Constructing forward curves of Futures prices

Master's Degree in Computational Finance

Tong Su, Riccardo Niero, Gianvittorio Parolin, Francesco Landi

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UNIVERSITÀ DEGLI STUDI DI PADOVA

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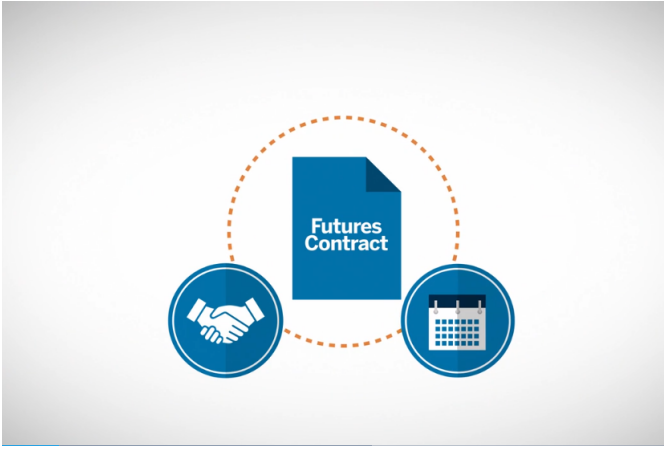
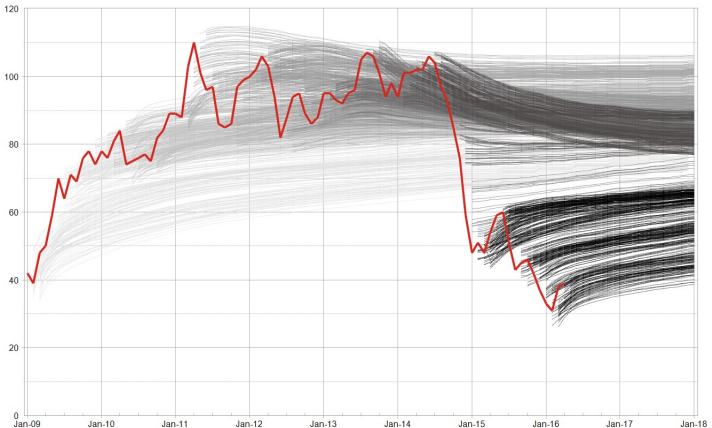
Futures Contracts

1 Introduction



Forward Curves

1 Introduction



Dataset

1 Introduction

Date	Open	High	Low	Close
08/1/2024	73.6	73.98	72.08	72.18
05/1/2024	72.51	74.3	72.35	73.86
04/1/2024	73.2	74.12	71.24	72.36
03/1/2024	70.77	73.36	69.56	72.89
02/1/2024	71.9	73.8	70.32	70.62
29/12/2023	72.15	72.8	71.47	71.84
28/12/2023	74.04	74.62	71.92	71.97
27/12/2023	75.57	75.81	74.01	74.34
26/12/2023	73.74	76.31	73.32	75.71
22/12/2023	74.07	75.11	73.55	73.73

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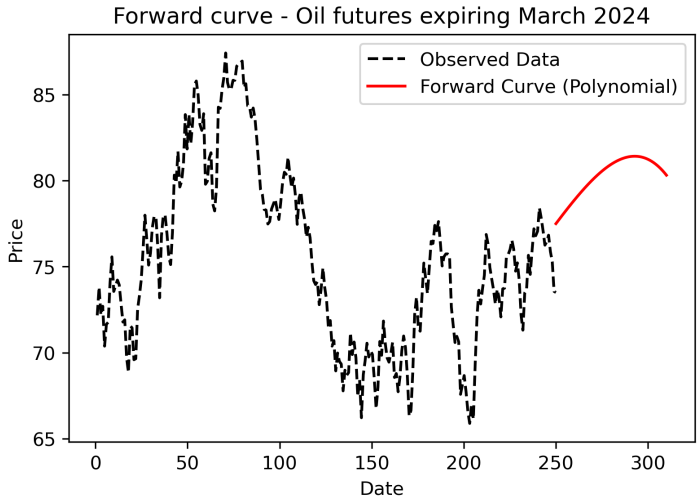
Polynomial Approximation

2 Models

- Least square approach
- Python application



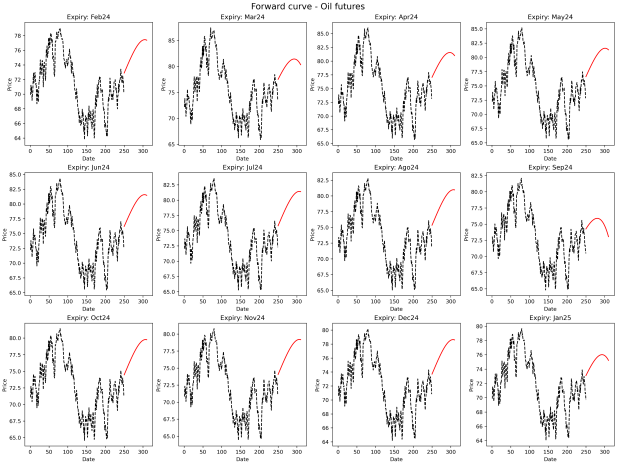
Choice of the Degree for the Polynomial

2 Models

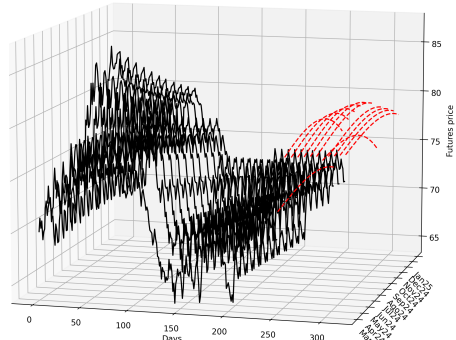
- Model selction
- AIC and BIC
- Occam's razor principle

Graphs

2 Models



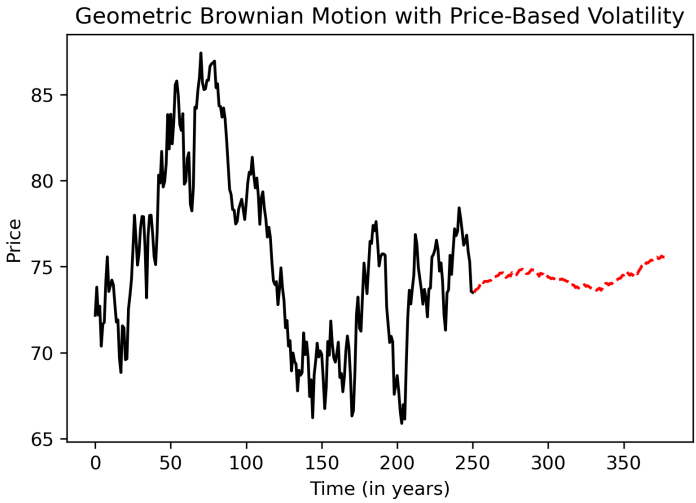
Forwards curves in 3D



GBM Model

2 Models

- Geometric Brownian Motion Model
- Widely used for futures price behaviour
- The issue of volatility and unforeseeable events



Composition of GBM:

2 Models

- 1. Stochastic Process
- 2. Drift (μ) and Diffusion (σ)
- 3. Stochastic Differential Equation (SDE)

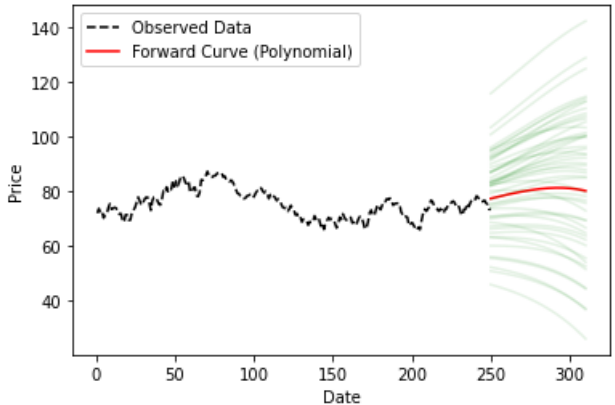
Formula

$$dS(t) = (\mu)S(t)dt + (\sigma)S(t)dW(t)$$

Monte Carlo Simulation

2 Models

Monte Carlo simulation, a mathematical technique synonymous with uncertainty estimation, takes center stage in our oil price forecasting project. It provides a method for estimating outcomes in situations where predicting the future is challenging.



Comparing Models

2 Models

Our analysis involves a comprehensive comparison of observed data, polynomial model estimates, GBM model and forecast data from 30 rates website. Our models exhibit differences in precision and accuracy compared to forecast data, understanding these distinctions is crucial.

Data	Mean	Dev.Standard	Mean Squared Error
Observed Data	75.36	5.17	
Polynomial Data	79.13	0.90	45.08
”OIL Forecast” data	76.12	2.05	23.05
”WTI OIL Forecast” data	71.11	2.02	8.93
GBM Estimated Data	74.40	0.49	45.14

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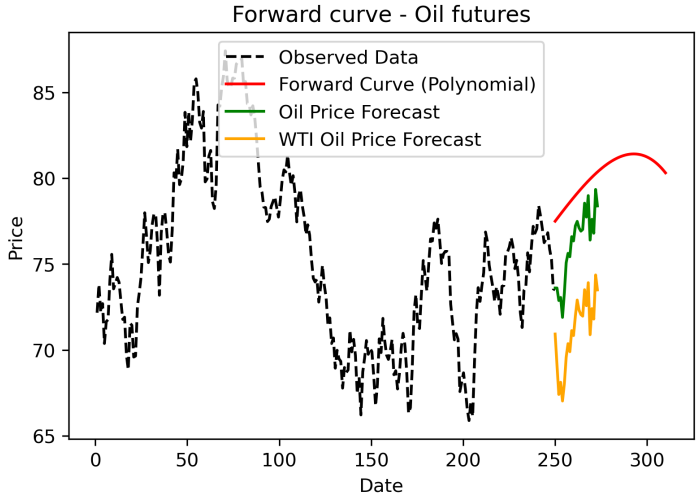
Forecast Trends

3 Results

- The polynomial model suggests a growth of 3.87%, while the GBM model forecasts 1.57% at 25 days, slightly increasing to 1.42% over 60 days.
- In contrast, external sources predict higher growth rates 6.49% for oil prices and 3.62% for WTI crude oil.
- ”*The only certainty about the future is that it will be uncertain*.” - Peter Drucker

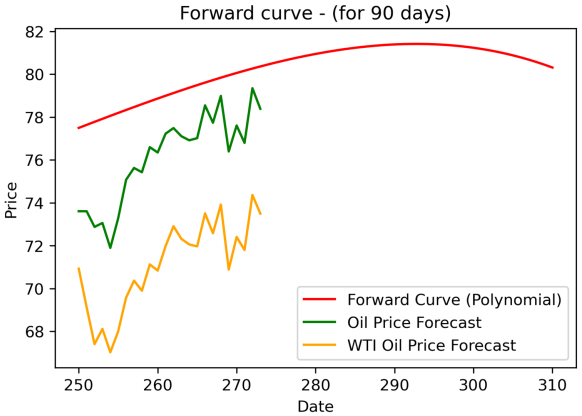
Comparison with “Brent OIL” and “WTI” price

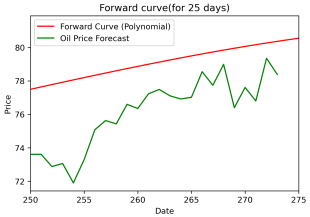
3 Results

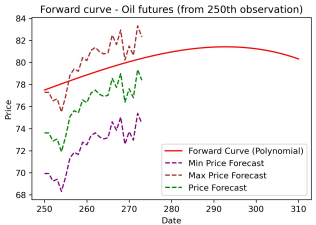


Polynomial Models comparison with “Brent OIL” and “WTI” price

3 Results

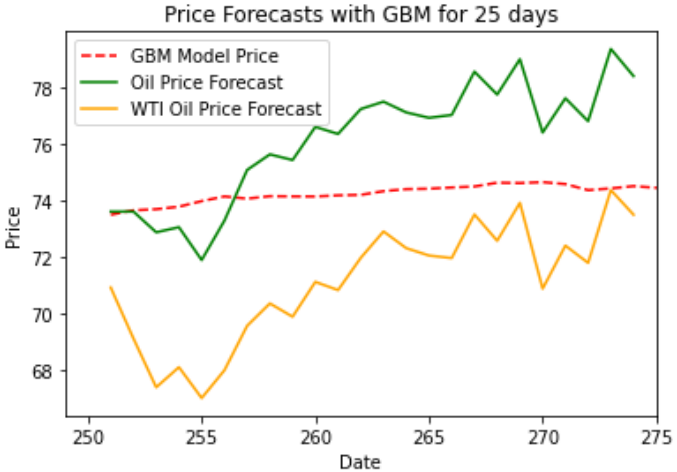






GBM Model and comparison with “Brent OIL” and “WTI” price

3 Results



Conclusions

3 Results

- Models Comparison:
  - Analysis of polynomial and GBM, with Brent crude oil and WTI crude oil.
- Polynomial Model:
  - Fourth-degree polynomial to minimize error for 60-day forecast.
- GBM Model:
  - Application of Geometric Brownian Motion for a 127-day forecast.

Thank you so much for your attention!