Behavioral and Personal Finance
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Module – 02
Personal Finance
Lecture - 28
Portfolios for Individual Investors

Hello, welcome back to the course Behavioral and Personal Finance. So far, in this course; we have learned about different biases and heuristics that might affect our understanding of economic theories and how these biases and heuristics can affect our personal finance decisions.

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This week, we will learn more about what are different tools and techniques and investment strategies that are available for Individual Investors and how we can implement those strategies and investment tools and techniques in the interest of our financial security and to get a better return on the investment that we make.

This session of the module focuses on what are the portfolio strategies or tools that an individual investor can consider while making personal financial decisions and how these portfolio strategy can be contextualized to individual preferences of risk and return.

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The topics that we are considering this week are the construction of investment portfolios. And how different risk and return choices associated with the investment opportunities available to us can be taken into account while making a trade off for our own investment

objectives. We all understand that, investment portfolio is basically a combination of different assets in different proportion.

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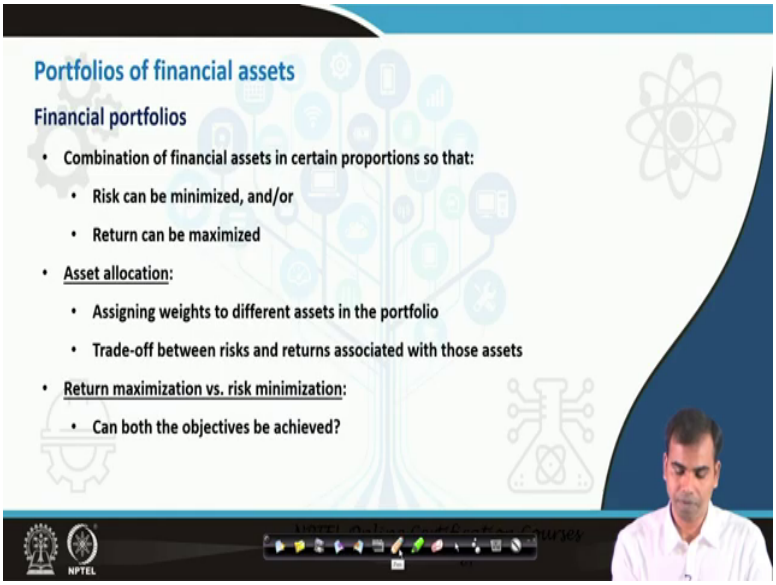

Suppose, I have certain disposable amount of money to invest in different financial securities or financial assets. I will have to first choose the set of assets or financials securities where I would like to invest my savings. Now, those securities will offer unique combination of risk and return. What it implies is that; the risk and return characteristic of all the choices that we have are unique and are preferences for going into one direction or choosing a particular investment asset depends on our ability to take risk and return associated with those investment.

Basically, when we try to identify a combination of different assets to form a portfolio, we intend to achieve one or both of these two objectives. The objectives that we want to achieve through investment is either minimize the risk or maximize the return.

In many cases we also try to achieve a dual objective of minimizing risk as well as maximizing return. This these two objectives can be achieved through in appropriate asset allocation strategies wherein we try to find suitable weights for each of the assets being considered to form a portfolio. And the tradeoff between risk and return associated with those assets. The question here is; what should be the right amount or right weight of individual securities or assets that should be combined together in order to form a portfolio that are able to maximize return and or minimize risk.

If we go back to few sessions ago where we discussed risk and return of different portfolios or a combination of assets we had learnt earlier; that risk can be defined as the standard deviation of individual securities where we try to calculate the standard deviation of returns over a period of time and return is basically the average rate of return that we try to calculate from the given data or the prices that we observe.

We had learnt that a return can be calculated as the mean or the average value of the price changes and risk can be calculated as the standard deviation of the changes in price. When we try to combine different assets in proportion, what we get to form or to calculate risk and return is as follows.

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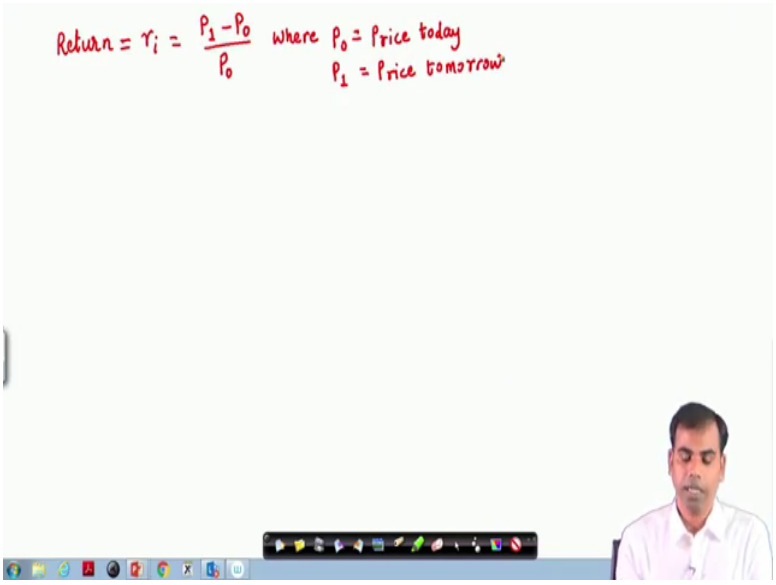

So, return and risk of individual securities can be defined as return of individual security is basically change in price over the price that we had purchased at. So, we basically have the price at time g t 0 and price at time t 1, where the return of that asset can be calculated as the change in price from time 0 to time 1 as a function as a factor of price at time 0 which is basically, the percentage change of price for a given asset.

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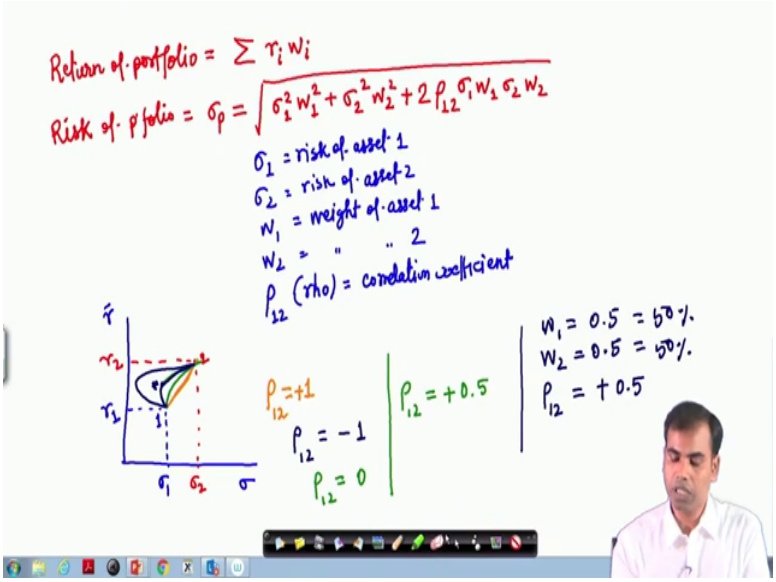

Similarly, we calculated we learned how to calculate the risk which is given by sigma and if you try to understand it in the context of a portfolio, we know that return of a portfolio is basically sum of all the returns of individual assets and weight of individual assets which means if we have 5 port 5 assets in our portfolio. The return of those 5 assets over a period of time during which we have held the assets with us and the weight of individual assets in the portfolio will be combined together to understand the weighted average rate of return for the portfolio that we hold.

And risk of a portfolio can be calculated as portfolio sigma as a function of individual risk of asset. So, if there are 2 asset, we have asset 1 and asset 2; where we calculate the individual risk weight of each of the 2 assets that we have and.

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This is how we calculate the risk of a portfolio, which is basically, the risk of individual assets where sigma 1 is risk of asset 1, sigma 2 is basically risk of asset 2, similarly weight 1 is weight assigned to asset 1 and weight 2 is weight assigned to asset 2.

Here we have one more function known as rho or correlation factor. So, rho is basically, the correlation coefficient of the 2 assets that we hold. Now, if you try to understand this on a risk return graph, we can explain this as follows. So, suppose if I have two assets which I can try to explain with a visual way. So, here is the sigma and here is the return that we hold. So, if we have 2 assets which let us say asset 1 which is giving me a sigma 1 and return 1 and similarly, if I have second asset which is giving me a sigma of risk of sigma 2 and return of r 2.

If you try to understand this the portfolio that we would like to construct with this these 2 assets 1and 2. If the correlation factor is 1, correlation between 1 and 2 is 1; which is plus 1, the as portfolio would look something like this where, we will try to have a portfolio along with the line. And if the correlation factor looks like, correlation between 1 and 2 is minus 1; the portfolio curve would look like this where we will have our portfolio along this line. And if the correlation factor is to be 0 which is very rare case, then the value of the curve of portfolio might look very much similar to this and if we assume that correlation between 1 and 2 is minus or let us assume that average of 0.5, it should look like this.

So, this is how the portfolio looks on a risk return graph. When I try to understand the position of the portfolio of 2 assets, asset 1 and asset 2, it will be shown on these graphs or these curves basically where depending on how much weight we put on asset 1 and what is the remaining weight to be put in asset 2 will determine the position of my portfolio on curve of these natures.

So, basically if I have, let us say an asset which has weight in asset 1 is equal to 0.5 which is my 50 percent of money is invested in asset 1 and the remaining 50 percent is in asset 2, then my portfolio would assuming that the correlation between these 2 assets is basically 0.5. Then my asset would look will be along this line somewhere here where my asset would my portfolio would be positioned. If I try to change this weight of asset 1 to be 0.

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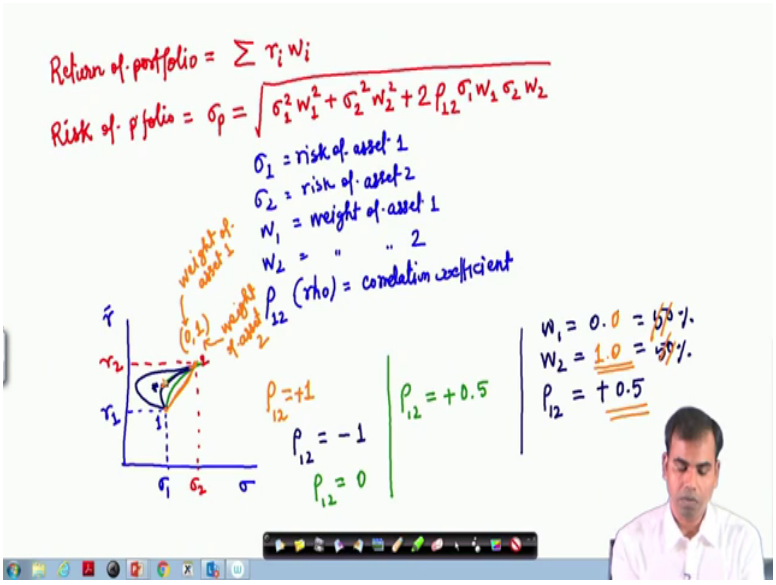

So, if the weight of asset 1 becomes 0; which means, weight of asset 2 will become 100 percent which is essentially 1. Assuming that; this is the same correlation between these 2 assets, my portfolio would be lying along this line close at this particular point where the value of the asset 1 will be 0 and value of asset 2 or the weight of asset 2 will be 1.

So, if we try to explain this on a risk return graph, weight of asset 1 being 0 and weight of asset 2 being 1. Which implies that; if we put 100 percent of our money in asset 2, my portfolio would be positioned here if I reverse this situation, my portfolio would be positioned here, if I have 50 50 percent in these 2 assets; my portfolio would be lying somewhere here.

So, based on these movement along with the curves based depending on what is the correlation between the assets that we are holding, our portfolio would move along with the curves on these risk return graph. Now, this is too simplistic because the world is not so

simple to have just 2 assets there might be multiple assets where you want to invest and the moment you have multiple assets you have to consider multiple combinations of risk and return.

So, if you try to expand this idea; it should look like as follows. Suppose, we have to show the combination of risk return of different assets depending on the weights.

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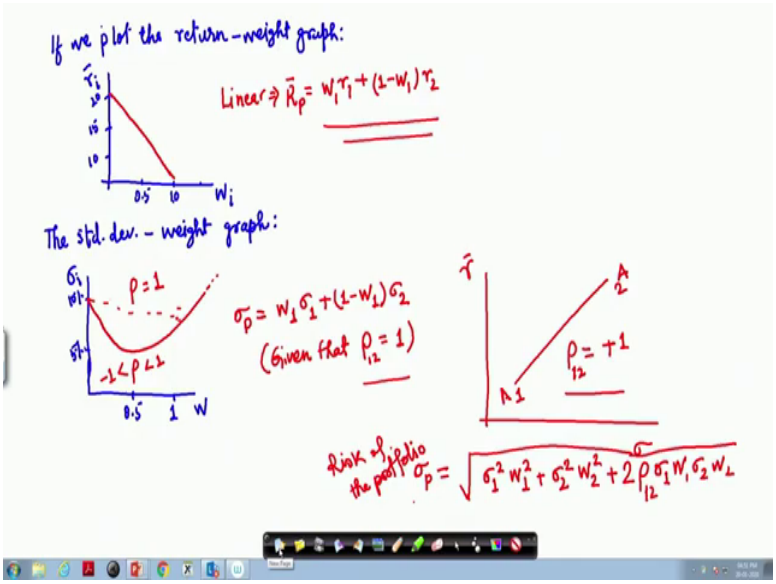

So, if we would like to plot the return weight graph. It should look something like this. So, here you have weight of individual asset and here you have a return on individual asset. So, if we have let us say 10 percent return 15 percent return 20 percent return and so on.

And here we have let us say 50 percent of weight, 100 percent of weight and so on. So, my portfolio the curve would look something like this where the moment we move towards a

particular assets weight I will be moving along the these two lines. Similarly, so we can say that this is linear to the weight that we are holding. So, it implies that the return of portfolio would be weight of asset 1 return of asset 1 and 1 minus weight of asset 1 into return on asset 2.

If I try to find the relationship between the standard deviation which is basically the risk measure and weight graph which is another way to look at the same graph, it should look like, you have the weight here 1, that is 100 percent, 0.5 which is the 50 percent and sigma of individual asset.

So, if we have let us say 5 percent sigma and 10 percent sigma; the curve should look like, first it will come down and then it will start going up because the moment you put all your money in a particular asset; the risk of that asset will be dominant and depending on the correlation coefficient of this these 2 assets basically the curve of the portfolio would be looking like this.

Where the correlation coefficient is 1 and in this case correlation coefficient could be minus 1 to plus 1. So, here the sigma would be sigma of a portfolio which is basically the risk of the portfolio would be weight of asset 1, sigma of asset 1 plus 1 minus weight of asset 1 and sigma of asset 2, but as we change our correlation factor here given that correlation between 1 and 2 asset is 1.

So, if the correlation changes then the shape of this curve will also keep on changing. Suppose, the graph of risk and return with a positive correlation factor which is correlation being plus 1, then the graph would of risk and return would always look like linear where you have asset 1 and asset 2. So, let us say asset this is asset 1 and this is asset 2. So, the graph of the 2 asset portfolio would always look like this where the correlation between 1 and 2 is plus 1.

Now, in this case the return and risk both will be linear because, return we know that is always the function of weighted average rate of return and risk is a function of both weight as well as

sigma along with the correlation coefficient which is given as the sigma of portfolio as explained earlier.

Sigma of asset 1, weight of asset 1, sigma of asset 2, weight of asset 2 and then correlation coefficient of 1 and 2 if it is positive, then sigma of asset 1, weight of asset 1, sigma of asset 2, weight of asset 2. We have already discussed this the effect of these correlation coefficient having an impact on the overall risk of the portfolio.

So, this is basically risk of the portfolio. Now, if you want to expand this argument for a situation where there are multiple asset the scenario would be as following.

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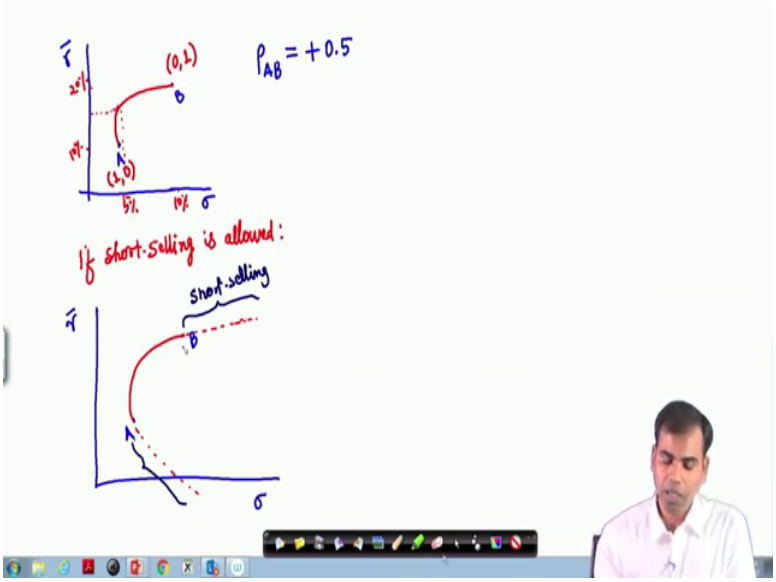

We know that in a situation where there are two assets the curve of the risk return of 2 asset portfolio would be as following; where we have two assets, A and B and these 2 that the correlation coefficient between A and B or any 2 asset is assumed to be moderate which is 0.5.

Given this assumption; we can assume that the curve of the portfolio would look like this where my portfolio would be moving along this line depending on, how much money we have put in which of the asset. So, suppose if we put all our money in asset B, then portfolio would be 0 1 which is basically the 100 percent weight in B and if you put all our money in asset A it will be 1 0.

So, if A has 10 percent of return and 5 percent of risk, then it I will be getting 10 percent of return if I invest in this portfolio here. If B has 20 percent of return, so let us say this is 20 percent and this is 10 percent of return and this is 5 percent of risk and this is 10 percent of risk.

So, if I put all my money in B, the return that I will be getting is 20 percent at this much of risk, but if I want to combine these two assets to the extent of 50 50, then my portfolio would be lying somewhere here, where I can generate a return with lower amount of risk. So, this is how it should be looking like.

Now, assume a situation where you have a provision or an opportunity to short sell. So, short selling if I assume that; if short selling is allowed, so short selling basically is provision in the market, where you can sell something that you do not own; which is basically allowing an investor to take a position where the person can sell a stock or an investment even if he or she does not own that particular stock. And this is done with the hope that if the prices fall tomorrow or in future he or she will buy that asset at a lower price and deliver that asset to the person to whom he sold.

This is a very crude way to explain short selling, but short selling essentially implies that; if you have if you do not have a particular asset and still you want to take up position you can simply sell it at a higher price and buy it at a lower price in future to settle the deal. So, if short

selling is allowed; the curve that we are talking about should look like this where this will be sigma which is basically risk and return and if there are 2 assets and 2 assets are A and B.

And they are correlated moderately, then if short selling is allowed this curve can be expanded further where depending on the short selling of the asset A or B they can move along this line. Now, if this particular reason is basically short selling reason, similarly this also is short selling and this is basically long where you invest your own money.

Now, if we use this argument of short selling of assets that you are holding in your portfolio or that you want to hold in your portfolio what you can do simply is you can consider this short selling provision and then take the argument further to create more portfolios.

Now, assume that I have this portfolio where I have a combination of risk and return in different quantities or different values. So, basically these are the risk and return quantities. Similarly, if I have this much I have a portfolio here it is basically giving me this much of risk with this much of return, if I have a portfolio here, I have this much of risk and this much of return.

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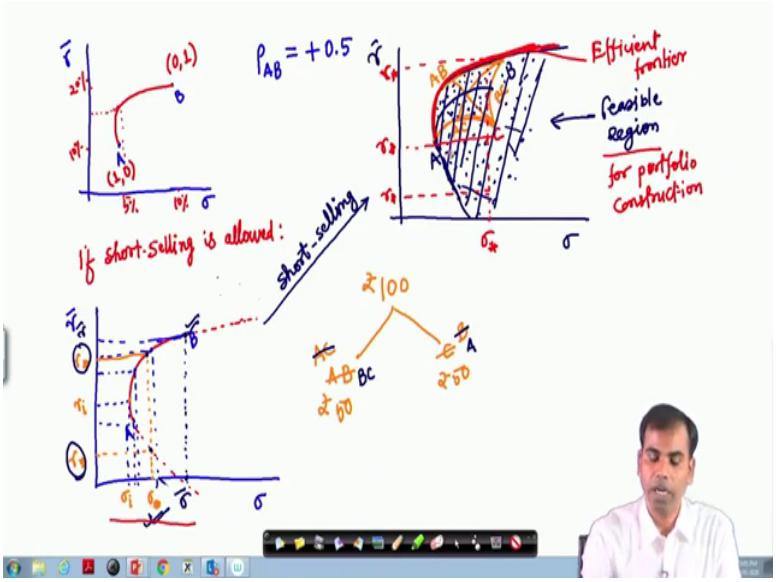

So, can I say that if I have and in I have an investment portfolio here which is giving me a higher rate of return for a lower level of risk. So, this is the risk that I am talking about this particular point of this curve is basically giving me a return at a lower level of risk. So, any individual who would like to hold a portfolio where he or she gets a higher rate of return at a lower rate of risk.

But, if you move along this curve, no one would like to have a portfolio here where for the same level of risk. So, let us say this star, the return that he or she is getting is much lower than or the return that could possibly he or she get in this situation. So, for this risk only a person has a choice to invest here or here where he will get this return or this return. So, no one would like to have a portfolio here where the return is lower for the same amount of risk.

So, it means that, an investor would like to invest anywhere that is giving him the best return for the same level of risk. For example, if I have a return a risk here which is basically let us say sigma hat, I can invest here or here or here anywhere along this line, but my best portfolio

would be here where I will get highest level of return at this point of time; at this point of the curve.

Now, if you try to take this argument more in a more general generalist way or the argument of combining two or more assets together, we can simply take an example where there are more than 2 assets. So, which means if I have 2 asset, I presented the scenario of 2 portfolios, but if I have more than two asset if I can combine it like let us say A B and then I have an asset which is C and I know that these three assets can be correlated to a moderate level with each other.

Which means if I have a portfolio of A B, it will be along this line and if I have a portfolio of A C it will be along this line if and if I have a portfolio of BC it will be along this line. Now, assuming that the correlation between these assets or the pair of assets is moderate the portfolio curve it will look like this. If you want to have an as a portfolio of A and C you will invest somewhere along this line.

So, if I invest 50 50 percent in A and C, my portfolio would be here, if I invest 50 percent in a and b my portfolio would be here and if I invest 50 percent in B and 50 percent in C my portfolio would be here. Now, imagine a case where you have 100 rupees to invest and 100 rupee is invested in portfolio A B to the tune of 50 rupees and portfolio C or rather asset C to the tune of 50 rupees.

Now, in this case where my portfolio is going to lie? So, A B basically is this curve, so I invest somewhere here and my for my assets C investment is here. So, my portfolio should lie along this curve right. Similarly, if I have instead of A B I have A C and here I have B, so my portfolio of a c will be along this line and b will be here. So, my portfolio would be lying along this curve.

If I have a portfolio where instead of A B, I put in 50 rupee in B C and remaining 50 in A, then my portfolio would be somewhere here that is B C and then this A. So, my portfolio

would be lying along this line, because this particular combination is B and C and this is my asset A.

So, if we generalize this argument and assume that you can create as many combinations as possible you can create as many portfolios as possible along this entire region. Which means each of the points within this region is basically a combination of assets available in the market and the assets available in the market essentially in this example is A, B and C.

So, given the fact that you have 3 assets in the market and these 3 assets are moderately correlated with each other. You can create as many portfolios as possible within this region. And if you take this argument of short selling. So, if short selling argument is taken to this example, then I can extend this reason further to find a combination where I can create as many portfolios as possible in the entire region. So, entire region is basically a combination where you can find a portfolio. Now, this particular reason is known as feasible region where you find combination of assets available in the market.

So, if I could say that the entire area this particular area is a possible area where you can create as many portfolios as possible. Now, for a sane investor as I explained in this example; if you want to take this much of risk, you have a choice to invest anywhere along this line right. So, you can invest here where you will get this return, you can invest here where you will get this much of return and you can also invest here where you are going to get this much of return.

Now, for a sane investor; it is always preferable for investing in the point where he is getting the highest level of return for the same amount of risk. So, we can say that even though this particular entire reason is a possible feasible reason for investment or for portfolio construction for an investor to choose for portfolio construction, it is always preferable to find combination of assets that are lying at the external boundary or upper boundary of this entire region.

So, this boundary or this upper boundary is known as efficient frontier. Basically, what it means is these the points along with this curve are the points or the combination of all the

assets available in the market where you can invest your money and get the highest level of return for a given level of risk. So, if I can simplify this, I can say that this is the upper boundary of the entire combinations of A B and C which are the available assets in the market. This can be used as the reference point or a or a set of points where you can put your money and decide, how much is the weight for asset A, B and C or any combination thereof.

Now if I take this argument further, I can say that this is the entire set of points efficient frontier. Now, if I know that I can bear only this much of risk, this is my risk that I can bear.

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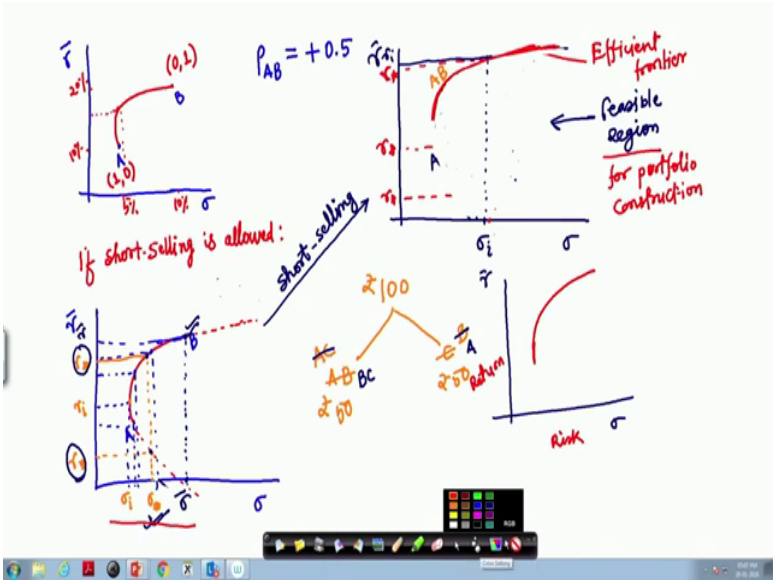

I know that for me the best combination of assets available in the market is this point where I am going to get the best return. So, this is my point at which I am going to get the best return. So, in that sense again the lower boundary of this particular feasible external boundary of feasible region is of no use rather just the upper boundary is useful.

So, if I simplify this graph further, I can say that if given that 2 dimensional graph of risk and return and there are multiple assets available in the market; the efficient frontier that an investor has is basically going to look like this where you have a combination of assets along this line with the best possible risk return combination. So, this is going to be your risk and this is going to be your return.

Now, just to add one more point, I would show how adding one more asset in the scenario would make the decision making even more efficient.

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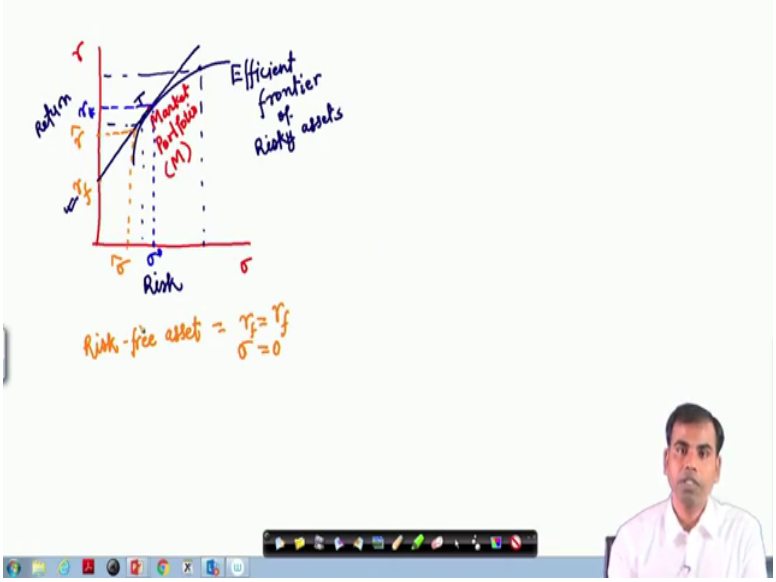

So, assuming that you have a situation where you have a combination of risk and return. So, this is your risk and this is your return and we just showed that the efficient frontier is going to be like this.

So, we know this is going to be the efficient frontier of combination of assets given their risk return characteristic, this is our risk dimension, this is our return dimension. So, if we believe that there is a risk free asset; risk free asset. For example, an asset that gives you some amount of return with 0 risk. So, there will be some return and risk will be 0 which means it should be lying along this line. So, if this is assumed to be the risk free rate.

So, basically the risk free rate is going to be r f. So, this is your risk free rate where you have no risk at all with some amount of return and if you want to combine a portfolio of risky asset. So, efficient frontier of risky asset, because all the assets and their combination on this frontier is carrying some amount of risk right. If you have here your portfolio here you have some risk and some return, if we have your portfolio here you have some risk and some return.

So, if this the efficient frontier of risky assets and this is your risk free asset and if you want to combine your portfolio with a risky asset and risk free asset, the portfolio is going to be like this where it will intersect or it will be tangent with the risky portfolio and the risky risk free portfolio.

So, for an individual let us say deciding or wanting to create a portfolio where he or she can put some amount of money in risky assets and some amount of money in risk free asset. Because, you do not want to put all your money on in risky assets, then this is the portfolio curve that he or she should be following. Which means; that your portfolio should lie along this line where you have some exposure to risk free asset and some exposure to risky asset in the market.

This tangent portfolio basically represent the market portfolio also which is basically representing the best combination of asset and this market portfolio basically indicates the best combination of assets that are available in the market for a given level of risk and return. So, if we can conclude this session by saying that given the fact that individual would want to increase or maximize the return and minimize the risk together it is in best interest or it is most likely that he or she would try to maximize the return for a given level of risk or minimize the risk for a given level of return.

On a graph it looks like this. So, if I have I am an investor who has this much of risk bearing capacity. So, let us say sigma star, I know that or I can tell that how much return I am going to get given that these factors are available or if I know that an individual investor or an investor who has a desire to earn this much of return r hat and this return is basically earned through investment in risky and risk free asset. Then I can tell that this is the risk that he or she should be ready to bear.

So, this is the advantage of having a portfolio of construction using assets available for investment in the market and combining the assets of risky in nature with a risk free asset given as r f. And then we try to find a combination of assets that are best suitable for the investment objective and risk bearing capacity of the individual for which we are making the decision. I stop it here.

Thank you very much.