Curriculum Vitae

Alec N. Kercheval

May 3, 2018

Florida State University
Department of Mathematics
Love Building, Room 208
Tallahassee, FL 32306-4510

Phone: (850) 644-8701
Fax: (850) 644-4053
Email: akercheval@fsu.edu
Homepage: http://www.math.fsu.edu/∼kercheva

Education

PhD, University of California, Berkeley, 1987. Major: Mathematics.

BA & MA, University of Oxford, England, 1982. Major: Mathematics.

BS, Harvey Mudd College, Claremont, CA, 1980. Major: Mathematics/Physics.

Professional Experience

Professor, Mathematics, Florida State University, 2009–
  Director of Financial Mathematics, 2012–2018 , 2007, Co-Director 2011–2012
  Director of University Office of Undergraduate Research, 2010–2012

Associate Professor, Mathematics, FSU, 2001–2009
  Director of Financial Mathematics, 2007–2008

Senior Research Consultant, Global Fixed Income, MSCI Barra, Inc., Berkeley, CA 1999–2001

Assistant Professor, Mathematics, University of Texas at Austin, 1992–1999

Assistant Professor (NSF Postdoc), Mathematics, University of Texas at Austin, 1989–1992

Visiting Assistant Professor (NSF Postdoc), Mathematics, Indiana University, Bloomington,
  Fall 1991 & 1992

Visiting Assistant Professor, Mathematics, Boston University, 1987–1989

PhD Dissertations Directed

17. Chenchen Zhou, **PhD, Financial Mathematics, FSU**, Summer 2017: *On the multidimensional default threshold model for credit risk.* (Placement: Wells Fargo, Charlotte, NC)

16. Yuanda Chen, **PhD, Financial Mathematics, FSU**, Spring 2017: *Modeling the limit order book using Hawkes processes.* (Placement: Goldman Sachs, NY)

15. Chun-Yuan Chiu, **PhD, Financial Mathematics, FSU**, Fall 2016: *Modeling credit risk in the default threshold framework.* (Placement: Bank of America Merrill Lynch, NYC)
14. Dawna Jones, **PhD, Financial Mathematics, FSU**, Summer 2015 (co-directed with Paul Beaumont): *Asset pricing equilibria for heterogeneous, limited-information agents.* (Placement: Wells Fargo, Charlotte, NC)
13. Aaron Schmerbeck, **PhD, Economics, FSU**, Summer 2014 (co-directed with Paul Beaumont): *Financial Assets in a Heterogeneous agent general equilibrium model with aggregate and idiosyncratic risk.*
12. Yuan Zhang, **PhD, Financial Mathematics, FSU**, Fall 2013: *Modeling high frequency order book dynamics with support vector machines.* (Placement: Yahoo, Sunnyvale, CA)
11. Pierre Garreau, **PhD, Financial Mathematics, FSU**, Fall 2013: *Jump dependence and multidimensional default risk: A new class of structural models with stochastic intensities.* (Placement: Deutsche Bank, Jacksonville and Frankfurt)
10. He (Henry) Huang, **PhD, Financial Mathematics, FSU**, Spring 2012: *Modeling Order Book Processes Using Queues and Point Processes.* (Placement: Quantitative Analyst, AllianceBernstein, New York)
9. Yang Liu, **PhD, Financial Mathematics, FSU**, Spring 2012: *Risk Forecasting and Portfolio Optimization with GARCH, Skewed t Distributions, and Multiple Timescales.* (Placement: Portfolio Manager, Florida State Board of Administration)
8. Tianyu Liang, **PhD, Applied Mathematics, FSU**, Spring 2012 (co-directed with Xiaoming Wang): *Alternative Models for Stochastic Volatility Corrections for Equity and Interest Rate Derivatives*. (Placement: Quantitative Analyst, ING, Philadelphia)
7. Yuanying (Michelle) Guan, **PhD, Financial Mathematics, FSU**, Summer 2011 (co-directed with Paul Beaumont): *Asset Market Dynamics of Heterogeneous Agent Models with Learning.* (Placement: Assistant Professor of Mathematics, Indiana University Northwest)
6. Juan F. Moreno, **PhD, Financial Mathematics, FSU**, Fall 2007: *Impulse Control Problems Under Non-constant Volatility.* (Placement: Intermediate Analyst, State of Wisconsin Investment Board)
5. Andrew Culham, **PhD, Financial Mathematics, FSU**, Summer 2007 (co-directed with Paul Beaumont): *Asset Pricing in a Lucas Framework with Boundedly Rational, Heterogeneous Agents.* (Placement: Quantitative Analyst, Florida Power and Light)
4. Jianke Zhang, **PhD, Financial Mathematics, FSU**, Spring 2007: *Numerical methods for portfolio risk estimation.* (Placement: Quantitative Analyst, Florida Power and Light)
3. Wenbo Hu, **PhD, Financial Mathematics, FSU**, Fall 2005: *Calibration of multivariate generalized hyperbolic distributions using the EM algorithm, with applications in risk management, portfolio optimization, and portfolio credit risk.* (Placement: Quantitative Trader, Bell Trading, Chicago)
2. Brian Tandy, **PhD, Mathematics, UT Austin**, Spring 1997: *Cantor sets and Lipschitz actions on circles and trees.* (Placement: security software designer, Lockheed-Martin, Palo Alto)
1. Paul Fabel, **PhD, Mathematics, UT Austin**, Spring 1994: *Self-homeomorphisms of the 2-sphere which pointwise fix a nonseparating continuum.* (Placement: Assistant Professor of Mathematics, Mississippi State University)

Publications

Note on names: Until 1999, my name appears as "A. Norton" on publications.

Note on author ordering: Co-authors are usually listed alphabetically with credit equally shared. If listed out of order, the lead author is listed first.

Books

Published

G. Anderson and A. Kercheval (2010). **Lectures on Financial Mathematics: Discrete Asset Pricing**. Synthesis Lectures on Mathematics and Statistics, Vol. 3, No. 1, Steven G. Krantz, series editor, Morgan and Claypool Publishers, 63 pages.

Refereed Articles

Published

39. C.-Y. Chiu and A. Kercheval (2018), *Modeling credit risk in the jump threshold framework*, Applied Mathematical Finance, 23 pages, published online April 2018, DOI: 10.1080/1350486X.2018.1465349.

38. P. Garreau and A. Kercheval (2016), *A structural jump threshold framework for credit risk*, SIAM Journal on Financial Mathematics, **7**, 1, 642–673.

    A new framework for multidimensional default risk for exponential Levy assets leads to explicit formulas for credit derivatives for the first time in a structural model context.

37. A. N. Kercheval and Y. Zhang (2015), *Modeling high-frequency limit order book dynamics with support vector machines*, Quantitative Finance, **15**, 3, 1315–1329.

    Support Vector Machines are used effectively for short-horizon price forecasts in the high-frequency limit order book for equities.

36. P. Beaumont, Y. Guan, and A. Kercheval (2014). *Complex Dynamics in Equilibrium Asset Pricing Models with Boundedly Rational, Heterogeneous Agents*, Complexity, **19**, 3, 38–55.

    We study price dynamics is a two-agent market model with one asset in which prices are fully endogenous, agents optimize long term utility, but have limited information and attempt to learn equilibrium prices by forecasting with constant gain learning, equivalent to an exponentially weighted average of historical price-dividend ratios. Chaos ensues.

35. P. Beaumont, A. J. Culham, and A. Kercheval (2013). *Asset Market Dynamics in Equilibrium Models with Heterogeneous Agents: Analytical Results*, Advances in Economics and Business, **1**, 2, 49-56.

    We solve the time evolution of asset prices and holdings in a market where prices are determined endogenously in each time step by balancing a fixed stock supply against demands determined by agents optimizing a time-separable logarithmic utility.

34. A. Kercheval and Y. Liu (2012). *Risk forecasting with GARCH, skewed t distributions, and multiple timescales,* chapter 7 in *Handbook of Modeling High-Frequency Data in Finance*, ed. by F. Viens, M. Mariani, I. Florescu, Wiley Handbooks in Financial Engineering and Econometrics, 163–218.

33. H. Huang and A. Kercheval (2012). *A generalized birth-death stochastic model for high-frequency order book dynamics*, Quantitative Finance, **12**, 4, 547–557.

    We propose a stochastic generalized birth-death model for high-frequency limit order book dynamics, with the ability to handle incoming orders of multiple sizes, and compute conditional probabilities by a novel approximation of first passage times.

32. W. Hu and A. Kercheval (2010). *Portfolio optimization for t and skewed t returns*, Quantitative Finance, **10**, 1, 91–105.

    We develop calibration methods that allow the use of t and skewed t distributions to model equity returns, which are more realistic that the standard Gaussian choices. [This paper was listed in June 2012 as one of the top 20 most-read articles in Quantitative Finance since 2007.]

31. W. Hu and A. Kercheval (2009). *The skewed t distribution for portfolio credit risk*, Advances in Econometrics, **22**: "Econometrics of Risk Management", 55–83.

    Studies the skewed t distribution in modeling bond defaults and portfolio credit risk securities, proposing methods making it superior to currently used distributions.

30. A. Kercheval (2008). *On Rebonato and Jackel's parametrization method for finding nearest correlation matrices*, International Journal of Pure and Applied Mathematics, **45**, 3, 383–390.

    I discuss a topological approach to a problem in portfolio risk management.

29. W. Hu and A. Kercheval (2007), *Risk management with generalized hyperbolic distributions*, Proceedings of the Fourth International Conference on Financial Engineering and Applications, IASTED, Sept. 24–26, 2007, Berkeley, CA, USA, Ed: P. Locke, ACTA Press, Calgary, 19 – 24. [Paper acceptance rate at this conference: 25%]

    Describes the advantages of Generalized Hyperbolic distributions, as compared to the more common Normal distributions, in Risk Management; illustrates with a Value-at-Risk backtesting study using S&P500 daily returns over a five year period.

28. A. Kercheval (2006), *Optimal covariances in risk model aggregation*, Proceedings of the Third International Conference on Financial Engineering and Applications, Oct. 9–11, 2006, Cambridge, MA, USA, Ed: M. Holder, ACTA Press, Calgary, 30 – 35. [Paper acceptance rate at this conference: 36%]

    Provides and analyzes an effective numerical technique for risk model aggregation.

27. G. Anderson, L. Goldberg, A. Kercheval, G. Miller, and K. Sorge (2005). *On the aggregation of local risk models for global risk management*, Journal of Risk, **8**, 1, 25–40.

    Describes a technique for optimally combining risk models for different markets while preserving positive semidefiniteness of the covariance matrix forecast. Makes use of the geometry of the orthogonal group.

26. L. Goldberg, A. Kercheval, and K. Lee (2005). *t-Statistics for weighted means in credit risk modeling*, Journal of Risk Finance, **6**, 4, 349–365.

    Generalizes the two-sample t-test to the case of weighted averages reflecting variable reliability of samples; application to credit risk factor models.

25. A. Kercheval, L. Goldberg and L. Breger (2003). *Modelling Credit Risk*, Journal of Portfolio Management, **29**, 2, 90–100.

    A study of credit spreads for investment grade bonds in Europe, the UK, and the US, exploring the violation of covered interest arbitrage across these markets.

24. L. Breger, L. Goldberg and A. Kercheval (2002). *Currency Dependence in Global Markets*, Horizon, the Barra Quarterly, Vol. 172, 2–6.

    A view of the influence of underlying currency on international corporate bond risk factor models.

23. A. Kercheval (2002). *Denjoy minimal sets are far from affine,* Ergodic Theory and Dynamical Systems, **22**, 6, 1803–1812. Also: *Erratum*, arXiv:1004.1363v1 [math.DS] (2010), 1 page.

    No C^2 nearly affine Cantor sets can arise as Denjoy minimal sets, improving work of D. McDuff.

22. A. Kercheval, L. Goldberg and L. Breger (2002). *Examining market influence on credit risk,* Risk Management for Investors, **15**, 6 (a supplement to Risk Magazine), S21–S22.

    A summary of a study of credit risks across markets, tailored to this popular journal for practitioners.

21. A. N. Kercheval, L. Goldberg and L. Breger (2001). *Currency dependence in global credit markets* (in Japanese), Security Analysts Journal **39**, 10, 61–74.

    A first study of the dependence of credit risk spreads on market currency.

20. A. Norton and B. Tandy (1999). *Cantor sets, binary trees, and Lipschitz circle homeomorphisms,* Michigan Math. Journal, **46**, 29-38.

    Uses combinatorial techniques to show that certain minimal sets cannot arise for Lipschitz aperiodic circle homeomorphisms.

19. A. Norton (1999). *Denjoy's Theorem with Exponents,* Proc. Amer. Math. Soc., **127**, 10, 3111-3118.

    Explores the relationship between smoothness and dimension for Denjoy counterexamples of Poincare's conjecture than any differentiable circle diffeomorphism without periodic points is conjugate to irrational rotation.

18. A. Norton and D. P. Sullivan (1996). *Wandering domains and invariant conformal structures for mappings of the 2-torus,* Ann. Acad. Sci. Fenn., Series A I Math., **21**, 51-68.

    Using ideas from quasiconformal mappings, finds rigidity conditions for irrational rotations of the 2-torus in analogy with Denjoy's famous one-dimensional results.

17. S. Bates and A. Norton (1996). *On sets of critical values in the real line,* Duke Math. Journal, **83**, 399-413.

    Gives a geometric characterization of sets of critical values for functions of one variable.

16. A. Norton (1994). *The Zygmund Morse-Sard Theorem,* Journal of Geometric Analysis, **4**, 3, 403-424.

    Improves the hypotheses of the classical Morse-Sard theorem by means of the Zygmund class from harmonic analysis.

15. A. Norton, D. Galambos, T. L. Hwang, M. Stimson, and A. J. Shaka (1994). *Amplitude modulated pulse shapes for the elimination of cross relaxation during multiple-pulse NMR experiments,* Journal of Magnetic Resonance, Series A, **108**, 51–61.

    A calculus of variations analysis is used to find optimal radio-frequency amplitude pulse shapes for 2-D Nuclear Magnetic Resonance spectroscopy.

14. A. Norton and J. Velling (1994). *Conformal irregularity for Denjoy Diffeomorphisms of the 2-torus,* Rocky Mountain Journal of Math., **24**, 2, 655–671.

    Gives conditions under which a diffeomorphism semiconjugate to an irrational translation of the 2-torus must be rigid.

13. J. Harrison and A. Norton (1992). *The Gauss-Green theorem for fractal boundaries,* Duke Math. Journal, **67**, 575–588.

    Continues prior joint work to show that the Gauss-Green theorem holds in all dimensions even for domains with fractal boundaries.

12. A. Norton (1991). *A $C^{1\times\infty}$ function with an interval of critical values,* Indiana Univ. Math. Journal, **40**, 4, 1483–1488.

    Shows that the anlayticity hypothesis in Pugh's $C^{m\times\omega}$ Morse-Sard theorem is necessary.

11. J. Harrison and A. Norton (1991). *Geometric integration on fractal curves in the plane,* Indiana Univ. Math. Journal, **40**, 2, 567–594.

    Develops a new theory of geometric integration for unrectifiable curves in the plane.

10. A. Norton and C. Pugh (1991). *Critical sets in the plane,* Michigan Math. Journal **38**, 441-459.

    Characterizes those closed sets that can arise as critical sets for smooth functions on the plane.

9. A. Norton (1991). *Minimal sets, wandering domains, and rigidity in the 2-torus, in Continuum Theory and the Theory of Dynamical Systems,* Contemporary Mathematics, **117**.

    Analyzes the problem of wandering domains for maps of the 2-torus, discussing conditions leading to rigidity results.

8. A. Norton (1991). *An area approach to wandering domains for smooth surface endomorphisms,* Ergodic Theory and Dynamical Systems **11**, 181–187.

    Shows that area noncontraction on the boundaries of an orbit of domains implies the domain is non-wandering; one application is an easy proof of Sullivan's "no wandering domains" theorem in the hyperbolic case.

7. A. Norton (1989). *Functions not constant on fractal quasi-arcs of critical points,* Proceedings of the American Mathematical Society, **106** (1989), 397–406.

    Shows that a large class of fractal curves (quasi-arcs) are critical sets for smooth nonconstant functions.

6. A. Norton (1988). *Continued fractions and differentiability of functions,* American Math. Monthly, **95**, 639–643.

    Explores the relation between degrees of differentiability at a point and degrees of approximability of an irrational by rationals for a class of functions including the Dirichlet function.

5. A. Norton (1986). *A critical set with non-null image has large Hausdorff dimension,* Transactions of the American Mathematical Society, **296**, 367–376.

    Answers a 50-year-old question of Whitney, giving a geometric necessary condition for a critical set of a smooth function to have positive measure image.

4. B. Lotto and A. Norton (1984). *Complex roots made visible,* College Journal Math., **15**, 248–249.

    Shows how to graphically find the complex roots of a real quadratic polynomial from it's graph.

Invited Articles

3. A. Kercheval (2012), "Financial Economics: A Concise Introduction to Classical and Behavioral Finance", *Quantitative Finance*, **12**, No. 10, 1487–1489. **Book Review** of *Financial Economics: A Concise Introduction to Classical and Behavioral Finance*, by T. Hens and M. O. Rieger, Springer-Verlag, 2010.

2. A. Norton (1995). *Dynamics: An Introduction*, in *Mind as Motion: Explorations in the Dynamics of Cognition,* R.F. Port and T. Van Gelder, eds., MIT Press, 45–68.

    An introduction to dynamical systems intended for psychologists, cognitive scientists, and philosophers interested in applications to theories of mind and mental processes, plus an annotated glossary.

1. A. Norton (1992), "Measure, Topology, and Fractal Geometry", American Mathematical Monthly, **99**, No.4, 378–382. **Book Review** of G. A. Edgar, *Measure, Topology, and Fractal Geometry*, Springer-Verlag, 1990.

Contributed papers, e-Prints, and technical reports

A. Kercheval and J. F. Moreno (2009). *Optimal intervention in the foreign exchange market when interventions affect market dynamics,* 28 pages. arXiv:0909.1142v1 [q-fin.GN]

W. Hu and A. Kercheval (2006). *Skewed t-distributions and t-copulas with applications in portfolio credit risk,* Proceedings of the 5th Annual Hawaii International Conference on Statistics, Mathematics, and Related Fields, Jan. 16–18, 2006, Honolulu, HI, http://www.hicstatistics.org, 908–940.

Applies new algorithms to calibration problems for the use of skewed t-distributions in portfolio credit risk problems.

A. Kercheval (2000). *Brady Bonds in BARRA's Athena analytics library,* BARRA fixed income research technical report.

A. Kercheval (2000). *BARRA Athena Project: Futures,* BARRA fixed income research technical report.