Project Description [v3 21mar20]

Working title:

Pricing Financial Derivatives for Electricity Prices.

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Research question:

How do option pricing models which incorporate price volatility fluctuations empirically perform against constant volatility in the Black-Scholes model, in the volatile Nordic electricity power market?

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 Nordic 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 Nordic electricity market.
- Understanding time series pattern for electricity prices at the Nord Pool exchange; autoregressive modelling for day-ahead forecasting of electricity prices.
- Determine risk-neutral-measure for pricing electricity derivatives (futures and options); we anticipate valuation through closed form solutions such as the Black-Scholes-Merton method.

Relevant literature:

1: Hull, J. (2015) 'Options, Futures, and Other Derivatives', 9th Edition. *New Jersey. Pearson Education.*

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.*

5: Fama, E. (1987) 'Commodity Futures Prices', *The Journal of Business. Vol. 60-1, 55-73.*

6: Burger, M. et al. (2004) 'A Spot Market Model for Pricing Derivatives in Electricity Markets', *Journal of Quantitative Finance. Vol. 4-1, 109-122.*

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

8: 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.*

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

10: Tryggestad et al. (2018) 'What if the latest wind and solar auction results were the new reality of electricity prices?' *McKinsey Energy Insights.*