

PHANUEL MARIANO

CONTACT INFORMATION

Union College
Department of Mathematics
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RESEARCH INTERESTS

Probability theory, stochastic analysis, sharp inequalities in probability, analysis and PDEs.

EDUCATION

University of Connecticut

Ph.D., Mathematics, August 2018

Dissertation Topic: “Functional Inequalities for Hypocoelliptic Diffusions Using Probabilistic and Geometric Methods.”

Ph.D. Advisor: Maria Gordina

M.S., Mathematics, December 2014

Western Connecticut State University

B.A., *Summa Cum Laude*, Mathematics, May 2012

Honor’s Thesis: “On the Coarse Geometry of $L^p([a, b])$.”

HONORS, AWARDS AND GRANTS

- *PI, NSF grant DMS-2316968: LEAPS-MPS* \$227,184, 2023-2026.
- *PI, NSF grant DMS-2154896: 2022 Union College Mathematics Conference.* \$21,050, 2022.
- *PI, AMS-Simons Travel Grant* \$5,000, 2019-2023.
- *Michael Neumann Dissertation Award.* University of Connecticut, 2018.
 - Awarded to the top dissertation in the math department.
- *2018 Outstanding Graduate Teaching Award.* \$2,000, Center for Excellence in Teaching and Learning, University of Connecticut, 2018.
 - University wide award given to two graduate students at UConn.
- *Connie Strange Graduate Community Award.* University of Connecticut, 2017.
- *Gloria Brunell Award in Mathematics.* Western Connecticut State University, 2011.

PAPERS

- [1] *Geometric properties of optimizers for the maximum gradient of the torsion function*, joint with K. Burdzy and I. Ftouhi. (submitted, 2025) arXiv:2512.09400
- [2] *Spectral bounds for exit times on metric measure Dirichlet spaces and applications*, joint with J. Wang, **Stochastic Process. Appl.**, 189 (2025), no. 104707. arXiv:2211.05894
- [3] *Survival probability for jump processes in unbounded domains on metric measure spaces*, joint with J. Wang. (submitted, 2025) arXiv:2508.21158
- [4] *A central limit theorem with explicit Lyapunov exponent and variance for products of 2×2 random non-invertible matrices*, joint with A. Benson, H. Gould, G. Newcombe, J. Vaidman., **J. Stat. Phys.**, 191 (2024), no. 120. arXiv:2406.10364
- [5] *Correlations Between Dental Hygiene Students’ Participation in Program Assessments and Program Improvements.*, joint with S. D’Amato-Palumbo, A. Richards and L. Tierney Konecny, **J. Dent. Hyg.**, 98 (2024), no. 6.
- [6] *On a conjecture of a Pólya functional for triangles and rectangles*, joint with R. Bañuelos. (submitted, 2024) arXiv:2406.01778

- [7] *Bounds for exit times of Brownian motion and the first Dirichlet eigenvalue for the Laplacian*, joint with R. Bañuelos and J. Wang, **Trans. Amer. Math. Soc.**, 376 (2023), no. 09, 5409-5432. arXiv:2003.06867
- [8] *Improved upper bounds for the Hot Spots constant of Lipschitz domains*, joint with H. Panzo & J. Wang, **Potential Anal.** 59 (2023), pp. 771-787. arXiv:2110.03672
- [9] *CLT with explicit variance for products of random singular matrices related to Hill's equation*, joint with H. Panzo, **Random Matrices: Theory Appl.** 11 (2022), paper no. 2, 20 pp. arXiv:2012.02173
- [10] *Conformal Skorokhod Embeddings and related extremal problems*, joint with H. Panzo, **Electron. Commun. Probab.** 25 (2020), paper no. 42, 11 pp. arXiv:2001.12008
- [11] *Gradient bounds for Kolmogorov type diffusions*, joint with F. Baudoin and M. Gordina, **Ann. Inst. Henri Poincaré Probab. Stat.** 56 (2020), no. 1, 612–636. arXiv:1803.01436
- [12] *Lyapunov exponent and variance in the CLT for products of random matrices related to random Fibonacci sequences*, joint with R. Majumdar, H. Panzo, L. Peng and A. Sisti, **Discrete Contin. Dyn. Syst. Ser. B** 25 (2020), pp 21.arXiv:1809.02294
- [13] *On the Cheng-Yau gradient estimate for Carnot groups and sub-Riemannian manifolds*, joint with F. Baudoin and M. Gordina, **Proc. Amer. Math. Soc.** 147 (2019), no. 7, 3181–3189. arXiv:1809.07433
- [14] *The financial value of knowing the distribution of stock prices in discrete market models*, joint with A. Amiran, F. Baudoin, S. Brock, B. Coster, R. Craver, U. Ezeaka and M. Wishart, **Involve** 12 (2019), no. 5, 883–899. arXiv:1808.03186
- [15] *Coupling in the Heisenberg group and its applications to gradient estimates*, joint with S. Banerjee and M. Gordina, **Ann. Probab.** 46 (2018), no. 6, 3275–3312. arXiv:1610.06430
- [16] *On the coarse geometry of $L^p([a, b])$* , **Rose-Hulman Undergrad. Math J.** Volume 14, 2013, No. 2, pp 1-22.

BOOKS AND
EXPOSITORY
PAPERS

- [1] *Differential Equations*, joint with R. Tully-Doyle. Open Educational Resource (2021). Online Access at <https://www.math.union.edu/~marianop/ODEv2/frontmatter-1.html>
- [2] *Upper level undergraduate probability with actuarial and financial applications*, joint with R. Bass, P. Alonso Ruiz, F. Baudoin, M. Gordina, O. Mostovyi, A. Sengupta, A. Teplyaev, E. Valdez. Open Educational Resource (2020). Online Access at <https://probability.oer.math.uconn.edu/wp-content/uploads/sites/2187/2020/03/OERprobability2020.pdf>
- [3] *A derivation of the Black-Scholes option pricing model using a central limit theorem argument*, joint with R. Majumdar, L. Peng and A. Sisti, 2018 arXiv:1804.03290 (REU).

EMPLOYMENT

Union College Assistant Professor,
Union Mathematics Department

Fall 2020 –

Purdue University Visiting Scholar,
Purdue Mathematics Department

Fall 2023

Union College Director of the Financial & Actuarial Mathematics Minor,
Union Mathematics Department

Fall 2022 -

University of New Haven Assistant Professor,
UNH Mathematics & Physics Department

Fall 2019 – Summer 2020

Purdue University *Golomb Visiting Assistant Professor (postdoc)*, **Fall 2018 – Summer 2019**
Purdue Mathematics Department

Postdoc Mentor: Rodrigo Bañuelos

University of Connecticut *Instructor/Teaching Assistant*, **Fall 2013 – Summer 2018**
UConn Mathematics Department

INVITED RESEARCH
TALKS

- *On a conjecture of a Pólya functional for triangles and rectangles*, Analysis and Applied Mathematics (AAM) Seminar, Kennesaw State University Spring 2025.
- *On a conjecture of a Pólya functional for triangles and rectangles*, Spectral Geometry in the Clouds Seminar, Winter 2025.
- *Large time behavior of non-local semigroups in unbounded domains*, AMS Special Session, University at Albany, Fall 2024.
- *Bounds for the Hot Spots Constant of Lipschitz Domains*, Probability Seminar, Lehigh University, Spring 2024.
- *Bounds for the Hot Spots Constant of Lipschitz Domains*, Vassar Math Colloquium, Vassar College, Winter 2024.
- *Sharp bounds for the torsional rigidity and the first Dirichlet eigenvalue of triangles and rectangles*, PDE and Geometric Analysis Seminar, University of Illinois, Urbana-Champaign, Fall 2023.
- *Bounds for the Hot Spots Constant of Lipschitz Domains*, Probability Seminar, Purdue University, Fall 2023.
- *Improved Upper Bounds for the Hot Spots Constant of Lipschitz Domains*, Frontier in Stochastic Analysis, University of Illinois, Chicago, Summer 2023.
- *The Hot Spots Problem*, Bridgewater State University Math Seminar, Spring 2023.
- *Spectral bounds for exit times on metric measure spaces and various applications*, Joint Mathematics Meeting Boston, AMS Special Session on Stochastic Analysis and Applications, Winter 2023.
- *Improved upper bounds for the hot spots constant of Lipschitz domains*, Joint Mathematics Meeting Boston, AMS Special Session on Advances in Partial Differential Equations, Numerical Analysis, and their Applications, Winter 2023.
- *Spectral bounds for exit times on metric measure spaces and various applications*, U Albany Analysis and Data Science Seminar, Fall 2022.
- *Spectral bounds for exit times on metric measure spaces and various applications*, Purdue Probability Seminar, Fall 2022.
- *Improved upper bounds for the hot spots constant of Lipschitz domains*, Northeast Analysis Network - University at Albany, Fall 2022.
- *Spectral bounds for exit times on metric measure Dirichlet spaces with applications*, TAMU Workshop in Analysis and Probability: Concentration Week on Geometry and Analysis on Nonsmooth Spaces, Summer 2022.
- *Spectral bounds and large time asymptotics for exit times on metric measure Dirichlet spaces with applications*, Joint Mathematics Meeting - AMS Special Session on Heat Content, Exit Time and Geometric Analysis, Spring 2022. (virtual)
- *Can you hear the shape of a drum using probability?*, 2022 Abramson Colloquium at Bridgewater State University - Keynote Lecture - PME Ceremony, Spring 2022. (virtual)
- *Spectral bounds for exit time moments of Brownian motion and related results*, AMS Special Session on Analysis and Probability in Sub-Riemannian Geometry at Purdue, Spring 2022. (virtual)
- *Spectral bounds for exit time moments of Brownian motion and related results*, AMS Special Session on Analysis and Probability in Sub-Riemannian Geometry at Purdue, Spring 2022. (virtual)
- *Spectral bounds for exit times on metric measure Dirichlet spaces with applications to sub-Riemannian manifolds*, AMS Special Session on Analysis and Probability in Sub-Riemannian Geometry at Purdue, Winter 2022. (virtual)
- *The Cheng-Yau gradient estimate for Carnot groups and sub-Riemannian manifolds*, AMS Spe-

- special Session on Geometry and Geometric Analysis at UNM, Fall 2021. (virtual)
- *Can you hear the shape of a drum using probability?*, Spring Central Virtual Sectional Meeting at U of Cincinnati, Winter 2021. (virtual)
- *Can you hear the shape of a drum using probability?*, Iona College Mathematics Seminar, Winter 2021. (virtual)
- *Can you hear the shape of a drum using probability?*, Texas A & M Probability Seminar, Fall 2020. (virtual)
- *Can you hear the shape of a drum using probability?*, University of New Mexico Colloquium, Fall 2020. (virtual)
- *The Cheng–Yau gradient estimate for Carnot groups and sub-Riemannian manifolds*, Miniconference on Analysis and Probability in sub-Riemannian spaces, Spring 2020. (virtual)
- University of Virginia, AMS Special Session on Probabilistic methods in Analysis and Geometry, Spring 2020. (cancelled due to Covid)
- Purdue University, AMS Special Session on Analysis and Probability in Sub-Riemannian Geometry, Spring 2020. (cancelled due to Covid)
- *Can you hear the shape of a drum using probability?*, Purdue University Probability Seminar, Spring 2020. (virtual)
- *Can you hear the shape of a drum using probability?*, Colgate University Colloquium, Fall 2019.
- *Solving Differential Equations with Probability?*, University of Hartford Colloquium, Fall 2019.
- *Can you hear the shape of a drum using probability?*, Boston University Statistics & Probability Seminar, Fall 2019.
- *Coupling hypoelliptic diffusions and applications to gradient estimates*, Purdue University Probability Seminar, Fall 2018.
- *Coupling Brownian motion on the Heisenberg group and its applications to gradient estimates*, University of New Haven Colloquium, Spring 2018. ★
- *Coupling Brownian motion on the Heisenberg group and its applications to gradient estimates*, Western Kentucky University Colloquium, Spring 2018. ★
- *Coupling on the Heisenberg group and its applications to gradient estimates*, AMS Special Session in Orthogonal Polynomials, Quantum Probability, and Stochastic Analysis, JMM, January 2018.
- *Couplings for hypoelliptic diffusions and applications to gradient estimates*, University of Virginia Probability Seminar, Fall 2017. ★
- *Coupling on the Heisenberg group and its applications to gradient estimates*, Lehigh University Probability & Statistics Seminar, Spring 2017. ★

CONTRIBUTED
TALKS/POSTERS

- *Large time behavior of non-local jump processes in unbounded domains*, 2024 Seminar in Stochastic Processes, Rice University, Winter 2024.
- *The Hot Spots Problem*, Union College Math Student Seminar, talk, Fall 2022.
- *Spectral bounds for exit times on doubling Dirichlet spaces with applications*, Seminar in Stochastic Processes at Lehigh University, poster and minitalk, Spring 2022.
- *Solving Differential Equations with Probability*, Union College Math Student Seminar, talk, Fall 2021.
- *Brownian motion and its various applications*, Applied Math Day at Skidmore College, talk, Fall 2021.
- *Conformal Skorokhod embeddings and related extremal problems*, Seminar in Stochastic Processes, Michigan State University, talk, Spring 2020.
- *Isoperimetric-type inequalities for the lifetime of space-time Brownian motion*, Eighteenth Northeast Probability Seminar, talk, Fall 2019. †
- *Isoperimetric-type inequalities for the lifetime of space-time Brownian motion*, Finger Lakes Probability Seminar, talk, Spring 2019. †
- *Gradient bounds for general Kolmogorov diffusions using coupling*, Recent trends in continuous and discrete probability Conference, talk, Summer 2018. †
- *Gradient bounds for general Kolmogorov diffusions using coupling*, Sixteenth Northeast Probability Seminar, talk, Fall 2017. †
- *Functional inequalities of hypoelliptic operators using coupling*, Southeast Probability Conference,

- poster, Summer 2017. †
- *Functional inequalities of hypoelliptic operators using coupling*, Seminar in Stochastic Processes, poster, Spring 2017. †
- *Coupling on the Heisenberg group and its applications to gradient estimates*, Fifteenth Northeast Probability Seminar, talk, Fall 2016. †
- *On the Coarse Geometry of L^p* , JMM- AMS Special Session, January 2013.

CONFERENCES
ATTENDED

- Seminar in Stochastic Processes, Bloomington IN, Winter 2025.
- AMS Eastern Sectional Meeting, Albany NY, Fall 2024.
- Recent Progress in Stochastic Analysis and its Applications, Chicago IL, Summer 2024.
- Seminar in Stochastic Processes, Houston TX, Winter 2024.
- Frontiers in Stochastic Analysis, Chicago IL, Summer 2023.
- Joint Mathematics Meeting, Boston MA, January 2023.
- Northeast Probability Seminar, Columbia University, November 2022. †
- Northeast Analysis Network, University at Albany, Fall 2022.
- TAMU Workshop in Analysis and Probability: Concentration Week on Geometry and Analysis on Nonsmooth Spaces, August 2022.
- Seminar in Stochastic Processes, Lehigh University, March 2022. †
- Joint Mathematics Meeting, Spring 2022. (virtual)
- AMS Eastern Sectional Meeting, Winter 2022. (virtual)
- AMS Central Sectional Meeting, Winter 2022. (virtual)
- 5 Day Workshop at Banff International Research Station, Stochastics and Geometry, March 2022. (virtual)
- Northeast Probability Seminar, New York, November 2022. (virtual)
- AMS Western Sectional Meeting, Fall 2021. (virtual)
- *Can you hear the shape of a drum using probability?*, Spring Central Virtual Sectional Meeting at U of Cincinnati, Winter 2021. (virtual)
- Miniconference on Analysis and Probability in sub-Riemannian spaces, Spring 2020. (virtual)
- Seminar in Stochastic Processes, Michigan State University, March 2020.
- Eighteenth Northeast Probability Seminar, CUNY Graduate Center, November 2019. †
- Stochastic Processes and their Applications, Northwestern University, Summer 2019. †
- Finger Lakes Probability Seminar, Cornell University, April 2019. †
- Seminar in Stochastic Processes, University of Utah, March 2019. †
- Recent Trends in Continuous and Discrete Probability Conference, Georgia Tech, Summer 2018. †
- Joint Mathematics Meetings, January 2011, 2012, 2013, and 2018.
- Seminar in Stochastic Processes, Brown University, May 2018. †
- Southeast Probability Conference, Duke University, May 2017. †
- Seminar in Stochastic Processes, University of Virginia, March 2017. †
- Fifteenth Northeast Probability Seminar, Baruch College, November 2016. †
- Seminar in Stochastic Processes, University of Delaware, March 2015. †
- New England Section of the MAA-Spring Meeting, Spring 2012, Spring 2018

FUNDING

- † NSF travel support to conference. Fund administered by the conference organizers.
- * Travel support given by host institution.
- Spring research was supported in part by NSF Grant DMS-1405169, 2018.
- Summer research was supported in part by NSF Grant DMS-1262929, 2017.
- Summer research was supported in part by NSF Grant DMS-1007496, 2016.

INVITATIONS TO
REFEREE/REVIEW

National Science Foundation Panel Reviewer (2021, 2022, 2024)
Potential Analysis
Proceedings of the American Mathematical Society
Transactions of the American Mathematical Society

Stochastics and Dynamics
Stochastics
Electronic Journal in Probability
Electronic Communications in Probability
Journal of Applied Probability
Journal of Dynamical and Control Systems
Journal of Fractal Geometry
Journal of Theoretical Probability
Communications on Stochastic Analysis
Forum Mathematicum

TEACHING
EXPERIENCE

Union College

Instructor, Mathematics Department

Fall 2020 – Present

- Courses taught:
 - IMP 121 - Integrated Math and Physics 2
 - MTH 105 - Differential Calculus with Precalculus
 - MTH 112 - Calculus 2.
 - MTH 115 - Differential Vector Calculus
 - MTH 130 - Ordinary Differential Equations
 - MTH 197 - Discrete Math for Computer Science.
 - MTH 199 - Logic & Set Theory
 - ECO/MTH 227 - Financial Mathematics
 - MTH 228 - Probability Theory

University of New Haven

Instructor, Mathematics and Physics Department

Fall 2019 – Spring 2020

- Courses taught:
 - (# of semesters) Differential Equations(2), Probability & Statistics I(1), and Probability & Statistics II (1).

Purdue University

Instructor, Purdue Mathematics Department

Fall 2018 – Summer 2019

- Courses taught:
 - **Instructor of Record:**(# of semesters) Differential Equations(2), Probability(1).

University of Connecticut

Instructor, UConn Mathematics Department

Fall 2014 – Spring 2018

- Responsibilities included preparing and delivering lectures, writing quizzes and exams, grading, holding office hours, and conducting review sessions.
- Courses taught:
 - **Instructor of Record:**(# of semesters) Upper Level Probability(2), Differential Equations(2), Multivariable Calculus(3), Discrete Mathematics(1), Math for Business and Economics(1).
- Experience using WebAssign for online homework.

Teaching Assistant, UConn Mathematics Department

Fall 2013 – Spring 2014

- Courses taught:
 - **Discussion Leader:**(# of semesters) Calculus I(1), Calculus II(1), Differential Equations(1), Business Calculus(3).

Head T.A., UConn Summer Session **Summer 2014, 2016-2018**

- Head Teaching Assistant for an online calculus course for business students in summers of 2014, 2016, 2017.
- Used SMART board technology integrated with WebEx to provide live online office hours and review sessions in real time.

Instructor, UConn “Bridge” Engineering Diversity Program **Summer 2014-2017**

- Coordinated the placement of students into their Bridge math course. Used Aleks and the UConn Math Placement Exam scores.
- Lecture calculus for incoming engineering students from diverse and underrepresented groups based on data analysis to address shortcomings and needs of each group. Relate topics from these courses to mathematical concepts learned in high schools as a way of “bridging” students to succeed in a college setting.
- Conduct study sessions after classroom hours to promote effective study techniques.
- Mentor and coordinate former Bridge students who work as mathematics tutors during the program.

Instructor, Enrichment Programs **Spring 2015, 2016, 2017**

Lecturer for preparatory course on mathematics needed for Dental Admissions Test. Concepts include algebra, trigonometry, basic calculus, and perceptual reasoning.

Instructor and Tutor, UConn Student Support Services **Summer 2014, 2015**

Program for incoming freshmen from diverse and/or underrepresented groups.

- Tutor for Elementary Discrete Mathematics in 2014.
- Instructor for Elementary Discrete Mathematics in 2015.

SERVICE

Director, Minor in Financial & Actuarial Mathematics **Fall 2022 - present**

Division III Faculty Representative, Honor Council (3 year term) **Fall 2024 - present**

Co-organizer, 2025 Discrete and Continuous Probability Conference **Fall 2024 - Fall 2025**

Co-organizer, 2025 Distinguished Lecture in Interdisciplinary Mathematics **Fall 2024 - Spring 2025**

Member, Math Department Job Search Committee **Fall 2024 - Winter 2025**

Member, Math Department Job Search Committee **Fall 2023 - Winter 2024**

Co-organizer, Math Student Seminar **Spring 2025 - present**

Member, Curriculum Steering Committee **Fall 2023 - present**

Member, committee that introduced the new Minor in Financial & Actuarial Mathematics **Winter 2021 - Spring 2022**

Co-organizer, Union College Math Conference **Winter 2021 - Summer 2022**

Principal Investigator, Union College Math Conference Grant Committee **Winter 2021 - Summer 2022**

- Co-Organizer*, Union Math Seminar **Spring 2021 - Winter 2022**
- Co-Advisor*, Actuarial Science Advisor **Fall 2020 - present**
- Co-Organizer*, UNH Mathematics and Physics Lecture Series **Fall 2019 - Spring 2020**
- Co-adviser*, UNH Math and Physics Club **Fall 2019 - Spring 2020**
- Co-organizer with Patricia Alonzo Ruiz*, Spring Eastern Sectional Meeting **Spring 2019**
- Co-organized AMS Special session titled “Special Session on Stochastic Processes, Random Walks, and Heat Kernels”
- Organizer*, 5th Northeast Mathematics Undergraduate Research Mini-Symposium **August 2017**
- Organizer*, S.I.G.M.A graduate student seminar **2016-2017**
- Invited speakers and coordinated food for the seminar
 - Organized special events such as the “Grad Student Meet & Greet”, “Grad School Panel”, and “Job Applications Panel”.
- New T.A. Orientation* **2016,2017**
- Helped facilitate the T.A. orientation program. Worked in small groups and answered questions about lesson planning and being a T.A. in the math department.
- Graduate student mentor* **2014-2017**
- Mentored incoming first year graduate students.
- Open Source Textbook Author in Differential Equations* **Spring 2020-present**
- Co-writing an open source textbook in Differential Equations.
 - Website: <http://math.newhaven.edu/rtullydo/diffeqs/frontmatter-1.html>
- Mentor*, NSF site Research Experience for Undergraduates (REU) **Summer 2017, 2018**
- Lead a research group of three REU students during a 10 week period.
 - Prepared lectures, designed research questions, and worked on publications.
 - Organized weekly seminars and events for the entire REU.
 - Website: <http://mathreu.uconn.edu/>
- Open Source Textbook Author in Probability* **Spring 2017-present**
- Part of a team of probabilists from the UConn math department that created a new open source textbook for the upper level probability course. The goal is to provide a free open source resource to undergraduates and to lower their textbook costs per semester.
 - Created several sections for the new textbook, including exercises and solutions.
 - Used this textbook for my own course when I taught probability in the Fall of 2017.
 - Website: <http://probability.oer.math.uconn.edu/>
- Lightboard Technology* flipped classroom experience **Fall 2017**
- Lightboard technology reverses the video so that the lecturer can write onto a glass panel and allows the video to appear correctly to viewers. I recorded videos and implemented this technology into my probability class.
 - Partially implemented a flipped classroom experience by presenting the information by video ahead of time. This allowed for more class time to be spent in interacting with the students and answering their questions.

RELATED
EXPERIENCE