Lehrstuhl für Finanzmathematik
Fakultät für Mathematik
Technische Universität München

Announcement SoSe 2021
Lecture in Mathematical Finance

Commodity and Energy Markets

Prof. Dr. Rüdiger Kiesel, Prof. Dr. Lorenz Schneider

Area: / Modulnr.: Mathematical Finance/ MA 5725

Course Structure: Lecture: 2h

Content:

The aim of this course is to give an introduction to commodity and energy markets, the financial products traded on them, and how these products are mathematically modelled by market participants. Commodity and energy markets are important for many institutions such as commodity producers, commodity trading houses, investment banks, insurance companies, and hedge funds.
The first half of the course will be delivered by Dr. Rüdiger Kiesel, and will cover electricity markets, renewable energies, management of wind farms, and weather derivatives. The second half of the course will be delivered by Dr. Lorenz Schneider and will cover agricultural commodities, crude oil, natural gas, base metals, and precious metals.
Empirical features of these markets such as contango, backwardation, seasonality, the Samuelson volatility effect, and the implied volatility surface will be presented. Products covered will include forward and futures contracts, Asian swaps, Asian options, basket and barrier options, and more exotic options such as spread options, calendar spread options, and swing options. Models used for pricing these products will include the classic Black (1976) model, the Schwartz and Smith (2000) short-term/long-term model, the Heston
(1993) stochastic volatility model, and one- and multi-factor models of the entire futures curve such as Clewlow and Strickland (1999a,b) and Schneider and Tavin (2018). These models will be implemented in C#, as the students should also gain insight into implementing commodity models and pricing specific products with them. Econometric concepts such as time series, state space models, the Kalman filter, and parameter estimation will also be covered and implemented using market data.
Textbooks referred to in the course include Burger et al. (2007), Geman (2005), Schofield (2007), Downey (2009), Hull (2012), Clark (2011, 2014), and Roncoroni et al. (2015).

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Audience: MSc Mathematik

Prerequisite: MA4405 (Stochastic Calculus)

Literature:

Fisher Black. The pricing of commodity contracts. Journal of Financial Economics, 3(1-2):167–179, March 1976.
Markus Burger, Bernhard Graeber, and Gero Schindlmayr. Managing Energy Risk: An Integrated View on Power and Other Energy Markets. Wiley, 2007.
Iain J. Clark. Foreign Exchange Option Pricing: A Practitioner's Guide. Wiley Finance. Wiley, 2011.
Iain J. Clark. Commodity Option Pricing: A Practitioner's Guide. Wiley Finance. Wiley, 2014.
Les Clewlow and Chris Strickland. Valuing energy options in a one factor model fitted to forward prices. Working Paper, 30 pages, April 1999a.
Les Clewlow and Chris Strickland. A multi-factor model for energy derivatives. Working Paper, 20 pages, August 1999b.
Morgan Downey. Oil 101. Wooden Table Press, 2009.
Hélyette Geman. Commodities and Commodity Derivatives. Wiley Finance. Wiley, 2005.
Steven Heston. A closed-form solution for options with stochastic volatility with applications to bond and currency options. Review of Financial Studies, 6 (2):327–343, 1993.
John Hull. Options, Futures, and Other Derivatives. Pearson, eighth edition, 2012.
Andrea Roncoroni, Gianluca Fusai, and Mark Cummins. Handbook of Multi-Commodity Markets and Products: Structuring, Trading and Risk Management. Wiley Finance Series. Wiley, 2015.
Lorenz Schneider and Bertrand Tavin. From the Samuelson volatility effect to a Samuelson correlation effect: An analysis of crude oil calendar spread options. Journal of Banking and Finance, 95:185–202, October 2018.
Neil C. Schofield. Commodity Derivatives - Markets and Applications. Wiley Finance. Wiley, 2007.
Eduardo Schwartz and James Smith. Short-term variations and long-term dynamics in commodity prices. Management Science, 46(7):893–911, July 2000.

Certificate: Exam, 3 CP

Location/ Time: See TUMonline