Curriculum Vitae

Sayan Banerjee

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Personal Information

- *Address:* Department of Statistics and Operations Research, 353 Hanes Hall CB number 3260, University of North Carolina, Chapel Hill, NC 27599.
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Education

- *Ph.D. (Mathematics):* University of Washington, Seattle, 2013.
- *Master of Statistics:* Indian Statistical Institute, Kolkata, 2010.
- *Bachelor of Statistics:* Indian Statistical Institute, Kolkata, 2008.

Professional Experience

- *Associate Professor* at University of North Carolina, Chapel Hill, August 2022-present.
- *Assistant Professor* at University of North Carolina, Chapel Hill, July 2016-July 2022.
- *Research Fellow* at Department of Statistics, University of Warwick, November 2013-June 2016. Mentor: Wilfrid S. Kendall.

Awards

- *NSF CAREER Award* DMS 2141621 from July 2022- July 2027. Total award amount $450,000.
- *Staff Merit Award* for exceptional research, University of Warwick, 2015.
- *Academic Excellence Award*, by University of Washington, 2011.

- *Mahalanobis International Symposium on Statistics Prize* (Gold Medal) on having been selected as the most outstanding Master of Statistics student thesis in Indian Statistical Institute, 2010.

Bibliography and products of scholarship

Research interests: Ergodicity of diffusion processes, interacting particle systems, dynamic random networks, load balancing policies on networks, probabilistic couplings of diffusions and their connections to geometry, ergodicity of non-elliptic diffusions, large deviations, random walks in random environments, random matrices.

(I) **Publications - Refereed**

1. S. Banerjee, S. Bhamidi and X. Huang. Co-evolving dynamic networks. Accepted for publication in *Probability Theory and Related Fields (2024), 60 pp.* Available at `https://arxiv.org/abs/2203.11877`.

2. S. Banerjee, A. Budhiraja and B. Estevez*. Load Balancing in Parallel Queues and Rank-based Diffusions. Accepted for publication in *Mathematics of Operations Research (2024), 34 pp.* Available at `https://arxiv.org/abs/2302.10317`.

3. N. Antunes, S. Banerjee, S. Bhamidi and V. Pipiras. Learning Attribute and Homophily Measures Through Random Walks. *Applied Network Science (2023), 26 pages.*

4. S. Banerjee, P. Deka* and M. Olvera-Cravioto. PageRank Nibble on the sparse directed stochastic block model. *Proceedings of the 18th Workshop on Algorithms and Models for the Web Graph, Toronto, Canada, March 2023, 17 pages, 2023.* Available at `https://arxiv.org/abs/2303.06699`.

5. S. Banerjee and X. Huang*. Degree centrality and root finding in growing random networks. *Electronic Journal of Probability, 2023, Vol. 28, paper no. 42, 1-39.* Available at `https://arxiv.org/abs/2105.14087`.

6. S. Banerjee, A. Budhiraja and B. Estevez*. The inert drift Atlas model. *Communications in Mathematical Physics (2022), 55 pp., https://doi.org/10.1007/s00220-022-04589-2.* Available at `https://arxiv.org/abs/2202.05893`.

7. S. Banerjee, S. Bhamidi and I. Carmichael*. Fluctuation bounds for continuous time branching processes and nonparametric change point detection in growing networks. Accepted for publication in *The Annals of Applied Probability (2022), 57 pp.* Available at `https://arxiv.org/abs/1808.02439`.

8. S. Banerjee and B. Brown*. Dimension-free local convergence and perturbations for reflected Brownian motions. *The Annals of Applied Probability 33(1): 376-416 (February 2023). DOI: 10.1214/22-AAP1818.* Available at `https://arxiv.org/abs/2009.12937`.

9. S. Banerjee and A. Budhiraja. Domains of attraction of invariant distributions of the infinite Atlas model. *The Annals of Probability 50(4): 1610-1646 (July 2022). DOI: 10.1214/22-AOP1570.* Available at `https://arxiv.org/abs/2103.10508`.

10. S. Banerjee and M. Olvera-Cravioto. PageRank asymptotics on directed preferential attachment networks. *The Annals of Applied Probability 32(4): 3060-3084 (2022). DOI: 10.1214/21-AAP1757.* Available at `https://arxiv.org/abs/2102.08894`.

11. S. Banerjee and S. Bhamidi. Persistence of hubs in growing random networks. *Probability Theory and Related Fields 180,891?953 (2021). https://doi.org/10.1007/s00440-021-01066-0.* Available at `https://arxiv.org/abs/2004.13785`.

12. S. Banerjee and A. Sankararaman. Ergodicity and steady state analysis for Interference Queueing Networks. Accepted for publication in *AMS Contemporary Mathematics: Special volume in honor of M. M. Rao (2021), 12 pp.* Available at `https://arxiv.org/abs/2005.13051`.

13. S. Banerjee and S. Bhamidi. Root finding algorithms and persistence of Jordan centrality in growing random trees. *The Annals of Applied Probability 32(3): 2180-2210 (June 2022). DOI: 10.1214/21-AAP1731.* Available at `https://arxiv.org/abs/2006.15609`.

14. S. Banerjee, A. Budhiraja and A. Puha. Heavy Traffic Scaling Limits for shortest remaining processing time queues with heavy tailed processing time distributions. *The Annals of Applied Probability 32(4): 2587-2651 (August 2022). DOI: 10.1214/21-AAP1741.* Available at `https://arxiv.org/abs/2003.03655`.

15. S. Banerjee and K. Burdzy. Rates of convergence to equilibrium for Potlatch and Smoothing processes. *The Annals of Probability 49(3): 1129-1163 (May 2021). DOI: 10.1214/20-AOP1473.* Available at `https://arxiv.org/abs/2001.09524`.

16. S. Banerjee, A. Budhiraja and M. Perlmutter. A new approach to large deviations for the Ginzburg-Landau model. *Electron. J. Probab. 25 (2020), no. 26, https://doi.org/10.1214/20-EJP434, 51 pp.* Available at `https://projecteuclid.org/download/pdfview_1/euclid.ejp/1582254382`.

17. S. Banerjee and B. Brown*. Inert drift system in a viscous fluid: Steady state asymptotics and exponential ergodicity. *Trans. Amer. Math. Soc. 373 (2020), 6369-6409, DOI: https://doi.org/10.1090/tran/8098.* Available at `https://arxiv.org/abs/1905.11868`.

18. S. Banerjee and A. Budhiraja. Parameter and dimension dependence of convergence rates to stationarity for Reflecting Brownian Motions. *The Annals of Applied Probability 30(5): 2005-2029 (October 2020). DOI: 10.1214/19-AAP1550.* Available at `https://arxiv.org/abs/1902.04501`.

19. S. Banerjee and D. Mukherjee*. Join-the-Shortest Queue Diffusion Limit in Halfin-Whitt Regime: sensitivity on the heavy-traffic parameter. *The Annals of Applied Probability 30(1): 80-144 (February 2020). DOI: 10.1214/19-AAP1496.* Available at `https://arxiv.org/abs/1809.01739`.

20. S. Banerjee and D. Mukherjee*. Join-the-Shortest Queue Diffusion Limit in Halfin-Whitt Regime: Tail Asymptotics and Scaling of Extrema. *The Annals of Applied Probability 29(2): 1262-1309 (April 2019). DOI: 10.1214/18-AAP1436.* Available at `https://arxiv.org/abs/1803.03306`.

21. S. Banerjee and W.S. Kendall. Coupling Polynomial Stratonovich Integrals : the two-dimensional Brownian case. *Electronic Journal of Probability, Volume 23 (2018), paper no. 24, 43 pp.* Available at `https://projecteuclid.org/euclid.ejp/1519722153`.

22. S. Banerjee, K. Burdzy and M. Duarte. Gravitation versus Brownian motion. *Ann. Inst. H. Poincaré Probab. Statist. 55 (2019), no. 3, 1531–1565. doi:10.1214/18-AIHP927.* Available at `http://arxiv.org/abs/1510.02328`.

23. S. Banerjee, M. Gordina and P. Mariano*. Coupling in the Heisenberg group and its application to gradient estimates. *The Annals of Probability (2018), 42 pp.* DOI:10.1214/17-AOP1247. Available at `https://arxiv.org/abs/1610.06430`.

24. S. Banerjee and W.S. Kendall. Coupling the Kolmogorov Diffusion: maximality and efficiency considerations. *Advances in Applied Probability (2016), 24 pp.* DOI: 10.1017/apr.2016.40. Available at `http://arxiv.org/abs/1506.04804`.

25. S. Banerjee and W.S. Kendall. Rigidity for Markovian Maximal Couplings of Elliptic Diffusions. *Probability Theory and Related Fields (2016), 47 pp.* DOI:10.1007/s00440-016-0706-4. Available at `https://arxiv.org/abs/1412.2647`.

26. S. Banerjee and C. Hoffman. Random mass splitting and a quenched invariance principle. *Stochastic Processes and their Applications (2016), 21 pp.* DOI:10.1016/j.spa.2015.09.012. Available at `http://arxiv.org/abs/1309.0768`.

27. S. Banerjee. The Brownian Conga Line. *Probability Theory and Related Fields (2015), 60 pp.* DOI: 10.1007/s00440-015-0649-1. Available at `http://link.springer.com/article/10.1007/s00440-015-0649-1`.

28. S. Banerjee and A. Bose. Noncrossing partitions, Catalan words, and the Semicircle Law. *Journal of Theoretical Probability. June 2013, Volume 26, Issue 2, 23 pp.* Available at `http://link.springer.com/article/10.1007%2Fs10959-011-0365-4`.

(II) **Submitted Articles and Preprints**

1. S. Banerjee, A. Budhiraja and D. Imon. Flocking under Fast and Large Jumps: Stability, Chaos, and Traveling Waves. *Submitted (2024), 52 pp.* Available at `https://arxiv.org/abs/2404.13117`.

2. S. Banerjee, S. Bhamidi, J. Shen and S. P. Young. Local weak convergence and its applications. *Submitted (2024), 33 pp.* Available at `https://arxiv.org/abs/2403.01544`.

3. S. Banerjee, A. Budhiraja and P. Rudzis. Fluctuations of the Atlas model from inhomogeneous stationary profiles. *Submitted (2023), 58 pp.* Available at `https://arxiv.org/abs/2310.04545`.

4. N. Antunes, S. Banerjee, S. Bhamidi and V. Pipiras. Attribute network models, stochastic approximation, and network sampling and ranking algorithms. *Submitted (2023), 48 pp.* Available at `https://arxiv.org/abs/2304.08565`.

5. S. Banerjee, P. Deka* and M. Olvera-Cravioto. Local weak limits for collapsed branching processes with random out-degrees. *Submitted (2023), 23 pp.* Available at `https://arxiv.org/abs/2302.00562`.

6. S. Banerjee and A. Budhiraja. Long time behavior of finite and infinite dimensional reflected Brownian motions. *Submitted (2022), 27 pp.* Available at `https://arxiv.org/abs/2208.02855`.

7. S. Banerjee and A. Budhiraja. Extremal Invariant Distributions of Infinite Brownian Particle Systems with Rank Dependent Drifts. *Submitted (2022), 24 pp.* Available at `https://arxiv.org/abs/2207.08331`.

8. Z. Zhao*, S. Banerjee and D. Mukherjee. Many-server asymptotics for Join-the-Shortest Queue in the Super-Halfin-Whitt Scaling Window. *Submitted to Mathematics of Operations Research (2021), 69 pp.* Available at `https://arxiv.org/abs/2106.00121`.

* denotes that the co-author was a student at the time of submission.

(III) **Doctoral Thesis**

- *On Particle Interaction models. University of Washington, 2013, 123 pp.* Thesis supervised by Krzysztof Burdzy. Available at `https://digital.lib.washington.edu/researchworks/handle/1773/25217`.

(IV) **Unpublished articles**

1. Heteroscedastic Wigner matrices (with A. Bose and S. Sen). *ISI technical reports.* Available at `https://www.isical.ac.in/~statmath/report/31110-13.pdf`
2. Brownian motion with boundary diffusion (2013).

(IV) **Invited and contributed talks**

(a) **International and National meetings**

- *PageRank driven networks.* CMStat Berlin 2023.
- *Ergodicity of rank-based diffusions.* ICIAM Tokyo 2023.
- *Ergodicity of rank-based diffusions.* ICSAA Edinburgh 2023.
- *Long-time behavior of Atlas models.* SIAM conference Philadelphia 2023.
- *Attributed dynamic random networks.* IISA Colorado 2023.
- *Ergodicity of reflected particle systems.* INFORMS 2022 (Anaheim, CA)
- *Shortest remaining processing time queues in heavy traffic.* Online seminar series in Applied Probability, Organized by Anton Braverman (Kellogg).
- *Persistence and root detection in dynamic random networks.* INFORMS 2020 (Online).
- *Convergence rates of reflecting Brownian motions.* INFORMS 2019, Seattle, WA.
- *Convergence rates of reflecting Brownian motions.* INFORMS-APS 2019, Brisbane Australia.
- *Non-parametric change point detection in growing networks.* INFORMS-APS 2019, Brisbane Australia.
- *Non-parametric change point detection in growing networks.* North-West Probability Seminar, October 2019, UW Washington and Microsoft Research, Seattle, WA.
- *Non-parametric change point detection in growing networks.* Probabilistic Couplings and Geometry (conference in honor of Wilfrid Kendall's 65th birthday), Coventry, UK.

- *Convergence rates of reflecting Brownian motions.* AMS special session in Hartford, Connecticut (2019).
- *Convergence rates of reflecting Brownian motions.* AMS special session in Riverside, California (2019).
- *Steady states of large queueing networks.* CMO Workshop: Scaling Limits of Dynamical Processes on Random Graphs , Oxaca, Mexico, May 2019 (participation by invitation only).
- *Steady states of large queueing networks.* IMS Asia Pacific Research Meeting 2018 (Singapore).
- *Steady states of large queueing networks.* IISA International Conference on Statistics 2018 (Gainsville, Florida).
- *Coupling, geometry and hypoellipticity.* Markov chains, mixing times and cut-offs, Durham UK, in 2017.
- *Rigidity of Markovian maximal couplings.* 38th conference on Stochastic Processes and Applications, Oxford, in 2015.
- *Coupling diffusions.* Conference in honor of Jim Pitman, UCSD, in 2014.
- *The Brownian conga line.* Seminar on Stochastic Processes, Duke University, in 2013.
- *Non-crossing partitions, Catalan words and the semi-circle law.* Seminar on Random Matrices, ISI Kolkata, in 2011.

(b) **Departmental Seminars**

- *Ergodicity and Stationary Fluctuations of Atlas models.* NC State Probability seminar (February 2024).
- *Exploration-driven networks.* CUNY Probability seminar (October 2023).
- *Attributed dynamic random networks.* ISI Kolkata (July 2023).
- *Ergodicity of reflected particle systems.* Applied Probability and Risk seminar in Columbia University (April 2022).
- *Persistence and root detection in dynamic random networks.* Seminar talks at City University of New York (Oct 2020), McGill University (Oct 2020), University of Wisconsin, Madison (Nov 2020), University College London (June 2021), University of Washington (January 2022).

- *Non-parametric change point detection in growing networks.* Seminar talk at Columbia University (Nov 2019), University of Bristol (Dec 2019).
- *Singular reflected diffusions.* Seminar talk at Brown University (October 2018), University of Washington (February 2019), Duke University (March 2019).
- *Coupling, geometry and hypoellipticity.* Seminar talks at Universities of Purdue (January 2016), UNC Chapel Hill (January 2016), Connecticut (September 2016), UT Austin (October 2016), Kansas (March 2017), Duke (April 2017), North Carolina State (June 2017).
- *Rigidity of Markovian maximal couplings for elliptic diffusions.* Seminar talks at Universities of Washington (June 2014), Cambridge (December 2014), ISI Kolkata (Dec 2014), Bonn (May 2015), Bath (November 2014), York (February 2015), Sheffield (October 2015), Oxford (July 2015).
- *The Brownian Conga Line.* Seminar talks at Universities of Washington (October 2013) and Warwick (January 2014).

(c) **Other Conferences attended**

- Seminar on Stochastic Processes 2017 (Virginia), 2018 (Brown), 2019 (Utah) and 2020 (Michigan State).
- South East Probability conference 2017, 2018, 2019 (Duke).
- 60th birthday conference for Greg Lawler, Cambridge, 2015.
- UK-Japan Stochastic Analysis School, 2014.
- Durham Random Walks meeting, 2014.
- 60th birthday conference of Martin Barlow and Ed Perkins, 2013.
- Pacific Northwest Probability Seminars 2010-2013.
- University of British Columbia, Summer School in 2011.

Teaching

(I) **Courses taught in past three years**

- Stability of Markov processes (Special topics course STOR 890) during Fall 2020 (6 students) and Fall 2018 (16 students) at UNC, Chapel Hill.
- Weak convergence (STOR 831) during Fall 2019 at UNC, Chapel Hill (15 students).

- Probability II (STOR 635) during Spring 2020 (17 students) and Spring 2018 (12 students) at UNC, Chapel Hill.
- Undergraduate probability (STOR 435) during Fall 2021 (108 students), Spring 2021 (2 sections, approximately 105 students each), Fall 2019 (107 students) and Spring 2019 (97 students) at UNC, Chapel Hill.
- Introduction to Data Models and Inference (STOR 155) during Fall 2018, Fall 2017, Spring 2017 and Fall 2016 at UNC, Chapel Hill (approximately 105 students in each section).
- Invitation to Graduate Probability (ST910) at University of Warwick, UK (15 students).

(II) **Doctoral Students**

- Brendan Brown (PhD April 2021). 'Convergence for reflected diffusions arising from interacting particles'. Currently employed as senior statistician at Target RWE.
- Prabhanka Deka (5th year PhD, joint with Mariana Olvera-Cravioto). Working on 'Pagerank on Random networks'.
- Benjamin Estevez (5th year PhD, joint with Amarjit Budhiraja). Working on 'Inert drift-type interacting particle systems'.
- Dilshad Imon (2nd year PhD, joint with Amarjit Budhiraja). Working on 'Asymptotics and long-time behavior of flocking processes'.

(III) **Masters Students**

- Gang Li (completed April 2017, thesis title: Methylation Data Analyses), Siyu An (completed December 2017, thesis title: A Study of Donation Pattern for UNC Loyalty Fund), Xinjie Qian (Determinants of rejected mail ballots) all co-advised with J.S. Marron, at UNC, Chapel Hill.
- Matthew Dickson, Jesse Pritchard (completed May 2016, thesis title: Multi-server Queueing Networks), both co-advised with Wilfrid Kendall, as part of the MASDOC program at the University of Warwick, UK.
- Boyang Tang, working on mixing times of Markov chains.

(IV) **Undergraduate Students**

- Josie Gu (Senior). Reading on Mixing times of Markov Chains.

- Michael Muller (Junior). Reading on 'Simulation of Preferential Attachment Networks'.

Grants

(i) Received the *NSF CAREER Award* DMS 2141621 from July 2022- July 2027. Total award amount $450,000.

(ii) Co-PI for NSF RTG grant that was funded during 2022-2027. Net award amount $2.4 million.

(iii) Applied for NSF DMS grants in probability as PI in 2021 (withdrawn due to the above CAREER award getting funded), 2020, 2019, 2018, 2017 and 2016.

(iv) Submitted (jointly with S. Bhamidi) White Paper to AFOSR in 2021 (pending).

(v) Junior Faculty Development Award in 2019 awarded by UNC.

Professional Services and Activities

(I) **Organizing sessions in conferences**

- I co-organized the South East Probability Conference at Duke in 2021, 2019 and 2018 (around 7 speakers each).
- I co-organized the AMS sectional meeting on 'Coupling in Probability and Related Fields' with Terry Soo (University of Kansas) on October 27-28, 2018 in San Francisco (13 speakers).
- I organized the session on 'Stochastic Analysis and its Applications' at the IMS Asia Pacific Research Meeting 2018 (4 speakers).

(II) **Referee Work**

I have been a referee for the following journals: Journal of Theoretical Probability, Journal of Applied Probability, Transactions of the American Mathematical Society, The Annals of Applied Probability, The Annals of Probability, Communications in Mathematical Physics, Management Science, Stochastic Systems, Annales de l'Institut Henri Poincaré, Electronic Journal of Probability, Siam Journal of Applied Math, Stochastics, ALEA, IEEE Transactions on Information Theory, Probability Theory and Related Fields.

(III) **Departmental Committees**

(i) I have served in the Course Scheduling committee (along with Quoc Tran-Dinh) for the STOR department at UNC in Fall 2017, 2018, 2019, 2020 and Spring 2017, 2018, 2019, 2020 and 2021.

(ii) I am in the Ph.D. committees of Sumit Kar, Hui Shen, Brendan Brown, Yang Yu, Kevin O'Connor, Miheer Deewaskar, Adam Waterbury, Michael Conroy, Deyi Liu, Jonghwan Yoo and Samopriya Basu.

(iii) I have been in the hiring committee for faculty in Applied Statistics in 2019-2020.

(iv) I am currently in the PhD admissions committee for STOR.

(v) I am in charge of organizing a 'Research Day' to expose incoming graduate students to department research.

(IV) **Other Committees**

- I am part of the 2021-2022 IMS Committee on Nominations in charge of nominating candidates for the IMS President-Elect and the Council.
- I served on the NSF-DMS panel on Data, Optimization and Numerical Analysis in March 2022.