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| **Brent Crude Oil price forecasting with ARIMA/LTSM hybrid modelling techniques** |
| *A price forecasting of Brent Crude Oil Spot prices (Dollars per Barrel) over the next 30 days (insert here)* |

Introduction

The price of a barrel of Brent Crude Oil is subject to geopolitical and economic factors, supply and demand fluctuations, environmental policies and many more. These factors are not only difficult at times to quantify, but they are perpetually changing. The sheer complexity of the interconnected nature of Brent Crude Oil’s prices makes it challenging to accurately forecast its price. New approaches, such as Machine Learning (ML) offer potential improvements – such as adjusting for the non-linearity. Here, we will explore a hybrid approach – combining traditional time series forecasting models with new ML models.

Our purpose is to forecast the prices of Brent Crude Oil over the next 30 days. Our data, Brent Crude Oil Spot Price (Dollars per barrel) has been collected daily since May 21st, 1986 – a time series. Time series forecasting allows us to predict future values of a dependent variable by analysing the relationship between the dependent variable and its past values – in this case historical data. By training a forecasting model on historical data, the model learns underlying trends and patterns within the data to predict future values.

ARIMA (Auto Regressive Integrated Moving Average) models have typically been used for forecasting purposes owing due to their thoroughly researched applications over the last few decades. They are simple, linear models used for stationary time series data. This simplicity allows for little computational load allowing us to capture general trends. This simplicity does, however, have its limitations. ARIMA assumes stationarity of the time series, which ours is far from. It also only captures linear trends yet, despite it steadily increasing over time, Brent Crude does not follow a linear growth.

This is generally acceptable for short term trends, while not ideal. To adjust to the non-linear nature of the Brent Crude Oil prices we require modelling techniques that allow us to capture non-linear patterns. As touched on previously, ML techniques can capture non linearity. Specifically, we will use Long Term Short Memory (LTSM) Network, a form of Neural Network (NN). By using nonlinear activation functions for the NN’s neurons or layers, we can capture non-linear patterns within the time series data.

Background

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| Figure 1. Average Yearly Europe Brent Spot Price in Dollars per Barrel since 1986. Source: Author |

It is key to note the prices in Figure 1 are nominal from [insert here] and are therefore not adjusted for inflation. Importantly also, Figure 1 allows the reader to see the nonlinear nature price growth. In some areas, a linear pattern would fit well, for example, we can see an almost linear growth from 1986 to 2004 and from 2004 to 2008. Despite this, the volatility of the price results in a nonlinear trend overall. We cannot accurately describe the relationship between price and time as a linear one, hence we require a hybrid approach to allow us to capture the linear and non-linearity of its relationship.

Thus, our hybrid approach will use both ARIMA models and LTSM.

ARIMA:

An ARIMA model is composed 3 components : Auto Regressive, Integrated and Moving Average. Each of which perform a specific mathematical function to capture the behaviour of the time series.

First, the Auto Regressive (AR) component. This component is based on regression

LTSM…

Methodology

Results

Conclusions and Evaluation

References:

1. Brent Crude website