



# COMPUTATIONAL APPROACHES TO FINANCIAL DATA ANALYSIS

Christian Ivery, Subas Subedi, Malik Warren and Eric Sakk

Department of Computer Science, Morgan State University, Baltimore, MD 21251

## Introduction

Financial markets have traditionally been managed by human beings and their collective contributions. Given the overwhelming volume of transactions in today's markets, computer algorithms now handle the bulk of order flows. This paradigm shift in how transactions are managed directly implies that trading and investing techniques have the potential to benefit from objective algorithms [1], [2].

Within the trading community, outstanding questions continue to remain as to which types of moving averages and technical indicators lead to optimal trading strategies [3]. Our goal is to compare sets of trend-based algorithmic trading strategies by applying computational rules to historical stock market price data.

In this work, price trend is characterized using various sets of moving averages. The study begins by comparing the profitability of Simple Moving Average (SMA) crossover strategies against Exponential Moving Average (EMA) crossover strategies using only long market entries. Next, the Relative Strength indicator is introduced in order to investigate whether improvements can be realized. Lastly, the overall strategy is modified to include both long and short entries. For each set of tests, parameter optimization is achieved numerically by exhaustively comparing all possible combinations of indicator parameters. When the results are correlated with the original time series data, as expected, it is determined that optimal combinations of indicators occur during intervals where a well-defined trend is established. However, the size of those intervals vary as function of the stock behavior.

## Methods

- PyAlgoTrade is a algorithmic trading library that focuses on back testing data from Yahoo finance, and converts online trading data into CSV files to be manipulated and analyzed.
- Pandas Library provided us with a method to perform data visualization and analysis.
- Yahoo finance: Provides us the stock data and financial reports.
- Anaconda IDE: a scientific python distribution used for python programming, data science and machine learning.
- Matplotlib: A Python 2D plotting library which produces publication quality figures in a variety of hard copy formats and interactive environments across platforms.
- Relative strength index (RSI) is a momentum indicator that measures the magnitude of recent price changes to evaluate overbought or oversold conditions in the price of a stock or other asset.
- Simple Moving Average (SMA) : A simple moving average (SMA) is an arithmetic moving average calculated by adding recent closing prices and then dividing that by the number of time periods in the calculation average.

The Formula For SMA Is

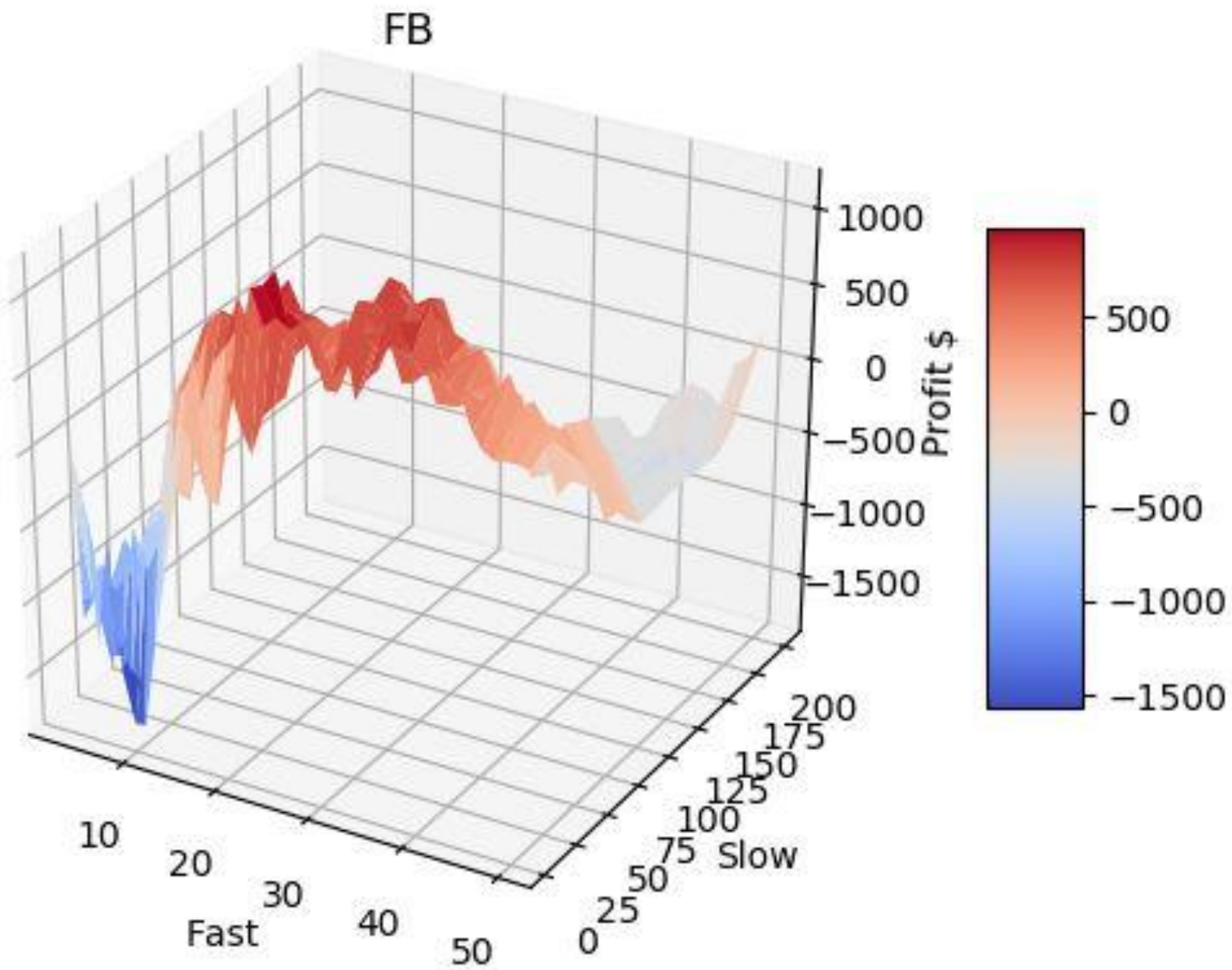
$$SMA = \frac{A_1 + A_2 + \dots + A_n}{n}$$

where:

$A_n$  = the price of an asset at period  $n$   
 $n$  = the number of total periods

- Exponential Moving Average(EMA): An exponential moving average (EMA) is a type of moving average (MA) that places a greater weight and significance on the most recent data points.

## Results



This is the 3D illustration of multiple sets of SMAs (Simple Moving Average) with respect to profitability of the FB (Facebook ,Inc.) using crossover strategy.

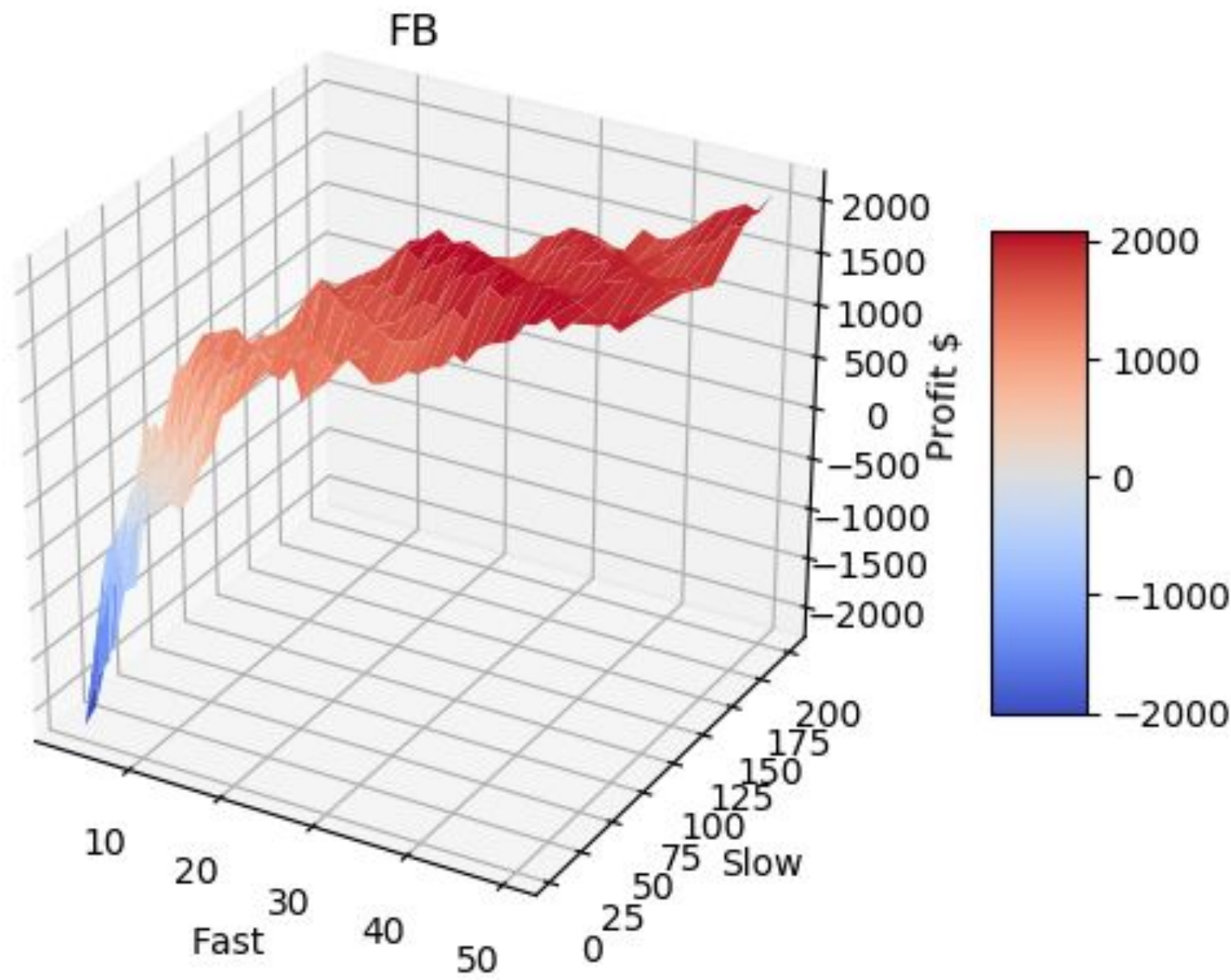
SMA vs EMA						
Ticker	SMA with Max Profit		Max Profit Amount	EMA with Max Profit		More Profitable?
	Slow MA	Fast MA		Slow MA	Fast MA	
GOGL(Google)	168	42	\$41.36	168	42	EMA
AAPL(Apple)	12	5	\$2,193.46	135	45	\$1,691.55 SMA
TSLA(Tesla)	9	6	\$3,540.80	6	4	\$866.20 SMA
SBUX(Starbucks)	39	26	\$258.62	19	13	\$37.41 SMA
NXPI(NXP Semiconduct)	15	10	\$661.62	82	33	\$617.95 SMA
FB(Facebook)	36	24	\$2,501.70	80	40	\$2,209.70 SMA
JNJ(Johnson & Johnson)	64	43	\$424.66	44	11	\$544.46 EMA
NVDA(Nvidia)	27	18	\$3,867.12	55	37	\$3,986.87 EMA
PYPL(Paypal)	200	50	\$953.70	88	44	\$867.90 SMA
INTC(Intel)	66	44	\$414.70	86	43	\$282.68 SMA

When Comparing the SMA and the EMA our Hypothesis was that the EMA would be more profitable because EMA uses the most recent Data however after testing our theory we were proven incorrect; the SMA was in fact more profitable

SMA with RSI												
Ticker	RSI + SMA (Long)					RSI + SMA (Long/Short)					Profit	
	Fast Period	Slow Period	RSI Period	Oversold Threshold	Profit	Fast Period	Slow Period	RSI Period	Overbought Threshold	Oversold Threshold		
GOGL	10	50	5	30	\$84.14	20	50	2	70	30	\$115.03	
AAPL	40	100	5	20	\$1,635.07	40	100	5	90	20	\$1,635.07	
TSLA	40	50	14	50	\$3,406.60	40	50	3	80	10	\$2,930.00	
SBUX	20	100	2	10	\$324.16	20	100	2	90	10	\$341.79	
NXPI	20	80	3	30	\$597.28	30	100	7	70	20	\$1,037.53	
FB	10	80	2	20	\$2,642.00	10	80	2	90	20	\$2,743.80	
JNJ	40	50	3	10	\$479.49	40	50	3	90	10	\$400.15	
NVDA	10	50	10	50	\$3,738.40	10	150	3	70	20	\$4,737.03	
PYPL	20	200	10	40	\$1,297.00	40	200	5	70	20	\$1,327.80	
INTC	20	50	7	40	\$569.83	30	80	3	70	20	\$574.19	

In this chart we compare the effects of the RSI on the profitability of the SMA when comparing it to a “going long” strategy versus a “going long and short” strategy.

## Results(cont.)



This is the 3D illustration of multiple sets of EMAs (Exponential Moving Average) with respect to profitability of the FB (Facebook ,Inc.) using crossover strategy.

EMA with RSI												
Ticker	RSI + EMA (Long)					RSI + EMA (Long/Short)					Profit	
	Fast Period	Slow Period	RSI Period	Oversold Threshold	Profit	Fast Period	Slow Period	RSI Period	Overbought Threshold	Oversold Threshold		
GOGL	40	170	2	30	\$87.63	40	170	2	80	30	\$142.50	
AAPL	10	170	14	30	\$1,725.96	10	170	3	70	10	\$1,747.82	
TSLA	5	80	3	10	\$2,263.20	5	80	5	90	20	\$2,186.00	
SBUX	40	60	2	10	\$326.80	10	50	3	80	30	\$273.08	
NXPI	30	80	3	30	\$817.99	30	80	3	90	30	\$1,287.39	
FB	20	50	2	20	\$2,552.20	10	60	2	90	20	\$2,836.80	
JNJ	20	60	2	30	\$332.18	30	50	2	90	30	\$284.86	
NVDA	20	80	3	30	\$4,010.19	20	80	3	70	30	\$5,226.96	
PYPL	20	170	7	30	\$1,265.60	10	200	3	70	20	\$1,272.60	
INTC	40	50	2	20	\$455.86	20	60	2	90	20	\$399.30	

In this chart, we compare the combined effect of RSI and EMA on profitability while ‘going long’ and ‘going short and long’ strategies.



In the early stages of this project we worked on the concept of the impact of different SMA's and their effectiveness to find profit of different stocks

## Conclusion

In Conclusion , through a variety of testing .we have found the following Bullet Points to be Correct:

- Even though the EMA(Exponential Moving Average) provides us the latest information about any stock, trading based on SMA (Simple Moving Average) found to be more profitable in case of most companies.
- While comparing the profitability of SMA and SMA combined with RSI, we found that there was no uniformity on the pattern.
- Besides, while comparing the profitability of SMA combined with RSI on long strategy vs on short/long strategy, trading with combined SMA and RSI with short/long strategy found to be more profitable.
- While looking on profitability of the EMA combined with the RSI It is clearly shown that the RSI does not affect the long strategy however when the RSI is incorporated into the EMA Long/Short strategy it does in fact yield profits 70% of the time
- The Stock Market Price isn't a sole Indicator on how Strong a Company truly is
- When focusing solely on the SMA after backtesting optimal SMA data point it is proven that the SMA Directly Correlates to possible profits being made
- Any company is susceptible to a bad day on the stock market. whether it be a rival company achievement or an internal company causing
- An Earning Report of a Company can drastically affect its value in the stock market ,unintentionally this can also cause the prices of other companies to fluctuate
- On this Project we are not looking for certain universal magic numbers that yield huge profit but we are looking for a set of technical indicators combined with a computational algorithms that can yield high average profit most of the time.

## References

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- [3] Levine, A. and Pedersen, L.H., Which Trend Is Your Friend?, Financial Analysts Journal, 72(3), p51-66, 2016.

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