Decision Support System for Managers
Prof. Anupam Ghosh
Vinod Gupta School of Management
Indian Institute of Management, Kharagpur

Module - 07
Decision Support System for Finance
Lecture - 34
Evaluating Investment Proposals; NPV, IRR

Hello and welcome to "Decision Support Systems for Managers"! We are into module 7, 'decision support system for finance' and today we will cover lecture 1 that is 'evaluating investment proposals: NPV and IRR'. Now, finance is a very-very important function of any organization which all of us can easily understand.

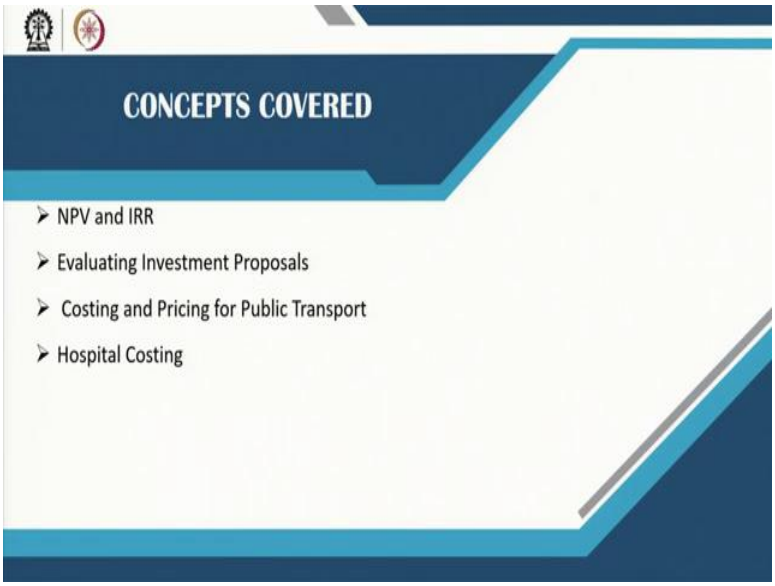
For the simple reason that without finance, you just cannot run your business for a single day. So, finance is one of the core activities, so primary activities of a business; ok. As we all know the primary activities of business is selling through which it earns revenue but to produce without production you cannot sell and for production you need finance.

So, it is a cyclic affair for any business; that these three most important things basically run the business, and finance is the core or the integral part of any decision support system; ok.

So, today we will cover or in this module we will cover areas or aspects of finance. Now, I have to say something here or add something here; this area of finance one is pure business finance, second is another area is coming up, financing or methods of finance or accounting or whatever way you look at it for the public systems. So, we will try to cover both these dimensions for business and for public systems; ok.

Now, so let us start with some basic idea of finance.

(Refer Slide Time: 02:02)



So, what we plan to cover is, in this module we want to cover NPV and IRR that is net present value and internal rate of return; evaluating investment proposals that is an investment proposal has come, whether to accept that investment proposal or to leave it or to let it go. And costing for public; costing and pricing for public transportation systems which is very-very important because it is a social good, and most important in today's setting; hospital costing.

So all these have; why we choose these four topics is? First two topics are dealing with pure business and topic three and topic four is dealing with the public aspect or the social aspect of any financing decision; ok.

(Refer Slide Time: 02:54)

Now, so let us proceed. Now, first one, first item that we want to cover is NPV and IRR. Now, what is NPV? NPV stands for net present value and IRR is internal rate of return, ok. Now, NPV or net present value basically means, what is the present value of my future earnings; what is the present value of my future earnings.

What do you mean by that what is the present value of my future earnings? Say, today is 1st of January, just assume today is 1st of January, and your friend tells you that please give me a loan of 100 rupees; please give me a loan of 100 rupees and I will repay you after 1 year 100 rupees.

So please give me a loan of 100 rupees and I will repay you after 1 year, 100 rupees. Will you give 100 rupees to your friend that is my question? Will you give; one is I do not have money, I will not give my friend anything, but that is not the issue. The issue is you want to help out your friend; but will you give 100 rupees, will you give more or will you give less? Given that your friend will return to you 100 rupees after 1 year.

Now, if you have kept that money in a bank, you could have earned some interest. Let us assume that bank would have paid me an interest of 10 percent. So, for 100 rupees, I could have earned in 1 year 10 rupees as interest, right. If I had kept that 100 rupees in the bank, I could have earned 10 rupees as an interest.

So, ideally what should I do? If my friend is returning me 100 rupees after 1 year, ideally what should I do? Ideally I should give my friend 90 rupees; because I am foregoing the interest of 10 rupees right, I am foregoing the interest of 10 rupees.

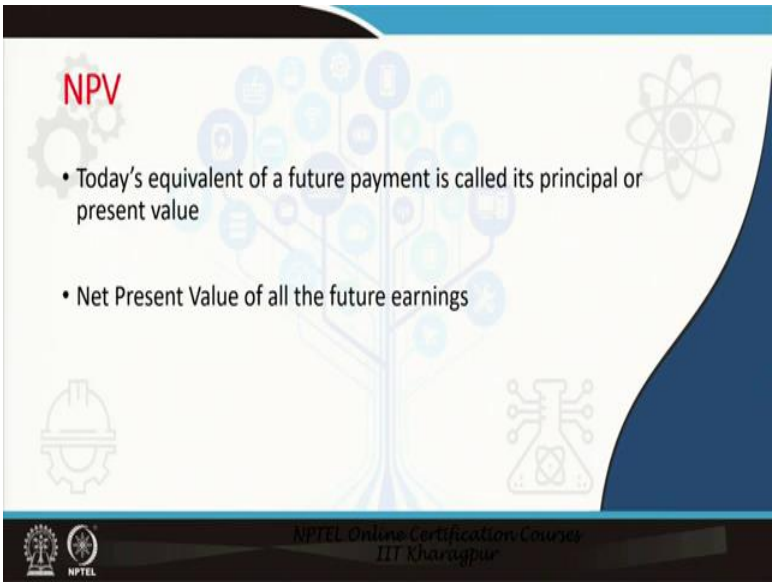
Understood, I am repeating again; that is what is called as present value. What it means is, I am giving you 100 rupees today and the person is returning me same 100 rupees after 1 year; but had I kept that money in the bank, I could have earned an interest of 10 rupees. So, if I just give 100 today and get 100 back after 1 year, it is my loss; because I am losing the interest.

So, what do I do? I deduct 10 rupees and give 90 rupees to my friend; then that solves the problem. So, what is the present value? I am repeating, what is the present value of rupees 100? What is the present value, today's value of rupees 100 to be repaid after 1 year; present value of rupees 100 to be repaid after 1 year?

So, that value is 90 rupees. So, present value is always less than the value that I would get after some time. So, present value is 90 rupees this is called as the net present value deducting all the other dimensions, ok. So, net present value, we basically if we have a cash flow of 3, 4 years then we use the word net; ok.

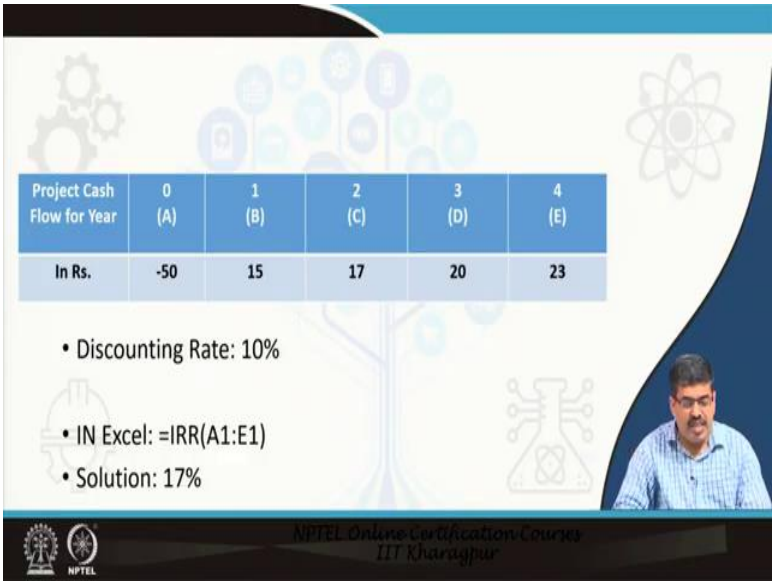
So, net present value. So, net present value of rupees 100 today is rupees 90. So, I should give my friend 90 rupees that is the concept of NPV ok, net present value; right.

(Refer Slide Time: 06:54)



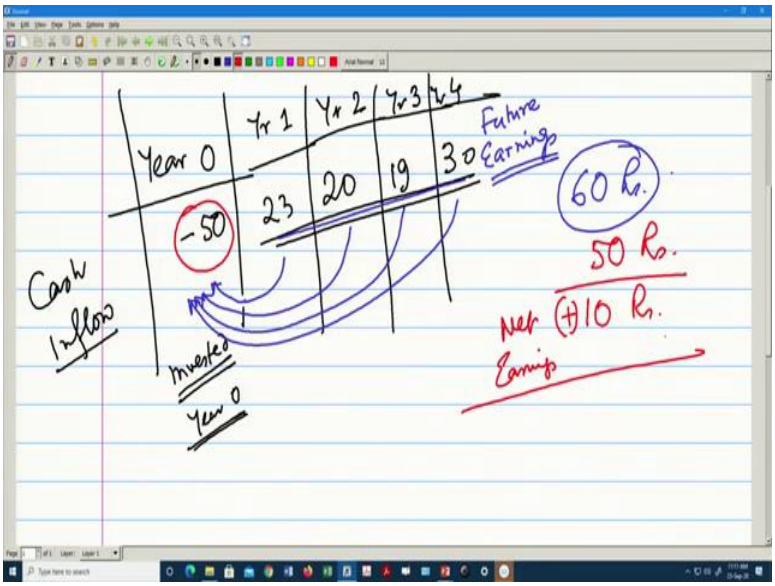
So, that is what I mentioned; today's equivalent of a future payment is called its principal or present value; ok, net present value of all the future earnings.

(Refer Slide Time: 07:06)



Now, this is one problem that I have for you, ok. Now, this problem says, the projected cash flow for a year 0, 1, 2, 3, 4; rupees minus 50, 15, 17, 20, 23, discounting rate is 10 percent. Now, if you are exposed to this concept of NPV for the first time, you will see, [FL] what is this; I do not know, I feel scared, nothing to be worried about it, ok. This is basically the way we do these calculations. So, let us see how we will go ahead, ok. What is this minus 1, minus 2; let us see.

(Refer Slide Time: 07:51)



Now, here what did we say, year 0 it was minus 50; minus 50 is the what? Is the cash in flow. Cash inflow minus 50 means what? Cash has gone out, minus 50; cash has gone out means what? Actually you have invested this money in year 0 ok; that means, at the beginning of year 1, you are starting with this investment ok, you are starting with this investment.

Year 1; at the end of year 1 there is a cash inflow of let us say 23 rupees; at the end of year 2 there is a cash inflow of let us say 20 rupees; year 3 19 rupees; year 4 let us say 30 rupees, right. But how much have you spent on year 0? You have spent rupees 50, and this is the inflow every year 23, 20, 19, 30.

What is the present value of these money; ok? So, what is the present value of 23 rupees brought to this year, ok? Present value of 20 rupees, present value of 19 rupees and present value of 30 rupees; if we can get the present value of all these amounts, if we can get the present value of all these amounts, then suppose we are getting a present value of 60 rupees of all these future earnings these are my future earnings right, these are my future earnings ok, these are my future earnings.

So, if I am getting the present value of all these future earnings and I see that my present value; today's value of all my future earnings is rupees 60 and my initial expenditure as of today is 50. So, present value of my future earnings is 60, present value of my expenditure is 50.

So, what is my net earnings? 10 rupees right, this is my net earnings ok, net earnings and this is positive, ok. So, I may go for accepting this business ok; any business you see around does this calculation, does this rough calculation before landing into any business venture, ok. So, this calculation is very much required. So, this is basically the concept of net present value.

Now, how will you do this, ok? So, here we had this problem, here we had this problem, ok. Now if you see this table, as I said my 1st year; the beginning of year 1 that is at the end of year 0 my investment basically is minus 50 is 50; that is why the cash inflow is showing as minus, because it is an outflow.

And 1st year I am earning 15 rupees, 2nd year 17 rupees, 3rd year 20 rupees, 4th year 23 rupees. Discounting rate is 10 percent; means this is the discounting factor or the bank interest rate basically, the bank interest rate, the interest I would have earned if I put the money in bank or the income percentage I would have earned, rate of return I would have earned if I had put the money in some other investment; ok.

So, that with that amount, that percentage the amount will get reduced; by that percentage the prince amount will get reduced, like we said bank interest was 10 percent for my 100 rupees. So, that 10 percent is the amount by which the 100 rupees gets reduced ok, this is very simple; ok.

So, this is NPV. Now, how to solve this? There are formulas, this a divided by 1 plus r to the power the number of years, etc.; ok.

(Refer Slide Time: 11:51)

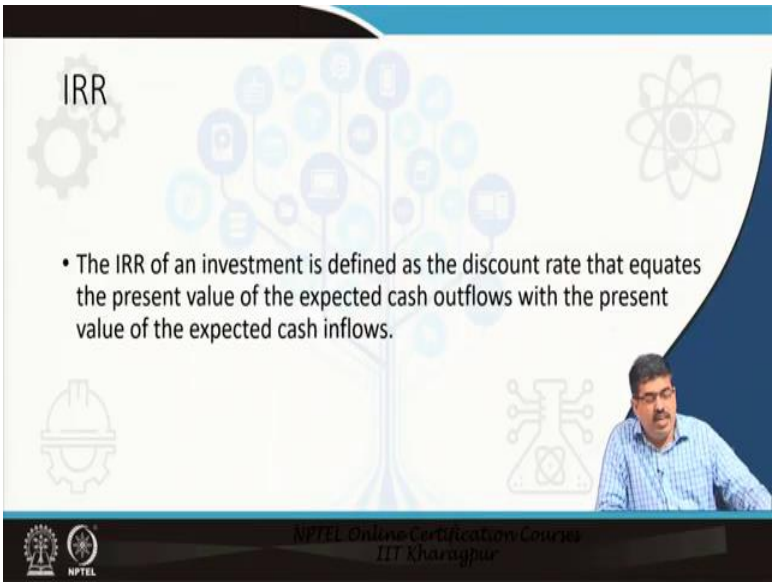
But now with the days of computer systems, you do not need to bother; just do this, in excel it is put equal to minus 50. Why minus 50? Minus 50, why? Because minus 50 was your 1st years cash inflow plus NPV and net present value bracket 0.1. What is 0.1? The discounting rate 10 percent.

So, 0.1 comma 15, 17, 20, 23 what are these? The cash inflows, ok. So, minus 50 year 0 NPV within bracket 10 percent discount comma NPV of year 1, year 2, year 3, year 4 ok; close bracket, press enter and you will get 8.42.

So, my present value of these future earnings is 8.42, this is after taking care of the initial investment of 50 rupees. So, basically my earning is 58.42 of which 50 is the investment; so 50 rupees gone. So, 8.42 is my net earnings; ok. Now, if you have four, five such projects; for each project you will have to come up with these net earnings; ok.

And then you decide which project you should invest in. So, that is basically NPV. So, nowadays we do not need to do all these calculations, excel has these functions inbuilt. So, minus 50 plus NPV within bracket discounting rate comma all the cash flows bracket closed; is this clear?

(Refer Slide Time: 13:33)



Now, next we will move on to what is called as internal rate of return; it is the discounting rate that equates the present value of the expected cash flows with the present value of the expected cash inflows.

So, internal rate of return is basically the rate at which your cash inflows and cash outflows, the percentage rate at which your cash inflows and cash outflows become equal. So, you will calculate the rate of return and if your, if you had invested the money in a bank or some other place; if your return was less, you would invest in this business; ok.

So, I am repeating what I have said, suppose your internal rate of return that is the profit calculations percentage is coming to 13 percent, internal rate of return and your bank interest you are getting is 15 15 percent. So, you will not accept this project, ok. But if your bank interest is 10 percent and your internal rate of return is 13 percent; you will accept this project; ok.

But here again there will be priorities; if I have five projects or six projects, I will go for that project which is giving me a higher margin, clear. So, that is internal rate of return. Now, how do we define it and how do we go about it? Yes this is the problem, same problem we have given; same problem, discounting rate 10 percent.

Now, internal rate of return is in excel got as IRR A 1 is to E 1. What is A 1? That is your minus 50, that is why I put there you see A, B, C, D, E and in blue I have put it know in the blue row A, B, C, D, E. So, A 1 is minus 50 and E 1 is 23, ok. So, A, B, C, D, E are the columns and one is the row, ok. So, row one column A to column E, ok. So, what we do? IRR A 1 to E 1. And what do we get? 17 percent.

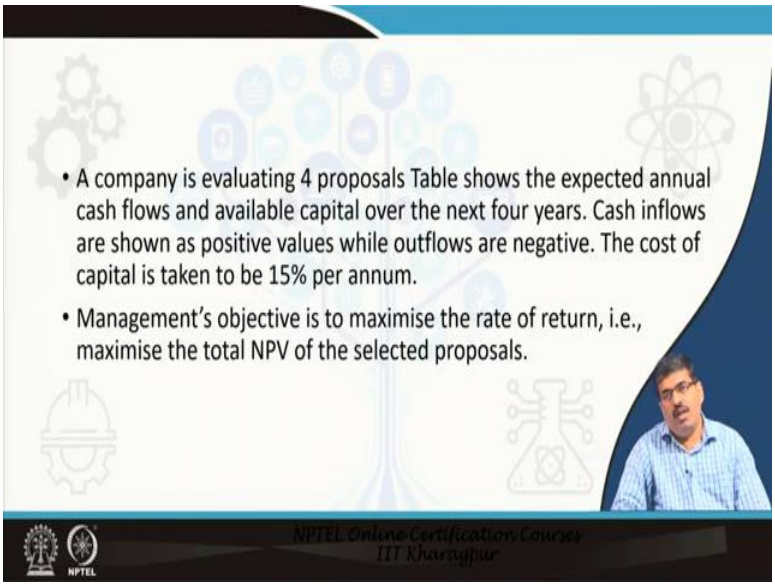
So, if I am in this business my interest or the return that I will earn is 17 percent. How was it come? From the projected cash flows; from the projected cash flows, I am getting an internal rate of return of 17 percent. What could I have earned if I had kept the money in bank? 10 percent, the discounting rate.

So, what is the net outcome? Net outcome basically is that let us go for accepting the project, clear. So, this is the basic concept of NPV and IRR; earlier we used to do these entire problems by hand or excel sheet in build the formulas etcetera, nowadays just typing these simple things in excel, you can get hold of the solution, clear. But the underlying logic I explain to you.

(Refer Slide Time: 16:34)

The next thing that is evaluating investment proposals. We have investment proposals, invest in this that this that; how do we evaluate them, ok? As a business manager, you will face these issues every day; ok; how do you evaluate investment proposals?

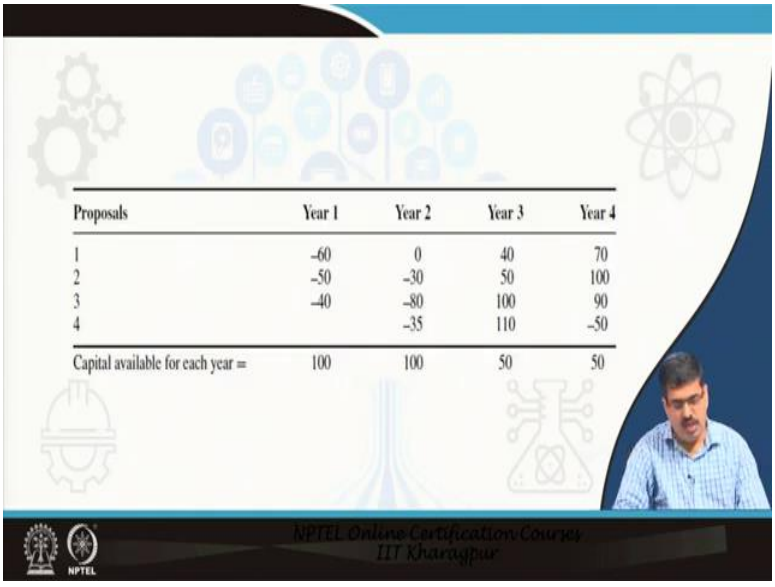
(Refer Slide Time: 16:52)



Now, just look at this problem. A company is evaluating 4 proposals. Table shows the expected annual cash flow and available capital over the next four years. Cash inflows are shown as positive values while outflows as negative, no problems. Cost of capital is 15 percent, earlier problem we had 10 percent. Managements objective is to maximize the rate of return, that is maximize the total NPV of the selected proposals; ok.

So, the company is evaluating 4 proposals and the expected cash inflow and outflow are given, available capital is also given.

(Refer Slide Time: 17:28)

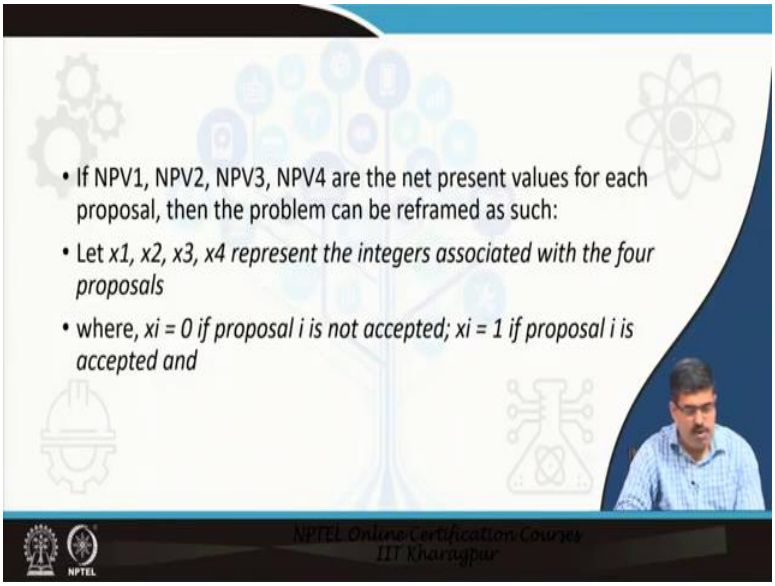


These are the proposals. Now, proposal year 1 all the proposals are generating negative cash inflow right; that means actually this is the initial investment. All the proposals were showing that minus 60 is the investment for the first one, 50 is for the second and 40 is for the third. How much capital do, how much money do you have for investment? 100.

Year 2, proposal 1 is generating 0 cash; proposal 2, 3, 4 again is generating means you have to pump in money. How much capital do you have? 100, ok. Year 3 onwards slowly the cash inflow is becoming positive. How much capital do you have? 50. Year 4 again they are positive means, cash inflow is coming; but project 4 is negative value; ok.

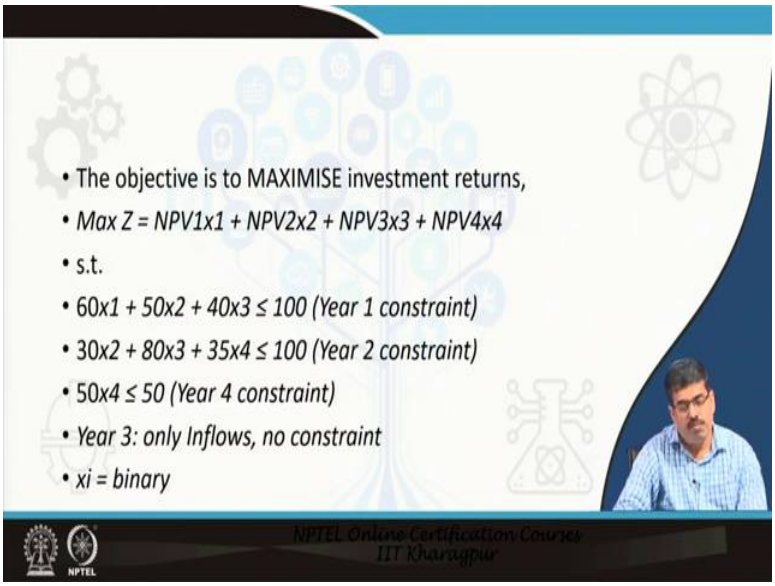
Then how much capital do you have again is 50, ok. So, how do you solve this problem? Now, if you look very carefully, this is a; we can frame this problem as a linear programming problem. You can frame this problem as a linear programming problem.

(Refer Slide Time: 18:40)



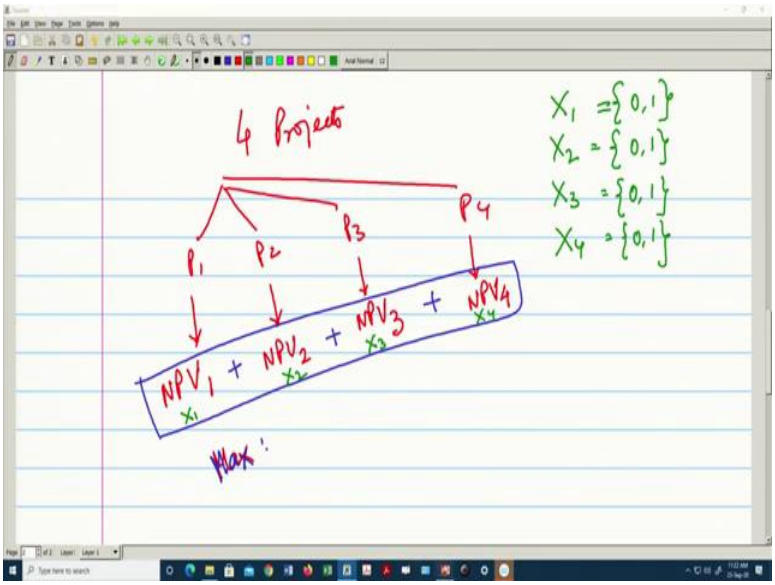
If NPV 1, NPV 2, NPV 3, NPV 4 are the net present values for each proposal, then the problem can be reframed as such; x 1, x 2, x 3, x 4 are the integers associated with the proposal. x 1 if is accepted and x 2 sorry x 1 is 0, if it is x sorry x 1 is 0; if it is rejected and x 1 is 1, x i is 1 if proposal is accepted, clear. So, 0 if it is rejected and 1 if it is accepted, right ok. So, x 1, x 2, x 3, x 4 are the binary, the integers and NPV 1, 2, 3, 4 are the NPV of these four proposals; ok.

(Refer Slide Time: 19:27)



What is my objective? The NPV 1 x 1, NPV 2. So, we have to maximize the NPV, right. So, let us go by it. Let us go by this and see what is happening; ok.

(Refer Slide Time: 19:46)



So, let us see, what is we are saying is we have 4 projects, right; 4 projects. And so, there will be P 1, P 2, P 3, P 4 ok; this project will give me NPV for project 1, NPV for project 2, NPV for project 3 and NPV for NPV for project 4, ok. So, we have 4 projects P 1, P 2, P 3, P 4 and each projects has its NPV.

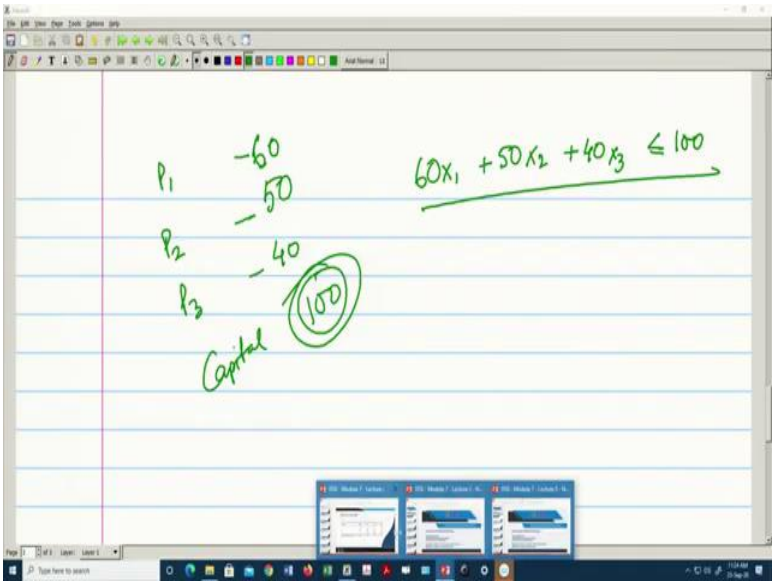
What is my objective? My objective is maximize, my objective is maximize. Maximize what? Maximize NPV 1 plus NPV 2 plus NPV 3 plus NPV 4 ok; this is my objective, is it clear right? This I have to maximize this; ok.

So, let us go to the next constraint, ok. So, this is what you are seeing max NPV x 1. Now, max NPV x 1, NPV x 2, x 3, x 4. Why are these x 1, x 2, x 3, x 4 have come? This x 1, x 2, x 3, x 4 have come, because I may take this project, I may not take this project right; I may take this project, I may not take this project. I may take, I may not take; if I take it is 1, if I do not take it is 0; ok.

So, NPV 1 x 1, NPV 2 x 2, NPV 3 x 3 this is my max. Now, subject 2 see, what was the original problem? This was my initial cash flow right 60 x 1, 50 x 2, 40 x 3. What is the maximum capital available? 100, right. So, what are we doing? You see 60 x 1, 50 x 2, 40 x 3 less than equal to 100 year 1 constraint, right year 1 constraint; right.

Is it clear? 60, 50, 40; see my cash outflow is this ok, my cash outflow is this, let us go here.

(Refer Slide Time: 22:27)



My cash outflow is what? First year for project sorry, 1st year for project 1 my cash outflow is minus 60, for project 2 my cash outflow is 60, 50, 40. For project 2 my cash outflow is 50, for project 3 my cash outflow is 40. What is my total availability? Total

availability is only 100, capital total availability capital is only 100; just check-up, just check-up see total availability is 100; ok.

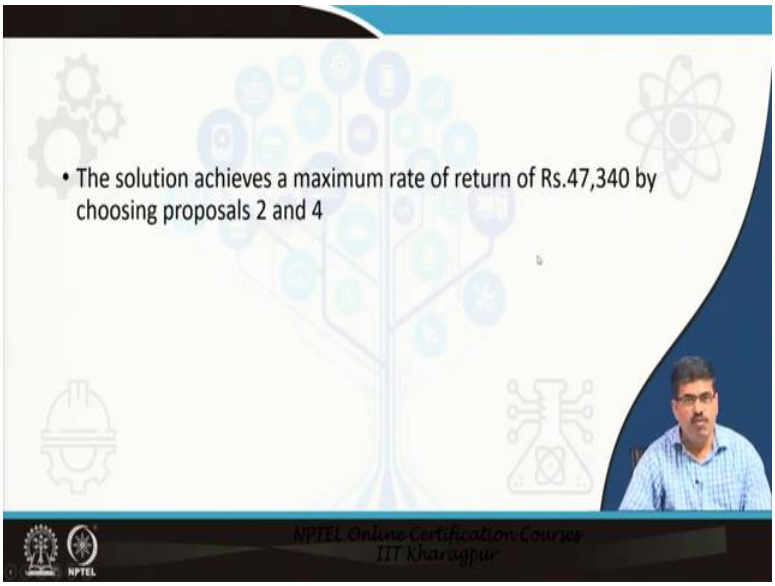
So, very simple, 60 if I have the project, 50 if I go for the project, 40 if I go for the project. So, this total money should be less than equal to 100; total money should be less than equal to 100, because this is the maximum available money that I have right. So, this is the first constraint; ok.

Next constraint 30, 80, 35 year 2 constraint less than equal to 100; this is very easy minus 30, minus 80, minus 35 ok, this is the outflow and that should be less than or equal to 100 ok, that should be less than equal to 100. Same as year 1.

Now, year 3 no need, because my cash inflow is enough. So, I do not need to go for, there will be no capital required by additional pumping of money; no additional pumping of money is required, no additional pumping of money is required. So, this is year 3; year 3 I have no constraint, because no additional pumping of money is required, ok. Year 2 what will be this? 30 x 1, 30 x 2 plus 80 x 3 plus 35 x 4 less than equal to 100; ok; that is year 3.

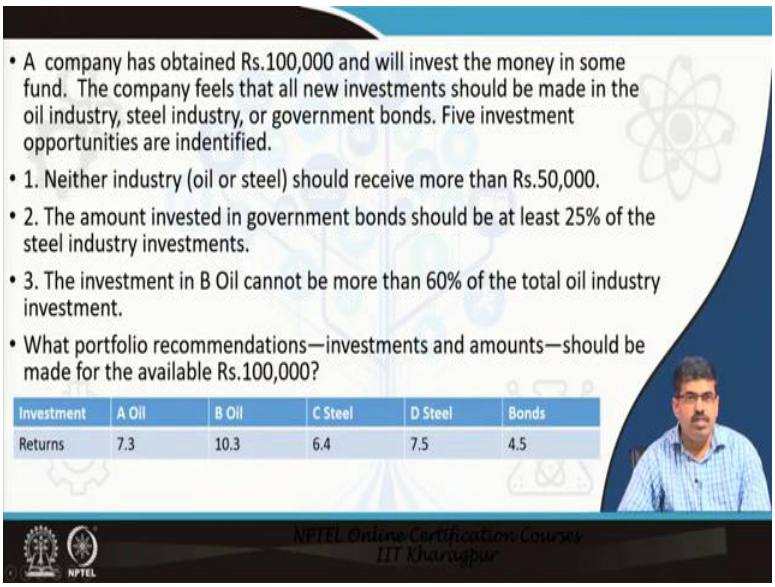
Year 4 again my only this minus, minus 50; this is the outflow that should minus 50 x 4 should be less than equal to 50 that is cash, clear. So, this is what is shown in this problem; 50, 50 x 4 less than equal to minus 50, ok. Now, that is my year 4 constraint, year 3 only inflows no constraints. So, if you look at this is the entire problem ok; this is the entire investment proposal problem, we have framed it as a linear programming problem and you can solve it.

(Refer Slide Time: 25:12)



There are many ways to solve it, many softwares are available; the solution achieves a maximum rate of return of rupees 47340 by choosing proposals 2 and 4; ok.

(Refer Slide Time: 25:23)

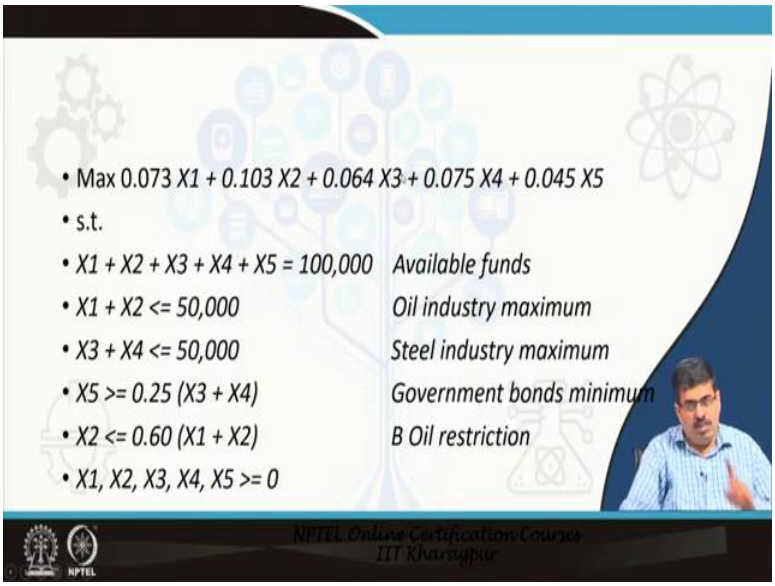


Now, this is another problem that I will leave you with, I will not solve this; solution is given here, solution is given in the slide. You try it; do not look at the solution, you try it. If you cannot, then only look at the solution; ok. A company has obtained rupees 100000 and we will invest the money in some fund.

Now, of course there is investment opportunities in oil companies A oil, B oil in steel companies C steel and D steel and the third is bonds, ok. Neither industry oil nor steel, what is your investment amount? 100000, neither invest neither industry should receive more than rupees 50000.

Amount invested in government bonds should be at least 25 percent, simple linear programming problem. Investment in B oil cannot be more than 60 percent, ok. What should be the portfolio? This is somewhat your portfolio selection though not the selection theories of Harry M Markowitz, etc.; this is somewhat your portfolio selection theories; ok.

(Refer Slide Time: 26:29)



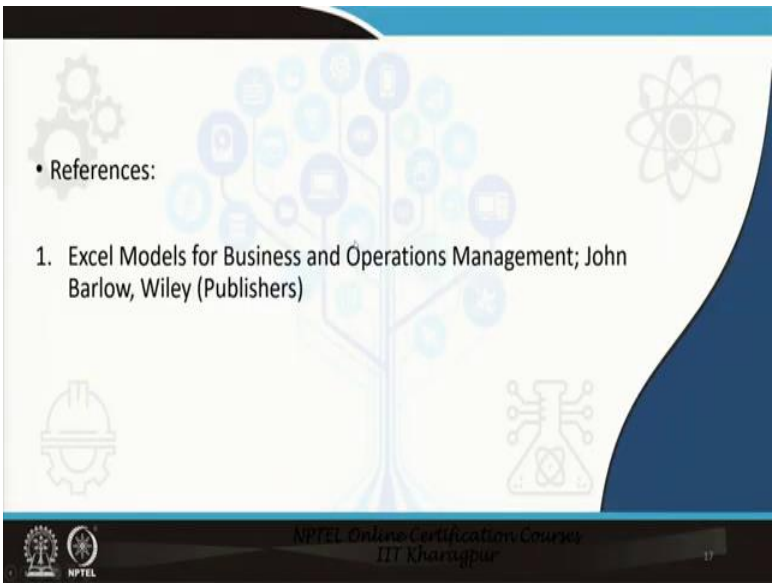
Now, this is the solution, but do not look at the solution [laughter], do not look at the solution, try to solve it; ok. So, this is the finance, the basic financing few questions. What is my profit? So, for that we went to my NPV and IRR, ok. What should I go for an investment; should I not go for an investment; what interest should I earn; this is my NPV and IRR?

Next is, we went and discussed investment proposal; ok. Should I go for a particular investment; should I not go for a particular investment? Ok. So, this is the second one, right ok. So, this is the basic. So, investment decision, financing decision is the most important decision in any financial system. So, this one will help you to take care of that issue; ok.

In the next lecture, we will deal with costing and pricing of transport; costing and pricing of hospitals, which are very-very important in the present setup; ok.

(Refer Slide Time: 27:35)

(Refer Slide Time: 27:37)



So, we will end here, this particular lecture; ok. This is a reference, 'Excel Models for Business and Operations Management, Barlow'. And so you can go through it.

Thank you!