

DARRELL DUFFIE

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UNIVERSITY EDUCATION

Stanford University, Ph. D. (Engineering Economic Systems) (1984)

University of New England (Australia), Master of Economics (Economic Statistics) (1980)

University of New Brunswick (Canada), Bachelors of Science in Engineering (Civil Engineering) (1975)

ACADEMIC AWARDS AND HONORS

1985-86 NSF Research Fellowship
1988-89 Batterymarch Fellowship
1990-92 NSF Research Grant
1992-93 Catalyst Institute Research Grant
1994-95 Q Group Research Award
1994-96 NSF Research Grant
Fellow, Econometrica Society
1997, Smith-Breeden Distinguished Paper Prize, *Journal of Finance*

EMPLOYMENT EXPERIENCE

1984-present: Graduate School of Business, Stanford University
Current Position: James I. Miller Professor of Finance
On leave: Mathematical Sciences Research Institute, University of California, Berkeley; September, 1985 - March, 1986; Université de Paris, Dauphine; January 1998 - July, 1998.

1981-1983: Systems Control Technology Incorporated, Palo Alto, CA
Engineer - Decision Systems

Responsibilities: economic modeling for U.S. Department of Energy and various industrial clients, including research on futures markets, descriptor variable models; and algorithms for micro-economic and forecasting problems in physical distribution systems.

1978-1979: Dept. of Civil Engineering, University of New Brunswick
Lecturer: February, 1978 - June, 1979

Assistant Professor: June, 1979 - June, 1984 (on leave)

Responsibilities: lecturing in statistics, cost estimating, and engineering economics.

1975-1978: Bell Telephone Company of Canada Limited
Junior Engineer, Facilities: May, 1975 - February, 1976

Responsibilities: planning, design, and approval of facilities.
Leave of Absence: February, 1976 - February, 1977
Junior Engineer - Special Assignment: February, 1977 - February, 1978
Responsibilities: capital budgeting.

RESEARCH
INTERESTS

Incomplete security markets; derivative security markets; market and credit risk management of banks and other financial institutions; asset pricing theory; preference theory under uncertainty, financial market innovation and security design; interest-rate modeling and fixed-income security pricing; options and other derivative security markets; credit risk.

BOOKS

Security Markets: Stochastic Models, Boston: Academic Press, 1988.

Futures Markets, Englewood Cliffs, New Jersey: Prentice-Hall, 1989. Japanese translation, Kinzai Publishing Company, 1994; Chinese translation, 1996.

Dynamic Asset Pricing Theory, Princeton University Press, 1992; Third Edition, 2001; French Translation, *Modèles Dynamiques d'Évaluation*, Paris: Presse Universitaire Française, 1993; Japanese Translation, Shinbun Press, 1998; portions appearing in Italian translation in *Il Principio di Arbitraggio*, edited by M. de Felice and E. F. Moriconi, Società Editrice Il Mulino, Bologna, 1996.

Credit Risk: Pricing, Measurement, and Management, with Kenneth J. Singleton, Princeton University Press, 2003.

PUBLISHED
ARTICLES

“Implementing Arrow-Debreu Equilibria by Continuous Trading of Few Long-Lived Securities,” (with Chi-fu Huang), *Econometrica*, vol. 53 (1985), pp. 1337-1356, forthcoming in reprinted form in *Continuous-Time Finance*, edited by Stephen Schaefer, London: Edward Elgar, 2000.

“Competitive Equilibria in General Choice Spaces,” *Journal of Mathematical Economics*, vol. 14 (1986), pp. 1-23.

“Stochastic Equilibria: Existence, Spanning Number, and the ‘No Expected Financial Gains From Trade’ Hypothesis,” *Econometrica*, vol. 54 (1986), pp. 1161-1184.

“Predictable Representation of Martingale Spaces and Changes of Probability Measure,” *Séminaires de Probabilité XIX*, edited by J. Azéma and M. Yor, *Lecture Notes in Mathematics Number 1123*, (1985) Springer-Verlag: Berlin, pp. 278-285.

“Multiperiod Security Markets with Differential Information: Martingales and Resolution Times” (with Chi-fu Huang), *Journal of Mathematical Economics*, vol. 15 (1986), pp. 283-303.

“Stochastic Equilibria with Incomplete Financial Markets”, *Journal of Economic Theory*, vol. 41 (1987), pp. 405-416. Corrigendum, vol. 49 (1989), p. 384.

“Equilibrium in Incomplete Markets: I. A Basic Model of Generic Existence” (with Wayne Shafer), *Journal of Mathematical Economics*, vol. 13 (1985), pp. 285-300, forthcoming in reprinted form in *General Equilibrium Theory*, edited by Gerard Debreu, Edward Elgar Publishing, Cheltenham, England.

- “Equilibrium in Incomplete Markets: II. Generic Existence in Stochastic Economies” (with Wayne Shafer) *Journal of Mathematical Economics*, vol. 15 (1986), pp. 199-216, forthcoming in reprinted form in *General Equilibrium Theory*, edited by Gerard Debreu, Edward Elgar Publishing, Cheltenham, England.
- “Intertemporal Arbitrage and the Markov Valuation of Securities” (with Mark Garman), *Cuadernos Economicos de ICE*, vol. 49 (1991), pp. 37-60.
- “An Extension of the Black-Scholes Model of Security Valuation,” *Journal of Economic Theory*, Vol. 46 (1988), 194-204.
- “Optimal Hedging and Equilibrium in a Dynamic Futures Market” (with Matthew O. Jackson), *Journal of Economic Dynamics and Control*, Vol. 14 (1990), 21-33.
- “Optimal Innovation of Futures Contracts” (with Matthew O. Jackson) *Review of Financial Studies*, Vol. 2 (1989), pp. 275-296.
- “Money in General Equilibrium Theory,” Chapter 3, *Handbook of Monetary Economics*, Volume 1 (1990), edited by B. M. Friedman and F. H. Hahn, Elsevier Science Publishers, Amsterdam, pp. 81-100.
- “The Consumption-Based Capital Asset Pricing Model” (with Bill Zame), *Econometrica*, Vol. 57 (1989), pp. 1279-1298.
- “Transactions Costs and Portfolio Choice in a Discrete-Continuous Time Setting” (with Tong-Sheng Sun), *Journal of Economic Dynamics and Control*, Vol. 14 (1990), 35-51.
- “The Risk-Neutral Value of the Early Arbitrage Option”, *Advances in Futures and Options Research*, vol. 4 (1990), pp. 107-110.
- “Arrow and General Equilibrium Theory” (with Hugo Sonnenschein), *Journal of Economic Literature*, Vol. 27 (1989), pp. 565-598.
- “Corporate Financial Hedging with Proprietary Information” (with Peter Demarzo), *Journal of Economic Theory*, Vol. 53 (1991), pp. 261-286.
- “From Discrete to Continuous Time Finance: Weak Convergence of the Financial Gain Process” (with Philip Protter), *Mathematical Finance*, Vol. 2 (1992), pp. 1-16.
- “Mean-Variance Hedging in Continuous Time” (with Henry Richardson), *Annals of Applied Probability*, Vol. 1 (1991), 1-15.
- “Pricing Continuously Resettled Contingent Claims” (with Richard Stanton), *Journal of Economic Dynamics and Control*, Vol. 16 (1992), pp. 561-574.
- “Stochastic Differential Utility,” (with Larry Epstein), *Econometrica*, Vol. 60 (1992), pp. 353-394.

- “The Theory of Value in Security Markets,” *The Handbook of Mathematical Economics, Volume IV*, Chapter 31, edited by Werner Hildenbrand and Hugo Sonnenschein, North-Holland (1991), 1615-1682.
- “Frontiers of Modern Financial Theory, Volume 1, Theory of Valuation,’ A Review,” *Review of Financial Studies*, Vol. 2 (1989), pp. 267-272.
- “The New Palgrave: Finance,’ A Review,” *Journal of Monetary Economics*, Vol. 25 (1990), 477-480.
- “PDE Solutions of Stochastic Differential Utility” (with P.-L. Lions) *Journal of Mathematical Economics*, Vol. 21 (1992). 577-606.
- “The Nature of Incomplete Security Markets,” *Advances in Economic Theory, Volume 2*, edited by Jean-Jacques Laffont, Cambridge University Press (1992), pp. 214-262.
- “Asset Pricing with Stochastic Differential Utility” (with Larry Epstein), *Review of Financial Studies*, Vol. 5 (1992), pp. 411-436.
- “Intertemporal General Equilibrium: Comment,” *Value and Capital, Fifty Years Later*, edited by Lionel McKenzie and Stefano Zamagni, London: Macmillan (1991), 461-468.
- “Simulated Moments Estimation of Markov Models of Asset Prices” (with Ken Singleton), *Econometrica*, Vol. 61 (1993), pp. 929-952.
- “Spanning in Security Markets” in *The New Palgrave Dictionary of Money and Finance*, (1992) edited by P. Newman, M. Milgate, and J. Eatwell, London: The Macmillan Press.
- “The Modigliani-Miller Theorem,” in *The New Palgrave Dictionary of Money and Finance*, (1992) edited by P. Newman, M. Milgate, and J. Eatwell, London: The Macmillan Press.
- “Optimal Investment with Undiversifiable Income Risk” (with Thaleia Zariphopoulou), *Mathematical Finance*, Vol. 3 (1993), pp. 135-148.
- “Martingales, Arbitrage, and Portfolio Choice,” *Proceedings of The European Congress of Mathematics, Volume II, Invited Lectures*, edited by A. Joeseph and R. Rentschler, Boston: Birkhäuser Press, 1994, pages 3-21.
- “Arbitrage Pricing of Russian Options and Perpetual Lookback Options” (with J. Michael Harrison), *Annals of Applied Probability*, Vol. 3 (1993), 641-651.
- “Asset Pricing in Incomplete Markets,” *Hitotsubashi Journal of Economics*, Vol. 34 (1993), 139-148.
- “Continuous-Time Security Pricing: A Utility Gradient Approach” (with Costis Skiadas), *Journal of Mathematical Economics*, Vol. 23 (1994), 107-132.

- “Efficient and Equilibrium Allocations with Stochastic Differential Utility,” (with Pierre-Yves Geoffard and Costis Skiadas), *Journal of Mathematical Economics*, Vol. 23 (1994), 133-146.
- “Stationary Markov Equilibria” (with John Geanakoplos, Andreu Mas-Colell, and Andy McLennan), *Econometrica*, Vol. 62 (1994), 745-782.
- “Debt Management and Interest Rate Risk,” *Risk Management: Challenges and Solutions*, ed. W. Beaver and G. Parker, McGraw-Hill Publishing Company, 1994.
- “Incomplete Security Markets with Infinitely Many States: An Introduction” *Journal of Mathematical Economics*, Vol. 26 (1995), 1-8.
- “Volatility in Energy Prices,” with S. Gray and P. Hoang, in *Managing Energy Price Risk*, edited by Lou Pai and Peter Field, Risk Publications, 1995, revised for second edition, 1999, pp. 273-290.
- “Multi-Factor Interest Rate Models,” with Rui Kan, *Philosophical Transactions of The Royal Society, Series A*, Volume 347 (1993), pp. 577-586, reprinted in *Mathematical Models in Finance*, Chapman and Hall, 1995.
- “Black’s Consol Rate Conjecture” (with Jin Ma and Jiongmin Yong), *Annals of Applied Probability*, Vol. 5 (1995), pp. 356-382.
- “Hedging in Incomplete Markets with HARA Utility” (with Wendell Fleming, Mete Soner, and Thaleia Zariphopoulou), *Journal of Economic Dynamics and Control* Vol. 21 (1997), pp. 753-782.
- “Efficient Monte Carlo Estimation of Security Prices” (with Peter Glynn), *Annals of Applied Probability* Vol. 5 (1996), pp. 897-905.
- “Financial Market Innovation and Security Design” (with Rohit Rahi), *Journal of Economic Theory*, Vol. 65 (1995), pp. 1-42.
- “Corporate Incentives for Hedging and Hedge Accounting” (with Peter DeMarzo), *Review of Financial Studies*, Vol. 8 (1995), 743-772.
- “Special Repo Rates,” *Journal of Finance*, Vol. 51, (1996) 493-526.
- “Asset Pricing with Heterogeneous Consumers” (with George Constantinides), *Journal of Political Economy*, Vol. 104 (1996), pp. 219-240.
- “A Term Structure Model with Preferences for the Timing of the Resolution of Uncertainty” (with Mark Schroder and Costis Skiadas), *Economic Theory*, Vol. 9 (1997), pp. 3-22.
- “A Yield-Factor Model of Interest Rates” (with Rui Kan), *Mathematical Finance* Volume 6 (1996) pp. 379-406, reprinted in *The New Interest Rate Models*, London: Risk Books, 2000; and in *Options Markets*, edited by G. Constantinides and A. Malliaris, London: Edward Elgar, forthcoming.

- “Swap Rates and Credit Quality” (with Ming Huang), *Journal of Finance*, Volume 51 (1996) pp. 921-950.
- “Recursive Valuation of Defaultable Securities and the Timing of the Resolution of Uncertainty” (with Mark Schroder and Costis Skiadas), *Annals of Applied Probability*, Vol. 6 (1996) pp. 1075-1090.
- “State-Space Models of the Term Structure of Interest Rates,” in H. Körezlioglu, B. Øksendal, and A. Üstünel, editors, *Stochastic Analysis and Related Topics V: The Silivri Workshop, 1994*, Boston: Birkhäuser, 1996, republished in *Vasicek and Beyond*, edited by Lane Hughston (RISK: London, 1997).
- “An Econometric Model of the Term Structure of Interest Rate Swap Yields” (with Ken Singleton), *Journal of Finance*, Vol. 52, pp. 1287-1321, forthcoming in reprinted form in *Options Markets*, edited by G. Constantinides and A. Malliaris, London: Edward Elgar, 2000.
- “An Overview of Value at Risk,” (with Jun Pan), *Journal of Derivatives*, April, 1997, pp. 7-49, forthcoming in reprinted form in *Options Markets*, edited by G. Constantinides and A. G. Malliaris, London: Edward Elgar, 2000.
- “A Liquidity-Based Model of Security Design” (with Peter DeMarzo), *Econometrica*, Vol. 67 (1999), pp. 65-99.
- “Black, Merton, and Scholes — Their Central Contributions to Economics,” *Scandinavian Journal of Economics*, Vol. 11 (1998), pp. 411-424.
- “Modeling Term Structures of Defaultable Bonds” (with Ken Singleton), *Review of Financial Studies*, Vol. 12 (1999), 687-720.
- “Credit Swap Valuation,” *Financial Analysts Journal*, January-February, 1999, pp. 73-87, reprinted in *Credit Risk: Models and Management*, edited by David Shimko, London: Risk Books, 1999, pp. 245-258, and to be reprinted in *International Securities*, edited by George Philippatos and Gregory Koutmos, The International Library of Critical Writings in Financial Economics, Senior Editor, Richard Roll, Edward Elgar Publishing, 2000.
- “Transform Analysis and Asset Pricing for Affine Jump-Diffusions,” (with Jun Pan and Ken Singleton), *Econometrica*, Vol. 68 (2000), pp. 1343-1376.
- “Floating-Fixed Credit Spreads,” (with Jun Liu), *Financial Analysts Journal*, May-June, 2001, pp. 76-87.
- “Term Structures of Credit Spreads with Incomplete Accounting Information,” (with David Lando), *Econometrica*, Vol. 69 (2001), pp. 633-664.
- “Analytical Value-at-Risk with Jumps and Credit Risk,” (with Jun Pan), *Finance and Stochastics*, Vol. 5 (2001), pp. 155-180.
- “Risk and Valuation of Collateralized Debt Obligations,” (with Nicolae Gârleanu), *Financial Analysts Journal*, January-February, 2001, pp. 41-62, winner, Graham and Dodd Scroll Award.

- “Universal State Prices and Asymmetric Information,” (with Rui Kan), *Journal of Mathematical Economics*, Vol. 38 (2002), pp. 191-196.
- “Securities Lending, Shorting, and Pricing,” (with Nicolae Gârleanu and Lasse Pedersen), *Journal of Financial Economics*, Vol. 66 (2002), pp. 307-339.
- “Liquidation Risk,” (with Alexandre Ziegler), *Financial Analysts Journal*, May-June 2003, pp 42-51..
- “Modeling Sovereign Yield Spreads: A Case Study of Russian Debt,” (with Lasse Pedersen and Ken Singleton), *Journal of Finance*, Vol. 58, pp. 119-159.
- “Affine Processes and Applications in Finance,” (with Damir Filipovic and Walter Schachermayer), *Annals of Applied Probability*, Vol. 13 (2003), 984-1053.
- “Large Portfolio Losses,” (with Amir Dembo and Jean-Dominique Deuschel), *Finance and Stochastics*, Vol. 8 (2004), pp. .
- “Market Pricing of Deposit Insurance,” (with Robert Jarrow, Amiyatosh Purnanandam, and Wei Yang), Graduate School of Business, Stanford University, March, 2003, forthcoming, *Journal of Financial Services Research*.
- “Credit Risk for OTC Derivatives Portfolios: Exposure and Valuation,” (with Eduardo Canabarro), forthcoming in, *ALM of Financial Institutions*, edited by Leo Tilman, Institutional Investor Books.
- “Intertemporal Asset Pricing Theory,” Graduate School of Business, Stanford University, March, 2002, forthcoming in *Handbook of Financial Economics*, edited by George Constantinides, Milt Harris, and René Stulz, Amsterdam, North-Holland Elsevier.
- RESEARCH PAPERS
- “Diffusion Approximation in Arrow’s Model of Exhaustible Resources,” (with Michael Taksar) Technical Report Number 416, Stanford Institute for Mathematical Studies in The Social Sciences (Economics Series), Stanford University, August, 1983.
- “Price Operators: Extensions, Potentials, and the Markov Valuation of Securities”, Research Paper No. 813, Graduate School of Business, Stanford University, July, 1985.
- “Stochastic Production-Exchange Equilibria” (with Chi-Fu Huang), Research Paper, Graduate School of Business, Stanford University, May 1986.
- “Equilibrium and The Role of the Firm in Incomplete Markets” (with Wayne Shafer), Graduate School of Business, Stanford University, August, 1986.
- “A Liquidity-Based Model of Asset-Backed Security Design” (with Peter DeMarzo), Working Paper, Kellogg Graduate School of Management, Northwestern University, November, 1993.

“Estimation of Continuous-Time Markov Processes Sampled at Random Times,” (with Peter Glynn), Graduate School of Business, Stanford University, March, 1996.

“Asymptotic Efficiency of Hansen-Scheinkman and Resolvent Estimators of Ornstein-Uhlenbeck Processes,” (with Qiang Dai and Peter Glynn), Working Paper, Graduate School of Business, Stanford University, 1997.

“First-to-Default Valuation,” Working Paper, Université de Paris, Dauphine, and Graduate School of Business, Stanford University, 1998.

“Defaultable Term Structure Models with Fractional Recovery of Par,” Working Paper, Graduate School of Business, Stanford University, 1998.

“Simulating Correlated Defaults,” (with Ken Singleton), Working Paper, Graduate School of Business, Stanford University, 1998.

“Valuation in Over-The-Counter Markets,” (with Nicolae Garleanu and Lasse Pedersen), Working Paper, Graduate School of Business, Stanford University, August, 2003.

“Over-The-Counter Marketmaking,” (with Nicolae Garleanu and Lasse Pedersen), Working Paper, Graduate School of Business, Stanford University, August, 2003.

EDITORIAL

Management Science, May 1986 to March, 1989.

BOARDS

Journal of Mathematical Economics, July, 1988 to February, 1996.

Advances in Futures and Options Research, May, 1989 to May 1991.

Annals of Applied Probability, September, 1989 to May, 1994.

Economic Theory, December, 1989 to February, 1996.

Journal of Economic Theory, 1986 to 1999.

Mathematical Finance, October, 1989 to January, 2001.

Econometrica, July, 1990 to present.

Asia-Pacific Financial Markets, August 1993 to present.

The Review of Derivatives Research, December, 1993 to present.

Finance and Stochastics, April, 1995 to January, 2002 (co-editor, 1998-2002).

Review of Finance, July, 1995 to present.

Journal of Computational Finance, February, 1997 to present.

Advances in Mathematical Economics, August, 1998 to present.

Stochastic Processes and Their Applications, July, 1999 to present.

Quality-Rated Journal of Theoretical Economics. May, 2000 to present.

Journal of Financial Economics. November, 2001 to present.

Journal of Bond Trading and Management. January, 2002, to present.

PROFESSIONAL

Council, Bachelier Society, 1996 to 1999.

Governing Board, International Association of Financial Engineers, 1997 to present.

SERVICE

External Advisory Board, Institute for Computational Finance, University of Texas, Austin, 1996 to present.

Co-Director and Co-Developer, Stanford University Graduate School of Business Executive Education Courses on Market and Credit Risk for Financial Institutions, 1996 to present.
 International Advisory Board, Centre for Financial Engineering, National University of Singapore.
 Advisory Board, Financial Strategies Group, Graduate School of International Business Strategy, Hitotsubashi University, Tokyo, Japan.
 Research Associate, National Bureau of Economic Research.
 International Examinations Committee, The Association of Certified International Investment Analysts, Japan.
 Moody's Investors Service and Moody's Risk Management Services Academic Research and Advisory Committee.
 Organizing Committee, Congress of the Bachelier Society.
 Board of Directors, American Finance Association, 2002-2005.

OUTSIDE	Shell Oil Development Company, Houston, Texas (oil and related product price risk measurement, valuation of derivative instruments, and hedging).
COMPENSATED	Vestek Systems, San Francisco (equity and fixed income valuation, risk management, and portfolio management systems design).
ACTIVITIES	Merck and Company, Rahway, New Jersey (exchange rate risk management consulting and system design, derivative security valuation, and interest rate risk management).
	U.S. Treasury Department, Office of Thrift Supervision, Washington, D.C.; Federal Deposit Insurance Corporation and Resolution Trust Corporation, U.S. Department of Justice, Washington D.C. (consulting and expert witness testimony on mortgage-related security valuation and interest rate risk management).
	Caisse Autonome de Refinancement (Caisse de Depots), Paris (consulting on fixed-income collateralized obligations).
	Cadwalader, Wickersham, and Taft, New York, (consulting on U.S. Treasury markets).
	Mobil Corporation, Fairfax, Virginia (interest rate risk management).
	Catalyst Institute, Chicago (U. S. Treasury Market Project).
	Hewlett-Packard Corporation, Palo Alto, California (executive compensation, option valuation).
	Enron Corporation, Houston (risk management and energy derivatives modeling).
	J.P. Morgan and Co., New York (valuation of government assets).
	Morgan Stanley Dean Witter and Co, New York (fixed-income modeling and risk management).
	Bank of America Corporation, San Francisco (interest rate and credit risk management).
	Susquehanna Investment Group, Philadelphia (equity derivatives models).
	Nikko Securities, Tokyo (risk management and fixed-income modeling).
	VEBA, Dusseldorf (risk management).
	Royal Bank of Canada, Toronto (risk management and credit derivatives).
	Lehman Brothers, New York (risk management).
	Federal Reserve Board of Governors, Washington, D.C. (interest rates and credit risk).
	Gifford Fong Associates, San Francisco (derivatives modeling).
	Paribas Capital Markets, London (credit and interest rate risk).

U.S. Department of Justice, Washington D.C. (consulting and expert witness testimony, banking and risk management).
Goldman Sachs, New York (risk management).
Caxton Corporation, New York (review of trading strategies).
PriceWaterhouseCoopers, New York (member of Risk Institute).
Fenwick and West, Palo Alto (valuation of equities and warrants).
Longitude, Incorporated, New York (financial e-commerce).
Fannie Mae, Washington, D.C. (credit risk analysis) .
Hummingbird Capital Management, Philadelphia (development of trading strategies).
Bank One and U.S. Internal Revenue Service, Chicago (expert testimony, valuation of swaps).
Board of Directors, Affinium Fund, London.

This resumé is current as of September, 2003.