Project Description [v2 2nov19]

Working title:

Pricing derivative contracts for Electricity Prices.

Group members:

Simon Eugen Matell, StudentID: sima14ah

Mads Schøn Kühnel, StudentID: maku15af

Research question:

Firstly, who are the constituent agents and suppliers of electricity in the Danish market, and how is the deregulated market structured? Secondly, what is the statistical behavior of the electricity prices, how difficult are they to forecast on the day-ahead horizon? Thirdly, why do electricity prices inhibit great variation, and what defines a suitable volatility measure for option pricing? Ultimately, which financial instruments are typically used, and which other could be applicable to trade electricity prices?

Motivation:

In recent years increased attention has been made to lowering carbon emission. Functioning as an archetypal of the transition from traditional fossil fuels to renewable energy resources, Denmark has invested significantly in wind production facilities, with more than half of all electricity stemming from on- and off-shore wind production. A fundamental complication which arises with this transition as well as solar based solutions are their great variation in production output as well as inability to be stored, making for both great fluctuation and variation in prices. This thesis addresses this issue of determining a suitable measure for the rough volatility of the Danish market through a statistically rigorous investigation of realized and implied volatility. Additionally, the results will have increasing relevance for companies as digitalization and sustainability will increase dependency on clean energy.

Description of approach/implementation:

- Understanding mechanics of the Danish electricity market.
- Understanding time series pattern for electricity prices at the Nord Pool exchange; autoregressive modelling for day-ahead forecasting of electricity prices.
- Determine martingale measure for pricing options (futures, forwards, swing- and caps options); we anticipate value estimation through numerical methods such as Monte Carlo and the Euler Scheme method.

Relevant literature:

1: Raschka, S. et al (2017) 'Python for Machine Learning', 2nd Edition. *New York. Packt Publishing.*

2: Tsay, R. S. (2010) 'Analysis of Financial Time Series', 3rd Edition. *New York. Wiley.*

3: Ruppert, D. (2015) 'Statistics and Data Analysis for Financial Engineering', 2nd Edition. *Ithaca Springer.*

4: Benninga, S. (2014) 'Financial Modeling', 4th Edition. C*ambridge. MIT Press.*

4: Weron, R. & Nowotarski, J. (2018) 'Recent advances in electricity price forecasting: A review of probabilistic forecasting', *Renewable and Sustainable Energy Reviews. Vol. 81, 1548-1568.*

5: Pavlatka, P. (2010) *'*Option Derivatives in Electricity Hedging' *(working paper)*

6: Energistyrrelsen (2017) 'Energy statistics 2017: Data, tabels, statistics and maps' *[Annual report for the Danish Ministry of Energy, Utilities and Climate].*

7: McKinsey & Co. (2018) 'What if the latest wind and solar auction results were the new reality of electricity prices?' *McKinsey Energy Insights.*