**R min** represents the minimum return maximized that we can take (it can also be seen as a maximum loss minimized by changing the sign)

**Expected return:** We firstly calculated the Expected Return with respect to each asset by doing the average of each one for the whole time period.

The expected return is the profit or loss that an [investor](https://www.investopedia.com/terms/i/investor.asp) anticipates on an investment that has known historical [rates of return](https://www.investopedia.com/terms/r/rateofreturn.asp) (RoR).

We can calculate the Expected Return as:

A picture containing icon

Description automatically generated

**Decisions variables:** Then, we proceed to set the decision variables as fraction of the capital Xi invested in the 30 assets.

**Portfolio constraints:** At this point we started to impose/implement/add the constraints to our model, starting from the portfolio constraint in which we set that the sum of the weight of the assets must be equal to 1.

Finally in order to **maximize the minum loss** we need to define Z as the minum value of the weighted return:

1. The next constraint to be imposed is the Z Value Constraint, the Z Value is calculated by taking the minimum value of the sum of each return multiplied by their weigth for each time period.
2. Once we found the Z Value, we imposed that the Z Value (which is in the RHS) must be lower or equal ( >=) than the LHS.

Once we use the optimizator we will see a variation in the weigths.

We use the Excel Solver in order to maximize the objective function (z), then we set the assets weight as the desicion variables and by adding all the previous mentioned constraints, we maximize the objective function (as a linear model).

**R max:**

Now our purpose is to find out the maximum expected return (rmax) of the portfolio,

1. by multiplying the weight of each assets per the expected return of each assets
2. In this case the only constraint this the one related to the portfolio, which tell us that LHS = RHS

We used the Excel solver in order to maximize the objective function (expected return of the portfolio), then we set the assets weight as the desicion variables and by adding the portfolio constraint, we maximize the objective function (as a linear model).

**Efficient frontiers:**

when choosing a portfolio, the investor prefers a high return and a low risk.

Given the above principle, it is possible to reduce the set of possible portfolios to a smaller subset by eliminating those portfolios which are surely worse than another one available in the same market.

According to the principle we know that the investor would like to pick a portfolio which is located in the region in which return increases and risk decreases

**The expected return constraint** that we use, is given by imposing the sum of the weight per their expected return equal to the target value

The purpose of this step is to fix 10 equally spaced values between Rmin and Rmax and compute the MM Model, by doing so, everytime we want to find the MinRisk value (associated to each value), we change the expected return constraint and maximize z

In this way we can plot the EF, related to the minimum return maximized against the maximized expected return, by plottng the graph we should expect the results in the North West box.

Instead if we want to analyze it from a loss point of view, we can change the sign of our minimum return maximized so that we have a loss but the plot as we are used to.

As we can see in the plot we have a increase of 10% bewteen each point starting from Rmin to P10 and then a bigger gap betwen our P10 and Rmax, obviously because the differnce between this last two points, is higher than 10%