Team ID#: 010

Portfolio Management: Maximizing Investment Return

SUMMARY OF RESULTS:

As the portfolio managers, we suggest investing the $30,000 as such:

Stock Symbol	Price ($)	Number of Shares	Total Money Spent on Particular Stock
INFY	$53.10	234	$12,425.40
MSFT	$27.76	209	$5,801.84
ORCL	$16.71	242	$4,043.82
BMC	$29.96	76	$2,276.96
CAI	$46.41	43	$1,995.63
COGN	$39.78	86	$3,421.08

Total Spending:	$29,964.73

We arrived at this conclusion based on extensive research and analysis. First, we studied each of the factors given (Free Cash Flow, ROIC, P/E ratio, P/S ratio, and the beta value). We weighed and ranked the factors and came up with an equation unifying them to output a "Basis of Comparison" value. We used this value, in conjunction with the beta value (which shows the volatility and risk of a particular stock) to analyze the 18 stocks given. We then graphed the data and used constraints on beta values and the Basis of Comparison values to target optimum values. This resulted in six "best" stocks. We used several computer programs written in the Microsoft Visual C++ programming language to substantiate our claims as to the best stocks.

We fitted a normal curve distribution to the data to determine the percentage of the number of shares that should be acquired for each company. This was based on the deviation of that particular company's beta value from the targeted value of 1.2. Our investment strategy was not to take an overly conservative route. We figured that 20% over the market growth would be a fantastic return on the portfolio. However, at the same time, it was not overly risky. Having acquired these percentages, we wrote a system of eight equations to solve for the specific number of shares that should be bought for each of the stocks based on their prices and the total amount of money we have.

We evaluated the suggestion that relatively high ROIC and relatively low P/E values are strong indicators of the value of a stock. We found that, in our case, the stocks chosen would be the same. This further substantiates the validity of our model. Furthermore, we considered replacing one of the indicators used in the model but found this to be repetitive. We used another computer program to substantiate this claim. In addition, we came up with a suggestion for testing and validating our model using historical data.

INTRODUCTION AND DISCUSSION OF PROBLEM:

"October. This is one of the peculiarly dangerous months to speculate in stocks. The others are July, January, September, April, November, May, March, June, December, August, and February."
– Mark Twain

Investors all over the world face the agonizing problem of maximizing investment return. The stock market is an attractive investment opportunity for many people. However, it is also dangerous. Many theories exist of how to optimize returns.

We have been given $30,000 to invest in the stock market for one year. Our goal is to analyze 18 technology company stocks based on several key indicators, given in the table below, and select up to 6 stocks in which to invest:

Eighteen Computer Software/Services Corporation Stocks

Stock symbol	Price ($/share)	Cash Flow ($/share)	ROIC (%)	P / E Forward ($/$)	P / S ($/$)	Beta
ADBE	38.66	1.38	10.16	29.74	9.33	1.69
ADVS	34.88	0.87	5.00	74.35	5.88	2.38
BMC	29.96	1.58	19.23	22.59	4.08	1.61
CAI	46.41	3.92	7.48	18.58	0.79	0.70
CDNS	19.65	1.10	5.98	19.06	4.21	2.25
CTXS	31.26	1.37	14.16	24.00	5.49	2.49
COGN	39.78	2.03	13.37	21.46	3.72	1.59
INFY	53.10	0.78	38.41	37.48	10.92	1.30
MSCS	12.54	0.10	2.53	25.98	2.17	1.05
MFE	29.98	2.02	10.56	24.24	4.94	2.30
MSFT	27.76	1.20	30.76	19.11	6.06	1.04
NUAN	13.97	0.40	-2.07	37.08	5.35	3.03
ORCL	16.71	0.83	17.75	18.03	5.52	1.27
QADI	8.07	0.47	16.88	19.55	1.18	2.11
RHT	22.01	0.85	5.58	61.38	13.54	1.80
SPSS	33.50	1.24	10.04	26.80	2.80	1.39
SRX	23.69	1.50	11.76	22.37	1.14	0.23
SYMC	16.90	1.20	3.15	20.43	3.22	0.56

ASSUMPTIONS:

1. **Market –** The market is generally increasing

2. **Accounting –** All the companies have an equal level of corruption and faulty bookkeeping.

3. **ROIC –** There is no drastic fluctuation in the ROIC value based on a "fluke" project.

ANALYSIS OF PROBLEM:

Factors to consider when investing:

Free Cash Flow (FCF) – This value measures the company's financial strength. It is the cash not required for operations or reinvestment. In order to calculate Free Cash Flow, one must take net earnings before depreciation, amortization, and non-cash charges and subtract capital expenditures. A high FCF value is desired.

Return on Invested Capital (ROIC) – This value is a gauge for comparing the relative profitability of a company. It is calculated by taking the net profit after taxes and dividing by invested capital. A high percentage is desired.

Price-to-Earnings Ratio (P/E ratio) – This measures how "expensive" a stock is by showing how much investors are willing to pay per dollar of earnings. It is calculated by taking the price per share of stock and dividing by the earnings per share of stock. A high P/E ratio could mean that a stock is overvalued; a low P/E means that even if a stock is undervalued, it will take a long time for the market to value the stock properly. Historically, the P/E ratio has been between 15 and 25, and therefore this value should be neither too high nor too low for a good investment.

Price-to-Sales Ratio (P/S ratio) – The P/S ratio is a way to value a stock relative to its past performance or to that of other companies. The ratio shows how much Wall Street values every dollar of the company's sale. It is calculated by dividing the shares by its revenue per share for the past twelve months. It is a useful measure for sizing up stocks. The lower the ratio, the more desirable the investment.

Beta, – Beta measures a stock's volatility. When beta is equal to one, the price of the stock fluctuates with the overall market. When beta is greater than one, the stock has a greater volatility than the market and is therefore more risky. A beta that is less than one indicates that a stock is not as volatile and as a result less risky. The desired value of beta is individual for each investor based on how much risk he/she is willing to take.

Ranking and Justifications

After researching these factors, we decided to order them from what we considered most important to least important. We then assigned each one a weight (using percentages).

We purposely neglected beta in the initial ranking because we wanted to assess risk independent of the other factors. Risk is the only "personal style" factor where there is no clear-cut optimum value.

1. Free Cash Flow:

Pro

This data gives a clear view of the earning ability of the company and thus future profits. Also, this is the money that allows the company to employ offensive strategies against its competitors. For example, strategic investments such as buying out another companies or making improvements is done with FCF. A greater value for this aspect increases the financial flexibility of that company.

Con

It is easy to distort this value by "cooking the books." Often, companies will try to mislead stockholders with this value.

Justification: We decided to rank this value first because it takes into account capital expenditures and gives insight into the earning potential of a company. We assume that all the companies have an equal level of corruption and faulty bookkeeping. Therefore any distortion caused by corporate dishonesty is irrelevant in our model.

2. Return on Invested Capital

Pro

ROIC reflects the management of a company and its effectiveness. Many investment experts believe that this is a reliable tool in assessing a company's future performance.

Con

ROIC does not take into account the origin of the revenue. For example, one successful "fluke" project could yield a high ROIC number, skewing its value. This could lead to a possible misinterpretation of the overall earning power of the company.

Justification: We decided to rank this factor second because it shows the cash rate of return on capital that the company has invested (shows how much cash is going out of a business in relation to how much is coming in). Our research indicates that the ROIC is reliable and can accurately predict a company's future performance. We assumed that there was no drastic fluctuation on the ROIC value based on a "fluke" project.

3. Price to Sales Ratio

Pro

A low P/S can be useful in valuing "growth stocks" that have suffered temporary setbacks. The P/S is good for checking that a company's growth has not become overvalued.

Con

The P/S ratio does not take debt into account.

Justification: We rated the P/S ratio third (higher than the P/E ratio). We found sources that substantiated that the P/S factor can replace the P/E factor because the P/S ratio can ensure that a company's growth has not become overvalued.

4. Price-to-Earning Ratio

Pro

The P/E value takes into account market expectations for a company's growth (optimism concerning a company's growth prospects).

Con

The P/S value can replace the P/E value. A low P/E value does not necessarily mean that the company is not failing, nor does a high P/E ratio necessarily imply that the company is booming. Factors such as inflation and "hype" can skew the P/E ratio. The P/E ratio should be studied over time to notice trends.

Justification: The reason we ranked this last was because there are many factors that could skew the P/E ratio. For example, inflation could cause the P/E ratio to be high even if the company is not growing. Also the P/E ratio could be dependent on "hype" and unsubstantiated human interest in the company. We found in our sources that P/E ratios have to be used with extreme caution.

Weighting Using Percentages

Based on our analysis we decided to use number values for each factor to "weigh" them. We assigned numbers as such:

Free Cash Flow (FCF): 40 %
Return on Invested Capital (ROIC): 35%
Price to Sales (P/S) ratio: 15%
Price to Earnings (P/E) ratio: 10%

Optimum Trends

Before expressing the factors in equation form, we determined the optimum trend for each factor:

Factor (Variable)	Units	Optimum
FCF	$/Share	Large Value
ROIC	%	Large Percentage
P/S	$/$	Small Value
P/E	$/$	Small and Between 15–25 (20)*

*We realize that an optimum P/E value is actually lower. However, all P/E values given in the problem statement for each stock were above 18. The average of all the P/E values given is 29. Historically the average ratio has fluctuated between been 15–25. Therefore, we decided to use 20 as the optimum value for the P/E ratio. A high P/E ratio can represent an overvalued company and vice versa. Twenty is thus neither too high nor too low.

Correcting Factors

Before integrating these variables into one equation, we needed to develop a method so that the final output would accurately reflect the rankings and optimum trends for each variable.

Factor (Variable)	Correcting Factor
FCF	N/A*
ROIC	N/A*
P/S	1/(P/S)**
P/E	1/[abs(20-(P/E))]***

*For FCF and ROIC, the optimum value is a large value, thus no correcting factor value was needed.
**For P/S, a smaller value is more desirable. Thus we took the inverse of the P/S ratio to "correct" it in our equation.
***For P/E, we wanted the value to be as close to 20 as possible. We also wanted the value to be as small as possible. In the unlikely case that P/E equals 20, we will substitute 0.0001 for the [abs(20-(P/E))].

Integrated Equation

The final equation integrates all the factors that were discussed above.

$$\text{Basis of Comparison Value} = 0.4 \cdot CF + 0.35 \cdot ROIC + \frac{0.15}{(P/S)} + \frac{0.1}{|20 - (P/E)|}$$

After completing the equation, we wrote a C++ program that computed the "Basis of Comparison" values for all 18 stocks. The program is included in the appendix and is titled Program #1. The following are the data obtained from the program (the stocks are organized by the basis of comparison value—highest to lowest):

Stock Symbol	Basis of Comparison Value
INFY	13.77
MSFT	11.38
BMC	7.43
ORCL	6.62
QADI	6.44
COGN	5.6
CTXS	5.55
SRX	4.88
MFE	4.56
CAI	4.45
ADBE	4.13
SPSS	4.07
CDNS	2.67
RHT	2.31
ADVS	2.13
SYMC	1.86
MSCS	1.01
NUAN	-0.5

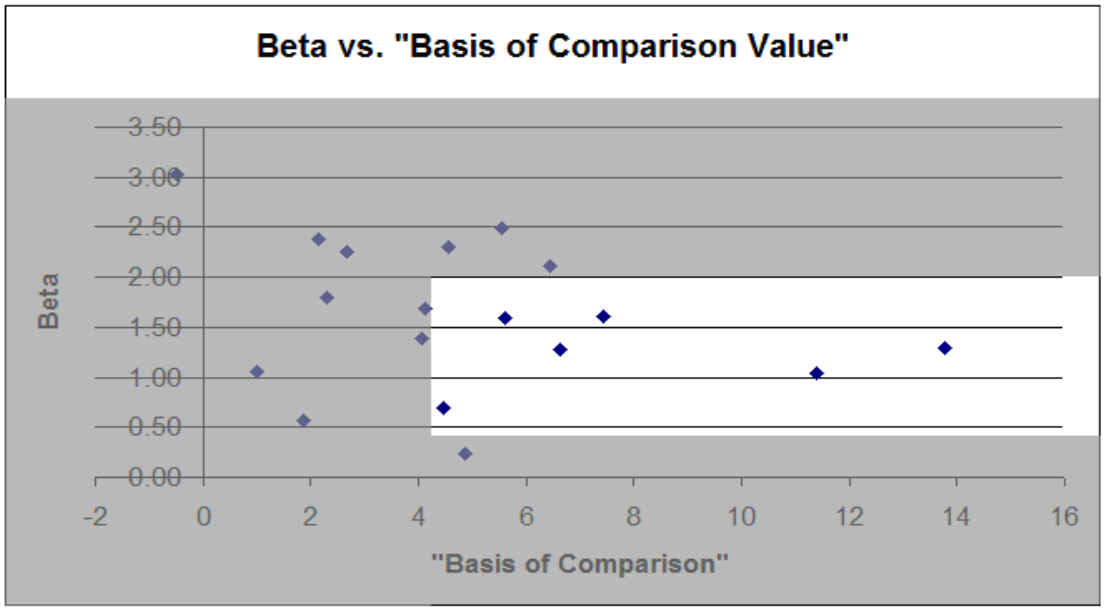
Incorporating Beta

Once we had the stocks in rank order based purely on FCF, ROIC, P/S, and P/E factors, we addressed the issue of risk and volatility (beta).

Since the problem statement indicates a general rising trend in the market, we decided to choose a beta of 1.2. A beta of 1.2 has enough potential to make the investment worthwhile, while not becoming too much of a risk. The team figured that this percentage would provide a good return, but at the same time would not be too risky.

Final Ranking System

We wanted a way to incorporate all variables. We graphed a function of Basis of Comparison vs. the beta value. We constrained the data and eliminated all beta values higher than 2.0 and lower than 0.4 because we did not want a stock that neither was too risky nor too conservative (which would have minimized returns). We took the remaining data points and picked the six with the highest Basis of Comparison value. We decided to pick six rather than one or two because we felt that diversity in investments offered more security for the overall portfolio. We wrote a C++ program to compute the six optimal companies that we want to invest in. The program is included in the appendix and is titled Program #2.



DESIGN OF THE MODEL:

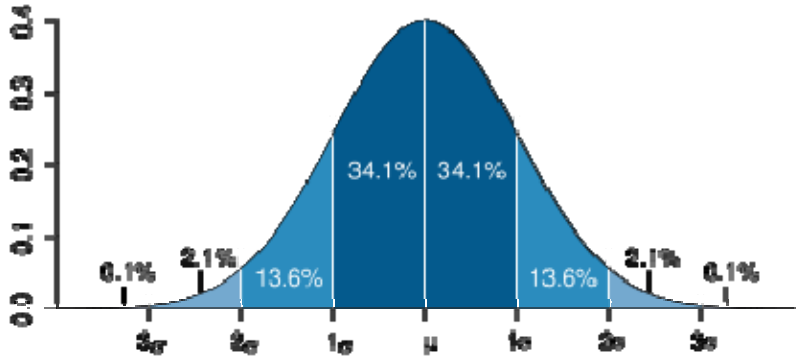
Once the top six companies were determined by the method previously described, we had as a result the summative table shown below:

Stock Symbol	Basis of Comparison Value	Beta
INFY	13.77	1.30
MSFT	11.38	1.04
ORCL	6.62	1.27
BMC	7.43	1.61
CAI	4.45	0.70
COGN	5.6	1.59

The issue now was to decide the distribution or the number of shares that should be bought of each stock. The team decided that for this, the decisive factor was the volatility and risk of purchasing a particular stock, given by beta. While stocks with a higher beta have a chance to have a higher return than the market return, there is also more risk involved. The market is defined to have a beta value of 1. Beta is actually a percentage value. For example, if the market is expected to have a return of 8%, then a stock with a beta of 1.5 should return 12%. Stocks with a beta value of less than 1 have less risk involved but also a lower return percentage.

In order to come up with an accurate distribution of the number of shares of each particular stock, the team used a normal bell curve as a basis of comparison. The team knew that they wanted a beta value that was not too far from 1.2, the target value, and also to purchase the most number of shares for the stock whose beta value was closest. Therefore, the distance of the stock beta to the target beta should be proportional to the number of shares purchased.

To come up with an equation for a bell curve, the (mean) and the standard deviation (c) had to be known. The mean was 1.2 because this was the target beta value. In order to find the standard deviation, the team had to use the range of the bell curve which was [0.4 – 2.0]. Now, since the 1.2 was in the middle of the range, approximately 99% of the data was within this range. By statistical methods, a normal distribution has three standard deviation bands as shown below:

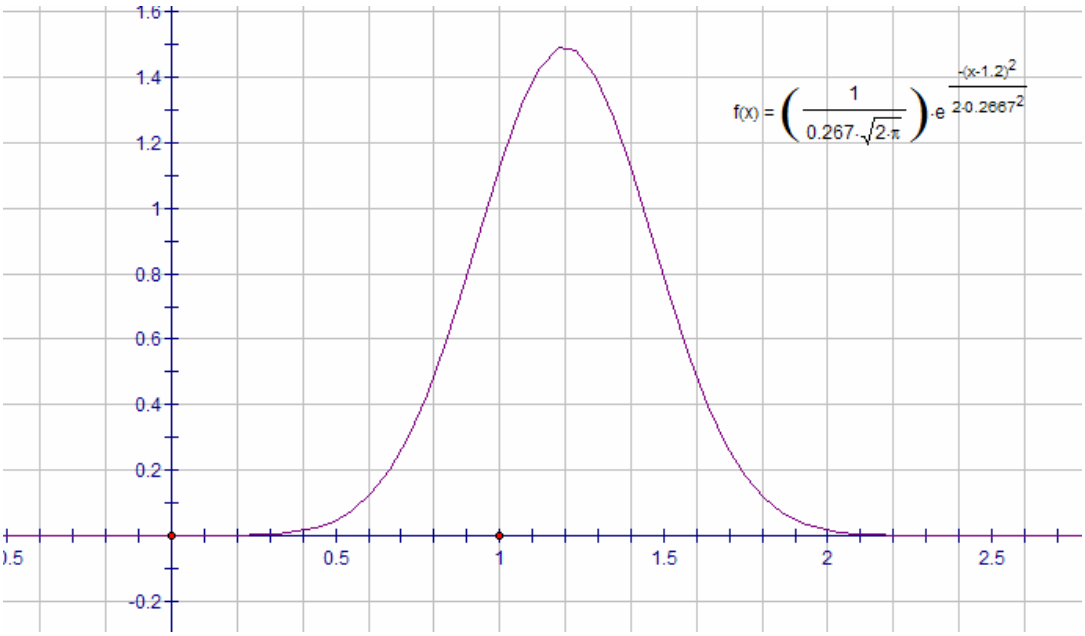


Therefore, 0.8 (half the range) divided by 3 would give the standard deviation of 0.2667. Using this information, the equation for the normal bell curve for this situation (beta values on the x-axis) is the following:

$\mu = 1.2$
$c = 0.2667$

$$f(\beta) = \frac{e^{\frac{-(\beta-1.2)^2}{2\cdot(0.2667)^2}}}{0.2667 \cdot \sqrt{2\pi}}$$

The following is a graph of this function:



Then the team plugged in the specific beta values for the top six stocks that were previously determined. The f(ß)/∑f(ß) gave by way of percentage the distribution of the number of shares of each stock that should be purchased. Therefore, using this information, INFY should be 26.21% of the number of shares purchased; MSFT should be 23.49% of the number of total shares purchased, etc.:

Stock Symbol	ß	f(ß)	f(ß)/∑f(ß) = s
INFY	1.3	1.39274	26.21%
MSFT	1.04	1.248088	23.49%
ORCL	1.27	1.443576	27.17%
BMC	1.61	0.458365	8.63%
CAI	0.7	0.25774	4.85%
COGN	1.59	0.512929	9.65%

sum of f(ß) 5.313439

Once the distribution of the stock share number is determined, the price and the total amount of money should be taken into account to come up with the definitive share numbers that

should be purchased. In order to do this, the team came up with a system of equations based on the criteria previously described:

$$30{,}000 = n_1 \cdot p_1 + n_2 \cdot p_2 + n_3 \cdot p_3 + n_4 \cdot p_4 + n_5 \cdot p_5 + n_6 \cdot p_6,$$

$$n_t = n_1 + n_2 + n_3 + n_4 + n_5 + n_6,$$

$$s_1 = \frac{n_1}{n_t}, \qquad s_2 = \frac{n_2}{n_t}, \qquad s_3 = \frac{n_3}{n_t}, \qquad s_4 = \frac{n_4}{n_t}, \qquad s_5 = \frac{n_5}{n_t}, \qquad s_6 = \frac{n_6}{n_t}.$$

The first equation was simply an evaluation of the total money spent versus how much there was to spend. $n_1, n_2, \ldots, n_6$ were all variables that needed to be determined. However, the team knew the ratio of each number versus the total number of stocks from the percentages determined in the previous section (labeled in the equations as s_1, s_2, etc). The numerical order was the same as used in the tables in this section, with 1 corresponding to INFY, 2 to MSFT…. Using the system of equations above and a TI-89 Titanium calculator (solve function), each of the variables was determined:

Stock Symbol	Price ($)	Number of Shares	Total Money Spent on Particular Stock
INFY	$53.10	234	$12,425.40
MSFT	$27.76	209	$5,801.84
ORCL	$16.71	242	$4,043.82
BMC	$29.96	76	$2,276.96
CAI	$46.41	43	$1,995.63
COGN	$39.78	86	$3,421.08

Total Spending:	$29,964.73

This is the final result the team has come up with. The stock symbol, price per share, and the number of shares to be bought are all in the table above. The total available $30,000 was not used because there exist transaction fees. Using the Trade King Company, the fee is $4.95 per transaction. Therefore, for this particular case with six transactions, the fee would be $29.70. Thus, $5.57 of the available money would be left over.

We would have preferred to purchase the stocks for our six companies directly from the companies themselves. However, after calling the companies, the only company that had a direct investment program was Microsoft. The plan is known as the Direct Investment Program and is sponsored by the Mellon Investor Services. The price per transaction through this program, however, is $12 per transaction. We found a company, named above, that sells stock for less than $12 per transaction. Thus, we concluded that purchasing our stocks through Trade King would maximize profits.

ROIC AND P/E ANALYSIS:

Recent results suggest that a relatively high ROIC and relatively low (but not too low) P/E are strong indicators of the value of a stock. Below are two charts which compare the stocks based on the ROIC and the P/E values (arranged in the desirable order—ROIC greatest to least and P/E least to greatest).

Comparison of Stocks Based on ROIC to P/E

Stock symbol	ROIC (%)
INFY	38.41
MSFT	30.76
BMC	19.23
ORCL	17.75
QADI	16.88
CTXS	14.16
COGN	13.37
SRX	11.76
MFE	10.56
ADBE	10.16
SPSS	10.04
CAI	7.48
CDNS	5.98
RHT	5.58
ADVS	5.00
SYMC	3.15
MSCS	2.53
NUAN	-2.07

Stock symbol	P / E Forward ($/$)
ORCL	18.03
CAI	18.58
CDNS	19.06
MSFT	19.11
QADI	19.55
SYMC	20.43
COGN	21.46
SRX	22.37
BMC	22.59
CTXS	24.00
MFE	24.24
MSCS	25.98
SPSS	26.80
ADBE	29.74
NUAN	37.08
INFY	37.48
RHT	61.38
ADVS	74.35

Based just on the ROIC and the P/E analysis above (the charts are color coded) the six most attractive stocks are MSFT, BMC, ORCL, CTXS, and COGN. Four of these, MSFT, BMC, ORCL, and COGN, were included in the final list that we picked using the methods previously described. The remaining two choices we believe to be poor investments because:

QADI has a very low cash flow value and also a relatively high beta, which shows that it is risky and does not have great financial flexibility;

CTXS has an extremely high beta value of 2.49, which makes the stock extremely volatile and risky.

Based on these reasons, the recent results that suggest that a relatively high ROIC and relatively low (but not too low) P/E values are strong indicators of the value of a stock would not change our decisions about the six stocks that we picked. Four of them match between the comparisons which makes us believe that our model is actually a very good predictor of stock value. We would not have included the two that did not match for the reasons given above.

REPLACING ONE OF THE INDICATORS:

We decided that the factor that we would remove is the P/E ratio. While we realize that most shareholders hold this particular value to be the best measure of true stock value, we believe that for this particular cluster of stocks this is not so. The P/E value shows how much money investors are willing to pay for a stock per dollar of earnings for the company. While this is generally a good indicator of stock value, because the stocks in question are from the technical market, there is a great deal of false investments or "hype" involved in this field. Thus, the P/E may be unusually high for reasons other than the company having a good value. Also, the earnings of a company, a figure that is used to calculate the P/E value, can be easily manipulated by the accounting principles of the company in question, making it somewhat unreliable.

Return on Earnings (ROE) – We chose ROE as the indicator to replace P/E because it is a useful means for comparing the profitability of a company to that of others in the same industry. ROE shows how much profit a company earned in comparison to the total amount of shareholder equity (the shareholder equity is equal to the total assets minus the total liabilities). If a business has a high return on equity, it is more likely to generate cash internally. Also, ROE is a good indicator of the firm's growth rate and gauges growth potential.

However, upon obtaining the ROE values for each of the stocks given initially, we discovered that a most of the stocks had the same values for the ROE and ROIC. The difference between ROIC and ROE is that ROIC factors in the debt of the company while ROE does not. Thus, this exposes companies which borrow heavily to boost their returns. Because these values for a lot of the companies are the same or close, especially for the stocks that we picked with our mode, we decided that our stock choices had little or no debt. Therefore we decided against including a new indicator into our model.

Furthermore, data from another C++ program (Program #3 in the appendix) indicated that the stock choices would not have varied between the two models.

SUGGESTION FOR TESTING MODEL:

The purpose of our mathematical model and the methods used previously is to pick the best 6 stock options based on several important indicators to have a maximum value of return in a one-year period without too much risk. Our suggestion for testing the validity of our model would be to look at the historical data of a market that had a general upwards trend, such as the 1997–1998 stock market rise. Then our model could be applied to pick several stocks; how well those stocks fared during that one-year period could be used to validate our suggestion.

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APPENDIX:

Program #1:

```
//Team 010 – Determining the Basis of Comparison Value
# include <iostream>
# include <iomanip>
# include <time.h>
# include <stdio.h>
# include <stdlib.h>
# include <math.h>
using namespace std;
struct stocks                                   //construct a structure with the 4 major factors
{
    double cf;
    double roic;
    double ps;
    double pe;
    double invpe;
    double invps;
};
void main()
{
    stocks company;                             //instantiate an instance of stocks
    double expectedvalue;           //declare constants-IE the weighted values
    double const1=.4;
    double const2=.35;
    double const3=.15;
    double const4=.1;
    cout<<"input the cash flow"<<"\n";          //input all values from the user
    cin>>company.cf;
    cout<<"input the Return on Investment Capital"<<"\n";
    cin>>company.roic;
    cout<<"Input the Price to earnings ratio"<<"\n";
    cin>>company.pe;
    cout<<"Input the price to sales ratio"<<"\n";
    cin>>company.ps;
    company.invpe=1/(abs(20-company.pe));               //calculate the inverse
    company.invps=1/company.ps;
    expectedvalue=const1*company.cf+const2*company.roic+const3*company.invps+const4*
company.invpe; //calculate the expected value
    cout<<"The expected value coefficent is "<<expectedvalue<<"\n";
```

Program #2:

```
//Team 010 – Constraining the Data Points
# include <iostream>
# include <iomanip>
# include <time.h>
# include <stdio.h>
# include <stdlib.h>
# include <math.h>
# include <string.h>
using namespace std;
struct finance
{
    double ev;
    double beta;
    char name[4];
    int result;
};
void main()
{
    struct finance total[18];
    for(int x=0;x<=17;x++)
    {
            cout<<"input the expected value "<<"\n";
            cin>>total[x].ev;
            cout<<"input the beta "<<"\n";
            cin>>total[x].beta;
            cout<<"enter the name of the company"<<"\n";
            cin>>total[x].name;
    }
    cout<<total[0].beta;
    for(x=0;x<=1;x++)
    {
            if(total[x].beta<.4 || total[x].beta>2)
            {
                    total[x].result=1;

            }
            else
            {
                    total[x].result=0;

            }
    }
    for(x=0;x<=217;x++)
    {
            if(total[x].result==0)
```

```
                {
                        cout<<"The company values are "<<total[x].name<<" and the beta is
"<<total[x].beta<<" the ev is "<<total[x].ev<<"\n";
                }
        }
    }
```

Program #3:

```
# include <iostream>
# include <iomanip>
# include <time.h>
# include <stdio.h>
# include <stdlib.h>
# include <math.h>
using namespace std;
struct stocks                           //construct a structure with the 4 major factors
{
        double cf;
        double roic;
        double ps;
        double roe;
        double invps;
};
void main()
{
        stocks company;                         //instantiate an instance of stocks
        double expectedvalue;           //declare constants-IE the weighted values
        double const1=.4;
        double const2=.25;
        double const3=.25;
        double const4=.1;
        cout<<"input the cash flow"<<"\n";          //input all values from the user
        cin>>company.cf;
        cout<<"input the Return on Investment Capital"<<"\n";
        cin>>company.roic;
        cout<<"Input the Return on Common Equity"<<"\n";
        cin>>company.roe;
        cout<<"Input the price to sales ratio"<<"\n";
        cin>>company.ps;                //calculate the inverse
        company.invps=1/company.ps;
        expectedvalue=const1*company.cf+const2*company.roic+const3*company.roe+const4*co
mpany.invps; //calculate the expected value
        cout<<"The expected value coefficent is "<<expectedvalue<<"\n";

}
```