LECTURE 5

Chapter 6 - Continued

SINGLE FACTOR ASSET MARKET

Distinction between Systematic and firm-specific Risk. Systematic is largely macroeconomic affecting all securities which firm-specific risk factors affect only one particular firm or, perhaps, its industry.

FACTOR MODELS are structural models designed to estimate these two components of risk for particular security or portfolio.

CAPM – introduction

To construct the efficient frontier from the universe of 100 securities we need 100 expected returns, 100 variances and 100 * 99/2 = 4,950 covariance.... More for more securities.....

ROR in excess of risk free rate (Premium)

$Ri = ri - rf$

$$Ri = \beta_i R_M + e_i + \alpha_i$$

R_M = Excess Return on a broad market index
Bi = Beta relationship to the industry / market
α_i = expected excess return
e_i = Firm specific events (unanticipated impact)

Dell stock is expected to be 9.0% with beta of 1.2x (every 1.0% move in the market, Dell moves 1.2%) then,

R dell = 9.0% + 1.2. M + e i

R dell = 9.0% + 1.2 * 2% + 0

R dell = 9.0% + 2.4% = 11.4%

CHAPTER 7

CAPITAL ASSET PRICING MODEL (CAPM) AND ARBITRAGE THEORY

CAPM
The model that predicts the relationship between the risk and equilibrium expected returns on risky assets

Unrealistic World
1. Investment Cannot affect process by their individual trades (Perfect Competition)
2. All investors have identical Holding Period
3. Investors form a portfolio of stocks and bonds
4. No taxes / fees
5. Everyone is seeking efficient frontier portfolio
6. Analysis is the same across the board.

EQUILIBRIUM IN SECURITY MARKETS

Market Portfolio (M) is efficient frontier / optimal Risky portfolio

Risk Premium on the market portfolio will be proportional to the variance of the market portfolio and investors' typical degree of risk aversion.
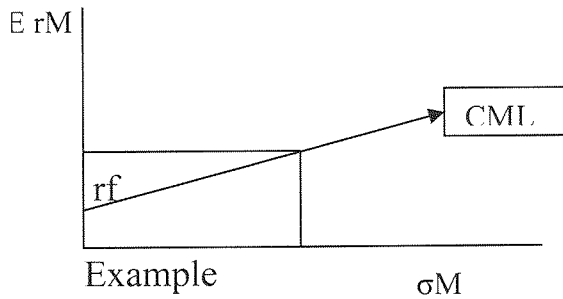
Mathematically:

$$E(r_M) - r_f = A * \sigma_M^2$$

σ_M = Standard Deviation of the Return of the Market portfolio
A = Scale Factor representing the degree of risk Aversion

CAPM implies that a passive strategy using CML as optimal CAL is a powerful alternate to an active strategy.

Example

Rf = 5%

Risk Aversion (A) = 2

Standard Deviation of the Market portfolio (M) = 20%

Then $E(rM) - rf = A * \sigma M^2$

$E(rM) = rf - A * \sigma M^2$

$E(rM) = 0.05 + 0.08 = 13.0\%$

At A = 3, then 12.0% + 5% = 17%

Historical: S&P had 8.5% Risk Premium with 20% Standard Deviation

$$E(rs) = rf + b * p + e$$

$Ri = ri - rf$ Excess Return

$Ri = E(ri) + Bi * M + ei$

REAL WORLD

Let's use it for DCF analysis on a private company – equity analysis – Alexandria Hotel

From Chapter 7 and Instructor's notes - Review

5 TECHNICAL RISK RATIOS – FOR PORTFOLIO MANAGEMENT:

1. **Seeking Alpha** (A measurable way to gauge a manager's ability to outperform the market - Alpha > the Market Return – This will be discussed later in the next LECTURE.
2. **Calculating Beta** (Volatility compared to Market)
3. **Standard Deviation**: Difference / Variation or Deviation from the mean return
4. **R-squared** – statistical measurement that represents % of fund or security 's movement that can be explained by movement in the market benchmarked (S&P 500) scale 0-100% (85 or higher – beta is valid, less than 70, the Beta is not that important – (To be discussed in the next LECTURE)
5. **Sharpe Ratio:** Relationship between Premium Return (Rf – Ri) and Risk (standard deviation)

1. CALCULATING BETA COEFFICIENTS

- The CAPM is an *ex ante* model, which means that all of the variables represent before-the-fact, *expected* values. In particular, the beta coefficient used in the SML equation should reflect the expected volatility of a given stock's return versus the return on the market during some *future* period. However, people generally calculate betas using data from some *past* period, and then assume that the stock's relative volatility will be the same in the future as it was in the past.

- To illustrate how betas are calculated, consider Figure 5A-1. The data at the bottom of the figure show the historical realized returns for Stock J and for the market over the last five years. The data points have been plotted on the scatter diagram, and a regression line has been drawn. If all the data points had fallen on a straight line, as they did in Figure 5-9 in Chapter 5, it would be easy to draw an accurate line. If they do not, as in Figure 5A-1, then you must fit the line either "by eye" as an approximation or with a calculator.

- Recall what the term *regression line*, or *regression equation*, means: The equation $Y = a + bX + e$ is the standard form of a simple linear regression. It states that the dependent variable, Y, is equal to a constant, a, plus b times X, where b is the slope

coefficient and X is the independent variable, plus an error term, e. Thus, the rate of return on the stock during a given time period (Y) depends on what happens to the general stock market, which is measured by X =kM.
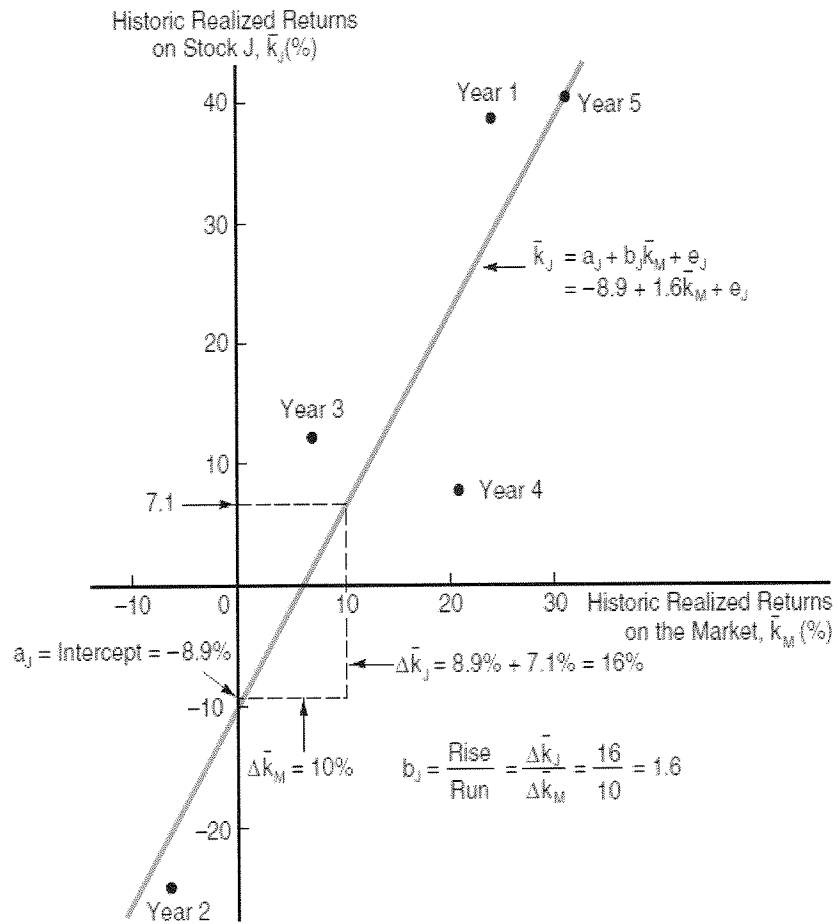
- Once the data have been plotted and the regression line has been drawn on graph paper, we can estimate its intercept and slope, the a and b values in $Y = a + bX$. The intercept, a, is simply the point where the line cuts the vertical axis. The slope coefficient, b, can be estimated by the "rise-over-run" method. This involves calculating the amount by which kJ increases for a given increase in kM. For example, we observe in Figure 5A-1 that kj increases from 8.9 to 7.1 percent (the rise) when kM increases from 0 to 10.0 percent (the run). Thus, b, the beta coefficient, can be measured as follows:

$$b = Beta = \frac{Rise}{Run} = \frac{\Delta Y}{\Delta X} = \frac{7.1 - (-8.9)}{10.0 - 0.0} = \frac{16.0}{10.0} = 1.6.$$

- Note that rise over run is a ratio, and it would be the same if measured using any two arbitrarily selected points on the line. The regression line equation enables us to predict a rate of return for Stock J, given a value of kM. For example, if kM = 15%, we would predict kJ = 8.9% + 1.6(15%) = 15.1%. However, the actual return would probably differ from the predicted return. This deviation is the error term, eJ, for the year, and it varies randomly from year to year depending on company-specific factors. Note, though, that the higher the correlation coefficient, the closer the points lie to the regression line, and the smaller the errors.

- In actual practice, monthly, rather than annual, returns are generally used for Kj and kM, and five years of data are often employed; thus, there would be 5 x 12 = 60 data points on the scatter diagram. Also, in practice one would use the *least squares method* for finding the regression coefficients a and b. This procedure minimizes the squared values of the error terms, and it is discussed in statistics courses.

FIGURE 5A-1	Calculating Beta Coefficients

Historic Realized Returns on Stock J, $\bar{k}_J(\%)$

$$\bar{k}_J = a_J + b_J\bar{k}_M + \bar{e}_J$$
$$= -8.9 + 1.6\bar{k}_M + \bar{e}_J$$

a_J = Intercept = -8.9%

$\Delta\bar{k}_J = 8.9\% + 7.1\% = 16\%$

$\Delta\bar{k}_M = 10\%$

$$b_J = \frac{\text{Rise}}{\text{Run}} = \frac{\Delta\bar{k}_J}{\Delta\bar{k}_M} = \frac{16}{10} = 1.6$$

Historic Realized Returns on the Market, $\bar{k}_M(\%)$

YEAR	MARKET ($\bar{k}_M$)	STOCK J ($\bar{k}_J$)
1	23.8%	38.6%
2	(7.2)	(24.7)
3	6.6	12.3
4	20.5	8.2
5	30.6	40.1
Average $\bar{k}$	14.9%	14.9%
σ_k	15.1%	26.5%

Statistics Worksheet

Calculating Beta Coefficient

7-month Data

Day	Starwood Hotel Stock Prices	S&P500 Index		Starwood Change HPR	S&P500 Change HPR
30-Apr	20.86	872.81			
29-May	24.47	919.14		17.31%	5.31%
30-Jun	22.20	919.32		-9.28%	0.02%
31-Jul	23.10	987.48		4.05%	7.41%
31-Aug	29.78	1020.62		28.92%	3.36%
30-Sep	33.03	1057.08		10.91%	3.57%
30-Oct	29.06	1036.19		-12.02%	-1.98%

	Dependent Starwood Company Y	Independent S&P Market X		E (Y - Avg Y)	F (X - Avg X)	E x F	F^2	Beta (Slope)
30-Apr								
29-May	17.31%	5.31%		0.10657	0.02359	0.00251	0.00056	
30-Jun	-9.28%	0.02%		-0.15926	-0.02929	0.00467	0.00086	
31-Jul	4.05%	7.41%		-0.02595	0.04465	-0.00116	0.00199	
31-Aug	28.92%	3.36%		0.22269	0.00407	0.00091	0.00002	
30-Sep	10.91%	3.57%		0.04264	0.00623	0.00027	0.00004	
30-Oct	-12.02%	-1.98%		-0.18669	-0.04925	0.00919	0.00243	
Average =	6.65%	2.95%				0.01639	0.00589	2.782408
Variance	2.473%	0.118%						
St. Deviation =	15.726%	3.432%						

$$\frac{\sum [y - Avg(y)] \cdot [x - Avg(x)]}{\sum [x - Avg(x)]^2} =$$

Slope (b)=	2.7824	=SLOPE(C21:C27,D21:D27)	Relationship between Dependent Y with Independent X
Forecast =	2.7668	=FORECAST(1,C21:C27,D21:D27)	predicts value of y given a value of x=1%
Standard Error =	0.1397	=STEYX(C21:C27,D21:D27)	predicts the standard error y-value for each x in the regression

Company Vs. Market