Exploring Algorithmic Solutions for Effective Decisions Concerning Investments in Equity Stocks Amidst Financial Disruptions Using the COVID 19 and Sub-prime Crises as Case Studies

Shaunak Mainkar*[1] , Hemangi Borawake[2] and Tanishq Ranjane[3]

Abstract

Investors face a basic dilemma during a financial crisis i.e., whether to exit and re-enter or to continue with the existing set of positions. The timing of entry and exit plays a crucial role in determining the rate of returns generated by a portfolio. Thus, the problem faced by investors during a crisis is whether to exit or to continue and how to determine the timing of exit if the first option is chosen. This research paper attempts to find solutions to the problems faced by investors.

The research paper focuses on addressing the parameters used to determine the exit and re-entry and the time factor associated with it. A timely entry in the right stocks will lead to a good return on the portfolio. The research paper is an attempt to determine the factor by which rate of return is affected if the norms of timely entry and exit are followed.

The team of researchers has identified two specific times in the history of financial markets when the fall in the markets was considerable and led to a lot of confusion amongst investors. These two times are the case studies for comparison: The first one is the sub-prime lending crisis in 2008-09 and the second one is the fall due to COVID-19 in 2019-20. These two events underline the fact that decision making in the financial markets is a very subjective domain and the returns are dependent on the system followed by the investors.

JEL: B26, C51, D91, E71 **SDG:** SDG8, Target 8.A

Keywords: Financial crisis, investment, sub-prime crisis, COVID-19, portfolio.

[1] Assistant Professor, IMDR, Pune. Corresponding Author.shaunak.mainkar@imdr.edu
[2] Student, IMDR, Pune. hemaborawake52@gmail.com
[3] Student, IMDR, Pune. tanishqranjane2@gmail.com

Disruptions in the financial markets is not a recent discovery. Ever since the birth of financial instruments, the market values have been undergoing ups and downs on a frequent basis. Liquidity is what distinguishes the financial markets from other forms of markets and the forces responsible for liquidity result in adding volatility to the prices of the instruments. Thus, disruptions are very much the building blocks of the markets.

These disruptions result in the creation of price variances that can be utilized as opportunities in the stock market. Such opportunities are broadly of two types i.e., Exit before disruption and entry after disruptions. Investors are concerned about their investments and the rate of return during times of crisis. They must decide to determine a suitable exit to avoid a fall in the rate of return due to the disruptions; also, they must decide their entry after the start of a bull run.

The main concern of investors during the crisis is the decision of 'sell or hold'. During any period of crisis, a disinvestment at a particular time and re-investment at another time will help investors protect themselves from any major loss of return. It is observed that long-term investors do not resourcesvest from the markets during a shorter timeframe; however, a timely exit from the markets can save time and the resources can be allocated in the productive sector.

The stock market is well known for the volatility it encounters. The spillover of volatility was highly witnessed during the black swan events such as the subprime mortgage crisis & COVID-19 pandemic. The COVID-19 pandemic swiftly spread over the world and had a significant impact on the financial markets. Its spread wrecked the market, and risk-averse investors quickly incurred large financial losses. Similarly, there was dramatic change caused by the global financial crisis in 2008.

Nifty 50 fell 64.56% from its topmost point during subprime lending crisis in 2008-09. It was a fall of unprecedented intensity and magnitude. A similar kind of fall in the markets was experienced as an effect of COVID-19; a fall of 39.58% from its topmost point. By taking both the falls as case studies, this research is attempting to find ways to protect investors from the fall by exploring algorithmic solutions to the problems faced by investors.

Figure I: Fall during 2008

Figure II: Fall during COVID-19

Literature review:

1. **(Ganie, 2022) -** During the lockdown period, most stock exchanges were open to trading and impact of COVID19 on economic activity created fear amongst participants. It was observed that, initially, markets reacted relatively well to the virus' arrival in new areas, but fear built up as it spread. The effect of pandemic on market was such that in March 2020, the Indian stock market NIFTY 50 and BSE had been suspended twice in 15 days after falling by 10%. The major impact is evident as the indices generated negative means if returns of −0.052.
2. **(Guru BK, 2020)** - This research paper through its findings states that, total volatility spillovers reached 69% during COVID-19. The major net volatility transmitters were the energy sector, followed by the oil and gas sector. Whereas the net beneficiaries of volatility were FMCGs followed by telecommunications, information technology, real estate, and healthcare.
3. **(Mainkar, 2019)**: This paper is an attempt towards developing a scientific view towards perceiving the stock price moves. All stock price moves are merely data and thus statistics can be used to predict the future stock price movements by considering the present price moves.
4. **(Mainkar, 2020):** This research paper establishes swing trading as a means towards achieving financial innovation for individual traders and investors. It mentions the statistical techniques that can be used to predict stock price movements in the short-term.
5. **(Deinwallner, 2020)** - The author, through an analysis investigates whether an investor should hedge or sell a stock portfolio during a crisis. It is suggested through the findings that, hedging a portfolio is more profitable than not hedging a portfolio, but not important, if hedging profits are reinvested in the portfolio. Selling in the event of a decline in the market, holding cash or investing in alternatives is clearly more profitable than hedging an account. It is notable that hedge funds can buy time for investors to decide on the crisis and assess its scope. In essence, when markets are at risk of distress, the investor can hedge by selling.
6. **(Stephanos Papadamou, 2023):** Key findings of this research paper shows that, all positive and negative market moving events affecting the underlying equity index shall be considered in the level of volatility index, as it is derived directly from option prices. It is a volatility measure which differs from any option pricing model in that it represents the risk Neutral Risk Tolerance Measure for anticipated volatility and so also includes both market uncertainties and investors' hesitations to take risks. Investors tend to expect higher expected volatility in the underlying equity market. To protect themselves from

future losses, they are willing to pay higher premiums for out-of-the-money options, while simultaneously purchasing out-of-the-money options and participate in the potential reversal of the stock price, this is leading to more expensive options and higher implied volatility.

7. **(Cevik, 2022)** - Found significant relationships between investor sentiment and stock market returns and volatility. An increase in positive investor sentiment leads to a rise in returns of stocks even though negative investor sentiment decreases stock returns. Across the distribution, investor sentiment has a clear effect on volatility: negative attitudes increase volatility and positive attitudes reduce it.
8. **(P. Bhatia, 2020):** The results of this research paper show that, according to the symmetrical model used, NBI (Nifty Bank) and PSBI (Public Sector Undertaking Bank) have remained most volatile during the subprime crisis. It was the lowest for PSUBI with asymmetric effects. In the subprime crisis and in COVID-19, leverage effects have been significant for all three indices, but PSUBI appears to be of particular importance. It may be concluded with these results, there's a negative shock of the subprime crisis over any further good news persisted during that period for each of the indices, the same was not true for COVID 19. It further suggested that NBI and PSBI (Private Sector Bank) may be a good source for investors to hedge the portfolio in the long run.
9. **(Doukas, 2012):** The paper examines whether technical currency trading by individual currency traders is profitable. The results show a negative correlation with performance in the case of Technical Analysis. Furthermore, the cross section of revenues for each currency trader is appropriately described in the technical trading model that has been developed. This result arises because individual currency traders use well-known technical indicators to trade currencies, which implies that such currency traders suffer from reduced performance.

Research Gaps:

All the papers reviewed have tested certain applications of technical analysis and statistical indicators in the financial markets; however, testing the same during crisis isn't the subject matter of any of the research papers. This research paper attempts to compare, contrast and evaluate the use of a system during two biggest falls faced by the financial markets and attempts to find a system that has a high possibility of working in the future crisis as well. Furthermore, there is a need of addressing the utility of algorithm in this domain. This research paper addresses the need in depth.

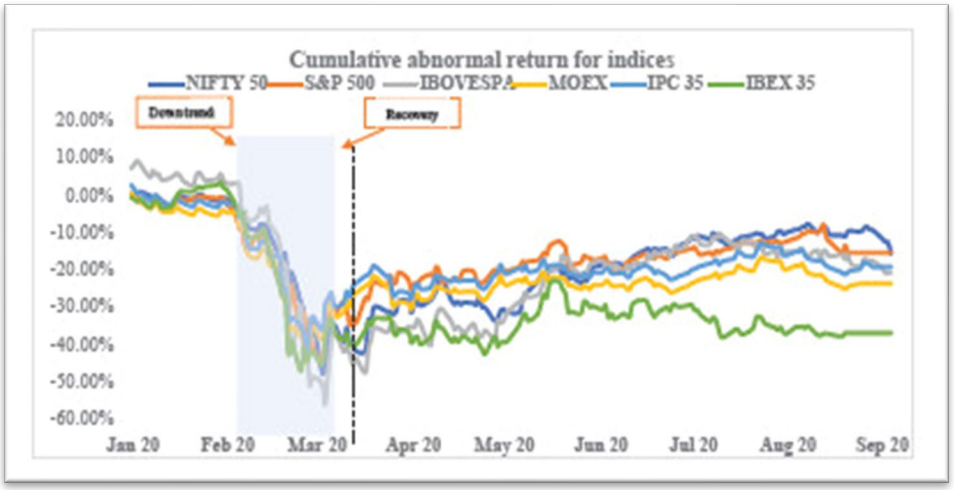
Research Objectives:

1. To test the use of algorithms in taking investment decisions specifically associated with exit and re-entry or continuation of existing portfolio without any change.
2. To study the application of statistical indicators in determining entry and exit in stocks.
3. To define the types of entries and exits and verify their effects on the rate of return of a portfolio.
4. To back test the algorithm at the time of crisis to derive conclusions on the same.
5. To develop a system that recommends entry and exit from the markets during times of crisis.

Research problem:

The disruptions caused by black swan events such as COVID-19 pandemic and sub-prime crisis, may affect investment portfolios in various ways. These can be in the form of rapid & severe market fluctuations, variations in industry and sectors, impact on diversified portfolio, changes in the interest rates and monetary policies. This type of implication highly impacts the portfolios and leads to instability of the same.

Figure III: Abnormal Returns during Covid 19 period



Source:Ganie, I. R., Wani, T. A., & Yadav, M. P. (2022)

Pertaining to black swan events, two types of losses faced by the investors are loss of return and loss of time. Loss of returns would occur when a stock is exited at a loss because of a fall in the stock price. Loss of time would occur when investors decide to hold the stock in expectation of a price rise. Investors holding stocks in expectation of a better price in the future face a lower annual rate of return. Investors selling their holdings face an opportunity cost.

Fall from high can be considered a measure of determining probable losses in stocks. The magnitude of the fall in a matter of couple of weeks denotes the immediate effect of the disruptions caused by black swan events. Hence, the examples of three stocks in Covid 19 pandemic, belonging to different sectors and having a weightage in the respective sectors have been quoted below in this regard: Reliance Industries Ltd, HDFC Bank Ltd, Larsen & Toubro Ltd.

Figure IV: Reliance Industries Ltd fall

Figure V: L&T Ltd fall

Figure VI: HDFC Bank Ltd fall

To tackle this type of scenario, an investor should be able to follow a system that indicates a continuation or an exit in the case of crisis. Using fintech solutions specifically algorithms is a proposed solution given by this research paper that would help investors to mitigate the risk associated with such disruptions. These algorithms deliver sensitive exit and stable entry on to the market.

Definitions:

Stable Entry: It is a term utilized to determine the timing of buying a stock. An entry made after having at least two confirmations in a longer time frame is called a stable entry.

For the purposes of this research paper a stable entry will be given when the following three criteria are met on a weekly timeframe:

1. 8 EMA crosses above 100 EMA.
2. Relative Strength Index is above 60.

Stable Exit: A reversal of the entry condition in the longer time frame signifies a stable exit. Thus, in this case a stable exit will be given when both the following conditions are met **on a weekly timeframe**:

1. 100 EMA crosses below 8 EMA.
2. Relative Strength Index is below 40.

Criteria for sensitivity:

Sensitivity is decided by the timeframe chosen. Timeframe and sensitivity are inversely related to each other. A higher timeframe reduces the sensitivity and lesser timeframe improves the sensitivity. For this research paper's purposes, change in the timeframe from weekly to daily has reduced sensitivity.

Sensitive Entry: A fulfilment of entry conditions in shorter timeframe leads to a sensitive entry. Thus, when the following conditions are met **on a daily timeframe:**

1. 8 EMA crosses above 100 EMA.
2. Relative Strength Index is above 60.

Sensitive Exit: An exit with a smaller timeframe will make the exit sensitive. The following conditions when satisfied on a daily timeframe:

1. 100 EMA crosses below 8 EMA.
2. Relative Strength Index is below 40.

Selection of a combination:

After reviewing the definitions, the following combinations can be observed:

a) Stable Entry and a Stable Exit.
b) Stable Entry and a Sensitive Exit.
c) Sensitive Entry and a Sensitive Exit.
d) Sensitive Entry and a Stable Exit.

During the study of both the crises, it was observed that the probability of crisis leads to a sudden rise in volatility in the financial markets and a delay in decision for a single day may lead to a considerable fall in the rate of return from the investments. To avoid such a situation and to protect the portfolio returns of the investors, this study recommends a sensitive exit.

Further, during the fall, it was observed that there are sudden corrections that are bullish in nature. Investors confuse the temporary bullish action with a reversal of trend and start entering the markets only to get trapped for a longer time. Hence, a sensitive entry during crisis creates greater confusion and needs to be avoided.

Alternatively, a stable entry after the crisis would lead to a better return on the portfolios and reduce the transaction cost due to a reduced frequency of transactions in the portfolios. It will lead to an entry after multiple confirmations and hence an improvement in the portfolio's stability.

Hypothesis:

1. H1**:** Sensitive Exit enables a save from a major loss of return during crisis.

   H0: Sensitive Exit does not have any effect on the rate of return of a portfolio.

2. H1: Stable entry enables a long-term entry into stocks.

   H0: Stable entry does not give a long-term entry in the stocks

3. H1: Sensitive Exit and a stable entry are a good combination during times of crisis

   H0: Sensitive Exit and a stable entry can have a better alternative combination during times of crisis.

4. H1: Using algorithms is beneficial for taking investment decisions.

   H0: Using algorithms is not beneficial for taking investment decisions.

Research Methodology

This paper's research is based on secondary data and is descriptive in nature (survey based). For research purposes, data is collected from secondary sources such as websites, portals and published sources such as journal articles and research papers.

Black swan events such as the sub-prime crisis of 2008-09 and COVID-19 are taken as case study for the analysis. Highly weighted stocks of various sectoral indices listed on the National Stock Exchange are used as sample of the study. Major parameters used for the purpose of testing hypothesis are technical indicators viz, Relative Strength Index (RSI) and moving average exponential (EMA).

In this paper, we have decided to choose sectors that represent NIFTY 50. The reason behind choosing highly weighted stocks listed on the National Stock Exchange is as it represents the entire NIFTY 50 which has a long history of strong performance over the past 20 years with around 14% annual returns. One of the other reasons is the NIFTY 50 is a very liquid index, which means there are always buyers and sellers, which makes it easy to buy and sell shares in the index.

These are the following Sectorial Indices covered in the paper:

- NIFTY Auto Index
- NIFTY Bank Index
- NIFTY Financial Services Index
- NIFTY FMCG Index
- NIFTY IT Index

- NIFTY Media & Entertainment
- NIFTY Metal Index
- NIFTY Pharma Index
- NIFTY Private Bank Index
- NIFTY Public Sector Bank Index
- NIFTY Realty Index
- NIFTY Consumer Durable Index
- NIFTY Oil and Gas Index

This paper suggests usage of two of the utmost important technical Indicators i.e Relative Strength Index (RSI) and, Exponential Moving Average (EMA). The use of Relative Strength Index (RSI) has been done as it is an Indicator that measures the speed and magnitude of price changes. RSI can help the traders to identify potential reversals in the market. As per the settings suggested in this paper when RSI falls in the overbought position, it can suggest that the security may be due for correction and when in oversold position, it suggests that security may bounce back after making a base the bottom. The RSI 60 and 40 strategy is based on the idea that when RSI crosses 60, it is a signal that the stock is picking up momentum and can be bought simultaneously checking the Exponential Moving Average. On the other hand, when RSI crosses below 40, it is a signal that we need to exit our stock as it is showing lesser strength and may get into a phase of consolidation.

The use of Exponential Moving Average in this paper is used as it helps to Identify trends, identify support and resistance levels, and helps in confirming signals from other indicators. Exponential Moving Average is a type of moving average that gives more weight to recent price data than to older price data. When the Exponential Moving Average is rising, it indicates that the market is in a bullish trend. When the Exponential Moving Average is falling, it indicates that the market or any stock has lost momentum and is in a bearish trend.

In this paper, we have used the strategy of 8,48, and 100-day exponential moving averages (EMAs).

The 8-day EMA is a short-term moving average which is indicated using a green line. The 48-day EMA is a medium-term moving average indicated using a yellow line and the 100-day EMA is a long-term moving average indicated using a red line. The concept behind using EMA is that when the green line i.e., 8-day EMA crosses the red line i.e., 100-day EMA in an uptrend is an Indication of a stable entry on a time frame which is 1 week on charts. This, when clubbed with the Relative Strength Index crossing the mark of 60, would lead to an entry into the market. On the other hand, when the red line i.e., 100-day EMA crosses the green line i.e., 8-day EMA in a downtrend and when RSI falls below the mark of 40 it would suggest we sell off our positions in the market on a time frame which is 1 week on charts.

Sample size:

A sample of two heavy weight stocks of each sector have been selected as a sample to test the data of various entries and exits taken from 2008-09 and 2019-20.

Criteria for selection of sample size

1. Sectorial heavy weights are the benchmarks:

Understanding the behavior of highly weighted stocks is crucial for studying fluctuations in a particular sector. These stocks significantly represent the sector and often amplify the impact of such events. Studying them helps gauge the severity of the disruption and its cascading effects on the entire sector. Apart from

scaling the impact of disruption, high weighted stocks capture the trends and movements that drive the sector's performance.

For instance, if these stocks experience a sharp decline during a black swan event, it can indicate broader challenges within the sector. Conversely, if they remain resilient, it suggests sector-specific strengths. Therefore, movement in highly weighted stocks is often followed by similar changes in the sector's other stocks. It is evident that investors often use these stocks as benchmarks to assess the sector's direction and make strategic decisions.

2. Stocks experiencing both the events:

Stocks that have experienced both the events have been considered for the study so that comparison can be made on a suitable basis. The results of testing are also comparable because the effect of both the events, namely sub-prime crisis and Covid 19 pandemic can be studied for the same stocks. Therefore, considering the indicator role of highly weighted stocks of the respective sector. This research paper studies the stocks that have experienced the impact in both the events, namely Sub-prime crisis, and COVID-19.

Justification of Sample Size:

A sector-wise classification of the list of the stocks selected for sample study is as follows:

Table I: Sample size

Sector	Company
Auto	M&M
	Maruti
Bank	HDFC
	ICICI
FMCG	ITC
	HUL
IT	Infosys
	TCS
Media Entertainment	ZEEL
	PVR Inox
Metal	Tata Steel
	Adani Enterprises
Pharma	Sunpharma
	Dr. Reddy
PSUs	SBI
	Bank of Baroda
*Realty	DLF
Consumer Durable	Titan
	Havels
Oil & Gas	Reliance
	ONGC

***(Reality sector consists of only one stock which is a heavy-weight and present during both the periods of disruptions)*

Secondary Data Analysis- Researchers have considered two highly weighted stocks of the sectorial indices of NSE. The following data was collected for stable entry post COVID-19 pandemic and sub-prime crisis of 2008-09 using the RSI and EMA indicators suggested by the researchers.

Table II: Data of COVID-19 pandemic stable entry

COVID 19 Pandemic					
Sr. No	**Name of Index**	**Company**	**Date of entry**	**Date of exit**	**Point of return**
1	NIFTY Auto	M&M	28.03.2022	-	91.73%
		Maruti	12.10.2020	26.04.2021	12.74%
2	Bank	HDFC	28.9.2020	2.5.2022	28.20%
		ICICI	26.10.2020	-	139.08%
3	FMCG	ITC	13.9.2021	-	105.22%
		HUL	14.2.2022	4.7.2022	-14.63%
4	IT	Infosys	25.5.2020	27.2.2023	115.94%
		TCS	12.9.2022	14.11.2022	-8.68%
5	Media Entertainment	ZEEL	27.9.2021	28.2.2022	38.45%
		PVR Inox	23.3.2020	4.1.2021	-54.04%
6	Metal	Tata Steel	9.11.2020	20.6.2022	135.19%
		Adani Enterprises	27.2.2023	29.5.2023	-29.70%
7	Pharma	Sunpharma	26.10.2020	-	126.14%
		Dr. Reddy	30.1.2023	-	28.11%
8	PSUs	SBI	7.12.2020	-	127.46%
		Bank of Baroda	31.5.2021	-	144.52%
9	Realty	DLF	23.11.2020	-	167.15%
10	Consumer Durable	Titan	3.8.2020	-	196.62%
		Havels	24.8.2020	-	105.80%
11	Oil & Gas	Reliance	20.4.2020	27.2.2023	92.08%
		ONGC	26.4.2021	18.7.2022	29.25%
				SUM	**1576.63%**

Figure VII: DLF Ltd

Figure VIII: Bank of Baroda Ltd

The above images represent the strategy which is used by the researchers. A combination of Relative Strength Index and Exponential Moving Average is used to get an entry in the market. When Relative Strength Index (RSI) crosses the mark of 60 and the 8-day EMA crosses the 100-day EMA it would lead to an entry in the market.

The company Titan gave us an entry with the following strategy on 3.8.2020. RSI crossed the mark of 60 and the green line crossed the red line, leading us to entry in the market. From the day of entry i.e., 3.8.2020 till date if the strategy suggested by the researchers had been used, one would have earned a return of more than 195% till date. One who has bought position in this stock can keep holding until the green line crosses the red line in a downward fashion also looking at RSI and if it goes below the levels of 40.

Delhi Land and Finance (DLF) is a leading Real Estate Developer company having numerous projects in hand. When researchers tried to implement a combination of Relative Strength Index and Exponential moving Average strategy on the stock, from the day of entry i.e., 23.11.2020 the stock has given massive returns of more than 167.15% and the trade is still open i.e. the 8-day EMA has not crossed the 100-day EMA in downward trend and RSI remains above the levels of 60, which signifies that more returns can be expected in future.

Bank of Baroda has been doing exceptionally well considering a Public Sector Bank. Using a similar strategy given by the researchers the stock gave an entry around 31.5.2021. Considering the longer time frame the stock has given positive returns of more than 144% to date. An exit in Bank of Baroda would only happen when the 8-day EMA would cross the 100-day EMA in a downward pattern and on a similar level RSI would go below the levels of 40.

Table III: Data of Sub-prime crisis stable entry

Sub-prime crisis					
Sr. No	**Name of Index**	**Company**	**Date of entry**	**Date of exit**	**Point of return**
1	NIFTY Auto	M&M	5.10.2009	18.5.2015	500.50%
		Maruti	6.4.2009	31.1.2011	77.06%
2	Bank	HDFC	11.5.2009	9.3.2020	919.76%
		ICICI	8.6.2009	15.8.2011	54.66%
3	FMCG	ITC	6.4.2009	11.5.2015	275.98%
		HUL	28.6.2010	12.12.2016	222.19%
4	IT	Infosys	18.5.2009	1.8.2011	76.84%
		TCS	22.6.2009	11.1.2016	551.58%
5	Media Entertainment	ZEEL	13.7.2009	10.1.2011	46.00%
		PVR Inox	30.11.2009	22.11.2010	10.41%
6	Metal	Tata Steel	7.9.2009	21.6.2010	17.92%
		Adani Enterprises	27.4.2009	26.9.2011	163.07%
7	Pharma	Sunpharma	20.4.2009	30.11.2015	617.15%
		Dr. Reddy	18.5.2009	21.12.2015	498.89%
8	PSUs	SBI	18.5.2009	20.6.2011	81.27%
		Bank of Baroda	13.4.2009	17.10.2011	180.27%
9	Realty	DLF	7.1.2013	13.5.2013	1.46%
10	Consumer Durable	Titan	1.6.2009	9.9.2013	378.53%
		Havells	14.9.2009	20.1.2020	2411.25%
11	Oil & Gas	Reliance	4.5.2009	30.8.2010	18.25%
		ONGC	11.5.2009	14.2.2011	34.80%
				SUM	**7137.84%**

Figure IX: Havells India Ltd

Figure X: Sun Pharmaceutical Industries Ltd

Figure XI: Tata Consultancy Services Ltd

Sensitive Exit:

A sensitive exit is the first question investors face when there is crisis in the visible future ahead. Failure to decide on an exit leads the investors to stay invested in loss making sectors for extended amounts of time. Sensitive Exit as defined earlier is the exit given by a smaller timeframe.

The following data was collected for sensitive exit during sub-prime lending crisis:

Table IV: Data of Sub-prime crisis sensitive exit

Sub-prime crisis Sensitive Exit						
Sr. No	**Name of Index**	**Company**	**Date of Exit**	**Exit price**	**Low**	**Loss saved**
1	NIFTY Auto	M&M	21.01.2008	166.8	59.3	64.45%
		Maruti	10.01.2008	909.2	433	52.38%
2	Bank	HDFC	08.02.2008	144.2	77.4	46.32%
		ICICI Bank	08.02.2008	195.25	45.85	76.52%
3	FMCG	ITC	12.06.2008	66.65	44	33.98%
		HUL	22.01.2008	184.05	220.55	-19.83%
4	IT	Infosys	14.03.2007	252.5	156.9	37.86%
		TCS	15.01.2008	235	103.85	55.81%
5	Media Entertainment	ZEEL	21.01.2008	136.15	46.25	66.03%
		PVR Inox	07.03.2008	229.3	58.2	74.62%
6	Metal	Tata Steel	22.01.2008	67.05	13.75	79.49%
		Adani Enterprises	13.02.2008	348.95	126.15	63.85%
7	Pharma	Sunpharma	22.01.2008	96.9	110.35	-13.88%
		Dr. Reddy	22.01.2008	595	355.25	40.29%
8	PSUs	SBI	04.03.2008	187.55	110	41.35%
		Bank of Baroda	03.03.2008	67.95	34.05	49.89%
9	Realty	DLF	07.02.2008	846.5	124.05	85.35%
10	Consumer Durable	Titan	22.01.2008	55.15	33.35	39.53%
		Havels	24.01.2008	54	10	81.48%
11	Oil & Gas	Reliance	30.01.2008	612.15	245.2	59.94%
		ONGC	22.01.2008	159.9	105.85	33.80%

Figure XII: State Bank of India Ltd.

Figure XIII: Sun Pharmaceutical Industries Ltd

Figure XIV: Maruti Suzuki India Ltd.

Observations during subprime crisis:

Each of the stocks have been exited when a sensitive exit is given as defined above. A sensitive exit is useful for investors already owning the said stocks in the portfolio. The observations given are about an all-sector sample chosen for the study. The same sensitive exit can be applied to any stock in the portfolio. Havells was the stock giving maximum fall from its exit point. Hindustan Unilever and Sunpharma did not show a fall from the exit point.

An overall summary of the observations proves that the system defined above is a high-probability system that holds true for 21 out of 22 stocks selected as sample. Thus, the probability of the system succeeding can be calculated to be 90.90%.

Table V: Data of COVID-19 Sensitive exit

COVID 19 Sensitive Exit						
Sr. No	**Name of Index**	**Company**	**Date of Exit**	**Exit price**	**Low**	**Loss saved**
1	NIFTY Auto	M&M	11.02.2020	524.05	245.4	53.17%
		Maruti	18.02.2020	6781.1	4001.1	41.00%
2	Bank	HDFC	25.02.2020	1200.3	738.75	38.45%
		ICICI Bank	09.03.2020	457.75	268.3	41.39%
3	FMCG	ITC	04.12.2019	243.15	134.6	44.64%
		HUL	18.03.2020	1923.8	1757.3	8.65%
4	IT	Infosys	09.03.2020	704.45	509.25	27.71%
		TCS	28.02.2020	2000.15	1506.05	24.70%
5	Media Entertainment	ZEEL	06.01.2020	261.5	114	56.41%
		PVR Inox	04.03.2020	1662.05	718.3	56.78%
6	Metal	Tata Steel	25.02.2020	42.15	25.1	40.45%
		Adani Enterprises	12.03.2020	160.45	118.2	26.33%
7	Pharma	Sunpharma	11.02.2020	414.6	312	24.75%
		Dr. Reddy	17.03.2020	2781.2	2495.05	10.29%
8	PSUs	SBI	02.03.2020	287.4	149.45	48.00%
		Bank of Baroda	27.01.2020	92.35	36	61.02%
9	Realty	DLF	27.02.2020	208.7	114.55	45.11%
		Godrej Properties	06.03.2020	915.4	505	44.83%
10	Consumer Durable	Titan	12.03.2020	1076.75	720.9	33.05%
		Havells	22.11.2019	638.55	447.05	29.99%
11	Oil & Gas	Reliance	26.02.2020	1378.95	867.45	37.09%
		ONGC	26.11.2019	130.25	50	61.61%

Figure XV: Oil and Natural Gas Corp

Figure XVI: ITC LTD

Figure XVII: Zee Entertainment Ent Ltd

Observations during COVID 19 crisis:

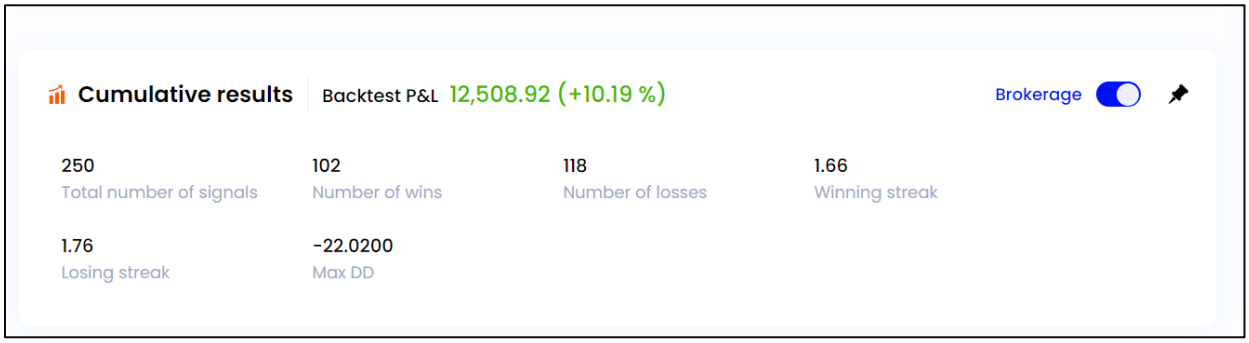
Sensitive exit during COVID 19 also seems to work in the same way as in the sub-prime crisis. Hindustan Unilever didn't have a big fall from the stated exit point. ONGC had the the highest fall from the exit. Investors following the system of sensitive exit will be saved from a fall and will benefit by a timely exit. The probability of being saved from a loss is clearly more than 95% as visible in the table above.

Algorithmic Solution:

After the process of defining sensitive exit and a stable entry, the system was converted into an algorithm, and it was tested during various time periods. It can be observed from the screenshot below that the system works not only during crises but also during normal times. The below screenshot presents data from 10th September 2022 to 10th September 2023. The most recent data has been presented for reference.

The design of an algorithm takes away the role played by emotions in investing. It leads to investments on a more scientific basis. An algorithm can also be converted into a financial product and can be sold to investors who can use it to alert themselves about an entry and exit from their investments.

Figure XVIII: Cumulative results



Summary & Recommendations

A sensitive exit is the best way to stay away from the market during a fall. It saves the investors from a prolonged wait time and invests in productive sectors at the right time.

1. A stable entry after the crisis leads to a positive rate of return in the long run. A stable entry provides a long-term entry point in stocks that is not affected by volatility due to a crisis.
3. An algorithm can be used to replace and reduce the manual task of finding the right time of entry and exit. Deploying an algorithm can help the investors stay away from any emotions during investments and can lead to a scientific approach to investments.
4. During the research it was observed that in a crisis, exit & re-entry is better than continuing with existing portfolio investments. There are two reasons for the same:
    a. Uncertain bottom: It is very unlikely to find out when the fall would end in a crisis. In 2008-09, the fall continued for 1 calendar year. However, Covid – 19 showed a bounce back and a higher high within one year.
    b. Waiting time in unproductive sectors: Failure to exit at the right time leads to an increase in the waiting time for investors. This waiting time in unproductive sectors leads to an added opportunity cost.
5. The rule-based system generated through this research leads to a guidance mechanism for entry and exit in investments. This guidance system holds itself true not only during crises but also during normal times.

Reference list:

Bhatia, P., & Gupta, P. (2020). Sub-prime Crisis or COVID-19: A Comparative Analysis of Volatility in Indian Banking Sectoral Indices. FIIB Business Review, 9(4), 286-299. https://doi.org/10.1177/2319714520972210

Cevik, E., Kirci Altinkeski, B., Cevik, E.I. et al. Investor sentiments and stock markets during the COVID-19 pandemic. Financ Innov 8, 69 (2022). https://doi.org/10.1186/s40854-022-00375-0

Deinwallner, U.R. (2020). Portfolio Management: Hedge or Sell during a Crisis? https://doi.org/10.36348/sjef.2020.v04i05.001

Doukas, Borris.S. Abbey, Is Technical Analysis Profitable for Individual Currency Traders? The Journal of Portfolio Management Fall 2012, 39 (1)142 - 150 DOI: https://doi.org/10.3905/jpm.2012.39.1.142

Ganie, I. R., Wani, T. A., & Yadav, M. P. (2022). Impact of COVID-19 Outbreak on the Stock Market: An Evidence from Select Economies. Business Perspectives and Research, 0(0). https://doi.org/10.1177/22785337211073635

Ganie, I. R., Wani, T. A., & Yadav, M. P. (2022). Impact of COVID-19 Outbreak on the Stock Market: An Evidence from Select Economies. Business Perspectives and Research, 0(0). https://doi.org/10.1177/22785337211073635

Guru, B. K., & Das, A. (2020). COVID-19 and uncertainty spillovers in Indian stock market. MethodsX, 8, 101199.https://doi.org/10.1016/j.mex.2020.101199

Shaunak Mainkar. (2019). Unravelling the science behind Investments. International Journal for Research and Analytical Review. 6

Shaunak Mainkar. (2020). Swing Trading: A Milestone towards Financial Innovation. Our Heritage Journal. ISSN: 0474- Vol-68, Special Issue-13.

Stephanos Papadamou, Athanasios P. Fassas, Dimitris Kenourgios, Dimitrios Dimitriou, Effects of the first wave of COVID-19 pandemic on implied stock market volatility: International evidence using a google trend measure, The Journal of Economic Asymmetries, Volume 28, 2023, https://doi.org/10.1016/j.jeca.2023.e00317

Websites:

1. https://in.investing.com/charts/live-charts
2. https://trade.fyers.in/
3. https://www.researchgate.net/
4. https://shodhganga.inflibnet.ac.in/
5. https://www.sciencedirect.com/