**Unit 2, Lecture 1-3 Review**

**Risk and Return**

Risk and Return

* Risk: the probability that actual future returns will deviate from expected returns (measure of uncertainty)
  + Represents the variability of returns
    - Implies a chance for some unfavorable event to occur
* From a finance perspective, risk could be any of the following terms
  + Sales
  + COGS
  + Inventory
  + Exchange rates

Historical Risk and Return

* Average Return: average percentage return on an investment over a sample time period
* Variance: measures how far returns fall from the mean/average
  + AKA volatility
  + A bank CD has almost 0 volatility while a start-up company has a lot of volatility
* A return is the interest or percentage that we earn over a time period (typically a year or month)

= Price today of investment

= Price at beginning of investment

= Dividend paid today

* The average return is then just the total percentage gain or loss divided by the number of returns
* The variance, or standard deviation, is how far each return falls from the average
  + The greater the variance, the greater the volatility or risk of the investment
  + The SD or variance is also known as the stand-alone risk
    - Stand-alone simply implies the risk associated with only investing in that stock

Holding Period Return

* HPR = compounded return = total TVM return
* The HPR tells you what you truly made
  + More realistic than the average return

Annual Compounded Return

* To find the annual compounded return, we use the HPR formula, but with a geometric return () instead of annual return ()

Forward Looking Returns and Risk

* A Random Variable: some measurement that can have a number of possible future outcomes
  + Ex: temperature, rainfall, company performance
  + The goal with a random variable is to predict the expected outcome and volatility
* Probability Distribution: a function that assigns probabilities to the various possible outcomes that a random variable can have
  + There are 2 forms of probability distribution:
    - Discrete: outcomes can take only on a finite number of values
      * Countable
    - Continuous: outcomes can take on infinitely many values over a continuous range of values
      * Ex: stock returns, sales
  + For either the continuous or discrete probability function, the probabilities must add to 1

Discrete Probability Distribution

* We can use the distributions given in the problem to calculate 2 key statistics:
  + Expected Value: the measure of central tendency of the distribution (the average value)
  + Variance: measures the spread of the distribution or the variation in possible outcomes about the expected value

Continuous Probability Distribution

* Finance uses the continuous, rather than the discrete, probability distribution
* The Normal Distribution is an example of the continuous probability distribution
  + The Normal Distribution is often used with financial variables such as returns or cash flows
  + Normal is symmetric around a mean and calculates a z-score that measures how many standard deviations a specific value falls from the mean
    - The safer something is, the more clustered the return (the smaller the spread)
    - The risker something is, the less clustered the return (the larger the spread)
  + The Normal curve creates confidence intervals for where a random observation will fall
    - Ex: 68% confidence means there’s a 68% chance my future outcome will fall in the predicted range

Comparing Two Stocks

* To compare two stocks, we have to look at the expected returns
* If the two stocks have the same expected return, then we look at the SD and make a decision
  + If two stocks have the same expected returns, then choose the stock with the smaller SD because this implies less volatility
* If the two stocks have different expected returns, we can use the coefficient of variation to determine which stock offers the most return per unit of risk
  + The coefficient of variation tells us how many units of risk you get per unit of return

Lowering Risk with a Portfolio

* The goal of every investor is to build a portfolio and reduce average risk
  + A portfolio allows you to lower your overall risk
    - “Don’t put all your eggs in one basket”

= Weight in asset A

= (Dollars invested in asset A) / (Total Dollars Invested)

Formula for Portfolio Risk:

= Correlation

* The latter half of the formula represents the co-variance, which describes how A and B interact together
* The correlation between two variables is a measure that indicates how much the two variables move or vary together
  + Correlation falls between -1 and 1 (-1 < < 1)
  + Positive Correlation (0 < < 1)
    - When asset A’s returns are above its average, then Asset B’s return tends to be above its average
      * Assets tend to move in the same direction
  + Negative Correlation (-1 < < 0)
    - When Asset A’s returns are below its average, then Asset B’s returns tend to be above its average
      * Ideal
  + Zero Correlation
    - No relationship
  + \*\*\*The lower the correlation, the greater the diversification, and therefore the lower the risk\*\*\*
    - Most stocks have a correlation between 0.2-0.8

Risk of 3-Asset Portfolio

* With an increased number of assets, co-variation is all that matters

Market Wide Risk vs. Firm Specific Risk

* What causes volatility?
  + Market Wide Risk
    - There are economic events that have broad implications and cause all stocks to move up or down together
    - Events like economic recessions or booms, interest rate changes, taxes, political developments, or oil prices will generally impact all firms and thus stock prices
    - These events affect returns in the same direction but not necessarily in the same magnitude (“A high tide moves all boats”)
    - Market risk = non-diversifiable risk = systematic risk
      * An increase in non-diversifiable risk 🡪 an increase in returns
  + Firm Specific Risk
    - These are economic and business events that impact only one or a few firms at a time
    - Risk that is unique to a specific firm or industry
      * Ex: the release of a new product or technology, a lawsuit, a CEO change
    - Firm specific risk = diversifiable risk = nonsystematic risk

Determining the Market Risk Premium

* Market Portfolio: a portfolio that contains all assets in existence
  + Each asset is held in the same proportion as its value is to the total value in the economy
* Risk of Market Portfolio: the stand-alone risk of the market portfolio is entirely non-diversifiable risk
* Investors have some expected return to hold the market portfolio
  + Using this return, we can determine the market risk premium, or the excess return required for the investor to buy the market portfolio

Stocks Relevant Risk

* A stocks relevant risk = a stocks non-diversifiable risk
* A stocks relevant or market risk equals its stand-alone risk times the correlation coefficient that exists between the stocks returns and market portfolio

i = stock “i”

= correlation between returns on stock i and returns on the market portfolio

* The higher the , the more stock i is influenced by the market portfolio, and the higher the stock i market risk
  + The higher the the less the diversification

A Stocks Beta

* Beta is a risk index
  + Beta is a ratio of a stocks relevant risk divided by the relevant risk of the market portfolio
* The higher the , the higher the required return
* The portfolio is the weighted average of each in the portfolio
* Key Point: Beta predicts the expected relationship between the market return and the return on the individual stock
  + Beta measures how the stock responds to the market
* What do the following Beta’s represent?
  + = 1.50
    - When >1, stock i is riskier than the average investment
  + = 0.75
    - When <1, stock i is less risky than the average investment
    - If the market is up by 1%, then the average stock i return is up by 0.75%
    - When the market goes up/down, stock i tends to go up/down by a smaller amount
  + = 1
    - When =1, stock i has the same risk as the average investment

The CAPM Formula

* The CAPM formula relates a stocks market risk to its required return

= risk free return (safe, 0 risk investment)

= risk index

= expected return on market portfolio

= bonus return for average risk investment = market portfolio risk premium

= bonus return for risk of stock i

* Beta determines the required return
  + A safe investment means there is a smaller Beta and a smaller return
* The problem with the CAPM formula is that is a regression coefficient, meaning it uses historical returns
  + It’s bad that we are focusing on past numbers because company risk never remains the same
  + In practice, CAPM has some issues but it’s the best we have

The Security Market Line

* The Security Market Line is really the graphical representation of CAPM

Need 2 Points:

X ( Y()

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* Buy the stock if actual return > required return
* Sell the stock if actual return < required return
* If actual return > required return…
  + Investors will buy the stock
    - The stock is undervalued, meaning its priced too low
  + With people buying the stock, the price will increase, making returns decrease
    - Price will increase until actual return = required return
* If actual return < required return…
  + Investors will sell the stock
    - The stock is overvalued, meaning its priced too high
  + With people selling the stock, the price will decrease, making returns increase
    - Price will decrease until actual return = required return

Extra Notes

* Pope bought into Google in 2013 for $345/share and later sold in 2017 at $800/share, but stock prices actually rose even more after that