Financial Management for Managers
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Lecture 44
Risk Analysis in Capital Budgeting - Part V

Welcome all, so now after having talked about the 3 basic techniques of the Risk Analysis in Capital Budgeting I will take you to the next 3 techniques. They are looking complex but not that much complex that we cannot understand. They are very interesting tools where the mathematical models have been say doubt to go for the risk analysis in the capital budgeting. So one important technique is called as a Hillers model.

And in this Hillers model very simple concept though it looks very complex here but very simple concept has been applied by Professor called as FS Hiller, so if you see what professor Hiller has tried to do, do dwell place model he has done one thing is that he has say that there are the projects where the say cash flows are either correlated or they are uncorrelated. Especially the cash inflows. So because they are more important for say calculating the NPV of the project.

Whatever the outflow is going to be there that is the largely in one go, it may be in the subsequent ends also but largely it is in the beginning. So that outflow is fine but inflow is coming over the number of years depending upon the life of the project, so he says for explaining this model he says that you have to divide the projects into 2 categories or it belongs to either of the 2 categories. The project which is in question for the valuation by us.

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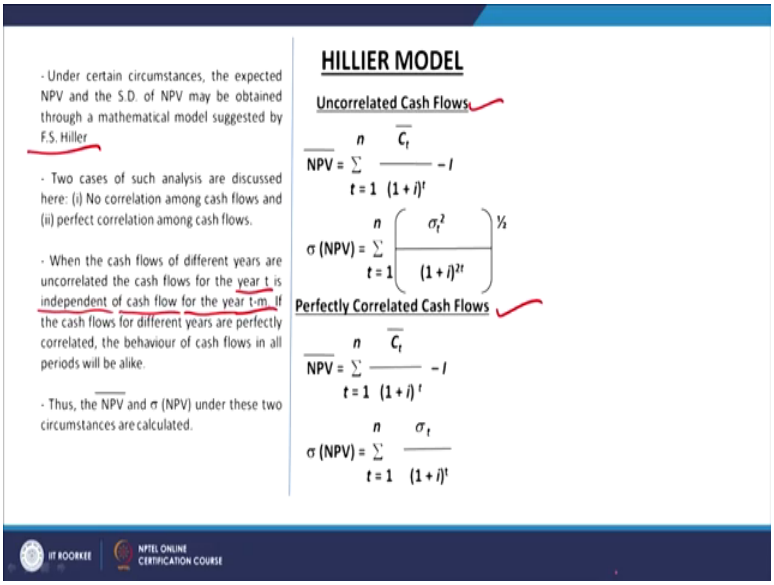

The project may either fall into the first category where the cash flows are uncorrelated or second category where the cash flows are perfectly correlated. So when we talking about the uncorrelated or we are talking about the perfectly correlated means what does it mean? That normally we see that we have seen 2 kind of the cash flows by re-valuating the capital investments proposals.

One was that we were keeping the cash inflows like cash outflow as it was say only in the 0 period or in the current period we were considering, cash inflow we were considering as a constant cash inflows that for example 200 million are going to be there in the first to last 10 years or maybe in the previous case also there we discuss the financial breakeven point, we also considered that the cash inflows will be constant or they will be correlated.

You can see they are going be constant means correlated, so we can easily find out that what is the cash flow in the first year? Same amount of the cash flow is going to be the 2nd year, 3rd year, 4th year or even the change in the cash flow is going to be there even then that is a predictable change that yes, we will be increasing our sales by 10 percent which is in our hands, does not depend on the market, that is in our hand so we will be selling for 200 millions in the 1st year next year will be selling for 220 millions then will be increasing the sales at the rate of the 10 percent.

May be of the base value or may be of the say the previous year, so if it is possible to correlate the cash flows then it is one category of the project but sometimes the project may fall into the category where the project, where the cash flows especially the inflows are uncorrelated. So if the cash inflows are uncorrelated it means the element of risk is high. The projects where the cash flow is correlated or they perfectly correlated then you can say that the element of risk in the project is quite less.

But those cash flows where the say which are uncorrelated, correlated cash flows the element of the risk is quite high, so he has applied the concept of the standard deviation of the say cash flows, so he says that we should calculate the expected NPV from the project and then we should calculate the expected standard deviation of the cash flows from the project. So it means you can say NPV will be calculate what we do.

We simply sum up the cash inflows and then discounted we are talking about, discounted cash inflows we sum them up and from that figure of the discounted summed up figure of the cash inflows we subtract the cash outflows so we are left with NPV, so in a way you call it as that is called as the say expected NPV is basically the mean of the cash flows expected over the life of the project.

And standard deviation you can call it as another name of the standard is variance, so he has applied the concept of mean variance analysis on the risk analysis of the capital budgeting projects and he has proposed that we should try to find out that if the cash flows are correlated, perfectly correlated then what is expected NPV from the project and what is the expected standard deviation of the cash flows of the project and they are if they are uncorrelated then both the things should be calculated.

So what happens that is the higher the amount of NPV, expected NPV and lower the amount of say standard deviation of the cash flows then what is the situation? Project is least risky as compared to the situation when the say expected NPV of the project is lower and the expected standard deviation is very high right, because standard deviation is basically called as the synonymous to risk.

Then in the financial terms we go to measure the risk in the market whether you call it as the mean variance theory of the say portfolio theory which is basically given to us by the Harry

Markowitz so that theory which is called as a portfolio theory which is a basically the base of the CAPM Capital Asset Pricing Model which we use for calculating the cost of capital which we use for the calculation of the cost of the capital in the next topic we will discuss the CAPM say Capital Asset Pricing Model for discussing or calculating the cost of capital.

So that is the base of the CAPM is the mean variance theory or you call it as a portfolio theory given to us by the Harry Markowitz, William Sharpe has given us the CAPM and Harry Markowitz have given us the portfolio theory both are awarded the Nobel prize for their contribution into the financial economics. So here the Hiller model also says or FS Hiller also says that while applying this concept means in this case when applying this concept of the say risk analysis in the capital budgeting we should try to first of all try to find out which category the project belong or falls into.

Whether it falls into the category where the cash flows are uncorrelated or it falls into the category where the cash flows are perfectly correlated. If it falls into the category of the cash flows uncorrelated then be careful right because element of risk will be very high because when you calculate the standard deviation of the cash flows in the different years you will certainly find the standard deviation will be very high.

So one point of question but if the cash flows are perfectly correlated. So means the next years cash flows is correlated to the previous year's cash flow so you can predict the changes in the cash flow and we can understand certainly there the level of sigma standard deviation will be quite low and if the level of standard deviation is quite low it means the level of risk I too low or quite low.

So what is written here, just read the important points for your means understanding, first see, under certain circumstances the expected NPV and standard deviation of NPV may be obtained through a mathematical model suggested by FS Hiller, so FS Hiller has suggested this model and what he has said, 2 cases of such analysis are discussed here, no correlation among the cash flows and the perfect correlation among the cash flows.

No correlation among the cash flows and perfect correlation among the cash flows. Next thing what he says, when the cash flows of the different years are uncorrelated the cash flows for the years T is independent of the cash flow of the year T minus m, this is a very important line.

When the cash flows of different years are uncorrelated the cash flows for the year T, for the cash flows for the year T is independent or are independent of the cash flow for the year T minus m.

If the cash flow for the different years are perfectly correlated the behavior of the cash flows in all periods will be alike. So you can understand either we have the constant cash inflows or even they are changing, they are changing in a predictable manner in predictable fashion.

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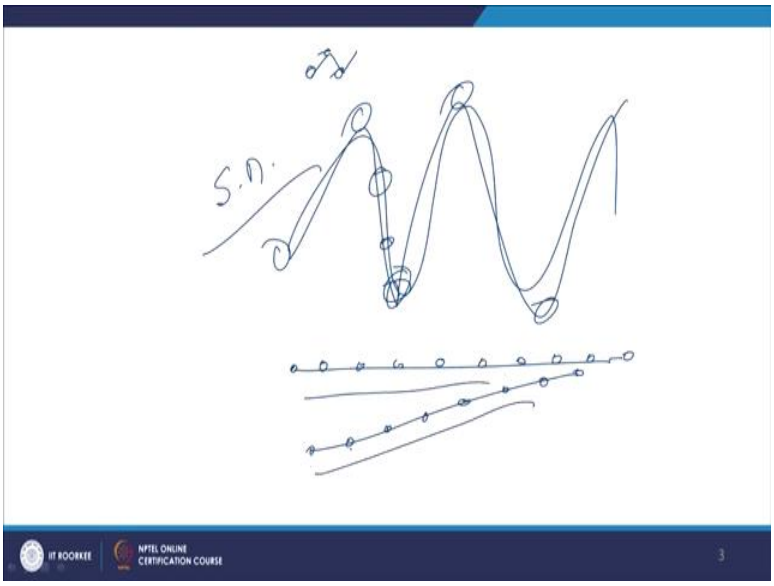

For example, you I can draw the two trends like this, the one cash flow is moving like this. So you have this level then you have this level, then you have this level, you have this level so it means you can understand that what is the level of the standard deviation, this is very high level of standard deviation you cannot predict whether we will have next year we have this level, so we will have this level of the cash flow, we will have the this level of cash flow or it will fall down to this level of cash flow.

Whereas in case of the correlated cash flows either you can have a straight line, if they are going to be the constant or even they are rising also, they are rising in this fashion. They are not creating a situation that or even if there is a rise and fall also you can say it may go like this, it may go like this. So it is something like this. So it means if it is we say that initially it was there, initial this place it may come down to this level, so they are correlated to some extent.

But more level of correlation will be exhibited by this when it is the constant cash flow or it is growing up in a predictable fashion, it is considered as a perfectly correlated because this year cash flow is impacting this years, so this year cash flow depends largely or is correlated to this year. Similarly you talk about this year, so it means you can easily find out what is going to happen with regard to the cash flows.

And in this case it is very easy to find out the cash flows that how they are whether they are correlated or not correlated or what is going to happen. In this case the standard deviation if you calculate of this particular trail it will be very high but in this case if you calculate the standard deviation means in this case it will be quite low, in this case it will not be there at all because the cash flows are constant, they are moving in the same fashion or is in the same design.

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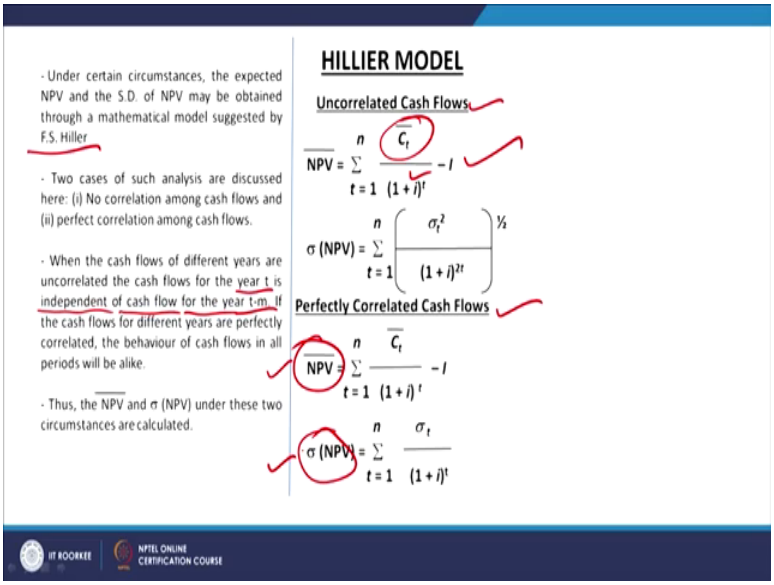

So further he says, if the cash flows for the different years are perfectly correlated the behavior of the cash flows in all periods will be alike. You can understand, you can predict in advance it is where you can predict the cash inflow the element of risk is very high because level of standard deviation in the cash flows is very high, sorry is very low, the level of risk is very low sorry the level of risk will be very low not very high.

Because you can easily predict that how much is going to be the cash inflow in the next year or in the next 2 year, 3 years, 4 years, 5 years or 7 years or 10 years. Because they are perfectly correlated. So level of risk will be very low because level of sigma or standard deviation of the

cash flows is quite low but where the trend is something like this. So it means standard deviation is very high and higher the amount of standard deviation in the cash flows brings the higher amount of risk.

So this is a simple concept of mean variance analysis has been applied by FS Hiller and finally he says, thus the NPV, expected NPV and the standard deviation under these two circumstances are calculated. So it means what we are doing here, this particular model is helping us to calculate the expected NPV where it is n is the number of years summation of the cash flows T CT is the expected cash flow and this is the you can call it as I, yes this is a point of difference here.

I is basically what? Is basically the risk free rate of return, I is not the cost of capital it is called as r fr, it is the risk free rate of return, so it means we discount it with the risk free rate of return, minimum you call it as. What is the minimum rate of return available from the risk free means no risk involved in that, that much of the return is always available? For example you have 2 options, if you have your surplus savings available, if you give your savings to the bank or you deposit them in the bank.

It means the rate of interest being offered to you is the risk free rate of interest or the risk free rate of return because bank is certainly going to return you that much of rate of interest or that much rate of return, so it means your total risk averse you do not want to take any kind of risk though you are satisfied with the say given return or rate of return by the bank, so that is called as the risk free rate of return.

But the investor if he is not satisfied with the, satisfied by the returns given by the bank, so he has a number of options, he can invest as savings into the real estate, he can buy the stocks or he can go to the stock market and invest them to the shares of different companies, so the moment he goes to the real estate market or the moment he goes to the stock market he is considered as the risk pro, risk neutral and he is ready to take the higher amount of the risk for the want of higher amount of returns.

So how much returns you want accordingly the level of risk will be there, so in this case we are saying that the minimum return which is a risk free rate of return which is taken here as I, it is not cost of capital normally we use a cost of capital as the say discount rate but in this case we

are saying that, that level of return should be known to us which is a risk free rate of return. If any project is not able to return even the risk free rate of return then I think element of risk nis very high in that project and we should not go ahead with that kind of the investment proposal.

So here we are calculating with the help of this, this is the say model for calculating the expected NPV of the project and with the help of this model you can calculate the standard deviation of the cash flows occurring in the different years and in both the cases whether it is the uncorrelated cash flows or whether it is the perfectly correlated cash flows, in the first case we have calculated the expected NPV, we have calculated the expected this your standard deviation.

So NPV indicates the or represents the average returns available from the investment proposal and this indicates the element of risk associated with that proposal, so our decision criteria should be or to define the risk, how to look at the risk in this kind of situation is only those projects should be say undertaken or should be expected where the average expected return is quite high and the expected standard deviation is quite low.

The projects which gives us the high standard deviation but low average returns or expected NPV those projects should be abandoned, we should not go ahead with making investment because for the distance of high level of sigma or standard deviation the element of risk associated with those projects is very high. So this is the simple model theoretically I am explaining it to you, so we can easily calculate the average returns we are calculating, expected NPV we are calculating and we have to calculate the standard deviation of the cash flows also.

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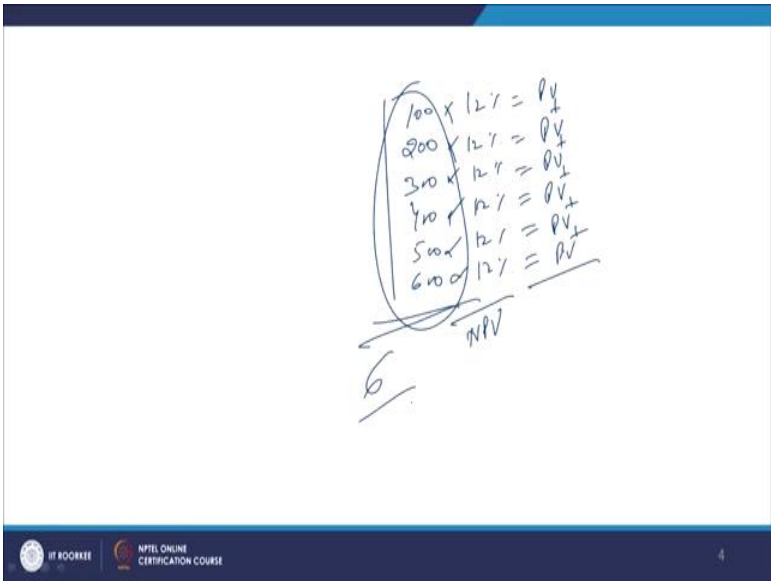

Again you have the 2 distributions, one distribution is here that for example the cash flows is 100 then you have 200 then it is 300 so it is a correlated cash flow, 400, 500, 600 right, so you can calculate the average return we are doing it, we are discounting it for the discount factor say for example 12 percent and it may be the I, risk free rate of return, so we are discounting it for that and once we are discounting it we are calculating the discounted value we are calculating the present value.

So we are calculating the present value of all these, once that present value of the cash flows is calculated we are summing up this present value so this plus this plus this plus this plus this is known as the expected NPV of the project when from this present value of the cash inflows when you are subtracting the present value of the cash outflows so the net result is going to be the NPV and bar here it is that is expected NPV.

Similarly from this distribution if you calculate the sigma by following the root of the variance, first you calculate the mean and form the mean you calculate the variance and variance you calculate and when you take the say this finally from the variance you can easily calculate the standard deviation, so it means variance also itself is indicator of the risk mean variance. So variance even you leave it at the variance level, so variance is also the indicator of the risk and when you going to convert the variance into the say standard deviation you can convert that also.

So both variance and standard deviation say communicate the element of the risk, higher the level of standard deviation or variance because if these cash flows are highly variable then you can understand element of risk is very high. So by calculating the from this distribution of the cash flows, future cash flows, cash inflows especially if you calculate the expected NPV and if you calculate the sigma so you can understand what is element of risk, decision criteria as I am repeatedly telling you that higher the NPV, lower the sigma should be our decision criteria.

If the reverse happens the project is not worth while it should be abandoned, so simple concept of the mean variance has been applied by the professor FS Hiller and he this modeling is popularly called as the Hillers model? So this is one technique.

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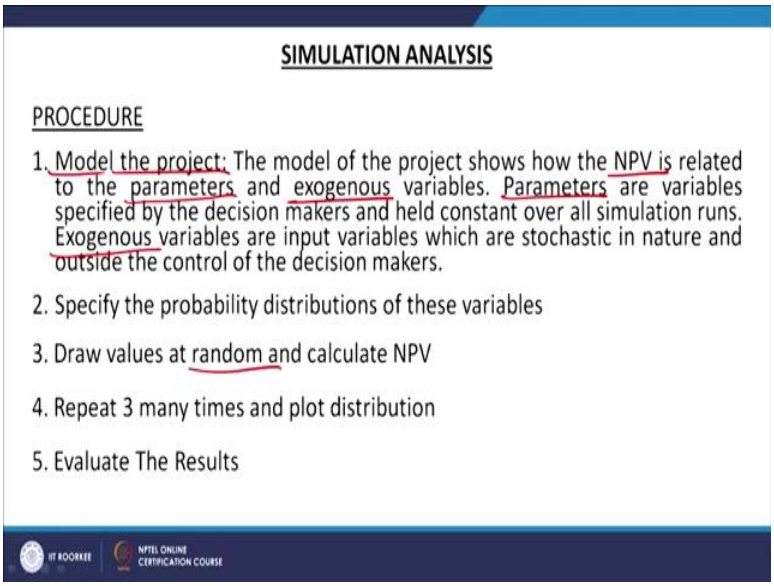

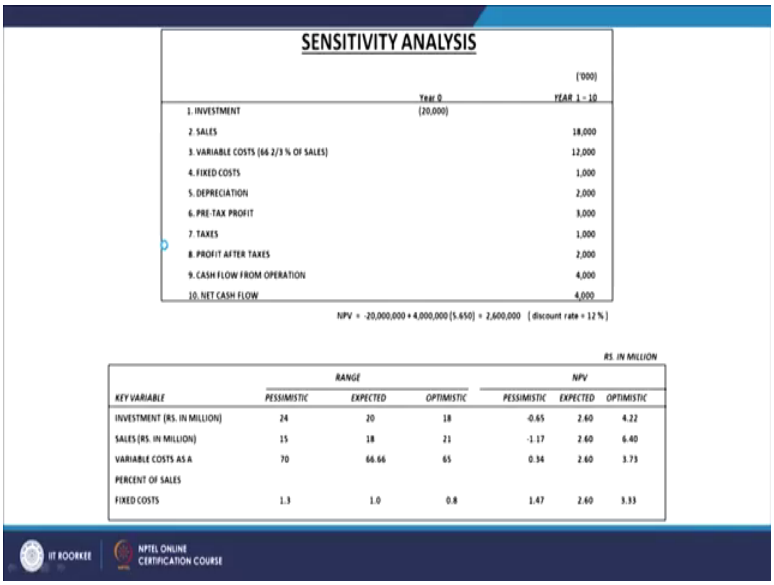

Next technique is now we move forward is with the stimulation analysis and after this we will talk about or will discuss the say your decision tree analysis. Simulation analysis is operations research technique basically but as now sometimes we started applying it for the project evaluations also especially for the risk analysis in the project capital budgeting proposals, so stimulation is basically because it is a very complex process.

It is not possible to be done manually though we do it on the systems or the computers but manually also it can be done if the situation is very simple and there if the say total calculations to be done are not very complex. So stimulation as the words communicate or this term communicates stimulation means to stimulate something, to stimulate something so it means under stimulation analysis what we do, we create an artificial model of the project.

We create the artificial model of the project where we predict everything depending upon the DPFR information given in the Detailed Project Feasibility Report we try to put all the things at the respective places and with the help of stimulation process which is a methodology technique we try to create the model of the project and then we try to see whether this model looks worthwhile or not.

So why we need the computerize analysis because many a times you have to change the figures to means arrive at the acceptable estimates so here when you talk about the stimulation technique or the stimulation process of say risk analysis here is a procedure given here. Number 1, point number 1 says model the project, this point says model the project.

You have to convert the whole project into a model and what it is written here? The model of the project shows how the NPV is related to the parameters and exogenous variables, how the NPV is related to the parameters and exogenous variables, what are the parameters now? Parameters are the variables specified by the decision makers and held constant over all stimulation runs whereas exogenous variables if you talk about these exogenous variables are inputs or the input variables which are stochastic in nature, very volatile in nature and outside the control of the decision makers.

So what you have to do is, you have to identify the parameters, now what are the parameters? Parameters are like say for example which will remain constant, first of all cash outflow, then you talk about the cash outflow means investment and then you talk about the cash inflow and then you talk about the different parameters here that in case of the say for example let us go back to the sensitivity analysis, if you go back to the sensitivity analysis means stimulation analysis is sort of a technique which is advanced version of the sensitivity analysis.

Under sensitivity analysis what we have done, we change 1 variable at a time, we change investment then we see what is the impact upon NPV? Then we change sales, what is the impact upon NPV? Then we change the variable cost, then we can change the fixed cost, so 1 variable at a time but the problem there we face is that we are not able to establish that how likely the change in the sales is going to be there.

How likely the change is going to be there? How likely it is that the variable cost will be changed and it will be this much? How likely it is that the fixed cost will be changed and it will be this, that likelihood is not possible to be established in the sensitivity analysis but in the stimulation analysis we remove that limitation and in that case we try to find out what are the parameters, means what is the cash (inflow) outflow? What is the cash inflow in terms of means for calculating the cash inflow you have to follow the sensitivity analysis and within this case you have to determine these parameters.

These parameters are given to here to you are for example investment we have to find out, sales, variable cost, fixed cost, depreciation, pre-tax profit and taxes. These parameters are known as a constant parameters, cash outflow will be there, sales will be there both the cost will be there,

that is the fixed cost and the variable cost, depreciation will be there, tax will be there, all these things which is which are going to be constant there are known as the parameters.

But what are the exogenous variables? Exogenous variables are their values, these values here. These values are not in our control, if you go to sell certain amount of quantity in the market to some extent we can try but largely that depends upon the market situation. Similarly when you talk about the investment, when you going to make investment we have pre-estimated the investment we are going to make but they are sometimes out of the control also that when we started building the project the prices of the steel went up.

Or when we want to say build up the project labour prices went up, so it means it is beyond your control. So both the variables we have to identify that is the parameters and the exogenous variables, once these variables are one are constant another are stochastic highly volatile so one is sales are going to be there, how much sales are going to be there? That is a exogenous factor.

Similarly variable cost is going to be there that is stable, for sure we know it but how much variable cost is going to be there? We have estimated but it can change also, so that is called a stimulation that we change the variable cost, change the figures time and again, if this is a variable cost what is the result? If this is a variable cost what is the result? And then how likely we are able to establish with the help of this technique.

So stimulation means creating a prototype of the project on system not physically on the system and then means taking all the information into account trying to find out whether it is going to be as far our expectations or not? If it is not going to be as per our expectations then I think its better to abandoned the proposal but it is going to be then so you can change means the flexibility here is you can change the figures time and again and you can see the impact of the changes.

So you have to model the project, second thing is specify the probability distribution of these variables, probability distribution of these variables that is the likelihood this much of the sales will be there, this much of the variable cost will be there, this much of the fixed cost will be there, probability you have to assign depending upon different estimates either you can see the say figure form the adjusting firms or information source is or you can take the help from other sources but you have to assign the probability somehow.

Then draw values at random and calculate NPV, so it means after say putting the values whatever the values we want, say for example sales in the 1st year will be 100 million, 2nd year will be 150 million, then will be 200 million, so it means they are basically the say the drawing the values at random, random we are writing here but they depend largely upon the market random analysis and assign the probability that when we went to the people what was your mindset when they responding to the question.

So I think people were largely serious about it because the product we are going to manufacture it is going fulfill one of their necessities so I think they will certainly buy, so probability can be 80 percent. But if you go to non-serious respondents probability can be 50 percent, he may buy, he may not buy. So like that you have to change it. Repeat 3, we can call it as repeat these steps, repeat this point number 3 you call it as repeat point number 3, many times and plot the distribution, this is the random draw values at random, so you can say.

When you talk the value of random so you can say it can be 100 million, it can be 150 also, it can be 75 million also. So repeat step number 3, may times and plot the distribution. After that applying the probability and these values, these values you have to change, so if you change these values time and again it can be 75 million also, it can be 100 million also, it can be 150 million also and whatever the probability that we have assigned, so multiply those figures with the probability and then the expected value can be calculated and their distribution can be plotted.

And on the basis of that whatever the total means the relationship between the cash outflow and inflow depending upon the level of sales, depending upon the level of fixed cost and the variable cost comes up that can be worked out. So it means we have created a project where any kind of changes were required we have done that and we have different kind of distributions by changing the different say exogenous variables not parameters.

So values we have changed randomly we have applied the values, we use the word randomly but we are say basing it upon some estimates and then multiplying it by the probability estimates then you can easily develop that distribution and that distribution when means plotted on the paper will give us some idea about whether the project is going to be a worthwhile proposition or it is not going to be a worthwhile proposition right.

So this is the stimulation analysis, I am not doing any problem here with regard to the stimulation analysis, so for the detailed reference of this Hiller model as well as the stimulation analysis one simple problem has been discussed in the book which I means time and again refer to Financial Management by Prasanna Chandra if you refer to that book in the say risk analysis in the capital budgeting proposals author has explained how the stimulation model will work but there also the author has admitted that in fact the stimulation can be applied with the help of the computers or with the help of the software.

But still for the sake of simplicity and understanding the stimulation analysis well the author has done one simple example. So if you want to learn practically that how stimulation analysis can be used in the risk reduction or the risk analysis or the capital budgeting proposals you can refer to the book. So after these two techniques, technical say methods or mathematical approaches FS Hiller model as well as the stimulation analysis next thing is the decision tree analysis.

This technique is very interesting technique you must have say heard about this technique decision tree where we try to find out that yes if there is any decision to be taken we can say that this decision may be taken may not be taken. If we take the decision what is the probability of success? If we do not take the decision, what is the probability of say not taking or if we take the decision what is the probability of success? What is the probability failure?

So should we make investment? Should we not make investment? So develop a tree, we try to find out what are the possible outcomes and with the help of those outcomes we try to assign some probabilities, so we means try to find out certain decision points and certain chance points. In the decision points we say yes or no or we propose different options available and in the chance point we assign the probability to those options or those decisions and then we try to calculate again NPV of the project.

And with the help of that NPV we can decide about whether to go for this project or not, so how this decision tree will work and what this technique is I will discuss this technique with you not now in the next class so till then means you should read, you should try to understand what are the other than the first 3 techniques like sensitivity analysis, scenario analysis and breakeven analysis what is the Hillers model which is basically mean variance analysis.

It looks a very complex model but it is a very simple and interesting model where the expected NPV and expected sigma or the standard deviation is worked out. NPV represents return and the sigma returns the risk in that model and stimulation is all we understand.

Stimulation is basically the say creating the project on the paper by changing the different variables which are say you can call it as exogenous variables the values of that assigning the probability and trying to find out that in the best possible situation how the project is going to behave and in the worst possible situations how the project is going to respond and whether to finally go for the project or not.

So these were the means till now we have completed the 5 techniques and the last technique that is a decision tree analysis again most interesting most useful technique and how we can use in the risk analysis of the capital budgeting proposals or the new investment proposals that I will discuss with you in the next class, till then thank you very much.