

# Stock Returns, Risk and Beta

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## Abstract

*The purpose of this paper is to serve as a guide for students' use of actual data for risk and return calculations. The study of stock return risk has been of interest to investors and academics for several decades. Early discussion of the "mean-variance framework" described the rationale for requiring additional expected income as a reward for choosing higher risk investments. The general concept is to evaluate return risk on either a stand-alone basis (commonly using standard deviation or variance) or on a relative basis (calculating a beta value using a market index or calculating multiple securities portfolio risk). This paper presents a description of the procedure for calculating stand alone risk and the Capital Asset Pricing Model (CAPM) Beta value using stock prices and the SP500 market index. In addition, the risk (beta) stability over time is addressed.*

## INTRODUCTION

This paper is designed to improve the pedagogy for applying stock return analysis to information from online financial sites. Investors have long recognized that there is a valid reason to make portfolio choices based on an individual's risk tolerance and an adequate understanding of the potential for loss or gain of various investments. There are a variety of ways in which risk can be classified, such as systematic or non systematic; purchasing power; default or liquidity, among others. Measures of stock price (return) risk are of interest to investors.

Financial Management textbooks present risk in a variety of ways. Block, Hirt and Danielson (2009) discuss returns risk through a CAPM Beta calculation illustration. This presents the data (Stock and market) annual returns and a graph showing a plot of these data pairs. Discussion of the Security Market Line shows a beta value, the risk free return and market return proxies. Applications of beta to forecasting returns and risk adjustments for Capital Budgeting follow. Parrino (2009) devotes a chapter to Quantitative Measures of Return. Returns calculation is illustrated, along with a thorough discussion of standard deviation and variance. Risk of a single asset is described in the context of possible economic outcomes and the associated probabilities, providing the opportunity to calculate standard deviation and the coefficient of variation. In addition, the concept for calculation of risk for a multiple asset portfolio is discussed. Systematic risk is presented with a five year plot of General Electric stock returns and the S&P 500 Index. Brigham and Houston (2007) discusses beta and provides examples of reasons that

there might be shifts in the Security Market Line and discusses matters pertaining to beta changes over time. A spreadsheet problem at the end of the chapter asks students to calculate a beta value using 6 annual return values for 2 stocks and an appropriate industry index. There are a number of illustrations of beta values, the risk free rate, and estimated market returns used for stock returns forecasting.

Among the Financial Modeling textbooks, the risk calculation instruction is more developed. One of the best Financial Modeling textbook beta calculation discussions is presented by Benniga (2008). He presents an approach for downloading stock return and index data from Yahoo Finance. The method is consistent with the risk and return calculation technique discussed in this paper.

This paper seeks to improve the pedagogy for investment mean-variance instruction. This is accomplished by establishing the association between a professionally prepared beta value that can be found online (in Yahoo Finance) and the beta value from the instructions presented here. This serves to improve the student's confidence in stock analysis when they learn the technique using real data. This establishes a connection between classroom ("theory") and information provided by the experts.

A graph of the simultaneous stock and market returns is useful to set the stage for understanding the relationship between these values. Shown here are five-years of returns for Conagra (CAG) and the SP500 (^GSPC). Visual inspection shows that CAG returns track the market returns fairly well, as one would expect for a company that has a beta near 1.0 (in this case, the Beta is 0.80)

**Insert Figures 1a and 1b about here.**

These graphs from Yahoo Finance shows 5 years of Conagra foods (CAG) returns and the simultaneous SP500 (^GSPC) returns. Graph 1b shows the Conagra stock prices and SP500 levels for 5 years.

**Capital Asset Pricing Model (Beta).** The CAPM Beta is a measure of relative risk, in this case risk relative to the *market*, which is represented by an index. Beta is calculated using a **stock's** returns and the simultaneous **market** return.<sup>1</sup> There are also several indices such as the NYSE composite, the SP500 and the Wilshire 3000. Sometimes the stock and market returns are corrected using a risk-free rate "proxy", such as the US Government t-bill rate.

The screenshot shows the Yahoo Finance Key Statistics page for ConAgra Foods, Inc. (CAG). The page displays various financial metrics and an advertisement for Scottrade. The Beta value is highlighted as 0.8.

| VALUATION MEASURES                            |        |
|---|--------|
| Market Cap (intraday) <sup>5</sup> :          | 10.14B |
| Enterprise Value (2-Feb-10) <sup>3</sup> :    | 13.17B |
| Trailing P/E (ttm, intraday):                 | 13.22  |
| Forward P/E (fye 31-May-11) <sup>1</sup> :    | 12.01  |
| PEG Ratio (5 yr expected):                    | 1.12   |
| Price/Sales (ttm):                            | 0.81   |
| Price/Book (mrq):                             | 2.04   |
| Enterprise Value/Revenue (ttm) <sup>3</sup> : | 1.05   |
| Enterprise Value/EBITDA (ttm) <sup>3</sup> :  | 7.89   |

| FINANCIAL HIGHLIGHTS            |           |
|---------------------------------|-----------|
| <b>Fiscal Year</b>              |           |
| Fiscal Year Ends:               | 31-May    |
| Most Recent Quarter (mrq):      | 29-Nov-09 |
| <b>Profitability</b>            |           |
| Profit Margin (ttm):            | 6.16%     |
| Operating Margin (ttm):         | 10.67%    |
| <b>Management Effectiveness</b> |           |
| Return on Assets (ttm):         | 7.18%     |
| Return on Equity (ttm):         | 15.94%    |
| <b>Income Statement</b>         |           |
| Revenue (ttm):                  | 12.56B    |

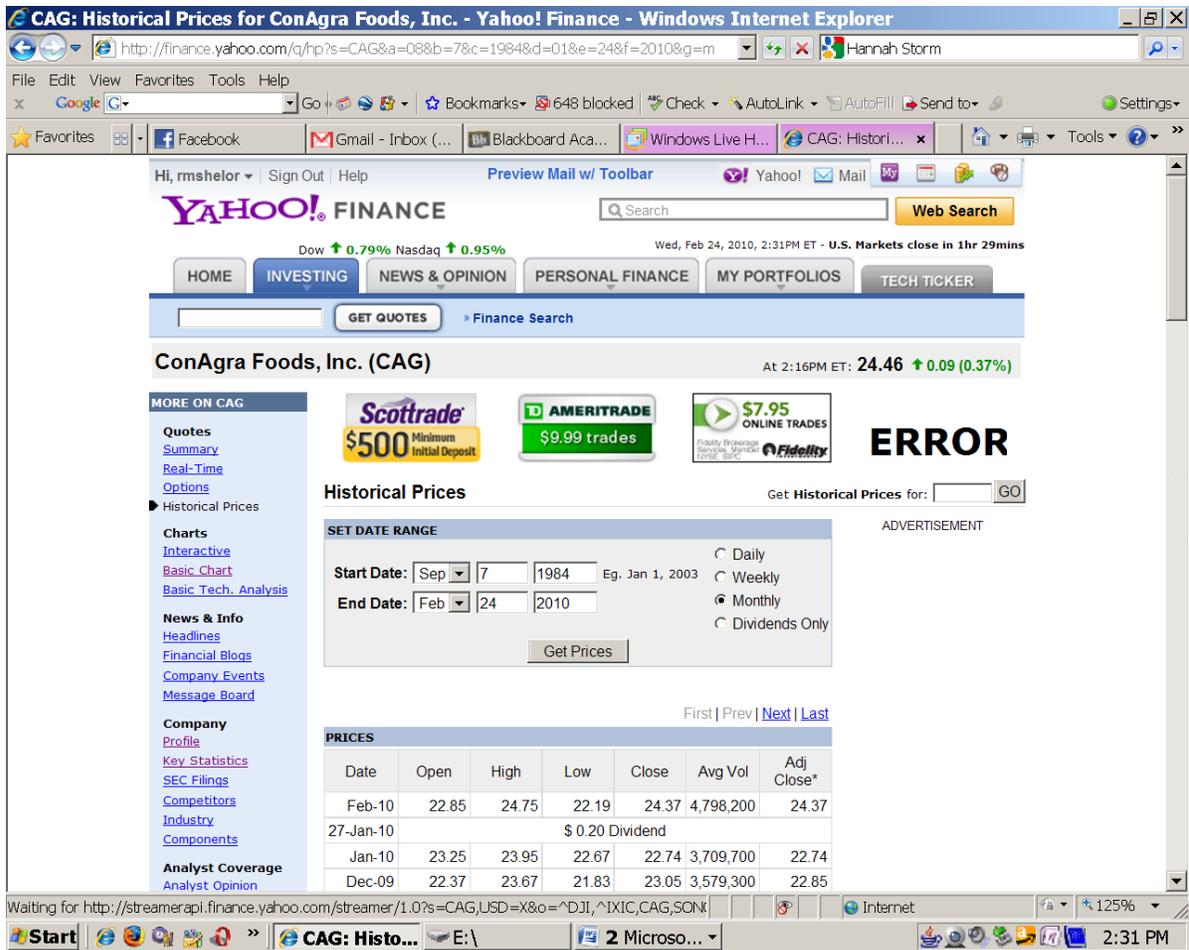
| TRADING INFORMATION                     |        |
|---|--------|
| <b>Stock Price History</b>              |        |
| Beta:                                   | 0.8    |
| 52-Week Change <sup>3</sup> :           | 31.69% |
| S&P500 52-Week Change <sup>3</sup> :    | 31.95% |
| 52-Week High (21-Jan-10) <sup>3</sup> : | 23.95  |
| 52-Week Low (12-Mar-09) <sup>3</sup> :  | 14.00  |
| 50-Day Moving Average <sup>3</sup> :    | 23.05  |
| 200-Day Moving Average <sup>3</sup> :   | 21.58  |
| <b>Share Statistics</b>                 |        |

This Yahoo Finance *Key Statistics* screenshot shows the February 2010 Conagra (Ticker: CGA) Beta value of 0.8. The link for this page is <http://finance.yahoo.com/q/ks?s=CAG>. Beta is obtained from Standard and Poor’s Capital IQ, which uses three years of monthly returns and the SP500 market “proxy” index (Ticker: [^GSPC](http://finance.yahoo.com/q/ks?s=^GSPC)). The Capital IQ website is <https://www.capitaliq.com/main.asp>. There are several other investment websites that provide beta values.

The Yahoo Finance Key Statistics page contains a variety of financial data, including the most recent beta value. This will permit verification that the observed and calculated beta values are identical.

### Calculation of Stock Returns, Standard Deviation, Variance and Beta

Raw data is obtained from Yahoo Finance Historical Prices link for CAG: <http://finance.yahoo.com/q/hp?s=CAG>



This Yahoo Finance screenshot shows the historical prices page. Prices are available on a daily, weekly or monthly interval. The data may be downloaded into a spreadsheet compatible format.

Beta stability analysis requires several years of these values. In this illustration, six years of monthly stock price and market data are used to calculate betas for each sequential thirty six month interval.<sup>ii</sup>

**Data retrieval and statistical calculations.** From the Yahoo Finance Historical Prices page, select monthly (prices) and select the “Get Prices” button. “Download to Spreadsheet” prices for Conagra (Ticker: CGA), and for the SP500 (Ticker: ^GSPC). Each month’s beta is calculated for a range that corresponds to the immediately preceding 3 years (36 months).

Save these files using EXCEL. Merge the contents of the SP500 file worksheet and the stock prices worksheet. One method is to copy and paste the contents of one worksheet into the other. Make sure that all dates (rows) are correctly aligned. Retain only the columns containing dates and **adjusted closing prices** and delete all other columns. Chronologically sort the prices using the EXCEL sort function (sort by date). Calculate monthly rates of return using the equation  $(P1-P0)/P0$ .<sup>iii</sup> Use the autofill handle to

replicate the formula through the other cells in the stock price returns calculation column. Repeat this process to calculate changes in the market index.<sup>iv</sup>

**Insert Figure 2 about here.**

Details of the beta calculation concept are contained in this Yahoo Finance link:  
<http://help.yahoo.com/l/us/yahoo/finance/tools/research-12.html>

Yahoo describes the Beta value this way: *The Beta used is Beta of Equity. Beta is the monthly price change of a particular company relative to the monthly price change of the S&P500. The time period for Beta is 3 years (36 months) when available.*

Figure 2 shows adjusted Conagra prices and the monthly percentage change, the SP500 index and the percentage monthly change. At the bottom are the mean, standard deviation and variance for 36 months. Each of these is calculated using the appropriate EXCEL statistical function<sup>v</sup>. The last column is the beta, which is calculated for the 36 preceding months. Each beta value based on 36 monthly stock returns and the simultaneous market returns.

The Beta value is the Ordinary Least Squares (OLS) regression slope. This is contained in several EXCEL functions, including the STATISTICS SLOPE function.<sup>vi</sup> The SLOPE function *fx* is within the Statistics drop-down function menu. Select this and enter the range of values for the 36 most recent stock returns (the y-value) and index changes (the x-value). The most recent beta value calculation (SLOPE) should be placed in the row that contains the most recent date, price and returns values.<sup>vii</sup> See Figure 1.

Figure 3 shows the X-Y plot of 36 market and stock returns superimposed with the OLS regression line. The Beta value is the slope. The plot is often presented in textbook CAPM discussions and is presented here to further establish the interpretation of the relationship between the stock return and market change.

**Insert Figure 3 about here**

An additional dimension of risk analysis is an examination of whether the risk measures are constant over time. In this case, Beta values are calculated for sequential months over an extended interval. To facilitate calculation of these, the SLOPE function for the most recent month can be easily replicated into cells that correspond to other three year stock and index return intervals. The EXCEL autofill handle feature allows for the rapid recalculation of the SLOPE (BETA) for any 36 month data set. The resulting series of beta values can be tested for stability using scedasticity measures.

**Insert Figure 4 about here**

**Conclusion**

The relationship between risk and return is one of the foundational tenants of Finance theory and is often applied to investment decisions. From its origin, analysts have

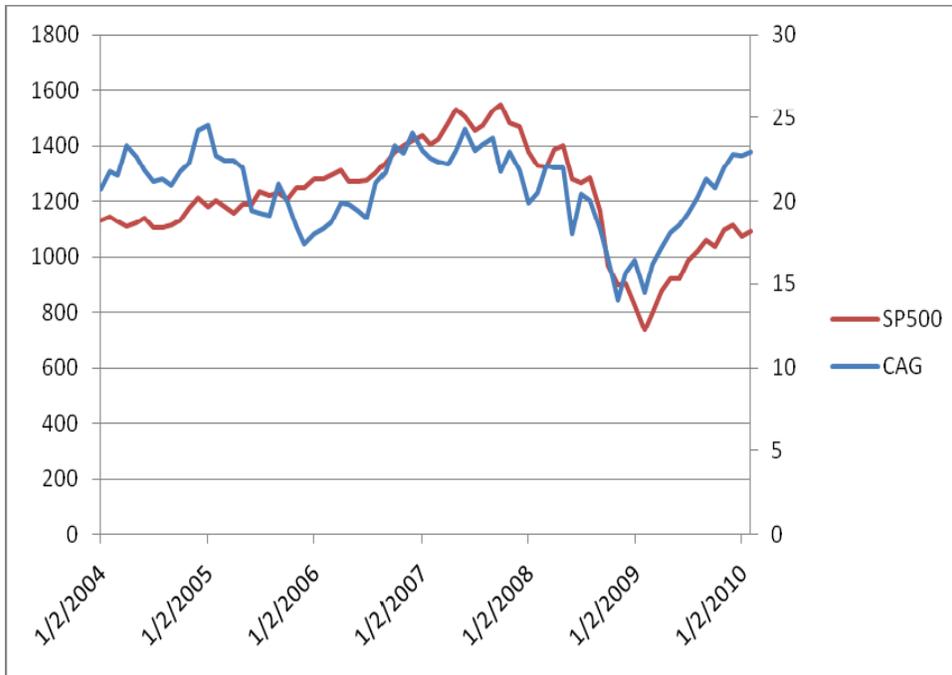
calculated these measures from stock prices and market indices. In early times, data access was cumbersome and analysis tedious.

The approach described here allows investors and students at all experience levels to apply these concepts to familiar sources of information and build their confidence. Data from several financial websites can be retrieved for technical analysis using common software. Specific instructions for calculation of CAPM Betas that match those of professional analysts are presented here.

**Figure 1a.** Conagra and SP500 Returns. This graph shows the returns profile for Conagra (CAG) and the SP500 (^GSPC) for a 5 year interval.



**Figure 1b.** Conagra Prices and SP500 Levels. This graph shows the price levels profile for Conagra (CAG) and the SP500 (^GSPC) for a 6 year interval.



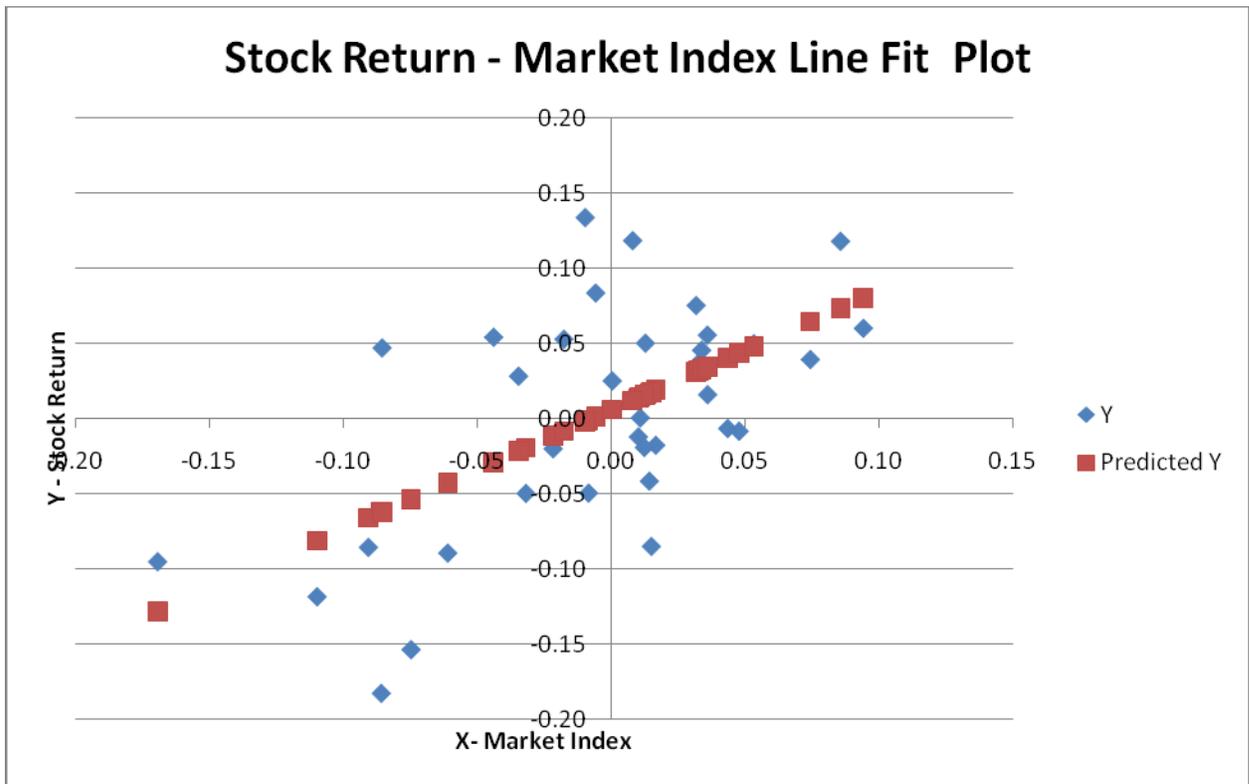
**Figure 2.** Figure 2 presents the raw data from Yahoo Finance (Conagra CAG price and Market – SP500 level) and the associated percentage changes in these values. Measures of return (Average) and risk (Standard Deviation and Variance) are calculated and presented in the bottom rows. The beta value is in the fifth column, in each case calculated from the returns of the immediately preceding three years of monthly returns data.

**CONAGRA 3 YR (MONTHLY) BETA - SP500 INDEX - FEB 2010**

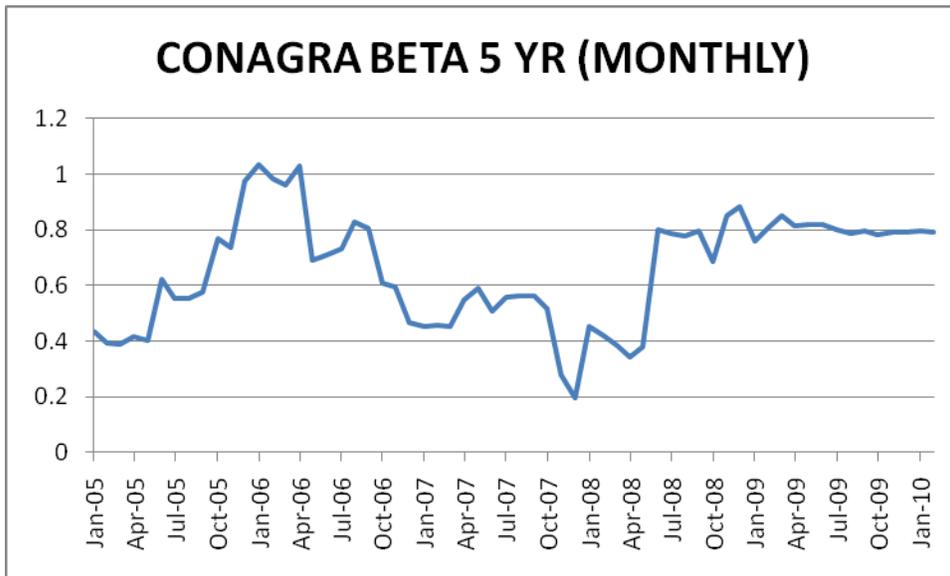
| DATE     | CAG   | CAG %   | SP500   | SP500%  | BETA 3 YR |
|----------|-------|---------|---------|---------|-----------|
| 03/01/07 | 22.35 | -1.19%  | 1420.86 | 1.00%   | 0.451116  |
| 04/02/07 | 22.22 | -0.58%  | 1482.37 | 4.33%   | 0.547358  |
| 05/01/07 | 23.05 | 3.74%   | 1530.62 | 3.25%   | 0.590917  |
| 06/01/07 | 24.28 | 5.34%   | 1503.35 | -1.78%  | 0.509207  |
| 07/02/07 | 23.08 | -4.94%  | 1455.27 | -3.20%  | 0.559366  |
| 08/01/07 | 23.4  | 1.39%   | 1473.99 | 1.29%   | 0.564317  |
| 09/04/07 | 23.79 | 1.67%   | 1526.75 | 3.58%   | 0.560532  |
| 10/01/07 | 21.78 | -8.45%  | 1549.38 | 1.48%   | 0.518657  |
| 11/01/07 | 22.96 | 5.42%   | 1481.14 | -4.40%  | 0.280245  |
| 12/03/07 | 21.83 | -4.92%  | 1468.36 | -0.86%  | 0.197221  |
| 01/02/08 | 19.89 | -8.89%  | 1378.55 | -6.12%  | 0.454279  |
| 02/01/08 | 20.46 | 2.87%   | 1330.63 | -3.48%  | 0.42163   |
| 03/03/08 | 22.18 | 8.41%   | 1322.7  | -0.60%  | 0.383203  |
| 04/01/08 | 22    | -0.81%  | 1385.59 | 4.75%   | 0.34465   |
| 05/01/08 | 22.02 | 0.09%   | 1400.38 | 1.07%   | 0.37922   |
| 06/02/08 | 18    | -18.26% | 1280    | -8.60%  | 0.800827  |
| 07/01/08 | 20.42 | 13.44%  | 1267.38 | -0.99%  | 0.787163  |
| 08/01/08 | 20.03 | -1.91%  | 1282.83 | 1.22%   | 0.775941  |
| 09/02/08 | 18.33 | -8.49%  | 1166.36 | -9.08%  | 0.795655  |
| 10/01/08 | 16.59 | -9.49%  | 968.75  | -16.94% | 0.685973  |
| 11/03/08 | 14.04 | -15.37% | 896.24  | -7.48%  | 0.850172  |
| 12/01/08 | 15.71 | 11.89%  | 903.25  | 0.78%   | 0.881524  |
| 01/02/09 | 16.46 | 4.77%   | 825.88  | -8.57%  | 0.758996  |
| 02/02/09 | 14.51 | -11.85% | 735.09  | -10.99% | 0.808375  |
| 03/02/09 | 16.24 | 11.92%  | 797.87  | 8.54%   | 0.852685  |
| 04/01/09 | 17.22 | 6.03%   | 872.81  | 9.39%   | 0.813412  |
| 05/01/09 | 18.08 | 4.99%   | 919.14  | 5.31%   | 0.816748  |
| 06/01/09 | 18.54 | 2.54%   | 919.32  | 0.02%   | 0.82012   |
| 07/01/09 | 19.28 | 3.99%   | 987.48  | 7.41%   | 0.802703  |
| 08/03/09 | 20.16 | 4.56%   | 1020.62 | 3.36%   | 0.787113  |
| 09/01/09 | 21.29 | 5.61%   | 1057.08 | 3.57%   | 0.794199  |
| 10/01/09 | 20.82 | -2.21%  | 1036.19 | -1.98%  | 0.780702  |
| 11/02/09 | 22    | 5.67%   | 1095.63 | 5.74%   | 0.79116   |
| 12/01/09 | 22.85 | 3.86%   | 1115.1  | 1.78%   | 0.789554  |

|          |          |                 |          |                 |                 |
|----------|----------|-----------------|----------|-----------------|-----------------|
| 01/04/10 | 22.74    | <b>-0.48%</b>   | 1073.87  | <b>-3.70%</b>   | <b>0.794721</b> |
| 02/01/10 | 22.94    | <b>0.88%</b>    | 1089.19  | <b>1.43%</b>    | <b>0.791683</b> |
| MEAN     | 20.32056 | <b>0.003124</b> | 1195.001 | <b>-0.00541</b> |                 |
| STD DEV  | 2.749487 | <b>0.072746</b> | 246.8593 | <b>0.05687</b>  |                 |
| VAR      | 7.559677 | <b>0.005292</b> | 60939.53 | <b>0.003234</b> |                 |

**Figure 3.** Beta Plotting: Using the Tools - Data Analysis - Regression feature. Identify an X value (the market return) and a Y value (the stock return). Once these are selected, progress through the remaining wizard screens. Check the box that says **LINE FIT PLOTS**. The output worksheet contains the Beta (Slope) value and a variety of other statistics related to the regression analysis.



**Figure 4. Beta Stability.** The value of any statistic for purposes of forecasting is best if there is a reasonable continuity of the statistical measure. This is a presentation of a series of betas calculated with the technique described here. Visual examination of the graph allows one to draw conclusions about the beta stability and make inferences about the suitability of the beta value for returns estimation.



## REFERENCES

1. Benninga, Simon (2008) *Financial Modeling*; MIT Press
2. Benninga, Simon (2006) *Principles of Finance with EXCEL*; MIT Press
3. Block, Hirt and Danielson (2009) *Foundations of Financial Management*, 13<sup>th</sup> ed. McGraw-Hill Irwin
4. Brigham and Houston (2007) *Fundamentals of Financial Management* 5<sup>th</sup> ed. Thomson South-Western
5. Parrino and Kidwell (2009) *Fundamentals of Corporate Finance*, 1st ed. Wiley
6. <http://finance.yahoo.com>
7. <https://www.capitaliq.com/main.asp>

## ENDNOTES

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<sup>i</sup> Betas may be calculated for various return intervals, such as daily, monthly or annually and typically extend over a period of several months to many years, as appropriate for the compounding interval.

<sup>ii</sup> Three years of these values are shown in Figure 1.

<sup>iii</sup> As an example, if your prices are in Column B, the EXCEL formula might be  $= (B2-B1)/B1$ .

<sup>iv</sup> One column containing monthly stock returns and another column containing the coincidental monthly SP500 change are needed to calculate beta.

<sup>v</sup> These are calculated using the STATISTICS drop down menu.

<sup>vi</sup> Another location is the EXCEL Data Analysis Toolpack REGRESSION function.

<sup>vii</sup> The calculated beta should match or be very close to the Yahoo Finance Key Statistics beta. Common discrepancies are related to a mismatch of dates between the stock and the index. Another possible difference may be for firms that are thinly traded, such as those traded OTC. If the betas do not match, it is recommended this illustration be replicated.