**MOODY'S MEGA MATH CHALLENGE 2007**

# *RISKY BUSINESS*: USING MATHEMATICAL MODELING TO MAXIMIZE RETURNS AND MINIMIZE RISK IN THE STOCK MARKET

**TEAM #104**

**SUMMARY**

The goal of any investor, whether the commodity is a stock, bond, or other security, is to maximize earning potential while limiting risk. In attempting to reach an equilibrium between these two factors, we utilized several mathematical models based on various data.

Using the given data on the Free Cash Flow, Return on Invested Capital (ROIC), Price to Earnings ratio, Price to Sales ratio, and Beta coefficient, we created two portfolios that resulted in relatively high gains with relatively low risk. However, these gains would not have been sufficient to entice any but the most frivolous investors, so we created a system to maximize potential returns while minimizing risk.

Using concepts such as professional analysis, Sharpe Ratios, and historical figures in conjunction with the given data, we were able to create the best possible portfolio from the eighteen given stocks. By directly comparing a stock's potential ROIC to its standard deviation (a derivative of its Beta coefficient), we were able to construct a portfolio that is expected to return a high profit while putting relatively little capital at risk.

**Assumptions Made**

The stock market will steadily increase: given in the problem.

No more than $30,000 can be invested: given in the problem.

Each portfolio created contains exactly **six** stocks: the problem sets the maximum at six, and it would be unwise to select less than six because portfolio diversification allows for both greater profitability and greater security.

Any one stock's value, and therefore the entire portfolio's value, has an equal chance of increasing as decreasing: it would be unreasonable to expect complete security in the stock market. While the market as a whole will increase, individual securities fluctuate on a day-to-day and year-to-year basis.

There will be no significant inflation over the next year: the inflationary increase that normally occurs over the course of one year would not affect the market in a large enough way so as to change the eventual outcome of this exercise.

**Stock Picks and Amounts Invested**

Upon first examining the data provided in the table, we decided that two of the stronger indicators of a stock's profitability are the health of its company and the value of the stock versus its price. The first is measured by the Free Cash Flow; the second is measured by the Price to Sales (P/S) ratio. In order to find the stocks that are most profitable according to these guidelines, we organized the list of stocks into two lists: the first in order of Cash Flow from highest to lowest, and the second in order of P/S ratio from lowest to highest.

**Table 1a**

Average Cash Flow: 1.269

| Stock | Cash Flow |
|---|---|
| **CAI** | **3.92** |
| **COGN** | **2.03** |
| **MFE** | **2.02** |
| **BMC** | **1.58** |
| **SRX** | **1.50** |
| **ADBE** | **1.38** |
| **CTXS** | **1.37** |
| SPSS | 1.24 |
| MSFT | 1.20 |
| SYMC | 1.20 |
| CDNS | 1.10 |
| ADVS | 0.87 |
| RHT | 0.85 |
| ORCL | 0.83 |
| INFY | 0.78 |
| QADI | 0.47 |
| NUAN | 0.40 |
| MSCS | 0.10 |

**Table 1b**

Average P/S Ratio:5.019

| Stock | P / S |
|---|---|
| **CAI** | **0.79** |
| **SRX** | **1.14** |
| **QADI** | **1.18** |
| **MSCS** | **2.17** |
| **SPSS** | **2.80** |
| **SYMC** | **3.22** |
| **COGN** | **3.72** |
| **BMC** | **4.08** |
| **CDNS** | **4.21** |
| **MFE** | **4.94** |
| NUAN | 5.35 |
| CTXS | 5.49 |
| ORCL | 5.52 |
| ADVS | 5.88 |
| MSFT | 6.06 |
| ADBE | 9.33 |
| INFY | 10.92 |
| RHT | 13.54 |

We found that five stocks were ranked above average on both scales: CAI, COGN, MFE, BMC, and SRX. Our sixth stock choice, SPSS, ranked well above average on the P/S ratio scale and only three cents below the average Cash Flow. After making these choices, we also came to the realization that the Beta coefficients of the six stocks are distributed in a very even manner. One could be considered a low-risk investment (SRX), one a high-risk investment (MFE), and four moderate-risk investments (BMC, CAI, COGN, and SPSS).

When dividing the $30,000, we first decided which stocks would receive the most money. Our first conclusion was that, since it has the lowest Beta coefficient by far and therefore has the potential to make the least money over the course of a single year, SRX would receive the least money. We decided on an arbitrary value of $2,500 to invest in this stock. In order to make the most money possible, we decided to invest the most money in the high-risk, high-integrity stock MFE. We assumed that, in the worst-case scenario, the high-risk stock would lose enough money to offset average profits from two of the moderate stocks. With that in mind, we used the following equation to determine the amount invested in MFE:

$$\$30,000 - \$2,500 = \$27,500 = 4x + y = 6x,$$

where $x$ is equal to the amount invested in a moderate stock and $y$ is equal to the amount invested in MFE. This calculation resulted in an investment of $9,166 in MFE. After these two investments, a sum of $18,332 remained to be invested. We divided this amount evenly between the four moderate stocks, allotting $4,583 for each.

After dividing these theoretical totals by the share prices and multiplying the resulting number of shares by the price per share, our portfolio resulted in the following:

**Table 2**

| Stock Symbol | Theoretical Total Invested | Price per Share | Shares Purchased | Total Invested | % of Portfolio's Total Value |
|---|---|---|---|---|---|
| BMC | $4,583.00 | $29.96 | 152 | $4,553.92 | 15.19% |
| CAI | $4,583.00 | $46.41 | 98 | $4,548.18 | 15.17% |
| COGN | $4,583.00 | $39.78 | 118 | $4,694.04 | 15.66% |
| MFE | $9,166.00 | $29.98 | 305 | $9,143.90 | 30.50% |
| SPSS | $4,583.00 | $33.50 | 136 | $4,556.00 | 15.20% |
| SRX | $2,500.00 | $23.69 | 105 | $2,487.40 | 8.30% |

The total value of the portfolio is $29,983.44, leaving $16.56 that cannot be invested.

**Using More Data**

After calculating our portfolio's expected rate of return and its overall risk, we came to the realization that a strong portfolio cannot be based solely on these two parameters. We repeated the above process of selecting six stocks, this time using the Return on Invested Capital (ROIC) value and the Price to Earnings (P/E) ratio in addition to the P/S and Cash Flow values. We again organized the eighteen stocks in order from most favorable to least favorable, shown below.

**Table 3**

| Cash Flow | P/S | ROIC | P/E |
|---|---|---|---|
| **CAI** | **CAI** | **INFY** | **ORCL** |
| **COGN** | **SRX** | **MSFT** | **CAI** |
| **MFE** | **QADI** | **BMC** | **CDNS** |
| **BMC** | **MSCS** | **ORCL** | **MSFT** |
| **SRX** | **SPSS** | **QADI** | **QADI** |
| **ADBE** | **SYMC** | **CTXS** | **SYMC** |
| **CTXS** | **COGN** | **COGN** | **COGN** |
| SPSS | **BMC** | SRX | **SRX** |
| MSFT | **CDNS** | MFE | **BMC** |
| SYMC | **MFE** | ADBE | **CTXS** |
| CDNS | NUAN | SPSS | **MFE** |
| ADVS | CTXS | CAI | **MSCS** |
| RHT | ORCL | CDNS | **SPSS** |
| ORCL | ADVS | RHT | ADBE |
| INFY | MSFT | ADVS | NUAN |
| QADI | ADBE | SYMC | INFY |
| NUAN | INFY | MSCS | RHT |
| MSCS | RHT | NUAN | ADVS |

BMC and COGN, two of our original picks, ranked above average on all four scales. QADI and CTXS ranked above average on three scales, so we chose them as well. For our final two picks, we chose ORCL and MSFT. These stocks ranked above average on two scales and only slightly below average on the other two. We classified two of these new choices (CTXS and QADI) as high-risk and the other four as moderate-risk.

In dividing the $30,000 among the stocks in this new portfolio, we repeated the assumption that the worst realistic loss inflicted by a high-risk stock can be compensated for by the profits of two moderate stocks. We designated the two stocks featured in both portfolios

(BMC and COGN) as the compensators, and so allotted twice as much to those as to the high-risk stocks. For the sake of simplicity, the other two moderate stocks (MSFT and ORCL) received the same amounts as the high-risk stocks. The allotments in the second portfolio can therefore be modeled by the following equation:

$$\$30{,}000 = 4x + 2y = 8x,$$

where $x$ is equal to the amount invested in each high-risk stock and $y$ is equal to the amount invested in each compensating moderate stock. The amount invested in each high-risk stock is therefore \$3,750 and the amount invested in each compensator is twice that, or \$7,500. Again, some small changes occurred after actually purchasing the stocks, and our second portfolio resulted in the following:

**Table 4**

| Stock Symbol | Theoretical Total Invested | Price per Share | Shares Purchased | Total Invested | % of Portfolio's Total Value |
|---|---|---|---|---|---|
| BMC | \$7,500.00 | \$29.96 | 251 | \$7,519.96 | 25.07% |
| COGN | \$7,500.00 | \$39.78 | 188 | \$7,478.64 | 24.93% |
| CTXS | \$3,750.00 | \$31.26 | 120 | \$3,751.20 | 12.51% |
| MSFT | \$3,750.00 | \$27.76 | 135 | \$3,747.60 | 12.49% |
| ORCL | \$3,750.00 | \$16.71 | 224 | \$3,743.04 | 12.48% |
| QADI | \$3,750.00 | \$8.07 | 465 | \$3,752.55 | 12.51% |

The total value of this portfolio is \$29,992.99, leaving a sum of \$7.01 uninvested.

**Table 5**

| | 2002-2003 | 2003-2004 | 2004-2005 | 2005-2006 | 2006-2007 | EXPECTED RETURN | VARIAN | STD DEV | Sharpe Ratio |
|---|---|---|---|---|---|---|---|---|---|
| **SYMC** | -4.93% | 18.17% | -53.93% | -21.10% | 0.42% | -12.27% | 5.91% | 24.31% | -0.7154 |
| **MSFT** | -59.86% | 2.97% | -3.05% | 12.58% | 2.02% | -9.07% | 6.70% | 25.89% | -0.5479 |
| **SRX** | 29.00% | 30.10% | -12.43% | -7.33% | -100.00% | -12.13% | 22.44% | 47.37% | -0.3642 |
| **MSCS** | -66.30% | 13.68% | 26.33% | 79.25% | -59.55% | -1.32% | 30.19% | 54.94% | -0.1172 |
| **CDNS** | -55.77% | 47.40% | 1.42% | 23.68% | 6.27% | 4.60% | 11.71% | 34.22% | -0.0152 |
| **ADBE** | -23.48% | 27.47% | 70.92% | -47.97% | 10.62% | 7.51% | 16.93% | 41.15% | 0.0581 |
| **ORCL** | -15.31% | 10.70% | 4.00% | 9.70% | 22.06% | 6.23% | 1.50% | 12.26% | 0.0904 |
| **ADVS** | -79.45% | 53.62% | -2.68% | 56.33% | 22.73% | 10.11% | 24.74% | 49.74% | 0.1003 |
| **MFE** | -42.93% | 30.34% | 25.33% | 7.85% | 23.22% | 8.76% | 7.25% | 26.92% | 0.1353 |
| **CAI** | -4.98% | 28.90% | 28.44% | 19.05% | -29.41% | 8.40% | 5.09% | 22.56% | 0.1453 |
| **COGN** | -17.23% | 36.71% | 34.42% | -6.83% | 2.26% | 9.87% | 4.79% | 21.88% | 0.2169 |
| **BMC** | -22.42% | 29.56% | -23.27% | 44.40% | 38.32% | 13.32% | 8.94% | 29.90% | 0.2741 |
| **QADI** | -4.55% | 187.85% | -37.68% | -9.55% | 7.89% | 28.79% | 65.48% | 80.92% | 0.2925 |
| **CTXS** | -23.84% | 64.29% | 10.18% | 59.11% | -17.52% | 18.44% | 13.81% | 37.16% | 0.3585 |
| **SPSS** | -35.46% | 62.54% | -5.49% | 82.06% | 5.81% | 21.89% | 19.14% | 43.75% | 0.3834 |
| **NUAN** | -23.60% | 23.33% | -32.97% | 217.47% | 18.29% | 40.50% | 83.23% | 91.23% | 0.3879 |
| **RHT** | -4.74% | 324.49% | -52.67% | 156.46% | -21.34% | 80.44% | 201.35% | 141.90% | 0.5308 |
| **INFY** | -6.34% | 33.22% | 33.22% | 33.22% | 33.22% | 25.31% | 2.50% | 15.82% | 1.2760 |

**Choosing the Perfect Portfolio**

As a means of improving our stock choices and increasing the success of our portfolio, we used the Sharpe Ratio to add another element to consider in making our decisions. The Sharpe Ratio can be defined with the equation

$$S = \frac{E[R - R_f]}{\sigma}$$

where the Risk Free Rate of return is subtracted from the asset return and then divided by the standard deviation. The Sharpe Ratio represents the ratio between high return and low risk.

**Table of Sharpe Ratios**

| | |
|---|---|
| INFY | 1.2670 |
| RHT | 0.5308 |
| NUAN | 0.3879 |
| SPSS | 0.3834 |
| CTXS | 0.3585 |
| SYMC | -0.7154 |
| QADI | 0.2925 |
| BMC | 0.2741 |
| COGN | 0.2169 |
| CAI | 0.1453 |
| MFE | 0.1353 |
| ORCL | 0.0904 |
| ADBE | 0.0581 |
| CDNS | -0.0152 |
| MSCS | -0.1172 |
| SRX | -0.3642 |
| MSFT | -0.5479 |
| SYMC | -0.7154 |

**First Trial**

To begin choosing our best portfolio we chose the 6 companies that had the greatest Sharpe Ratio. These were SPSS, RHT, CTXS, INFY, NUAN, and QADI. We added their Sharpe Ratios (SR) together creating a total sum (TS):

$$SR_{SPSS} + SR_{RHT} + SR_{CTXS} + SR_{INFY} + SR_{NUAN} + SR_{QADI} = TS$$
$$(0.3834) + (0.5308) + (0.3585) + (1.2670) + (0.3879) + (0.2925) = 3.2291$$

We then divided each Sharpe Ratio by the total sum to determine the percentage of our $30,000 budget that would go into each stock.

SPSS = 0.3834/3.2291 = .1187100% = 11.87%
RHT = 0.5308/3.2291 = .1644 X 100% = 16.44%
CTXS = 0.3585/3.2291 = .1110 X 100% = 11.10%
INFY = 1.2670/3.2291 = .3952 X 100% = 39.52%
NUAN = 0.3879/3.2291 = .1201 X 100% = 12.01%
QADI = 0.2925/3.2291 = .0906 X 100% = 9.06%
=100%

After calculating this, we multiplied each percentage by $30,000 to determine the amount of money we would invest in each particular company.

| | |
|---|---|
| = 11.87% | times $30,000 = $3,561 |
| = 16.44% | times $30,000 = $4,932 |
| = 11.10% | times $30,000 = $3,330 |
| = 39.52% | times $30,000 = $11,856 |
| = 12.01% | times $30,000 = $3,603 |
| = 9.06% | times $30,000 = $2,718 |

Sum of Investments (SOI) = $30,000

This, however, led to a variance of 23.19%, a standard deviation of 48.15%, and a return value of 32.74%. This generated an expected profit of $9,821.08. So although the revenue from the investments would be a good amount of money, the risk and high standard deviation percentage led us to change investments in different stocks.

**Second Trial**

We then looked to replacing the companies with the largest Sharpe Ratio since we thought this was driving up our standard deviation. We first decided to remove RHT due to its low return and overpricing (according to the P/E, investors would pay $61.38 for every $1 of earnings) and replace it with BMC. We utilized our same process:

$$SR_{SPSS} + SR_{BMC} + SR_{CTXS} + SR_{INFY} + SR_{NUAN} + SR_{QADI} = TS$$
$$(0.3834) + (0.2741) + (0.3585) + (1.2670) + (0.3879) + (0.2925) = 2.9724$$

SPSS = 0.3834/2.9724 = .1290 X 100% = 12.90%
BMC = 0.2741/2.9724 = .0922 X 100% = 9.22%
CTXS = 0.3585/2.9724 = .1206 X 100% = 12.06%
INFY = 1.2670/2.9724 = .4293 X 100% = 42.93%
NUAN = 0.3879/2.9724 = .1305 X 100% = 13.05%
QADI = 0.2925/2.9724 = .0984 X 100% = 9.84%

Multiply by $30,000 to determine the amount invested in each:

= 12.90% times $30,000 = $3,870
= 9.22% times $30,000 = $2,766
= 12.06% times $30,000 = $3,618
= 42.93% times $30,000 = $12,879
= 13.05% times $30,000 = $3,915
= 9.84% times $30,000 = $2,952
SOI = $30,000

This, however, resulted in a variance of 10.15%, a standard deviation of 31.86%, and a return of 22.43%, with an expected profit of $6,728.03.

**Third Trial**

We now tried to rotate BMC with INFY and bring back RHT into our portfolio:

$$SR_{SPSS} + SR_{RHT} + SR_{CTXS} + SR_{BMC} + SR_{NUAN} + SR_{QADI} = TS$$
$$(0.3834) + (0.5308) + (0.3585) + (.2741) + (0.3879) + (0.094) = 2.2272$$

We calculate the percentage of each SR in the total SR of the portfolio:

SPSS = 0.3834/2.2272= .1721 100% = 17.21%
RHT = 0.5308/2.2272= .2383 X 100% = 23.83%
CTXS = 0.3585/2.2272= .1610 X 100% = 16.10%
BMC = .2741/2.2272= .1231 X 100% = 12.31%
NUAN = 0.3879/2.2272= .1742 X 100% = 17.42%
QADI = 0.094/2.2272= .1313 X 100% = 13.13%

Multiply by $30,000 to determine the amount of money invested in each:

SPSS = 17.21% times $30,000 = $5,163
RHT = 23.83% times $30,000 = $7,149
CTXS = 16.10% times $30,000 = $4,830
BMC = 12.31% times $30,000 = $3,693
NUAN = 17.42% times $30,000 = $5,226
QADI = 13.13% t times $30,000 = $3,939
SOI = $30,000

This resulted in a variance of 34.31%, a standard deviation of 58.58%, a return of 34.60%, and a profit of $10,380. Since both cases where we replaced the higher value with BMC resulted in a standard deviation higher than our return we discarded this idea and decided to keep INFY due to its low standard deviation and its high return but completely eliminate RHT from further combinations of stocks for our portfolio because of its constant increase in standard deviation and because it is overpriced (as mentioned earlier).

**Fourth Trial**

We then picked a new combination without RHT and QADI due to their extremely high standard deviations 141.90% and 80.92% respectively.

$$SR_{BMC} + SR_{ORCL} + SR_{CAI} + SR_{COGN} + SR_{INFY} + SR_{CTXS} = TS$$
$$(0.2741) + (0.0904) + (0.1453) + (0.2169)\ (1.2760) + (0.3585) = 2.3612$$

We calculate the percent of each SR in the total SR of the portfolio:

BMC = 0.2741/2.3612 = .1161 X 100% = 11.61%
ORCL = 0.0904/2.3612 = .0383 X 100% = 3.83%
CAI = 0.1453/2.3612 = .0615 X 100% = 6.15%
COGN = 0.2169/2.3612 = .0919 X 100% = 9.19%
INFY = 1.2760/2.3612 = .5404 X 100% = 54.04%
CTXS = 0.3585/2.3612 = .1518 X 100% = 15.18%

Multiply by $30,000 to determine the amount invested in each:

BMC = 11.61% times $30,000 = $3,483
ORCL = 3.83% times $30,000 = $1,149
CAI = 6.15% times $30,000 = $1,845
COGN = 9.19% times $30,000 = $2,757
INFY = 54.04% times $30,000 = $16,212
CTXS= 15.18% times $30,000 = $4,554
SOI = $30,000

This resulted in a significant drop in the variance 1.75%, a standard deviation of 13.22%, and a return of 16.88%, with an expected gross profit of $5,065.31.

**Fifth Trial**

In our final analysis of the Sharpe Ratios and trial-and-error method we came up with a lineup of stocks that would yield us maximum profit along with a standard deviation that would be lower than our return.

$$SR_{BMC} + SR_{CAI} + SR_{COGN} + SR_{INFY} + SR_{MFE} + SR_{ORCL} = TS$$
$$(0.2741) + (0.1453) + (0.2169) + (1.2760) + (0.1353) + (0.0904) = 2.138$$

We calculate the percent of each SR in the total SR of the portfolio:

BMC = 0.2741/2.138= .1282 100% = 12.82%
CAI = 0.1453/2.138= .0633 X 100% = 6.33%
COGN = 0.2169/2.138 = .0680 X 100% = 6.80%
INFY = 1.2670/2.138 = .1014 X 100% = 10.14%
MFE = 0.1353/2.138 = .5968 X 100% = 59.68%
ORCL = 0.0904/2.138 = .0423 X 100% = 4.23%

We then multiply again by $30,000:

BMC = 12.82% times $30,000 = $3,846
CAI = 6.33% times $30,000 = $1,899
COGN = 6.80% times $30,000 = $2,040
INFY = 10.14% times $30,000 = $3,042
MFE = 59.68% times $30,000 = $17,904
ORCL = 4.23% times $30,000 = $1,269

SOI = $30,000

This combination resulted in our variance of 2.56%, a standard deviation of 16.01%, a return of 18.94%, and an expected profit of $5,681.17. We now had a positive difference of 2.93 between the return and the standard deviation, making this our best possible choice.

## Table 6

| | BMC | CAI | COGN | INFY | MFE | ORCL | | |
|---|---|---|---|---|---|---|---|---|
| **% of Portfolio** | 12.82% | 6.80% | 10.14% | 59.68% | 6.33% | 4.23% | | 100.00% |
| **Expected Return** | 13.32% | 8.40% | 9.87% | 25.31% | 8.76% | 6.23% | | |

**Historical Returns**

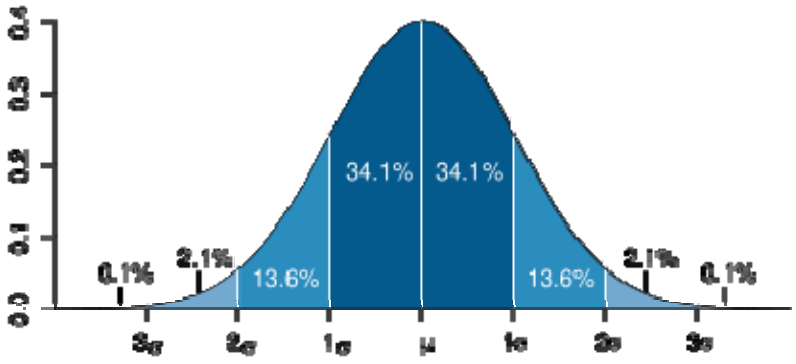
| | BMC | CAI | COGN | INFY | MFE | ORCL |
|---|---|---|---|---|---|---|
| **March 02 - March 03** | -22.42% | -4.98% | -17.23% | -6.34% | -42.93% | -15.31% |
| **March 03 - March 04** | 29.56% | 28.90% | 36.71% | 33.22% | 30.34% | 10.70% |
| **March 04 - March 05** | -23.27% | 28.44% | 34.42% | 33.22% | 25.33% | 4.00% |
| **March 05 - March 06** | 44.40% | 19.05% | -6.83% | 33.22% | 7.85% | 9.70% |
| **March 06 - March 07** | 38.32% | -29.41% | 2.26% | 33.22% | 23.22% | 22.06% |

| | BMC | CAI | COGN | INFY | MFE | ORCL |
|---|---|---|---|---|---|---|
| **BMC** | 8.94% | -1.07% | -0.41% | 2.83% | 3.85% | 2.85% |
| **CAI** | -1.07% | 5.09% | 3.03% | 1.06% | 1.82% | -0.45% |
| **COGN** | -0.41% | 3.03% | 4.79% | 2.14% | 4.58% | 0.94% |
| **INFY** | 2.83% | 1.06% | 2.14% | 2.50% | 4.09% | 1.70% |
| **MFE** | 3.85% | 1.82% | 4.58% | 4.09% | 7.25% | 2.80% |
| **ORCL** | 2.85% | -0.45% | 0.94% | 1.70% | 2.80% | 1.50% |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Variance x %Porfolio** | 0.36% | 0.13% | 0.29% | 1.51% | 0.27% | 0.07% | **Variance** | 2.56% |
| | | | | | | | **Standard Deviation** | 16.01% |
| **Return for each stock** | 1.71% | 0.57% | 1.00% | 15.10% | 0.55% | 0.26% | **Return** | 18.94% |
| | | | | | | | **Expected Gross Profit** | $5,681.17 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Individual Variance** | 2.83% | 1.58% | 2.51% | 2.39% | 4.06% | 1.56% |
| **Ind Std. Dev** | 16.83% | 12.56% | 15.85% | 15.45% | 20.16% | 12.48% |

Conclusion:



Assuming that our chance to get a profit or loss are the same and knowing our expected return minus 1 standard deviation is 2.93%, the interval (-1, infinity) of standard deviation would have an 84% chance of getting a 2.93% or more profit. This is why we have partially secured a profit of 2.93% or more with the combination of these investments.

**Other Justifications**

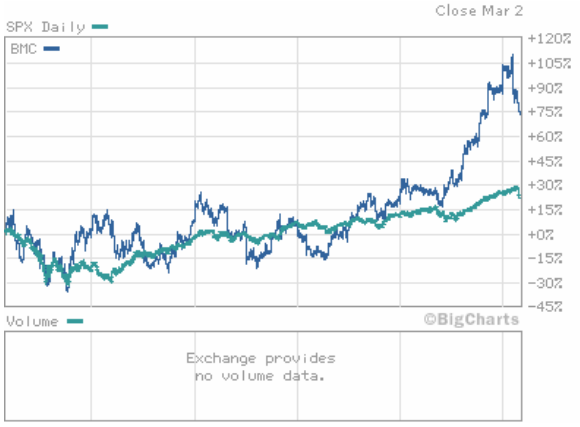
After finding the "perfect" portfolio using Sharpe Ratios, we used several methods to verify our results. The first of these took the form of professional analysis from Internet sources. Shown below are the buying recommendations of one such source. On a scale of one to five, with one meaning "strongly buy" and five meaning "strongly sell," Yahoo.com recommends the following:

**Table 7**

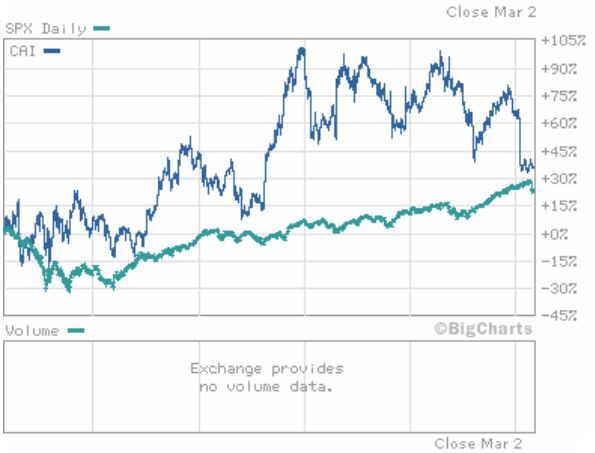
| Stock Name | Yahoo.com's Recommendation |
|---|---|
| ADBE | 2 |
| ADVS | 2 |
| BMC | 3.1 |
| CAI | 2.8 |
| CDNS | 2 |
| COGN | 2.5 |
| CTXS | 2.2 |
| INFY | 1.8 |
| MFE | 2.3 |
| MSCS | 2.5 |
| MSFT | 2 |
| NUAN | 1.6 |
| ORCL | 2.2 |
| QADI | 2.3 |
| RHT | 2.6 |
| SPSS | 2.2 |
| SRX | 2.7 |
| SYMC | 2.8 |

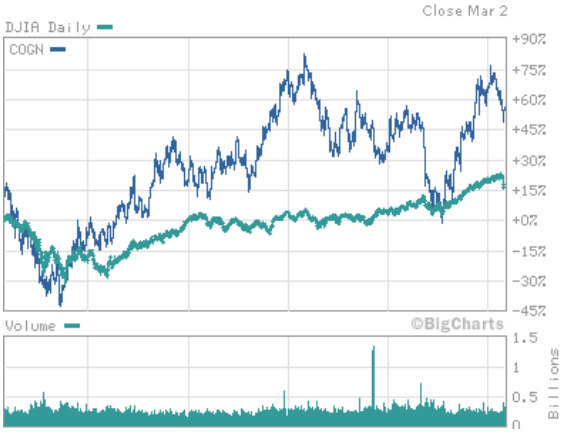
All six of the stocks selected for the final portfolio have ratings of "hold" or better, and one even has a rating between "buy" and "strongly buy." Interestingly enough, there are several options that come more highly recommended by the analysts; needless to say, there are certainly more elements that factor into a stock's success than the purely mathematical ones. The disparity between the advice and our portfolio can be explained by our lack of knowledge in the non-mathematical areas of the stock market game.

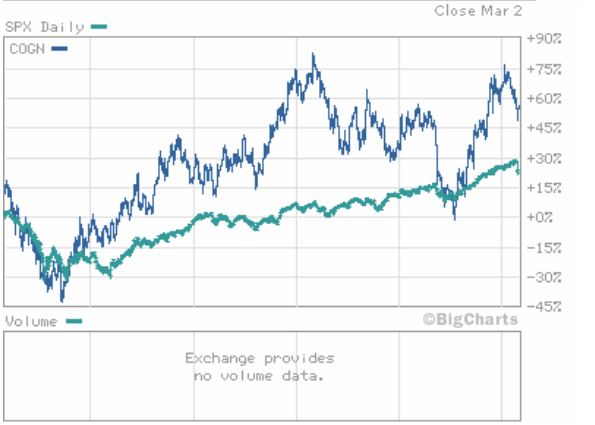
In addition to these analyses, we also compared our six stocks to the S&P 500 and the Dow Jones Industrial Average over the space of five years. The dark blue lines represent the returns on the six stocks, and the teal lines represent the average values of the indices. BMC, CAI, COGN, and INFY consistently rank higher than the indices. MFE and ORCL, while usually below the indices, rise at the same pace as the indices and can therefore be considered safe and profitable investments.

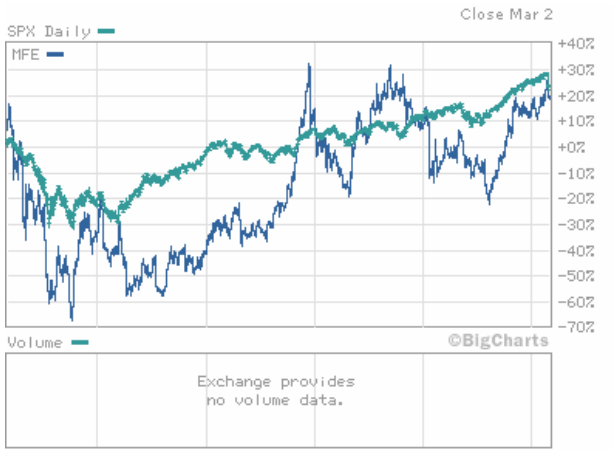


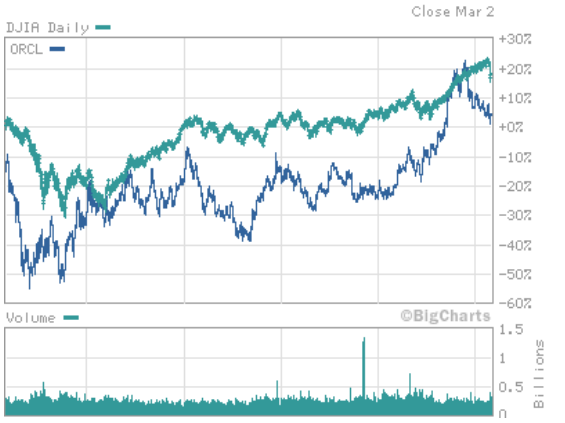


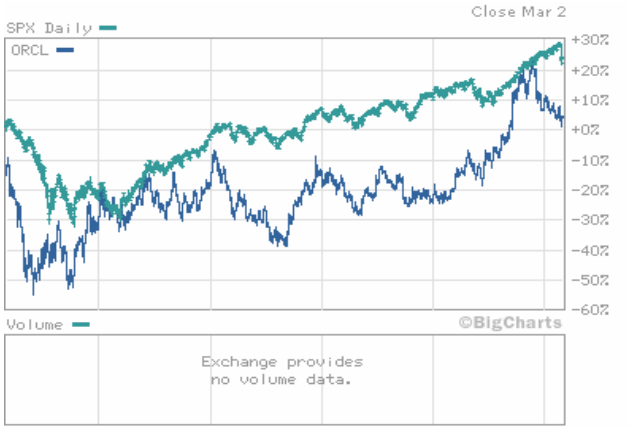




Close Mar 2
DJIA Daily
MFE
+40%
+30%
+20%
+10%
+0%
-10%
-20%
-30%
-40%
-50%
-60%
-70%
Volume
©BigCharts
1.5
1
0.5
0
Billions


Close Mar 2
SPX Daily
MFE
+40%
+30%
+20%
+10%
+0%
-10%
-20%
-30%
-40%
-50%
-60%
-70%
Volume
©BigCharts
Exchange provides
no volume data.


Close Mar 2
DJIA Daily
ORCL
+30%
+20%
+10%
+0%
-10%
-20%
-30%
-40%
-50%
-60%
Volume
©BigCharts
1.5
1
0.5
0
Billions


Close Mar 2
SPX Daily
ORCL
+30%
+20%
+10%
+0%
-10%
-20%
-30%
-40%
-50%
-60%
Volume
©BigCharts
Exchange provides
no volume data.

**References**

http://www.investopedia.com/university/peratio/default.asp

http://en.wikipedia.org/wiki/Capital_Asset_Pricing_Model

http://en.wikipedia.org/wiki/Image:Standard_deviation_diagram.svg

http://en.wikipedia.org/wiki/Modern_portfolio_theory

http://en.wikipedia.org/wiki/Sharpe_ratio

http://en.wikipedia.org/wiki/Treynor_ratio

http://www.smartmoney.com

http://finance.yahoo.com

Hartman, Stephen W., Jae K. Shim, and Joel G. Siegal. *Schaum's Quck Guide to Business Formulas*. New York: McGraw-Hill, 1998.

Witte, John S., and Robert S. Witte. *Statistics. Fifth Edition*. New York: Harcourt Brace, 1997.

Little, Jeffrey B., and Lucien Rhodes. *Understanding Wall Street. Third Edition*. Liberty Hall Press, 1991.

Bodie, Zvi, Alex Kane, and Alan J. Marcus. *Essentials of Investments. Fourth Edition*. New York: McGraw-Hill, 2001

Reilly, Frank K. *Investment Analysis and Portfolio Management. Fourth Edition*. New York: The Dryden Press, 1994.