JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

"OPTIMUM PORTFOLIO CONSTRUCTION USING SHARPE'S INDEX MODEL WITH REFERENCE TO PHARMACEUTICAL SECTOR AND AUTO SECTOR"

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- **Abstract**: Portfolio construction is a widely used theory that describes how investors can build investment portfolios to maximize expected returns while minimising risk. Implementing an asset allocation strategy, which involves balancing investment risk and return by adjusting the percentage of a portfolio allocated to each asset class, is part of portfolio construction practise. Asset allocation is determined by an investor's risk tolerance, investment goals, and time horizon. An attempt is made here to gain an understanding of the concept embedded in Sharpe's single index model and to empirically construct an optimal portfolio using this model. The study's goal was to create an optimal portfolio using Sharpe's single index model. The monthly closing prices of companies listed on the NSE and the NSE index (Nifty) for the period of the period from January 2010 to December 2016 was taken into account. Finally, it is recommended that, with the exception of three stocks (Maruti, Tata Steel, and HDFC), all of the stocks in the sample are undervalued, and investors should consider adding these stocks to their portfolio.
- **Keywords**: Sharpe's Single Index Model, Return and Risk Analysis, Risk Characteristic Line, Portfolio Analysis, Optimal Portfolio Construction
- **Introduction**

1.1 Investment:

Portfolio construction is a widely-used theory on how investors can construct investment portfolios to maximise expected returns and minimise risk. The practice of portfolio construction includes implementing an asset allocation strategy, which involves balancing investment risk and return by adjusting the percentage of a

portfolio allocated to each asset class. Asset allocation is devised based on an investor's risk tolerance, investment goals and investment timeframe.

1.2 Portfolio:

Any collection of financial assets such as stocks, bonds, and cash is referred to as a portfolio. Individual investors may hold portfolios, which are managed by financial professionals, hedge funds, banks, and other financial institutions. It is a widely held belief that a portfolio should be constructed in accordance with the investor's risk tolerance, time frame, and investment objectives. The monetary value of each asset can influence the portfolio's risk/reward ratio, which is known as asset allocation. To successfully build an impact investment portfolio, investors must designate an individual or a team to source, commits to, and manages this collection of investments. As shown in the examples below, institutional investors use a variety of organizational structures to achieve their goals.

1.3 Portfolio Construction:

Portfolio is the combination of securities such as a stock bonds and money market instrument. The process of blending together the broad asset classes so as to obtain optimum return with minimum risk is called portfolio construction. Diversification of investment helps to spread risk over many assets. A drive as mentioned, this study focuses only on the construction part of an investment process and thus understands the theory behind portfolio construction is a prerequisite. In particular, the portfolio constructed in this thesis build on the portfolio, the theory introduced in the seminal and heavily cited study by Markowitz (1952).

Portfolio of stocks could be compared and constructed such that; no other portfolio has higher return for the same risk. No other portfolio has lower risk for same return he called these portfolios efficient and developed computer algorithms to find all efficient portfolio from a given set of stocks i.e. the efficient frontier. All the identified feasible portfolio minimizes risk for given level of expected return and maximize expected return for a given level of risk.

1.4 Portfolio Management:

When it comes to investing in securities, an investor faces the challenge of selecting among a huge number of options. His decision is based on the risk-return characteristics of specific securities. He'd prefer to invest in the most attractive assets. He was once again faced with the task of determining which securities to hold and how much to invest in each. An investor has an endless number of portfolios or groups of securities to choose from. Portfolio risk and return characteristics differ from those of individual securities that are combined to form a portfolio. The investor attempts to select the best portfolio by weighing the risk-reward characteristics of all conceivable portfolios.

1.5 Sharpe Index:

Sharpe developed a composite measure of portfolio performance in 1966 that is very similar to the Treynor measure. The only distinction is that standard deviation is used instead of beta. The Sharpe index is a metric that we can use to assess the performance of our portfolio over a given time period. In order to calculate the Sharpe index, we must know three things: the portfolio return, the risk-free rate of return, and the portfolio standard deviation. Another option is to use the average return for the risk-free rate of return. The portfolio's standard deviation is used to assess the portfolio's systematic risk. There are many sectors in optimum portfolio construction. But here we will take only two sectors.

1) Pharmaceutical sector
2) Auto sector

Pharmaceutical sector: With the quick expansion of the economy and increased disposable income, as well as expanding health awareness among the general public, the pharmaceutical sector is one such area that has bright prospects. Such an industry has great development potential. Because of health-care reforms, the global pharmaceutical sector is growing at a rapid rate, with developing nations lead global health spending. In terms of India, the country's pharmaceutical industry is establishing itself as a worldwide leader. In terms of volume, India is the world's third biggest, and fifteenth in terms of value. The Indian pharmaceutical market is expected to reach US$1 billion by 2020.

AUTOMOBILE SECTOR: The Indian automobile industry is one of the worlds largest. The industry contributes 7.1 percent of the country's GDP (GDP). In the fiscal year 2014-15, India produced about 31% of all compact vehicles sold worldwide. Due to a growing middle class and a young population, the two-wheeler category leads the Indian automobile industry with an 81 percent market share. Moreover, the rising interest of businesses in investigating rural markets supported the sector's growth. The overall Passenger Vehicle (PV) category accounts for 13% of the market. India is a major auto exporter, with high export growth prospects in the near future.

ASSUMPTIONS OF SIM

The following assumptions explain the Sharpe's Single Index Model:

1. All investors have similar expectations, and each security's risk and return are assessed using a standard duration.
2. The price of a security has changed. Business and economic situations in general also have an impact on them.
3. Market proxies for some securities are likely to be indexes to which each asset's returns are connected.
4. The random disturbance term 'ei' has a low variance and a zero expected value (0). It has no link with any other asset's return on market portfolio (Rm) or error term (ei).

• Literature Review

1) **Desai et al.,** (2013): For a three-year period, they constructed an optimal portfolio utilising fifty companies listed on the NSE. Only ten companies were chosen from the fifty for the most optimal portfolio construction
2) **Francis Mary and G. Rathika** (2015): Their study focussed on portfolio construction by using the monthly closing prices of ten companies listed in NSE and CNX Pharma. The period of study was from September 2010 to September 2014. Based up on the cut-off value out of the ten companies only one company is selected for the optimal portfolio construction.

3) Hal Varian analyses the quantitative revolution in finance pioneered by three Nobel laureates, particularly Markowitz, **Miller, and Sharpe**, in (1993). Before analysing a portfolio, it emphasises the various contributions of the three in the core principles of risk and return. Finally, the study emphasizes that it is not sufficient to just examine capital market equilibrium; rather, a theory of the link between these risks and return factors is critical.

4) In (2006), **Hendrik Scholz** outlined how to overcome issues in evaluating fund performance based on ex post Sharpe ratios and measuring fund performance during periods of decreasing markets. This research examines sample data from US stock mutual funds, constructs Sharpe ratio modifications, and compares them to the original Sharpe ratio, demonstrating that the normalized Sharpe ratio yields important results not only in down markets, but in any market time.
5) No company in the automobile sector can battle competition on price," says **Arvind Saxena**, director and board member (marketing and sales), Hyundai Motor India (HMIL). In order to develop, businesses must have the necessary product, distribution, CRM, and after-sales service networks.

- **Research methodology**

a) Research design**:**

The information will be gathered from various sources and analysed using data analysis. As a result, the research design for the study will be a Qualitative Descriptive Cross-sectional design in order to cover all of the study's areas.

b) Research objective:

- To get a proper understanding of the concept behind Sharpe's index model;
- To actually create an optimal portfolio using the Sharpe's Single Index Model; and
- To calculate the proportion of investment to be made in each stock included in the optimal portfolio.

c) Sampling method:

Sharp's single index model

d) Types of data:

This study conducted using secondary data.

e) Tools of data collection:

Data was collected from the NSE's website, and also research papers from previous studies & a few other helpful stock-related websites.

f) Statistical tools:

William Sharpe's Single Index Model

g) Hypothesis:

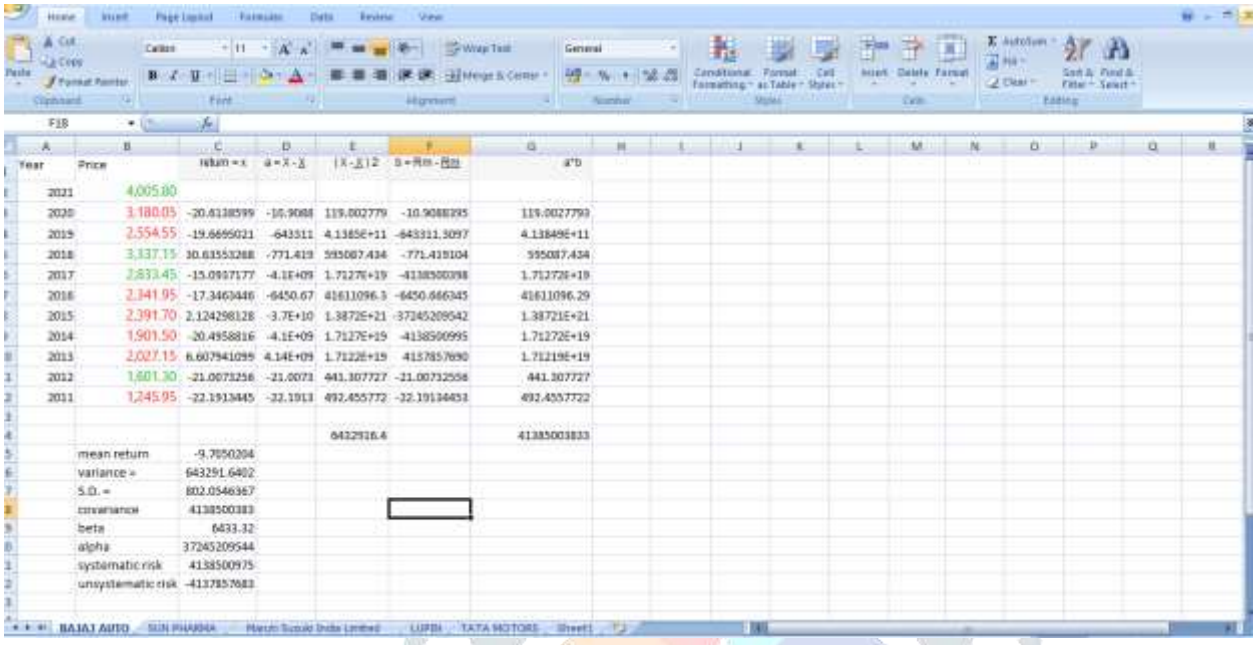
Most of the time, the hypothesis is regarded as the most important research tool. Hypotheses must be tested in specific circumstances as part of the research process. This study tested the following hypotheses: - ANOVA (One-Way Analysis of Variance): ANOVA is an abbreviation for Analysis of Variance (One-Way Analysis of Variance It is advantageous to compare them.

h) Limitations:

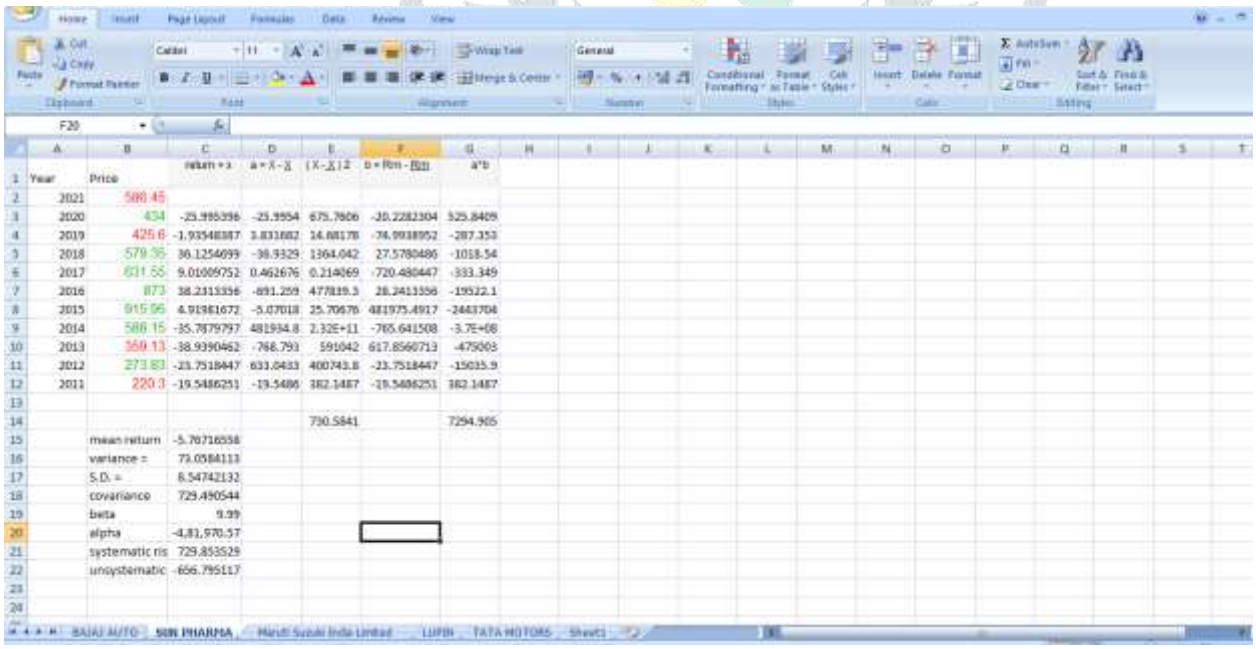
1. The study uses yearly prices instead of monthly data
2. The results of the study may not be universally applicable
3. The study is based on secondary data only.
4. The study is only related to Receivable management of the automobile companies and possibility of adaptation of farm specific marketing practices for Indian pharmaceutical companies

- **Data analysis and Interpretation:**

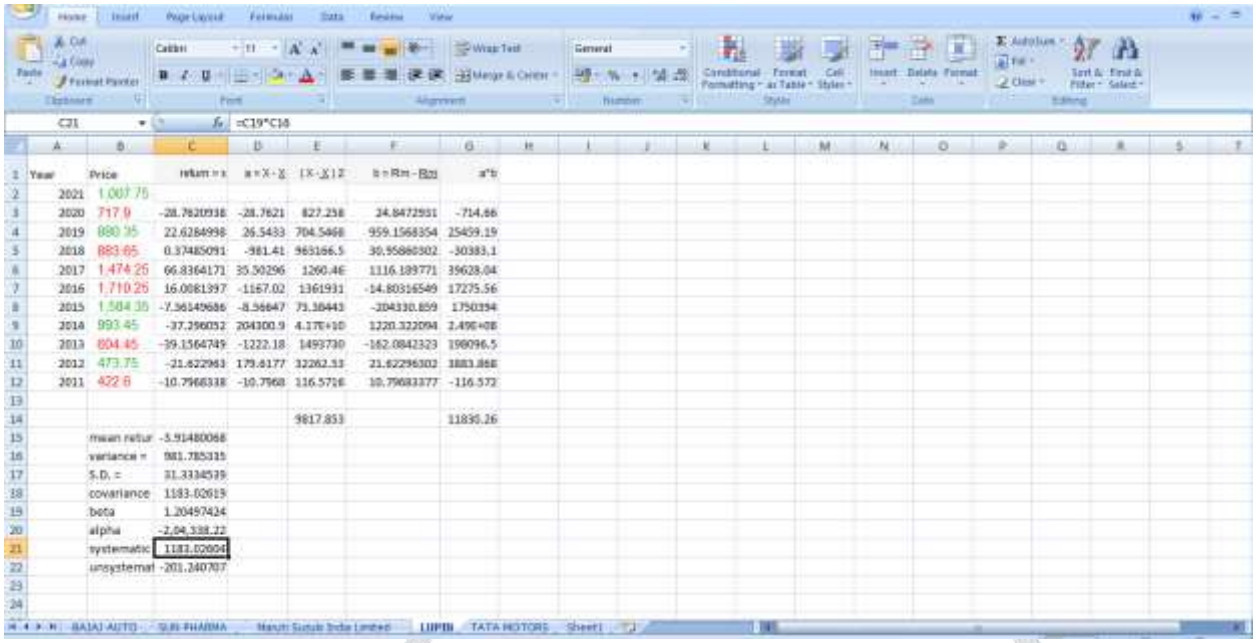
The 2 sectors have been selected for constructing the portfolio. They are: Pharmaceutical sector and Automobile sector. From each of the sectors top two companies have been selected on the basis of performance as given by moneycontrol.com.



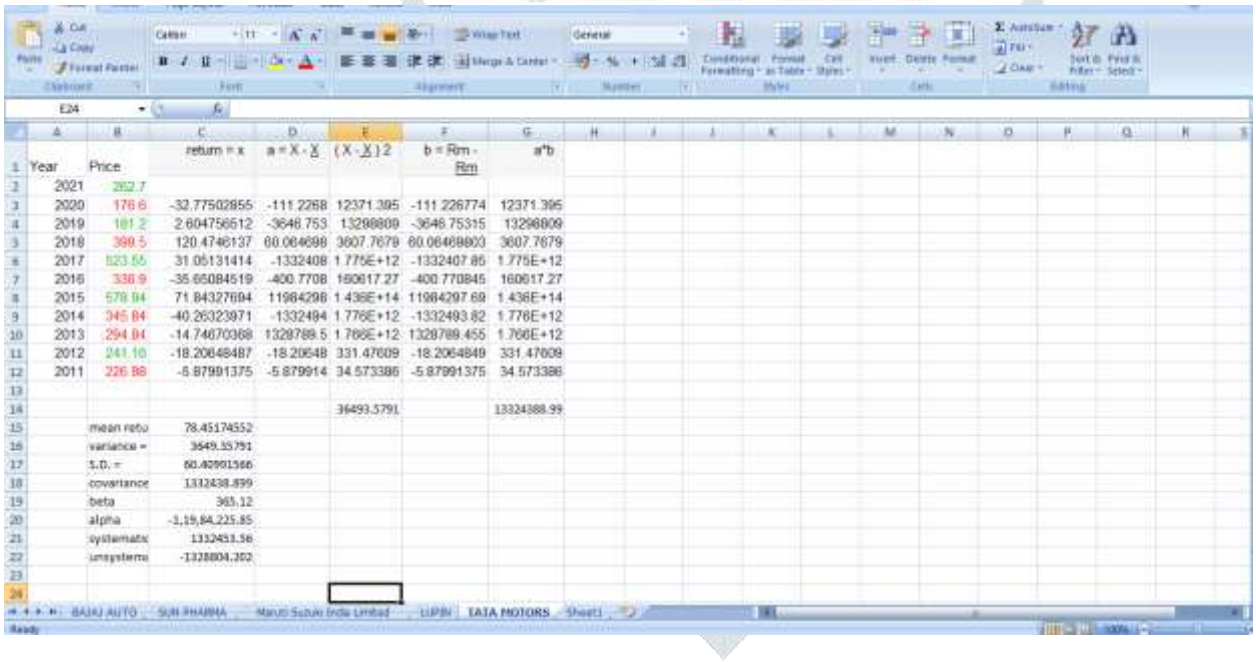
Year	Price	return = x	a = X - X̄	|X - X̄|2	b = Rm - R̄m	a*b
2021	4,005.80					
2020	3,180.05	-20.6138599	-10.9088	119.002779	-10.9088395	119.0027793
2019	2,554.55	-19.6699021	-643311	4.13856+11	-643311.3097	4.13849E+11
2018	3,337.15	30.63553268	-771.419	595087.434	-771.419104	595087.434
2017	2,833.45	-15.0997177	-4.1E+09	1.7127E+19	-4138500398	1.71272E+19
2016	2,341.95	-17.3463446	-6450.67	41611096.3	-6450.666345	41611096.29
2015	2,391.70	2.124298128	-3.7E+10	1.38722+21	-37245209542	1.38721E+21
2014	1,901.50	-20.4958816	-4.1E+09	1.7127E+19	-4138500995	1.71272E+19
2013	2,027.15	6.607941099	4.14E+09	1.7122E+19	4137857690	1.71219E+19
2012	1,601.30	-21.0073256	-21.0073	441.307727	-21.00732556	441.307727
2011	1,245.95	-22.1913445	-22.1913	492.455772	-22.19134453	492.4557722
				6432916.4		4138500383
	mean return	-9.7050204				
	variance =	643291.6402				
	S.D. =	802.0546367				
	covariance	4138500383				
	beta	6433.32				
	alpha	37245209544				
	systematic risk	4138500975				
	unsystematic risk	-413785768				



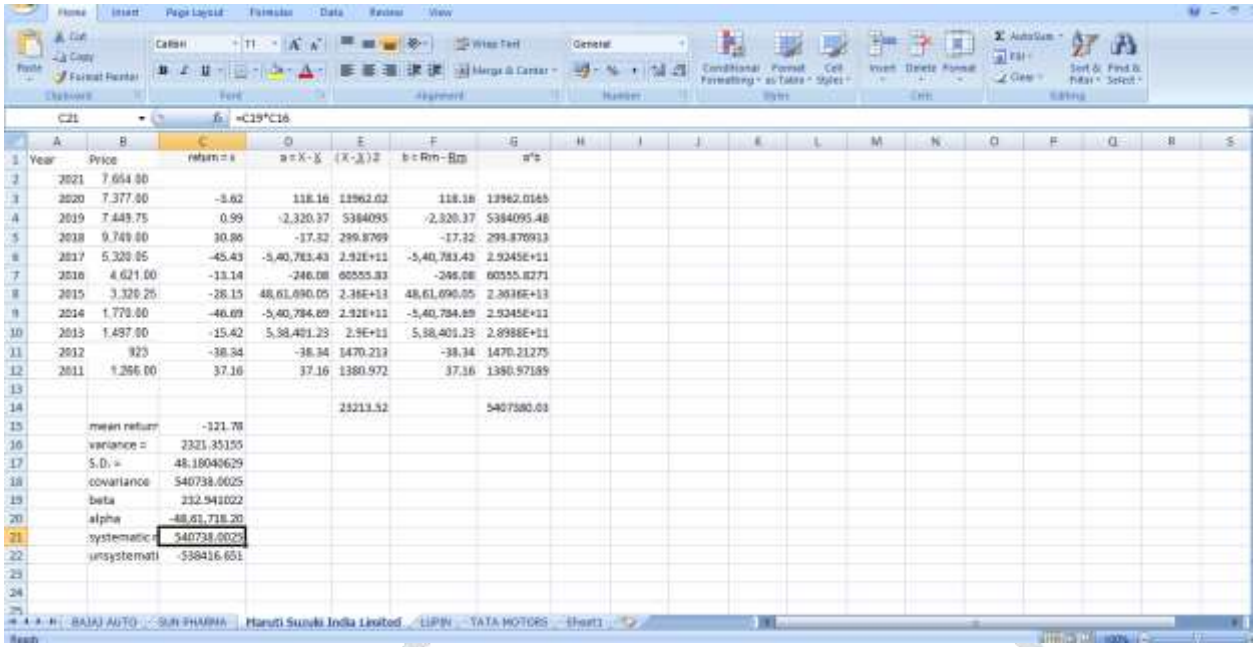
Year	Price	return = x	a = X - X̄	|X - X̄|2	b = Rm - R̄m	a*b
2021	588.45					
2020	434	-25.995396	-25.9954	675.7606	-20.2282304	525.8409
2019	425.6	-1.93548387	3.831682	14.68178	-74.9938952	-287.353
2018	579.35	36.1254099	-38.9329	1364.042	27.5780486	-1018.54
2017	631.55	9.01009752	0.462676	0.214069	-720.480447	-333.349
2016	873	38.2313356	-691.259	477839.3	28.2413356	-19522.1
2015	915.95	4.91981672	-5.07018	25.70676	481975.4917	-2443704
2014	586.15	-35.7879797	481934.8	2.32E+11	-765.641508	-3.7E+08
2013	569.13	-38.9390462	-768.793	591042	617.8560713	-475003
2012	273.83	-23.7518447	631.0433	400743.8	-23.7518447	-15035.9
2011	220.3	-19.5486251	-19.5486	382.1487	-19.5486251	382.1487
				730.5841		7294.905
	mean return	-5.76716558				
	variance =	73.0584113				
	S.D. =	8.54742132				
	covariance	729.490544				
	beta	9.99				
	alpha	-4,81,970.57				
	systematic ris	729.853529				
	unsystematic	-656.795117				



Year	Price	return = x	a = X - X̄	(X - X̄)2	b = Rm - R̄m	a*b
2021	1,007.75					
2020	717.9	-28.7820938	-28.7621	827.258	24.8472931	-714.66
2019	880.35	22.6284998	26.5433	704.5468	959.1568354	25459.19
2018	883.65	0.37485091	-981.41	963166.5	30.95886302	-30383.1
2017	1,474.25	66.8364171	35.50296	1260.46	1116.189771	39628.04
2016	1,710.25	16.0081397	-1167.02	1361931	-14.80316549	17275.56
2015	1,584.35	-7.36149686	-8.56647	73.38443	-204330.859	1750394
2014	993.45	-37.296052	204300.9	4.17E+10	1220.322094	2.49E+08
2013	604.45	-39.1564749	-1222.18	1493730	-162.0842323	198096.5
2012	473.75	-21.622963	179.6177	32262.53	21.62296302	3883.868
2011	422.6	-10.7966338	-10.7968	116.5716	10.79683377	-116.572
				9817.853		11830.26
	mean retur	-5.91480068				
	variance =	981.785315				
	S.D. =	31.3334539				
	covariance	1183.02619				
	beta	1.20497424				
	alpha	-2,04,338.22				
	systematic	1183.02604				
	unsystemat	-201.240707				



Year	Price	return = x	a = X - X̄	(X - X̄)2	b = Rm - R̄m	a*b
2021	282.7					
2020	178.6	-32.77502855	-111.2268	12371.395	-111.226774	12371.395
2019	181.2	2.604756512	-3646.753	13298809	-3646.75315	13298809
2018	398.5	120.4746137	60.064698	3607.7679	60.06469803	3607.7679
2017	523.55	31.05131414	-1332408	1.775E+12	-1332407.85	1.775E+12
2016	338.9	-35.65084519	-400.7708	160617.27	-400.770845	160617.27
2015	578.94	71.84327694	11984298	1.436E+14	11984297.69	1.436E+14
2014	345.84	-40.26323971	-1332494	1.776E+12	-1332493.82	1.776E+12
2013	294.84	-14.74670368	1328789.5	1.766E+12	1328789.455	1.766E+12
2012	241.16	-18.20648487	-18.20648	331.47609	-18.2064849	331.47609
2011	226.88	-5.87991375	-5.879914	34.573386	-5.87991375	34.573386
				36493.5791		13324388.99
	mean retu	78.45174552				
	variance =	3649.35791				
	S.D. =	60.40991566				
	covariance	1332438.899				
	beta	365.12				
	alpha	-1,19,84,225.85				
	systematic	1332453.56				
	unsystema	-1328804.202				



Year	Price	return = x	a = X - x̄	(X - x̄)2	b = Rm - Rm	a*b
2021	7,654.80					
2020	7,377.00	-3.62	118.16	13962.02	118.16	13962.0165
2019	7,449.75	0.99	-2,320.37	5384095	-2,320.37	5384095.48
2018	9,749.00	30.86	-17.32	299.8769	-17.32	299.876913
2017	5,320.05	-45.43	-5,40,783.43	2.92E+11	-5,40,783.43	2.9245E+11
2016	4,621.00	-13.14	-246.08	60555.83	-246.08	60555.8271
2015	3,320.25	-28.15	48,61,690.05	2.36E+13	48,61,690.05	2.3636E+13
2014	1,770.00	-46.69	-5,40,784.69	2.92E+11	-5,40,784.69	2.9245E+11
2013	1,497.00	-15.42	5,38,401.23	2.9E+11	5,38,401.23	2.8988E+11
2012	923	-38.34	-38.34	1470.213	-38.34	1470.21275
2011	1,266.00	37.16	37.16	1380.972	37.16	1380.97189
				23213.52		5407580.03
	mean return =	-121.78				
	variance =	2321.35155				
	S.D. =	48.18048629				
	covariance =	540738.0025				
	beta	232.941022				
	alpha	-48,61,718.20				
	systematic ri	540738.0025				
	unsystemati	-538416.651				

- **Conclusion:**

A normal investor will find it difficult to build an optimal portfolio. Portfolio construction using the Sharpe Index Model (SIM) is a lengthy process that necessitates numerous calculations. It is difficult for all investors to construct the same optimal portfolio because each investor has different assumptions about market expected return and market variance. The expected market return and variance are important factors in stock ranking and cut-off point selection. Stock Beta values have been observed to play the primary role in the selection of stocks for the optimal portfolio, with stock average return playing a secondary role.

SIM hasn't considered less volatile stock even though stocks have a good average return, example Hero Honda has a good average return, but this stock is having less Beta value, not considered for the optimal portfolio. Optimal Portfolio Return, Variance, and Beta values are equal to market, meaning that whatever market gives return and variance Sharpe optimal portfolio also gives same return and variance. According to this paper, Sharpe Index Model is good for the construction of an optimal portfolio for the investor who will think stock volatility is near to equal to market volatility. It is concluded that Sharpe Index Model is the best model to construct an optimal portfolio.

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