RETURN & RISKANALYSIS

***KEY TAKEAWAYS:***

* *Before investing, the investor needs to consider the following four factors:*
	1. *measure the expected return*
	2. *quantify the risk;*
	3. *how to allocate the investments; and*
	4. *time or determine the exit strategy or realization of the investment.*
* *To determine the return expectation or predict the investment payoff, the analyst could use fundamental analysis, technical analysis or behavioral analysis. The chapter will focus on the first two.*
* *By allocating the investments across different asset classes including stocks, bonds and cash, the investors can diversify their risk and achieve portfolio efficiency which is the point where you achieve the highest possible return at the lowest possible risk.*
* *The analyst can also determine the future risk/return expectation by analyzing the historical trends and apply various economic scenarios based on probability outcomes such as the expected performance under recessionary or economic boom environment.*

**ECONOMIC RECESSIONS**



**The 4 Investment Factors:**

* **Return (Expected Return)**
* **Risk – Quantifying Risk – Volatility/credit/interest/duration/systemic**
* **Time**
* **Allocation**

**Analysis:**

* **Fundamental**
* **Technical**
* **Behavioral**

**Rates of Return – Holding Period Return (HPR)**

**The first basic measurement of return does not consider the time that length of time that which the return was achieved is the Holding Period Return (HPR). HPR is focused on what the net return over the investment life**. It measures the rate of return from the time the investor initiated the investment until the investment was realized – basically the rate of return for the holding period whether is one month or 5 years. The ratio in its most basic form is:

HPR = $\frac{CF}{I}$

Where CF is the Cash Flow (inflow and outflow) during the investment period and I is the initial investment. For example, if an investor buys the stock for $100 and sells it for $120 and during the investment he or she received $2 dividend then the cash flow on the numerator will be $120 of proceeds for selling the stock plus $2 of cash dividend received (cash inflow) minus the initial investment of $100 (cash outflow) the net cash flow will be $22 ($120 + $2 - $100). The HPR will be calculated by dividing the net cash flow of $22 by the initial investment of $100 resulting to a 22% return:

$$\frac{\left(120-100+2\right)}{100}=\frac{22}{100}=0.22=22\%$$

For a quick analysis of expected return, the HPR ratio which represents the relationship between cash flow to the initial investment can be found in many applications on various asset classes. For example, let’s assume the investor is interested in buying a bond that has an 8% per year coupon rate or annual interest income of $80 on a $1,000 bond and the secondary market price of the bond is 95% of par or $950. To calculate the expected return or the current yield (CY) in bond “talk” the numerator of $80 representing the annual expected payment or cash flow and the denominator of $950 representing the purchase price of the bond or initial investment will calculate the expected annual return of 8.42%:

$$CY =\frac{CF}{I}=\frac{Annual Coupon Payment}{Market Price of the Bond}=\frac{80}{950}=0.0842=8.42\%$$

In many cases an expected return (discussed in depth later) that the investor sets as a target before making the investment determines the initial investment needed to achieve the expected cash flow. Using the bond example above were the annual coupon payment of $80 is already set based on the bond agreement (indenture) but in this case the investor desires a 10.0% return based on new measured risk assessment of this bond, then to achieve 10.0% the numerator will be $80 divided by the expected return of 0.10 or 10.0% calculating the initial investment needed $800.00 by solving for Investment (I):

$$since CY =\frac{CF}{I}, then CF=\left(CY\right).\left(I\right) and I= \frac{CF}{CY}= \frac{80}{.10}=\$800.00$$

**This relationship between cash flow, investment, return and time are the basic variables calculating “Time Value of Money”** discussed in many finance text books where the cash flow is the expected cash flow to be received in the future or future value (FV) minus the investment, the investment representing today’s investment or present value (PV) and return or expected return is the interest rate (i) at a set time (t). Showing below how this ratio of HPR can translate to the concept of “Time Value of Money”:

$$HPR=\frac{CF}{I} or i=\frac{(FV-PV)}{PV } or i=\frac{FV}{PV}-\frac{PV}{PV} or i=\frac{FV}{PV} -1 $$

$$then present value (PV) is $$

$$PV=\frac{FV}{\left(1+i\right)} for in one year $$

$or PV=\frac{FV}{\left(1+i\right)^{t}} in future year t$

and to calculate future value (FV)

FV = PV $\left(1+i\right)^{t}$

*Excel formulas for Present Value, Future Value and Rate of Return:*

*= PV (rate, years, future value)*

 *=FV (rate, years, present value)*

*=Rate (years, future value, -present value)*

**End boxed text here]**

When trying to calculate the annual rate instead of the total rate of return for the entire investment hold period, then this rate is referred to as the Internal Rate of Return or IRR covered in the next section below.

**Rates of Return –Annual Rate of Return (ROR) and Internal Rate of Return (IRR)**

The concept of “Time Value of Money” is mostly used for calculating the annual rate of return as the basis of comparing such return to other years, or to the risk-free rate to establish the risk premium – explained in later chapters. The relationship between todays’ investment to future expectation for given years will result to an annual rate of return.

Starting with the basic time value of money formula of Present Value, the formula is:

$ PV=\frac{FV}{\left(1+i\right)^{t}} in future year t$

where it calculates the initial investment needed to achieve at set future payoff in year “t” at the annual rate of return (ROR) or “i”. For example, what do you need to invest today to receive $100 in 5 years at 5% return per year? Based on the calculation below, you need to invest $78.35:

$$pv=\frac{\$100}{\left(1+0.05\right)^{5}}=\frac{100}{1.2763}=\$78.35$$

If we know what we need to invest today at an annual rate “i”, and we are trying to calculate what the investment will be “t” years, then the formula is:

FV = PV $\left(1+i\right)^{t}$

For example, if you invest $100 today for 5 years and expect 5% return per year, you investment will be calculated to grow to $127.63:

$$Fv=\$100\left(1+0.05\right)^{5}=\$100 \left(1.2763\right)=\$127.63$$

To then reverse this formula to calculate the annual rate of return (ROR). The formula is:

$\left(1+i\right)^{t}=\frac{FV}{PV}$ , then $i$ = $\sqrt[t]{\frac{FV}{PV}}$ - 1

For example, if you invest $100 today and expect is 5 year a payoff of $127.63 what is the rate of return per year? The calculation below shows 5.0% annual return:

ⅈ=5127.63100$ⅈ=\sqrt[5]{\frac{127.63}{100}}-1=1.05-1=0.05=5\%$

**For an investment that the investor who receives annual cash flows during the investment period, the ROR calculation is a little more challenging than a one-time payment in the future**. If the cash flows from the investment are the exact same amount for every year then the annual cash flows over the investment represent the annual return including original investment amount – similar to a bond investment that the investor receives annual or semi-annual fixed payments and a one-time principal payment at maturity of the bonds or early repayment (sometimes refer to as redemption).

For example, if we invest $100 to an investment that pays $5 fixed per year for 5 years plus receiving the initial investment of $100 in year 5, then the annual (ROR) will be 5%.

The more challenging calculation is if the payment is different every year, so the annual rate of return must be weighted based on size and the year paid. This type of rate return method is the Internal Rate of Return. Its challenging because each year the investment would have different payoffs and sometimes negative numbers. The best approach to calculate the IRR is using spreadsheet analysis. The formula that will be used throughout this book is =IRR (CF0, CF1, CF2, CF3….CFt).

**Insert Figure 1.1**



**Rates of Return – Average Annual Rate of Return**

The average annual rate of return can be calculated by looking at 5 to 10 years of historical returns and averaging them to represent the annual return. It gives the investor an indication what to expect on an average. This method is used for comparing to other investments calculated the same way and by taking this number to the next level of assessment how volatile in the return as compared to the average on a given year. We will examine relationship between the rate of return and volatility which measure the risk of such investment. They are two methods of calculating the risk/return: Historical and Scenario Analysis method.

**Scenario and Historical Analysis**

Scenarios Analysis and Probability Distributions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Scenarios** | **Probability** | **HPR** | **WAHPR** |
| Boom Growth | 1 | 0.25 | 44% | 11.00% |
| Normal Growth | 2 | 0.5 | 14% | 7.00% |
| Recession Growth | 3 | 0.25 | -16% | -4.00% |
|  |  |  |  | 14.00% |

extra small.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Scenarios** | **Probability** | **HPR** | **WAHPR** | **Variance** |
| Boom Growth | 1 | 0.25 | 44% | 11.00% |  225.00  |
| Normal Growth | 2 | 0.5 | 14% | 7.00% |  0.00  |
| Recession Growth | 3 | 0.25 | -16% | -4.00% |  225.00  |
|  |  |  |  | **14.00%** |  450.00  |
|  |  |  |  | St. Dev = | **21.21%** |

SD (r ) = σ = √ Var (r )

E (r) = (0.25 \* 44% ) + ( 0.50 \* 14%) + (0.25\*(-16%)) = **14%**

Sigma ^2 = 0.25 ( 44 – 14) ^2 + 0.50 (14 – 14) ^2 + 0.25 (-16-14)^2 = 450

And so, the SD sigma = √450 = **21.21%**

**EXAMPLE**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Current Price=** |  **23.50**  |  |  |  |  |  |  |
|  |  **Scenarios**  | **Probability** | **End-of the yr Price** | **Dividends** | **HPR %** | **WAHPR** | **Variance** |
| High Growth | 1 |  0.35  |  $ 35.00  |  $ 4.40  |  67.66  |  23.68  |  591.41  |
| Normal Growth | 2 |  0.30  |  $ 27.00  |  $ 4.00  |  31.91  |  9.57  |  8.62  |
| No Growth | 3 |  0.35  |  $ 15.00  |  $ 4.00  |  (19.15) |  (6.70) |  731.04  |
|  |  |  |  |  | E (r ) = |  **26.55**  |  1,331.07  |
|  |  |  |  |
|  |  |  |  |  |  | StDev = |  **36.48**  |
| Standard Deviation = Sq Rt of V |  |  |  |  |  |  |
| Variance = 0.35 \* (67.66 - 26.55) ^ 2 + .30 \*(31.91 - 26.55) ^ 2 + .35 \* (-19.5 - 26.55) ^ 2 |  |  |
|  |  |  |  |  |  |  |  |

Sharpe Ratio:

Risk Premium over the Standard Deviation of portfolio excess return

(E(r p) – r f ) / σ

8% / 20% = 0.4x. A higher Sharpe ratio indicates a better reward per unit of volatility, in other words, a more efficient portfolio

Sharpe Ratio is more useful for ranking portfolios - it is not valid for individual assets – is useful across Asset Classes.

HISTORICAL ANALYSIS





σ =

The Capital Allocation Line (CAL)

Different values of Y (risky portfolio)

The slope (s) of the CAL equals the increase in expected return that an investor can obtain per unit of additional standard deviation.

THE REWARD-TO-VOLATILITY RATIO (Sharpe Ratio)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Exp. Return | Risk Premium | Standard Dev. | Sharpe Ratio |
| Portfolio P. | 15% | 8% | 22% | 8/22 = 0.36 |
| Portfolio C. | 11% | 4% | 11% | 4/11 = 0.36 |

Plot on CAL the Sharpe Ratio is the same

CAL Line

Rf = 7% …. If the investor can borrow at (risk free) rate of rf=7.0%, then he/she can construct a complete portfolio that plot on the CAL line to the right of P where y>1

Example:

$300,000 – borrows additional $120,000 = $420,000 invested at y risk

this is a levered position in the risky assets

y = 420,000 / 300,000 = 1.4x and 1-y= - 0.4, reflecting a short position in the risk-free assets – a borrowing position = 7.0%

The portfolio rate of return is

E(rc) = 7 + (1.4 \* 8 ) = 18.2%

Your income = $63,000 (15% of $420,000) and pay $8,400 (7% of 120,000) interest

$63,000 – 8,400 = 54,600

54,600 / 300,000 = 18.2%

Sharpe Ratio:

σi = 1.4 \* 22 = 30.8

S = (E (ri) – rt) / σi = (18.2 – 7.0) / 30.8 = 11.2 / 30.8 = 0.36

**Chapter 6:**

**EFFICIENT DIVERSIFICATION**

How investors can construct the best possible risky portfolio – efficient Diversification

“Diversification reduces the variability of portfolio returns”

**DIVERSIFICATION AND PORTFOLIO RISK**

From one stock to two stocks to three stocks….. sensitivity to external factors (i.e. oil, non-oils stocks) – But even extensive diversification cannot eliminate risk – MARKET RISK

* Other Names for Market risk: Systematic risk, non-diversifiable risk
* The Risk that can be eliminated by diversification is called:
	+ Unique Risk
	+ Firm-specific risk
	+ Non-systematic risk
	+ Diversifiable risk

**ASSET ALLOCATION**

Asset allocation between 2 risky assets

**COVARIANCE AND CORRELATION**

Relationship between the return of two assets

1. Tandem

Depends on the Correlation between the two returns

1. Opposition

Use the Economic Scenarios between two asset classes (Stocks and Bonds)



The Covariance is calculated in a manner similar to the Variance. Instead of measuring the typical difference of an asset return from its expected value.

Instead measure the extent to which the variation in the returns of the two assets tend to reinforce or offset each other

**COVARIANCE**

Cov (rs.rb) = Σ p (i) [ rs (i) – avg rs] [ rb (i) – Avg rb]

Rs = return on the stock

Rb = return on the bond

P (i) = expected portfolio return

**CORRELATION COEFFICIENT**

Psb = Cov (rs,rb) / σs . σb

Psb = portfolio of Stocks and bonds

σs = Standard Deviation of s

σb = Standard Deviation of b

**THE 3 RULES OF TWO-RISKY ASSET PORTFOLIOS**

Rule 1: ROR of the portfolio is weighted average of the returns

rp = Wb. rb + Ws. rs

Rule 2: Expected ROR or the portfolio

E (rp) = Wb . E (rb) + Ws . E (rs)

Rule 3: Variance of ROR or two-risky asset portfolio.

σp^2= (Wb.σb)^2 + (Ws.σs)^2 + **2 (Wb.σb) (Ws.σs). Pbs**

Pbs is the correlation between the return on stock and bonds

Example: 100% Bonds, then decide to shift to 50% of bonds and 50% of stock

Input Data:

E(rb) = 6.0%

E(rs) = 10%

σp^2=(0.5\*12)^2 + (0.5\*25)^2 + 2(0.5\*12)(0.5\*25)\*0

σp = SqRt of 192.25 = 13.87%

σb= 12%

σs= 25%

Pbs = 0

Wb=0.5

Ws=0.5

If we averaged the 2 standard deviations of each asset class we will have incorrectly predicted an increase in the portfolio’s SD (25 + 12)/2 = 18.5% showing an increase of 6.5% when moving from all bond portfolio to half/half bond/stock. The actuality is that the SD movement is much lower to 13.87% (as is calculated above) or 1.87% from all bond portfolio SD of 12.0% - **SO THE GAIN OF DIVERSIFICATION CAN BE SEEN AS FULL 6.50 – 1.87 = 4.62%.**

*If weights 0.75 and 0.25 then (0.75\*6) + (0.25\*10) =* ***7.0% expected returns***

*Variance = (0.75\*12) ^2 + (0.25\*25)^2 + 2(0.75\*12) (0.25\*25) \*0*

*SqRt of 120* ***= 10.96%***

Check page 159 – Graph and Table at rs=10, rb=6, σs=25, σb=12 at different weights





The Mean – Variance Criterion

Investors Desire portfolios to lie to the Nortwest (Graph) – with higher return and lower Standard Deviation (Risk)

Let’s assume Portfolio A is said to dominate portfolio B if all investors prefer A over B. This will be the case that has the highest Return and lost Variance

E (rA) ≥ E (rB) and σA ≤ σB

If we graph the relationship PA will be to the Northwest of PB

**WHAT ARE THE IMPLICATIONS OF PERFECT POSITIVE CORRELATION BETWEEN BONDS & STOCKS??**

Let’s say the correlation is 1 or Pbs = 1 (so far we used 0 correlation)

Pbs = 1

σp^2 = Wb^2 σb ^2 + Ws^2 σs^2 + 2 Wb σb Ws σs \* 1 = Wb.σb + Ws.σs)

**so if Pb = 1 then σp = Wb.σb + Ws.σs**

**we learned if**

**Pb = 0 then σp = SqRt of (Wb.σb)^2+ (Ws.σs)^2**

Example we were using (σs = 25, σb = 12)

σp= (.50 \* 12) + (.50 \* 25) = 18.75% …. If Pbs = 1, straight average – No gain for diversification, where Pbs = 0 we calculated previously that the σp = 13.87% .

Graph of Pbs = 1 and Pbs = 0 and in between

|  |  |  |  |
| --- | --- | --- | --- |
| With Correlation = 1 |  |  |  |
| **Psb =** | **1** |  |  |  |
|  |  |  |  |  |
| **Portfolio Weights** |  | **Std Dev.** | **Exp Return** |
| **Ws** | **Wb** |  | **σp %** |  **E(rp) %** |
| 0.0 | 1.0 |  | 12.00 | 6.00 |
| 0.1 | 0.9 |  | 13.30 | 6.40 |
| 0.2 | 0.8 |  | 14.60 | 6.80 |
| 0.3 | 0.7 |  | 15.90 | 7.20 |
| 0.4 | 0.6 |  | 17.20 | 7.60 |
| 0.5 | 0.5 |  | 18.50 | 8.00 |
| 0.6 | 0.4 |  | 19.80 | 8.40 |
| 0.7 | 0.3 |  | 21.10 | 8.80 |
| 0.8 | 0.2 |  | 22.40 | 9.20 |
| 0.9 | 0.1 |  | 23.70 | 9.60 |
| 1.0 | 0.0 |  | 25.00 | 10.00 |
|  |  |  |  |  |



Use Extreme Example where **Pbs = -1**

**σp^2 = (Wb.σb – Ws.σs)^2**

**or σp = ABS Wb.σb – Ws.σs**

(using ABS or absolute because there is no negative standard deviation)

using our example = .50\*12 - .50\*25 = Abs 6.5%

|  |  |  |  |
| --- | --- | --- | --- |
| With Correlation = -1 |  |  |  |
| **Psb =** | **-1** |  |  |  |
|  |  |  |  |  |
| **Portfolio Weights** |  | **Std Dev.** | **Exp Return** |
| **Ws** | **Wb** |  | **σp %** |  **E(rp) %** |
| 0.0 | 1.0 |  | 12.00 | 6.00 |
| 0.1 | 0.9 |  | 8.30 | 6.40 |
| 0.2 | 0.8 |  | 4.60 | 6.80 |
| 0.3 | 0.7 |  | 0.90 | 7.20 |
| 0.4 | 0.6 |  | 2.80 | 7.60 |
| 0.5 | 0.5 |  | 6.50 | 8.00 |
| 0.6 | 0.4 |  | 10.20 | 8.40 |
| 0.7 | 0.3 |  | 13.90 | 8.80 |
| 0.8 | 0.2 |  | 17.60 | 9.20 |
| 0.9 | 0.1 |  | 21.30 | 9.60 |
| 1.0 | 0.0 |  | 25.00 | 10.00 |
|  |  |  |  |  |



**THE OPTIMAL RISKY PORTFOLIO W A RISK-FREE ASSET**

Let’s add Risk Free in our portfolio (bringing what we discussed before regarding CAL line)

Historical Correlation between Bonds and Stocks is 0.20

T-Bills = 5.0% (risk free)

GRAPH introducing the CAL in our previous Graph of Bonds and Stock

Using the minimum (point A) on a .20 correlation between bonds and stock. We were given the minimum weights at Wb= 87.06% and Ws = 12.94% so PA expects to return 6.52% and σA is 11.54%calculated as follows:

rA = (.8706 \* 6 ) + (.1294 \* 10 ) = 6.52

σA=(.8706 \* 12) ^2 + (.1294 \* 25) ^2 = 11.54%

Sharpe Ratio is SA = (E (rA) – rf ) / σA = (6.52 – 5) / 11.54 = 0.13

Now consider the CAL uses portfolio B instead of A. Portfolio B consists of 80% Bonds and 20% Stock, then rbs = 6.80%, σbs = 11.68% then,

SB = (6.80 – 5 ) / 11.68 = 0.15

SB – SA = 0.02

This implies that portfolio B provides 2 extra basis points (0.02%) of expected return for every percentage point (1.0%) increased in Standard Deviation (Risk)

The higher Sharpe Ratio of B means that its capital allocation line (CAL) it’s steeper than A, therefore, CAL(B) plots above CAL(A).

In other words, combination of portfolio B and the risk-free asset provide a higher expected return for any level of risk (SD) than combination of portfolio A and the risk free risk.

**GOAL =** **CAL NEED TO REACH TANGENCY (GRAPH) FOR OPTICAL RISKY PORTFOLIO**

Graph 6.6, page 166

**Solution for maximizing of the Sharpe Ratio:**

**Wb = [(E(rb) – rf).σs^2 – (E9rs) – rf).σb.σs.Pbs] / [ (E (rb) – rf) σs^2 + (E (rs) – rf).σb^2 – rf + E (rs) – rf.σb.σs.Pbs**

Ws = 1- Wb

**BUILDING A PORTFOLIO WITH RISK FREE, STOCK, AND BONDS**

Assume we want to invest 45% of our portfolio in Risk Free assets = 55% is in a risky portfolio between bonds (50%) and stocks (50%),

We find the CAL with our optimal portfolio (o) in a slope – Lets say:

Pro = 8.68% and σ0=17.97%, Wb = 32.99% and Ws = 67.01% from the long formula above.

So = 8.68 – 5 / 17.97 = 0.20

E(rc) = 5 + 0.55 \*( 8.68 – 5) = 7.02%

σc = 0.55 \* 17.97 = 9.88%

Wrf = 45%

Wb = 0.3299 \* .55 = 18.14%

Ws = 0.6701 \* .55 = 36.86%

**REVIEW – CHAPTER 6**

**THE EFFICIENT FRONTIER OF RISKY ASSETS**

3 STEPS:

**STEP 1:**

Identify the best possible or most efficient risk-return combination available from the universe of risky assets (Plot them on Return/Standard Deviation Graph)

*Expected Return – SD combination for any individual asset end-up inside the efficient frontier, because single-asset portfolios are inefficient (are not efficiently diversified)*



**STEP 2:**

Determine the optimal portfolio of risky assets by finding the portfolio that supports the steepest CAL (Risky free return introduced)

*Risky free assets – using the current Risk Free Rate, we search for CAL with the highest Sharpe Ratio*





**STEP 3:**

Choose an appropriate complete portfolio based on the investors risk appetite (risk aversion) by mixing the Rf Asset with the optimal risky portfolio.

*Choose the appropriate optimal risky portfolio (o) above T-bills – Separation Property step - RISK AVERSE comes in play in this step – when selected the desire point of the CAL. More risk averse clients will invest in the risk-free asset and less in the optimal risky portfolio O.*

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 = E (ri) + Bi . M + ei**

E (ri) = Expected Excess (Premium)(

Bi = Beta relationship to the industry / market

M = Macroeconomic surprises

Ei = 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

**Mathematically:**

**E (rM) – rf = A . σM^2**

σM = 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,

E rM

CML

 rf

σM

Example

Rf = 5%

Risk Aversion (A) = 2

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

Then E (rM) - rf = A . σM^2

E (rM) = rf – A. σM^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).
6. **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:

* 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.





**Modern Portfolio Theory (MPT):**



CHALLENGED BY BEHAVIORAL ECONOMICS



**Efficient Frontier** is the intersection of the Set of Portfolios with Minimum Variance (MVS) and set of portfolios with Maximum Return



1. **CALCULATING STANDARD DEVIATION**



1. **CALCULATING R SQUARE**



1. **CALCULATING SHARP RATIO**

|  |  |  |  |
| --- | --- | --- | --- |
| **A** | **B** | **C** | **D** |
| **100** | **Calculating Sharp Ratio** |
| **101** |  |  |  |
| **102** | Risk Free (rf) = | 2.50% |  |
| **103** | Return = | 6.65% |  |
| **104** | Standard Deviation = | 15.73% |  |
| **105** |  |  |  |
| **106** |  |  |  |
| **107** | **Sharp Ratio** | **0.26** | =+(C132-C131)/C133 |
| **108** |  |  |  |
| **109** |  |  |  |