TRADING STRATEGIES USING TECHNICAL INDICATORS

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by

Omkar Sunil Surve

(Roll No. 222123035)

to the

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INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI

GUWAHATI - 781039, INDIA

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CERTIFICATE

This is to certify that the work contained in this report entitled **"Trading Strategies using Technical Indicators"** submitted by **Omkar Sunil Surve** (**Roll No: 222123035**) to Department of Mathematics, Indian Institute of Technology Guwahati towards the requirement of the course **MA699 Project** has been carried out by him under my supervision.
Turnitin percentage - 13%

Guwahati - 781 039
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(Dr. N. Selvaraju)
Project Supervisor

ABSTRACT

The main aim of the project is to understand how the technical indicators work and how we can use them to create trading strategies that would help us in taking more informed decision regarding buying and selling the stocks. Here our main focus is on creating strategies and comparing them on various stocks from different sector and classify which strategy works better for which sector.

We backtest the strategy over the past data and then analyze the performance of each strategy. This investment option when done with proper strategy and care, can give great return compared to other form of investment options.

Here we have created trading strategies based on the technical indicators. We have observed the patterns among the indicators and tried to make use of these patterns to create signal that could help us in out decision to buy and sell the stock.

Among these strategies, some performed well on specific type of sector. Our main aim is to create and use such sector specific strategies for trading.We have used more than 10 year of data of different stocks for backtesting our strategies.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

In today's constantly shifting financial markets, investors and traders are continuously looking for effective strategies to deal with volatility and uncertainty. Technical analysis, which examines previous market data to estimate future price changes, has evolved as an effective technique for making sound trading decisions. Technical indicators, in particular, are critical in studying price patterns, trends, and momentum, helping traders in identifying probable entry and exit points into the market.

This project aims to create various trading strategies based on technical indicators and evaluate the performance by back testing them on stocks from various sectors. We will be selecting few sectors and perform our analysis on stocks from those sectors. We will then try to determine which strategies performed better in which sectors.

Throughout this project, we will try to understand how technical indicators are built, how they behave, and how to use them to create strategies. We will mostly use the technical indicator alone, without merging other indicators,

but we will also develop a combined strategy that integrates the behavior of both technical indicators.

Nowadays we all are aware of improved trading systems that are able to execute trades quicker. Having well established strategies at our hands will help us in creating more robust trading setup. More better strategies can be created by combining strategies for better entry and exit signals.

But before creating any strategy using indicators, we must first must first understand what are indicators and how are they calculated. In the upcoming chapters we will be discussing about the indicators that we will be using for creating our strategies and the strategies in detail along with their logic.

Chapter 2

Indicators

Indicators are statistics used to measure current conditions as well as to forecast financial or economic trends. In our context of indicators, we will be mostly focusing on technical indicators.

Technical indicators are mathematical calculations which uses price, volume of a stock. These type of indicators are mainly used by active traders. They help in identifying entry and exit points. There are 2 types of technical indicators

1. Overlays :- Indicators that are of the same scale as price and are plotted on the chart along with the price of stock. Eg : Exponential Moving Average (EMA) , Volume Weighted Moving Average (VWMA).

2. Oscillators :- These oscillates between a local minimum and maximum and are not in the same scale as that of price. They are mostly displayed below the price chart. Eg : Moving Average Convergence Divergence (MACD) , Relative Strength Index (RSI).

We will be using MACD , EMA , RSI , VWMA for our analysis and strategy creation.

2.1 Moving Average Convergence Divergence (MACD)

MACD is a Momentum Oscillator technical indicator that helps in identifying price trends and market entry points for buying or selling. This consists of 2 lines on the chart: MACD (Blue) and Signal Line (Orange), and a histogram representing the difference between the MACD and Signal line. Here we make use of 12 - EMA and 26 - EMA of Close price for calculation.

MACD = (12-EMA) - (26-EMA)

Signal line = (9-EMA) of MACD

Histogram = MACD - Signal line

Whenever the MACD is above the Signal line, the stock is considered to be in an uptrend. When the MACD is below the Signal line, then we say that the stock is in a downtrend. The histogram shows the difference between the MACD and Signal line. This is used for identifying bullish or bearish trends.

Figure 2.1: MACD chart

2.2 Exponential Moving Average (EMA)

Exponential Moving Average (EMA) falls under the category of Overlay indicators, which is a moving average that gives more weightage to recent data points. Here we are using 3 - EMA lines i.e. 12,24 and 55 days window for calculating the EMA.

$\mathbf{EMA}_{Today} = (Value_{Today} \times (1 + \frac{Smoothing}{1+Days})) + \mathbf{EMA}_{Yesterday} \times (1 - (\frac{Smoothing}{1+Days}))$

where smoothing = 2

Here we have 3 - EMA in a chart. 12-EMA having red color,24-EMA having yellow color and 55-EMA having purple color.

Now whenever the red line is above both,we consider the stock to be in uptrend whereas when the purple line is above both, we consider the stock to be in downtrend.

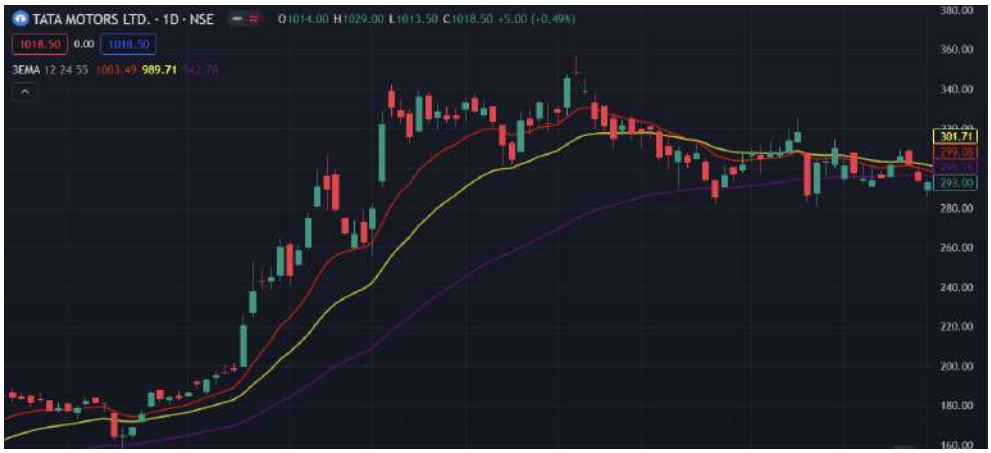

Figure 2.2: UpTrend chart

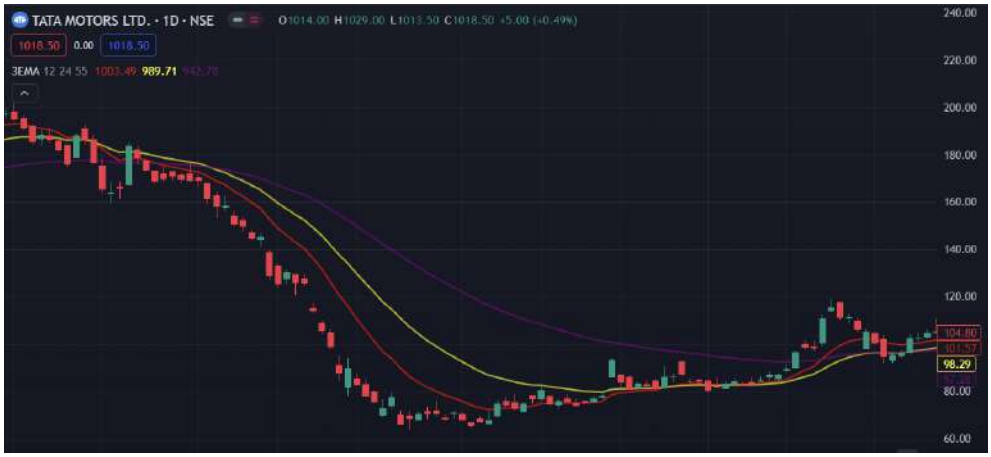

Figure 2.3: DownTrend chart

2.3 Relative Strength Index (RSI)

RSI is a Momentum Oscillator indicator. It measures the speed and magnitude of price change of a stock. RSI helps in determining whether a stock is overvalued or undervalued. Typically, when the RSI value is above 70, we consider that the stock is overvalued and we may expect the stock price to correct itself i.e the price may fall whereas when the RSI is below 30, we consider the stock to be undervalued and we may expect the price to rise.

$$\mathbf{RSI}_{StepOne} = 100 - 100 \times \left[1 + \left(\frac{AverageLoss}{AverageGain}\right)\right]^{-1}$$

$$\mathbf{RSI}_{StepTwo} = 100 - 100 \times \left[1 + \left(\frac{(Previous\ \ Average\ \ Loss \times 13) + Current\ \ Loss}{(Previous\ \ Average\ \ Gain \times 13) + Current\ \ Gain}\right)\right]^{-1}$$

In RSI, we have 2 levels which indicate overbought and oversold. Whenever the stock is in the overbought region , one may expect the stock price to fall whereas for oversold region , one may expect the price to rise.

So the strategy here is to look if the stock is in the over bought region or

oversold region. If we are in the oversold region, we will short sell the stock and when in oversold region we will buy the stock.

Figure 2.4: RSI OverBought chart

Figure 2.5: RSI Oversold chart

2.4 Volume Weighted Moving Average (VWMA)

VWMA falls under Overlay category of indicators. It is a variation of Simple moving average (SMA) giving greater weightage to period with greater trade volumes. In simple terms, the VWMA takes into account both the price and volume of an asset over a given period of time and calculates the average price weighted by the volume of trades. Here we make use of 2-VWMA lines

one with period of 13 days(red) and other with 20 days(white). We create strategy based on the crossover pattern of these 2 lines.

$\mathbf{VWMA} = \frac{\sum(Closing\ \ Price \times Volume)}{\sum Volume}$

Here we calculate the VWMA for each candle in our data and then plot it. We are using 2 VWMA with different periods name 13(red) and 20(white) for creating signals that will help us in deciding our position.

Whenever the red line crosses above the white, we say the stock is in uptrend. We consider this as a buy signal and take long position in the stock whereas when the white line crosses over the red line, we say the stock is in downtrend. We consider this as a sell signal and take short position in the stock.

Figure 2.6: VWMA chart

In this chapter we discussed about the indicators. In the next chapter we start with the construction of strategies. We create a logic on how the strategy will behave under various market situation.

Chapter 3

Strategies

From here we start with the construction of the actual strategy. As described earlier, we will use the same logic, for creating strategies. The strategies that we are creating are based on experiments on historical data and some pattern observation of the charts. We will be using these strategies on various stocks from different sector and try to identify which strategy performed well in which kind of sector. We will create code for each strategy in python language and simulate each strategy on various stocks and analyze the results. Here in each of our strategy we will be describing when to take position in a stock and when to exit. In every strategy we roughly have 4 points to consider which taking position in them. Each point describes the situation and plan of action if this situation occurs.

3.1 MACD

In MACD we have 2 lines, MACD (Blue) and Signal line (Orange). Here the signal for buy and sell are generated based on the crossover of the MACD and the signal line.

The process is as follows,

1. If the MACD (Blue line) crosses above the Signal line (Orange line), we take long position in the stock i.e buy the stock.

2. If the MACD crosses below the Signal line, then we take short position in the stock i.e sell the stock.

3. Now suppose, we already have bought the stock and then we come across the situation in point 2, we get out of the position by selling the stock.

4. Similarly, when we are on the short position and we encounter the situation in point 1, we get out of the position.

Figure 3.1: Buy and Sell signal using MACD chart
(1) Indicates Selling point and (2) indicates Buying point.

3.2 EMA

Here we have 3 EMA lines on our chart. 12-EMA (red) , 24-EMA (yellow) , 55-EMA (purple). We are mostly concerned about the cross over between the red and the purple line.

The process is as follows.

1. If the 12-EMA (red line) crosses above both 24-EMA (yellow line) and 55 - EMA (purple line), we take long position in the Stock i.e. buy the stock.

2. If the purple line crosses above the red line,then we take short position in stock i.e. sell the stock.

3. Now if we already are in long position and situation in 2 happens, we sell the stocks.

4. If we are in short position and situation in 1 happens, then we get out of the position.

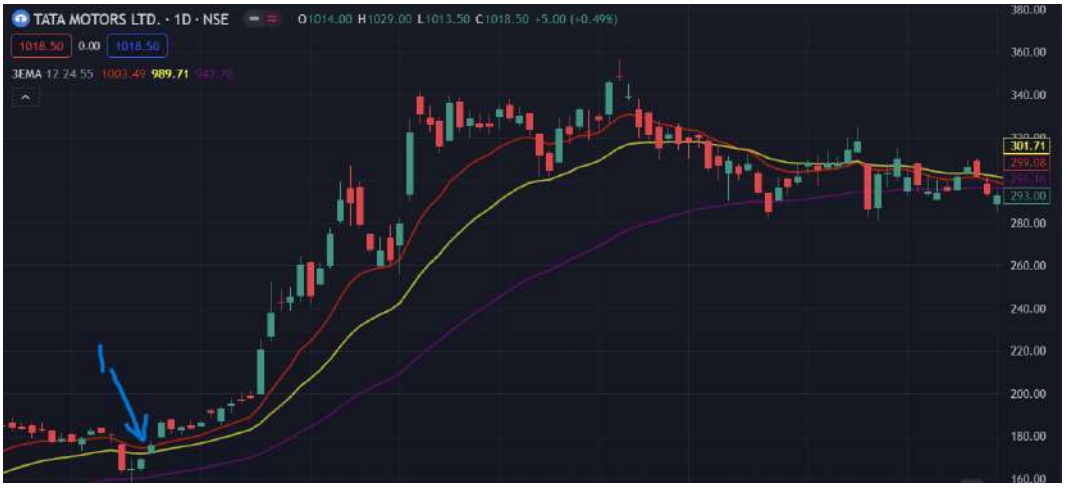

Figure 3.2: Buy signal using EMA Crossover
(1) Indicates Buying point.

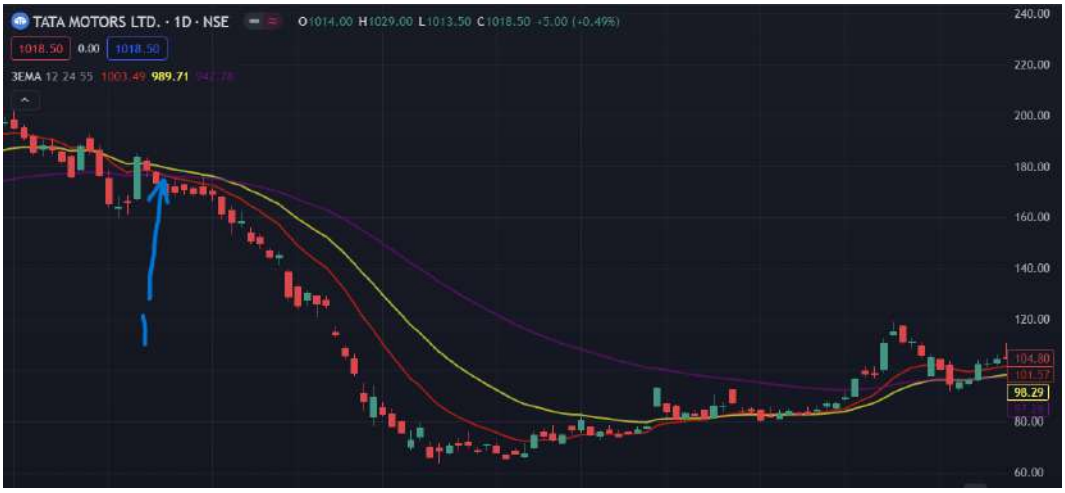

Figure 3.3: Sell signal using EMA Crossover
(1) Indicates Selling Point.

3.3 RSI

Here we have 2 levels marked (in our case we have set it to 30 and 70) such that whenever the purple line crosses the 70 mark, we say that the stock is overpriced and then we may expect that the market will correct itself by stock price falling whereas when the purple line is below the 30 level mark, we say that the stock is undervalued and we expect the price to rise.

The process is as follows.

1. We look for the RSI to be in the oversold region i.e. below 30, then we take long position i.e buy the stock.

2. If the RSI is in the oversold region i.e. above 70, then we take short position in the stock i.e sell the stock.

3. Now if already we are in long position,and situation in point 2 happens we get out of the position by selling the stocks.

4. If we are in short position and situation in 1 happens, then we get out the

position.

(a) Buy signal using RSI (b) Buy signal using RSI

Figure 3.4: Sell signal using RSI
(1) Indicates Buying Point and (2) indicates Selling Point.

3.4 VWMA

In this we have 2 VWMA lines, 13-VWMA (red) and 20-VWMA (white). Now whenever red is above the white line,we say that the stock in in uptrend and when white is above the red line, we say the stock is in downtrend.

The process is as follows.

1. We look for 13-VWMA (red line) crossing above the 20-VWMA (white line), we get into long position i.e buy the stock.

2. If the red line is below the white line, we get into short position i.e. sell the stock.

3. Now if we are in long position and we encounter the situation in point 2,

we get out of the position by selling the stock.

4. If we are in short position and encounter the situation in point 1, we get out of the position.

Figure 3.5: Buy Sell signal using VWMA
(1) Indicates Buying Point and (2) indicates Selling Point.

Now we start testing these strategies on various stocks from different sectors and do a sector wise comparison of various strategies. We will also combine few strategies and check whether they together perform better or not. First we start by collection of data and setting up our python environment for backtesting our strategies. Here our metric for deciding which strategy performs better is the final return that the strategy generates. Initially we will be investing 1 lakh (1,00,000) and run our backtest. We observe the final value of our investment and decide the performance of our strategy.

3.5 Custom Strategy

This approach combines the logic and observations of the MACD and 3-EMA strategies to generate proper buy and sell signals. The process is as follows.

1. We look for when the MACD generates buy signal and get into long position i.e buy the stock.

2. If both EMA and MACD are generating sell signal, only then we will short our position i.e sell the stocks.

3. Now if we are in long position and we encounter situation in point 2, we sell our stocks.

4. Now if we are in short position and encounter the situation in point 1, we get into long position.

Figure 3.6: Buy and Sell signal using Custom Indicator
(1) Indicates Buying Point and (2) indicates Selling Point.

In next chapter we start with the our data collection and Analysis.

Chapter 4

Data Collection and Analysis

4.1 Data Collection

Python helps us getting the data in easy manner. We will be using Yahoo Finance to get the data of our Indian stocks over the last 20 years. The time frame would be of 1 day. The data would consists of the Open , High , Low , Close , Adjusted Close , Volume values for that specific day. We will be mostly using Close value for our simulation. Now to get the data of Indian stocks from Yahoo Finance, we are supposed to use '.NS' extension after writing the ticker name of our stock . For e.g 'ICICIBANK.NS'.

Date	Open	High	Low	Close	Adj Close	Volume
2021-01-01	535.549988	537.000000	526.099976	527.500000	518.554138	13592625
2021-01-04	532.299988	535.000000	524.299988	531.700012	522.682922	16549750
2021-01-05	526.650024	539.950012	523.000000	537.250000	528.138855	23311516
2021-01-06	538.750000	550.599976	535.849976	546.700012	537.428528	28178838
2021-01-07	552.150024	554.400024	539.750000	541.099976	531.923462	21138034

Figure 4.1: ICICI stock price data

4.2 Understanding the Output Plot

Figure 4.2: Output of our strategy

After backtesting our strategy, we are directed to a page which displays output as shown above. The Output window is divided into 3 part.

1. (Top) Equity Region.

This shows how our investment has changed the value with time. Now currently in this chart, we could see that the Peak Equity is of 140% i.e our investment during the entire course reached a maximum value of 140%. Then we have the final value of our investment i.e the value at the end of our simulation. In the above case it is roughly 134% i.e we have gained 34% of our original value by investing in this asset.

2. (Middle) Profit and Loss Region.

This shows the trades which were executed. Red triangle indicates that this trade resulted in loss whereas the green triangle indicates that this trade resulted in profit. The magnitude of Profit and Loss are proportional to the size of the triangles.

3. (Bottom) Candle Chart with trade.

This region shows us the actual price chart along with the VWMA indicators. Here the green dashed lines represent profitable trades and their duration while the red dashed lines represents loosing trades and their duration. This graph also helps us in understanding that our strategy is still not solid proof and we can come up with more subtle logic to avoid these loss trades.

Along with the above chart, we get a second output about the performance of our strategy.

Start	2021-01-01 00:00:00
End	2023-12-29 00:00:00
Duration	1092 days 00:00:00
Exposure Time [%]	52.091768
Equity Final [$]	13448.200317
Equity Peak [$]	13979.250793
Return [%]	34.482003
Buy & Hold Return [%]	88.928905
Return (Ann.) [%]	10.600282
Volatility (Ann.) [%]	17.466792
Sharpe Ratio	0.606882
Sortino Ratio	1.068704
Calmar Ratio	0.512488
Max. Drawdown [%]	-20.683942
Avg. Drawdown [%]	-3.652257
Max. Drawdown Duration	284 days 00:00:00
Avg. Drawdown Duration	49 days 00:00:00
# Trades	32
Win Rate [%]	50.0
Best Trade [%]	16.922542
Worst Trade [%]	-8.263801
Avg. Trade [%]	0.951873
Max. Trade Duration	82 days 00:00:00
Avg. Trade Duration	17 days 00:00:00
Profit Factor	2.032156
Expectancy [%]	1.049498
SQN	1.332722
_strategy	VWMA
_equity_curve	...
_trades	Size EntryB...

Figure 4.3: Details of the Strategy

In this we are able to see various ratios and other important values that

will help us analyze the performance of our strategies.

Our main aim is to maximize the Equity Final value. But apart from this we have the start and the end date of our simulation. Equity Peak tells us the highest value our investment has reached throughout the duration of investment. Return tells us how much we have gained over our investment. Buy and Hold Return tells us that how much we could have earned if we would have bought the stock and hold it for entire period without actively trading. Return (Ann.) is the annual return that our strategy generates. Volatility (Ann.) tells us the volatility of the stock. The Sharpe Ratio measures the risk-adjusted return. This tells us the excess return that we are receiving per unit risk. A higher Sharpe Ratio indicates better risk-adjusted performance compared to a lower Sharpe Ratio.

The Sortino Ratio is a variation of Sharpe ratio which only consider the downside volatility i.e volatility during negative return of the stock. This helps us in understanding how our strategy performed during negative return phase. A higher Sortino Ratio indicates better risk-adjusted returns relative to the downside risk. The Calmar Ratio compares an investment's annualized return to its maximum drawdown, which helps in understanding risk-adjusted performance by calculating returns relative to downside risk. Higher Calmar Ratios suggest greater risk-adjusted returns, implying better trade-offs between gains and drawdowns. Max. Drawdown indicates the decline of investment from its peak value to its minimum value. Max. Drawdown Duration tells us the duration it takes to recover from maximum drawdown, It is measured from the peak of the maximum drawdown to the point where our investment rises above this peak. This can be seen in the pre-

vious chart with red line indicating maximum drawdown period. # Trades measure total number of trades made during our simulation. Win Rate measure the number of profitable trade out of all executed trades. Best Trade tells us about the trade where we had the highest increase in our investment in terms of percentage. Worst Trade tells us about the trade where our investment dwindled down. Max. Trade Duration measures the maximum days between consecutive trades. Profit factor is the ratio of profit generated by winning trades to the loss generated by losing trades. Profit ratio greater than 1 indicates that the strategy is profitable. Expectancy measure the average expected return per unit risk. SQN stand for 'System Quality Number' . It measures the ratio of Expected return to the standard deviation of the returns.Higher SQN indicates better risk-adjusted returns. _strategy tells us the strategy we are currently using in our simulation. So in the above case its VWMA. _equity_curve indicates how our investment has evolved over time. _trades shows us the data of all the trades executed during our simulation. This contains our Entry Price , Exit Price , Entry time, Exit time , Duration of trade , Return Percentage of trade.

All these factors helps us in understanding the performance of our strategies. With help of them we can work on optimising our strategies based on some of the factors. But as mentioned earlier , our main concern will be to maximize Equity Final.

Now we have different strategies at our hands and we also know what metric to focus on. In the following section, we will begin testing these strategies on stocks from various sectors and compare the results to determine which strategies performed better in for each sector.

4.3 Sector-wise Analysis of Strategies

Every stock in our Indian market falls under some Sector. We will be selecting few Known sectors like Automobile,FMCG,Banks,Healthcare,Finance etc for our analysis. Within each sector we will picking 20 stocks at random and perform our analysis on that. We first display the performance of every strategy on every sector and then provide a comparison as to which strategy did well in which sector.

So first we start from the Automobile and Ancillaries Sector. As the name suggests, this is the sector which manufactures vehicles and the components. The result of our strategy is as follows

index	VWMA	MACD	EMA	RSI	CTIND
TATAMOTORS.NS	8.554573	26.382470	19.159216	0.299722	28.712998
MARUTI.NS	15.993502	13.583825	17.160710	4.279894	20.137686
HEROMOTOCO.NS	1.672602	1.100072	7.707388	5.552603	12.298341
BAJAJ-AUTO.NS	12.574351	11.355298	17.587208	5.008415	19.482377
EICHERMOT.NS	33.787585	17.602138	32.108565	4.270662	34.956017
ASHOKLEY.NS	4.307078	7.191770	17.097117	-4.266412	18.056439
TVSMOTOR.NS	23.377953	23.507986	35.021647	-4.562673	38.350172
M&M.NS	12.750081	11.314062	19.135887	0.315466	24.336315
FORCEMOT.NS	13.458446	35.646413	27.744355	5.731680	41.417429
BOSCHLTD.NS	17.151032	15.003518	19.715233	2.805682	23.703526
MOTHERSON.NS	4.278990	17.637174	32.962088	-7.462701	39.118161
CUMMINSIND.NS	10.497740	7.937154	22.563505	-1.989996	19.903689
UNOMINDA.NS	18.324930	24.028504	35.479448	0.187292	45.242447
SCHAEFFLER.NS	19.814790	19.641310	27.652922	1.246906	31.214031
EXIDEIND.NS	3.666631	6.643226	16.516007	1.460265	22.220721
APOLLOTYRE.NS	12.344164	9.855032	10.490308	-7.482196	21.579788
TIMKEN.NS	4.611465	19.670795	5.928033	-2.825830	24.227026
JBMA.NS	12.205925	25.042825	45.027717	0.678198	53.642148
CASTROLIND.NS	3.585103	3.795263	4.529562	-2.307650	4.246890
MEAN RETURN	12.260892	15.628360	21.767732	0.049438	27.518221

Figure 4.4: Output of our strategy for Automobile sector

Next we move to Banking sector. As the name suggest this sector contains as the banking related stocks. The results are

index	VWMA	MACD	EMA	RSI	CTIND
ICICIBANK.NS	6.990787	5.931145	15.263252	5.162359	14.096371
HDFCBANK.NS	3.317311	8.663896	9.648476	1.387636	18.606827
AXISBANK.NS	10.242952	11.288693	19.383236	1.658065	22.900440
KOTAKBANK.NS	12.742227	17.038176	21.805542	8.351353	27.408986
SBIN.NS	8.364613	16.611033	10.575650	0.577047	19.514633
BANKBARODA.NS	16.413653	20.740621	12.514342	-0.338115	20.729225
PNB.NS	14.471414	21.166749	11.431108	4.126911	23.529519
INDUSINDBK.NS	3.438395	6.380339	20.882952	-4.010016	25.169275
BANDHANBNK.NS	6.950685	23.184685	-9.639091	4.349000	2.144276
IDFCFIRSTB.NS	10.725268	13.796395	5.786731	-6.105646	11.038636
UNIONBANK.NS	15.024473	7.303117	9.577713	0.437866	12.708604
CANBK.NS	8.139358	10.511166	8.833946	3.042801	13.468288
IDBI.NS	-2.817995	11.442255	0.050899	-0.581906	16.555448
YESBANK.NS	4.167144	-5.669862	9.157133	-3.890849	6.889150
CENTRALBK.NS	10.362532	16.392759	8.749583	-5.352737	20.490042
RBLBANK.NS	7.241225	11.723006	12.968540	-13.855632	16.039334
KARURVYSYA.NS	21.683650	27.793754	11.655897	-1.580973	26.003277
FEDERALBNK.NS	14.251090	18.119730	16.636987	1.887607	26.831247
MAHABANK.NS	8.419886	6.185657	13.244286	-5.475937	12.883639
IOB.NS	2.300034	15.978256	11.677926	-2.363988	15.426928
MEAN RETURN	9.121435	13.229079	11.010255	-0.628758	17.621707

Figure 4.5: Output of our strategy for Banking sector

Next we move to FMCG sector. FMCG stands for 'Fast Moving Consumer Goods'. This includes companies which manufactures eatable thing , beverages , personal care items , household goods etc. The result is

index	VWMA	MACD	EMA	RSI	CTIND
HINDUNILVR.NS	5.458320	6.557248	3.536738	1.064567	5.966743
NESTLEIND.NS	7.512367	4.421642	5.679193	0.016414	5.544046
VBL.NS	13.284059	23.653289	32.001676	11.423033	42.644051
GODREJCP.NS	9.063263	9.837278	8.177534	4.362743	17.844412
BRITANNIA.NS	17.780867	13.765225	17.582410	-3.812716	20.354281
ITC.NS	0.402376	5.696881	5.157608	0.607716	11.244093
COLPAL.NS	7.701297	8.730869	8.099820	4.950465	13.996829
DABUR.NS	3.682591	2.353178	11.203671	2.632062	14.447083
MARICO.NS	1.965827	2.028222	13.889219	0.238051	18.449727
GLAXO.NS	5.016326	6.809434	7.572681	-2.339974	10.262787
JUBLFOOD.NS	9.077563	12.721218	16.710564	3.706696	28.429641
GILLETTE.NS	14.488390	12.868574	14.236144	-1.176431	20.086268
GODFRYPHLP.NS	17.066585	6.861798	6.485764	-0.744270	10.704104
JYOTHYLAB.NS	9.944234	7.325276	16.309854	0.545995	17.922461
ZYDUSWELL.NS	3.317621	11.105925	11.998279	-2.127625	15.074679
ORIENTELEC.NS	9.000376	4.707643	-0.623011	-7.894164	5.983465
HNDFDS.NS	-19.864749	-10.661588	-15.756580	21.505125	-4.494806
SAFARI.NS	16.296728	31.063109	51.194352	1.475346	48.606341
VIPIND.NS	20.232993	23.875174	22.540868	-6.263399	35.771712
BAJAJCON.NS	-2.457741	3.551047	5.975509	-7.538082	10.398150
MEAN RETURN	7.448465	9.363572	12.098615	1.031578	17.461803

Figure 4.6: Output of our strategy for FMCG sector

Finance sector contains stocks of companies which provide financial services like loan , asset management etc. The result is

index	VWMA	MACD	EMA	RSI	CTIND
BAJFINANCE.NS	34.988837	22.057157	50.370015	4.682753	49.350651
BAJAJFINSV.NS	28.069939	8.468655	26.394718	0.618953	19.476231
IRFC.NS	52.339731	57.576859	59.503281	2.660312	71.092467
PFC.NS	10.101934	13.345880	16.218976	-2.371482	20.131343
CHOLAFIN.NS	16.670597	20.596749	31.552389	-2.312268	38.689189
SHRIRAMFIN.NS	8.725086	17.498807	20.778515	8.700144	28.453621
BAJAJHLDNG.NS	16.904020	12.057726	17.638364	1.465548	21.246518
CHOLAHLDNG.NS	12.595785	18.215609	29.280290	-4.229201	31.865523
HDFCAMC.NS	7.735777	10.831091	19.856135	-13.051786	27.906048
SBICARD.NS	-0.862858	-3.248839	8.235147	2.780297	-0.272209
MUTHOOTFIN.NS	8.706485	13.156683	8.116119	0.888762	18.827464
SUNDARAM.NS	-13.234538	7.389005	-5.829270	-5.135632	1.100486
L&TFH.NS	8.018182	16.591342	9.289638	7.604677	19.554818
HUDCO.NS	11.563270	25.971043	5.841365	4.071147	16.895104
LICHSGFIN.NS	14.119483	18.490135	11.914369	-5.137047	21.029450
MFSL.NS	-1.695169	18.401193	2.957806	12.318100	13.799739
TATAINVEST.NS	20.374816	15.700080	16.067694	3.078924	22.118444
MOTILALOFS.NS	25.232393	19.830373	16.365326	-13.627981	19.280984
ISEC.NS	8.394217	6.024247	19.937044	-2.798188	29.310707
ANGELONE.NS	75.591814	81.496505	91.082455	-2.077809	106.855243
MEAN RETURN	17.216990	20.022515	22.778519	-0.093589	28.835591

Figure 4.7: Output of our strategy for Finance sector

Healthcare Sector contains stocks of companies which have their presence in medical fields. The result is

index	VWMA	MACD	EMA	RSI	CTIND
SUNPHARMA.NS	6.083800	12.071005	12.281334	2.072871	18.362317
CIPLA.NS	2.330702	4.347527	4.271914	-12.856323	10.062746
DRREDDY.NS	3.480290	4.451695	8.143985	-5.547628	12.290149
DIVISLAB.NS	17.980312	16.503221	20.921543	3.659795	26.380198
MANKIND.NS	20.742716	-9.041717	5.431083	0.000000	14.244075
ZYDUSLIFE.NS	3.718283	6.012217	14.386773	-5.913524	20.097737
APOLLOHOSP.NS	4.282164	7.896962	10.195613	5.316414	17.113079
TORNTPHARM.NS	8.340754	8.490080	12.657856	5.777643	18.605842
MAXHEALTH.NS	42.465712	9.607038	48.034360	-3.638665	48.707943
LUPIN.NS	17.096853	15.752707	18.657586	3.406881	19.796138
AUROPHARMA.NS	13.957138	9.898696	25.448001	-5.521126	25.413431
ABBOTINDIA.NS	7.625239	17.550884	12.689134	8.189991	20.808421
ALKEM.NS	14.240521	12.020265	8.249550	6.863075	12.395799
IPCALAB.NS	16.371394	17.408606	23.973436	0.815258	30.959516
FORTIS.NS	-3.441400	4.970913	-1.390617	-1.053275	4.810756
BIOCON.NS	-2.805292	-3.694308	4.572269	-2.685877	9.205977
GLAND.NS	16.472291	5.143729	13.027229	-12.163242	4.910090
GLENMARK.NS	13.862171	9.249821	26.728943	4.234594	31.120379
SYNGENE.NS	3.147130	2.920459	8.080755	-1.850596	14.633323
AJANTPHARM.NS	13.065133	16.216425	23.663313	-3.767150	34.182812
MEAN RETURN	10.950796	8.388811	15.001203	-0.733044	19.705036

Figure 4.8: Output of our strategy for Healthcare sector

Power sector consists of companies that either produce power or do some kind of exchange in power. The results are

index	VWMA	MACD	EMA	RSI	CTIND
NTPC.NS	6.507470	8.341743	0.898713	1.345742	6.917494
POWERGRID.NS	-5.738392	0.217372	0.682362	3.657275	1.227652
TATAPOWER.NS	5.371308	18.085107	9.696799	1.805090	20.647026
ADANIPOWER.NS	23.021741	20.302671	18.567634	1.107990	22.994170
JSWENERGY.NS	4.241575	4.048235	15.198579	4.483899	17.108493
NHPC.NS	0.366785	6.695656	0.947942	-3.483067	8.830659
TORNTPOWER.NS	12.175024	15.501388	12.006137	2.435490	20.057652
SJVN.NS	0.638202	1.559582	0.727996	2.835303	5.781669
INDOWIND.NS	6.756824	3.028072	-0.358721	-4.274852	0.365480
NLCINDIA.NS	9.204906	21.549677	8.590300	-5.890119	21.479684
CESC.NS	11.953987	13.127971	15.081008	-0.817373	26.948040
IEX.NS	2.032877	7.459335	12.872934	-0.130856	10.226816
SWSOLAR.NS	2.369029	32.152672	7.640031	0.758441	35.788870
RPOWER.NS	11.377940	9.960804	0.802750	-10.393945	0.944604
INDIGRID.NS	3.392974	8.105435	2.836963	0.341561	5.972160
INOXWIND.NS	13.486312	19.520369	11.605051	-11.261251	31.975707
NAVA.NS	14.561121	16.630448	22.939880	1.268779	24.874252
PTC.NS	1.249884	2.804068	5.959600	-3.508363	4.696116
RTNINDIA.NS	32.122491	43.092360	29.104113	-8.557425	38.083118
KIRLOSIND.NS	30.465361	20.321253	43.226978	-6.900171	40.828850
MEAN RETURN	9.277871	13.625211	10.951352	-1.758893	17.287426

Figure 4.9: Output of our strategy for Power sector

Now we come to our last sector for analysis. IT sector is one the major sector in India that has helped India to grow at international level. The results are

index	VWMA	MACD	EMA	RSI	CTIND
TCS.NS	7.693037	9.006658	9.235779	8.744297	18.248643
INFY.NS	1.726025	2.492615	9.146031	1.681209	9.305600
HCLTECH.NS	4.343624	1.163197	9.951135	4.826636	16.229801
WIPRO.NS	2.488233	4.749323	10.234011	-0.004965	12.295457
ZOMATO.NS	-2.965668	-9.687389	30.820461	-9.358597	22.516469
LTIM.NS	20.393914	17.645429	30.186885	9.785914	39.326872
TECHM.NS	13.899901	6.217618	15.808535	-3.842439	15.408187
IRCTC.NS	32.479584	39.777765	31.040598	-6.096251	44.663169
OFSS.NS	12.054974	8.916799	14.345150	-2.272518	19.894685
PERSISTENT.NS	17.360719	24.554129	25.613363	2.702629	37.161727
TATAELXSI.NS	20.240700	21.104982	27.342948	-5.360589	31.427181
MPHASIS.NS	5.300858	4.602513	13.737560	4.295226	14.658812
KPITTECH.NS	18.732696	42.586938	82.699078	6.206406	106.246150
COFORGE.NS	14.042910	14.162019	15.696826	3.714004	25.678905
PAYTM.NS	-0.751437	-18.373952	8.394367	-3.325446	-8.180944
CYIENT.NS	12.742803	9.688338	25.849218	0.131223	27.878925
SONATSOFTW.NS	16.488921	13.319770	23.372129	0.639450	25.243282
BSOFT.NS	12.881869	20.072338	29.395160	1.593246	36.758351
AFFLE.NS	48.069671	36.379297	34.645042	7.412630	39.153631
ZENSARTECH.NS	15.263211	16.168195	26.778628	6.198209	22.788129
MEAN RETURN	13.624327	13.227329	23.714645	1.383514	27.835152

Figure 4.10: Output of our strategy for IT sector

Sector	VWMA	MACD	EMA	RSI	CTIND
Automobile	12.27	15.60	21.64	0.06	27.52
Banking	9.12	13.23	11.01	-0.63	17.62
FMCG	7.45	9.36	12.10	1.03	17.46
Finance	17.22	20.02	22.78	-0.09	28.84
Healthcare	10.96	8.39	15.00	-0.73	19.70
Power	9.28	13.63	10.95	-1.76	17.29
IT	13.62	13.23	23.71	1.38	27.83

Table 4.1: Comparison of strategies
Here entries represent the annualized return the strategy has given over a period of 24 years.

The numbers indicate average return generated by a specific strategy for 20 stocks over a data of more than 10 years. We will be using average return generated by a strategy for comparison and arrive at the conclusion of best performing strategy.

Sector	Best Performing Strategy
Automobile	EMA and CTIND
Banking	MACD and CTIND
FMCG	EMA and CTIND
Finance	EMA and CTIND
Healthcare	EMA and CTIND
Power	MACD and CTIND
IT	EMA and CTIND

Table 4.2: Results of Backtesting
Top 2 best performing strategies for every sector.

From the above table we can infer that among all the strategies, EMA and CTIND are the strategies that outperformed everyone else. Especially the custom indicator that we created by combining the MACD and EMA

indicator outperformed the EMA as well. This shows us that combining strategies can result in better strategies.

EMA outperformed others except the custom indicator. In EMA, we had 3 lines indicate 12,24,55 days moving exponential average. So we get a quick response to the market change due to 12 day EMA and get a late response due to 55 day EMA. As EMA is more quick to react to changes, this strategy did perform well as compared to others.

MACD is an oscillator indicator. MACD did perform better than EMA in few sectors. But MACD reacts with a lag to the price changes. This is one of the main reason why it did not perform in some cases.

RSI is an oscillator indicator. The strategy performed worst amongst all the others. This could be due to the threshold set i.e 30 for oversold and 70 for over bought. As in some case, even in uptrend RSI did not give any signal and stayed within the limits. Signal is only generated when the RSI value falls below 30 or rises above 70. But majority of times, RSI remains within this bound due to which a lot of trading opportunities are missed.

VWMA is an overlay indicator. Here we are using 13 day VWMA and 20 day VWMA. This strategy did generate a decent return. Here we considering the volume weighted average. This indicator also lag a bit due to which we miss upon entry points.

CTIND is the strategy that we have generated by combining trading logic from MACD and EMA strategy. Here using both strategy, we are combining both of their good factors. Due to this, we were able to avoid false signal and generate a more robust strategy. This strategy performed better than every other strategy due to this reason.

Chapter 5

Conclusion

Creating an automated trading system requires robust strategies. The strategies that we created did perform by generating decent return. We observed that, the more a strategy is sensitive to price change, the more we are at advantage given that we have a proper logic for the strategy. If that isn't the case then we can end up in huge loss. The strategies that we worked with, individually did well but upon combining them, we observed that the resultant strategy outperformed all the others. This always may not be the case. But looking at the patterns and refining our logic will result in better strategy. Every strategy needs to be backtested on historical data and its performance must be evaluated.

So our final conclusion is that the custom indicator did help us gain more return as compared to others. This indicator incorporated the qualities of both the strategies i.e MACD and EMA. So using multiple strategies for signal production will help us in gaining more return.

5.1 Further Improvement

Here in this project we did focus only on generating maximum return without actually optimising for other factors such as number of trades executed. This would affect our overall profit as more trades implies more commission. So we could optimize our simulation to maximize profit and minimize number of trades. We could also consider various ratio as discussed earlier for optimization.

Further we could also consider finding better parameters for testing a strategy. This is done using backtesting.py where we perform a grid search to find optimal parameters that would help us in maximizing our return. In backtesting.py we can create our optimising function that we can feed into our simulation so as to achieve necessary results. The feature of finding best parameters using grid search will help us in tuning our strategy and thereby improving the performance of the strategy.

We can observe that our strategies react to changes in market with a lag. This can be observed in MACD. This is the divergence that we can incorporate in our strategies to make them more robust and resistant to generating false signals. Many times we observe that false signals are the root cause of loss. Working on reducing false signals would help us in reducing our loss.

We can further do this analysis on more sectors and arrive at a similar conclusion. Creating new strategies out of existing can lead to better performance as demonstrated above. We can incorporate market sentiment and other patterns of stock market like (head and shoulder pattern) etc in our analysis to make our strategies perform in more better way. These are few improvements that can be done as a part of further work.

Bibliography

[1] Exponential moving average (ema). https://www.investopedia.com/terms/e/ema.asp.

[2] Moving average convergence divergence (macd). https://www.investopedia.com/terms/m/macd.asp#:~:text=MACD%20is%20calculated%20by%20subtracting,an%20exponentially%20weighted%20moving%20average.

[3] Relative strength index (rsi). https://www.investopedia.com/terms/r/rsi.asp.

[4] Ta-lib. https://github.com/ta-lib/ta-lib-python.

[5] Trading view. https://in.tradingview.com/chart/0X6tuRfW/.

[6] Volume weighted moving average (vwma). https://fxopen.com/blog/en/what-is-a-volume-weighted-moving-average-vwma/.