

# Nicolas Fraiman

## Curriculum Vitae

### Education

- 2013 Doctor of Philosophy in Mathematics. *McGill University* (Montreal, Canada).
- 2008 Master of Science in Mathematics. *Universidad de la República* (Montevideo, Uruguay).
- 2005 Bachelor of Science in Mathematics. *Universidad de la República* (Montevideo, Uruguay).
- 2005 Computer Systems Analyst. *Universidad de la República* (Montevideo, Uruguay).

### Professional Experience

- 2023–now Associate Professor. *University of North Carolina at Chapel Hill* (Chapel Hill, NC).  
Department of Statistics and Operations Research.
- 2016–2023 Assistant Professor. *University of North Carolina at Chapel Hill* (Chapel Hill, NC).  
Department of Statistics and Operations Research.
- Fall 2021 Visiting Research Scholar. *Duke University* (Durham, NC).  
Rhodes Information Initiative at Duke.
- 2015–2016 NSERC Postdoctoral Fellow. *Harvard University* (Cambridge, MA).  
Department of Mathematics.
- 2013–2015 Hans Rademacher Instructor. *University of Pennsylvania* (Philadelphia, PA).  
Department of Mathematics.

### Honors & Awards

- 2013–now Research Associate of Sistema Nacional de Investigadores (Uruguay).
- 2022–2027 “RTG: Networks: Foundations in Probability, Optimization and Data Sciences” (NSF DMS).
- 2021–2022 Subaward of “HDR TRIPODS: Innovations in Data Science: Integrating Stochastic Modeling, Data Representations, and Algorithms” (NSF CCF).
- 2019–2020 Junior Faculty Development Award (UNC).
- 2018–2019 James Moeser Award for Distinguished Research (UNC).
- 2018–2019 University Research Council Grant (UNC).
- 2015–2016 NSERC Postdoctoral Fellowship (Canada).
- 2011–2012 Graduate Research Enhancement and Travel Award (McGill University).
- 2010–2013 Institut des Sciences Mathématiques Scholarship (Canada).
- 2009–2010 Principal’s Graduate Fellowship (McGill University).
- 2006–2008 Agencia Nacional de Investigación e Innovación Masters Scholarship (Uruguay).
- 2001 Silver medal in Ibero-American Mathematical Olympiad.  
Gold medal in Ibero-American Chemistry Olympiad.

## Publications

1. N. Fraiman, T. Lin and M. Olvera-Cravioto. Opinion dynamics on directed complex networks. (Preprint arXiv:2209.00969).
2. N. Fraiman, S. Mukherjee and G. Thoppe. The Bulk and the Extremes of Minimal Spanning Acycles and Persistence Diagrams of Random Complexes. To appear in *Discrete Analysis*, 2022. (Preprint arXiv:2012.14122).
3. C. Carlson, E. Davies, N. Fraiman, A. Kolla, A. Potukuchi and C. Yap. Algorithms for the ferromagnetic Potts model on expanders. To appear in *Proceedings of the 63rd Annual IEEE Symposium on Foundations of Computer Science (FOCS 2022)*, Denver, CO, October 31–November 3, 2022. (Preprint arXiv:2204.09596).
4. N. Fraiman and Z. Li. Beam Search for Feature Selection. (Preprint arXiv:2203.04350).
5. N. Fraiman and Z. Li. Classification with Disjoint Centroids. (Preprint arXiv:2109.10436).
6. N. Fraiman, L. Lichev and D. Mitsche. On the power of choice for Boolean functions. To appear in *SIAM Journal on Discrete Mathematics*, 2022. (Preprint arXiv:2109.13079).
7. N. Fraiman, T. Lin and M. Olvera-Cravioto. Stochastic recursions on directed random graphs. To appear in *Stochastic Processes and their Applications*, 2022. (Preprint arXiv:2010.09596).
8. N. Fraiman and Z. Li. Biclustering with Alternating K-Means. (Preprint arXiv:2009.04550).
9. A. Budhiraja, N. Fraiman and A. Waterbury. Asymptotics of Quasi-Stationary Distributions of Small Noise Stochastic Dynamical Systems in Unbounded Domains. *Advances in Applied Probability*, 54(1) : 64–110, 2022.
10. A. Budhiraja, N. Fraiman and A. Waterbury. Approximating Quasi-Stationary Distributions with Interacting Reinforced Random Walks. *ESAIM: Probability and Statistics*, 26 : 69–125, 2022.
11. S. Bhamidi, R. Fan, N. Fraiman and A. Nobel. Community Modulated Recursive Trees and Population Dependent Branching Processes. *Random Structures & Algorithms*, 60(2) : 201–232, 2022.
12. Z. Boyd, N. Fraiman, J. Marzuola, P. Mucha, B. Osting and J. Weare. A metric on directed graphs and Markov chains based on hitting probabilities. *SIAM Journal on Mathematics of Data Science*, 3(2) : 467–493, 2021.
13. N. Broutin, L. Devroye and N. Fraiman. Recursive functions on conditional Galton–Watson trees. *Random Structures & Algorithms*, 57(2) : 304–316, 2020.
14. N. Fraiman and D. Mitsche. The diameter of Inhomogeneous random graphs. *Random Structures & Algorithms*, 53(2) : 308–326, 2018.
15. A. McAvoy, N. Fraiman, C. Hauert, M. Nowak and J. Wakeley. Public goods games in populations with fluctuating size. *Theoretical Population Biology*, 121 : 72–84, 2018.
16. D. Fraiman, N. Fraiman and R. Fraiman. Nonparametric statistics of dynamic networks with distinguishable nodes. *TEST*, 26(3) : 546–573, 2017.
17. N. Fraiman and D. Mitsche. Metric and spectral properties of dense Inhomogeneous random graphs. *Trends in Mathematics*, Proceedings of Strategic Behavior in Combinatorial Structures, 41–45, 2017.

18. L. Beaudou, A. Bondy, X. Chen, E. Chiniforooshan, M. Chudnovsky, V. Chvátal, N. Fraiman and Y. Zwols. A De Bruijn-Erdős theorem for chordal graphs. *The Electronic Journal of Combinatorics*, 22(1) : #P1.70, 2015.
19. L. Devroye and N. Fraiman. The random connection model on the torus. *Combinatorics, Probability & Computing*, 23(5) : 796–804, 2014.
20. L. Devroye and N. Fraiman. Connectivity of Inhomogeneous random graphs. *Random Structures & Algorithms*, 45(3) : 408–420, 2014.
14. N. Broutin, L. Devroye, N. Fraiman and G. Lugosi. Connectivity threshold of random Bluetooth graphs. *Random Structures & Algorithms*, 44(1) : 45–66, 2014.
22. N. Fraiman. Connectivity of random graphs and networks. Ph.D. Thesis, *McGill University*, 2013. (Advisor: L. Devroye).
23. L. Beaudou, A. Bondy, X. Chen, E. Chiniforooshan, M. Chudnovsky, V. Chvátal, N. Fraiman and Y. Zwols. Lines in hypergraphs. *Combinatorica*, 33(6) : 633–654, 2013.
24. L. Devroye, O. Fawzi and N. Fraiman. Depth properties of scaled attachment random recursive trees. *Random Structures & Algorithms*, 41(1) : 66–98, 2012.
25. L. Devroye, O. Fawzi and N. Fraiman. The height of scaled of scaled attachment random recursive trees. *Discrete Mathematics and Theoretical Computer Science Proceedings*, 21st International Conference on the Analysis of Algorithms, 129–142, 2010.

## Invited Talks

- *Bulk and extremes of the weights of minimal spanning acycles*. Workshop on Analytic and Probabilistic Combinatorics (Banff, Canada; November 13–18, 2022).
- *Bulk and extremes of the weights of minimal spanning acycles*. Dartmouth College Department of Mathematics Colloquium (Hanover, NH September 22, 2022).
- *Algorithms for the Potts model on expander graphs*. University of Groningen Probability and Statistics Seminar (Online; June 15, 2022).
- *Clustering and classification based on disjoint features*. John Hopkins University Mathematical Institute for Data Science Seminar (Online; May 10, 2022).
- *Algorithms for the Potts model on expander graphs*. City University of New York Probability Seminar (Online; April 14, 2022).
- *Algorithms for the Potts model on expander graphs*. AMS Joint Mathematics Meetings (Online; April 6–9, 2022).
- *Algorithms for the Potts model on regular graphs*. Duke/UNC Probability Seminar (Durham, NC; March 3, 2022).
- *Aproximación de distribuciones quasi-estacionarias con sistemas de caminatas al azar reforzadas*. Universidad de la República Probability Seminar (Online; September 24, 2021).
- *Bulk and extremes of the weights of minimal spanning acycles*. Purdue University Probability Seminar (Online; April 28, 2021).
- *Bulk and extremes of the weights of minimal spanning acycles*. Ohio State University Topology, Geometry, and Data Analysis Seminar (Online; March 30, 2021).

- *Stochastic recursions on random trees and graphs*. University of Pittsburgh Industrial Engineering Colloquium (Online; March 11, 2021).
- *Stochastic recursions on random trees and graphs*. Queen's University Mathematics and Statistics Colloquium (Online; November 20, 2020).
- *Minimal spanning acycles of random complexes: bulk and extremes*. Bernoulli–IMS One World Symposium (Online; August 24–28, 2020).
- *Recursive functions on conditional Galton–Watson trees*. AMS Joint Mathematics Meetings (Denver, CO; January 15–18, 2020).
- *Recursive functions on conditional Galton–Watson trees*. XV Latin American Congress in Probability (Merida, Mexico, December 2–6, 2019).
- *Recursive functions on conditional Galton–Watson trees*. INFORMS Applied Probability Society Conference (Brisbane, Australia; July 3–5, 2019).
- *Recursive functions on conditional Galton–Watson trees*. Shanghai Center for Mathematical Sciences Seminar (Shanghai, China; June 20, 2019).
- *Inference for Recursive trees*. Joint Statistical Meetings (Vancouver, Canada; July 28–August 2, 2018).
- *Inference problems in trees and networks*. Big and Complex Data Theory, Applications and Value Creation (Montevideo, Uruguay; May 16–18, 2018).
- *Coupling from the past*. SAMSI Education and Outreach Workshop. (Research Triangle Park, NC; February 27, 2018)
- *Evolutionary games in branching populations*. Harvard University Evolutionary Dynamics Seminar (Cambridge, MA; October 17, 2017).
- *Geometric  $k$ -out graphs*. Fields workshop on Random Geometric Graphs (Toronto, Canada; June 19–23, 2017).
- *Effects of limited choice and cooperation in network formation, epidemics, and evolution*. UNC Statistics and Operations Research Colloquium (Chapel Hill, NC; February 15, 2016).
- *Estructura de redes aleatorias heterogéneas*. 5to Coloquio Uruguayo de Matemática (Montevideo, Uruguay; December 19–23, 2015).
- *Structure of Inhomogeneous random graphs*. UNC Probability Seminar (Chapel Hill, NC; December 2, 2015).
- *Connectivity and diameter of Inhomogeneous random graphs*. Workshop on Strategic Behavior and Transitions in Random Structures (Barcelona, Spain; June 8–12, 2015).
- *Geometric  $k$ -out graphs*. CRM/Universitat Politècnica de Catalunya Combinatorics and Applications Seminar (Barcelona, Spain; May 20, 2015).
- *Geometric  $k$ -out graphs*. City University of New York Probability Seminar (New York, NY; March 24, 2015).
- *Connectivity and diameter of Inhomogeneous random graphs*. XIII Latin American Congress of Probability (Cartagena, Colombia; September 22–26, 2014).
- *Geometric  $k$ -out graphs*. Cornell University Probability Seminar (Ithaca, NY; April 28, 2014).

- *Random Connection Model in the Torus*. Workshop on New Frontiers in Random Geometric Graphs (Leiden, Netherlands; April 14–17, 2014).
- *Random Connection Model in the Torus*. Rutgers University Discrete Math Seminar (Piscataway, NJ; March 4, 2014).
- *Random Connection Model via Fourier analysis*. University of Pennsylvania Probability Seminar (Philadelphia, PA; September 10, 2013).
- *Scaled attachment recursive trees*. CRM workshop on Random Trees (Montreal, Canada; August 12–16, 2013).
- *Connectivity of Bluetooth graphs*. Centre de Recherches Mathématiques Probability Seminar (Montreal, Canada; March 1, 2012).
- *Connectivity of Bluetooth graphs*. Workshop on Models of sparse graphs and network algorithms (Banff, Canada; February 5–10, 2012).
- *Stretch factor of Bluetooth networks*. Workshop on Probabilistic methods in Wireless Networks (Ottawa, Canada; August 21–24, 2011).
- *Scaled attachment recursive trees*. McGill University Discrete Mathematics Seminar (Montreal, Canada; February 21, 2011).
- *The height of Scaled attachment random recursive trees*. 21st International Meeting of Analysis of Algorithms (Vienna, Austria; June 28–July 2, 2010).
- *The height of recursive trees with choice*. CRM Workshop on Combinatorics, Randomization, Algorithms and Probability (Montreal, Canada; May 4–8, 2009).

## Invited Workshops

- Challenges in Probability and Mathematical Physics (Montreal, Canada; July 9–20, 2018).
- Network Models: Structure and Function (Oberwolfach, Germany; December 10–16, 2017).
- 12th Workshop on Probability and Combinatorics (Holetown, Barbados; April 1–April 7, 2017).
- Random Geometric Graphs and their applications to Complex Networks (Banff, Canada; November 6–11, 2016).

## Research Supervision

### Doctoral

- 2019–now Stephanie Lin (co-supervised with M. Olvera-Cravioto).  
*“Opinion models and stochastic recursions in networks”*.
- 2019–2022 Zichao Li.  
*“Clustering and Classification with Feature Selection for High-Dimensional Data”*.  
 (Research scientist, Meta)
- 2018–2021 Adam Waterbury (co-supervised with A. Budhiraja).  
*“Asymptotics and Approximation of Quasi-Stationary Distributions”*.  
 (Postdoctoral researcher, UC Santa Barbara)

2017–2020 Ruituo Fan (co-supervised with S. Bhamidi and A. Nobel).  
“*Learning Latent Community Structures in Network-based Data*”.  
(Quantitative researcher, Inno Asset Management)

### **Masters**

2020–2021 Zhaoqi Liu (co-supervised with S. Marron and P. Haaland).  
“*Does the amount of Lipolysis-stimulated Lipoprotein receptors in breast cancer cells affect the survival probability?*”.

2019–2020 Tong Zhu (co-supervised with S. Marron).  
“*Generalized Linear Regression models for the effect of ridesourcing demand on road crashes*”.

2018–2019 Casey Quintanilla (co-supervised with S. Marron).  
“*Study Abroad pre-departure and post-program survey data analysis*”.

2017–2018 Eric Goding (co-supervised with S. Marron).  
“*A dual look at the effects of parity on modern contraceptive method knowledge and the effects of method knowledge on usage in a Haitian community*”.

2016–2017 Ruige Luo (co-supervised with S. Marron).  
“*Analysis about exchange teachers’ beliefs and practices – from a statistical perspective*”.

2013–2014 Samuel Connolly (at University of Pennsylvania).  
“*Fixation probabilities of the Moran process on graphs*”.

### **Undergraduate**

2022-2023 Xiangyu Zeng (co-supervised with J. Marzuola, Department of Mathematics).  
“*Network clustering via random walks*”.

2021-2022 Oscar Fawcett.  
“*Performance evaluation of network clustering algorithms*”.

2018–2019 Kevin Lee Chen (co-supervised with E. Dayan, Biomedical Research Imaging Center).  
“*Neuroimaging-based statistical Machine Learning classification of Schizophrenia*”.

2017–2018 Nicholas Alfredo Larsen (co-supervised with P. Mucha, Department of Mathematics).  
“*Selecting generative models for networks using classification with Machine Learning*”.