

Case Study: Back testing of a Trading Strategy

Introduction

When you start trading in stock market, the questions arise are what stock to pick, when to buy, when to sell, which strategy yields profit and which one leads to loss. The answer for above questions are answered in this case study.

The following case study shows how a strategy can be evaluated using backtesting over a historical data. We start with defining a strategy explaining the importance of planning and the use of backtesting. Then demonstrate how to run a backtest and evaluate by applying our strategy in a Stock Market data.

Finally we analyze the results through backtesting and accept/reject the strategy based on its performance.

Strategy

Trading Strategy is a result of detailed study of the markets to plan the security transactions. The reasons for using a pre-defined strategy over spontaneous-decisions-based-on experience are consistency, verifiability and the ability to check the credibility of the technique. It guides the investor to make decisions that are profitable.

One of the most important tasks of the strategy is not just to analyze how the markets worked; it is also to predict the future for profits.

Testing

Testing the strategy is as vital as devising the strategy. Backtesting, a jargon used in Finance is a technique that cross-validates the strategy to evaluate the profitability of the methodology using historical data. It is an imperative step for automated or semi-automated strategies to back test and check for its validity and grading on the desirability of the technique.

If a trading strategy did not perform well in the past, it is unlikely to be profitable in the future. Backtesting helps to find the performance of the

strategy by applying on the historical data thereby reducing the probability of undesirable losses. They not only give a relative performance of a set of trading strategies, but also provide insight about the past behavior of the markets. It's a screening tool to filter out the underperforming strategies before risking money and losing out on the strategy in real life whose low performance would've showed up in back testing.

Backtest Process

Backtest is a set of objective rules written in computer language defined by the strategy. The back test engine applies the rules of the strategy to historical data for each selected stock symbol. The results are recorded for each trade and are compiled for each stock symbol. The results are then analyzed statistically and converted to a user friendly format and presented.



Fig. 1 Block diagram for evaluating strategy

The process of evaluating a strategy takes in three stages

- **Graphical Analysis**
- **Back testing**
- **Statistical Analysis**

Case Study: Back testing of a Trading Strategy

The process is repeated until the strategy is finalized.

Data Set

The data being evaluated is the Nifty Intraday (5 min) data. The data is first visually comprehended through the candle bar sticks that provide an insight of the down trends and the uptrends. Based on the trends, the entry strategy is devised.



Fig. 3 Charts indicating BUY and SELL signals

Main purpose of this case study is to analyze and implement back testing, hence we chose a simple strategy. In this strategy we test the nifty data with MACD(Moving Average Convergence Divergence) indicator and RSI(Relative Strength Index). Then the BUY and SELL signals are generated by filtering the uncommon ones, and then these signals are backtested.

MACD

MACD is a technical analysis indicator created by Gerald Appel in the late 1970s. It is used to spot changes in the strength, direction, momentum, and duration of a trend in a stock's price.

The MACD "oscillator" or "indicator" is a collection of three signals (or computed data-series), calculated from historical price data, most often the closing price. These three signal

lines are: the MACD line, the signal line (or average line), and the difference (or divergence). The term "MACD" may be used to refer to the indicator as a whole, or specifically to the MACD line itself. The first line, called the "MACD line", equals the difference between a "fast" (short period) exponential moving average (EMA), and a "slow" (longer period) EMA. The MACD line is charted over time, along with an EMA of the MACD line, termed the "signal line" or "average line". The difference (or divergence) between the MACD line and the signal line is shown as a bar graph called the "histogram" time series.

Algorithm:

BuyM=Cross(macd,signal);

SellM=Cross(signal,macd);

RSI

The relative strength index (RSI) is a technical indicator used in the analysis of financial markets. It is intended to chart the current and historical strength or weakness of a stock or market based on the closing prices of a recent trading period.

The RSI is most typically used on a 14 day timeframe, measured on a scale from 0 to 100, with high and low levels marked at 70 and 30, respectively. Shorter or longer timeframes are used for alternately shorter or longer outlooks. More extreme high and low levels 80 and 20, or 90 and 10 occur less frequently but indicate stronger momentum.

Algorithm:

BuyR=Cross(RSI,70);

SellR=Cross(30,RSI);

Final Buy and Sell Signals:

if(BuyM==1 AND BuyR==1)

{ Buy=1;}

If(SellM==1 AND SellR==1)

Case Study: Back testing of a Trading Strategy

{ Sell=1;}

Then the buy and sell signals were analyzed graphically and then strategically squared off. When there is a buy trigger and sell trigger has not appeared, the sell was squared off if the close value falls below the day's low. Then graphically analyzing, the strategy is back tested to evaluate the profitability of the strategy. The back testing is done implementing the above strategy and the reports are generated. Following are the screenshots of the charts and the reports generated.

Symbol	Trade	Date	Price	Ex date	Ex Price	% chg	Profit	% Profit	Shares	Position	Cum. P.	#bars	Profit	MAE
nifty data	Long	01-Jan-13 11:49:59 AM	5,990.6	01-Jan-13 12:00:00	5,990.7	0.00%	0.17	0.00%	1,667.06	10,000.00	0.17	7	0.02	-0.04%
nifty data	Long	01-Jan-13 12:59:59 PM	6,012	01-Jan-13 1:00:00	6,011.9	-0.00%	-0.17	-0.00%	1,666.37	10,000.17	0.00	5	-0.03	-0.00%
nifty data	Long	01-Jan-13 1:24:59 PM	6,011.05	01-Jan-13 1:30:00	6,010.5	-0.01%	-0.91	-0.01%	1,666.36	10,000.00	-0.91	8	-0.11	-0.12%
nifty data	Long	01-Jan-13 2:14:59 PM	6,006.0	01-Jan-13 2:30:00	6,010.1	0.05%	3.49	0.02%	1,664.93	9,999.09	4.58	4	1.37	-0.05%
nifty data	Long	01-Jan-13 2:44:59 PM	6,009	01-Jan-13 2:45:00	6,010.05	0.02%	1.75	0.02%	1,664.93	10,004.30	6.33	4	0.44	-0.00%
nifty data	Long	01-Jan-13 3:04:59 PM	6,009.75	02-Jan-13 9:00:00	6,028.95	0.50%	50.20	0.50%	1,669.02	10,006.33	56.61	8	6.28	-0.09%
nifty data	Long	02-Jan-13 9:44:59 AM	6,035.95	02-Jan-13 10:00:00	6,030.05	-0.08%	-8.50	-0.08%	1,666.02	10,036.61	48.11	7	-1.21	-0.16%
nifty data	Long	02-Jan-13 10:24:59 AM	6,029.2	02-Jan-13 12:00:00	6,034	0.08%	8.00	0.08%	1,666.37	10,040.11	56.11	6	1.33	-0.06%
nifty data	Long	02-Jan-13 11:24:59 AM	6,040	02-Jan-13 12:00:00	6,040	0.00%	0.32	0.00%	1,664.93	10,036.11	64.43	10	0.63	-0.06%
nifty data	Long	02-Jan-13 12:29:59 PM	6,042.5	02-Jan-13 12:30:00	6,037.15	-0.09%	-8.91	-0.09%	1,666.01	10,064.43	55.52	7	-1.27	-0.16%
nifty data	Long	02-Jan-13 1:44:59 PM	6,038	02-Jan-13 2:00:00	6,034	-0.07%	-4.66	-0.07%	1,665.37	10,055.32	48.86	5	-1.33	-0.16%
nifty data	Long	02-Jan-13 2:39:59 PM	6,036	02-Jan-13 2:45:00	6,037.4	0.02%	2.33	0.02%	1,664.93	10,040.86	51.19	4	0.58	-0.08%
nifty data	Long	02-Jan-13 3:14:59 PM	6,034.9	02-Jan-13 3:30:00	6,032	-0.04%	-4.16	-0.04%	1,665.31	10,051.19	55.36	4	1.04	-0.05%
nifty data	Long	03-Jan-13 9:24:59 AM	6,028.55	03-Jan-13 9:30:00	6,028	-0.11%	-10.76	-0.11%	1,667.88	10,055.36	66.11	4	2.89	-0.02%
nifty data	Long	03-Jan-13 9:49:59 AM	6,031.1	03-Jan-13 9:50:00	6,035.15	0.07%	6.76	0.07%	1,668.03	10,066.11	72.87	3	2.25	-0.07%
nifty data	Long	03-Jan-13 10:19:59 AM	6,033.2	03-Jan-13 10:30:00	6,038.35	0.05%	5.26	0.05%	1,665.57	10,072.87	78.13	3	1.75	-0.02%
nifty data	Long	03-Jan-13 11:04:59 AM	6,035.95	03-Jan-13 11:15:00	6,038.55	0.04%	4.34	0.04%	1,666.93	10,078.13	82.47	3	1.45	-0.02%
nifty data	Long	03-Jan-13 11:24:59 AM	6,035.55	03-Jan-13 11:30:00	6,042.25	0.13%	12.86	0.13%	1,670.51	10,082.47	95.33	4	3.22	-0.01%
nifty data	Long	03-Jan-13 11:49:59 AM	6,041	03-Jan-13 12:00:00	6,040.95	-0.00%	-0.08	-0.00%	1,671.14	10,095.33	95.25	5	-0.02	-0.02%
nifty data	Long	03-Jan-13 12:14:59 PM	6,039.15	03-Jan-13 12:30:00	6,032	-0.12%	-11.95	-0.12%	1,671.63	10,095.33	83.30	10	-1.20	-0.13%
nifty data	Long	03-Jan-13 1:29:59 PM	6,032.9	03-Jan-13 1:30:00	6,033.2	0.00%	0.50	0.00%	1,671.39	10,093.30	83.80	2	0.25	-0.01%
nifty data	Long	03-Jan-13 1:39:59 PM	6,032.95	03-Jan-13 1:45:00	6,034.5	0.05%	2.59	0.05%	1,671.45	10,093.30	86.39	2	1.30	-0.04%
nifty data	Long	03-Jan-13 2:14:59 PM	6,036.0	03-Jan-13 2:30:00	6,040.85	0.07%	6.77	0.07%	1,670.02	10,086.39	93.16	3	2.28	-0.03%
nifty data	Long	03-Jan-13 2:39:59 PM	6,039	03-Jan-13 2:45:00	6,042.5	0.06%	5.85	0.06%	1,671.33	10,093.16	99.01	5	1.17	-0.06%
nifty data	Long	03-Jan-13 3:14:59 PM	6,040.6	04-Jan-13 9:00:00	6,027.7	-0.21%	-21.57	-0.21%	1,671.85	10,099.01	77.44	7	-3.08	-0.33%
nifty data	Long	04-Jan-13 9:29:59 AM	6,015.3	04-Jan-13 9:30:00	6,018.1	0.05%	4.69	0.05%	1,675.31	10,077.44	82.13	4	1.17	-0.05%
nifty data	Long	04-Jan-13 10:24:59 AM	6,018	04-Jan-13 10:30:00	6,020.5	0.04%	4.19	0.04%	1,675.93	10,081.13	86.32	2	1.10	-0.04%

Fig. 4 Back tested results

A complete backtesting report is generated as shown in Fig 5. The winning percentage and losing percentage of the strategy is for the particular strategy is 59.89% and 40.11%. It also shows the total trades and profit factor which are key factors for a strategy. The report also shows the comparison of All trades, Long Trades and short trades.

[Statistics](#) | [Charts](#) | [Trades](#) | [Formula](#) | [Settings](#) | [Symbols](#)

Statistics			
	All trades	Long trades	Short trades
Initial capital	10000.00	10000.00	10000.00
Ending capital	9549.67	9549.67	10000.00
Net Profit	-450.33	-450.33	0.00
Net Profit %	-4.50 %	-4.50 %	0.00 %
Exposure %	49.47 %	49.47 %	0.00 %
Net Risk Adjusted Return %	-9.10 %	-9.10 %	N/A
Annual Return %	-13.61 %	-13.61 %	0.00 %
Risk Adjusted Return %	-27.50 %	-27.50 %	N/A
All trades	713	713 (100.00 %)	0 (0.00 %)
Avg. Profit/Loss	-0.63	-0.63	N/A
Avg. Profit/Loss %	-0.01 %	-0.01 %	N/A
Avg. Bars Held	5.16	5.16	N/A
Winners	427 (59.89 %)	427 (59.89 %)	0 (0.00 %)
Total Profit	3669.20	3669.20	0.00
Avg. Profit	8.59	8.59	N/A
Avg. Profit %	0.09 %	0.09 %	N/A
Avg. Bars Held	3.99	3.99	N/A
Max. Consecutive	12	12	0
Largest win	68.81	68.81	0.00
# bars in largest win	9	9	0
Losers	286 (40.11 %)	286 (40.11 %)	0 (0.00 %)
Total Loss	-4119.53	-4119.53	0.00
Avg. Loss	-14.40	-14.40	N/A
Avg. Loss %	-0.15 %	-0.15 %	N/A
Avg. Bars Held	6.91	6.91	N/A
Max. Consecutive	6	6	0
Largest loss	-98.50	-98.50	0.00
# bars in largest loss	7	7	0
Max. trade drawdown	-113.14	-113.14	0.00
Max. trade % drawdown	-1.16 %	-1.16 %	0.00 %
Max. system drawdown	-882.13	-882.13	0.00
Max. system % drawdown	-8.67 %	-8.67 %	0.00 %
Recovery Factor	-0.51	-0.51	N/A
CAR/MaxDD	-1.57	-1.57	N/A
RAR/MaxDD	-3.17	-3.17	N/A
Profit Factor	0.89	0.89	N/A
Payoff Ratio	0.60	0.60	N/A
Standard Error	110.49	110.49	0.00
Risk-Reward Ratio	-23.52	-23.52	N/A
Ulcer Index	4.41	4.41	0.00
Ulcer Performance Index	-4.31	-4.31	N/A
Sharpe Ratio of trades	-2.60	-2.60	0.00
K-Ratio	-0.0276	-0.0276	N/A

Fig 5. Back tested Report

Conclusion:

Back testing plays an important role in evaluating a strategy. Through the continued process of optimization and backtesting, a strategy can be rendered fit for experimentation on the real data. By Back testing the user gets an idea to start trading by selecting and make profits.