

# Indian Equity Short Term Trading Model

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## **Abstract**

*The **Indian Equity Market** is a mature market with most of regulation and practices in place. The leading exchange in India is NSE and index is NIFTY50. A selection of NIFTY50 stocks has been taken as our universe to ensure sufficient liquidity in order to build a practical short-term trading model. The aim of the paper is to investigate different aspects of building **Short term trading models** like **data collection, framework for back testing, strategy selection** and **capital allocation**. The final goal is to present a **trading portfolio** which will demonstrate a combination of trend following and mean reverting strategies so that combined equity curve has less draw down and high returns. The study can be repurposed and re used in any Equity market which has enough trade data and liquidity.*

## Background and Motivation:

Prediction of future stock prices is a widely intriguing subject in many fields like computer science, trading, finance, statistics to name a few. Chief motivator for which is to predict the direction of future prices such that profit can be made from purchase and sale of equities. Traders typically use fundamental and technical analysis to analyse equities to arrive at trading Strategies. Fundamental analysis is the traditional approach involves a study of company fundamentals such as revenues and expenses, market position, annual growth rates, and so on.

Technical analysis, is study based on the data demonstrating historical price fluctuations. Practitioners of technical analysis study price charts for price patterns and use price data in different calculations to forecast future price movements. There is a correlation between price and company which should be selected and data helps in determine time to enter and exit the market.

For finance and computer science, most traditional models of stock price prediction use statistical models and neural network models derived from price data. Trending strategy in computer science seems to be using evolutionary algorithms or machine learning neural networks.

## Impetus and Scope:

The attempt is to present a **trading portfolio** which will be combination of bunch of independent and low correlation strategies to present a combination of trend following and mean reverting strategies so that combined equity curve has high sharpe ratio and least drawdown. This model could be a decision support tool to a trader or can be extended for robot trader with an interface to stock exchanges. The first step is to procure historical data, filter it, have a chronology on top of it, adjustment to events like corporate actions and resample it. Next is to have a robust backtesting strategy having rich multi stock and multi processing capability. We have after considering several open source packages arrived at back trader.

## Methodology:

In order to achieve the stated objective of practical track of building short term trading models following methodology has been followed-

**Data collection:** The first step to most financial analysis is to have data to analyse. We came up with a process to build time/volume/tick/dollar bars from raw data. A comparison was done on the data parameters to come up with best suited data format for short term trading models.

**Logic and Strategy:** We identified short term trends and patterns through combination of technical indicators and candlestick patterns and test it on training data. The next step was to build a back testing framework. It involved feeding the data collected as the input to arrive at the trade sheet as a result.

**Validation of testing strategies and statistics:** We checked the equity curve, drawdowns, sharpe ratio, SQN and other performance parameters if a strategy is worth trading. A comparison of different input was done by running multiple simulation.

## Data Preparation:

We have procured data from vendor for NSE stock. NSE is the leading stock exchange operating in India. We have in scope 49 stocks and data scope is from 1<sup>st</sup> August 2017 to 30<sup>th</sup> April 2020. Although our focus in this document is on stocks listed on the National Stock Exchange, the developed model can just as easily be used for any other stock exchange where a sufficient amount of daily historical prices are available.

- 1) The data of NSE stock for the period 1<sup>st</sup> August 2017 to 30<sup>th</sup> April 2020 was procured from data vendor.
- 2) Data filtering: Each stock has futures available for current month, next month and next to next to next month, for example on a particular day of July there will be three futures contracts available for trading as follows:
  - a) July future expiring on last Thursday of July,
  - b) August future expiring on last Thursday of August,
  - c) September future expiring on last Thursday of September,The data provided was filtered to include only current month expiry (next 2 month contracts were removed), so that, a continuous data series can be formed.
- 3) The data was adjusted for corporate actions.
- 4) Then each stock data is resampled to 15 min, to form 15 min Open High Low Close (OHLC) candles.

## Moving Average

Moving average[8] is a simple, technical analysis tool. Moving average statistically is a calculation used to analyse data points by creating a series of averages of different subsets of the full data set. The impacts of random, short-term fluctuations on the price of a stock over a specified time-frame are mitigated by calculating the moving average. Moving averages are usually calculated to identify the trend direction of a stock or to determine its support and resistance levels. It is a trend-following—or lagging—indicator because it is based on past prices. The longer the time period for the moving average, the greater the lag. A 100-day moving average will have a much greater degree of lag than a 10-day moving average because it contains prices for the past 100 days. Moving averages are a totally customisable indicator, which means that a trader can freely choose whatever time frame they want when calculating an average. The shorter the time span used to create the average, the more sensitive it will be to price changes. The longer the time span, the less sensitive the average will be.

Moving averages are pervasive in technical stock market analysis because they are able to smooth price data, form trend-lines, and create an easily interpreted visual aid. Developed as a statistical tool for use in conjunction with data sets that span a specific period of time, moving averages have proven to be well-suited for price charts and other indicators.

Simple moving averages (SMAs) are calculated by the sum of data points in a time interval divided by the number of time periods therein. For example, a standard 10-day moving average on a candle stick chart takes the value of each closing price, adds them together, then divides the resulting figure by 10. The length of the interval and data points chosen are left up to the individual trader, making moving averages highly pliable.

The exponential moving average (EMA) uses the same principles as the SMA, except it applies more weight to the most recent price bars. By emphasising recent action, EMAs reduce lag in the time data and avoid distortions from information that may no longer be relevant.

## **Types of Moving Averages**

### **Simple Moving Average**

The simplest form of a moving average, known as a simple moving average (SMA), is calculated by taking the arithmetic mean of a given set of values. In other words, a set of numbers—or prices in the case of financial instruments—are added together and then divided by the number of prices in the set. The formula for calculating the simple moving average of a security is as follows:

$$SMA = (A1 + A2 + \dots + An)/n$$

### **Exponential Moving Average (EMA)**

The exponential moving average is a type of moving average that gives more weight to recent prices in an attempt to make it more responsive to new information. To calculate an EMA, you must first compute the simple moving average (SMA) over a particular time period. We must calculate the multiplier next for weighting the EMA (referred to as the "smoothing factor"), which typically follows the formula:  $[2 \div (\text{selected time period} + 1)]$ . So, for a 20-day moving average, the multiplier would be  $[2/(20+1)] = 0.0952$ . Then you use the smoothing factor combined with the previous EMA to arrive at the current value. The EMA thus gives a higher weighting to recent prices, while the SMA assigns equal weighting to all values.

## **Strategy**

We call a plan that includes trading signals for prompting trades, a rule for deciding how much of the portfolio to risk on any particular strategy, and a complete exit strategy for any trade an overall trading strategy[13]. Our concern now is to design and evaluate trading strategies.

We suppose that the amount of money in the portfolio involved in any particular trade is a fixed proportion; 10% seems like a good number. Now we need a means for deciding when to enter position and when to exit for a profit.

We plan to use a moving average crossover strategy. We will use two moving averages, one we consider "fast", and the other "slow".

The strategy is:

- Trade the asset when the fast moving average crosses over the slow moving average.
- Exit the trade when the fast moving average crosses over the slow moving average again.
- A long trade will be prompted when the fast moving average crosses from below to above the slow moving average, and the trade will be exited when the fast moving average crosses below the slow moving average later.

- A short trade will be prompted when the fast moving average crosses below the slow moving average, and the trade will be exited when the fast moving average later crosses above the slow moving average.

We were able to execute and evolve different methodology. The ones which are presented in this report are-

- Stochastic reversal
- Three green candles
- Increasing Trix

However we tried other approaches and combination on the same data set over several runs to arrive this. As highlighted in the result section the above approaches gave the most profitable deals.

## **Event Based back testing framework:**

Backtesting is arguably the most critical part of the trading system. If a strategy is flawed, rigorous backtesting will hopefully expose that.

Event driven trading systems are widely used in algorithmic trading. Event driven means every new data bar is considered as an event, as an event occurs, a function is called to process on that data to take buy/ sell decision. It allows back-testing of strategies in a manner that is extremely similar to live execution. There are many open source event driven trading systems available like ZipLine, PyAlgoTrade, BackTrader. After exploring we have chosen back-trader as our preferred choice for backtesting framework. Back-trader is functionally very rich, can trade multi-stocks and has inbuilt multiprocessing. Most frameworks go beyond backtesting to include some live trading capabilities.[9]

Other standard capabilities of open source backtesting platforms seem to include:

- Standard performance metric calculation/visualisation/reporting capabilities
- Optimisation: in the context of strategies developed using technical indicators, system developers attempt to find an optimal set of parameters for each indicator or any other variable used in trading logic.

### **Back trader**

This platform is exceptionally well documented, with an accompanying blog and an active on-line community for posting questions and feature requests. Back trader supports a number of data formats, including CSV files, Pandas DataFrames, blaze iterators and real time data feeds from three brokers[9]. These data feeds can be accessed simultaneously, and can even represent different timeframes. Supported brokers include Oanda for FX trading and multi-asset class trading via Interactive Brokers and Visual Chart.[13]

- Project Page: [www.backtrader.com](http://www.backtrader.com)
- Github: [github.com/mementum/backtrader](https://github.com/mementum/backtrader)
- License: [GPL v3.0](https://www.gnu.org/licenses/gpl-3.0.html)

We have scripted a python code which will be utilised in testing trading idea (code attached in a separate file and in appendix) throughout the project.

## **Performance measurement:**

### **Sharpe Ratio:**

Sharpe Ratio is a widely used risk-adjusted return measure and it takes risk-free return as its benchmark Chan[2]. Since, there is no risk on a risk-free asset, standard deviation of risk free return is zero.

$$\text{SharpeRatio} = \text{AverageofExcessReturns} / \text{StandardDeviationofPortfolioReturns}$$
$$\text{ExcessReturns} = \text{PortfolioReturns} - \text{RiskFreerateofReturn}$$

Chan argues that Sharpe ratio facilitates performance comparison across different strategies. Sharpe ratio is usually low if a strategy trades only few times a year and has a deep or lengthy drawdown. Sharpe ratio has been considered as performance measure for this paper.

### **Maximum Drawdown:**

Maximum drawdown focuses on capital preservation. It approximates worst-case scenario for a trading strategy for a period. It is the maximum loss observed from peak to trough, for a portfolio, before a new peak is attained. It helps to measure the risk incurred by trading strategy and helps to determine if it's practical to take on such risk. Miner[3] argues capital preservation is key to long-term successful trading and an important criterion for most investors. Chan[2] states that it is a better measure of tail risks, as it does not rely on measuring just the second moment of returns distribution. It is also asymmetric i.e. not concerned about periods with extremely positive returns.

$$\text{MaximumDrawdown} = \text{TroughValue} - \text{PeakValue}$$

From trading strategy development point of view, it can be visualised during back-testing phase. As this research involves back-testing, Maximum Drawdown has been considered as one of the measures of performance for this research.

### **System Quality Number(SQN):**

Dr. Van Tharp developed this Formula for Trading Systems. Later he found out that the SQN Indicator is a very powerful to measure the trendiness. He applied the SQN formula to the daily percent price change of a stock or an index, it proved to be an excellent measure of the quality of a trend.

$$SQN = \sqrt{N} * \text{Avg}(\text{ProfitOrLoss}) / \text{Stddev}(\text{ProfitOrLoss})$$

The large the N, the more trading opportunities you have.  
The large the average P&L, the better you are obviously.  
The smaller the Std dev (P&L), the more regular are your results and the smaller are the drawdowns.

Van Tharp describes the Quality of Stocks, Indices, Currencies and Commodities with this SQN Scores:

Score: 1.6 - 1.9 Below average, but trade-able

Score: 2.0 - 2.4 Average

Score: 2.5 - 2.9 Good

Score: 3.0 - 5.0 Excellent

Score: 5.1 - 6.9 Superb

Score: 7.0 - Keep this up, and you may have the Holy Grail.

What says the SQN Score: For Example a stock have an SQN Value of 2.8 that means the Performance over the last 100 Periods was 2.8 bigger than the Standard Deviation of the Stock.

### **Trade Analyser:**

This is a custom analyser for backorder tool. From the documentation[5] following about trade analyser-

Provides statistics on closed trades (keeps also the count of open ones)

- Total Open/Closed Trades
- Streak Won/Lost Current/Longest
- ProfitAndLoss Total/Average
- Won/Lost Count/ Total PNL/ Average PNL / Max PNL
- Long/Short Count/ Total PNL / Average PNL / Max PNL
- Won/Lost Count/ Total PNL/ Average PNL / Max PNL
- Length (bars in the market)
- Total/Average/Max/Min
- Won/Lost Total/Average/Max/Min
- Long/Short Total/Average/Max/Min
- Won/Lost Total/Average/Max/Min

### **Transactions:**

This is a custom analyser for backorder tool. From the documentation[6] following about trade analyser - This analyser reports the transactions occurred with each an every data in the system. It looks at the order execution bits to create a Position starting from 0 during each next cycle. The result is used during next to record the transactions.

### **Simulation and Run:**

Assumptions / standard parameters for trading portfolio

We have taken 0.0001 as commission which roughly translates to 1000 per crore of transaction or 1000 per 10 million of transaction. Total no of stocks are 49.

We have set initial portfolio value of 2.5 million for each strategy and each trade will be taken on 2% of portfolio value, this is to ensure that if there is trade on each and every stock at one point of time then total portfolio value should be greater than capital required.



After several trial and error strategies we finalised the following three for this report.

### **Strategy 1 - Stochastic reversal**

The stochastic oscillator is an indicator that helps determine when the price of an asset is about to change direction. It does this by giving signals on whether an asset is overbought or oversold. If the asset is overbought, it could be due for a reversal to the downside and if oversold, it could be due for a reversal to the upside. Traders use the stochastic oscillator to help them exit existing trades before a trend changes. They also use it to enter trades just as a new trend is beginning. The stochastic oscillator comprises two moving average lines. It measures an asset's recent closing price relative to its high-low range over a period of time. It is made up of two moving average lines that travel in between three zones on a chart: overbought (80-100), neutral (20-80) and oversold (0-20).

### **Strategy2 - Increasing Triple Exponential Average(TRIX)**

The Triple Exponential Average (TRIX) is a momentum indicator used by technical traders that shows the percentage change in a triple exponentially smoothed moving average. When it is applied to triple smoothing of moving averages, it is designed to filter out price movements that are considered insignificant or unimportant. As a powerful oscillator indicator, TRIX can be used to identify oversold and overbought markets, and it can also be used as a momentum indicator. When TRIX is used as a momentum indicator, a positive value suggests momentum is increasing while a negative value suggests momentum is decreasing. Many analysts believe that when the TRIX crosses above the zero line, it gives a buy signal, and when it closes below the zero line, it gives a sell signal. Also, any divergence between price and TRIX can indicate significant turning points in the market. Two main advantages of TRIX over other trend-following indicators are its excellent filtration of market noise and its tendency to be a leading than lagging indicator.

### **Strategy3 - Three Green Candles**

Three green soldiers is a bullish candlestick pattern that is used to predict the reversal of the current downtrend in a pricing chart. The pattern consists of three consecutive long-bodied candlesticks that open within the previous candle's real body and a close that exceeds the previous candle's high. These candlesticks should not have very long shadows and ideally open within the real body of the preceding candle in the pattern. The three white soldiers candlestick pattern suggests a strong change in market sentiment in terms of the stock, commodity or pair making up the price action on the chart. When a candle is closing with small or no shadows, it suggests that the bulls have managed to keep the price at the top of the range for the session. Basically, the bulls take over the rally all session and close near the high of the day for three consecutive sessions. In addition, the pattern may be preceded by other candlestick patterns suggestive of a reversal.

## Simulation Results

All file(s) is attached to GitHub[see Appendix] which contains all the detailed results of all the steps and result.

### Strategy 1 - Stochastic reversal

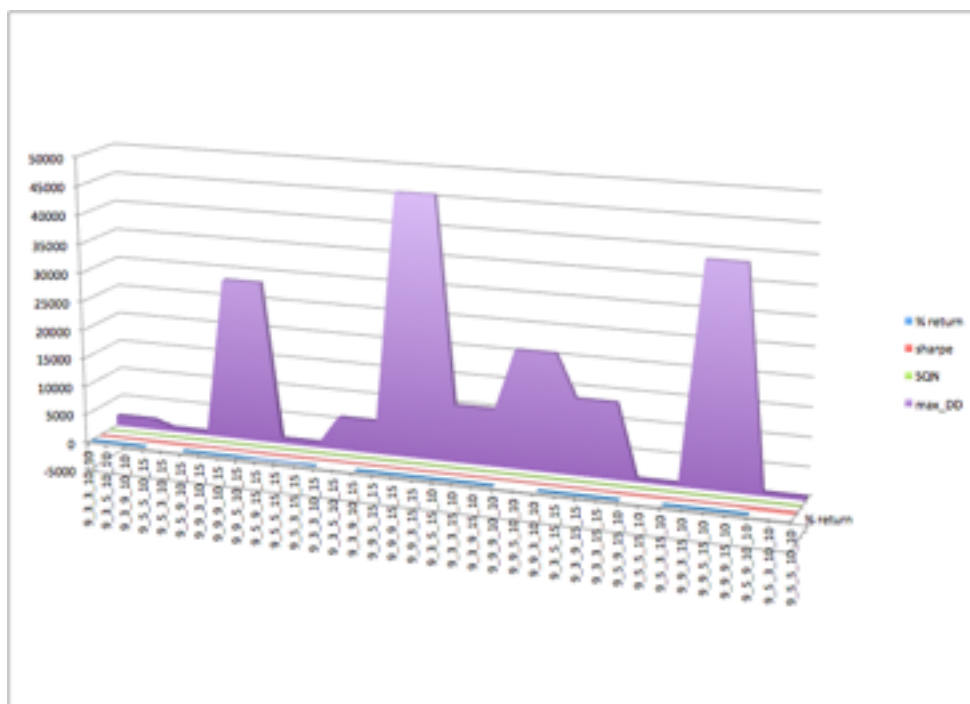
This follows stochastic reversal. The top run output is humble 0.13% positive.

Detailed Trade sheet and simulation run output can be found here-

<https://github.com/adityaprasann/WQUCapstoneRepository4Group44/tree/master/stochastic%20reversal>

Top 3 run as per the attached report

run_name	end	growth	N_scales	change	SDM	Traded	non_traded	average_sd	area_traded	loss_traded	log_traded	share_traded	mean_SD
9_10_12_30	2160N2160N010102	2160.648077167937	0.18	-0.14	1.22	27	0	11.88	30	17	18	10	11.387
9_10_12_30	2500N2160N010102	2160.648077167937	0.18	-0.14	1.22	27	0	11.88	30	17	18	10	11.387
9_10_12_30	1800N2160N010102	2160.648077167937	0.18	-0.14	1.22	27	0	11.88	30	17	18	10	11.387



### Strategy2 - Increasing Trix

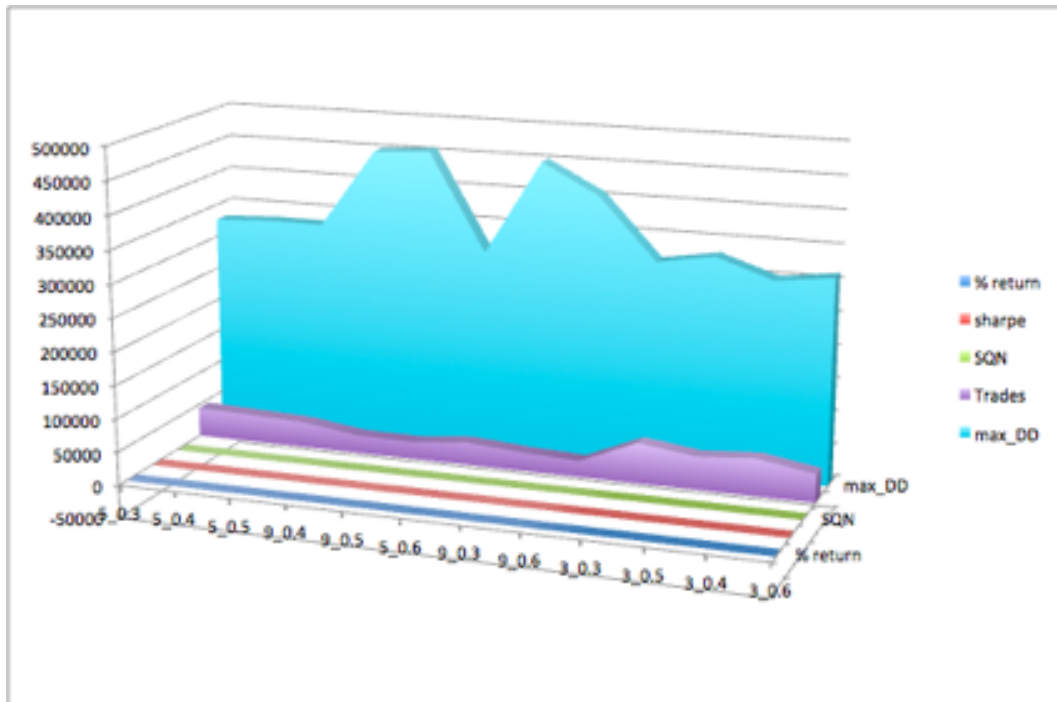
This follows increasing trix, trending strategy. The top run gives a handsome 22% returns.

Detailed Trade sheet and simulation run output can be found [here](#).

<https://github.com/adityaprasann/WQUCapstoneRepository4Group44/tree/master/increasing%20trix>

Top 3 run as per the attached report

run_name	url	growth	trades	shape	SQN	Trades	open_trades	average_profit	win_trades	loss_trades	long_trades	short_trades	max_DD
S_8.0	3C4D943.7202101045	540840.7092101045	2189	0.82	2.88	44300	41	11.01	10470	28110	20476	20273	102710.20
S_8.1	8C21370.3100000000	801200.3030000000	2037	12.71	2.88	13200	30	11.00	11000	22000	10000	20000	100000.00
S_8.5	2500180.8000000000	400180.8000000000	181	0.77	2.88	20000	31	10.85	11000	20000	10000	20000	100000.00



### Strategy3 - Three Green Candles

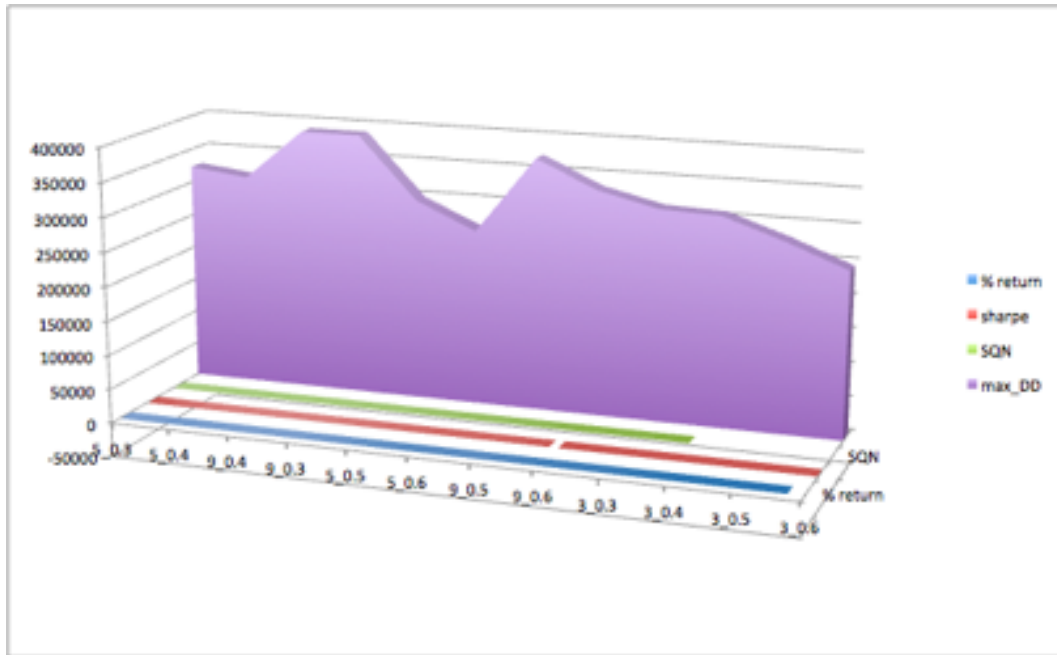
This follows trending strategy, three consecutive green candles, trix greater than 0 and solid body for purchase. Top run has 12.5% return.

Detailed Trade sheet and simulation run output can be found here-

<https://github.com/adityaprasann/WQUCapstoneRepository4Group44/tree/master/three%20green%20candles>

Top 3 run as per the attached report

run_name	url	growth	% return	sharpe	SQN	Trades	open_trades	average_profit	win_trades	loss_trades	long_trades	short_trades	max_DD
S_8.0	2010000.0000000000	1010000.0000000000	17.43	1.70	1.80	21000	31	8.14	10000	20000	10000	20000	100000.00
S_8.4	2000000.0000000000	2000000.0000000000	10.49	1.01	1.07	20000	30	0.20	10000	10000	10000	10000	100000.00
S_8.4	2000000.0000000000	2000000.0000000000	11.87	1.10	1.68	20000	30	10.87	10000	10000	10000	10000	100000.00



## Limitations and Further Study

Study is based on the assumption that new market information will generate a new trading signal resulting into trade execution. But in a live trading there may be many other unknown involved in this process. Transaction Costs, Slippage and Market Impact have been ignored in this study. The framework back trader lacks straight forward way to do something like walk-forward analysis. It is not very intuitive to be able to tell a which dates we want to use for training, which we want to use for testing, and then run lots of these tests in batch. The paper requires further analysis study on the dangers of overfitting, transaction cost and transaction constrain.

Document concludes from number of experimental strategies involving moving average crossover, that non-linear time series study is a complex topic. It requires more study from many different angles and not just moving average price crossover of price time series. Price return and price volatility should be explored to make trading strategy more robust. Regime modelling would be a next step needed to help allocation of capital to different strategies. Some work on testing the strategy on out of sample data is desirable to test the robustness of trading models.

## **Conclusion**

The goal of this paper was to develop, test and investigate short term trading model for liquid Indian equities and present a profitable portfolio. The outcome of this study exercise provides needed depth of knowledge of existing trading indicators. This paper has documented the working experience with trading model development, use of back-testing cum trading framework and trading model evaluation experience. As part of new trading model development exercise, many well-known existing trading strategies were studied and back-tested with historical data.

Multiple combination of trading strategy were tried during the paper. The entry signal, exit signal and trade size etc. has been specified clearly in the respective strategies. As described in this report the resulting final model has been back-tested with three years of historical daily price data. As stated in many academic literatures, three years' worth of data for a wide variety of forty nine liquid equity indexes would constitute sufficient number of observations to determine its success. It was observed during the back testing that developing a trading strategy is essentially a task to determine whether prices for a certain time horizon will be mean-reverting or trending. The portfolio presented has the capability to act as assistance to a trader for deciding his short term trading strategy. It can be extended as an autonomous trading tool with an interface to a stock exchange. Paper concludes that more research would be require to make short term trading model more robust.

## References

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## Appendix I : Indian Equity Indexes

Below table summaries the ticker code for NIFTY stocks which were used.

Adani Ports and Special Economic Zone Ld	ADANIPTS
Asian Paints Ltd	ASIANPAINT
Axis Bank Ltd	AXISBANK
Bajaj Auto Ltd	BAJAJ-AUTO
Bajaj Finserv Ltd	BAJAJFINSV
Bajaj Finance Ltd	BAJFINANCE
Bharti Airtel Limited	BHARTIARTL
Bharat Petroleum Corp Ltd	BPCL
Britannia Industries Ltd	BRITANNIA
Cipla Ltd	CIPLA
Coal India Ltd	COALINDIA
Either Motors Ltd	EICHERMOT
Gail (India) Ltd	GAIL
Grasim Industries Ltd	GRASIM
HCL Technologies Ltd	HCLTECH
HDFC Bank Limited	HDFCBANK
Housing Development Finance Corp Ltd	HDFC
Hero Motocorp Ltd	HEROMOTOCO
Hindalco Industries Ltd	HINDALCO
Hindustan Unilever Ltd	HINDUNILVR
ICICI Bank Ltd	ICICIBANK
Indusind Bank Ltd	INDUSINDBK
Bharti Infratel Ltd	INFRATEL
Infosys Ltd	INFY
Indian Oil Corporation Ltd	IOC

ITC Ltd	ITC
JSW Steel Limited Fully Paid Ord. Shrs	JSWSTEEL
Kotak Mahindra Bank Ltd Fully Paid Ord. Shrs	KOTAKBANK
Larsen & Toubro Limited	LT
Maruti Suzuki India Ltd	MARUTI
Mahindra and Mahindra Industries Ltd	MM
Nestle India Ltd	NESTLEIND
NTPC Limited	NTPC
ONGC Limited	ONGC
Power Grid Corporation of India Limited	POWERGRID
Reliance Industries Limited	RELIANCE
State Bank Of India	SBIN
Sun Pharmaceutical Industries Limited	SUNPHARMA
Tata Motors Limited Fully Paid Ord. Shrs	TATAMOTORS
Tata Steel Limited Fully Paid Ord. Shrs	TATASTEEL
Tata Consultancy Services Limited	TCS
Tech Mahindra Ltd	TECHM
Titan Company Ltd	TITAN
UltraTech Cement Ltd	ULTRACEMCO
UPL Ltd Fully Paid Ord. Shrs	UPL
Vedanta Limited	VEDL
Wipro Limited	WIPRO
Zee Entertainment Enterprises Limited	ZEEL



## **Appendix –II**

### **Python code**

<https://github.com/adityaprasann/WQUCapstoneRepository4Group44>

Increasing Trix -

[https://github.com/adityaprasann/WQUCapstoneRepository4Group44/blob/master/increasing%20trix/increasing\\_trix.py](https://github.com/adityaprasann/WQUCapstoneRepository4Group44/blob/master/increasing%20trix/increasing_trix.py)

Stochastic Reversal -

[https://github.com/adityaprasann/WQUCapstoneRepository4Group44/blob/master/stochastic%20reversal/stochastic\\_reversal.py](https://github.com/adityaprasann/WQUCapstoneRepository4Group44/blob/master/stochastic%20reversal/stochastic_reversal.py)

Three Green Candles -

[https://github.com/adityaprasann/WQUCapstoneRepository4Group44/blob/master/three%20green%20candles/three\\_green\\_candles.py](https://github.com/adityaprasann/WQUCapstoneRepository4Group44/blob/master/three%20green%20candles/three_green_candles.py)

### **Data files**

<https://github.com/adityaprasann/WQUCapstoneRepository4Group44/tree/master/data>