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    INTRODUCTION

    REVIEW OF LITERATURE

    NEED/IMPORTANCE OF THE STUDY

    STATEMENT OF THE PROBLEM

    OBJECTIVES

    HYPOTHESES

    RESEARCH METHODOLOGY

    RESULTS & DISCUSSION

    FINDINGS

    RECOMMENDATIONS/SUGGESTIONS

    CONCLUSIONS

    SCOPE FOR FURTHER RESEARCH

    ACKNOWLEDGMENTS

    REFERENCES

    APPENDIX/ANNEXURE

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CONTRIBUTIONS TO BOOKS
- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

JOURNAL AND OTHER ARTICLES
- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

CONFERENCE PAPERS
- Garg, Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–22 June.

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- Kumar S. (2011): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, Kurukshetra University, Kurukshetra.

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CREATING AN OPTIMAL PORTFOLIO ON S&P BSE SENSEX USING SHARPE'S SINGLE INDEX MODEL

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ABSTRACT

This is an attempt to construct an optimal portfolio consisting of securities of S&P BSE SENSEX using Sharpe Single index model. Taking S&P BSE SENSEX as market performance index and considering daily indices along with the daily prices of 30 securities of the S&P BSE SENSEX for the period of April 2008 to March 2013, variance of the market index and variance, beta, systematic risk and unsystematic risk of each security is calculated. In arriving at optimal portfolio, the emphasis of Sharpe model is on Beta and on the Market Index. The securities are selected on the basis of unique cut-off rate. The optimal portfolio consists of those securities whose excess return to beta ratio is greater than the cut-off rate. Once the choice of securities is made, the proportion of investment in each of the selected securities is computed on the basis of beta value, unsystematic risk, excess return to beta ratio and cut-off rate of each of the securities concerned. The study finds that optimal portfolio consists of securities of nine companies namely Dr Reddy's Lab ,Bajaj Auto, Hero MotoCorp, Hindustan Unilever, TCS, Sun Pharma, Cipla, Infosys, and ITC with maximum suggested investment in Dr Reddy's Lab followed by Bajaj Auto, Hero MotoCorp, Hindustan Unilever, TCS, Sun Pharma, Cipla, Infosys, and ITC respectively.

KEYWORDS
Beta, Market variance, Residual variance, Optimal portfolio, Single index model.

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INTRODUCTION

The objective of every rational investor is to maximize his return and minimise the risk. Portfolio is the combination of sets of assets of financial nature. Securities carry different degrees of expected risk. Most investor hope that if they hold several assets, even if one goes bad, the others will provide some protection from an extreme loss. By constructing a portfolio, investors attempt to spread risk by not putting all eggs into one basket. The goal of portfolio construction would be to generate a portfolio that provides the highest return at a given level of risk or lowest risk for a given level of return. Such a portfolio would be known as the optimal portfolio .It is an efficient portfolio most preferred by an investor because its risk/reward characteristics approximate the investor's utility function.

Markowitz model had serious practical limitation due to the rigours involved in compiling the expected returns, standard deviation, variance, co-variance of each security to every other security in the portfolio. Sharpe model has simplified this process by relating the return in a security to a single market index.

OBJECTIVES OF THE STUDY
The objectives of the study are as follows:
1. To construct an optimal portfolio using Sharpe's Single Index Model i.e. to find out the type of scrips on S&P BSE SENSEX in which investment is to be made and to find out the proportion to be invested in a particular selected scrip in the portfolio.
2. To find out the scrips that gives the maximum reward to risk in comparison to other scrips.
3. To guide investors to find out the company that gives the maximum return with minimum risk.

DATA AND METHODOLOGY
The data taken for the study is secondary in nature. For this purpose S&P BSE SENSEX is taken as the market performance index. The data has been collected from the official website of Bombay Stock Exchange (BSE), namely www.bseindia.com. The study is conducted with the price data of 30 scrips of S&P BSE SENSEX for the past five years from April 2008 to March 2013. For determining daily return of S&P BSE SENSEX, daily indices data for the period of April 2008 to March 2013 are taken into consideration. Similarly for determining the daily return of 30 securities of S&P BSE SENSEX, daily prices of each security for the period of April 2008 to March 2013 are taken into consideration. On the basis of computed return, variance of market index, variance of each security, beta (β) value , systematic risk and unsystematic risk of each security is calculated. Ranking of the stocks are done on the basis of their excess return to beta ratio from highest to lowest. The cut off rate (C_i) for each security is also calculated. Those securities whose 'Excess Return-to-Beta Ratio' is greater than the cut off rate are selected. Then to arrive at the optimal portfolio, the proportion of investment in each of the selected securities in the optimal portfolio is computed on the basis of beta value, unsystematic risk, excess return to beta ratio and cut-off rate of each of the securities concerned. Different Statistical and financial tools and techniques, and charts have been used for the purpose of analysis and interpretation of data.

1) RETURN
The daily return on each of the selected stocks is calculated with the following formula.

$$R_{it} = \frac{P_{it} - P_{it-1}}{P_{it-1}}$$

Where,

P_{it} , P_{it-1} are the share price at time t and t-1 for security.

2) RISK
The essence of risk in investment is the variation in its returns. The total variability in returns of a security represents the total risk of that security. Systematic risk and unsystematic risk are the two components of total risk.

The variance of securities has two components namely, systematic risk and unsystematic risk or unique risk. According to Sharpe, the variance explained by the market index is referred to as systematic risk. The unexplained variance is called residual variance or unsystematic risk. It follows:

Total risk of a security = Systematic risk + unsystematic risk

Systematic Risk $= \beta^2 \times$ (Variance of index)

Systematic Risk $= \beta_i^2 \times \sigma_m^2$

Unsystematic Risk = Total variance − Systematic risk

$\sigma_{ei}^2 = \sigma_i^2$ - systematic risk

Thus, the total risk = systematic risk + unsystematic risk

$$= \beta_i^2 \times \sigma_m^2 + \sigma_{ei}^2$$

From this, the portfolio variance can be derived.

$$\sigma_p^2 = \left[\left(\sum_{i=1}^{N} X_i \beta_i \right)^2 \times \sigma_m^2 \right] + \left[\sum_{i=1}^{N} X_i^2 \sigma_{ei}^2 \right]$$

Where,

σ_p^2 = Variance of portfolio

σ_m^2 = Expected variance of index

σ_{ei}^2 = Variation in security's return not related to the market index.

X_i = Proportion of stock 'i' in the portfolio.

3)   **SHARPE'S OPTIMAL PORTFOLIO**

The optimal portfolio selection technique used by Sharpe is called 'Single Index Model'. As per this model the desirability of a stock to be included in optimal portfolio is directly related to its excess return to beta ratio:

$(R_i - R_f) / \beta_i$

Where,

R_i = Expected return on stock i

R_f = Return on risk free asset

β_i = Percentage change in the rate of return on stock i associated with one unit change in the market return.

The excess return is the difference between the expected return on the stock and the risk less rate of interest such as the rate offered on the governmental securities or treasury bills. The excess return to beta ratio measures the additional return on a security per unit of systematic risk or non-diversified risk. This ratio provides a relationship between potential risk and reward.

Ranking of the stocks are done on the basis of their excess return to beta. The selection of the stocks depends on a unique cut off such that all stocks with higher ratios of $\dfrac{(R_i - R_f)}{\beta_i}$ are included and the stocks with lower ratio are left off. The cut-off point is denoted by C^*.

The steps for finding out the stocks to be included in the optimal portfolio are given below:

i.   Find out the "excess return to beta" ratio for each stock under consideration.

ii.   Rank them from the highest to the lowest (in descending order).

iii.   Proceed to calculated C_i for all the stocks according to the ranked order using the following formula.

$$C_i = \frac{\sigma_m^2 \sum_{i=1}^{N} \dfrac{(R_i - R_f)\beta_i}{\sigma_{ei}^2}}{1 + \sigma_m^2 \sum_{i=1}^{N} \dfrac{\beta_i^2}{\sigma_{ei}^2}}$$

Where,

σ_m^2 = variance of the market index

σ_{ei}^2 = variance of a stock's movement that is not associated with the movement of the market index i.e. stock's unsystematic risk.

iv.   The cumulated values of C_i start decline after a particular point and that point is taken as the cut-off point and that stock ratio is cut-off ratio C^*.

Once we know which securities are to be included in the optimum portfolio, we must calculate the percentage invested in each security.

The percentage involved in each security is:

$$X_i = \frac{Z_i}{\sum_{i=1}^{N} Z_i}$$

Where,

$$Z_i = \frac{\beta_i}{\sigma_{ei}^2} \left(\frac{(R_i - R_f)}{\beta_i} - C^* \right)$$

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ANALYSIS AND FINDINGS

TABLE 1: DATA NEEDED TO CONSTRUCT OPTIMAL PORTFOLIO USING SHAPE'S INDEX MODEL

SR No.	Company Security (i)	Mean Daily Return (R_i)	Variance (σ_{ei}^2)	Standard Deviation (σ_i)	Beta (β_i)	Systematic Risk ($\beta_i^2 \sigma_m^2$)	Unsystematic Risk (σ_{ei}^2)
1	Dr Reddys Lab	0.10587	3.552094	1.8847	0.395038	0.462892	3.089201
2	Bajaj Auto	0.134083	7.53156	2.744369	0.658242	1.29689	6.23467
3	Hero MotoCorp	0.083699	4.114386	2.028395	0.454113	0.61169	3.502695
4	Hindustan Unilever	0.068432	2.871017	1.694408	0.404926	0.486356	2.384662
5	TCS	0.094169	7.556629	2.748932	0.852284	2.154628	5.402001
6	Sun Pharma	0.051847	8.700109	2.949595	0.35899	0.382267	8.317842
7	Cipla	0.060821	3.310053	1.819355	0.470215	0.655836	2.654217
8	Infosys	0.078726	4.291539	2.071603	0.736648	1.609621	2.681918
9	ITC	0.06261	5.21863	2.284432	0.539926	0.864712	4.353917
10	Maruti Suzuki	0.062163	5.141974	2.267592	0.71372	1.510982	3.630992
11	Mahindra & Mahindra	0.073629	9.268295	3.044388	0.994635	2.934476	6.33382
12	ICICI Bank	0.074216	9.658521	3.107816	1.552099	7.145656	2.512865
13	SBI	0.052181	6.548902	2.559082	1.132718	3.805806	2.743096
14	Tata Motors	0.051384	15.6269	3.953088	1.267735	4.767167	10.85973
15	Wipro	0.041025	6.665128	2.581691	0.870694	2.248714	4.416415
16	HDFC Bank	0.027695	9.681016	3.111433	0.946455	2.657073	7.023943
17	HDFC	0.010552	11.58279	3.403351	1.140069	3.855365	7.72743
18	Hindalco Inds	0.00029	9.841144	3.13706	1.273923	4.813818	5.027325
19	Gail India	0.006389	5.468865	2.338561	0.730116	1.581198	3.887667
20	Tata Steel	-0.011443	9.947348	3.153942	1.367515	5.54712	4.400228
21	L&T	-0.013242	8.463252	2.909167	1.152134	3.937398	4.525854
22	Jindal Steel	-0.022365	14.33763	3.786506	1.16981	4.059135	10.27849
23	Coal India	-0.001661	3.091509	1.758269	0.577636	0.40177	2.689739
24	NTPC	-0.009163	3.343628	1.828559	0.678299	1.364724	1.978904
25	ONGC	-0.017813	9.200504	3.033233	0.779678	1.803157	7.397347
26	RIL	-0.043432	8.012813	2.830691	1.179131	4.124082	3.888731
27	Sterlite Inds	-0.066347	14.87481	3.856788	1.321674	5.181458	9.693357
28	Bharti Airtel	-0.03729	7.920908	2.814411	0.819532	1.992209	5.928698
29	Tata Power	-0.059658	12.12656	3.482322	0.910252	2.457687	9.668876
30	BHEL	-0.095619	11.10009	3.331679	1.037096	3.190372	7.909714

Variance of Market Index (σ_m^2) = 2.966218

R_f = 8% p.a. = 0.02192% Per Day (Based on approximate Return on Central and State Government Securities.

Return is calculated from Daily share prices of securities and daily market index (Period: 1 April, 2008 – 31 March, 2013) & the Data Source is www.bseindia.com)

Source: Own Compilation with Excel,

TABLE 2: RANKING OF SECURITIES ON THE BASIS OF EXCESS RETURN TO BETA VALUE

Company	R_i	R_f	β_i	$R_i - R_f$	$\dfrac{R_i - R_f}{\beta_i}$	Ranking
ITC	0.06260997	0.02192	0.539926	0.04068997	0.07536212	9
RIL	-0.043431757	0.02192	1.17913106	-0.0653518	-0.0554237	26
Infosys	0.078726269	0.02192	0.73664841	0.05680627	0.07711449	8
HDFC Bank	0.027695477	0.02192	0.94645546	0.00577548	0.00610222	16
HDFC	0.010552333	0.02192	1.14006919	-0.0113677	-0.009971	17
ICICI Bank	0.074216076	0.02192	1.55209932	0.05229608	0.03369377	12
TCS	0.094169305	0.02192	0.85228447	0.07224931	0.08477135	5
Hindustan Unilever	0.068431506	0.02192	0.40492574	0.04651151	0.11486429	4
L&T	-0.013241878	0.02192	1.15213428	-0.0351619	-0.0305189	21
ONGC	-0.017813352	0.02192	0.77967783	-0.0397334	-0.0509612	25
Tata Motors	0.051384108	0.02192	1.26773548	0.02946411	0.02324153	14
SBI	0.052181238	0.02192	1.13271791	0.03026124	0.0267156	13
Bharti Airtel	-0.037289929	0.02192	0.81953202	-0.0592099	-0.0722485	28
Sun Pharma	0.051846863	0.02192	0.35898982	0.02992686	0.0833641	6
Mahindra & Mahindra	0.073628827	0.02192	0.99463493	0.05170883	0.05198774	11
Dr Reddys Lab	0.105870079	0.02192	0.39503767	0.08395008	0.21251158	1
NTPC	-0.009163233	0.02192	0.67829853	-0.0310832	-0.0458253	24
Bajaj Auto	0.134082926	0.02192	0.65824186	0.11216293	0.17039774	2
Wipro	0.041025065	0.02192	0.87069399	0.01910507	0.02194234	15
Cipla	0.06082074	0.02192	0.47021466	0.03890074	0.08272975	7
Maruti Suzuki	0.062163443	0.02192	0.71372036	0.04024344	0.05638545	10
Coal India	-0.001660912	0.02192	0.57763615	-0.0235809	-0.0408231	23
Hero MotoCorp	0.083699191	0.02192	0.45411336	0.06177919	0.13604354	3
Gail India	0.006388705	0.02192	0.73011559	-0.0155313	-0.0212724	19
Tata Steel	-0.011442531	0.02192	1.36751539	-0.0333625	-0.0243965	20
Tata Power	-0.059657737	0.02192	0.91025225	-0.0815777	-0.089621	29
Hindalco Inds	0.000290436	0.02192	1.27392338	-0.0216296	-0.0169787	18
BHEL	-0.095619005	0.02192	1.03709636	-0.117539	-0.1133347	30
Sterlite Inds	-0.066347329	0.02192	1.32167425	-0.0882673	-0.0667845	27
Jindal Steel	-0.02236496	0.02192	1.16980963	-0.044285	-0.0378566	22

Source: Own Compilation with Excel

From Table-2 it is clearly seen that the security of Dr Reddy's Lab, having the highest excess return to beta ratio (0.21251158) , occupies the first place. The security of Bajaj auto, having the second highest excess return to beta ratio (0.17039774), occupies the second place. In this way, Hero MotoCorp is third and Hidustan Unilever is fourth and so on. The security of BHEL occupies the last place within the data set.

TABLE 3: CALCULATIONS FOR DETERMINING THE CUT OFF RATE (C_i), WHERE, σ_m^2 = 2.966218, R_f = 8% p.a. = 0.02192% PER DAY

Rank	Company	$\dfrac{R_i - R_f}{\beta_i}$	$\dfrac{(R_i - R_f)\beta_i}{\sigma_{ei}^2}$	$\sum\limits_{i=1}^{N} \dfrac{(R_i - R_f)\beta_i}{\sigma_{ei}^2}$	$\dfrac{\beta_i^2}{\sigma_{ei}^2}$	$\sum\limits_{i=1}^{N} \dfrac{\beta_i^2}{\sigma_{ei}^2}$	C_i
1	Dr Reddys Lab	0.212512	0.010735	0.010735	0.050516	0.050516	0.0276935
2	Bajaj Auto	0.170398	0.011842	0.022577	0.069496	0.120012	0.0497179
3	Hero MotoCorp	0.136044	0.008009	0.030587	0.058874	0.178886	0.0592746
4	Hindustan Unilever	0.114864	0.007898	0.038485	0.068758	0.247644	0.0658109
5	TCS	0.084771	0.011399	0.049883	0.134467	0.382111	0.0693557
6	Sun Pharma	0.083364	0.001292	0.051175	0.015494	0.397605	0.0696511
7	Cipla	0.08273	0.006892	0.058067	0.083302	0.480907	0.0709829
8	Infosys	0.077114	0.015603	0.07367	0.202337	0.683244	0.0721988
9	ITC	0.075362	0.005046	0.078716	0.066956	0.750199	0.0723936
10	Maruti Suzuki	0.056385	0.00791	0.086626	0.140291	0.890491	0.0705642
11	Mahindra & Mahindra	0.051988	0.00812	0.094746	0.156193	1.046684	0.0684674
12	ICICI Bank	0.033694	0.032301	0.127047	0.958672	2.005355	0.0542362
13	SBI	0.026716	0.012496	0.139543	0.467738	2.473093	0.0496556
14	Tata Motors	0.023242	0.00344	0.142983	0.147992	2.621085	0.0483342
15	Wipro	0.021942	0.003767	0.146749	0.171657	2.792742	0.0468867
16	HDFC Bank	0.006102	0.000778	0.147528	0.127532	2.920274	0.0452899
17	HDFC	-0.00997	-0.001677	0.145851	0.168201	3.088475	0.0425766
18	Hindalco Inds	-0.01698	-0.005481	0.14037	0.322812	3.411287	0.0374477
19	Gail India	-0.02127	-0.002917	0.137453	0.137118	3.548405	0.0353755
20	Tata Steel	-0.0244	-0.010369	0.127084	0.425	3.973405	0.0294823
21	L&T	-0.03052	-0.008951	0.118133	0.293296	4.266701	0.0256598
22	Jindal Steel	-0.03786	-0.00504	0.113093	0.133138	4.399838	0.0238746
23	Coal India	-0.04082	-0.005064	0.108029	0.124051	4.523889	0.0201758
24	NTPC	-0.04583	-0.010654	0.097375	0.232497	4.756386	0.0191174
25	ONGC	-0.05096	-0.004188	0.093187	0.082178	4.838563	0.0180047
26	RIL	-0.05542	-0.019816	0.073371	0.357533	5.196096	0.0132601
27	Sterlite Inds	-0.06678	-0.012035	0.061336	0.180208	5.376305	0.0107354
28	Bharti Airtel	-0.07225	-0.008185	0.053151	0.113285	5.48959	0.009122
29	Tata Power	-0.08962	-0.00768	0.045471	0.085693	5.575283	0.0076908
30	BHEL	-0.11333	-0.015411	0.03006	0.135981	5.711264	0.0049699

Source: Own Compilation with Excel

All the stocks with $(R_i - R_f)\big/\beta_i$ > C* are selected. The cumulated values of C_i start declining after a particular C_i and that point is taken as the cut-off point.

The highest value of C_i is taken as the cut-off point that is C*. From the Table 3, it is seen that stock of ITC has the highest cut-off rate of C*= 0.0723936. For the securities having the rank of 1 to 9, $\dfrac{(R_i - R_f)}{\beta_i}$ > C*. Hence the optimum portfolio consists of securities ranked 1 to 9 i.e. Dr Reddy's Lab, Bajaj Auto, Hero MotoCorp, Hindustan Unilever, TCS, Sun Pharma, Cipla, Infosys, and ITC.

TABLE 4: CALCULATION OF z_i AND x_i FOR THE SELECTED SECURITIES IN THE OPTIMAL PORTFOLIO

Company	$\dfrac{\beta}{\sigma_{ei}^2}$	$\dfrac{R_i - R_f}{\beta_i}$	z_i	x_i
Dr Reddys Lab	0.127876956	0.212512	0.0179178	36.08795
Bajaj Auto	0.105577666	0.170398	0.010347	20.83973
Hero MotoCorp	0.129646835	0.136044	0.008252	16.62014
Hindustan Unilever	0.16980426	0.114864	0.0072116	14.52483
TCS	0.157771987	0.084771	0.0019528	3.933099
Sun Pharma	0.043159011	0.083364	0.0004735	0.953585
Cipla	0.177157603	0.08273	0.0018311	3.687899
Infosys	0.274672219	0.077114	0.0012966	2.611436
ITC	0.124009243	0.075362	0.0003681	0.741333
			$\sum z_i$ = 0.0496504	$\sum x_i$ =100

From Table-4 it is seen that the proportion of investment to be made for each of the nine securities in the optimal portfolio of stocks viz. Dr Reddy's Lab ,Bajaj Auto, Hero MotoCorp, Hindustan Unilever, TCS, Sun Pharma, Cipla, Infosys, ITC are 36.09%, 20.84%, 16.62%, 14.52%, 3.933%, 0.954%, 3.688%, 2.611%, 0.741% respectively. Among nine securities selected for the investment, three companies viz. Dr Reddy's Lab, Sun Pharma, and Cipla belongs to pharmaceuticals sector, two companies viz. Bajaj Auto, Hero MotoCorp belongs to automobile sector, two companies viz. Hindustan Unilever, TCS belongs to FMCG sector and two companies viz. TCS and Infosys belongs to IT sector.

The proportion of stocks in the composition of optimal portfolio can be shown in the following Pie diagram (Figure 1):

FIGURE 1: PROPORTION OF INVESTMENT IN THE STOCKS OF OPTIMAL PORTFOLIO (CONSTRUCTED)
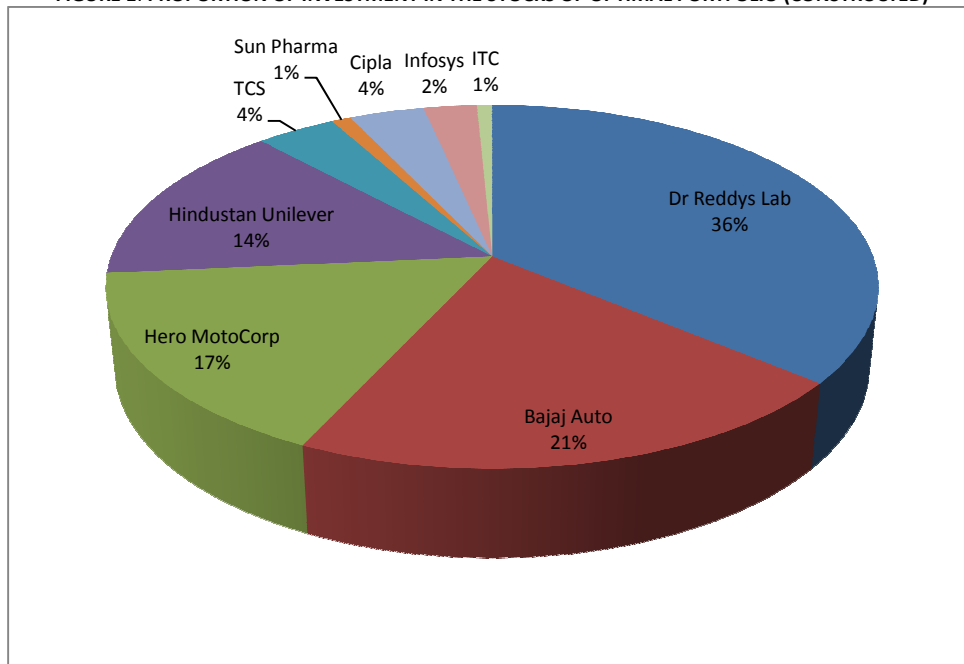
CONCLUSION

By constructing a portfolio, investors attempt to spread risk by not putting all eggs into one basket. Sharpe model has simplified the process of constructing portfolio by relating the return in a security to a single market index. Out of the 30 stocks that are included in S&P BSE SENSEX, nine stocks namely Dr Reddy's Lab, Bajaj Auto, Hero MotoCorp, Hindustan Unilever, TCS, Sun Pharma, Cipla, Infosys, ITC are included in the Optimal Portfolio constructed in this study with maximum suggested investment in Dr Reddy's Lab followed by Bajaj Auto, Hero MotoCorp, Hindustan Unilever, TCS, Sun Pharma, Cipla, Infosys, ITC respectively. The portfolio is well diversified consisting of securities from pharmaceuticals, automobile, FMCG and IT sectors.

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