WALL STREET

Data Driven

Trend Following

Introduction and Objective

Introduction and objectives

- Who am I
  - ✓ Freelance writer
- Organization / Department
  - ✓ Financial Blog / Education
- Target Audience
  - ✓ Anyone looking to invest their money without having to look at the financial markets 24/7.
- Business case
  - ✓ Find a simplistic trend following model.
- How will your prediction work help
  - ✓ Systematic buy/sell signal, no emotions involved.
  - ✓ Better returns for your money than your saving account.

Objectives

Optimize the 50/200 crossover strategy

Objectives

Date	Close Price	50_SMA	200_SMA	Signal	Position
2012-03-15 00:00:00	1402.6	1337.78	1336.59	1	Buy
2012-06-14 00:00:00	1329.1	1349.57	1350.31	0	Sell
2012-08-14 00:00:00	1403.93	1354.76	1353.56	1	Buy
2015-08-28 00:00:00	1988.87	2074.53	2075.41	0	Sell
2015-12-21 00:00:00	2021.15	2061.51	2061.41	1	Buy
2016-01-11 00:00:00	1923.67	2055.59	2057.64	0	Sell
2016-04-25 00:00:00	2087.79	2017.85	2014.85	1	Buy
2018-12-07 00:00:00	2633.08	2758.02	2761.71	0	Sell
2019-04-01 00:00:00	2867.19	2760.23	2756.75	1	Buy
2020-03-30 00:00:00	2626.65	3018.65	3028.23	0	Sell
2020-07-09 00:00:00	3152.05	3028.79	3026.08	1	Buy

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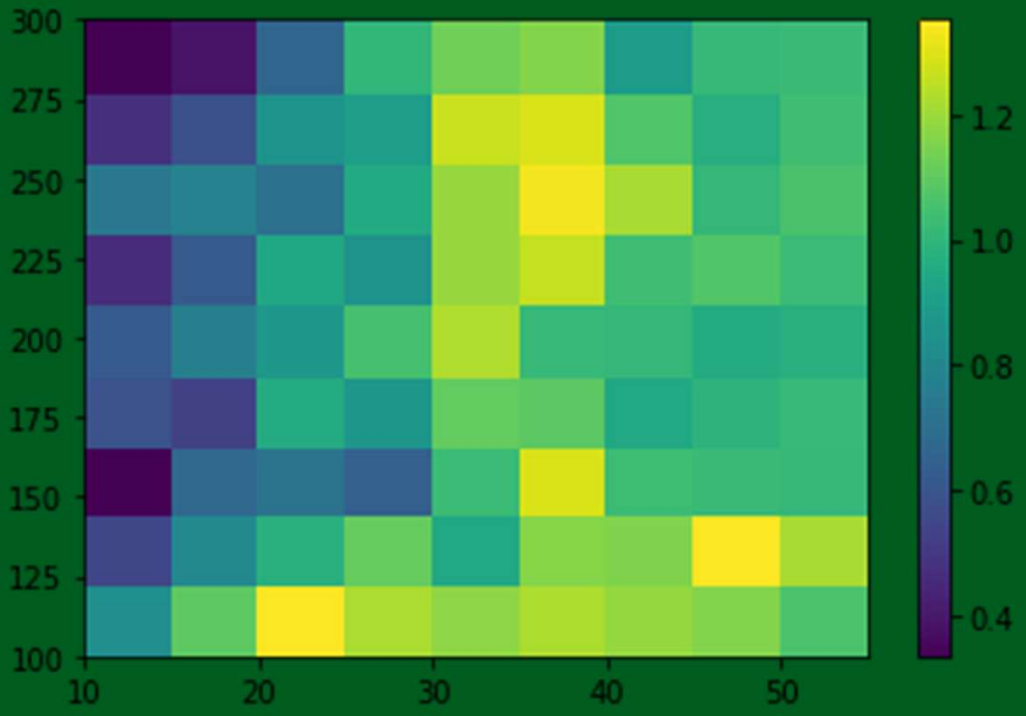
Profit = $1734.25

Methodology / Process workflow

- ✓ Read in data from Yahoo Finance for the S&P500 using an API. *(Application Programming Interface)*
- ✓ Create a column with the moving average spread differential.
- ✓ Set desired number of points as threshold for spread difference.
- ✓ Create columns containing daily market (and daily strategy) log returns.
- ✓ Set strategy equity to 1 (i.e. 100%) and generate equity curve.
- ✓ Create loop to test multiple Moving Average Crossover combinations within a given range.
- ✓ Show the results.

Finding the best Moving Average Crossover combination



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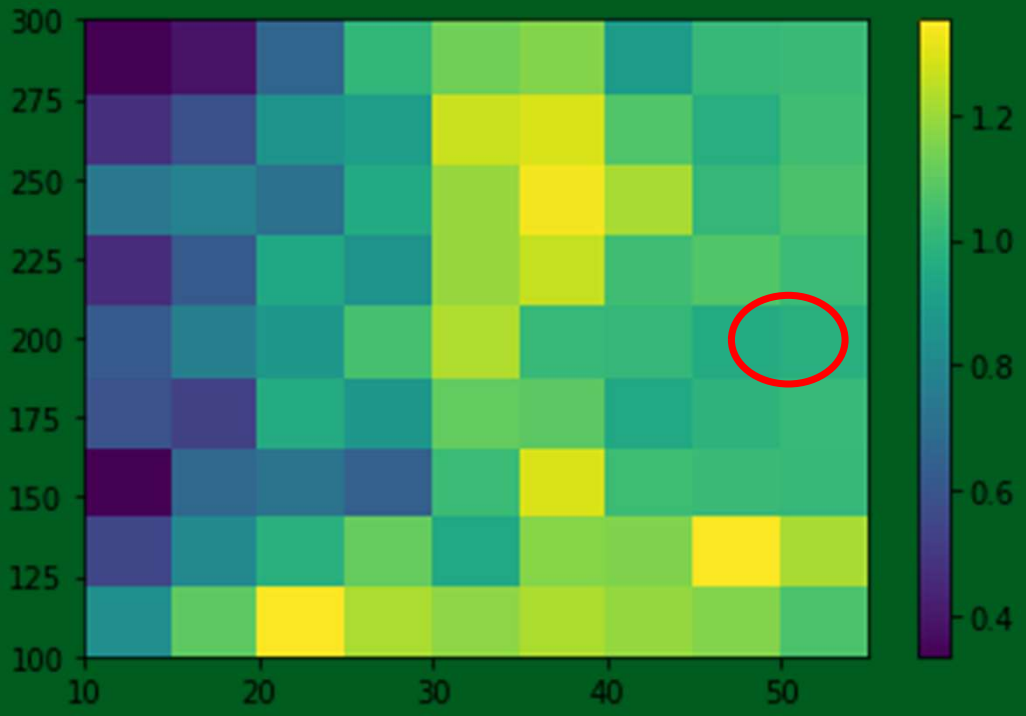
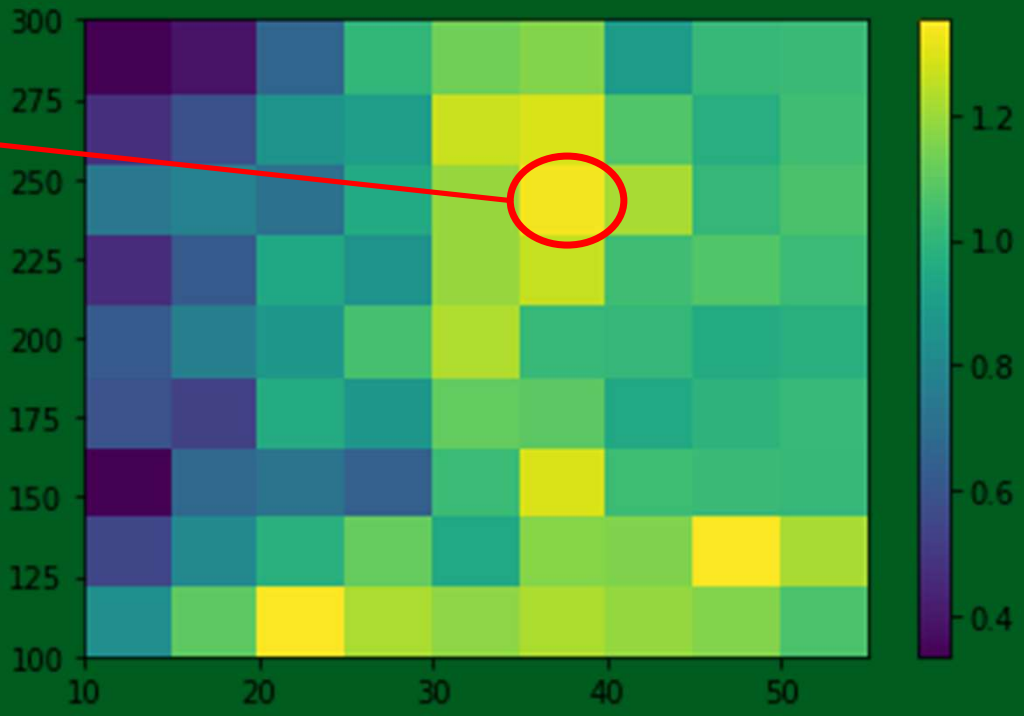


Finding the best Moving Average Crossover combination

STMA - **38**
LTMA - **245**



Simple Moving Average Crossover Strategy

Crossover Strategy in numbers

Date	Close Price	38_SMA	245_SMA	Signal	Position
2012-02-28 00:00:00	1372.18	1326.8	1325.53	1	Buy
2012-06-05 00:00:00	1285.5	1351.04	1352.36	0	Sell
2012-08-03 00:00:00	1390.99	1351.93	1351.28	1	Buy
2015-09-04 00:00:00	1921.22	2051.47	2054.85	0	Sell
2015-11-30 00:00:00	2080.41	2060.95	2060.94	1	Buy
2016-01-04 00:00:00	2012.66	2060.51	2061.78	0	Sell
2016-04-19 00:00:00	2100.8	2031.58	2030.64	1	Buy
2018-11-26 00:00:00	2673.45	2749.52	2754.99	0	Sell
2019-03-14 00:00:00	2808.48	2739.6	2737.16	1	Buy
2020-03-25 00:00:00	2475.56	2985.9	3003.18	0	Sell
2020-06-23 00:00:00	3131.29	3008.17	3006.24	1	Buy

50/200 SMAs vs 38/245 SMAs

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50/200 SMAs vs 38/245 SMAs

50/200 = $1734.25

38/245 = $1651.83

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ARIMA

ARIMA is an acronym that stands for AutoRegressive Integrated *Moving Average*.
A model that uses the dependent relationship between an observation and some number of *lagged observations*.

An **ARIMA model** is a class of statistical **model** for analyzing and **forecasting** time series data.

An autoregressive integrated moving average, or ARIMA, is a statistical analysis model that uses time series data to either better understand the data set or to **predict future trends**.

ARIMA uses several lagged observations of time series to forecast observations.
A weight is applied to each of the past term and the weights can vary based on how recent they are.
AR(x) means x lagged error terms are going to be used in the ARIMA model.

Methodology

Methodology

- Datasets
  - ✓ Yahoo Finance API
- Model
  - ✓ Time-Series Forecasting
- Metrics
  - ✓ Root Mean Squared Error on 2 different underlying

- Tools
  - ✓ Math (sqrt)
  - ✓ Matplotlib (pyplot)
  - ✓ Pandas (DataFrame, datetime)
  - ✓ Sklearn (metrics)
  - ✓ Statsmodels (ARIMA)
  - ✓ yfinance

Process Workflow

Process Workflow

- EDA / Data preparation / Data analysis
  - ✓ Retrieve date and closing price only
  - ✓ Price chart visualization
  - ✓ Add a moving average as test
- ML model training / evaluation
  - ✓ 2/3 training, 1/3 testing
  - ✓ RMSE
  - ✓ Test vs Prediction chart

Results

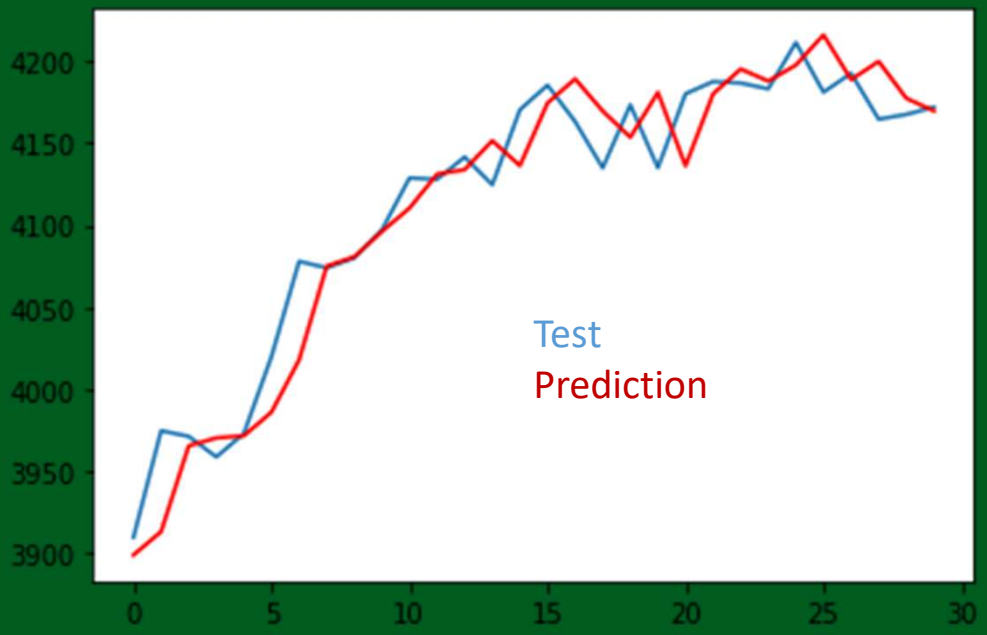
Results

- S&P500 (^GSPC)
  - ✓ RMSE = 26.155
  - ✓ ARIMA (p, d, q) = 4, 2, 1
- Microsoft (MSFT)
  - ✓ RMSE = 3.099
  - ✓ ARIMA = 6, 2, 2

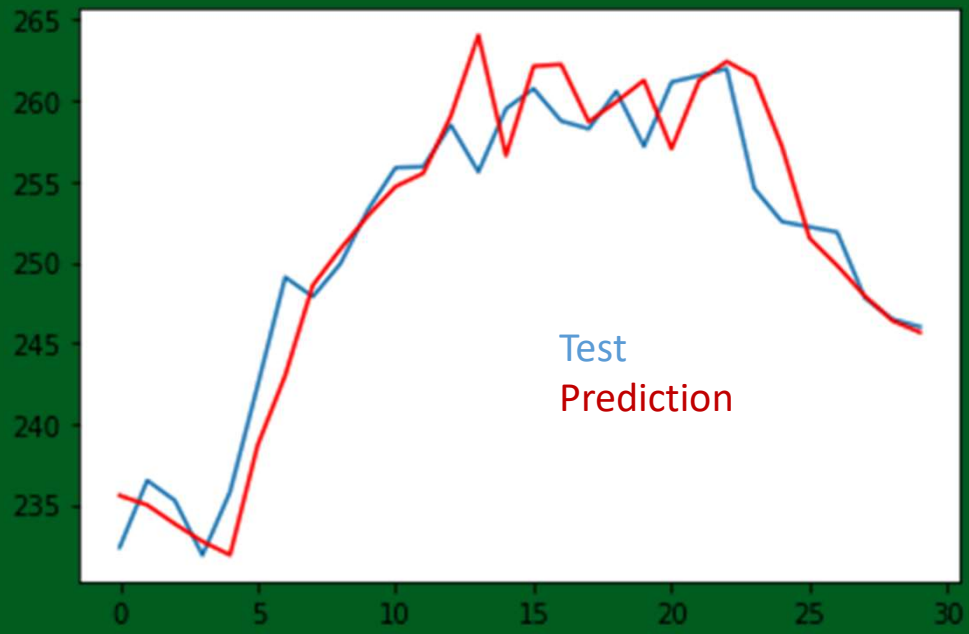
- **p**: The number of lag observations included in the model, also called the lag order.
  The order of the auto-regressive part.
- **d**: The number of times that the raw observations are differenced, also called the degree of differencing.
  The number of differentiation steps.
- **q**: The size of the moving average window, also called the order of moving average.
  The order of the moving average part

Results

- S&P500 (^GSPC)



- Microsoft (MSFT)



Conclusions

Conclusions

- Even-though MSFT has a lower RMSE, the model worked better on S&P500.
  - ✓ RMSE 26.155 on 4100 vs. 3.099 on 260.

- Continue to pursue the ARIMA model instead of the Moving Average Crossover strategy.
  - ✓ Forecasting time-series data vs. lagging indicator on time-series data.

Future Opportunities

Future Opportunities

- Test various underlying with the ARIMA Model and compare the outcomes
  - ✓ Stocks (old economy vs new economy)
  - ✓ Sectors (Consumer Defensive vs. Technology)
  - ✓ Cryptos / Commodities / Foreign Exchange
- Evaluate the Model not only with RMSE but also with other metrics.
- Create a Buy/Sell signal.

Q & A