Seminar Finance: Derivatives & Risk Management

Master Seminar

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Winter Term 2022/23

Requirements

- Preparation of a seminar paper in groups of up to 2
- Scope: 15/20 pages (depending on group-size)
- Independently perform empirical / quantitative analysis
- Use of appropriate statistics software (R/Matlab/Python/etc.)
- Pure literature research is not sufficient
- Presentation of seminar paper in blocked seminar
- Assessment: 60 % written work and 40 % presentation

Procedure

- 15.07.2022, Kick-off meeting in I-342
- 20.07.2022, submission of preferences
- 21.07.2022, allocation of topics via email (I send you an email)
- 25.07.2022, binding registration
- 18.11.2022, submission deadline
- Nov/Dec (TBA): presentation
- General information, registration form, grading specification form, guideline for writing seminar papers:
  `https://www.fcm.uni-hannover.de/de/lehre/seminare/`

Valuation of American Options Using Monte Carlo Simulation

Task:

- Theoretically describe the problems arising when pricing American options.
- Implement a Monte Carlo simulation technique to price American-style options.
- Perform further analyses, e.g., parameter sensitivity, application to real data, stochastic volatility/interest rates, multiple dimensions etc.

Literature:

- Longstaff, F. A., & Schwartz, E. S. (2001). Valuing American options by simulation: A simple least-squares approach. *Review of Financial Studies*, 14(1), 113-147.
- Broadie, M., & Glasserman, P. (1997). Pricing American-style securities using simulation. *Journal of Economic Dynamics and Control*, 21(8-9), 1323-1352.
- Glasserman, P. (2013). Monte Carlo methods in financial engineering (Vol. 53). Springer Science & Business Media.

Option Pricing Using Finite Differences

Task:

- Describe (one of) these methods for (American) option pricing.
- Implement at least one method.
- Perform further analyses, e.g., introduce dividends, estimate greeks, compare to market data, etc.

Literature:

- Seydel, R. U. (2009). Tools for computational finance (Vol. 4). Berlin: Springer.
- Hull, J. C. (2012). Options, Futures and Other Derivatives. Prentice Hall.

Option Pricing with Non-Constant Volatility

Task:

- Describe and implement at least one method to price options whose underlying exhibits non-constant volatility.
- Perform further analyses, e.g., compare Monte-Carlo to analytic solutions, study the influence of different GARCH-processes, etc.

Literature:

- Christoffersen, P., & Jacobs, K. (2004). Which GARCH model for option valuation?. *Management science*, 50(9), 1204-1221.
- Heston, S. L. (1993). A closed-form solution for options with stochastic volatility with applications to bond and currency options. *Review of financial studies*, 6(2), 327-343.

Model-Free Implied Volatility

Task:

- Estimate the model free implied volatility of an asset and compare it to its subsequently realized volatility.
- Perform further analyses, e.g., study conditional risk premia, compare it to Black-Scholes-Merton IV or historical forecasts (GARCH family), study the influence of discretization/truncation/interpolation, etc.

Literature:

- Britten–Jones, M., & Neuberger, A. (2000). Option prices, implied price processes, and stochastic volatility. *Journal of Finance*, 55(2), 839-866.
- Jiang, G. J., & Tian, Y. S. (2005). The model-free implied volatility and its information content. *Review of Financial Studies*, 18(4), 1305-1342.
- CBOE (2019). VIX white paper.

Interest Rate Derivatives

Task:

- Describe at least one interest rate model, calibrate it, and use it to price an interest rate derivative.
- For example, short rate models like Vasicek and CIR, no-arbitrage models like Ho-Lee and Hull-White, or models of the forward curve like HJM or the BGM LIBOR market model.

Literature:

- Hull, J. C. (2012). Options, Futures and Other Derivatives. Prentice Hall.

Variance Reduction Techniques for Monte Carlo Simulation

Task:

- Describe, implement, and combine variance reduction techniques like antithetic sampling, control variates, stratified sampling, importance sampling, moment matching, quasi-random sequences, etc.
- Quantify the impact on the trade-off between computational time and error rates by pricing a simple financial derivative using Monte Carlo simulation.

Literature:

- Glasserman, P. (2013). Monte Carlo methods in financial engineering (Vol. 53). Springer Science & Business Media.

Estimation of Greeks for Hedging

Task:

- Describe, implement, and compare methods to estimate the Greeks of an (exotic) option contract using Monte Carlo simulation.

Literature:

- Glasserman, P. (2013). Monte Carlo methods in financial engineering (Vol. 53). Springer Science & Business Media.