Machine Learning Models and Technical Analysis on SPY ETF

Evaluating models and temporal indicators on a high frequency price time series

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Project Objectives

There are many different models used to predict and trade assets, such as LSTM and sequential models. However, research is conflicted on which model outperforms others. Furthermore, more research is needed to investigate market indicators that incorporate time as a variables, such as 'speed of price change'.

The objectives of this project are twofold:

1) To compare the models LSTM, GRU, a combined LSTM+GRU model, ARIMA

2) To compare the temporal indicators 'speed of price change' and 'frequency of trading'

Comparison will take place across the metrics: Sharpe Ratio, PnL, RMSE, DirectionalAccuracy

Rankings for Models + Indicators across all 4 metrics:

Model/Count Per Rank	Ranking 1	Ranking 2	Ranking 3	Ranking 4
LSTM	1	1	2	0
GRU	0	1	1	2
LSTMGRU	2	1	1	0
ARIMAX	1	1	0	2

Feature-Combinations/ Count Per Rank	Ranking 1	Ranking 2	Ranking 3	Ranking 4
'speed'	1	0	0	3
'frequency'	0	2	1	1
'speed and frequency'	3	1	0	0
'none used'	0	1	3	0

Conclusion

The best performing model may be considered the LSTM+GRU combined model, which was the top performer in the Sharpe Ratio and PnL categories. It may also be considered that 'speed of price change' and 'frequency of trading' were effective when combined together in a feature set, as it performed the best in the Sharpe Ratio, PnL and RMSE categories. However, no model or feature set achieved top results in all categories, therefore we cannot conclusively define best performers.

Moreover, in order for this strategy to effectively trade at high frequency, significant improvements in infrastructure would be required.

Further research may also consider orderbook quotes and sentiment analysis as features.