

III

Editor-in-Chief Rama Cont

Encyclopedia of Quantitative Finance

Volume III: K-Q

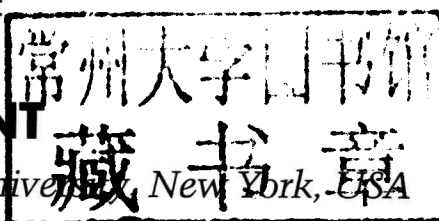
ENCYCLOPEDIA OF QUANTITATIVE FINANCE

Volume 3 K-Q

Editor-in-Chief

RAMA CONT

CNRS, Paris, France and Columbia University, New York, USA



Copyright © 2010 John Wiley & Sons Ltd,
The Atrium,
Southern Gate,
Chichester,
West Sussex,
PO19 8SQ, England

Telephone (+44) 1243 779777
Email (for orders and customer service enquiries): cs-books@wiley.co.uk
Visit our Home Page on www.wiley.com

Modeling Correlation of Structured Instruments in a Portfolio Setting which appears between pages 1220–1226 and *Credit Portfolio Insurance* which appears between pages 441–447 are copyright of the authors of those works.

Nested Simulation which appears between pages 1307–1311 is a US government work in the public domain and not subject to copyright.

Models which appears between pages 1226–1232 is copyright of the CFA Institute.

All Rights Reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning or otherwise, except under the terms of the Copyright, Designs and Patents Act 1988 or under the terms of a licence issued by the Copyright Licensing Agency Ltd, 90 Tottenham Court Road, London W1T 4LP, UK, without the permission in writing of the Publisher. Requests to the Publisher should be addressed to the Permissions Department, John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England, or emailed to permreq@wiley.co.uk, or faxed to (+44) 1243 770620.

This publication is designed to provide accurate and authoritative information in regard to the subject matter covered. It is sold on the understanding that the Publisher is not engaged in rendering professional services. If professional advice or other expert assistance is required, the services of a competent professional should be sought.

Other Wiley Editorial Offices

John Wiley & Sons Inc., 111 River Street,
Hoboken, NJ 07030, USA

Jossey-Bass, 989 Market Street,
San Francisco, CA 94103-1741, USA

Wiley-VCH Verlag GmbH, Boschstr. 12,
D-69469 Weinheim, Germany

John Wiley & Sons Australia Ltd, 165 Cremorne Street
Richmond Vic. 3121, Australia

John Wiley & Sons (Asia) Pte Ltd, 2 Clementi Loop #02-01,
Jin Xing Distripark, Singapore 129809

John Wiley & Sons Canada Ltd, 6045 Freemont Boulevard,
Mississauga, Ontario, Canada L5R 4J3

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

ISBN-978-0-470-05756-8 (HB)

Typeset in 9.5 / 11.5pt Times by Laserwords Private Limited, Chennai, India.

Printed and bound by Grafos SA, Barcelona, Spain.

This book is printed on acid-free paper responsibly manufactured from sustainable forestry in which at least two trees are planted for each one used for paper production.

ENCYCLOPEDIA **OF** **QUANTITATIVE FINANCE**

Editorial Board

Editor-in-Chief

Rama Cont

CNRS

Paris

France

and

Columbia University

New York, NY

USA

Associate Editor

Peter Tankov

Ecole Polytechnique

Palaiseau

France

Editors

ACTUARIAL METHODS

Soren Asmussen

University of Århus

Århus

Denmark

ARBITRAGE THEORY

Walter Schachermayer

University of Vienna

Vienna

Austria

Hailiang Yang

University of Hong Kong

Hong Kong

People's Republic

of China

ASSET ALLOCATION AND PORTFOLIO

OPTIMIZATION

Xunyu Zhou

University of Oxford

Oxford

UK

Michael Stutzer

University of Colorado
Boulder, CO
USA

ASSET PRICING MODELS

Paolo Guasoni

Boston University
Boston, MA
USA

CREDIT DERIVATIVES

Philipp Schönbucher

Goldman Sachs
London
UK

William Morokoff

Standard & Poor's
New York, NY
USA

CREDIT RISK

Greg M. Gupton

Fitch Ratings
Essex Fells, NJ
USA

Rüdiger Frey

Universität Leipzig
Leipzig
Germany

ENERGY AND COMMODITY DERIVATIVES

Helyette Geman

Birkbeck College
London
UK

Chris Harris

RWE Innogy
Swindon
UK

EQUITY DERIVATIVES: PRICING
MODELS

Rama Cont

Columbia University
New York, NY
USA

James Gatheral

Merrill Lynch & Co., Inc
New York, NY
USA

EQUITY DERIVATIVES: PRODUCTS
& STRATEGIES

Marco Avellaneda

New York University
New York, NY
USA

Ali Hirsä

Caspian Capital Management
and Columbia University
New York, NY
USA

FINANCIAL ECONOMETRICS

Ole Barndorff-Nielsen

University of Århus
Århus
Denmark

Eric Renault

University of North Carolina
Chapel Hill, NC
USA

FOREIGN EXCHANGE DERIVATIVES

Uwe Wystup

MathFinance Ltd
Waldems
Germany

HISTORY OF QUANTITATIVE MODELING
IN FINANCE

Perry Mehrling
Columbia University
New York, NY
USA

Murad Taqqu
Boston University
Boston, MA
USA

INTEREST RATE DERIVATIVES

Vladimir Piterbarg
Barclays Capital
London
UK

Leif Andersen
Bank of America Securities LLC
New York, NY
USA

MARKET MICROSTRUCTURE

Jean-Philippe Bouchaud
Capital Fund Management
Paris
France

Charles M. Jones
Columbia University
New York, NY
USA

MATHEMATICAL TOOLS

Philip Protter
Cornell University
Ithaca, NY
USA

OPTION PRICING: FUNDAMENTALS

Mark Davis
Imperial College
London
UK

PDES AND COMPUTATIONAL METHODS

Peter Forsyth
University of Waterloo
Waterloo
Ontario
Canada

Damien Lamberton
University of Marne-la-Vallée
Marne-la-Vallée
France

RISK MANAGEMENT

Michel Crouhy
NATIXIS
Paris
France

Rüdiger Frey
Universität Leipzig
Leipzig
Germany

SIMULATION METHODS IN
FINANCIAL ENGINEERING

Eckhard Platen
University of Technology Sydney
Sydney, New South Wales
Australia

Peter Jaeckel
OTC Analytics

To my parents

Mansoureh DANESH-KAZEMI

and

Gholam-Hossein CONT,

with infinite gratitude.

با سپاس فراوان از پدر و مادرم،
غلامحسین کنت و منصوره دانش کاظمی

راما کنت، آذر ۱۳۸۸

Contributors

- Acerbi, Carlo** *Abaxbank, Corso Monforte, Milan, Italy*
- Achdou, Yves** *Université Pierre et Marie Curie, Place Jussieu, Paris, France*
- Aït-Sahlia, Yacine** *Princeton University and NBER, Princeton, NJ, USA*
- AitSahlia, Farid** *University of Florida, Gainesville, FL, USA*
- Albrecher, Hansjörg** *University of Lausanne, Lausanne, Switzerland*
- Alexander, Gordon J.** *University of Minnesota, Minneapolis, MN, USA*
- Alfonsi, Aurélien** *CERMICS, MathFi Project, Ecole des Ponts, Cité Descartes, Champs-sur-marne, France*
- Almgren, Robert** *New York University, New York, NY, USA and Quantitative Brokers, New York, NY, USA*
- Amihud, Yakov** *New York University, New York, NY, USA*
- Andersen, Leif B.G.** *Bank of America Securities, New York, NY, USA*
- Andersen, Torben G.** *Northwestern University, Evanston, IL, USA*
- Andreasen, Jesper** *Danske Bank, Copenhagen, Denmark*
- Antonov, Alexandre V.** *NumeriX Software Limited, London, UK*
- Arnsdorf, Matthias** *JP Morgan, London, UK*
- Ashcraft, Adam** *Federal Reserve Bank of New York, New York, NY, USA*
- Asmussen, Søren** *Århus University, Århus, Denmark*
- Avellaneda, Marco** *New York University and Finance Concepts, New York, NY, USA*
- Ayache, Élie** *ITO 33, Paris, France*
- Back, Kerry** *Rice University, Houston, TX, USA*
- Bacmann, Jean-Francois** *RMF Investment Management, Pfäffikon, Switzerland*
- Bacry, Emmanuel** *Ecole Polytechnique, Palaiseau, France*
- Baheti, Prasun** *Barclay's Capital, New York, NY, USA*
- Balbas, Alejandro** *University Carlos III of Madrid, Madrid, Spain*
- Baptista, Alexandre M.** *George Washington University, Washington, Washington DC, USA*
- Barndorff-Nielsen, Ole E.** *University of Århus, Århus, Denmark*
- Barone-Adesi, Giovanni** *University of Lugano, Lugano, Switzerland*
- Barrieu, Pauline** *London School of Economics, London, UK*
- Baruch, Shmuel** *University of Utah, Salt Lake City, UT, USA*
- Bates, David S.** *University of Iowa, Iowa City, IA, USA and National Bureau of Economic Research, Cambridge, MA, USA*
- Becherer, Dirk** *Humboldt Universität Zu Berlin, Berlin, Germany*
- Beier, Claus-Christian** *DZ Bank AG, Frankfurt, Germany*
- Benhamou, Eric** *Pricing Partners, Paris, France*
- Benth, Fred E.** *University of Oslo, Oslo, Norway*
- Benzschawel, Terry** *Citigroup Global Markets, New York, NY, USA*
- Bergman, Yaacov Z.** *Hebrew University, Jerusalem, Israel*
- Bessembinder, Hendrik** *University of Utah, Salt Lake City, UT, USA*

- Biagini, Francesca** *Ludwig-Maximilians Universität, Munich, Germany*
- Biagini, Sara** *Pisa University, Pisa, Italy*
- Björk, Tomas** *Stockholm School of Economics, Stockholm, Sweden*
- Blanchet, Jose H.** *Columbia University, New York, NY, USA*
- Bonneton, Jerome** *ABN AMRO*
- Borovkova, Svetlana** *Vrije Universiteit, Amsterdam, The Netherlands*
- Bossu, Sébastien** *Columbia University, New York, NY, USA*
- Bossy, Mireille** *INRIA Sophia Antipolis – Méditerranée Research Center, Sophia Antipolis, France*
- Bouchard, Bruno** *Université Paris Dauphine, Paris Cedex, France and Institut universitaire de France, Paris, France*
- Bouchaud, Jean-Philippe** *Capital Fund Management, Paris, France*
- Boyle, Phelim** *Wilfrid Laurier University, Waterloo, Ontario, Canada*
- Braouezec, Yann** *ESILV, Paris, France*
- Brasch, Hans-Jürgen** *London, UK*
- Braun, Michael** *Dresdner Kleinwort, Frankfurt, Germany*
- Brender, Allan** *Office of the Superintendent of Financial Institutions Canada, Toronto, Ontario, Canada*
- Broadie, Mark** *Graduate School of Business, New York, NY, USA*
- Brockwell, Peter J.** *Colorado State University, Fort Collins, CO, USA*
- Browne, Sid** *Columbia University, and Brevan Howard Asset Management, New York, NY, USA*
- Bru, Bernard** *University Paris Descartes, Paris, France*
- Bruti-Liberati, Nicola** *University of Technology, Sydney, New South Wales, Australia*
- Bruyere, Richard** *Finance Concepts and Image & Finance, Paris, France*
- Buehler, Hans** *JP Morgan, Hong Kong, China and Technical University, Berlin, Germany*
- Campi, Luciano** *Université Paris-Dauphine, Paris, France*
- Carmona, René** *Princeton University, Princeton, NJ, USA*
- Carr, Peter** *Bloomberg/NYU, New York, NY, USA*
- Cattani, Corinne** *University of Lugano, Lugano, Switzerland*
- Cekan, Markus** *Landesbank Baden-Württemberg, Stuttgart, Germany*
- Çetin, Umut** *London School of Economic and Political Science, London, UK*
- Černý, Aleš** *City University London, London, UK*
- Chadam, John** *University of Pittsburgh, Pittsburgh, PA, USA*
- Champagnat, Nicolas** *INRIA Sophia Antipolis – Méditerranée Research Center, Sophia Antipolis, France*
- Chan, Alex Hamilton** *Massachusetts Institute of Technology, Cambridge, MA, USA*
- Chavez-Demoulin, Valérie** *EPF, Lausanne, Switzerland*
- Chen, Nan** *Chinese University of Hong Kong, Hong Kong, China*
- Chen, Oliver** *National University of Singapore, Singapore*
- Cheung, Ka Chun** *The University of Hong Kong, Hong Kong, China*
- Chevalier, Etienne** *Université d'Evry-Val d'Essonne, Evry, France*
- Chichilnisky, Graciela** *Columbia University, New York, NY, USA*
- Chourdakis, Kyriakos** *London, UK*
- Christoffersen, Peter** *McGill University, Montreal, Québec, Canada*
- Ciuca, Marian** *Pricing Partners, Paris, France*
- Coculescu, Delia** *ETHZ, Zürich, Switzerland*
- Coleman, Thomas F.** *University of Waterloo, Waterloo, Ontario, Canada*
- Comte, Fabienne** *Université Paris Descartes, Laboratoire MAP5, Paris, France*
- Cont, Rama** *Columbia University, New York, NY, USA and CNRS, Paris, France*
- Couderc, Fabien** *RiskMetrics Group, Petit Lancy, Switzerland*

- Cox, Alexander** *University of Bath, Bath, UK*
- Crouhy, Michel** *Natixis, Paris, France and New York, NY, USA*
- Crépey, Stéphane** *Evry University, Evry, France*
- Cuchiero, Christa** *Vienna University of Technology, Austria University of Vienna and Vienna University of Economics and Business Administration, Vienna, Austria*
- Curran, Michael** *New York, NY*
- Connor, Gregory** *National University of Ireland, Maynooth, Ireland and Northwestern University, Evanston, IL, USA*
- Dagraca, Julio** *Citigroup Global Markets, New York, NY, USA*
- Daniel, Gilles** *ETH Zürich, Zürich, Switzerland*
- Das, Sanjiv R.** *Santa Clara University, Santa Clara, CA, USA*
- Davis, Mark H.A.** *Imperial College, London, UK*
- Davis, Paul L.** *White Plains, NY, USA*
- Davis, Richard A.** *Columbia University, New York, NY, USA*
- Deheuvels, Paul** *Université Pierre et Marie Curie, Bourg-la-Reine, France*
- Derman, Emanuel** *Columbia University and Prisma Capital Partners, New York, NY, USA*
- Dhaene, Jan** *Katholieke Universiteit Leuven, Leuven, Belgium*
- Dimand, Robert W.** *Brock University St. Catharines, Ontario, Canada*
- Dowd, Kevin** *Nottingham University Business School, Nottingham, UK*
- Drekic, Steve** *University of Waterloo, Ontario, Canada*
- Duellmann, Klaus** *Deutsche Bundesbank, Frankfurt, Germany*
- Dupire, Bruno** *Bloomberg LP, New York, NY, USA*
- Durand, Philippe** *Banque de France, Paris, France*
- Durrleman, Valdo** *Ecole Polytechnique, Palaiseau, France*
- Eberlein, Ernst** *University of Freiburg, Freiburg, Germany*
- Eisenbaum, Nathalie** *CNRS, Université Paris VI, France*
- El Karoui, Nouredine** *University of California, Berkeley, CA, USA*
- Elliott, Robert J.** *University of Adelaide, Adelaide, South Australia, Australia and University of Calgary, Calgary, Alberta, Canada*
- Embrechts, Paul** *ETH Zürich, Zürich, Switzerland*
- Falbo, Paolo** *University of Brescia, Brescia, Italy*
- Fan, Yanqin** *Vanderbilt University, Nashville, TN, USA*
- Fasen, Vicky** *Technische Universität München, Garching bei München, Germany*
- Felletti, Daniele** *University of Milano Bicocca, Milano, Italy*
- Fernholz, Robert** *INTECH, Princeton, NJ, USA*
- Filipovic, Damir** *Vienna University of Technology, Austria University of Vienna and Vienna University of Economics and Business Administration, Vienna, Austria*
- Finger, Christopher C.** *RiskMetrics Group, Geneva, Switzerland*
- Fok, Henry** *Citigroup Global Markets, New York, NY, USA*
- Föllmer, Hans** *Humboldt Universität zu Berlin, Berlin, Germany*
- Foucault, Thierry** *HEC School of Management, Paris, France and Centre for Economic Policy Research (CEPR), London, UK*
- Fouque, Jean-Pierre** *University of California, Santa Barbara, CA, USA*
- French, Craig W.** *Corbin Capital Partners, New York, NY, USA*
- Frey, Rüdiger** *University of Leipzig, Leipzig, Germany*
- Friz, Peter K.** *University of Cambridge, Cambridge, UK; Austrian Academy of Science, Linz, Austria; and TU Berlin and WIAS Berlin, Germany*

- Fusai, Gianluca** *Università degli Studi del Piemonte Orientale, Novara, Italy*
- Galai, Dan** *Hebrew University, Jerusalem, Israel and Sigma PCM, Tel Aviv, Israel*
- Galluccio, Stefano** *BNP Paribas, London, UK*
- Gambera, Michele** *Ibbotson Associates, Chicago, IL, USA*
- Garrido, Jose** *Concordia University, Montreal, Quebec, Canada*
- Gaspar, Raquel M.** *Technical University Lisbon, Lisbon, Portugal*
- Gatfaoui, Hayette** *Rouen Business School, Mont Saint Aignan Cedex, France*
- Gatheral, Jim** *Bank of America Merrill Lynch, and New York University, New York, NY, USA*
- Gauthier, Pierre** *Pricing Partners, Paris, France*
- Geman, Helyette** *University of London and ESCP-EAP, London, UK*
- Gerstner, Thomas** *University of Bonn, Bonn, Germany*
- Gharavi, Reza K.** *Citigroup Inc., New York, NY, USA*
- Ghirardato, Paolo** *Collegio Carlo Alberto, Università di Torino, Torino, Italy*
- Ghysels, Eric** *University of North Carolina, Chapel Hill, NC, USA*
- Giles, Michael B.** *Oxford University, Oxford, UK*
- Gisler, Alois** *ETH Zürich, Zürich, Switzerland*
- Glosten, Lawrence R.** *Columbia University, New York, NY, USA*
- Goovaerts, Marc J.** *Katholieke Universiteit Leuven, Leuven, Belgium and Universiteit van Amsterdam, Amsterdam, The Netherlands*
- Gordy, Michael B.** *Federal Reserve Board, Washington, DC, USA*
- Gourieroux, Christian** *CREST, Paris, France and University of Toronto, Toronto, Ontario, Canada*
- Grandell, Jan** *Royal Institute of Technology, Stockholm, Sweden*
- Gregory, Jon** *Ockham Financial Training, Guildford, UK*
- Griebel, Michael** *University of Bonn, Bonn, Germany*
- Griebsch, Susanne A.** *Frankfurt School of Finance and Management, Frankfurt, Germany*
- Hakala, Jürgen** *Standard Chartered Bank, London, UK and EFG Financial Products AG, Zürich, Switzerland*
- Hall, Alastair R.** *University of Manchester, Manchester, UK*
- Hanouna, Paul** *Villanova University, Villanova, PA, USA*
- Hansen, Lars Peter** *University of Chicago, Chicago, IL, USA*
- Harris, Chris** *RWE npower, Swindon, UK and University of Bath, Bath, UK*
- Hendershott, Terrence** *University of California, Berkeley, CA, USA*
- Henderson, Vicky** *University of Oxford, Oxford, UK*
- Henry-Labordère, Pierre** *Société Générale, Global Markets Quantitative Research, Paris, France*
- Herzog, Benjamin** *Société Générale Corporate & Investment Banking, Paris, France*
- Hilber, Norbert** *ETH Zürich, Zürich, Switzerland*
- Hill, Jonathan B.** *University of North Carolina—Chapel Hill, Chapel Hill, NC, USA*
- Hinnerich, Mia** *Århus University, Århus, Denmark*
- Hirsa, Ali** *Caspian Capital Management, LLC, Columbia University and Courant Institute, New York, NY, USA*
- Hodges, Stewart D.** *City University, London, UK*
- Hurd, Thomas R.** *McMaster University, Hamilton, Ontario, Canada*
- Hvidkjaer, Soeren** *Copenhagen Business School, Copenhagen, Denmark*
- Hyer, Tom** *UBS, London, UK*
- Iscoe, Ian** *Algorithmics Inc., Toronto, Ontario, Canada*
- Islam, Saiyid S.** *Standard & Poor's, New York, NY, USA*

Iyengar Garud *Columbia University, New York, NY, USA*

Jacod, Jean *Université Pierre et Marie Curie, Paris, France*

Jacquier, Antoine *Zeliade Systems, Paris, France*

Jäckel, Peter *OTC Analytics*

Jaeck, Christophe *Societe Generale Corporate & Investment Banking, London, UK*

Jakobsen, Espen R. *Norwegian University of Science and Technology, Trondheim, Norway*

Jamshidian, Farshid *FELAB, University of Twente, Enschede, The Netherlands*

Jarrow, Robert A. *Cornell University, Ithaca, NY, USA and Kamakura Corporation, Honolulu, HI, USA*

Jeanblanc, Monique *Université d'Évry Val d'Essonne, Évry Cedex, France*

Jiang, Jennifer *Standard and Poor's, New York, NY, USA*

Jobst, Andreas A. *International Monetary Fund (IMF), Washington, DC, USA*

Jönsson, Henrik *Eindhoven University of Technology, Eindhoven, The Netherlands*

Jorion, Philippe *University of California, Irvine, CA, USA and Pacific Alternative Asset Management Company, Irvine, CA, USA*

Joseph, Viju *Eton Park Capital Management, New York, NY, USA*

Joshi, Mark *Nomura International plc, London, UK*

Jouini, Elyes *Université Paris Dauphine, Paris Cedex, France*

Jovanovic, Franck *TELUQ-UQAM (Université du Québec A Montréal), Montréal, Québec, Canada*

Juneja, Sandeep *Tata Institute of Fundamental Research, Mumbai, India*

Kahl, Christian *OTC Analytics*

Kaizoji, Taisei *International Christian University, Tokyo, Japan*

Kalkbrenner, Michael *Deutsche Bank AG, Frankfurt, Germany*

Kallsen, Jan *Christian-Albrechts-Universität zu Kiel, Kiel, Germany*

Kamal, Michael *Chicago Trading Company, New York, NY, USA*

Kaplin, Andrew S. *Moody's Analytics, San Francisco, CA, USA*

Kardaras, Constantinos *Boston University, Boston, MA, USA*

Kazemi, Hossein *University of Massachusetts-Amherst, Amherst, MA, USA*

Kelley, Eric K. *University of Arizona, Tucson, AZ, USA*

Kennedy, Joanne *University of Warwick, Coventry, UK*

Kienitz, Jörg *Deutsche Postbank AG, Bonn, Germany*

Kiesel, Rüdiger *Universität Duisburg-Essen, Essen, Germany*

Kim, June Ho *Stanford University, Stanford, CA, USA*

Kim, Woo Chang *Princeton University, Princeton, NJ, USA*

Kitamura, Yuichi *Yale University, New Haven, CT, USA*

Kleindorfer, Paul R. *INSEAD, Fontainebleau, France*

Kluppelberg, Claudia *Technische Universität München, Garching bei München, Germany*

Kocagil, Ahmet E. *Fitch Solutions, London, UK*

Kockelkoren, Julien *Capital Fund Management, Paris, France*

Kolkiewicz, Adam *University of Waterloo, Waterloo, Ontario, Canada*

Kolm, Petter N. *New York University, New York, NY, USA*

Korajczyk, Robert *National University of Ireland, Maynooth, Ireland and Northwestern University, Evanston, IL, USA*

Korchmáros, Tamás *The Royal Bank of Scotland, London, UK*

Korn, Ralf *University of Kaiserslautern, Kaiserslautern, Germany*

Kosowski, Robert *Imperial College London, London, UK*

Kou, Steven *Columbia University, New York, NY, USA*

Kreinin, Alex *Algorithmics Inc., Toronto, Ontario, Canada*

Kwok, Yue-Kuen *Hong Kong University of Science and Technology, Hong Kong, China*

Kyprianou, Andreas E. *University of Bath, Bath, UK*

Labart, Céline *Université Pierre et Marie Curie, Paris, France*

Lando, David *Copenhagen Business School, Copenhagen, Denmark*

Lapeyre, Bernard *Université Paris-Est, CERMICS, Marne la Vallée Cedex 2, France*

Laurent, Jean-Paul *Université de Lyon, Lyon, France and BNP Paribas, London, UK and Paris, France*

L'écuyer, Pierre *Université de Montréal, Montréal, Québec, Canada*

Lee, Roger *University of Chicago, Chicago, IL, USA*

Lee, Yim T. *UniCredit Group, London, UK*

Lelong, Jérôme *INRIA Rocquencourt, Le Chesnay, France and University of Udine, Udine, Italy*

LeRoy, Stephen F. *University of Melbourne, Melbourne, Victoria and University of Adelaide, South Australia, Australia*

Levy, Amnon *Moody's Analytics, San Francisco, CA, USA*

Li, David X. *China International Capital Corporation, Beijing, China*

Li, Yuying *University of Waterloo, Waterloo, Ontario, Canada*

Liang, Bing *University of Massachusetts-Amherst, Amherst, MA, USA*

Lillo, Fabrizio *Università degli Studi di Palermo, Palermo, Italy and Santa Fe Institute, Santa Fe, NM, USA*

Lin, X. Sheldon *University of Toronto, Toronto, Ontario, Canada*

Lindner, A. *Institute for Mathematical Stochastics, Braunschweig, Germany*

Linetsky, Vadim *Northwestern University, Evanston, IL, USA*

Lipkin, Mike *Columbia University and Katama Trading, LLC, New York, NY, USA*

Lipton, Alexander *Bank of America, Merrill Lynch, London, UK and Imperial College, London, UK*

Liu, Xinming *Merrill Lynch & Co., Inc., New York, NY, USA*

Liverance, Eric *UBS, Stamford, CT, USA*

Lord, Roger *Rabobank International, London, UK*

Ludkovski, Michael *University of California, Santa Barbara, CA, USA*

Luo, Chiyan *Merrill Lynch & Co., Inc., New York, NY, USA*

Ma, Jin *University of Southern California, Los Angeles, CA, USA*

MacLean, Leonard C. *Dalhousie University, Halifax, Nova Scotia, Canada*

Maclin, Lee *New York University, New York, NY, USA*

Madan, Dilip B. *Robert H. Smith School of Business, College Park, MD, USA*

Madhavan, Ananth N. *Barclays Global Investors, San Francisco, CA, USA*

Marinacci, Massimo *Università Bocconi, Milano, Italy*

Mark, Robert *Black Diamond Risk Enterprises, CA, USA and UCLA Anderson School of Management, Los Angeles, CA, USA*

Markowitz, Harry M. *Harry Markowitz Company, San Diego, CA, USA*

Marquardt, Tina M. *Technical University of Munich, München, Germany*

Martín, Jaime San *Universidad de Chile, Santiago, Chile*

Martini, Claude *Imperial Collage London, London, UK and Zeliade Systems, Paris, France*

Mashal, Roy *The Caesarea Edmond Benjamin de Rothschild Center for Capital Markets and Financial Risk Management, Herzelia, Israel*

Masol, Viktoriya *KBC Global Services NV, Brussels, Belgium*

Mehrling, Perry *Columbia University, New York, NY, USA*

Mehta, Nina *Traders Magazine, New York, NY, USA*

Meier, Iwan *HEC Montréal, Montréal, Québec, Canada*

Mendelson, Haim *Stanford University, Palo Alto, CA, USA*

Mendoza, Rafael *University of Texas at Austin, Austin, TX, USA*

Mercurio, Fabio *Bloomberg LP, New York, NY, USA*

Merton, Robert C. *Harvard Business School, Boston, MA, USA*

Meucci, Attilio *Bloomberg L.P., New York, NY, USA*

Meyer-Brandis, Thilo *University of Munich, Munich, Germany*

Miccichè, Salvatore *Università degli Studi di Palermo, Palermo, Italy*

Miri, Mohammed *Pricing Partners, Paris, France*

Misirpashaev, Timur S. *Bank of America Merrill Lynch, New York, NY, USA*

Monfort, Alain *CNAM and CREST, Paris, France*

Montesano, Aldo *Bocconi University, Milan, Italy*

Moulton, Pamela C. *Fordham University, New York, NY, USA*

Mulvey, John M. *Princeton University, Princeton, NJ, USA*

Murgoci, Agatha *Stockholm School of Economics, Stockholm, Sweden*

Muzy, Jean-Fran *Université de Corse, Corté, France*

Nagai, Hideo *Osaka University, Osaka, Japan*

Naldi, Marco *Barclay's Capital, New York, NY, USA*

Namvar, Ethan *University of California, Irvine, CA, USA*

Newton, David P. *Nottingham University Business School, Nottingham, UK*

Niederreiter, Harald *National University of Singapore, Singapore, Republic of Singapore*

Nikeghbali, Ashkan *Universität Zürich, Zürich, Switzerland*

Nimalendran, Mahendrarajah *University of Florida, Gainesville, FL, USA*

Obłój, Jan *University of Oxford, Oxford, UK*

Oosterlee, Cornelis W. *CWI—Center for Mathematics and Computer Science and Delft University of Technology, Amsterdam, The Netherlands*

Ordentlich, Erik *Hewlett-Packard Laboratories, Palo Alto, CA, USA*

Overbeck, Ludger *University of Giessen, Giessen, Germany*

Pacheco-González, Carlos G. *CINVESTAV-IPN, Mexico City, Mexico*

Pagano, Marco *Centre for Economic Policy Research (CEPR), London, UK; University of Naples Federico II, Naples, Italy; and European Corporate Governance Institute (ECGI), Brussels, Belgium*

Pagès, Gilles *Université Paris VI/LPMA, Paris, France*

Papatheodorou, Vasileios *Fitch Solutions, London, UK*

Parlour, Christine A. *University of California, Berkeley, CA, USA*

Paulsen, Jostein *University of Copenhagen, Copenhagen, Denmark*

Pedersen, Claus M. *Barclays Capital, New York, NY, USA*

Pérez-Abreu, Víctor *Centro de Investigación en Matemáticas CIMAT, Guanajuato, Mexico*

Pham, Huyên *Université Paris VII, Paris, France*

Pietersz, Raoul *Royal Bank of Scotland, London, UK*

Pilz, Kay F. *University of Technology, Sydney, New South Wales, Australia*

Pironneau, Olivier *Université Pierre et Marie Curie, Place Jussieu, Paris, France*

Piterbarg, Vladimir V. *Barclays Capital, London, UK*

Piza, Marcelo *Bloomberg LP, New York, NY, USA*

Platen, Eckhard *University of Technology, Sydney, New South Wales, Australia*

Pluto, Katja *HSBC Holdings plc, London, UK*

Podolskij, Mark *ETH Zürich, Zürich, Switzerland*

Poitras, Geoffrey *Simon Fraser University, Vancouver, British Columbia, Canada*

Polizu, Cristina *Standard and Poor's, New York, NY, USA*

Poulsen, Rolf *University of Copenhagen, Copenhagen, Denmark*

Priaulet, Stéphane *Dauphine University, Paris, France and Allianz Global Investors, Paris, France*

Pykhtin, Michael *Federal Reserve Board, Washington, DC, USA*

Qian, Michael *Trading Machines LLC, Stamford, CT, USA*

Quenez, Marie-Claire *Université Paris-Diderot, Paris, France*

Rachedi, Omar *Katholieke Universiteit Leuven, Leuven, Belgium*

Rajan, Uday *University of Michigan, Ann Arbor, MI, USA*

Ramrattan, Lall *University of California, Berkeley, CA, USA*

Randall, Curt *SciComp Inc, Austin, TX, USA*

Reich, Nils *ETH Zürich, Zürich, Switzerland*

Reisman, Haim *Technion–Israel Institute of Technology, Haifa, Israel*

Ren, Yong *Saba Capital Management LP, New York, NY, USA*

Renault, Eric *University of North Carolina, Chapel Hill, NC, USA*

Renner, Christoph *Dresdner Bank AG, Frankfurt, Germany*

Ressel, Martin Keller *Vienna University of Technology, ETH Zürich, Switzerland*

Resti, Andrea *Bocconi University and Centre for Applied Research in Finance (CAREFIN), Milan, Italy*

Rheinländer, Thorsten *London School of Economics, London, UK*

Rivaille, Pierre-Yves H. *Pricing Partners, Paris, France*

Röell, Ailsa *Centre for Economic Policy Research (CEPR), London, UK; European Corporate Governance Institute (ECGI), Brussels, Belgium; and Columbia University, New York, NY, USA*

Roncoroni, Andrea *ESSEC Business School, Paris - Singapore*

Rösch, Daniel *Leibniz University of Hannover, Hannover, Germany*

Rosen, Dan *R² Financial Technologies, and Fields Institute for Research in Mathematical Sciences, Toronto, Ontario, Canada*

Rosenfeld, Eric *Former LTCM partner, Larchmont, New York, USA*

Roubinet, Charles-Henri *VTB Capital, London, UK*

Ruffino, Doriana *University of Minnesota, Minneapolis, MN, USA*

Runggaldier, Wolfgang *University of Padova, Padova, Italy*

Russell, Jeffrey R. *University of Chicago, Chicago, IL, USA*

Rutkowski, Marek *University of New South Wales, Sydney, New South Wales, Australia*

Saar, Gideon *Cornell University, Ithaca, NY, USA*

Sabato, Gabriele *Royal Bank of Scotland, Amsterdam, The Netherlands*

Sangvinatsos, Antonios *University of Southern California, Los Angeles, CA, USA*

Saunders, David *University of Waterloo, Waterloo, Ontario, Canada*

Scaillet, Olivier *Swiss Finance Institute and HEC Université de Genève, Geneva, Switzerland*

Scandolo, Giacomo *University of Florence, Florence, Italy*

Schachermayer, Walter *University of Vienna, Vienna, Austria*

Schachter, Barry *Moore Capital Management, New York, NY, USA*

Scherer, Matthias A. *Technische Universität München, München, Germany*

- Schied, Alexander** *Cornell University, Ithaca, NY, USA*
- Schlögl, Erik** *University of Technology, Sydney, New South Wales, Australia*
- Schlögl, Lutz** *Nomura International Plc, London, UK*
- Schmidli, Hanspeter** *University of Cologne, Cologne, Germany*
- Schmidt, Thorsten** *Chemnitz University of Technology, Mathematical Institute, Chemnitz, Germany*
- Scholz, Stefan** *RMF Investment Management, Pfäffikon, Switzerland*
- Schoutens, Wim** *Katholieke Universiteit Leuven, Leuven, Belgium*
- Schroder, Mark** *Michigan State University, East Lansing, MI, USA*
- Schuermann, Til** *Federal Reserve Bank of New York, New York, NY, USA*
- Schwartz, Robert A.** *City University of New York, New York, NY, USA*
- Schweizer, Martin** *ETH Zürich, Zürich, Switzerland*
- Seneta, Eugene** *University of Sydney, Sydney, New South Wales, Australia*
- Seydel, Rüdiger U.** *Universität zu Köln, Köln, Germany*
- Shefrin, Hersh** *Santa Clara University, Santa Clara, CA, USA*
- Shepeleva, Anna** *PGGM Investments, Zeist, The Netherlands*
- Shephard, Neil** *University of Oxford, Oxford, UK*
- Shih, Yih-Fong** *University of London, London, UK*
- Shiryaev, Albert N.** *Russian Academy of Sciences, Moscow, Russia*
- Shypit, Rick L.** *Wachovia Securities, New York, NY, USA*
- Sidenius, Jakob** *JP Morgan Securities Ltd, London, UK*
- Siu, Tak Kuen** *Macquarie University, Sydney, New South Wales, Australia*
- Sornette, Didier** *ETH Zürich, Zürich, Switzerland and Swiss Finance Institute, Geneva, Switzerland*
- Spatt, Chester S.** *Carnegie Mellon University, Pittsburgh, PA and National Bureau of Economic Research, Cambridge, MA, USA*
- Stacey, Alan** *University of Melbourne, Victoria, Australia*
- Stefani, Silvana** *University of Milano Bicocca, Milano, Italy*
- Steffensen, Mogens** *University of Copenhagen, Copenhagen, Denmark*
- Straumann, Daniel** *RiskMetrics Group, Geneva, Switzerland*
- Stroock, Daniel W.** *M.I.T., Cambridge, MA, USA*
- Stutzer, Michael** *University of Colorado, Boulder, CO, USA*
- Sun, Jia** *University of Warwick, Coventry, UK*
- Sylla, Edith Dudley** *North Carolina State University, Raleigh, NC, USA*
- Szenberg, Michael** *Pace University, New York, NY, USA*
- Taksar, Michael** *University of Missouri, Columbia, MO, USA*
- Tang, Qihe** *University of Iowa, Iowa City, IA, USA*
- Tankov, Peter** *Ecole Polytechnique, Palaiseau, France*
- Tari, Michael J.** *Tari Auto Racing Investments (TARI), New York, NY, USA*
- Tasche, Dirk** *Lloyds Banking Group, London, UK*
- Tehranchi, Michael R.** *University of Cambridge, Cambridge, UK*
- Teichmann, Josef** *Vienna University of Technology, Austria University of Vienna and Vienna University of Economics and Business Administration, Vienna, Austria*
- Teräsvirta, Timo** *Århus University, Århus, Denmark*
- Todorov, Viktor** *Northwestern University, Evanston, IL, USA*
- Toivanen, Jari** *Stanford University, Stanford, CA, USA*
- Tompkins, Robert G.** *Frankfurt School of Finance and Management, Frankfurt, Germany*
- Torres, Soledad Torres** *Universidad de Valparaíso, Valparaíso, Chile*
- Toutain, Olivier** *Moody's Investors Services, Paris, France*