A TEACHING TOOL FOR COMPUTING STOCK RETURNS, RISK AND BETA

Roger Shelor, Ohio University
Scott Wright, Ohio University

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 either on 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 Beta value using stock prices and the SP500 market index. In addition, the risk (beta) stability over time is addressed.

JEL: C81; C87

KEY WORDS: Stock Returns; Risk; Capital Asset Pricing Model; Financial Modeling

INTRODUCTION

This paper improves 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. Risk is classified as systematic or non-systematic; purchasing power; default or liquidity, among others. Measures of stock price (return) risk are of interest to investors.

The approach discussed here should be useful for students of financial management who could benefit by having the opportunity to apply theoretical textbook illustrations to real world situations. Student may develop enthusiasm about analysis of financial information when they are able to replicate professional analysis.

Financial Management textbooks present risk in a variety of ways. Block, Hirt and Danielson (2009) discuss returns risk through a Capital Asset Pricing Model (CAPM) Beta calculation illustration. This presents (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 and Kidwell (2009) devote a chapter to Quantitative Measures of Return. Returns calculation is illustrated, along with a thorough discussion of standard deviation and variance. Single asset risk 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 SP500 Index. Brigham and Houston (2007) provides examples of reasons that there might be shifts in the Security Market Line, and discusses beta and matters pertaining to beta changes over time. A spreadsheet problem at the end of the chapter asks students to calculate a beta value using six annual return values for two 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. Benniga (2006) and Benniga (2008) present improved beta calculation discussions. 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 establishes the association between a professionally prepared beta value, 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 practice the technique using real data. This establishes a connection between classroom "theory" and information provided by the experts.

The remainder of the paper's organization is this: A review of related journal literature discusses advances in internet financial data retrieval, followed by a discussion of data sources for financial analysis and the associated EXCEL techniques for risk measures and beta calculation. The remaining section contains a summary of the motivation, presentation and applications.

LITERATURE REVIEW

There are several pedagogical benefits from the use of spreadsheets and internet data for financial modeling. Students can become more engaged in the theoretical and empirical concepts when they are able to download data and use a spreadsheet to replicate the results provided by professional analysts. In recent years, there have been several presentations of these techniques. Following are reviews of several recent articles, which describe innovations in the internet retrieval and financial data processing.

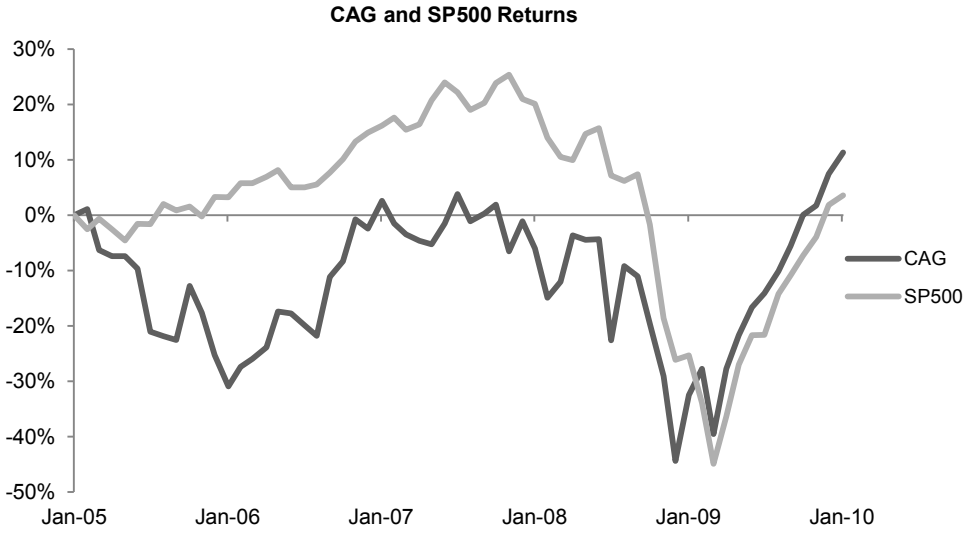
Holtzman and Kraft (2010) make a justification for student proficiency in the areas of quantitative analysis and computer skills. Employer and alumni survey results indicated that the most desired quantitative skills are in the areas of financial and accounting analysis and forecasting. Furthermore, following only the use of EMAIL, the most valued computer software proficiency is spreadsheet use.
Biktimirov and Nilson (2007) describe some procedures that are appropriate for an introductory finance class. In particular, instruction in portfolio expected return, risk, and diversification are enhanced using an online interactive course design.

MacDougall and Follows (2006) present the use of EXCEL spreadsheet templates as a way to enhance the model building skills of corporate finance students. Mukherji (2003) illustrates the use of EXCEL and computer based data sources for the construction of a common stock analyst's report. Carter, Dare and Elliott (2002) use Internet data and EXCEL to calculate the mean, variance and portfolio efficiency.

COMPUTATION TECHNIQUES

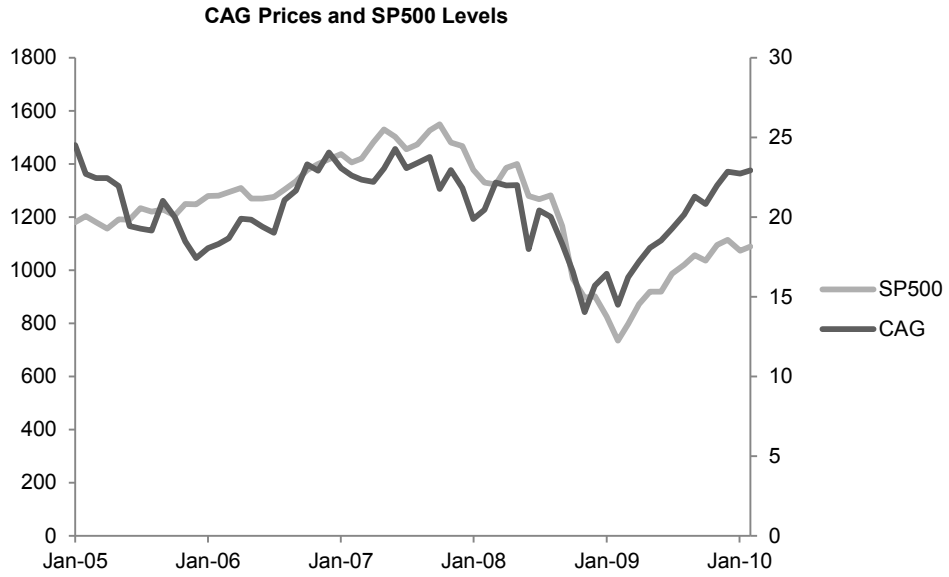
We present a method to quickly set-up and solve for mean-variance efficient portfolios in a Microsoft Excel spreadsheet using data downloaded from the Internet. As a pedagogical tool, this exercise provides several benefits. First, it stimulates student interest because of the use of 'real' data from the Internet; it builds their spreadsheet and general computer skills, and improves their understanding of financial concepts. The method can solve for mean-variance efficient portfolios equivalent to the Markowitz method but requires considerably less effort to formulate when using a spreadsheet.

Figure 1a: Stock Returns and Market Index (SP500) Changes



Conagra and SP500 Returns. This graph shows the returns profile for Conagra (CAG) and the SP500 (^GSPC) for a 5 year interval. At the beginning, each is standardized at zero; the graph shows a cumulative return. Note the degree to which the returns move synchronously.

Figure 1b: Stock Prices and a Market Index (SP500)



Conagra Prices and SP500 Levels. This graph shows the price levels profile for Conagra (CAG) and the SP500 (^GSPC) for a 5 year interval. The SP500 scale is on the left, the CAG price scale is on the right.

A graph of the simultaneous stock and market returns (Figure 1a) 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). Figure 1b shows the CAG price and SP500 index levels for the same interval. Yahoo Finance has a similar returns graph in the CAG Basic Charts window:
finance.yahoo.com/q/bc?t=5y&s=CAG&l=on&z=l&q=l&c=&c=%5EGSPC.

Capital Asset Pricing Model (Beta): The Capital Asset Pricing Model (CAPM) Beta is a measure of relative risk, in this case risk relative to the market, represented by an index. Beta is calculated using a stock's returns and the simultaneous market return. 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. 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 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. 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). The Capital IQ website is https://www.capitaliq.com/main.asp. Several other investment websites provide beta values.

Adjusted price data comes from the Yahoo CAG link: http://finance.yahoo.com/q/hp?s=CAG. The Yahoo Finance webpage presents adjusted historical prices, which are available on a daily, weekly or monthly interval. Download the data into a spreadsheet format.

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 that all dates (rows) correctly align. Retain only the columns containing dates and adjusted closing prices and delete all other columns. Chronologically sort the prices using the EXCEL sort function (ascending date sort). Calculate monthly rates of return using the equation (P1-P0)/P0. As an example, if your prices are in Column B, a suggested EXCEL formula is =(B2-B1)/B1. 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. Beta calculation requires one column containing monthly stock returns and another column containing the coincidental monthly SP500 change.

Details of the beta calculation concept are contained in this Yahoo Finance link:
http://help.yahoo.com/l/us/yahoo/finance/tools/fitakeystats.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 SP500. The period for Beta is 3 years (36 months) when available.*

Table 1 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. These calculated by the appropriate EXCEL STATISTICS drop down menu. The last column is the beta, calculated for the 36 preceding months. Each beta value is 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. Another method is the EXCEL Data Analysis Toolpack REGRESSION function. 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) belongs in the row that contains the most recent date, price and returns values. The calculated beta should match or be very close to the Yahoo Finance Key Statistics beta. A common mistake is a mismatch of dates between the stock and the index. Another possible difference may occur for thinly traded firms, such as some

NASDAQ securities. In the event that the calculated beta does not match the Yahoo beta, replicate the illustration in this paper.

Table 1: CONAGRA 3 Year (Monthly) BETA - SP500 Index- FEB 2010

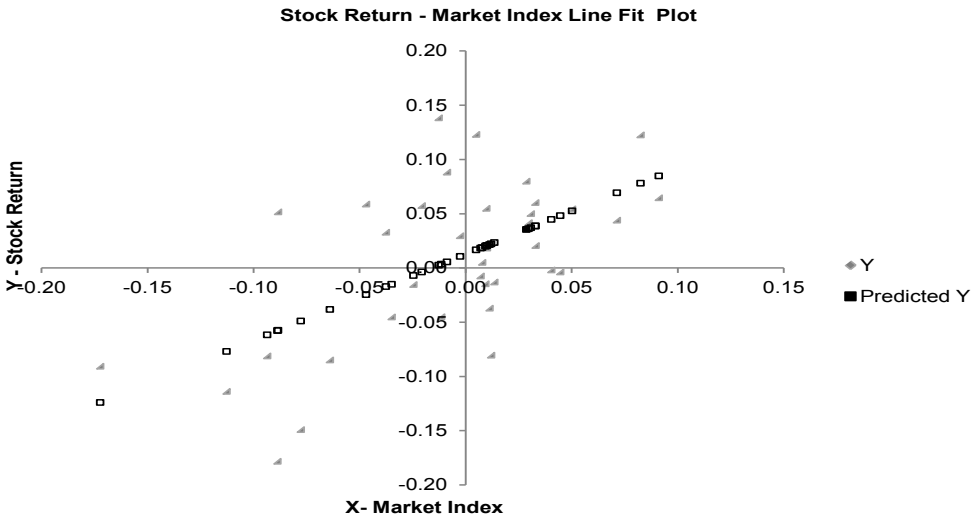
DATE	CAG $	CAG %	SP500 $	SP500%	BETA - 3 YR
03/01/07	22.35	**-1.19%**	1420.86	**1.00%**	**0.451116**
04/02/07	22.22	**-0.58%**	1482.37	**4.33%**	**0.547358**
05/01/07	23.05	**3.74%**	1530.62	**3.25%**	**0.590917**
06/01/07	24.28	**5.34%**	1503.35	**-1.78%**	**0.509207**
07/02/07	23.08	**-4.94%**	1455.27	**-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	**-0.48%**	1073.87	**-3.70%**	**0.794721**
02/01/10	22.94	**0.88%**	1089.19	**1.43%**	**0.791683**
MEAN	20.32056	**0.003124**	1195.001	**-0.00541**	
STD DEV	2.749487	**0.072746**	246.8593	**0.05687**	
VAR	7.559677	**0.005292**	60939.53	**0.003234**	

Raw Prices and Calculated Returns. Table 1 presents the raw data from Yahoo Finance (Conagra (CAG) prices plus Market (SP500)) levels and the percentage changes in these 2 values. Measures of return (MEAN) and risk (ST DEV and VAR) are calculated using EXCEL statistical functions and presented in the bottom rows. The beta value, shown in the fifth column, is in each case calculated from the returns of the preceding three years of monthly returns data.

Figure 2 shows the X-Y plot of 36 market and stock returns superimposed with the EXCEL OLS regression line. The Beta value is the slope. The plot is often in textbook CAPM discussions and presented here to establish the interpretation of the relationship between the stock return and market change.

An additional dimension of risk analysis is an examination of whether the risk measures are constant over time. See Figure 3. 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, which are not discussed in this paper.

Figure 2: Excel Generated Regression Plot Showing Returns and Line Fit

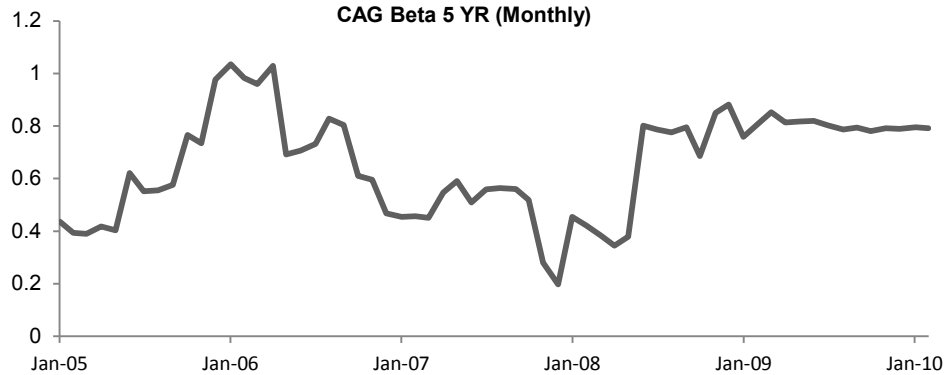


Beta Linear Model. Beta Plotting: Using the EXCEL Tools - Data Analysis - Regression feature. Identify an X value (the market return) and a Y value (the stock return). Once these are selected, progress through the remaining wizard screens. Check the LINE FIT PLOTS box . The output worksheet contains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

CONCLUDING COMMENTS

The relationship between risk and return is one of the foundational tenants of Finance theory and applies 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. This paper presents specific instructions for calculation of CAPM Betas that match those of professional analysts.

Figure 3: Excel Generated Plot of Sequential Beta Values



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.

Further applications of online financial data retrieval might be in other investment risk measures, especially in portfolio analysis. Opportunities for anomaly studies and stock and bond valuation are

available in a way that was impossible a decade ago. Students of investments can use online data to develop their confidence in many of the empirical topics from modern textbooks and classes.

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BIOGRAPHY

Roger Shelor, D.B.A. is the Fox Professor of Business and Professor of Finance at Ohio University. He can be contacted at 222 Copeland Hall, Athens OH 45701
EMAIL: shelorr@ohio.edu.

Scott Wright, M.B.A. is Instructor of Finance at Ohio University and director of the Center for International Business Education and Research. He can be contacted at 514 Copeland Hall, Athens OH 45701 EMAIL: wrights@ohio.edu.