Derivatives & Risk Management

Master Seminar

Institute of Finance and Commodity Markets

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Winter Semester 2020/2021

Supervisor

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Schedule

- Online kick-off-meeting:

  Wednesday, **15th July 2020**, **10 a.m.**, online (BBB)

- Submission of list of topic preferences until:

  Friday, **17th July 2020**, **11 a.m.**, via email

- Topic assignment:

  Monday, **20th July 2020**

- Binding registration until:

  Friday, **24th July 2020**

- Submission of seminar paper until:

  Wednesday**, 11th Nov. 2020**, **11 a.m.**, via email

- Presentations:

  Late November / mid December

Requirements

- Preparation of a seminar paper in groups of 2
- Scope: 20 pages (groups of 2)
- Independently performed empirical application or quantitative analysis is the core of the seminar paper
- Use of appropriate statistics software such as R, STATA, or Matlab is highly recommended
- Pure literature research is not sufficient
- Presentations of the seminar papers will be held in a blocked seminar in December
- Assessment: 60% written work, 40% presentation

Topic 1: Valuation of American Options Using Monte Carlo Simulation

Description:

- Unlike for European options, there is no close-form solution for the valuation of American options. Therefore, a number of Monte Carlo simulation-based approaches have been proposed within the past decade to address the problem of pricing American-style derivatives.

- The technique of MC simulation is a numerical tool to simulate uncertain events. By simulating these uncertain events sufficiently often, it is possible to obtain information about the distribution of the investigated variable.

Task:

- Theoretical description of valuation of American options.

- Valuation of American options making use of Monte Carlo simulation techniques.

Basic Literature:

- Hull, J. C., (2011). *Options, Futures, and Other Derivatives*. 8th ed., Prentice Hall.

- Tilley, J., (1993). Valuing American Options in a Path Simulation Model. *Trans. Soc. Actuaries*, 45, 83-104.

Topic 2: Valuation of American Options Using Binomial Tree Model vs. Finite Difference Method

Description & Task:

- In the binomial approach, the evolution of the stock prices modelled by Black-Scholes is approximated by a succession of independent binomial stochastic variables. These variables take one of two possible values, where the probabilities for either is determined via no arbitrage arguments.

- On the contrary, finite difference methods are built on the idea of approximating the partial derivatives in the continuous partial differential equation with approximations from Taylor series expansion around the points of interest.

- The goal is to study the advantages and disadvantages of the two methods when it comes to pricing American options; not just in theory, but also practically employed.

Basic Literature:

- Hull, J. C., (2011). *Options, Futures, and Other Derivatives*. 8th ed., Prentice Hall.
- Seydel, R., & Seydel, R. (2006). Tools for computational finance (Vol. 3). Berlin: Springer.

Description:

- Characterizing asset return dynamics using volatility models is an important part of empirical finance.

- The family of GARCH volatility models has become an important toolkit in empirical asset pricing and financial risk management.

Task:

- Theoretical description of "Generalized Autoregressive Conditional Heteroscedasticity" models.

- Use of an appropriate GARCH process to capture the variance process of log stock returns.

- Valuation of (European) options.

Basic Literature:

- Hull, J. C., (2011). *Options, Futures, and Other Derivatives*. 8th ed., Prentice Hall.

- Christoffersen, P., & Jacobs, K. (2004). Which GARCH Model for Option Valuation. *Journal of Management Science*, *50*,1204-1221.

- Duan, J.-C., (1995). The GARCH Option Pricing Model. *Mathematical Finance*, 5, 13-32.

Topic 4: Forecasting Volatility Using GARCH Models

Description & Task:

- Volatility modeling plays a special role in risk management, but also for asset allocation and pricing of derivatives. However, it is not trivial since the volatility of various asset returns is dynamic over time which leads to the emergence of volatility clusters. Hence, the crucial problem lies with the accurate estimation of volatility.

- For modeling volatility clustering, GARCH models by Engle (1982) and Bollerslev (1986) have proven to be particularly suitable for modeling volatility clustering.

- Compare models of the GARCH family empirically, especially based on their predictive power.

Basic Literature:

- Engle, R. F. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. *Econometrica*, 987-1007.

- Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics*, 31(3), 307-327.

- Alexander, C. (2008): Market risk analysis, Volume II: Practical financial econometrics.

Description:

- Volatility is a critical factor influencing the option pricing; however, it is an extremely difficult factor to forecast. Hence, the crucial problem lies with the accurate estimation of volatility.

Task:

- Theoretical description and discussion of historical vs. implied volatility.
- Forecast of historical and implied volatility using an appropriate choice of models.
- Comparison and evaluation of the obtained results.

Basic Literature:

- Hull, J. C., (2011). *Options, Futures, and Other Derivatives*. 8th ed., Prentice Hall.
- Prokopczuk, M., Wese Simen, C., (2014). The Importance of the Volatility Risk Premium for Volatility Forecasting, *Journal of Banking & Finance*, 40, 303-320.
- Fleming, J., Kirby, C., Ostdiek, B., (2001). The Economic Value of Volatility Timing, *The Journal of Finance*, 56, 329-352.
- Fleming, J., Kirby, C., Ostdiek, B., (2003). The Economic Value of Volatility Timing Using "Realized" Volatility, *The Journal of Financial Economics*, 67, 473-509.

Topic 6: VIX - High, time to buy?

Description:

- The CBOE Volatility Index (VIX Index) is a leading measure of market expectations of short-term volatility conveyed by S&P 500 Index (SPX) option prices, thus, it expresses the market's expected fluctuation range.

Task:

- Replicate the VIX
- Design and test a trading strategy based on the VIX
- Compare and evaluate the obtained results

Basic Literature:

- The CBOE Volatility Index - VIX, White Paper
- Fernandes, Medeiros, Scharth (2014), Modeling and predicting the CBOE market volatility index, *Journal of Banking and Finance*, Volume 40, pp.1-10.
- Hull, J. C., (2011). *Options, Futures, and Other Derivatives*. 8th ed., Prentice Hall.

Description & Task:

- The Value at Risk (VaR) measures the risk of investments and the potential loss over a certain period. The estimator is based on various assumptions and methods such as historical VaR, parametric VaR and Mote Carlo simulations.

- While each method has advantages and disadvantages, the question arises as to which one should be used for companies. The evaluation of a VaR model is typically performed by means of backtesting.

- The goal is an empirical investigation and comparison of different estimation methods using backtesting as a tool.

Basic Literature:

- Hull, J. C., (2011). *Options, Futures, and Other Derivatives*. 8th ed., Prentice Hall.
- Christoffersen, P. F. (2012). Elements of financial risk management. 2nd ed., Academic Press.
- Jorion, P. (2001). Value at Risk. McGraw-Hill.