



# EUR/USD Time Series Analysis

## Spencer Buckner



# Why?

- Gain better understanding of the EUR/USD currency
- Explore relationships between technical and fundamental data
- Goal is to predict next day close pricing of EUR/USD
- The more accurate our prediction, the better we can use future predictions to predict price movements



# Data Gathering

- 2 Schools of thought on data input
  - Technical Data
    - Kaggle Dataset
    - Wall Street Journal
  - Fundamental Data
    - Treasury.gov
    - Forexfactory.com

The background of the slide features a blurred image of a financial market data interface. It shows various data points, including 'GEPU\$D M15', '1.4506', '1.00', and '1.4508'. There are also indicators for 'Bid', 'Ask', 'Auto', and 'Sell'.

# Data Cleaning

- Due to the nature of financial data being relatively complete, there were very few null values
- Technical Data was resampled for business days only to line up with fundamental data
- Yield curve data regarding 2 mo and 30 yr were dropped due to high null values present
- Economic data (non treasury rates) were set to binary (1,0) and if they beat their expected forecast, it was marked 1.

The background of the slide features a blurred image of a financial market data screen. It shows various price feeds, including 'GBPUSD M15' with a value of '1.4506', and other indicators like 'Bid', 'Ask', 'Auto', and 'Sell'. The overall aesthetic is that of a professional trading environment.

# Technical & Fundamental Data Features

## Technical Data

- Bid Open
- Bid High
- Bid Low
- Bid Close

## Fundamental Data

- Daily Treasury Rates (1 mo, 3 mo, 6 mo, 1 yr, 2 yr, 3 yr, 5 yr, 7 yr, 10 yr, 20 yr)
- Federal Funds Rate - Interest rate at which depository institutions lend balances held at the Federal Reserve to other depository institutions overnight
- Main Refinancing Rate - Interest rate on the main refinancing operations that provide the bulk of liquidity to the banking system in Europe

The background of the slide features a blurred image of a financial market data screen. It shows various indicators such as 'M15', 'Bid', 'Ask', 'Auto', and 'Sell'. A specific data point 'GEPU50M15' is highlighted with a red box, showing values like '1.4503', '1.00', and '1.4500'.

## Fundamental Data contd.

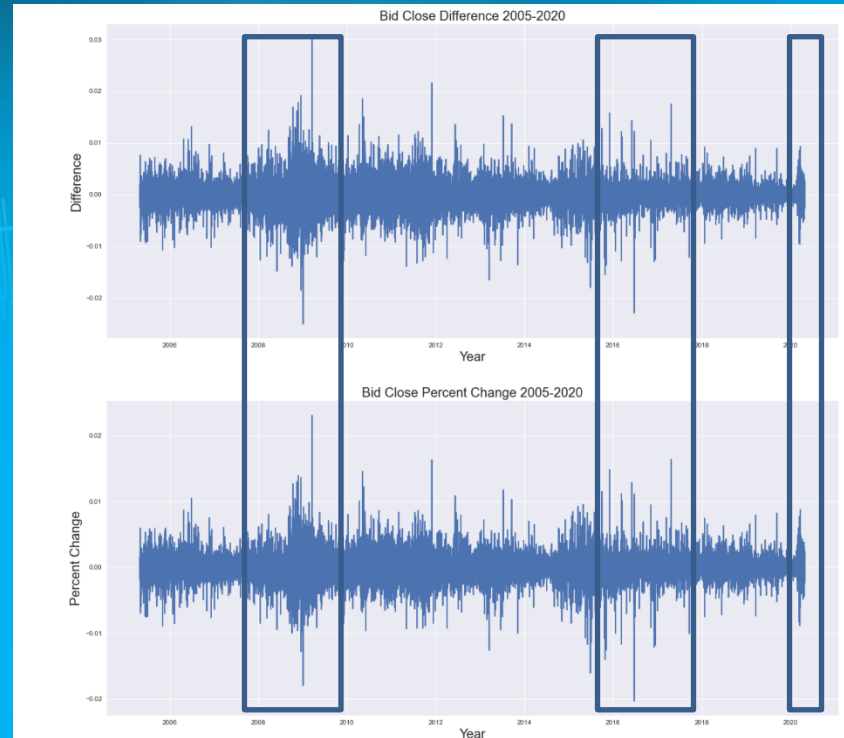
- Retail Sales - Change in the total value of sales at the retail level
- Core Retail Sales - Change in the total value of sales at the retail level, excluding automobiles
- PPI m/m - Change in the price of finished goods and services sold by producers
- Unemployment Rate - Percentage of the total work force that is unemployed and actively seeking employment during the previous month
- CPI m/m - Change in the price of goods and services purchased by consumers
- Core CPI m/m - Change in the price of goods and services purchased by consumers, excluding food and energy
- Prelim GDP q/q - Annualized change in the value of all goods and services produced by the economy

# Data Exploration





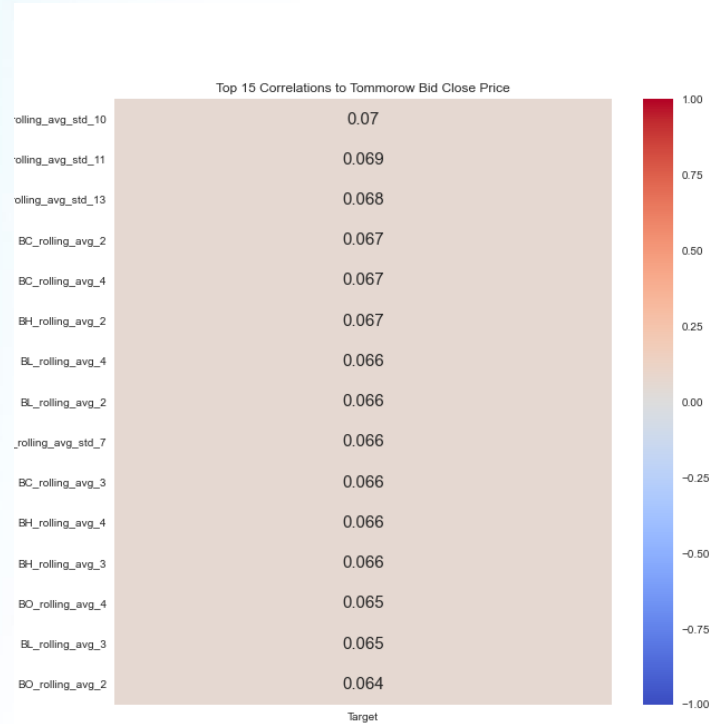
# Bid Close Diff and Percent Change 2005-2020





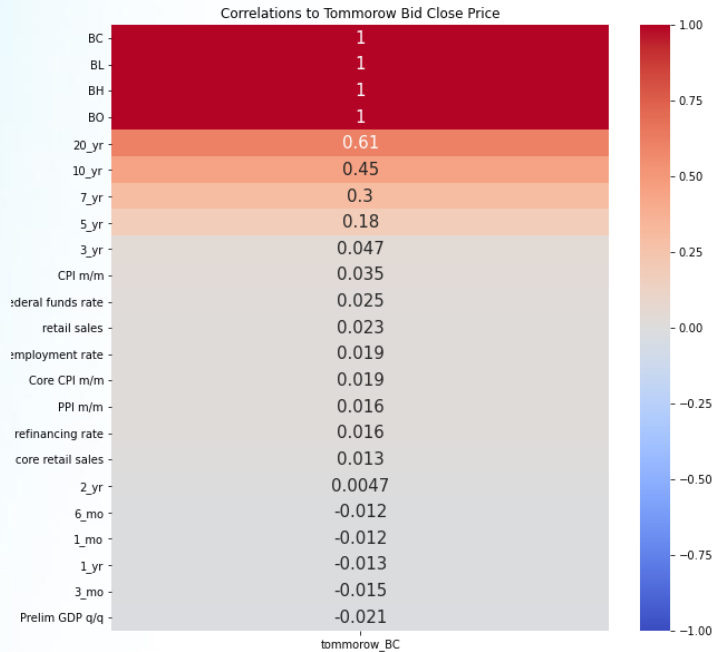


# Rolling Average/STD Correlation





# Rolling Average/STD Correlation





# Modeling

- LSTM Model (Long Short-Term Model)
  - Recurrent Neural Network Model
  - Uses a progression of gates each with its own RNN that will keep, forget, or ignore data points based on a probability model
  - Helps solve large problems simple RNN's face with gradient descent since RNN can keep, forget, or ignore values
  - Mean Absolute Percentage Error (MAPE) – metric used that tracks how far off the model prediction was from the actual value and returns the total mean value on all points



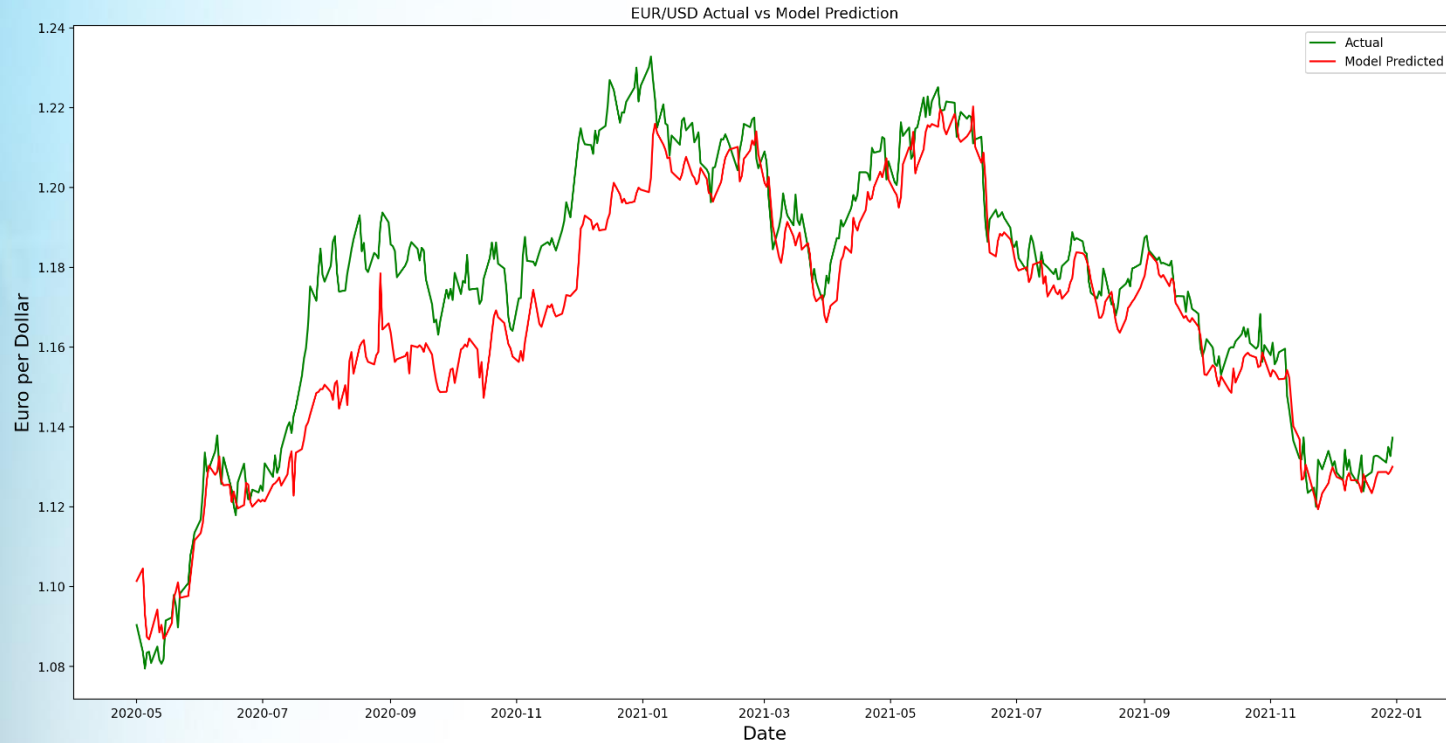
# Model Prediction vs Actual on Test Data



R2 Score = 0.99



# Model Prediction vs Actual on Future Data



R2 Score = 0.83



# Simple Trading Strategies

Simple Buy and Hold based on Model Prediction		
Timeframe	Method 1 Profit (Pips)	Method 2 Profit (Pips)
1/26/2018 - 4/28/2020	-839	-4
5/1/2020 - 12/30/2021	-331	743
Method 1: Buy/Sell and Hold until next day Bid Close		
Method 2: Buy/Sell and Hold until next day Bid Close, Risk to Reward of 1:2		



# Conclusion

Yield curve rates for higher time frame periods all produced higher correlations than their respective short term counter parts. As further models are created, this will be an interesting feature to expand upon. Other economic indicators represented as binary inputs did not seem to add anything to predicting next day bid close.

As trends continued, the model was able to stay within a relative range in the same direction as the next day bid close. Due to the model not being able to predict inflection points well, the strategy employed above of buy/sell and holding had several days of losses around these points, but still was able to produce a profit when implementing a risk to reward ratio.