Security Analysis and Portfolio Management

Assignment - I

Data source: <https://www.nseindia.com/index_nse.htm>

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**Table of Contents**

1. **Definitions**
2. **Individual Asset Performance Analysis**
   1. **Chennai petroleum corporation (CHENNPETRO)**
   2. **Oberoi realty ltd (OBEROIRLTY)**
   3. **Godrej consumer products (GCPL)**
   4. **JK paper**
   5. **Fortis Healthcare Ltd.**
3. **Portfolio Analysis**
   1. **FY 2013-14**
   2. **FY 2014-15**
   3. **FY 2015-16**
   4. **FY 2016-17**
   5. **FY 2017-18**
   6. **5 Year Analysis**
4. **Conclusion**

**Definitions**

**Beta**

A beta coefficient is a measure of the volatility, or systematic risk, of an individual stock in comparison to the unsystematic risk of the entire market. Beta is used in the capital asset pricing model (CAPM), which calculates the expected return of an asset using beta and expected market returns. In statistical terms, beta represents the slope of the line through a regression of data points from an individual stock's returns against those of the market.Stocks with betas greater than 1 are considered riskier than the overall market whereas stocks with betas less than 1 are considered less risky than the overall market.[[1]](#footnote-1)

**Expected Return**

The expected return on a financial investment is the expected value of its return (of the profit on the investment). It is a measure of the center of the distribution of the random variable that is the return.[[2]](#footnote-2)

**Required rate of return**

The required rate of return is the minimum return an investor will accept for owning a company's stock, as compensation for a given level of risk associated with holding the stock. The RRR is also used in corporate finance to analyze the profitability of potential investment projects.[[3]](#footnote-3)

**Sharpe Ratio**

The ratio is the average return earned in excess of the risk-free rate per unit of volatility or total risk.

Subtracting the risk-free rate from the mean return allows an investor to better isolate the profits associated with risk-taking activities. Generally, the greater the value of the Sharpe ratio, the more attractive the risk-adjusted return. It is used to help investors understand the return of an investment compared to its risk.[[4]](#footnote-4)

**CAPM**

The Capital Asset Pricing Model (CAPM) describes the relationship between systematic risk and expected return for assets, particularly stocks. CAPM is widely used throughout finance for pricing risky securities and generating expected returns for assets given the risk of those assets and cost of capital.Investors expect to be compensated for risk and the time value of money. The risk-free rate in the CAPM formula accounts for the time value of money. The other components of the CAPM formula account for the investor taking on additional risk.[[5]](#footnote-5)

**A) Individual Asset Performance Analysis**

1. **CHENNPETRO**

**Chennai Petroleum Corporation Limited** (**CPCL**) a Group company of Indian Oil Corporation (IOCL) is an Indian state-owned oil and gas corporation headquartered in Chennai, India. It was formed as a joint venture in 1965 between the Government of India (GOI), AMOCO and National Iranian Oil Company (NIOC), having a shareholding in the ratio 74%: 13%: 13% respectively. Currently IOC holds 51.88% while NIOC continued its holding at wax and petrochemical feedstocks production facilities.

The **main products** of the company are **LPG, Motor Spirit, superior kerosene, aviation turbine fuel, high speed diesel, naphtha, bitumen, lube base stocks, paraffin wax, fuel oil, hexane and petrochemical feedstocks**. CPCL plays the role of a mother industry supplying feedstocks to the neighbouring industries in Manali. CPCL's products are marketed through IOCL. CPCL's products are mostly consumed domestically except **naphtha, fuel oil and lubes** which are partly **exported.**

The company’s crude throughput for **2017-18** was **10.789 million metric tonnes** (MMT). The company’s turnover for **2017-18** was **Rs.44134 crores** and the **profit** after tax was **Rs.912.93** **crores.** The production line has been affected multiple times due to nature's adversities in form of drought and excessive rains.It is categorized as a **Miniratna-I** company by the government.[[6]](#footnote-6)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **YEAR** | **FY 13-14** | **FY 14-15** | **FY 15-16** | **FY 16-17** | **FY 17-18** | **5 YEAR** |
| **Average Returns** | -0.00184 | 0.000503 | 0.00525 | 0.002692 | -0.00032 | 0.001288 |
| **Standard Deviation** | 0.029306 | 0.030822 | 0.043758 | 0.02593 | 0.021513 | 0.031221 |
| **Variance** | 0.000859 | 0.00095 | 0.001912 | 0.00067 | 0.000463 | 0.000975 |
| **Beta** | 0.664786 | 1.572571 | 1.225639 | 1.105383 | 1.250328 | 1.082944 |
| **CAPM** | 0.153396 | 0.394042 | -0.1215 | 0.212951 | 0.108182 | 0.935727 |
| **Annual Return** | -0.37121 | 0.130659 | 2.663845 | 0.952846 | -0.077 | 3.91128 |
| **Average Sharpe ratio** | -0.89199 | -0.83864 | -0.62196 | -1.00718 | -1.23008 | -0.84384 |

**Analysis of Stock :**

The company underperformed when compared with the investor expectations for the FY13, FY14 and FY17 while it performed better than expected for the FY15, FY16 and 5-year period as per the CAPM model. The standard deviation that indicates the riskiness of investing in the company was low varying between 2.15% - 4.37% for the time horizon.

Beta the statistical coefficient of stock return over market return was <1 for the only FY13 implying the stock was less volatile than the market for that year but for the rest of the FYs it was greater than 1 implying that the stock was more volatile than the market.

Sharpe ratio is negative when the Risk Free Rate Rf is higher than the actual return on the stock and positive when the Risk Free Rate Rf is lower than the actual return on the stock.

For the FY13, FY14 and FY17 the actual returns are less than the expected returns (from CAPM model); sharpe ratio is negative for the FY13, FY14, FY15, FY16, FY15 and 5yr. For the FY15, FY15 and 5-year period the actual returns are higher than expected. Thus, investors would have made more money by investing in Government raised securities rather than investing in **Chennai Petroleum Corporation Limited** (**CPCL**) for the FY13, FY14, FY15, FY16, FY17 and 5yr (long term period) because negative sharpe ratio implies that either risk free rate is higher than market return or portfolio return is expected to be negative.

1. **OBEROIRLTY**

Oberoi Realty is a real estate developer based in Mumbai, Maharashtra. It is led by Vikas Oberoi, CMD. The company has developed over 42 projects at locations across Mumbai. Its main interest is in Residential, Office Space, Retail, Hospitality and Social Infrastructure properties in Mumbai.Over the past three decades, they have built growth and high-stature through consistent high-design and quality parameters that have truly made a significant difference to ease, comfort and efficiency to lives that interact with or inhabit these spaces. They have developed over 42 projects at strategic locations across the Mumbai skyline aggregating about 11.89 million sq. ft. of spaces (group entity including promoter group). With another 27.43 million sq. ft in the making, they have aggressive plans for upcoming projects in various parts of Mumbai and other regions.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **YEAR** | **FY 13-14** | **FY 14-15** | **FY 15-16** | **FY 16-17** | **FY 17-18** | **5 YEAR** |
| **Average Returns** | -0.0005303 | 0.00143901 | -0.0044324 | -0.0019854 | 0.00162926 | 0.00086726 |
| **Standard Deviation** | 0.02508318 | 0.02532941 | 0.06810899 | 0.06916088 | 0.02533541 | 0.02556675 |
| **Variance** | 0.00062916 | 0.00064157 | 0.00462716 | 0.00474637 | 0.00064188 | 0.00065365 |
| **Beta** | 0.06253666 | 0.03886530 | 0.01890497 | 0.00444803 | 0.09344718 | 1.08294429 |
| **CAPM** | 0.07784506 | 0.07800854 | 0.06704621 | 0.07057914 | 0.06345869 | 0.93572723 |
| **Annual (Actual)**  **Returns** | -0.1251288 | 0.42029927 | -0.6676953 | -0.3903562 | 0.49496116 | 1.91966335 |
| **Average Sharpe ratio** | -.026147 | -1.0204962 | -0.3995930 | -0.3776142 | -1.0444972 | -1.0304616 |

**Analysis of Stock** :

The company underperformed when compared with the expectations of the investors for the FY13, FY15 and FY16 while it performed better than expected for the FY14, FY17 and 5-year period as per the CAPM model. The standard deviation that determines the riskiness of investing in the company was low varying between 2.5% - 6.8% for the time horizon.

Beta the statistical coefficient of stock return over market return was <1 for all the fiscal years implying the stock was less volatile than the market for these years .

For the FY13, FY15 and FY16 the actual returns are less than the expected returns (from CAPM model); sharpe ratio is negative for the FY13, FY14, FY15, FY16, FY17 and 5yr. Since the Sharpe ratio is negative for all the years investor would have booked profits by investing in government security for (the FY 13,14, 15 ,16,17 and 5 year term ) because negative sharpe ratio implies that either risk free rate is higher than market return or portfolio return is expected to be negative.

1. **GODREJCP**

Godrej Consumer Products Limited (GCPL) is an Indian consumer goods company based in Mumbai, India. GCPL' s products include soap, hair colourants, toiletries and liquid detergents. The consumer products business was part of the erstwhile Godrej Soaps Limited (GSL) and was demerged into Godrej Consumer Products Limited in April 2001, pursuant to a scheme of demerger approved by the Honorable High Court of Judicature, Mumbai, dated 14 March 2001. GCPL operates in the domestic and international markets in the 'personal and household care' segment. Some of the categories are soaps, hair colourants, toiletries and liquid detergents. In 2012, it made an entry into fast-growing air freshener category by launching a new fragrance product "aer" in the market. GCPL has a widespread distribution network across India. It makes sales in both urban and rural markets, enabling it to benefit from the opportunities in both segments. As of 2014, GCPL employs 21000 employees.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **YEAR** | **FY 13-14** | **FY 14-15** | **FY 15-16** | **FY 16-17** | **FY 17-18** | **5 YEAR** |
| **Average Returns** | 0.00040 | 0.00060 | 0.00100 | 0.00076 | -0.00179 | 0.00023 |
| **Standard Deviation** | 0.02147 | 0.02345 | 0.02266 | 0.01681 | 0.04860 | 0.02896 |
| **Variance** | 0.00046 | 0.00055 | 0.00052 | 0.00029 | 0.00236 | 0.00084 |
| **Beta** | 0.66478 | 1.57257 | 1.2256 | 1.10538 | 1.25033 | 1.08294 |
| **CAPM** | 0.15340 | 0.39404 | -0.12150 | 0.21295 | 0.10925 | 0.93695 |
| **Annual returns** | 0.10670 | 0.15905 | 0.28217 | 0.20836 | -0.35883 | 0.32351 |
| **Average Sharpe ratio** | -1.21750 | -1.10243 | -1.20261 | -1.55361 | -0.54451 | 0.15084 |

**Analysis of Stock:**

The company underperformed when compared with the expectations of the investors for the FY13, FY14 FY16 FY17 and 5yr period while it performed better than expected for the FY15 as per the CAPM model. The standard deviation that determines the riskiness of investing in the company was low varying between 1.6% - 4.8% for the time horizon.

Beta the statistical coefficient of stock return over market return was <1 for the FY 13 implying the stock was less volatile than the market for this year.

For the FY13, FY14, FY16 and FY17 the actual returns are less than the expected returns (from CAPM model); sharpe ratio is negative for all the fiscal years. Since the Sharpe ratio is negative for all these years investor would have booked profits by investing in government security for (the FY 13,14, 15 ,16,17) and investing in 5 year term horizon portfolio because negative sharpe ratio implies that either risk free rate is higher than market return or portfolio return is expected to be negative.

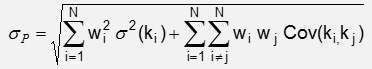
**B) Portfolio Analysis**

### **1) Analysis of Portfolio in FY 2013-14:**

The portfolio for the year 2013-14 thus, has the optimal weights as given below. The portfolio consists of five companies: **Chennai Petroleum Corporation Ltd, Oberoi Realty Ltd, Godrej Consumer Products Ltd, JK Paper Ltd, Fortis Healthcare Ltd.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Companies in Portfolio** | **Annualized Returns** | **Equal Weights (w =0.2)** | **Optimal Weights** |
| **Chennai Petroleum Corporation Ltd** | -0.37121 | 0.2 | 0 |
| **Oberoi Realty Ltd** | 0.128176 | 0.2 | 0.286030642 |
| **Godrej Consumer Products Ltd** | -0.09753 | 0.2 | 0 |
| **JK Paper Ltd** | 0.173321 | 0.2 | 0.713969358 |
| **Fortis Healthcare Ltd** | 0.015937 | 0.2 | 0 |
| **Portfolio return** | - | -0.03026 | 0.160408 |
| **Portfolio standard Deviation** | - | 0.200007 | 0.275856 |
| **Portfolio Sharpe ratio** | - | -0.50129 | 0.327737 |

The standard deviation of portfolio consisting of N assets can be calculated as follows:



where N is a number of assets in a portfolio, wi is a proportion of *i*th asset in a portfolio, wj is a proportion of *j*th asset in a portfolio, σ2 (ki) is variance of return of *i*th asset, and Cov(ki,kj) is covariance of returns of *i*th asset and *j*th asset.

### The covariance matrix is:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Covariance Matrix** | **CHENNPETRO** | **FORTIS** | **GODREJCP** | **JKPAPER** | **OBEROIRLTY** |
| **CHENNPETRO** | 0.000975 | 0.000164 | 7.74E-05 | 0.000217 | 0.000141 |
| **FORTIS** | 0.000164 | 0.000648 | 4.87E-05 | 0.000143 | 0.000103 |
| **GODREJCP** | 7.74E-05 | 4.87E-05 | 0.000637 | 0.000106 | 9.23E-05 |
| **JKPAPER** | 0.000217 | 0.000143 | 0.000106 | 0.000637 | 0.000145 |
| **OBEROIRLTY** | 0.000141 | 0.000103 | 9.23E-05 | 0.000145 | 0.000635 |

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### For the financial year 13-14, in the equally weighted portfolio, return, standard deviation and sharpe ratio were -0.03, 0.2 and -0.5 respectively, while in the optimal portfolio, return increased to 0.16, risk increases to .27 and sharpe ratio increased to 0.327.

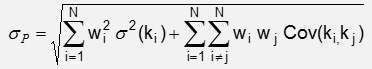
### Here, the usage of optimal weights rather than equal weights has increased the return, increased the standard deviation and increased the sharpe ratio considerably. This implies that the return over risk free investment is superior in case of optimal portfolio though a bit riskier.

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### **2) Analysis of Portfolio in FY 2014-15:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Companies in Portfolio** | **Annualized Returns** | **Equal Weights** | **Optimal Weights** |
| **Chennai Petroleum Corporation Ltd** | .093137 | .2 | 0 |
| **Oberoi Realty Ltd** | .44011 | .2 | 0 |
| **Godrej Consumer Products Ltd** | .294 | .2 | 0 |
| **JK paper Ltd** | .1325 | .2 | .713 |
| **Fortis Healthcare Ltd** | .1153 | .2 | .28 |
| **Portfolio return** | - | .21503 | 0.12763435 |
| **Portfolio standard Deviation** | - | .199686 | 0.293515214 |
| **Portfolio Sharpe ratio** | - | .72629 | 0.196358985 |

The standard deviation of portfolio consisting of N assets can be calculated as follows:



where N is a number of assets in a portfolio, wi is a proportion of *i*th asset in a portfolio, wj is a proportion of *j*th asset in a portfolio, σ2 (ki) is variance of return of *i*th asset, and Cov(ki,kj) is covariance of returns of *i*th asset and *j*th asset.

The covariance matrix is :-

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Covariance Matrix** | **CHENNPETRO** | **FORTIS** | **GODREJCP** | **JKPAPER** | **OBEROIRLTY** |
| **CHENNPETRO** | 0.000929849 | 6.95081 E-05 | 5.19581E-05 | 3.93996 E-05 | -1.31321E-06 |
| **FORTIS** | 6.95081E-05 | 0.000495919 | 0.000134367 | 3.81303 E-05 | -8.57445E-06 |
| **GODREJCP** | 5.19581E-05 | 0.000134367 | 0.00063896 | 0.000101972 | 1.23158E-05 |
| **JKPAPER** | 3.93996E-05 | 3.81303 E-05 | 0.000101972 | 0.000551577 | -4.97248E-06 |
| **OBEROIRLTY** | -1.31321E-06 | -8.57445 E-06 | 1.23158E-05 | -4.97248 E-06 | 7.58694E-05 |

### For the financial year 14-15, in the equally weighted portfolio, return, standard deviation and sharpe ratio were 0.215, 0.199 and 0.726 respectively, while in the optimal portfolio, return decreased to 0.127, risk increases to .293 and sharpe ratio decreased to 0.1963.

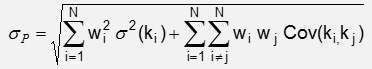
### Here, the usage of optimal weights rather than equal weights has decreased the return, increased the standard deviation and decreased the sharpe ratio considerably. This implies that the return over risk free investment is superior in case of equal portfolio though a bit riskier.

### **3) Analysis of Portfolio in FY 2015-16:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Companies in Portfolio** | **Annualized Returns** | **Equal Weights** | **Optimal Weights** |
| **Chennai Petroleum Corporation Ltd** | 2.741389302 | 0.2 | 0.77081203 |
| **Oberoi Realty Ltd** | -0.08851396938 | 0.2 | 0 |
| **Godrej Consumer Products Ltd** | 0.2873225822 | 0.2 | 0.22918797 |
| **JK paper Ltd** | 0.2997080937 | 0.2 | 0 |
| **Fortis Healthcare Ltd** | 0.1524198797 | 0.2 | 0 |
| **Portfolio return** | - | 0.69732 | 2.137454 |
| **Portfolio standard Deviation** | - | 0.283385 | 0.546973 |
| **Portfolio Sharpe ratio** | - | 2.213672 | 3.779807 |

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The standard deviation of portfolio consisting of N assets can be calculated as follows:



where N is a number of assets in a portfolio, wi is a proportion of *i*th asset in a portfolio, wj is a proportion of *j*th asset in a portfolio, σ2 (ki) is variance of return of *i*th asset, and Cov(ki,kj) is covariance of returns of *i*th asset and *j*th asset.

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### The covariance matrix is:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Covariance Matrix** | **CHENNPETRO** | **FORTIS** | **GODREJCP** | **JKPAPER** | **OBEROIRLTY** |
| **CHENNPETRO** | 0.001912285583 | 0.00004428527531 | 0.00013655166 | 0.00002245743572 | 0.00003285827486 |
| **FORTIS** | 0.00003285827486 | 0.00004981360414 | 0.00004911992468 | 0.00002821879923 | 0.0005810555583 |
| **GODREJCP** | 0.00013655166 | 0.0001048423085 | 0.0005162963189 | 0.0001143887869 | 0.00004911992468 |
| **JKPAPER** | 0.00002245743572 | 0.00004928405693 | 0.0001143887869 | 0.0005933441907 | 0.00002821879923 |
| **OBEROIRLTY** | 0.00004428527531 | 0.0009057513897 | 0.0001048423085 | 0.00004928405693 | 0.0000498136041 |

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### For the financial year 13-14, in the equally weighted portfolio, return, standard deviation and sharpe ratio were 0.68, 0.24 and 2.52 respectively.

### The usage of optimal weights rather than equal weights increases the return, the standard deviation and the sharpe ratio considerably. This implies that the return over risk free investment is superior in case of optimal portfolio though a bit riskier.

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### **6) Analysis of Portfolio for 5 Years:**

The 5-year portfolio has been created considering 5 companies: **Chennai Petroleum Corporation Ltd, Oberoi Realty Ltd, Godrej Consumer Products Ltd, JK Paper Ltd, Fortis Healthcare Ltd.**

The portfolio for the 5 years thus, has the optimal weights as given below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Companies in Portfolio** | **Annualized Returns** | **Equal Weights (w =0.2)** | **Optimal Weights** |
| **Chennai Petroleum Corporation Ltd** | 0.383321722 | 0.2 | 0.200743 |
| **Oberoi Realty Ltd** | 0.134530631 | 0.2 | 0 |
| **Godrej Consumer Products Ltd** | 0.179177455 | 0.2 | 0.047085 |
| **JK paper Ltd** | 0.487699787 | 0.2 | 0.639861 |
| **Fortis Healthcare Ltd** | 0.243822476 | 0.2 | 0.112311 |
| **Portfolio return** | - | 0.285710414 | 0.424829707 |
| **Portfolio standard Deviation** | - | 0.246079953 | 0.3179938 |
| **Portfolio Sharpe ratio** | - | 0.876586701 | 1.115838446 |

**Analysis:**

In the 5-year portfolio made by considering equal weights, the **portfolio return** is **0.285 (28.5%)** with associated **risk** **0.246 (24.6%)** and the **adjusted risk or Sharpe ratio** as **0.8765**. By optimizing the portfolio, the **return** increased to **0.4248 (42.48%)** with increased **risk** of **0.3179 (31.79%)** and increased **Sharpe ratio** to **1.115**. Though the risk has increased in the optimal portfolio, the increased returns have compensated for it and even the increased Sharpe ratio has compensated for the same.

Here we see that the usage of optimal weights rather than equal weights has increased the return, increased the standard deviation i.e. risk and increased the sharpe ratio. This implies that the return over risk free investment is superior in case of optimal portfolio.

As the annual returns of **Oberoi Realty Ltd.** are quite less compared to the other two companies in the portfolio, they haven't been considered in the optimal portfolio.

The optimal weights for **Chennai Petroleum Corporation Ltd** for FY 13-14, 14-15, and 5 yr portfolio are 0, 0 and 0.155883 respectively. This shows that the company didn’t performed well during FY 13-14 and 14-15. It wasn't profitable to invest in the company during FY 13-14 and 14-15.

The optimal weights for **Oberoi Realty Ltd** for FY 13-14, 14-15 and 5 yr portfolio are 0. 286030642, 0 and 0 respectively. This shows that the company performed well only during FY 13-14.

The optimal weights for **Godrej Consumer Products Ltd** for FY 13-14, 14-15, and 5 yr portfolio are 0, 0, and 0.047085 respectively. This shows that the company performed quite well during 5 year. It wasn't profitable to invest in the company during FY 13-14, 14-15. Long term investment (5 yr) in the company turned out to be profitable for the investors.

**Conclusion**

In this report, we chose five different companies from different sectors of the market and analyzed the performance of the stocks and compared their performance to the market and that perceived by the investors. We tried to justify which portfolio worked better for an investor for a particular time period or whether the investor was well of just by investing in the government bonds instead. We tried to gauge asset’s performance relative to risk as well as the minimum rate of return that any investor expects from the market accounting for the time value of money. We have analyzed the assets individually and also in a portfolio. We compared the equally weighted portfolio with the optimized portfolio using Excel and found the optimal solution that maximizes the Sharpe Ratio of the portfolio constrained by the weights of the portfolio.

Hence, we have used the following measures to evaluate the performance of various assets and portfolio of assets over different holding periods:

1. Annual return
2. Sharpe Ratio
3. CAPM Model
4. Standard Deviation

The above parameters have been used to perform an analysis of the chosen company stocks and portfolios of various stocks with different weights.

**References**

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