

Andrew Papanicolaou

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EDUCATION AND EMPLOYMENT

- North Carolina State University (Aug. 2020-present)
Assistant Professor in Department of Mathematics
- New York University Tandon School of Engineering (Sept. 2015-Aug. 2020)
Assistant Professor in Department of Finance & Risk Engineering
- The University of Sydney (Jul. 2013-Jun. 2015)
Lecturer in School of Mathematics & Statistics
- Princeton University (Sep. 2010-Jun. 2013)
Post-Doctoral Researcher/Lecturer in Department of Operations Research & Financial Engineering
- Brown University
Ph.D. in Division of Applied Mathematics (May 2010)
Thesis: New Methods in Theory & Applications of Nonlinear Filtering,
Advisor: Boris Rozovsky
- University of Southern California
M.S. in Financial Mathematics (May 2007)
- University of California at Santa Barbara B.S. in Mathematical Sciences (June 2003).

AWARDS

- NSF DMS-1907518, August 2019-March 2022, “Deep Neural Networks for Solving Non-Markov Optimization Problems”.
- University Research Challenge Fund, NYU Provost, June 1, 2019 - November 30, 2020, project title: “Machine Learning for Non-Markov Decision Problems.”
- Goddard Junior Faculty Fellowship, NYU Steinhardt, June 2018.
- Fellow at the Institute for Pure and Applied Mathematics (IPAM), National Science Foundation, Spring 2015 Program on “Broad Perspectives and New Directions in Financial Mathematics.”
- Australian Research Council, Discovery Early Career Research Award (DECRA), October 2015 (declined to accept).

PUBLICATIONS

1. “Principal Eigenportfolios for U.S. Equities”, M. Avellaneda, B. Healy, A. Papanicolaou, G. Papanicolaou, T. Xu (2020) (under review)
2. “Aggregate Alpha in the Hedge Fund Industry: A Further Look at Best Ideas” F. Amir-Ghassemi, A. Papanicolaou and M. Perlow (2020) (under review)

3. "Static Replication of European Standard Dispersion Options" S. Bossu, P. Carr and A. Papanicolaou, (2020) (under review)
4. "PCA for Implied Volatility Surfaces", M. Avellaneda, B. Healy, A. Papanicolaou, G. Papanicolaou, **Journal of Financial Data Science** (2020). DOI: 10.3905/jfds.2020.1.032
5. "Dynamic Optimal Portfolios for Multiple Co-Integrated Assets", T. Li and A. Papanicolaou, (2019) under review .
6. "A Functional Analysis Approach to Static Replication of European Options", S. Bossu, P. Carr and A. Papanicolaou, **Quantitative Finance**, (2020) (to appear).
7. "Consistent Inter-Model Specification for Time-Homogeneous SPX Stochastic Volatility and VIX Market Models", A. Papanicolaou, (2018) under review.
8. "Singular Perturbation Expansion for Utility Maximization with Order- ϵ Quadratic Transaction Costs", S. Chandra and A. Papanicolaou, **International Journal of Theoretical and Applied Finance**, (2019) 22(7):(TBD). DOI: 10.1142/S0219024919500390
9. "Statistics of VIX Futures and Applications to Trading Exchange-Traded Products", M. Avellaneda and A. Papanicolaou, **International Journal of Theoretical and Applied Finance**, (2019) 22(1):1-30. DOI: 10.1142/S0219024918500619
10. "Price Impact of Large Orders Using Hawkes Processes", L. R. Amaral and A. Papanicolaou, **ANZIAM Journal**, (2019) 61(2):161-194. DOI: 10.1017/S1446181119000038
11. "Backward SDEs for Control with Partial Information", A. Papanicolaou, **Mathematical Finance** (2019) 29(1):208-248. DOI: 10.1111/mafi.12174
12. "Extreme-Strike Comparisons and Structural Bounds for the VIX and SPX Options Markets", A. Papanicolaou, **SIAM Journal on Financial Mathematics**, (2018) 9(2):401-434. DOI: 10.1137/141001615
13. "Dimension Reduction in Statistical Estimation of Partially-Observed Multiscale Processes", A. Papanicolaou and K. Spiliopoulos, **SIAM Journal on Uncertainty Quantification**, (2017) 5(1):1220-1247. DOI: 10.1137/16M1085930
14. "Perturbation Analysis for Investment Portfolios Under Partial Information with Expert Opinions", J.-P. Fouque, A. Papanicolaou and R. Sircar, **SIAM Journal on Control and Optimization**, (2017) 55(3):1534-1566. DOI: 10.1137/15M1006854
15. "Pairs Trading of Two Assets with Uncertainty in Co-Integration's Level of Mean Reversion", S. Lee and A. Papanicolaou, **International Journal of Theoretical and Applied Finance**, (2016) 19(8):TBD. DOI:10.1142/S0219024916500540
16. "Analysis of VIX Markets with a Time-Spread Portfolio", A. Papanicolaou, **Applied Mathematical Finance**, (2016) 23(5):374-408. DOI: 10.1080/1350486X.2017.1290534
17. "Filtering and Portfolio Optimization with Stochastic Unobserved Drift in Asset Returns", J.-P. Fouque, A. Papanicolaou, and R. Sircar, **Comm. Math.**

- Sci.**, (2015) 13(4):935-953.
DOI: 10.4310/CMS.2015.v13.n4.a5
18. “Filtering the Maximum Likelihood for Multiscale Problems”, A. Papanicolaou and K. Spiliopoulos, **SIAM Journal on Multiscale Modeling and Simulation**, (2014) 12(3):1193-1229.
DOI: 10.1137/140952648
 19. “Implied Filtering Densities on the Hidden State of Stochastic Volatility”, C. Fuertes and A. Papanicolaou, **Applied Mathematical Finance**, (2014) 21(6):483-522.
DOI: 10.1080/1350486X.2014.891357
 20. “A Regime-Switching Heston Model for VIX and S&P 500 Implied Volatilities”, A. Papanicolaou and R. Sircar, **Quantitative Finance**, (2014) 14(10):1811-1827.
DOI: 10.1080/14697688.2013.814923
 21. “Dimension Reduction in Discrete Time Portfolio Optimization with Partial Information”, A. Papanicolaou, **SIAM Journal on Financial Mathematics**, (2013) 4(1):916-960.
DOI: 10.1137/16M1085930
 22. “Nonlinear Filters for Hidden Markov Models of Regime Change with Fast Mean-Reverting States”, A. Papanicolaou, **SIAM Journal on Multiscale Modeling and Simulation**, (2012) 10(3):906-935.
DOI: 10.1137/110819937
 23. “Filtering For Fast Mean-Reverting Processes”, A. Papanicolaou, **Asymptotic Analysis**, (2010) 70(3-4):155-176.
DOI: 10.3233/ASY-2010-1011

INVITED TALKS

1. *Rutgers-Princeton Finance Seminar (December 2020)* “Principal Eigenportfolios for U.S. Equities” Rutgers, NJ.
2. *Frontiers in Quantitative Finance Seminar (May 2020)* “PCA for Implied Volatility Surfaces” Oxford, UK.
3. *Princeton ORFE Department (February 2020)* “PCA for Implied Volatility Surfaces” Princeton, NJ.
4. *Lehigh University Industrial & Systems Engineering (February 2020)* “PCA for Implied Volatility Surfaces” Lehigh, PA.
5. *NC State Math Dept. (February 2020)* “PCA for Implied Volatility Surfaces” Raleigh, NC.
6. *UCLA Probability Seminar (January 2020)* “PCA for Implied Volatility Surfaces” Los Angeles, CA.
7. *IAQF Thalesians Seminar (January 2020)* “PCA for Implied Volatility Surfaces” New York, NY.
8. *Stanford University, Advanced Financial Technologies Laboratory Seminar (December 2019)* “PCA for Implied Volatility Surfaces” Stanford, CA.
9. *Illinois Institute of Technology, Applied Mathematics Seminar (October 2019)* “Tensor PCA for Implied Volatility Surfaces” Chicago, Ill.
10. *U. of Connecticut Probability Seminar (September 2019)* “Tensor PCA for Implied Volatility Surfaces” Hartford, CT.
11. *Courant Mathematical Finance Seminar (Apr. 2019)* “Reduced Order Representation of Implied Volatility Surfaces” New York, NY.

12. *Machine Learning and Statistics Seminar (Feb. 2019)* “Implied Vol. PCA” Knoxville, TN.
13. *Laboratoire LJLL-UPMC, INRIA-UPMC Seminar (Feb. 2019)* “Représentation réduite des surfaces de volatilité implicites.” (talk given in English) Paris, France.
14. *AMS Joint Mathematics Meeting (Jan. 2019)* “Nonlinear Filtering and Non-Markov Control in Financial Portfolio Optimization.” Baltimore, MD.
15. *UC Irvine, Applied and Computational Mathematics Seminar (Nov. 2018)* “Consistent Inter-Model Specification for Time-Homogeneous SPX Stochastic Volatility and VIX Market Models” Irvine, CA.
16. *Tulane U., Probability and Statistics Seminar (Nov. 2018)* “Consistent Inter-Model Specification for Time-Homogeneous SPX Stochastic Volatility and VIX Market Models” New Orleans, LA.
17. *3rd Eastern Conference on Mathematical Finance (October 2018)* “Statistics of VIX futures and their applications to trading volatility exchange-traded products” Chicago IL.
18. *Johns Hopkins U. Applied Math Student Seminar (Oct. 2018)* “Consistent Inter-Model Specification for Time-Homogeneous SPX Stochastic Volatility and VIX Market Models” Baltimore, MA.
19. *10th World Congress of the Bachelier Finance Society (June 2018)* “Statistics of VIX & VSTOXX Futures with Applications to Trading Volatility Exchange-Traded Products” Dublin, Ireland.
20. *2018 SIAM Annual Meeting (June 2018)* “Consistent Inter-Model Specification for Stochastic Volatility and VIX Market Models” Portland, OR.
21. *First Congress of Greek Mathematicians (June 2018)* “Consistent Inter-Model Specification for Stochastic Volatility and VIX Market Models” Athens, Greece.
22. *U. of Toronto/Fields Institute (February 2018)* “Mean Reversion in VSTOXX & VIX Futures” Toronto, Canada
23. *U. of Connecticut Mathematical Finance Seminar (February 2018)* “Mean Reversion in VSTOXX & VIX Futures” Hartford, CT.
24. *INFORMS Annual Meeting (Oct 2017)* “Trading Illiquid Goods: Market Making as a Sequence of Sealed-Bid Auctions.” Houston, TX.
25. *Qplum (Sept 2017)* “A Quantitative Approach to Contango in VIX Futures” Jersey City, NJ
26. *Sydney Dynamics Group (Aug 2017)* “A Quantitative Approach to Contango in VIX Futures” Sydney, NSW, Australia
27. *U. of Chicago, Market Microstructure and High-Frequency Data (June 2017)* “Trading Illiquid Goods: Market Making as a Sequence of Sealed-Bid Auctions, with Analytic Results” Chicago, IL.
28. *Worcester Polytechnic Stochastic Analysis and Financial Mathematics Common Seminar Series (May 2017)* “Trading in VIX Derivatives” Worcester, MA.
29. *IAQF Thalesians Seminar (April 2017)* “Trading in VIX Derivatives” New York, NY.
30. *Stevens Institute of Technology Financial Engineering Seminar Series (December 2016)* “Analysis of VIX Markets with a Time-Spread Portfolio” Hoboken, NJ.

31. *1st Eastern Conference on Mathematical Finance (March 2016)* “Numerical Methods for Backward SDEs for Control with Partial Information” Worcester, MA.
32. *IPAM workshop on Commodity Markets and their Financialization (May 2015)* “Investment in Commodities ETFs and Management of Contango ” Los Angeles, CA.
33. *Groupe de Travail: Finance mathématique, probabilités numériques et statistique des processus (January 2015)* “Extreme-Strike Comparisons and Structural Bounds for the VIX and SPX Options Markets” Paris, France.
34. *London Mathematical Finance Seminar Series (January 2015)* “Extreme-Strike Comparisons and Structural Bounds for the VIX and SPX Options Markets” London, UK.
35. *New Directions in Financial Mathematics and Mathematical Economics (Jul. 2014)* “Control with Partial Information”, Banff, Alberta Canada.
36. University of Sydney Financial Mathematics Seminar “Mean-Field Games in Finance” (Nov. 14, 21, and 28, 2013) Sydney, NSW.
37. *The 5th Western Conference on Mathematical Finance (May 2013)* “Filtering the Maximum Likelihood for Multiscale Problems” Stanford, CA.
38. *Applied Mathematics Colloquium at Caltech (Nov. 2012)* “Dimension Reduction in Discrete Time Portfolio Optimization with Partial Information” Pasadena, CA.
39. *Boston University Department of Mathematics & Statistics (Oct. 2012)* “Dimension reduction of the Bellman equations for maximum expected utility with partial information in discrete time” Boston, MA.
40. *IMS on Finance: Probability and Statistics (FPS), Workshop on Probability and Statistics in Finance (May 2012)* “Option Pricing with Filtering of Partial Information” Berkeley, CA.
41. *Humboldt-Princeton Conference (Oct. 2011)* “Nonlinear Filters For Hidden Markov Models Of Regime Change with Fast Mean-Reverting States” Berlin, Germany.
42. *Princeton-Lausanne Conference (May 2011)* Discussion for L. Mancini’s “The Term Structure of Variance Swaps, Risk Premia and the Expectation Hypothesis” Lausanne, Switzerland.
43. *Princeton University, Department of ORFE Stochastic Analysis Seminar (Feb. 2010)* “Nonlinear Filtering for Telescoping Markov Chains and Applications to Evolving Images” Princeton, NJ.
44. *UC Irvine Applied Mathematics Seminar (Jan. 2010)* “Nonlinear Filtering for Telescoping Markov Chains and Applications to Evolving Images” Irvine, CA.

**MEDIA
COVERAGE**

News article published on Risk.net discussing insight offered by VIX research:
“*VIX curve gave warning of February volatility spike*”

STUDENTS

PhD Students

- Tom Li, thesis title: “Optimal Pairs Trading Strategies Utilising the Stochastic Control Approach” (May 2019)

Masters Thesis Students

- Carlos Fuertes, Princeton (2011)

- Sangmin Lee, NYU Tandon (2016),
- Yonghyun Kwon, NYU Tandon (2017)
- Lucas Amaral, NYU Tandon (2017),
- Shiva Chandra, NYU Tandon (2017),
- Ruijing Yang, NYU Tandon (2018)
- Zhao Ma, NYU Tandon (2018)
- Kourosh Ghobadi, NYU Tandon (2018)
- Chang Liu, NYU Tandon (2018)
- Yangfan Cui, NYU Tandon (2019)

SERVICE ACTIVITIES

- Conference Organizer, “2nd Annual Eastern Conference on Mathematical Finance” November 2017 [ECMF2017](#)
- Conference Organizer, “New Ideas & Cutting-Edge Developments in Fin-Tech” May 2018 [QUANTFIN2018](#)
- Associate Editor, Stochastic Models (Taylor & Francis) 2020-present
- Associate Editor, Risk and Decision Analysis (IOS Press) 2017-2019
- Journals Refereed for (most frequently):
 - Mathematical Finance: An International Journal of Mathematics, Statistics, and Financial Economics (Wiley)
 - Quantitative Finance (Taylor & Francis)
 - Applied Mathematical Finance (Taylor & Francis)
 - SIAM Journal on Financial Mathematics (SIAM Publishing)
 - International Journal of Theoretical and Applied Finance (World Scientific)