CURRICULUM VITAE

KARL SIGMAN

April 2023

Employment:

Columbia University, Department of Industrial Engineering and Operations Research,
S. W. Mudd Building, 500 West 120th Street, MC: 4704, NY, NY 10027.

July 1997-present:	Professor (tenured 1993)
July 1991-June 1997:	Associate Professor
July 1987-June 1991:	Assistant Professor
July 1986- July 1987:	Postdoctoral Associate, Mathematical Sciences Institute, Cornell University, Ithaca, New York.

Fellowships:

May 2009: Tokyo Institute of Technology, JSPS Global COE program "Computation as a Foundation for the Sciences"

December 1994 - July 1995:
NSF International Programs, Science University of Tokyo, Tokyo, Japan.

June 1990 - June 1991:
Research Fellow under the ***Japan Society For The Promotion Of Science,*** Tokyo Metropolitan Institute of Technology, Tokyo, Japan.

Education:

University of California at Berkeley, Berkeley, California

July 1986:	Ph.D., Industrial Engineering and Operations Research. Dissertation Topic: Applications of Harris Ergodic Markov Chains to Queueing Systems (Dissertation Advisor: Ronald Wolff)
May 1984:	M.S., Industrial Engineering and Operations Research

June 1983: M.A., Mathematics

University of California at Santa Cruz, Santa Cruz, California

January 1980: B.A., Mathematics (Highest Honors)

Prizes and Awards:

2002: Distinguished Faculty Teaching Award (SEAS, Columbia University)

1998: Distinguished Faculty Teaching Award (SEAS, Columbia University)

1989: Presidential Young Investigator Award (NSF, March)

1986: George E. Nicholson Prize (First Prize) (Operations Research Society of America)

University of California at Berkeley:

Bernard Friedman Memorial Prize in Applied Mathematics, (Mathematics Department) (1986)

Outstanding Teaching Assistant Award (Department of Industrial Engineering and Operations Research) (1986)

Grants:

IBM Research Faculty Award: January 2003 – December 2003, $40,000

NSF, 2001-2004, $300,000: *Asymptotics and Bounds for Stochastic Networks in the Presence of Heavy Tails*

NSF, 1996-2001, $1000,000: *Center for Applied Probability (CAP): Infrastructure Support for an Interdisciplinary Research Center*. (One of several co-PI's.)

NSF, 1996-1999, $255,000: *Risk and Duality in Multidimensional Stochastic Recursions*

NSF, January 1995-July, 1995, $65,000: International Awards Program, *Fluid Flow Approximation in Open Networks* (Sabbatical in Tokyo Japan)

Presidential Young Investigator Award (PYI), NSF, 1989-1994: *Stability, Moments, and Regenerative Simulation of Queueing Networks*

Engineering Research Initiation Award, 1989 (superseded by PYI)

Bellcore, 1990-1992, $10,000: *Applied Probability in Telecommunications*

Research Interests:

Applied and theoretical aspects of stochastic modeling in:

Queueing theory and communications
Heavy-tailed distributions, Insurance risk theory
Financial Engineering, Economics, USA Presidential elections
Stationary marked point processes, simulation, high-resolution digital audio

Publications:

a. Papers published in scholarly journals

Sigman, K., (1988). Regeneration in Tandem Queues with Multi-server Stations, *Journal of Applied Probability,* **25**, 391-403.

Sigman, K., (1988). Queues as Harris Recurrent Markov Chains, *Queueing Systems (QUESTA),* **3,** 179-198.

Sigman, K., (1989). Notes on the Stability of Closed Queueing Networks, *Journal of Applied Probability*, **26, 3**, 678-682 [Correction: (1990),27,1].

Chao, X., M. Pinedo and K. Sigman, (1989). On the Interchangeability and Stochastic Ordering of Exponential Queues in Tandem with Blocking, *Probability in the Engineering and Informational Sciences (PEIS)*, **3**, 223-236.

Sigman, K., (1990). One-Dependent Regenerative Processes and Queues in Continuous Time, *Mathematics of Operations Research*, **15, 1**, 175-189.

Sigman, K., (1990). The Stability of Open Queueing Networks, *Stochastic Processes And Their Applications*, **35,1**,11-25.

Gelenbe, E., P. Glynn and K. Sigman, (1991). Queues with Negative Arrivals, *Journal of Applied Probability*, **28,** 245-250.

Sigman, K. (1991). A Note On A Sample-Path Rate Conservation Law And Its Relationship With $H= \lambda G$. *Advances In Applied Probability*, **23**, 662-665.

Yamazaki, G., K. Sigman and M. Miyazawa and (1992). Moments in Infinite Channel Queues. *Computers and Mathematics With Applications*, **24, 1/2**, 1-6.

Browne, S. and K. Sigman (1992) . Work-Modulated Queues With Applications To Storage Processes, *Journal of Applied Probability*, **29, 3**, 699- 712.

Sigman, K.(1992). Light Traffic For Work-Load In Queues. *Queueing Systems* , Vol. **11**, No. **4**, 429-442.

Sigman, K., and D. Simchi-Levi, (1992). A Light Traffic Heuristic for an M/G/1 Queue with Inventory. *Annals of Operations Research* , **40**, 371-380.

Bardhan, I., and K. Sigman (1993). Rate Conservation Law for Stationary Semimartingales. *Probability in the Engineering and Informational Sciences (PEIS*), **7, 1** ,1-17.

Sigman, K. and R. Wolff (1993). A Review of Regenerative Processes. *SIAM Review*, **35, 2**, 269-288.

Sigman, K. and G. Yamazaki (1993). Heavy And Light Traffic for Fluid Models With Burst Arrivals, *Ann. Inst. Statist. Math*.., **24, 1/2**, 1-6.

Sigman, K, H. Thorisson and R. W. Wolff (1994). The Existence of Regeneration Times. *Journal of Applied Probability*, **31,** 1116-1122.

K. Sigman and D. Yao, (1994). Finite Moments for Inventory Processes. *Ann. Appl. Prob.*, **4, 3,** 765-778.

Bardhan, I., and K. Sigman (1994). Stationary Regimes for Inventory Processes. *Stoch. Proc. Appls.,* **56**, 77-86.

Sigman, K. (1996) . Queues under preemptive LIFO and ladder height distributions for risk processes: a duality. *Stochastic Models,* **12,4**, 725-736.

Asmussen, S. and K. Sigman (1996). Monotone Stochastic Recursions and their Duals. *Probability in the Engineering and Informational Sciences (PEIS*), **10**, 1-20.

Jain, G. and K. Sigman (1996). A Pollaczek-Khintchine formulation for queues

O. Boxma, R. Boucherie and K. Sigman (1996). A note on negative customers, GI/GI/1 workload, and risk processes. *Probability in the Engineeriung and Informational Sciences (PEIS),* **10**, 305-311.

Jain, G. and K. Sigman (1996). A Pollaczek-Khintchine formulation for M/G/1 queues with disasters. *Journal of Applied Probability,* **33**, 1191-1200.

A.Scheller-Wolf and K. Sigman (1997). Delay moments in GI/GI/s queues. *Queueing Systems (QUESTA).* **25**, 77-96.

A. Scheller-Wolf and K. Sigman (1998). Moments in tandem queues. *Operations Research, **46**,* 378-380.

Glynn, P. and K. Sigman (1999). Independent Sampling of a Stochastic Process. *Stoch. Proc. Appls.* **74**, 151-164.

Asmussen, S., Kluppelberg, C, and K. Sigman (1999). Sampling at subexponential times, with queueing applications. *Stoch. Proc Appls.* **79**, 265-286.

Huang, T. and K. Sigman (1999). Steady-state asymptotics for tandem, split-match and other feedforward queues with heavy-tailed service. *Queueing Systems,* **33**, 233-260.

K. Sigman (1999). A Primer on heavy-tailed distributions. *Queueing Systems,* **33**, 261-275.

A. Scheller-Wolf and K. Sigman (1998). New Bounds for delay moments in multi-server queues. *Queueing Systems.* **26**, 169-186.

B. Blaszczyszyn and K. Sigman (1999). Risk and Duality in Multidimensions. *Stoch. Proc. Appls.* **83**, 331-356.

R. Ryan and K. Sigman (2000). Continuous time monotone stochastic recursions and duality. *Adv.. Appl. Prob,* **32**, 426-445.

Asymptotic Convergence of Scheduling Policies with respect to Slowdown (2002). Mor Harchol-Balter, K. Sigman and Adam Wierman Performance 2002. IFIP WG 7.3 International Symposium on Computer Modeling, Measurement and Evaluation.

L. Munasinghe and K. Sigman (2004). A hobo syndrome? Mobility, wages and job turnover. *Labour Economics*, **11,** 191-218.

P. Shahabuddin, M. Nakayama and K. Sigman (2004). On finite exponential moments for branching processes and busy periods for queues. *J. Appl. Prob) (Special Volume* **41A** on Stochastic methods and their applications)

G. Iyengar and K. Sigman (2004). Exponential penalty function based control. policies for loss queues Queues. *Ann. Appl. Prob.* **14**, 1698-1740.

J. Cosyn and K. Sigman (2004). Stochastic networks: admission and routing using penalty functions. *Queueing Systems* **48**, 237-262.

K. Sigman (2006) Stationary marked point processes. (Contributed invited chapter in *Springer Handbook of Engineering Statistics*, **8**, Springer-Verlag.

K. Sigman and U. Yechiali (2007) Stationary remaining service time conditional on queue length. Operations Research Letters **35**, 581-583.

M. Harchol Balter, Varun Gupta, K. Sigman and W. Whitt (2007) Analysis of join-the-shortest-queue routing for web server farms. Performance Eval. **64** (9-12): 1062-1081.

K. Sigman (2011). Exact simulation of the stationary distribution of the FIFO M/G/c queue. *Journal of Applied Probability*, **48A**, 209-216.

J. Blanchet and K. Sigman (2011). On Exact Sampling of Stochastic Perpetuities. *Journal of Applied Probability*, **48A,** 165-182.

K. Sigman and W. Whitt (2011). Heavy-traffic limits for nearly deterministic queues. *Journal of Applied Probability*, **48,** 657-678.

K. Sigman and W. Whitt (2011) Heavy-traffic limits for nearly deterministic queues II: Stationary distributions. *Queueing Systems*, **69**, 145-173.

K. Sigman (2012). Exact simulation of the stationary distribution of the FIFO M/G/c queue: The general case of Rho< *1. Queueing Systems*, **70***,* 37-43.

V. Goyal and K. Sigman (2011) On simulating a class of Bernstein polynomials. *ACM Transactions on Modeling and Computer Simulation (TOMACS)*, **22, 2,** Article 12.

Sigman (2013). Using the M/G/1 Queue Under Processor Sharing for Exact Simulation of Queues. *Annals of Operations Research*. June 2013

Marcus Ang, Karl Sigman, Jing-Sheng Song, Hanqin Zhang (2017). Closed-Form Approximations for Optimal (r,q) and (S,T) Policies in a Parallel Processing Environment. *Operations Research. 65(5),1414 - 1428.*

Cracking Crypto: An Implied Interest Rate Model for Valuing Cryptocurrency Products
K. Sigman,
Aakanxit Khullar, Dillon Biddiscombe, Alec Silverstein, and Omer Yatkin
Institute of Chartered Accountants in India (ICAI), September 2017, Pages 33--37.

J. Blanchet, Y. Pei, K. Sigman, "Exact sampling for some multi-dimensional queueing models with renewal input". *Advances in Applied Probability*. (2019), 51: 1179-1208

K. Sigman and W. Whitt (2019). Marked Point Processes in Discrete Time. *Queueing Systems*. 92:47–81

R. Erikson, K. Sigman and Linan Yao (2020). Electoral College Bias and the 2020 Presidential Election. *PNAS*. (45) 27940-27944

J. Bergquist and K. Sigman (2022). Stationary workload and service times for some non-work-conserving M/G/1 preemptive LIFO queues. *Stochastic Models*. **38,4**,5515-544

E. Gelenbe and K. Sigman (2022). IoT Traffic Shaping and the Massive Access Problem. *IEEE ICC*. Conference Proceeding. (Published in May 2022.)

K. Sigman (2022). Comparing backwards and forwards random walk maxima. *Queueing Systems*. Volume **100**.

b. 2000 Presidential Election Research (submitted to *Political Science*)

(See: www.ieor.columbia.edu/~sigman for details)

R. Erikson and K. Sigman (2000). A simple stochastic model for close US presidential elections.

R. Erikson and K. Sigman (2000). Gore favored in the Electoral College.

R. Erikson and K. Sigman (2000). A dead heat and the Electoral College (Bush Versus Gore)

c. 2008-12 Presidential Election Research

R. Erikson and K. Sigman (2008) Guest Pollster. http://www.pollster.com/blogs/guest_pollster_the_surveyusa_5.php

R. Erikson and K. Sigman. How Biased do the Polls Have to be for Romney to Win? *The Monkey Cage*, November 5, 2012. http://themonkeycage.org/2012/11/05/how-biased-do-the-polls-need-to-be-for-romney-to-win}}

K. Sigman. Columbia University Probability Professor: These Simple Calculations Are Probably Going Ruin Romney's Evening. *Business Insider*, November 5, 2012. {http://www.businessinsider.com/romney-will-lose-according-to-columbia-university-probability-professor-2012-11}}

d. Books/Special volumes

K. Sigman, (1995). *Stationary Marked Point Processes: An Intuitive Approach* Chapman and Hall, New York

P. Glasserman, K. Sigman and D. Yao (Editors) (1996). *Stochastic Networks: Stability and Rare Events*. Springer Lecture Notes in Statistics 117, Springer-Verlag, New York.

K. Sigman (1999) (Guest Editor). *Special Volume on Queues with Heavy-tailed Distribution,* Queueing Systems*,* **33.**

K. Sigman (2004) Queueing theory. (Contributed article in *Encyclopedia of Actuarial Science* (EoAS)), **3**, 1357-1361. John Wiley & Sons Ltd.

e. Technical reports

Kiang, S. and K. Sigman (1992). Burst Fluid Models with General Flow and Process Rates.

Bardhan, I., and K. Sigman (1993). A Note on Rate Conservation: The Non-ergodic Case.

Sigman, K. (1994). Light Traffic For Workload And Virtual Delay In Split And Match Queues.

R. Sah and K. Sigman (1996). Infinite channel queues with correlated service times.

Sigman, K. Implications of stochastic convex ordering for option pricing.

J. Cosyn and K. Sigman (2002). Stochastic admission control with queueing (submitted).

J. Cosyn and K. Sigman (2002). Admission control of the infinite server queue with applications to bandwidth control (submitted).

K. Sigman (2003). Stability region for a FIFO multiclass queueing network: sensitivity to distributions

K. Sigman (2009) ``Comparing the maximum of a random walk with the maximum when using time-reversed increments".

M. Harchol Balter, K. Sigman and W. Whitt (2006).The random assignment (RA) discipline for multi-server queues: approximations and bounds for join-the-shortest-queue (JSQ) and first-in-first-out (FIFO) disciplines.

P. Glynn and K. Sigman (2009). Exponential limits in heavy traffic for single-server queues with stationary input.

Visiting Professor Positions:

Summer 2014: Dept, Industrial Engineering, National University of Singapore
February 2009-April 2009, National University of Singapore, Department of Decision Sciences.
May 2009, Tokyo Institute of Technology, Department of Mathematical and Computing Sciences
September 2008-January 2009, University of Pisa, Dept. Statistics and Applied Mathematics
February 2009-April 2009, National University of Singapore, Department of Decision Sciences
May 2009, Tokyo Institute of Technology
September 2004, Mittag-Leffler Institute, Stockholm, Sweden (Queueing Theory)
Summer 2004, October 2004 Helsinki University of Technology, Dept. Mathematics
Summer 2003, University of Helsinki, Dept. Mathematics
February 2002 - May 2002, Eurandom, Eindhoven, Holland.
Spring/Summer 1995, Science University of Tokyo, Japan
Fall 1994, University of Aalborg, Aalborg Denmark
Summers 1989, '91, '92, Stanford University, Dept. of Operations Research
Summer 1988, University of California Berkeley, Dept. IEOR

Membership In :

The Institute for Operations Research and the Management Sciences (INFORMS)
Applied Probability Society of INFORMS
The American Mathematics Society (AMS)
The Institute For Mathematical Statistics (IMS)
The Bernoulli Society

Editorial And Other Professional Activities:

Chair, Applied Probability Society of INFORMS (2002-2004)
Subdivisions Council (SC) Representative on INFORMS SC (2003-2005)
Guest Editor, Queueing Systems, special vol. "Queues with heavy-tailed distributions".

Service Activities at Columbia University

Committee on Instruction (COI) (January 2016—2020, Fall 2021-Fall 2022)
SEAS 150th Anniversary Committee (2014)
Director of undergraduate studies, Dept. IEOR, 2011-2019
SEAS Advisory Committee on Undergraduate Curriculum (2011)
Director of the *Center for Applied Probability (CAP)* at Columbia University
Director of the Financial Engineering MS Program (2001--2004)

Presidential Teaching Awards Committee (2003-2006)
Committee on Instruction (COI) (1996-1997, 2013–2014)
past CVN representative for IEOR
past Omega Rho Society Representative for IEOR
Urban New York Program participant

Ph.D. Students:
Jacob Mason Bergquist (*Three Sojourns in Queueing Theory*), May 2023

Indrajit Bardham (*General Rate Conservation Law With Applications to Diffusion Approximations for Queues*), May 1992.

Gautam Jain (*A Rate Conservation Analysis of Generalized Queues and networks*), May 1996.

Alan Scheller-Wolf (*Finite Moment Conditions for Stationary Content Processes with Applications to Fluid Models and Queues*), May 1996.

Yongfeng Xi (*Queues with Vacations and Exceptional First Arrivals*), May 1996.

Rajesh Sah (*Queues with Correlated Service Times with Applications to Inventory Models*), May 1997.

Tao Huang (*Tail asymptotics for feedforward queueing networks with heavy tailed distributions*), January, 1999

Jan Cosyn, (*Queueing networks and control using penalty functions*), May 2003.