Project Management
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Module No # 2
Lecture No # 10
Project Risk Management Analysis II

Welcome back hope everybody who is taking this course is fine and I am sure the course is a content considering in contents the way it is being taught people are really understanding basic concepts of project management and as I have I have been already informing over the series of lectures for any queries please let the TA's and the instructor which is me know through your forum. So that we will be able to take care of all the queries we are able to answer based on what the candidates or the participants we have the course have as the course progresses.

So this is the tenth lecture for the course in project management and as we were discussing the capital asset pricing model and I told you in last slide for the ninth lecture before we just wrapped up the ninth lecture that how the capital asset pricing model is related to the simple linear equation Y = MX + C and how it can be derived very simple.

So it is basically a very simple concept of linear regression model where the assumption which are there for linear regression would be in somewhat in in different way but the general concept even the same would be extended for the CAPM model. So if we consider the few results important results for the CAPM model as applicable for investment or as applicable for a portfolio considering different sets of projects.

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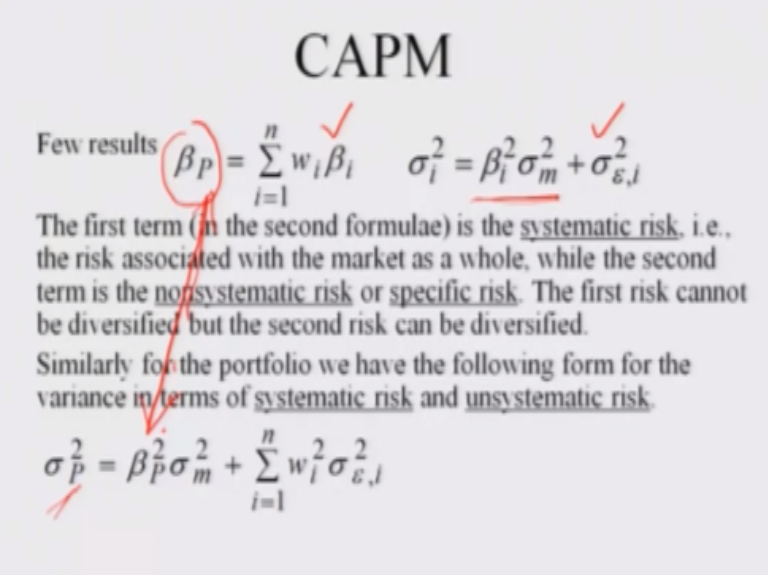

So you will see the overall beta now beta if you remember we have first encountered the concept of beta for a project or for any investment considering this is the type of risk. So beta for the risk overall portfolio would be the sum of the multiplication of two terms the first term is basically where the pencil is hovering is basically the weights or the total amount of investment which you are doing for project one, project two or project three and so henceforth.

For considering there are n number of projects and the value of beta I are the corresponding risks for the projects which are dependent on the so called market or some theoretical concept of the market which is there. So that is given by a simple expected value sum and if I consider the the concept of the overall risk of the portfolio or the project it is given by the for each and every item means each and every asset or each and every projects which you have in their portfolio consists of the two terms.

The first terms is basically the risk which is dependent on the market multiplied with this this sigma square M is the overall risk of the variance of the market multiplied by the square if the risk corresponding to each and every asset plus the overall risk of the white noise. So obviously for any project there would be variations. So the variations would be basically coming from the external sources.

So it is basically consists of two parts as just mentioned the first term which is in the second formula is the systematic risk that is the risk associated with the market or the overall portfolio or overall set of projects which is there while the second term is the non-systematic tress which basically is coming from the market like if I am planning to build a bridge or a huge stadium or consider I am trying to build oil rig platform in certain country or in a certain area of the sea and considering the political uncertainty is very high in that region.

So obviously it will have a negative impact so the overall risk which is the non-systematic risk would be very high is or it basically non-systematic and it is or mentioned in the specific reason the first risk cannot be diverse diversified but the second is can be diversified and made as low as possible depending on how you invest. Similarly for the portfolio if we consider the there are two types of risk again for the portfolio extending from this first so called first formula and the second formula you have the overall risk of the portfolio.

Which is now the multiplication portfolio means the conglomeration of assets are the projects which you are made. So that is the multiplication of two terms again the market risk multiplies by the square of the beta or the power of the portfolio. So this can be obtained from here so this is the formula which is given and plus the overall the risk for the white noise or the insist non-systematic risk for each and every so called asset of the project multiplied by the square of the total quantum of investment which you trying to make or that particular project.

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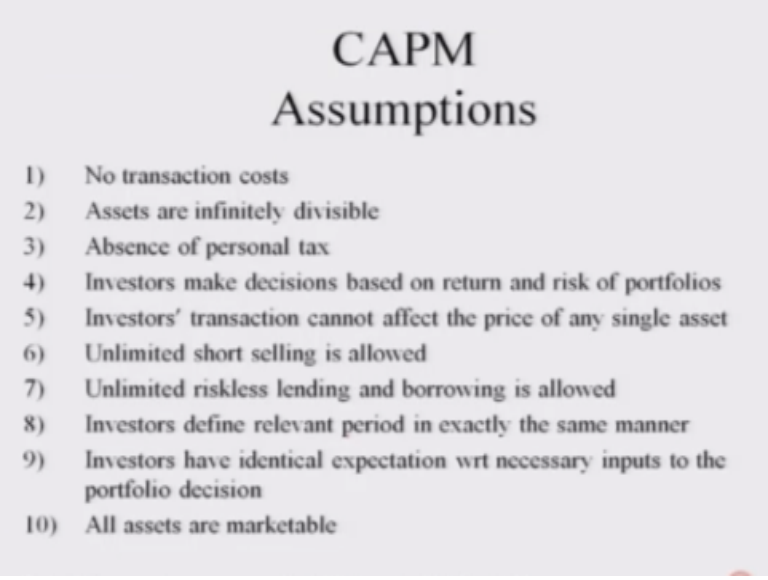

Now what are the assumptions of the CAPM so I will just go one by one they are they will consider there is not transaction cost that means when investing the transaction cost for buying and selling is zero which is may not be true in real practice assets of the projects are indifferent infinitely divisible which also is a very theoretical norm but in generally serves our purpose for trying to utilize very simplistic formula for real life problems.

This absence of personal tax or some sort of tax is not the investors make decision based on the return on the risk concept of the investment only. This unlimited short selling is allowed short selling is the concept which we see in finance where you basically borrow projects or borrow financial instruments let me be very specific for the finance concept it is basically.

Borrowing a financial assets which you do not have and with the intention that once the time frame based on which you have basically borrowed the financial asset it would be back to the original owner along with the terms and condition of see for example dividend or the price increase but this decrease whatever it is there will be paid back to the original owner. There is unlimited risk this lending and borrowing is allowed which means that you can borrow from the market which is the bank interest rate.

If you remember I have discussed our RF R suffix F this is lending and borrowing is allowed that means you can go to the bank borrow and you can also go to the bank and lend that means put

you money in the bank. Investors are the people who are there in the projects define relevant period in exactly the same sense. So this say for example it is for one time period it will be considered the same for each and every people who are there in the investment process for the project.

Investors are identical expectation with respects to the inputs to the portfolio or for the project decision. So now this identical expectation means the overall concept of utility now this is the first time and using the concept of utility that concept to the utility would be the same for each and every individual. So the overall utility functional form would be same but the parameters may be different for the utility function. And all the assets or all the projects are marketable such that you can buy and sell depending on or by any means invest and come out on the project depending on how the market is doing.

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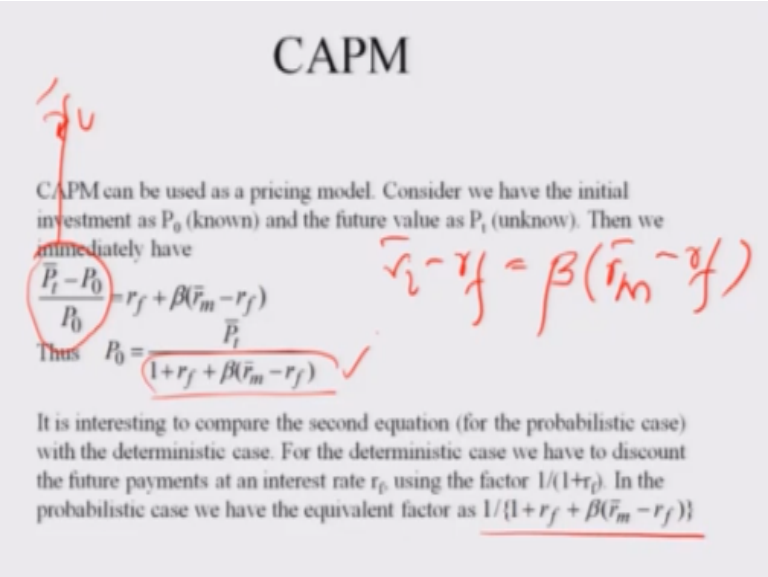

So the CAPM can be used as a pricing model for trying to find out whether you are making the right decision to find out from the investment process consider you have the initial investment value as P0 which is known and obviously the future value PT is unknown to you. So you have to basically find out then we immediately know that the first term which is there in the left hand side this is one.

It basically this P bar suffix T is basically is the actual expected value of the portfolio or the project or the investment at a certain time T you have started your investment process. While P0 as discussed is the initial investment which is known so this value which you have this ratio is is the rate of return of your investment in that project that is equal to.

So this is basically RI bar say for example is equal to RF which is risk free interest rate plus the beta factor for the investment multiplied by the difference of the market and the that is free interest not if you bring RF on to the left hand side. So this is the exactly the model which you have already considering the deterministic sense. So thus P0 is given by P bar T and the terms which it comes in the in the in the denominator basically it it gives you some concept of discounted rate of return.

So it is interesting count compared the second equation for the probabilistic phase with the deterministic one for the deterministic case we have to discount the future payment at an interest rate RF using the factor which is 1 + 1 by RF depending on the factor of the discounting which you have. So in the probabilistic sense we have the equivalent factor given by this which I have already discussed is there in the denominator.

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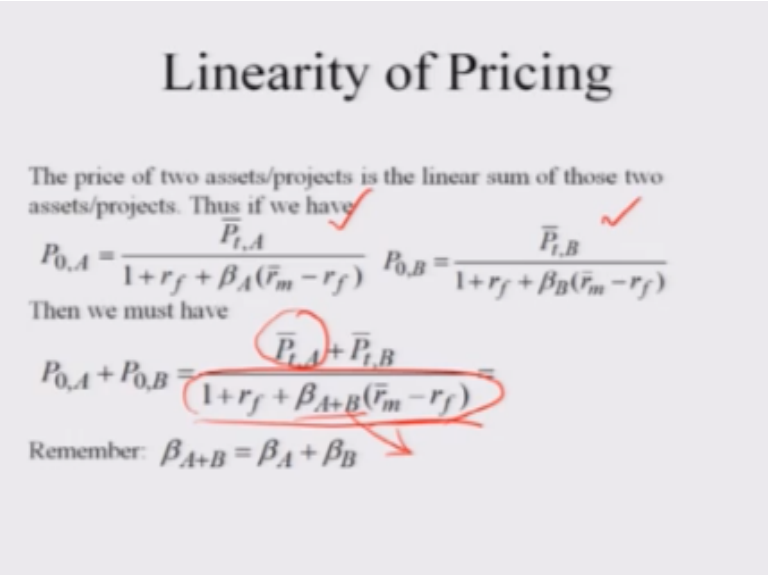

So the price of two assets of projects is basically a linear sum of these two assets of the projects or the prices which you have. So say for example which you have price as of now of project A or

asset A or investment as A and that for asset B for investment B with the suffix B then we will see the prices of the first one and second one will be based on the exact formula which you have does just derived.

Now what is the interesting to know that the linearity of price addition holds such that if you have P0 suffix A. P0 means the price of project A at time T = 0 plus if you have basically P0 suffix B which is the price of project B at time T = 0 and such prices are given. Then trying to find out the overall return or the price of those conglomeration of projects which you have at time T = 0 is very simple.

So what you do is this add them now if you want to find out the return would that would be based due the fact that these values prices you basically find out from the historical data some expected value and this RM – RF is already fixed for each and every investment which you have. So only thing which you need to do with and which is very simple to find out is basically the overall beta which you have.

So the beta is basically some of the betas for project A, project B, project C whatever you have. So again if I consider this is the discounted risk factor for the overall portfolio now portfolio is basically different type of small project which you have individually can be found out accordingly. Where if it is the individual sense in that case you will basically have I mentioned only the first price for say for example for project A.

And the denominator which you have which is the discounted so called interest rate there in that case beta would be specific to the project and RM – RF and RF remains as it is for the different type of investments because that does not change market again is basically the overall conglomeration of all the projects which you have.

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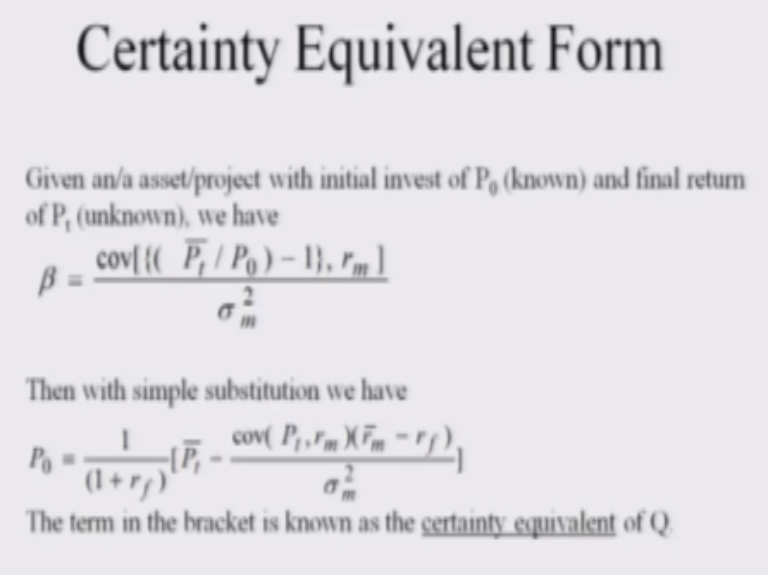

Given an asset project when initial investment P0 the final return would be given considering PT is unknown where the beta you can find out. So if you look at the denominator and the numerator in this equation the denominator is basically the market risk considering the standard deviation for the variance is used standard deviation is the square root of that. And if you consider the numerator which is very simply the covariance which exists between the rate of return for the project A or B or whatever it is with respect to the market.

So what I am trying to find out or what is actually needed beta is basically the ratio of the covariance of that particular project with respect to the market divided by the overall risk of the market because if I try to find out the overall concept of the covariance of the covariance of the market to itself then obviously you know that the covariance to the market itself would technically be the variance because the correlation coefficient is basically one for any random variable with respect to itself.

Then with the simple substitution we have value of P0 which is basically the price as I want to find it out is given by the difference of PT which is the value of the project price is expected value later on at some time T0. T or TE or T1, T2, T3 and he again if you look at very carefully at the numerator and the denominator.

The denominator remains as the market risk while the numerator is now basically the covariance which exist between the difference of the market and RF this second term and the market risk and the price values market risk means I am trying to basically find use the risk the sorry the return of the market and the price corresponding to the project which is there based on that I try to find out the covariance.

So if I have a very qualitative feel of this formula it basically mean that I am trying to find out what is the so called ratio between or particular investment or a project to the market divided by the overall risk of the market. The term in the market the term in the bracket is known as the certainty equivalent which is value of Q and based on that a person can find out whether or certain project is going to give you positive return or negative returns.

Because if considered if P bar T is positive or negative that would basically have a positive and negative impact on the overall term which is there inside the square bracket.

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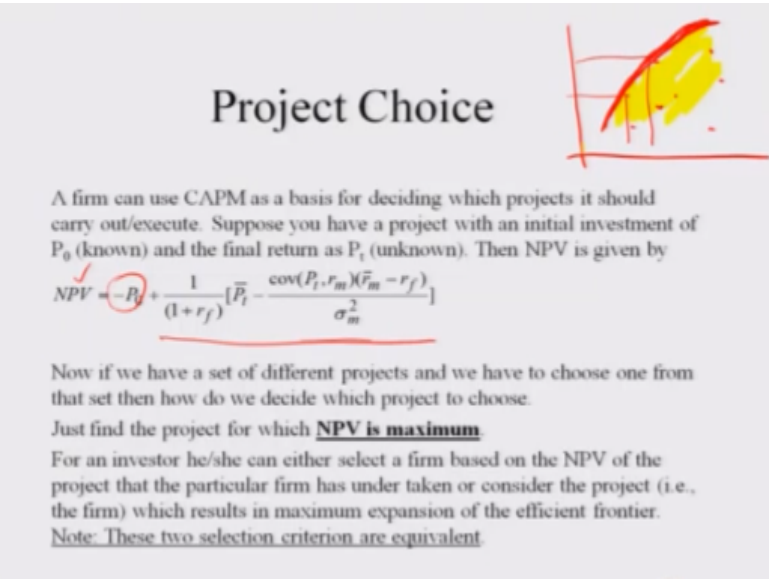

A form can use CAPM model as the basis for deciding which projects it should carry or execute or invest. Suppose if you have the project with an initial investment of P0 which as I mentioned in in the last two slides is known beforehand because you are trying to invest and suppose the final price PT at whatever time period it is unknown. Then the net present value is basically

considered the expected value of the overall project as of now is given by the difference or two terms.

This P0 is minus because it is the overall outflow of money from my pocket considering I am investing and the second term which you have is basically the value of the project depending on the price which expect at time T = T. So this value if it is positive and more the value of P0. P0 now it is negative because that is outflow of my pocket if the net formation value is positive which means that will definitely invest in that project.

Now the second question it would be that i if am different type of projects how should I basically base my overall decision is very simple you ways you tank them from the highest to the lowest where the top most value is the net present value is maximum positive sense and the lowest value would be the net present value maximum in the negative sense rank them and choose the one which gives you a maximum benefit.

Now if there are two different projects with the same net present value then what you do then you basically try to find out the variance you have to find out considering at point of to take the decision and if the variance is high or low you take a decision accordingly. So higher variance means there is more uncertainty lower the variance means there are less uncertainty and will take your decision accordingly.

Now if you have to set it two different projects we have to choose as I just mentioned one from that set there and then decide such that the net present value is maximum for an investment either he or she can either select a form based on the net present value that the particular firm has taken or consider the project which results in maximum expansion of efficient frontier.

Efficient frontier is basically the set of all those projects or all those investments which gives you the maximum risk return framework. So if I go back to the one of the graphs which was considered where different type of assets or investments were there so the efficient frontier or the frontier would be some sort of graph like this on the risk return framework where the boundary

basically give you the set of all the investments which are considering the risk and the return framework are of the best so called combinations.

So any set of just let me any set of assets or projects which are in this yellow region would basically need that considering the overall risk and return framework they are not the best but anyone which is on redline is basically the best. So these two selection criteria's which have just mentioned about trying to maximize the net present value and trying to expand trying to find out the maximum efficient frontier would give you the same result.

Now if you remember in the last class I did mention that we will start now doing the problem. So what I will do is that first I will discuss age very simple AHP problem just give you the solutions technique without going to the details the I will do a decision tree problem and the come to the concept of the decision theory problem and the utility theory and later on I will come into the concept of using the different type of financial concepts the IRR rate of return then what is the average rate of return and all this things in order to take a decision for a project.

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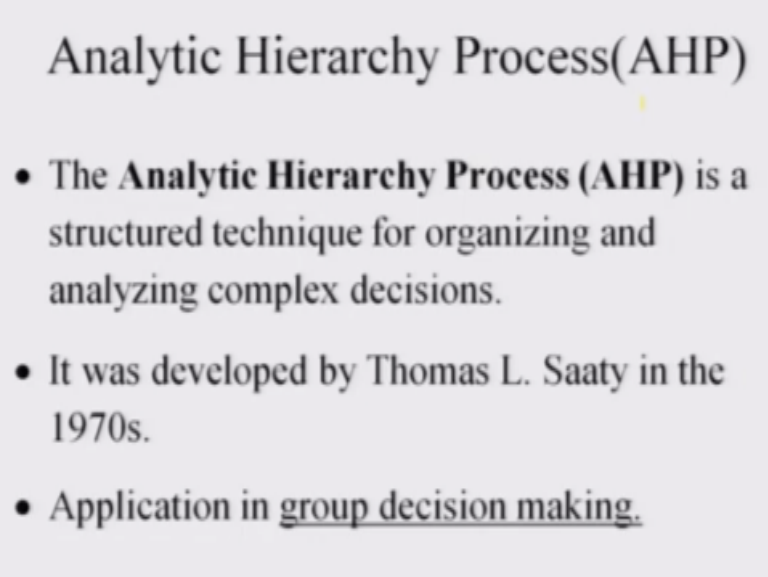

So as mentioned if you remember and if you remember and if you do recollect the name the Satty was the Thomas and L Satty he as the person who be who proposed the concept of of analytical hierarchy process which is a part and parcel of analytical network process we would not discuss in details is ANP but we will try to discuss AHP with this simple example.

Application is done in group decision making process where there are groups are want to basically make a decision for a project. Project as I mentioned need not be only building a dam need not be only building a car, need not be only building say for example hospital it can be different type of concepts it can be like.

I am try to hire the different people and that I consider that a project and this ten different people who are to be employed by my company should have different skill sets that considering some set of people would be there under productions shop floor for some set of people would be there in design shop floor somebody would be there in the marketing.

So I would have different criteria's based on which I will take it try to make a decision so that can be also considered our projects. So I would not go into those details example but I will very simple considered this AHP where the group decision present making process is being considered as a very qualitative way such that it gives you in a nutshell the conglomeration of all the decision process of different human beings may have.

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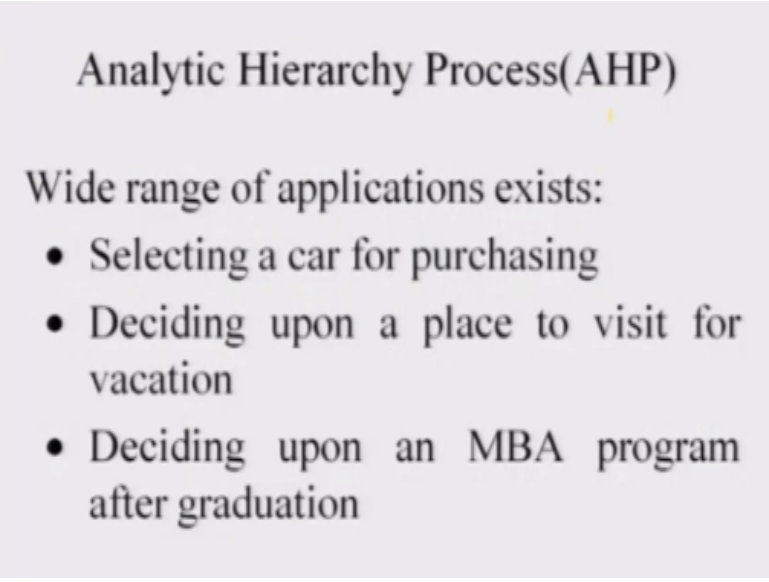

So it as wide range applications exist like say and I say for example selecting a car for purchasing deciding upon a place to visit for vacation desiring upon the MBA program all this can be decisions projects whatever it needs to be considered.

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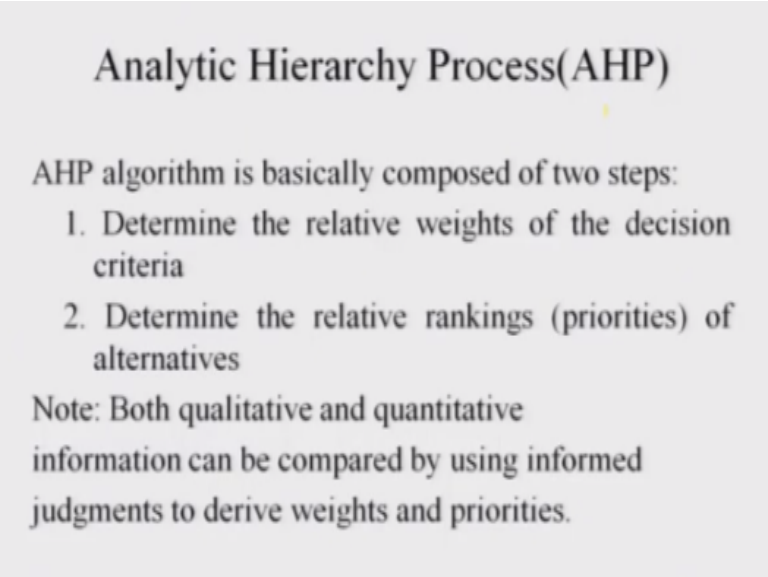

So AHP algorithm is basically composed of two steps the first step is determine the relative weights of the decision criteria based on which you make a decision and determining the relative ranking of priorities all the alternatives such that the decision set of criteria which are there affect your total priorities or the alternatives based on which you are trying to make a final decision.

Consider this this is the example which will consider you are okay let me let me give you two examples. So that I am sure we will give the participants are much better flavor consider there is student one and his name is RAM and consider RAM has been selected in one of the MBA programs in in somewhere in India that is good in the MBA program and his brother is also there sham he has also applied for MBA program.

So consider in the first sense the result comes out for RAM he has to choose one of the MBA program and his choice decision set is different he is very theoretical oriented he wants to be a teacher he does not want to go into a corporate field such that he will he will now rank that MBA institute based on how rigorous the academic schedule or that academic curriculum is how good are the professors how say for example he does not want to travel much.

So he will try to find out how far is it from his home considered he stays in Mysore I just let us consider it very simplistically while sham as I mentioned had applied but he has not got the call so RAM would basically make his decision based on his criteria and he will rank different MBA institute and take a decision accordingly. Now consider after two or three weeks Sham gets the call and now he gets the call from the same type of institutes where RAM has applied.

But sham overall criteria or overall basis based on which he will make a decision for selecting the name of the college is totally different he want to go into the corporate for him placement is a factor for him city is the factor because that should be one of the that should not be there in one of the best metropolitan city such that the placement concept is taking care to the best possible extent.

So if you consider RAM and Sham overall outlook for making a selecting and alternative is that which college they should go the criteria is different. So obviously they put different weights for them now if you if you try to understand the problem from the point of view RAM and Sham parents they have limited budget or say for example they want to give the best benefit to both of them on the equal scale.

That means they definitely want to take care of both the sons aspiration but obviously on the front that they should not be too much too far of the from the home or the cost factor is important for for the parents. So they can be different factors so when you try to consider this type of example this is a very simple the concept of group decision making comes into the picture. Now this example I would not highlight using the problem.

So the next best example which I am going to discuss is the problem which will discuss considered a family wants to buy a car and there are different model of cars. The cars have different type of specification cost is a factor or example say for example color is a factor, fuel efficiency is a factor. What type of loans you get is the factor? Or what is the overall safety features of the car is a factor or say for example what is the luxury feature of the car that is the factor.

So based on different type of things we will consider this simple example so note both quantitative and qualitative information can be compared by using inform judgment to derive the weights and make that is accordingly.

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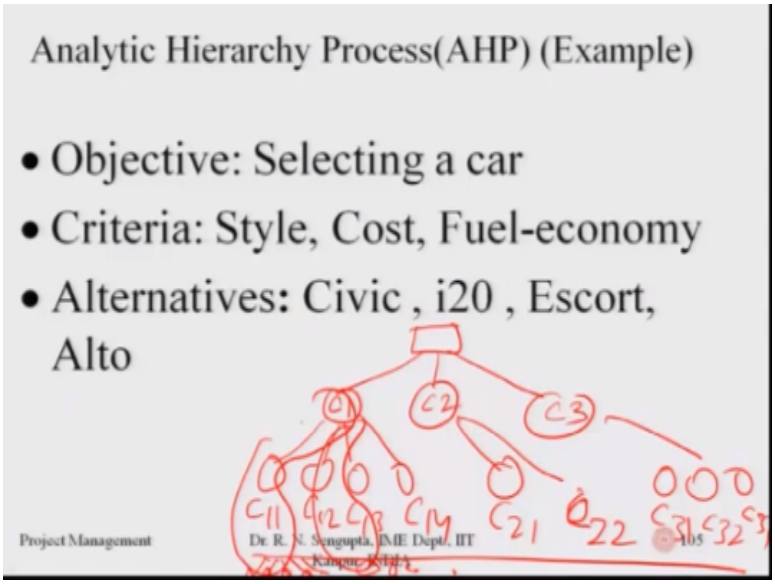

So now the second problem which I just mentioned objective is to select a car the criteria's are style cost fuel efficiency. Now if you consider that three points style or the criteria of the style cost will economy they are one hierarchy. So your actual decision is to buy the car what type of car you will buy up there basically depend on the three characteristics which is style cost fuel efficiency economy.

Now if you think that the first level of hierarchy which are the criteria can be broken on into in secondary and tertiary one then the problem would have like style would be can be broken up into how crash worthiness the car is or how good looking the car is. So there would be two sub categories under style. Cost can be what is the overall cost of the car? What is the resale value of the car? If the car is very good in the market the second hand market for that car is very good.

Obviously the resale value would be very high consider what is the fuel economy of the car in that case it may be possible that one car is diesel another car is petrol or it may be possible that that one of the car the overall service factor or the service cost to maintain the car is very high.

So they can be different type of hierarchies and then altering this simply are the CIVIC, I20, Escort, Alto they can be other car also.

So what I mean the criteria and sub criteria is like this your main decision is to buy the car and the first level of hierarchy other criteria. So I will just put the criteria is C1 so style is C1 the next one cost is C2 and the third one is C3 which is fuel economy. So one I mentioned about fuel economy or the cost or the depreciation value or the resale value it actually means that it may be possible C1 has different subcategories as C11, C12, C13, C14 similarly C2 can have different sub category C21, C22 C3 considered it has only 3 which is 3C31, C32 and C33.

So if you can go into secondary tertiary and so on and hence so forth now at the end considering this is the end level of your hierarchy there all the alternatives would come. So say for example in this there would be A1, A2, A3, A4 at the last stage which is civic, I20, Escort, Alto and this conglomeration of such alternatives would be there under the ending of each any group.

So what you want to do is that or what you want to find out is that collectively combine each stream one at a time such that we are able to find out the overall cost and what is the best decision based on which the car can be bought. So with this I will end the tenth lecture and continue with the example of AHP such that the students who are taking this course can understand how he is it can be utilized in any decision making or a project framework problem thank you.