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Forecasting the USD:GDP Exchange Rate and Developing a Trading Strategy

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Introduction

In 1986, the economist wrote an article to display purchasing power with a "lighthearted" guide to whether currencies are at their "correct" level. It compared the price of a Big Mac in each respective country
Exchange rates rely on concept of **purchasing power parity** - the notion that in the long run exchange rates should move towards the rate that would equalize the prices of an identical basket of goods and services (in this case, a burger) in any two countries (Economist).
Differences in local prices are one key factor in exchange rates, however they are far from the only one.

Recurrent neural networks are networks with loops built in them, creating persistence in memory. LSTMs are a branch of RNNs. They are comprised of input gate layers that move to different consecutive state cells. The output gate can be computed as such:

$$q_i^{(t)} = \sigma(b_i^o + \sum_j U_{i,j}^o x_j^{(t)} + \sum_j W_{i,j}^o h_j^{(t-1)})$$

Problem Statement

- Forecast the USD:GBP exchange rate on an adjustable time scale using a Recurrent Neural Network (Long Term Short Memory) with unique, tailored features
- Publish our methods with an accompanied trading strategy to quantify how much money could have been made if one traded dollar for pound, or vice versa, at any point in time
- Report our findings without paywalls: publicly and transparently

Current Literature

- Application of LSTM Neural Network in Forecasting Foreign Exchange Price To cite this article: Yaxin Qu and Xue Zhao 2019 J. Phys.: Conf. Ser. 1237 042036 https://www.fxstreet.com/rates-charts/forecast
- Nanayakkara, Sajeeka & Chandrasekara, Vasana & Jayasundara, D. (2014). Forecasting Exchange Rates using Time Series and Neural Network Approaches. European International Journal of Science and Technology.
- Tlegenova, Daniya. (2015). Forecasting Exchange Rates Using Time Series Analysis: The sample of the currency of Kazakhstan

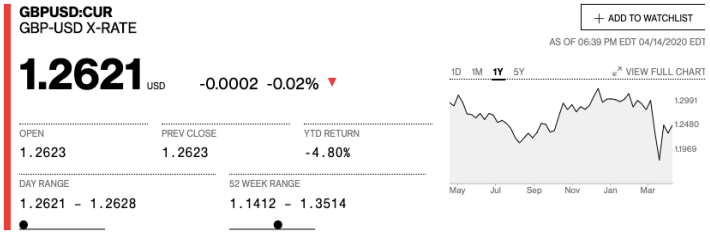
Approach

GBP/USD centered

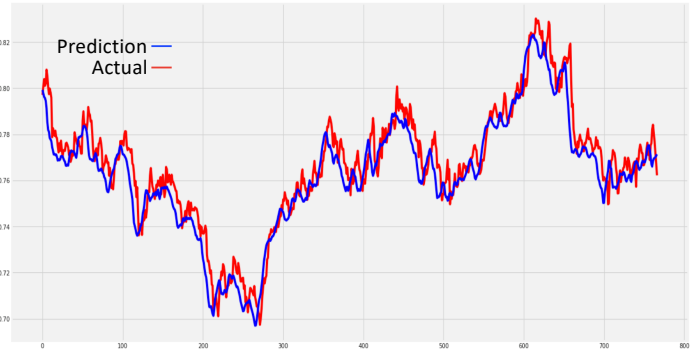
- Begin with Simple Recurrent Neural Network
- Move to Long Term Short Memory
- Hyperparameter and architecture optimization
  - [1 x 28] input array for 7 days of open, close, high, and low
  - 2 hidden layers each with 10 cells
  - Single dimension output (exchange rate)
- Test feature set accuracy (training and actual)
- Develop and test a short-term trading strategy as a measure of success
- Add explanation to results to develop a solid trading strategy
- Develop a website that updates automatically twice daily to display open and close rates
  - Deployed on Google Cloud
  - URL : cointoss.live

Process

- Pull live and historic exchange rate data from Bloomberg
- Train LSTM with historic data
- Predict movement of exchange rate for near future
- Based on prediction, create recommended trading strategy
- Incorporate trading fees, tell user to buy, sell, or hold their currency
- Output results to Google Cloud based website



Conclusions and Results



- Visible shift where the prediction begins predicting peaks and troughs before the actual exchange rate does
- To combat this, and optimize, we tested trading based on older data so to catch the changes with increased accuracy

Shift (days)	% Accuracy of Prediction
-5	98.706394%
-4	98.728627%
-3	98.74049%
-2	98.7495%
-1	98.752034%
0	98.744214%
1	98.67594%
2	98.61447%
3	98.549163%

- Our conclusion was that delaying the trade time by one day based on our forecasted data had the best results
- Additionally, we experimented with the frequency of trading
  - Instead of trading daily, what if one evaluated their position every other day, or once every three days, then traded based on the LSTM's forecast.

Trading Frequency (days)	Returns (3 years)
1	119.63%
2	127.70%
3	120.91%

Profitability Over 20 Years