PREDICTIVE SP500 LSTM MODEL USING WALK-FORWARD APPROACH

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INTRODUCTION

LSTM regression model on S&P 500 (SPX) returns:

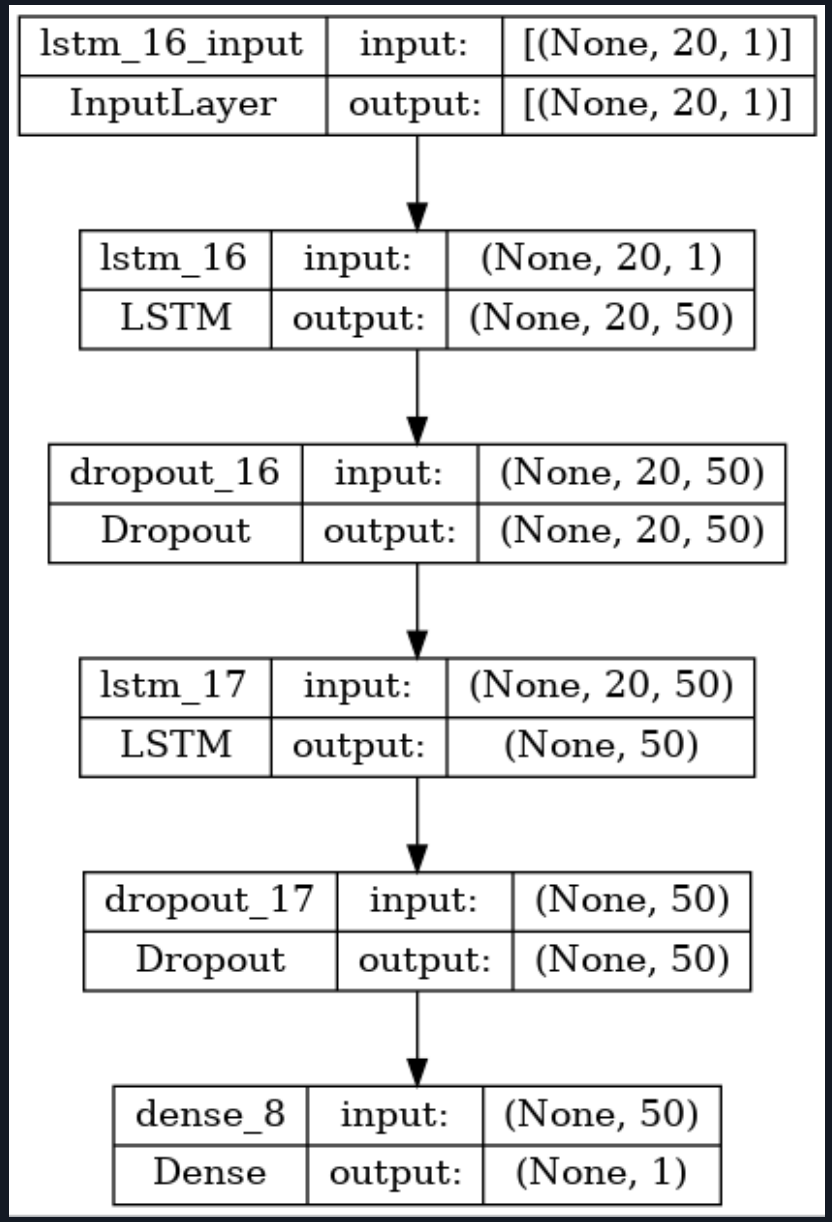
- Ranging from 1988-01-01 to 2023-10-30, split into:
  - 2 year training subsets
  - 1 year validation set
  - 1 year out-of-sample test set
- Frequency: daily
- Used adjusted close prices to calculate daily returns
- Data was min-max scaled

WALK-FORWARD APPROACH

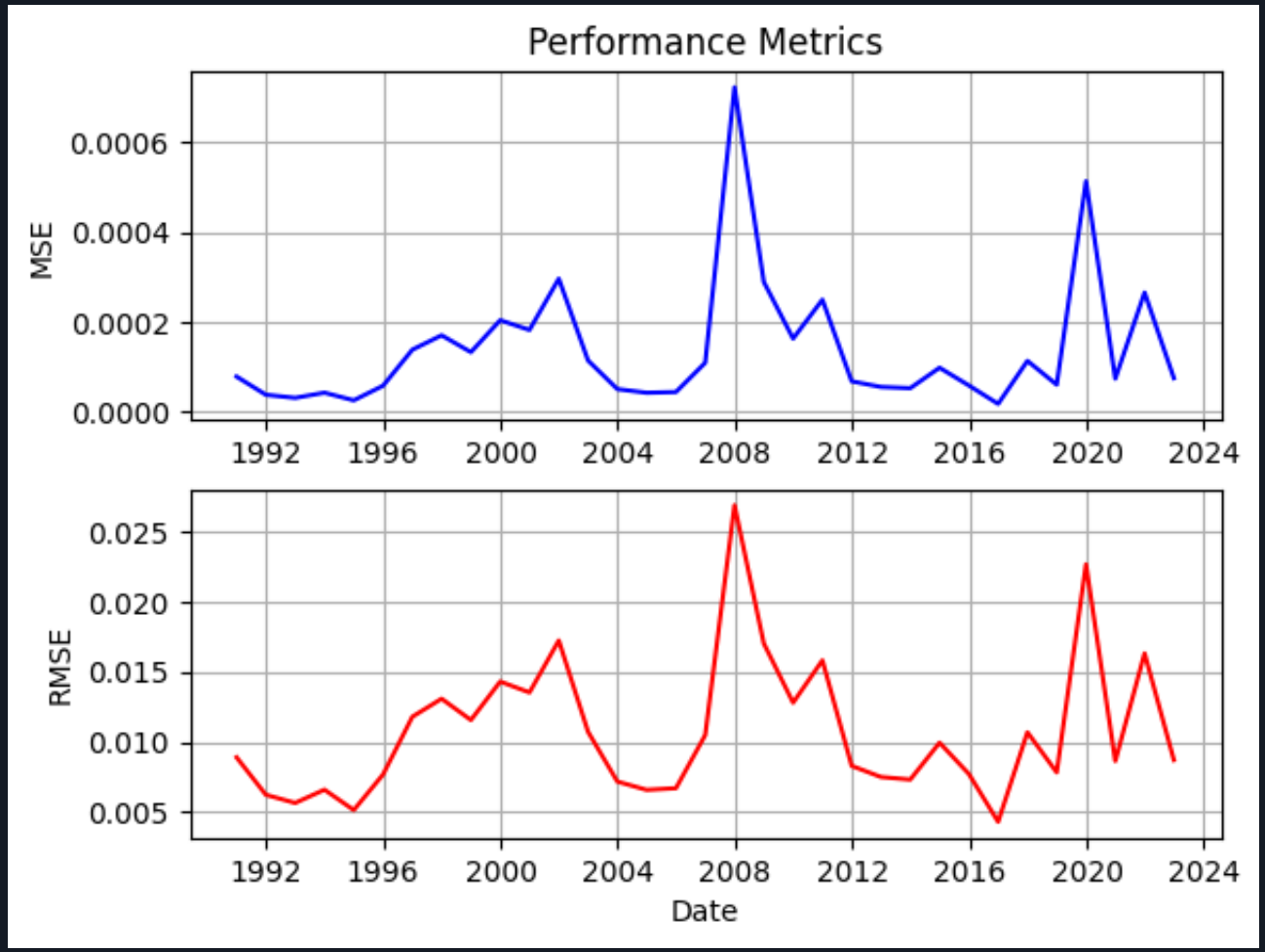
Source: Baranochnikov I. and Ślepaczuk R., 2022

MODEL SPECIFICATION

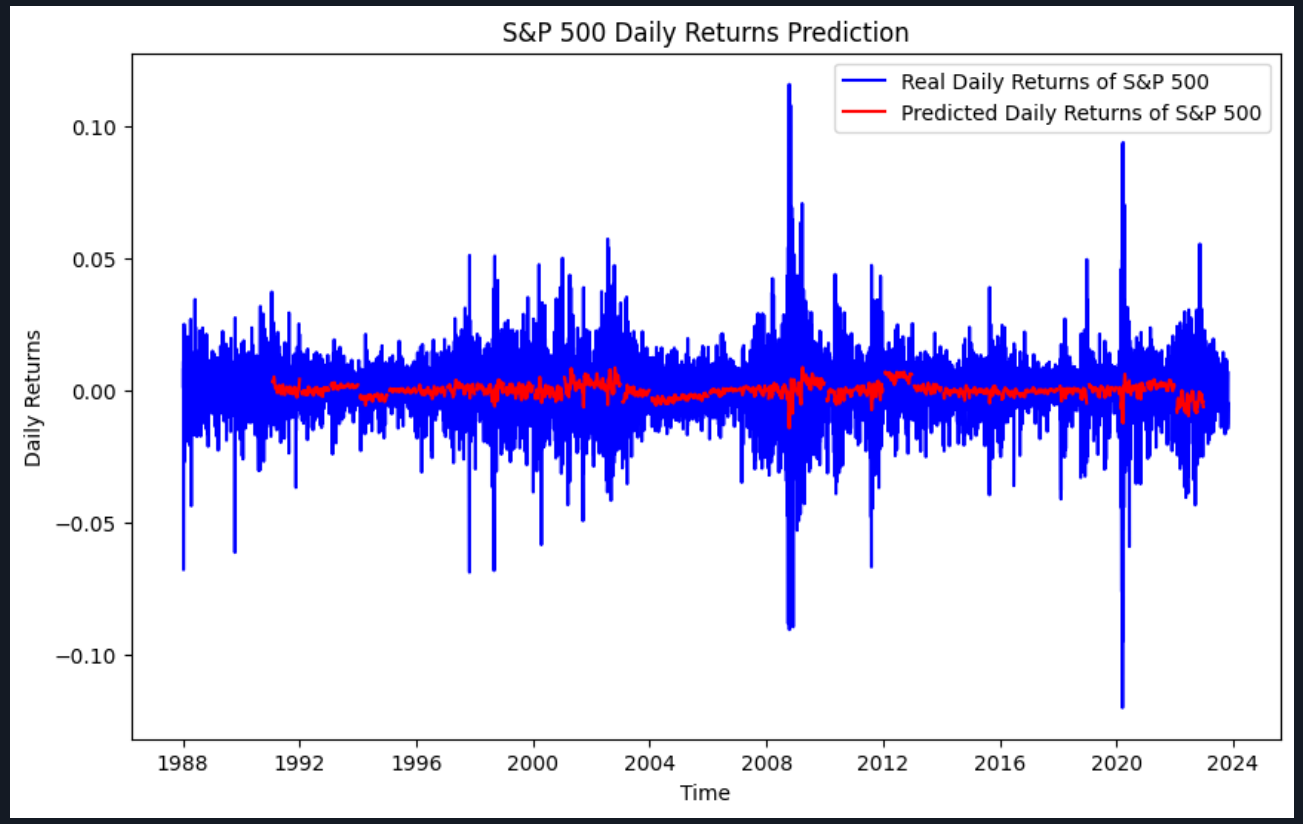
- Input: 20 previous daily returns (parametrized)
- Output: today's forecasted return
- Loss: MSE
- Optimizer: ADAM
- Learning rate: 0.001
- Dropout: 0.2
- Batch size: 32
- 10 epochs per timeframe



TRAINING RESULTS



TRAINING RESULTS

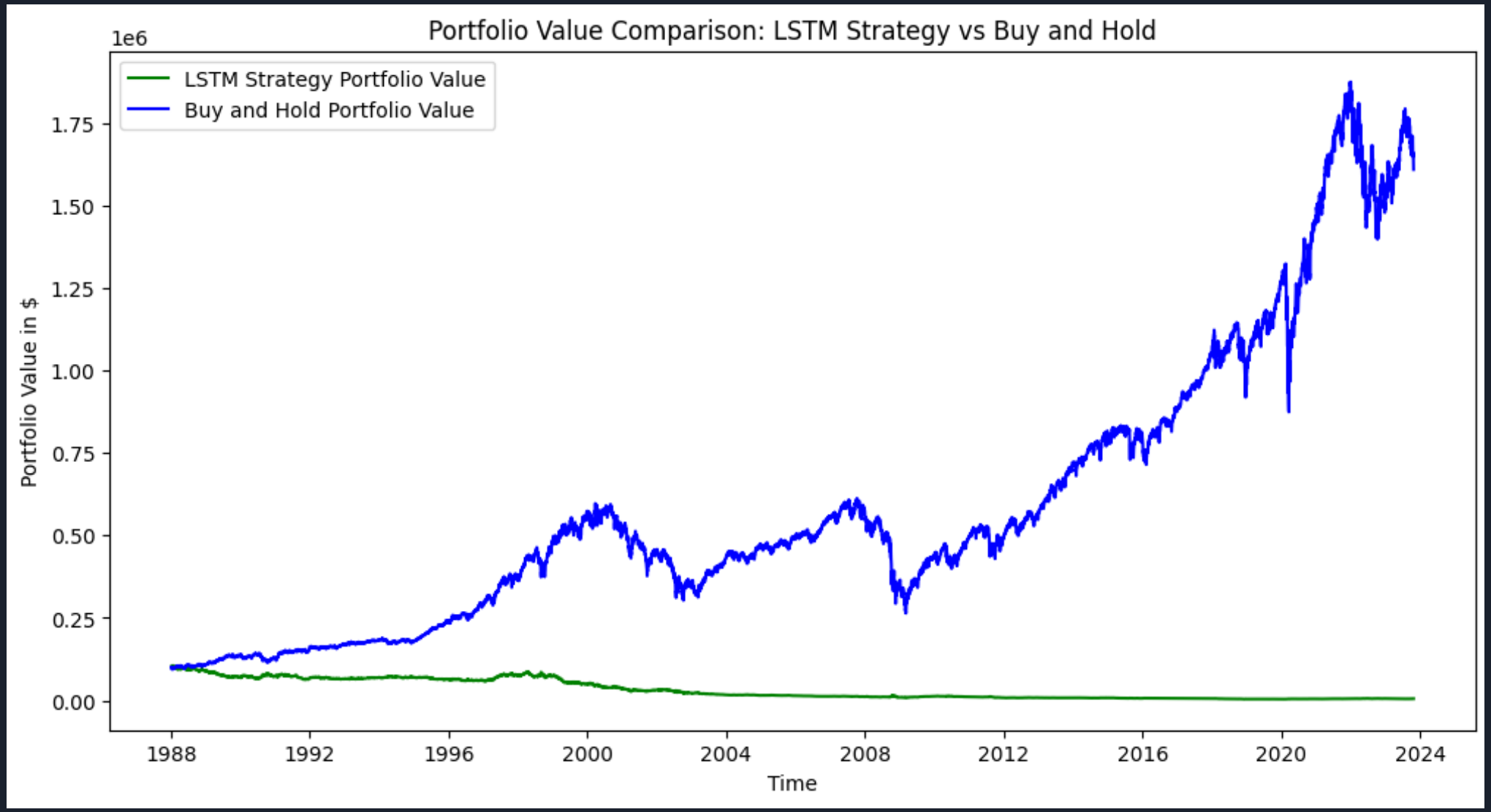


SIMULATION

Simulated the trading strategy based on the buy and sell signals with the following assumptions:

- Buy & Sell at close prices
- Transaction fees = 0.05%
- Starting capital = 100k USD
- Benchmark: Buy&Hold S&P500
- Strategy signal: If the forecasted return is positive, go long, short otherwise. Hold position until the signal reverses

SIMULATION RESULTS



SIMULATION RESULTS

	LSTM Strategy	Buy and Hold
Annualized Return Compounded	-0.077187	0.080342
Annualized Standard Dev.	0.180380	0.180306
Sharpe Ratio	-0.678495	0.194900
Information Ratio	-0.033729	N/A

CONCLUSIONS

- The model cannot outperform the benchmark in its current form
- Some improvements can be done:
  - *Add more features to the model*
  - *Hyperparameter tuining*
  - *Different approach: Combine LSTM with a conventional highly performant strategy, train toward a different objective (classification, strategy evaluation)*

SOURCES

Kryńska K., Ślepaczuk R., 2022, Daily and intraday application of various architectures of the LSTM model in algorithmic investment strategies on Bitcoin and the S&P 500 Index, Working Papers of Faculty of Economic Sciences, University of Warsaw, WP 25/2022 (401), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4628806

Baranochnikov I. Ślepaczuk R., 2022, A comparison of LSTM and GRU architectures with novel walk-forward approach to algorithmic investment strategy, Working Papers of Faculty of Economic Sciences, University of Warsaw, WP 21/2022 (397), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4628576