Portfolio – Risk and Return

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Introduction

A Portfolio is a collection of different investments that comprise an investor's total allocation of funds. Examples of a portfolio are an investor's holding of shares and/or investment properties. From a company's perspective, a portfolio can also consist of investments in many different capital projects. For both individuals and companies, the key considerations are the return that is required and the risk associated with the portfolio.

By allocating all of the available funds to a single investment, the entire fund may be lost if that individual project or security loses its value. However, by spreading the risk over a number of investments, the risk of total loss is considerably reduced. A portfolio is preferable to a single investment because it reduces risk while still offering a satisfactory return. The old adage of: 'Never put all your eggs in one basket' is applicable here. Thus, it is important to consider the relationship between risk and expected return when managing a portfolio.

Expected Return

If we can assign a probability to a variety of likely returns then we can establish the expected return of a security. When we use the term expected return it will be the sum of the probabilities of the return that the security will generate. In effect, expected return is calculated by multiplying potential outcomes by the likelihood of them occurring and then summing these results. This expected return is a statistical measure.

- The security or outcome can be represented as X
- The probability of the outcome can be represented as p
- The expected return is Px
- $\sum$**p X** is the sum of the probabilities of the expected return

Risk and Standard Deviation

There can be a high degree of variability in the expected returns for a security or portfolio of securities and hence there is the risk that we may not gain a return or that we may receive a lower return that we expected. Because of this variability, we need a measurement of the risk. Standard Deviation can be a statistical measure of how likely it is that the expected return will be achieved. It measures the variability of returns about the mean or average – what statisticians or data analysts refer to as degrees of dispersion around the mean. A high standard deviation implies greater variability of actual return while a low standard deviation implies that there is smaller risk for a given security or portfolio or Investment. We can say that the preferred position is high expected returns with low standard deviation. Standard Deviation can be represented as **σ**

To sum up so far we have introduced the concepts of Return and Expected Return in addition to Standard Deviation as a measure of risk. It is now opportune to introduce some examples enabling us to calculate risk and expected return.

Some Examples

If a security can make the following returns and the probabilities of making those returns are as indicated (below) what is the expected return?

Return	Probability	Expected Return
X	p	pX
8	20%	1.6%
10	20%	2.0%
12	50%	6.0%
14	10%	1.4%
		11.0

(Note: The total of the probabilities must equal 100 percent).

In our scenario X= ∑pX= 11%

This means that the expected return is 11%

We would next need to know the standard deviation to assess from a statistical viewpoint the level of risk with this expected return of 11%.

From our example, we can calculate the Standard Deviation

Return	Probability	Return	(x-X)	(x-X)2	p(x-X)2
X	p	pX			
8	20%	1.6%	8-11	9	1.8%
10	20%	2.0%	10-11	1	0.2%
12	50%	6.0%	12-11	1	0.5%
14	10%	1.4%	14-11	9	0.9%
		11.0			**3.4%**

Standard Deviation = √3.4% ……………………………………….. = 1.84%

Putting it all together:

We have, for this security, an Expected Return of 11% and a Standard Deviation of 1.84%

Investors will consider a portfolio of securities and will want to calculate the expected return of the portfolio. The expected return of that portfolio will be the weighted average of the expected return of the securities held in the portfolio. Let us take an example of four securities in a portfolio with the following weightings and expected returns

Security	Weighting	Security Return	Portfolio Return
X	w	X’	wX’
S	30%	5.2%	1.56%
T	20%	3.6%	0.72%
U	35%	10.5%	3.68%
V	15%	8.75	1.31%
			7.27%

Co-Efficient of Variation

What if there were two securities that had the same return and we had to choose just one (possibly because of limited funds) we would select the security with the lowest standard deviation. If both securities had the same standard deviation, we would select the one with the highest return. Frequently we need to calculate the measure of risk per unit of return – this is the Coefficient of Variation. This is calculated as Standard Deviation divided by expected return.

σ/ x’

Returning to our earlier example where the expected return was 11% and the Standard Deviation was 1.84%

Coefficient of Variation is σ/ x’… 1.84/ 11 generating a CV of 0.17 (Co-efficient of Variation is abbreviated as CV).

If a set of securities had the following Expected Returns (as indicated by X’) and Standard Deviation (as indicated by σ) which security would we select and what is our rationale for our decision

Example

Security	X’	**σ**	**σ/X’**
A	5.2%	1.25	0.24
B	3.6%	0.6%	0.17
C	10.5%	2.1%	0.20
D	8.7%	1.2%	0.14

We would select D as D is the least risky having the lowest risk per unit of return with a CV of 0.14. Security A would be the least favoured, as it is the most risky per unit of return having the highest CV.

Diversification and Correlation

All securities have this risk/reward relationship. A way of reducing risk is to diversify your selections. Means of diversification would include securities from different industry sectors, different geographical markets and inclusion of different forms of securities/investments ranging from shares, bonds, property, and commodities to cash. Furthermore we are trying, when possible, to spread the risk – this is what we mean when we talk about diversifying the risk – by endeavouring to select securities within our holding that when one venture fails the other venture might succeed and is not affected by the other venture. An example in a two-asset portfolio would be holding shares in a company that sells umbrellas – we can call this **Asset A** and holding shares in a company that sells ice cream – we can call this **Asset B**. In this scenario, the weather will affect the companies differently. If the weather conditions were sunny, we would expect the share of the company that sells ice cream (Asset A) to perform better than the share of the company that sells umbrellas (Asset B). This is what we term a negative correlation, as there is an inverse relationship between the two securities. If, in our two-asset portfolio, we had shares in a company that made umbrellas and another company that made rain coats we would expect that in rainy conditions both companies would do well but in fine conditions both companies would suffer. This is what we term positive correlation as if one performs well (or poorly) it is likely that the other one will perform similarly. Where we have no relationship between two securities there is no correlation – for example shares of a company in the catering sector and shares of an oil exploration company.

The Co-Efficient of Correlation can only take values between +1 and -1. A value close to +1 indicates high positive correlation and a figure close to -1 indicates high negative correlation. A value of 0 indicates no correlation.

Diversification does little to reduce risk if the portfolio consists of entirely positively correlated securities. Risk can be reduced in a portfolio by mixing securities/ investments that correlate negatively to each other (i.e. our umbrellas and ice – cream example). It is difficult to find securities/investments that have a full negative correlation.

Splitting the funds between Investments

Investors may wish to split their funds between securities – for example in a two asset portfolio say 50% of A and 50% of B – in which case the portfolio return will be a weighted average of the expected returns on the individual securities. If we return to our example and select Securities A & B for illustration purposes and invest 50% of our funds in A and 50% of our funds in B the expected return will be (5.2% x 0.5) + (3.6% x 0.5) generating a weighted return of **4.4%** for this two security portfolio.

If we selected all of our four securities and split our funds equally between the four securities 25% in each security the weighted return will be

(5.2% x 0.25) + (3.6% x 0.25) + (10.5% x 0.25) + (8.7% x 0.25)

1.3 + 0.9 +2.63 + 2.18 = **7.01** for this four-security portfolio

While the standard deviation can be used as a measure of risk with the Co Efficient of Variation being used as a measure of risk per unit of return and a basis for comparison between projects, it is also desirable for investors, and companies, to engage in a more comprehensive appraisal of risk before committing funds to a project. This classification of risk encompasses systematic and unsystematic risk.

Systematic and Unsystematic Risk

Systematic risk is risk that affects all projects or investment decisions as it is macro-economic related – interest rates, exchange rates, and Government policies. It therefore cannot be diversified. Unsystematic risk on the other hand is unique to the securities or investments selected as it relates to the sector and the company specifics. It can be diversified and as we have seen earlier by holding an appropriate mix of selections in the portfolio this type of risk can be reduced further. Markowitz in his work with Portfolio Theory concentrated on unsystematic risk and Sharpe in his later work on the Capital Asset Pricing Model concentrated on systematic risk on the basis that unsystematic risk had already been fully diversified through the earlier work of Markowitz.

Final Reflections

Finally, we had mentioned earlier in this article that when looking at expected returns that portfolio returns are a weighted average of the expected returns on the individual investments. What of standard deviation of the portfolio? The standard deviation for a portfolio is less than the weighted average risk of the individual investments, except for perfectly positively correlated investments.

These concepts of expected return, risk, probability, co-efficient of variation, correlation and diversification are fundamental principles of Portfolio Theory that provide guidance on the selection of investments in order to achieve the optimal combination of risk and return for both individuals and companies.