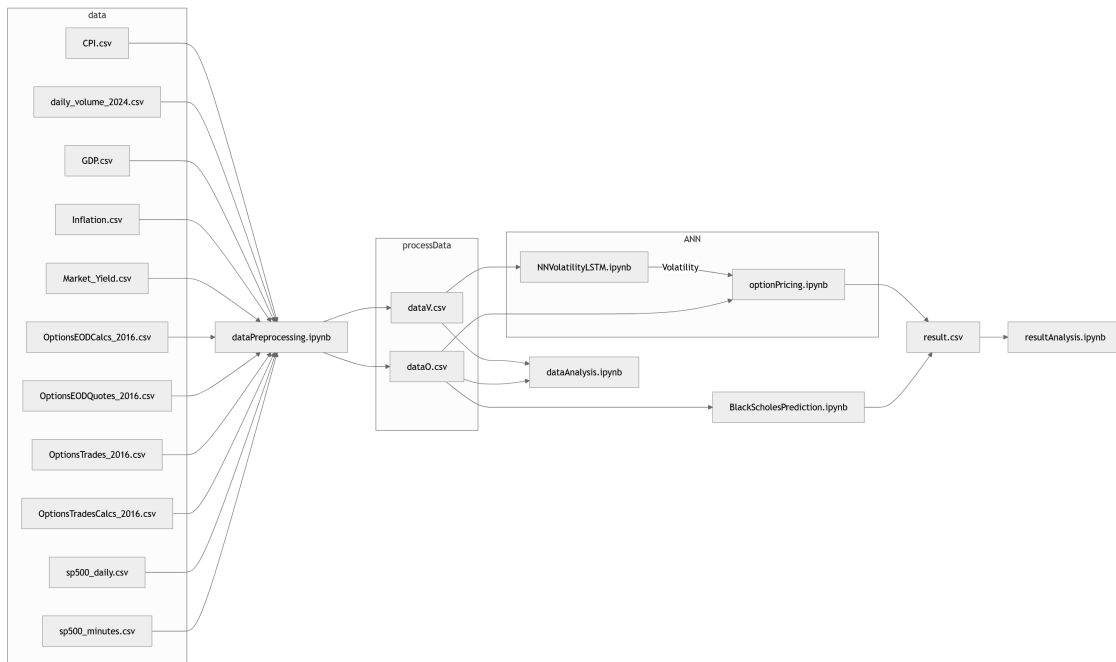


Research Project Report

March 4, 2025

1 Introduction

This document will clearly outline the advancement of the research project. Based on the Scrum and sprint methodology, I will update the document every week, including what is new and what is next.

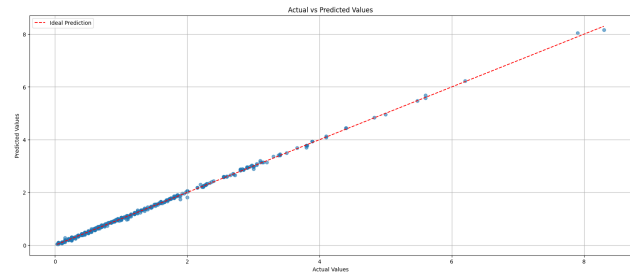
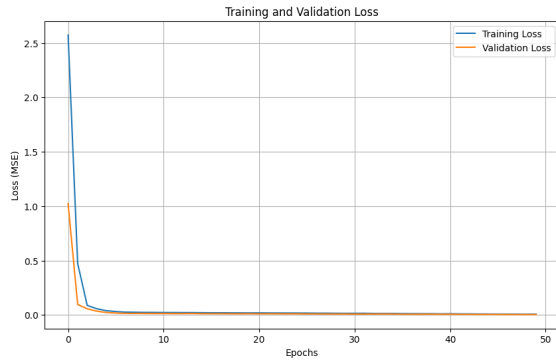


Iteration 1

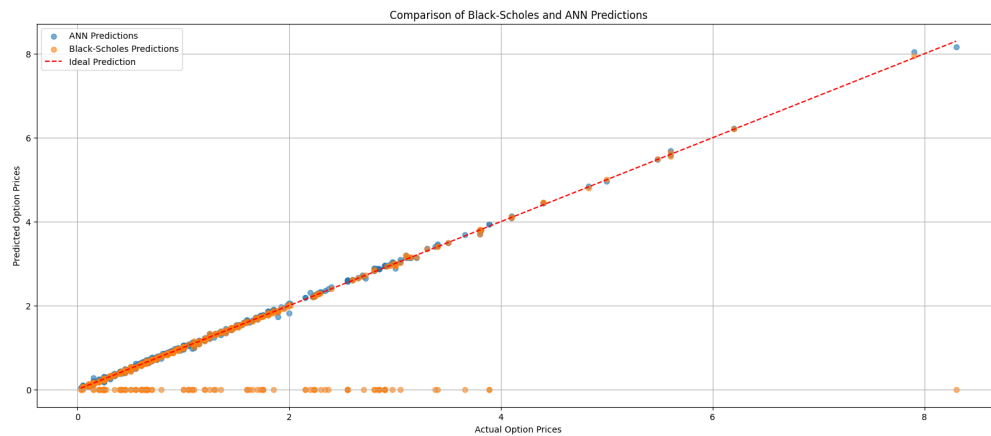
February 3, 2025

What Is New?

- Created and trained a ANN MLP model for option pricing, using Black-Scholes parameters to target option prices.



- Compared the model's performance against Black-Scholes models:



- Started to build a custom LSTM model with NumPy. For now, I think Python allows better flexibility and development time than C++, while still maintaining decent performance using only NumPy. I want the model to be compatible with TensorFlow formatting for easier use.

What Is Next?

- Finish the custom MLP model.
- Outliers suppression

Iteration 2

February 10, 2025

What Is New?

- First principle implementation of artificial neural network **multilayer perceptron**. Can be found here : `/code_/models/annModels.py`

- ```
mlp = am.MLP(n_input=22, n_hidden1=64, n_hidden2=32, n_output=1)
epochs = 5000
learning_rate = 0.001
```

```
#Training
```

```
history = mlp.train(X_train_normalized, y_train, epochs, learning_rate)
```

```
Predict
```

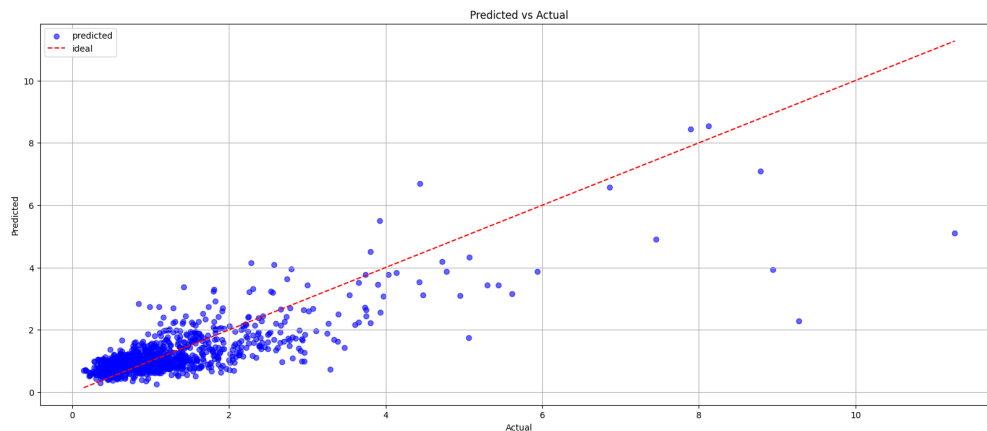
```
train_preds = mlp.forward(X_train_normalized)
```

```
y_pred = mlp.forward(X_test_normalized)
```

```
#---
```

```
Final Training Loss: 0.41194406219492513
```

```
Final Test Loss: 0.41460153925356924
```



### What Is Next?

- Parameter optimization for custom model implementation ?
- Would a Transformer work better ? - Wiki Transformer
  - Very likely, However, to get a working transformer model, the data volume is much more advanced than we currently use.

## Iteration 3

February 17, 2025

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### What Is New?

- Finnish data gathering with script `:/code_/tools/getData.ipynb`, all the assets data are gathered in `/data/stocks` (around 200 symbols)
- Transformer implementation in progress
- Benchmark against LSTM model
- Parameter optimization for custom model implementation ?

### What Is Next?

- Document on maths behind models (`models.pdf`)

## Iteration 4

February 24, 2025

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### What Is New?

- LSTM implementaiton in progress
- FFNN MLP and LSTM mathematics models

### What Is Next?

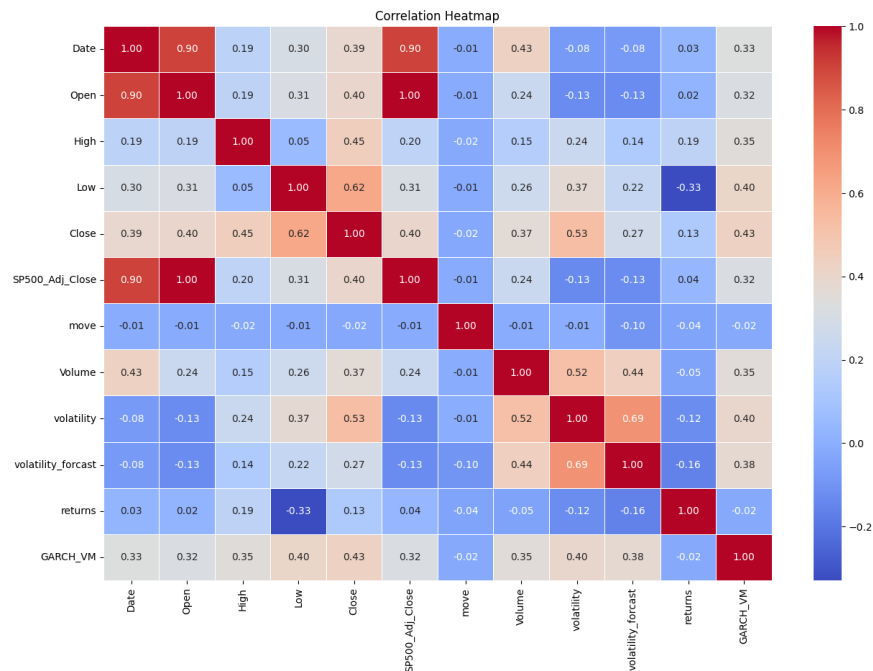
- Identifies specific aspect of volatility time series (mean reversion, volatility clustering, heavy tail)
- identifies drawback in LSTM architecture for specific financial time series
- Optimize model for financial time series
- identify best loss function for volatility time series

## Iteration 5

March 3, 2025

### What Is New?

- Data Work
  - Compare to litterature
  - Normalize data to improve models performances
  - Select relevant feature to work with the model (clean confusion matrix)
- Litterature about new/modify LSTM model for financial time series prediction
- Document on volatility model updated



### What Is Next?

- Improve mathematical relationship of LSTM models with litterature and financial time series properties.