**Portfolio**

A portfolio is the grouping of assets such as stocks, bonds, cash equivalents as well as their mutual, exchange-traded and closed-fund counterparts.

The choices the investor makes depends on risk-return characteristics of individual securities. The goal is to get the optimal portfolio, which is when you can achieve the highest return with the lowest risk. This process is known as portfolio selection.

An example of this is if you had a $1 million dollar portfolio and you had three assets X, Y, and Z. We know X has a return of 5%, Y has a return of 7%, and Z has a return of 3%. We also know we have $500,000 in X, $200,000 in Y, and $300,000 in Z.

Portfolio expected return =(($500,000/ $1 million) x 5%) + (($200,000/ $1 million) x 7%) + (($300,000/ $1 million) x 3%) = 2.5% + 1.4% + 0.9% = 4.8%

**Asset**

An asset is an item of economic value. These items can be cash, stocks, accrued incomes, many other items as well. In terms of predicting for a portfolio would typically stick to cash and stocks as values.

**Risk**

Risk is considered the chances that the actual results differ from the actual results. This risk could include losing all of your original investment. It is standard practice that if you are given two portfolio options with the same expected return, you would pick the one with the lower risk. Another standard is if two portfolios have the same risk then you would pick the portfolio with the higher expected returns.

Typically, there are two types of risk referred to mostly. These are systematic risk, and unsystematic risk. Systematic risk refers to the market as a whole, things that affect the everyone, inflation is an example of this. Unsystematic risk is unique to a specific company or industry.

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**Diversification**

Diversification is the idea that you should not pull all of your eggs in one basket. In the terms of economics, this translates to not putting all your money in on one stock, or one type of industry, diversifying can help lower risk.

**Returns**

Returns are what are referred to when talking about the gain or loss of a portfolio. The example in the Portfolio section is an example of calculated return.

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W in this equation represents the weights of the asset, and r represents the returns of each asset.

**Markowitz Model**

The Markowitz Model is a mathematical model that outputs the most optimal portfolio. It was theorized by Harry Markowitz in 1952 and is the driving idea behind the Modern Portfolio Theory. The theory behind this was based on two main concepts:

1. The investor’s goal is to maximize return for any risk level
2. Risk can be reduced by diversifying

These are assumptions that are taken by the model:

* The investors are rational.
* The supply and demand equilibrium are instantly achieved.
* There are no taxes.
* Information is easily accessible.
* Everyone has the same opportunity of borrowing and lending.
* Market is liquid.

When the standard deviation and expected return is graphed against each other, the efficient frontier is formed. The efficient frontier represents well diverse portfolios, which is what the investor wants to reach.

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The math goes as follows:

If we have two assets A and B the following would give us the expected return:

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Again, as above w represents the weight of the asset. We can calculate the variance of the portfolio with:



This equation can help us find the correlation coefficient between the assets in the portfolio. The two graphs shown below show the difference this coefficient makes, when the coefficient is -1, the portfolio will be considered risk free, but as seen in the second graph, as the coefficient approaches 1 the portfolio will become very risky and volatile.

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**Mean Variance Optimization**

Mean Variance Optimization is another tool used in Modern Portfolio Theory. It also helps in determining the risk level. There are two main parts to the Mean Variance Optimization. The first part is variance, which will tell you how far the numbers will be in a set. The second is expected return. The expected return again is how much money you think you are going to get back. The investor will choose a portfolio with a lower variance.

An example:

Investment X has an amount of 100,000 with an expected return of 5%

Investment Y has an amount of 300,000 with an expected return of 10%

The total portfolio is worth 400,000 X is worth 25% of the portfolio and Y is worth 75% of the portfolio. We can find that the variance of X is 7% and for Y it is 14%.

We can now calculate the portfolio variance.

Portfolio variance = (25% ^ 2 x 7% ^ 2) + (75% ^ 2 x 14% ^ 2) + (2 x 25% x 75% x 7% x 14% x 0.65) = 0.0137

This is now the number we would use to compare with other portfolios.

Knowing the variance can help protect the investor against risky stocks. Stocks whose prices have gone drastically down or up will produce a higher variance, telling the investor the risk.

**Risk Aversion**

Risk aversion logically is just what those two words mean, avoiding risk. In terms of the investor it means knowingly staying away from riskier stocks, that could have a high return, and in favor go for stocks with lower return but you are confident in the return you are going to get. In a real world example it may be better to hold on to a company like Apple, which pays dividends and can give you other forms of income, than something like Dogecoin, or other cryptocurrencies that are currently in a pump and dump.

The most common used formula when it comes to risk aversion is called the Arrow-Pratt measure. The formula is pictured below:

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Where U is a utility function, and those are the two derivatives of the function. The utility function in this case is representing the ‘satisfaction’ of owning a certain stock, bond etc…

In the example below W in the utility function stands for wealth. There are three common types of Risk Aversion commonly used, 1.Risk Averse 2.Risk Neutral 3.Risk Loving. Here is how to solve the equation for all three:

1. Risk Averse if U = W^.5

U’ = 0.5W^-.5

U’’=-(.05)(.05)W^-1.5

Plugging into equation:

APM = = 0.5/W

1. Risk Neutral if U = 10W

U’ = 10

U’’ = 0

Plugging into equation:

APM = -0/20 = 0

1. Risk Loving if U = W^2

U’ = 2W

U’’ = 2

Plugging into equation:

APM = -2/2W = -1/W

The first result will show that as your wealth W gets bigger the risk will get smaller. The second shows there is no correlation as it is 0. The third shows us that the risk is negative meaning that although as you have more wealth that is diversified the risk can be negated, if W is low you stand to lose more wealth.