrupt terrorist networks. I am also analyzing game theoretic models for optimizing defense allocations.

Previously, I have focused specifically on aviation security and maritime port security and developed probabilistic models to evaluate the effectiveness of security policies, to question or justify the allocation of financial resources to certain security measures, and to determine reasonable heuristics for the efficient allocation of servers to queues in the context of airport security checkpoints.

My broader research interests are in stochastic and optimization models for problems in the public sector, including not just other issues in homeland security, but also problems in health care, education and public safety that could benefit from careful mathematical analysis.

### **Education**

**Massachusetts Institute of Technology**, Cambridge, MA (2001-2005)  
Ph.D. in Operations Research, 2005  
*Dissertation title:* An Operations Research Approach to Aviation Security  
*Thesis advisor:* Arnold Barnett

**Cornell University**, Ithaca, NY (1995-1999)  
B.S. in Operations Research and Industrial Engineering, 1999  
Summa Cum Laude.

### **Honors**

Project NExT Fellow, Mathematical Association of America, 2006-2007  
Beckman Faculty Research Grant recipient, 2006, 2007  
Alfred P. Sloan Foundation Fellowship (through MIT Global Airline Industry Program), 2002-5  
Ida M. Green Fellowship Award, 2001  
Cornell University Merrill Scholar, 1999  
Marshall Scholarship Finalist, 1998

### **Student Research Advising**

**Michael Ernst, Sean Plott** (Summer research assistants), "Disrupting Terrorist Networks", 2007  
**Tim Sweda** (Summer research assistant), "Optimal Defense Allocations to Deter Terrorists", 2007  
**D4 Networks Clinic Team**, "A Scheduling and Pricing Model for an Air Taxi Business", 2007  
**Eugene Quan** (Sr. Thesis in Math), "Effective Cost Allocation for Deterrence of Terrorists", 2007  
**Minal Shankar** (Summer research assistant), "Assessing the Value of Information in Deterring Terrorists", 2006.

**Daniel Walton** (Summer research assistant), "Optimal Defense Allocations to Deter Terrorists", 2006. (Winner, SIAM award for Exemplary Student Presentation, 2006 MathFest conference, Knoxville, TN.)

**Sean Fogarty** (Sr. Thesis in Math/Bio), Location, Location, Location: A Facility Location Approach to Territorial Patrol in the Eastern Collared Lizard (*Crotaphytus collaris*), 2005-6.

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### Professional Practice

2005 - 2006

*Consultant, Homeland Security Institute*

### Previous Research Experience

2002 - 2005

*Research Assistant, MIT Global Airline Industry Center* (advisor: *Arnold I. Barnett*)

- Quantified historical threat posed by aviation terrorism
- Modeled advantages and pitfalls of passenger pre-screening (profiling) systems
- Estimated the cost-effectiveness of security measures protecting against explosives in cargo hold of passenger aircraft
- Used approximate dynamic programming methods to develop a heuristic for server allocation and queue control at airport security checkpoints

Summer 2004

*Summer Associate, RAND Corp.* (mentors: *Henry Willis, David Ortiz*)

- Developed framework to evaluate shipping container and seaport security policies
- Conducted feasibility study of 100% screening of incoming containers at US ports

Spring 1999

*Research Assistant, Cornell University* (advisor: *S. Thomas McCormick*)

- Explored and implemented approximation algorithms for VLSI wire routing

Summer 1998

*Research Assistant, Cornell University* (advisor: *David B. Shmoys*)

- Explored and implemented approximation algorithms for facility location

### Refereed Journal Publications

"How Effective Is Security Screening of Airline Passengers?", *Interfaces Special Issue on Homeland Security* 2006. (with Arnold I. Barnett)

"Applying Risk Assessment to Secure the Containerized Supply Chain", *RAND Europe* 2006. (with M. Van de Voort, H. Willis, D. Ortiz)

"Terror is in the Air", *Chance* (a journal of the American Statistical Association), **(17):2**, 25-27, 2004. (with Arnold I. Barnett)

### Refereed Book Chapters

"Evaluating the viability of 100 per cent container inspection at America's ports", *The Economic Impacts of Terrorist Attacks*, H. W. Richardson, P. Gordon, J. E. Moore II (eds.). Edward Elgar Publishing, 2005. (with Henry Willis and David Ortiz)

### Working Papers

"Optimal Defense Allocations to Deter Terrorists", 2006 (with D. Walton, E. Quan, T. Sweda)

"Dynamic Security Screener Allocation", 2005 (submitted for publication).

"Location, Location, Location: A Facility Location Approach to Territorial Patrol in the Eastern Collared Lizard (*Crotaphytus collaris*)", 2006 (with S. Fogarty)

### Presentations

"A Queueing Model for Airport Security", Invited Colloquium, Department of Mathematics, CSU San Bernardino, 2007.

"Some Probabilistic Conundrums", HMC Presidential Inauguration, 2007.

"Some Issues in Homeland Security", Invited speaker in course on airline operations, Department of Industrial and Systems Engineering, Georgia Tech, 2007.

"Some Issues in Homeland Security", Invited Colloquium, Department of Mathematics, Occidental College, 2006.

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- “Deterring the Determined: Quantitative Methods for the Deterrence of Terrorists”, INFORMS Annual Meeting, Pittsburgh, PA, 2006.
- “A Queueing Model for Airport Security”, Invited Colloquium, Department of Statistics, University of California at Riverside, 2006.
- “A Queueing Model for Airport Security”, Claremont Statistics Colloquium, 2006.
- “Quantitative Methods for the Deterrence of Terrorists”, Invited Colloquium, Department of Industrial and Systems Engineering, University of Southern California, 2006.
- “Some Issues in Airline Security: A Quantitative Perspective” Society for Risk Analysis Annual Meeting, Orlando, FL 2005
- “Evaluating the Security and Efficiency of the Global Containerized Supply Chain: A Case Study of 100% Screening” INFORMS Annual Meeting, San Francisco, CA 2005
- “Secure Flights? Models and Observations” Invited Speaker, MIT Global Airline Industry Program, Industry Advisory Board Meeting, 2005
- “Loopholes and Deterrence in Airline Passenger Pre-Screening Systems”, Homeland Security Institute, Advancing Analytic Techniques in Deterrence Analysis Workshop, 2005
- “Some Issues in Airline Security”, MIT Global Airline Industry Program, Industry Advisory Board Meeting, 2004.
- “Securing Baggage Holds: A Quantitative Analysis of Three Security Measures”, INFORMS Annual Meeting, Denver, CO, 2004.
- “Security Profiling of Airline Passengers: How Effective Would it Be?”, INFORMS Annual Meeting Atlanta, GA, 2003.

### Teaching

- Design and Analysis of Experiments (HMC Math 159), Spring 2007
- Linear Algebra, II (HMC Math 63), Spring 2006, 2007
- Introduction to Operations Research (HMC Math 187), Fall 2006
- Introduction to Statistics and Probability (HMC Math 62), Fall 2005, 2006
- Independent Study: Optimal Control (HMC Math 196), Spring 2006
- Statistical Linear Models (HMC Math 158), Spring 2006
- Linear Algebra and Dynamical Systems, I (HMC Math 12), Fall 2005

### Previous Teaching Experience

Summers 2002-2003

- Teaching Assistant, Sloan School of Management, Leaders for Manufacturing Program 15.064J: Engineering Probability and Statistics (50-60 joint MBA/M.Eng. students)*
- Prepared and taught weekly recitations, including statistical software tutorials
  - Held office hours
  - Prepared solutions for and graded homework and exams
  - Received evaluation scores from students of 4.94 out of 5.00

1999-2001

- High School Mathematics Teacher, U.S. Peace Corps, Republic of Guinea*
- Prepared and taught (in French) as sole instructor three calculus-level courses for 130 students preparing for national Baccalaureate exams
  - Conducted daily exam-preparation recitations and office hours
  - Planned and graded weekly assignments, exams, projects
  - Completed two months of teacher training, including two weeks of observed practice school
  - Collaborated with community members to budget, obtain funding for and implement a training program for 40 beekeepers in 3 villages on environment-friendly beekeeping techniques and tools
  - Integrated myself into a new culture and learned two foreign languages

Fall 1998

- Teaching Assistant, Cornell University*  
*ENGRD270: Engineering Probability and Statistics (50 undergraduate students)*
- Taught recitations, held office hours and graded homework/exams

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Fall 1998

*Participant, Cornell College of Engineering Teaching Assistant Development Program*

- Attended a one-day teaching assistant training workshop
- Taught a videotaped “micro-class” and discussed areas of improvement based on the video

Spring 1997

*Computer Science Consultant, Cornell University, Computer Science Department*

- Tutored students in sophomore-level Java programming class and graded assignments/exams

### Other Experience

Fall 1997

*Intern, Procter and Gamble (Management Systems), Global Category Mgmt.*

- Formalized Category Management data analysis requirements
- Investigated and recommended necessary data analysis tools

### Professional Development

Project NExT Fellow, “New Jobs, New Responsibilities, New Ideas”, workshops conducted by the Mathematical Association of America, at MathFest 2006, 2007, and MAA/AMS Joint Meetings 2007.

Participant, “The Art of Teaching Mathematics”, conference at Harvey Mudd College, June 11-12, 2007.

Participant, “Statistics Education for Undergraduate Students”, University of California at Riverside, June 2, 2007.

Participant, “Advances in Latent Variable Modeling”, workshop at the *Southern California American Statistical Association Workshop in Applied Statistics*, conducted by Bengt Muthen, March 31, 2007, University of California at Los Angeles.

Participant, Workshop on CPLEX optimization software, conducted by ILOG CPLEX, Dec. 2006.

Participant, “Applied Longitudinal Analysis” workshop at the *Southern California American Statistical Association Workshop in Applied Statistics*, conducted by Nan Laird, March 24, 2006, University of California at Los Angeles.

### Professional Service

Organizer, “Public Sector Operations Research”, HMC Math Conference, 2007.

Author, “Grading Quickly and Consistently Using Equivalence Classes”, Teaching Time Savers column of *Focus Magazine*, March 2007.

Session Chair, Joint Session on Risk and Decision Analysis Applications for Homeland Security III, INFORMS Annual Meeting, 2006.

Referee, *The UMAP Journal* (Undergraduate Mathematics and its Applications)

Referee, *Mathematical and Computer Modeling*

Editorial Board, *Terrorism Research*

### Collegiate Service

Subcommittee on Improving Diversity through Faculty Hiring

Incident Management Team

Core Coordinators Committee

Advisor, Engineers for a Sustainable World

Faculty-in-Residence, Sontag dormitory

Actuarial Coordinator

Women Faculty Lunch Group (coordinator: 2006 – 2007)

Strategic Planning “Looking Outside the Box” committee, 2006-7

### Outreach

“Making Decisions Using Math”, Pathways Outreach Program, 2007

“Making Decisions Using Math”, SWE WEST conference, 2007.

“Some Probabilistic Conundrums”, Pathways Outreach Program, 2006.

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“Using Math to Prevent Terrorism”, HMC Summer Institute, 2006.

“Some Probabilistic Conundrums” Invited Speaker, Los Angeles Professional Development and Outreach Group, 2005

**Societies and Affiliations**

Institute for Operations Research and Management Science (INFORMS), Mathematical Association of America (MAA), American Statistical Association (ASA) , Association for Women in Mathematics (AWM), American Mathematical Society (AMS), Sloan Foundation Industry Centers

**Other Interests**

Swimming, running, Senegalese sabar drumming, piano, foreign languages (French, Pulaar)