

Mathematical Finance: Mathematical Finance and Derivatives I

(First Semester, HS 2014)

Lecturer: Prof. Dr. Marc Chesney

Time: 13:15 - 16:00
Place: PLD-E-04
Start: Tuesday, September 16, 2014
Language: English

Content:

- Black and Scholes option pricing theory and changes of probability measures
- American options and hitting times
- Stochastic volatility models and time changed Brownian motions
- Tanaka's Formula and applications to Finance
- Itô's formula and Girsanov theorem for jump-diffusion processes
- The pricing of options in the presence of possible discontinuities
- Options for hedging purposes or as a tool for informed trading activities?
- The impact of financial innovation on systemic risk
- Regulation of derivatives markets
- Real options
- Environmental Finance

Description of the course:

The course objective is threefold. First, the theoretical foundations of modern derivative pricing will be presented. By relying on the main mathematical tools of continuous time finance, option pricing models will be derived. A particular focus on jump processes will be given. In light of the recent financial turmoils, the introduction of possible financial crashes in financial modelling is now essential and a clear understanding of Poisson processes is therefore important. A standard background in stochastic calculus is required.

Second, the aim of the course is to analyze the impact of financial innovation on systemic risk. We will shed light on the size and complexity of financial markets and also explore the need for regulation of these markets, in order to promote sustainable economic development.

Third, the real options topic will be covered. The standard Net Present Value (NPV) approach does not meet requirements, as it ignores the flexibility inherent in decision-making processes and the dynamic aspects of project selection. Basic and recent models will be presented. These include the introduction of competition and incomplete information into the real options framework. The use of the Real Options approach in Environmental Finance will also be introduced.

Literature (Selection):

TEXTBOOKS

Main textbook

1. JEANBLANC M., YOR M. and M. CHESNEY
Mathematical Methods for Financial Markets
Springer-Verlag, 2009

Other useful textbooks:

2. ACHARYA V. COOLEY T., RICHARDSON M. and I. WALTER
Regulating Wall Street
Wiley Finance, 2011
3. ACHARYA V. and M. RICHARDSON
Restoring Financial Stability
Wiley Finance, 2009
4. BERTOIN J.
Levy Processes
Cambridge University press, 2005
5. CHESNEY M., GHEYSSENS J. and L. TASCHINI
Environmental Finance and Investments
Springer-Verlag, 2013
6. DIXIT A. and R. PINDYCK
Investment under Uncertainty
Princeton University Press, 1994
7. LAMBERTON D. and B. LAPEYRE
Introduction to Stochastic Calculus Applied to Finance,
Chapman & Hall, London, 1996
8. PROFETA C., ROYNETTE B. and M. YOR
Option prices as probabilities
Springer-Verlag 2010
9. REVUZ D. and M. YOR
Continuous Martingale and Brownian Motion
Springer-Verlag, third edition, 1999
10. TRIGEORGIS L.
Real Options
MIT Press, 1998

ARTICLES

1. ABEL A. and J. EBERLY
A Unified Model of Investment under Uncertainty
American Economic Review, 84:1369-1384, 1984
2. BARONE-ADESI G. and R. WHALEY,
Efficient analytic approximation of American option values
Journal of Finance, 42:301-320, 1987
3. BATES D.S.
The Crash of 87; was it expected ? The evidence from options markets
The Journal of Finance, 46:1009-1044, 1991
4. BELLAMY N. and M. JEANBLANC
Incomplete markets with jumps
Finance and Sto., 4:209-222, 1999
5. BOYER M., E. GRAVEL and P. LASSERRE
Real Options and Strategic Competition: a Survey
Working paper, CIRANO, Canada, 2004
6. BRENNAN, M.J. and E.S. SCHWARTZ,
Evaluating Natural Resource Investments,
The Journal of Business 58, 2, 135-157, 1985
7. CALICE G. and C. LOANNIDIS,
**An Empirical Analysis of the Impact of the Credit Default Swap
Index Market on Large Complex Financial Institutions,**
Working paper, 2010
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1661923
8. CARR P., H. GEMAN, D. MADAN and M. YOR
Stochastic Volatility for Lévy Processes
Mathematical Finance, 13:345-380, 2003
9. CARR P., R. JARROW and R. MYNENI
Alternative Characterization of American Put Options
Mathematical Finance, 2:87-105, 1992
10. CARR P. and L. WU
Time-changed Lévy Processes and Option Pricing
Journal of Financial Economics, 17:113-141, 2004
11. CHE Y. and R. SETHI
Credit Derivatives and the Cost of Capital
Working paper, Columbia University, 2012
12. CHESNEY M., and L. GAUTHIER
American Parisian Options,
Finance and Stochastics, 10-475-506, 2006
13. CHESNEY M., and M. JEANBLANC
Pricing American Currency Options in an Exponential Lévy Model
Applied Mathematical Finance, 11: 207-225, 2004

14. CHESNEY M., M. JEANBLANC and M.YOR
Brownian excursions and Parisian barrier options
Adv. Appl. Prob., 29:165-184, 1997
15. CHESNEY M., and A. KEMPF
The Value of Tradeability
Review of Derivatives Research, 15:193 - 216, 2012
16. CHESNEY M. and L. TASCHINI
The Endogeneous Price Dynamics of Emission Allowances and an Application to CO2 Option Pricing
Applied Mathematical Finance, 19: 447 - 475, 2012
17. DIXIT, A.
Entry and Exit Decisions under Uncertainty
Journal of Political Economy, 620-638, 1989
18. DURBIN J.
The first passage density of the Brownian motion process to a curved boundary
J. of Appl. Prob., 29:291-304, 1992
19. FEHR, M. and J. HINZ
A Quantitative Approach to Carbon price risk modeling,
 Institute of Operations Research, ETH, Zurich, 2006
20. GARMAN M.B. AND S.W. KOHLHAGEN :
Foreign Currency Option Values
Journal of International Money and Finance, 2: 231-237, 1983
21. GAUTHIER L.
Options réelles et options exotiques, une approche probabiliste
 Thèse de doctorat, Univ. Paris 1, 2002
22. GERBER H. and B. LANDRY
On the discounted penalty at ruin in a jump-diffusion and the perpetual put option
Insurance: Mathematics and Economics, 22: 263-276, 1998
23. GERDING E.
Credit Derivatives, Leverage, and Financial Regulation's Missing Macroeconomic Dimension
Berkeley Business Law Journal, Symposium Edition, 29-73, 2011
24. GRENADIER S. and A. MALENKO
Real Options Signaling Games with Applications to Corporate Finance
Review of Financial Studies, 24(12): 3993-4036, 2011
25. HESTON S.I.
A Closed-form Solution for Options with Stochastic Volatility with Applications to Bond and Currency Options
The Review of Financial Studies, 6:327-343, 1993
26. HULL J. and A. WHITE
The pricing of options on assets with stochastic volatilities
Journal of finance, 42:281-300, 1987

27. KONG J. and Y. K. KWOCK
Real options in strategic investment games between two asymmetric firms
European Journal of Operational Research, 181: 967-985, 2007
28. LAMBRECHT B. and W. PERRAUDIN
Real Options and Preemption under Incomplete Information
Journal of Economics Dynamics and Control, 27:619-643, 2003
29. McDONALD R. and R. SIEGEL
The value of waiting to invest
Quarterly Journal of Economics, 101:707-728, 1986
30. MERTON R.
Option Pricing when underlying stock returns are discontinuous
Journal of Financial Economics, 3:125-144, 1976
31. MORDECKI E,
Optimal stopping for diffusion with jumps
Finance and Sto., 3:227-236, 1999
32. PAOLELLA, M. and L. TASCHINI,
An Econometric Analysis of Emission Allowances Prices
Journal of Banking and Finance 32:2022-2032, 2008
33. PAWLINA G. and P. KORT,
Real options in an asymmetric duopoly: Who benefits from your competition,
Journal of Economics and Management Strategy, 15: 1-35, 2006
34. PHAM H.
Optimal stopping free boundary and American option in a jump diffusion model
Applied Math. and optim., 35:145-164, 1997
35. PIGA G.
**Do Governments use financial derivatives appropriately?
Evidence from sovereign borrowers in developed economies**
International Finance, 4:189-219,2001
36. RICH D.R.
The mathematical foundations of barrier option-pricing theory
Advances in Futures and Options Research, 7:267-311,1994
37. SCOTT L.
**Option Pricing when the Variance Changes Randomly :
Theory, Estimation and an Application**
Journal of Financial and Quantitative Analysis, 22:419-438, 1987
38. VILLENEUVE S., H. LOUBERGE and M. CHESNEY
Long Term Risk Management of Nuclear Waste: a Contingent Claim Analysis
Journal of Economics Dynamics and Control, 27:157-180, 2002
39. WANG M., A. BERNSTEIN and M. CHESNEY
An experimental study on real-options strategies
Quantitative Finance, 1-20, July 2012

Links and reports:

- BCE, Credit Default Swaps and counterparty Risk, 2009
<http://www.ecb.int/pub/pdf/other/creditdefaultswapsandcounterpartyrisk2009en.pdf>
- The financial crisis inquiry report
Final report of the national commission on the causes of the financial and economic crisis in the United-States, 2011
<http://www.gpoaccess.gov/fcic/fcic.pdf>
- **Max Weber Lecture: “The Great Moderation, The Great Panic, and The Great Contraction”**, Charles Bean, 2010
http://cadmus.eui.eu/bitstream/handle/1814/13522/MWP_LS_2010_02.pdf?sequence=1
- **“To end all crises?” Finance Watch’s position paper 2012:**
<http://www.finance-watch.org/wp-content/uploads/2012/01/Finance-Watch-CRD-IV-Position-Paper.pdf>