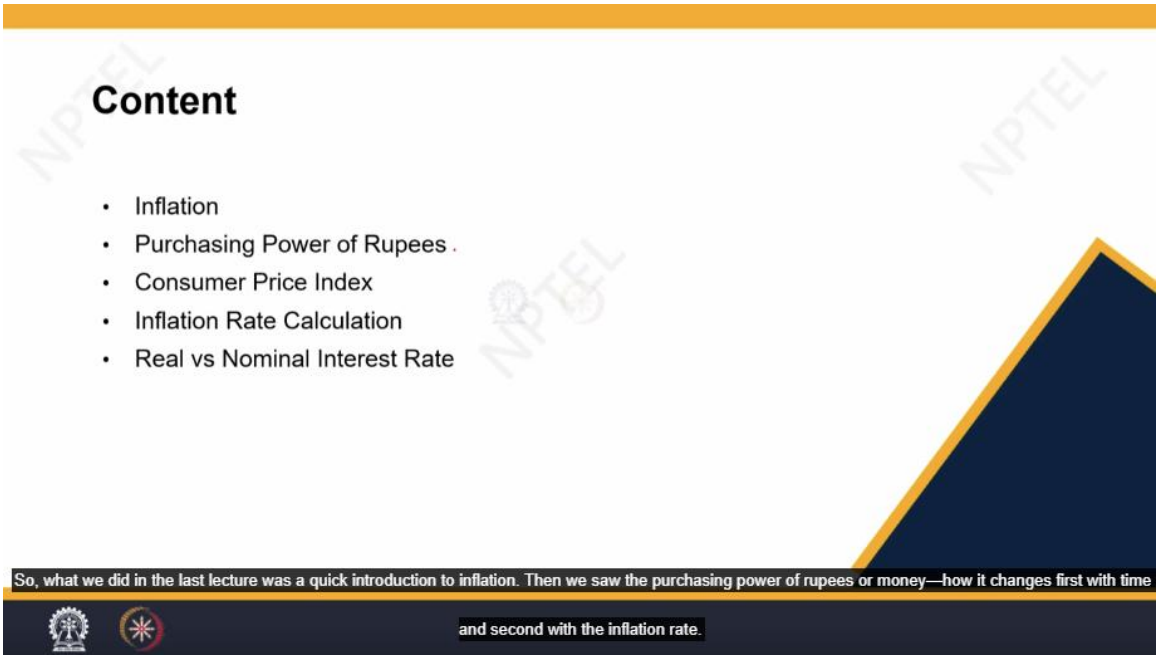
MINERAL ECONOMICS AND BUSINESS

Prof. Shantanu Kumar Patel

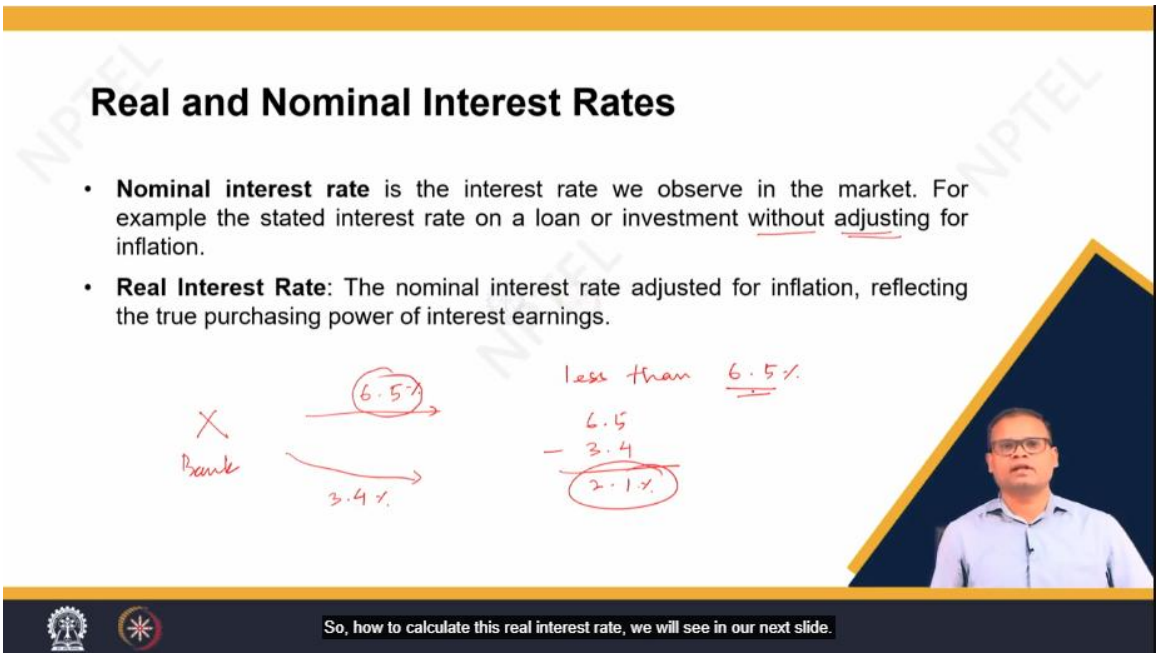
Department of Mining Engineering

IIT Kharagpur

Lecture 34: Inflation – 2

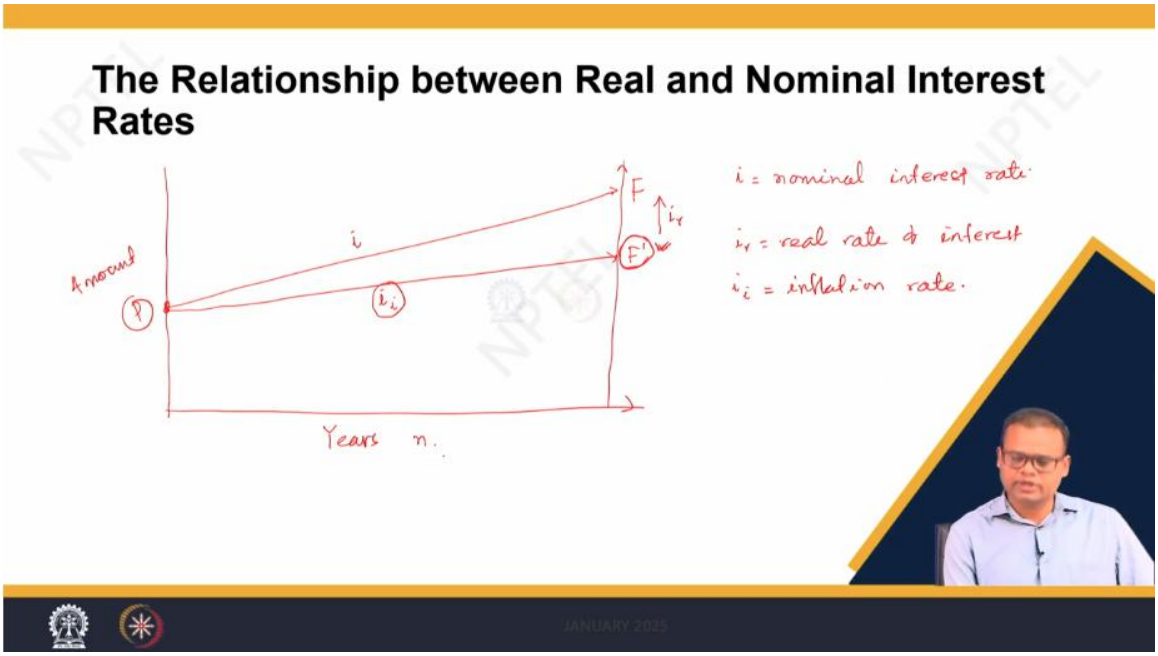


Hello everyone, and welcome again to this course on mineral economics and business. So, this is our lecture number 34, and this is the second part of the lecture on inflation. So, what we did in the last lecture was a quick introduction to inflation. Then we saw the purchasing power of rupees or money—how it changes first with time and second with the inflation rate. Then what we saw was the consumer price index (CPI), and also we saw WPI, which is the wholesale price index. From the CPI, we saw how to calculate the inflation rate. And in today's lecture, we are going to see real versus nominal interest rates. So, as you know, the nominal interest rate is the interest rate that we observe in the market for example, the stated interest rate on a loan or investment without adjusting for inflation.



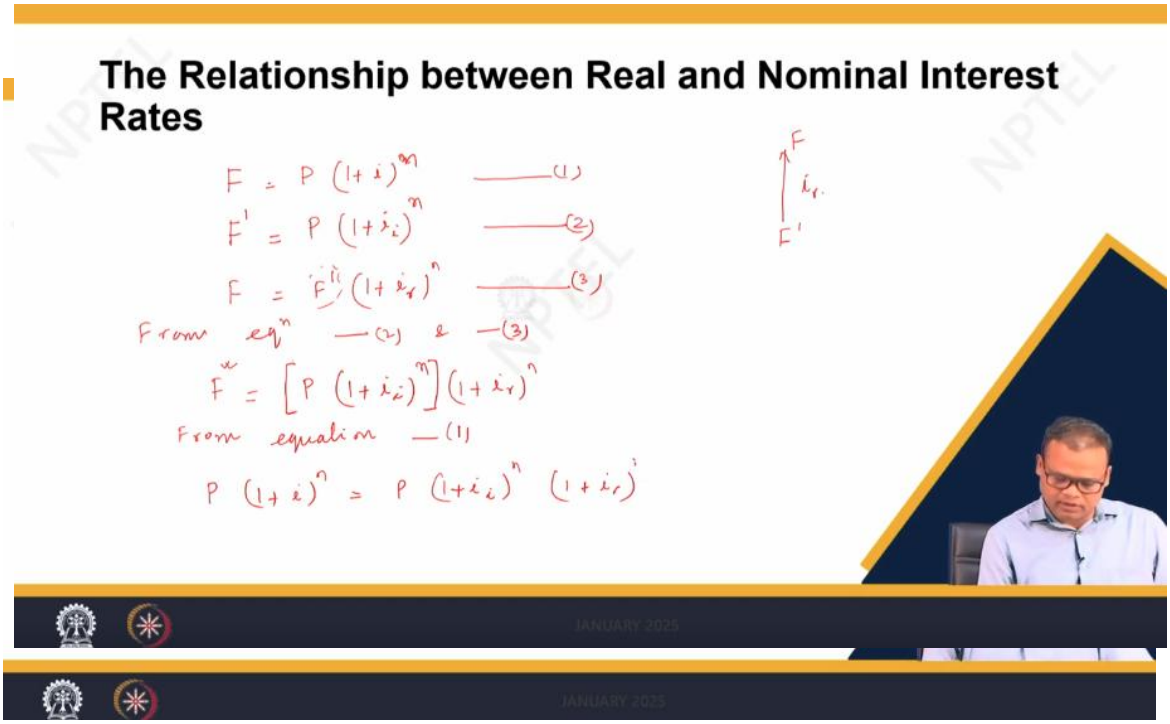
And the real rate of interest is the nominal interest rate adjusted for inflation, reflecting the true purchasing power of the interest earnings. So, what this means is, let us say we deposit some amount X in the bank. And the bank says, 'We are going to give you a 6.5 percent interest rate.' But maybe today we have inflation in our country, which is around, let's say, 3.4 percent. So, the effective interest rate—or the real interest rate—we are going to get is less than 6.5 percent. But also, it is not exactly 6.5 minus 3.4 percent, which is 2.1 percent. So, it is not exactly 2.1 percent,

but we know that it is less than 6.5 percent. So, how to calculate this real interest rate, we will see in our next slide.



So, for this, let us draw our diagram here, where on the y-axis we have the amount, and on the x-axis, this is, let us say, years. So, what we did here was that we initially invested some amount T at t = 0, and after n years with a nominal interest rate i (where i is our nominal interest rate), we got an amount, let us say F, after n years. But if we have inflation, the amount that we have to pay to purchase a product after n years, due to the inflation rate i, we have to put some different

amount to purchase the same item which we can purchase at t equal to 0. So, in other words, like you know, f dash, which is a little bit more than or maybe which is related to our inflation rate, you have to pay f dash amount to purchase the same item. So, effectively, you know what has happened within these n years is, we can say that f dash has changed to f. So, this change in f dash from f is through a real rate of interest I r. So, we can write it here that I r equal to our real rate of interest. and i i is our inflation rate.



So, here what we will try to see is how i r is related to our nominal interest rate i and the inflation rate i i. For this, you know what we can write is that

the amount we are going to get with a nominal interest rate, if the initial amount is p, then f equal to p into 1 plus i to the power n. So, let us say this is equation number 1. Similarly, to purchase the same item after n years we are going to spend F dash amount which is related to P, and because of the inflation, this F dash becomes P into 1 plus i i whole to the power n. So, let us say this is our equation number 2. Similarly, we saw that you know F dash has increased to F with n. So, we have F dash F here and F dash here.

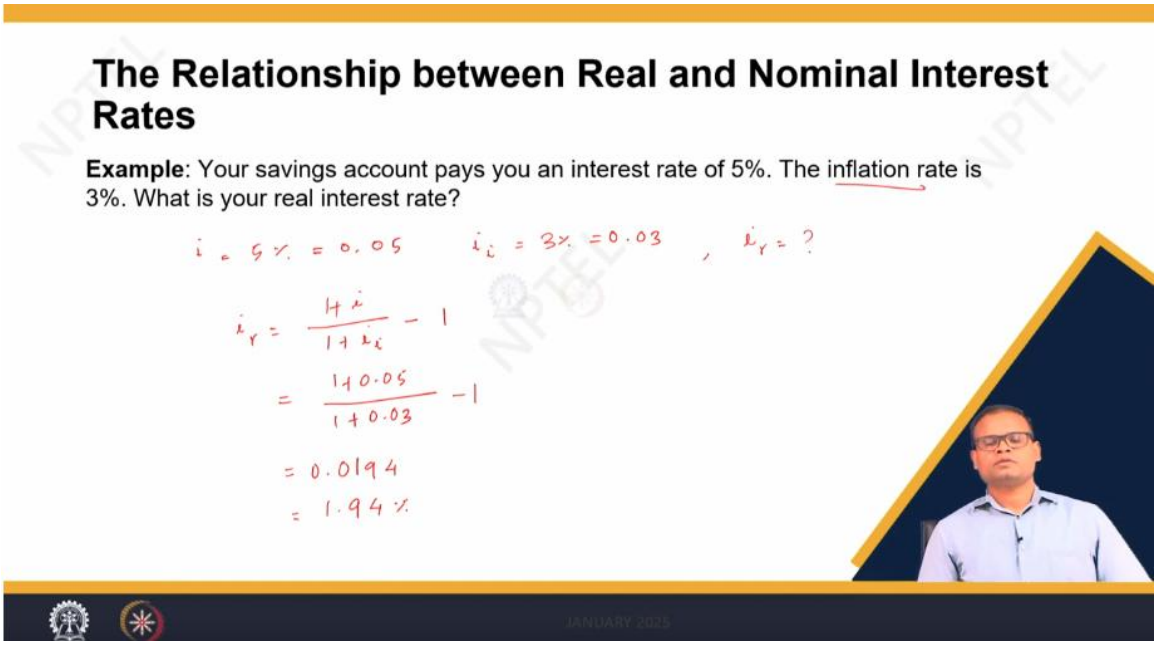
So, it has increased in n years with a real rate of interest I r. So, this f can be written as f dash into 1 plus I r to the power n. So, this is our equation number 3. So, from equation 2, And three. we can write f equal to if we substitute the value of f dash here. So, p into 1 plus i i whole to the power n into 1 plus i r to the power n. So, this is the f dash term and multiply with 1 plus i r to the power n.

and if we put the initial value of f from equation 1. equation 1, if you substitute the value of f, this becomes p into 1 plus i to the power n equal to p into 1 plus i i to the power n into 1 plus i r to the power n. So, if we cancel p dash p dash out from both the sides, so this becomes 1 plus i to the power n equal to 1 plus i i to the power n into 1 plus i r to the power

n. So, from here we can write like everything is powered n. So, 1 plus i equal to 1 plus i i into 1 plus i r. So, here our like if you take 1 plus i i to other side 1 plus i r becomes 1 plus i divided by 1 plus i i and if you take 1 to other side i r becomes

1 plus i divided by 1 plus i i minus 1. So, this is the relation between our real rate of interest and the nominal rate and the inflation rate. Similarly, if we have you know previously we saw that 1 plus i to the power equal to 1 plus i i into 1 plus i r. So, if we expand this 1 plus i becomes 1 into 1 is 1 plus i r plus i i plus i i into i r. So, 1 1 get cancelled here. So, this becomes i equal to i r plus i i plus i i into i r.

So, here if we know the ah our real rate of return ah and ah our inflation rate also we can calculate what is the nominal rate we are going to charge. Based based on this we have ah few examples here.



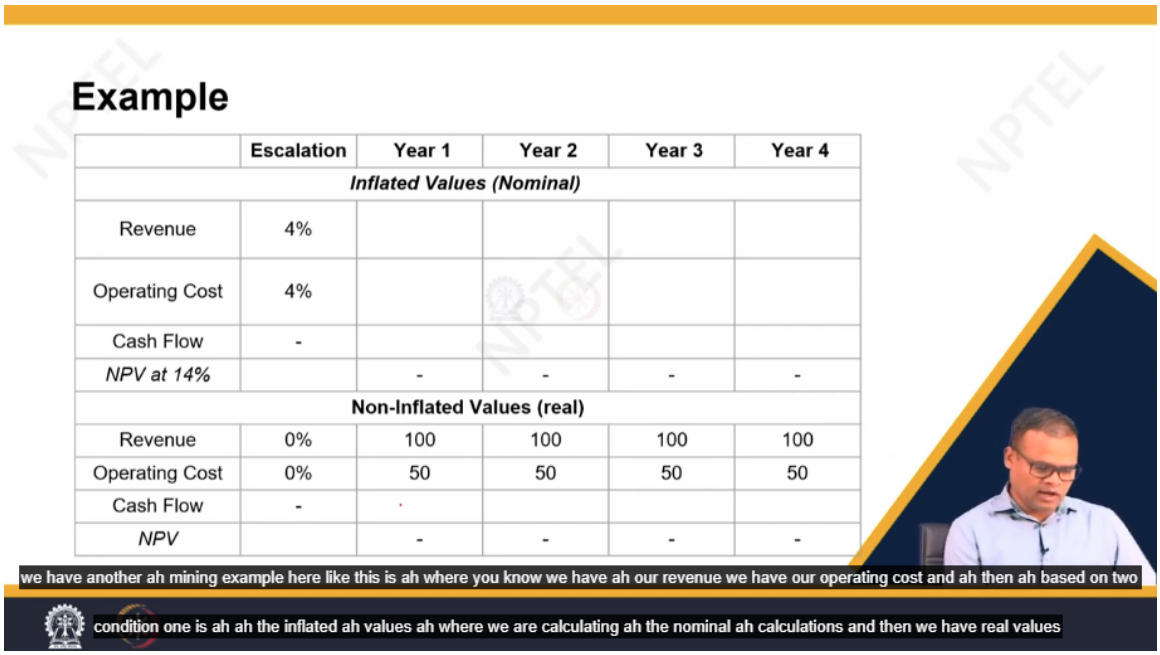
The first example it says that if you want to charge a 8 percent real rate and the inflation rate is expected to 10 percent what is the nominal rate you should charge. So, here we ah we have i r equal to 8 percent which is 0.08 and ah and the inflation rate is 10 percent.

So, i i equal to equal to 0.1. So, what is asked is what is the nominal rate we are going to charge. So, i equal to what? So, for this we know i equal to i i plus i r plus i i into i r.

So, if you put the values i i equal to 0.1 plus 0.08 plus 0.1 into 0.08. So, this becomes 0.188 or 1.8 sorry 18.8 percent of i. we have ah another example here like your serving account

pays you an interest rate of 5 percent the inflation rate is ah ah 3 percent what is your real rate of interest. So, in here what we have is ah the i the nominal rate of interest is 5 percent is ah 0.05 and the inflation rate is 3 percent.

So, I inflation equal to 3 percent is 0.03 and it is asked how you know also calculate I r the real rate of interest equal to what. So, we know that i r equal to 1 plus i divided by 1 plus i i minus 1. So, if you put the values 1 plus 0.05 divided by 1 plus 0.03 minus 1 and that is equal to 0.0194 or 1.94%.



we have another ah mining example here like this is ah where you know we have ah our revenue we have our operating cost and ah then ah based on two condition one is ah ah the inflated ah values ah where we are calculating ah the nominal ah calculations and then we have real values

So, in this example, what we have is, you know, considering non-inflated values which are real, we have, you know, operating costs and the revenue amounts are given in crores. So, in the first case, you know, the non-inflated value where we are not, you know, taking the inflation part. So, what we have is, in year number 1, we have 100 crores of revenue; year number 2, 100 crores of revenue; and the third and fourth years also, we have 100 crores of revenue. And here, you know, the operating cost from year 1 all the way up to year 4 is

50 crores. So, ah, and what we know is that we have, ah, the nominal rate of interest, i, equal to 14 percent here, and the, ah, inflation rate, i, equal to, ah, 4 percent.

So, we are going to do three things here: first, if we know the real amount, what should be the corresponding, ah, inflated amount. So, the first thing is to calculate inflated values. The second thing we are going to do is to calculate, if we know the nominal rate and the inflation rate, what is the real rate of interest. And based on this, like, you know, after calculating both of these things, ah, then we calculate, ah, like, you know, what will be the NPV, ah, considering inflated values and what will be the, ah, NPV considering real values.

So, for this, the first thing is the year one revenue. We saw that, or maybe we have assumed that it is 100 crores revenue, considering the VL case. So, if you have inflated this value, so what Revenue we need to get with 4 percent inflation is 1.04, which is 1 plus 4 percent, into 100. So, this becomes our 400—sorry, this becomes 104 crores.

So, if there is further inflation for the next year, which is 4 percent. So, if you multiply this value by 1.04, then this value becomes 108.16. Further, if there is 4 percent inflation, then the amount we have to get in the third year, which is equivalent to 100 crores in the third year in real terms. So, this becomes 112.49 and another with another inflation for the fourth year. So, this becomes if you just multiply by 1.04 again, this becomes 116.

So, similarly, you know the operating cost will also change with the 4 percent inflation. So, this will become 1.04 multiplied by 50. So, this is 52 crore and, like this, this will increase to 54 crores with 4 percent inflation. So, this becomes, you know, And this will increase to 56.24 and this will further increase to 58.49 with every year's 4% inflation.

So, if we know these things, if we can calculate the revenue and operating cost with inflated values, we can say the cash flow value is, you know, let us say this is R. And this is O. So, this cash flow is R minus O, and this becomes our, you know, 52. This becomes 54.08, this is 56.24, and this is 58.49. So, the first part is done, and once we know, you know, the real rate of interest, we can calculate the third thing, which is the NPVs. So, for this, what we can do for the second case where this is there. So, like we calculated all these revenues in the first year, second year, third year, and fourth year, and also the operating cost.

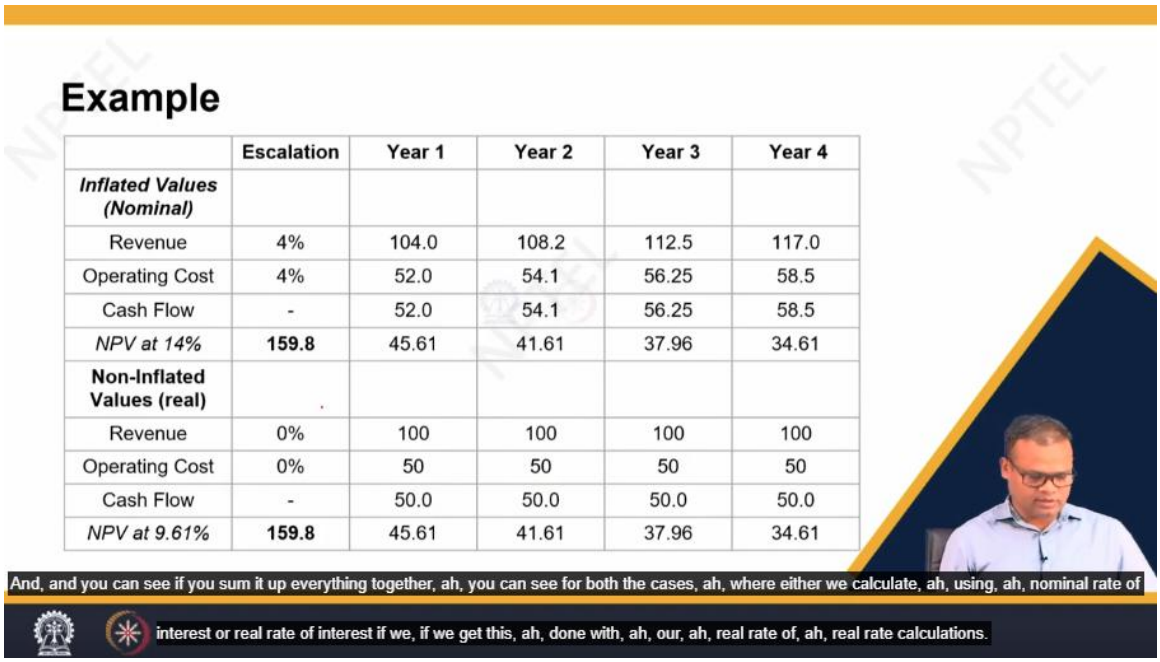
and we then we calculated this cash flows. So, once we have these values we can calculate what is the NPV based on 14 percent thing. So, this will be for the first year the present value of this amount is you know if this is c let us say c divided by 1 plus i which is 52 divided by i is 14 percentage. So, it is 1 plus 0.14.

So, this becomes 45.61 and the next one similarly this is 54 divided by 1 plus 0.14 square this is our 41.61 and the third this the present value of the 56.25 is 56.25 divided by 1 plus 0.14 cube. is 37.96 and the last one where the present value becomes 58.5 divided by 1 plus 0.14 to the power 4. So, this is 34.63. So, these are the present values of all the cash flow that we have there for first year, second year, third year and fourth year.

So, if we want to calculate the NPV you can just add all of them up. So, for the 4 years and this becomes 159.82. Similarly, for the case the real case ah we can calculate ah you know first is the cash flow because the revenue is 100 and operating cost is ah ah 50. So, if you subtract 100 minus 50 we have 50 here ah similarly for all the years ah we have constant ah cash flow of 50 considering the real case here.

So, in this case, we can, ah, first thing what we can do is to calculate, ah, what is our real rate of interest. So, we know i r equal to 1 plus i divided by 1 plus i i minus 1. So, if you put the values, so i is 1 plus i is 0.14 which is 14 percent divided by 1 plus i is 4 percent is 0.04 minus 1. So, this becomes So, we can calculate the NPV at real rate of interest I R equal to 9.61 percent.

So, And if you see the first year, the present value of this 50 crores becomes 50 divided by 1 plus i i r here which is equal to 45.61 and the second one similarly becomes 50 divided by 1 plus IR is 0.961 square so this is 41.61 and the third one becomes again, you know, the present value of this third year cash flow is 50 divided by 1 plus 0.961 So, this is your 37.96 and the fourth one, the present value is 50 divided by 1 plus 0.961 to the power 4



	Escalation	Year 1	Year 2	Year 3	Year 4
Inflated Values (Nominal)					
Revenue	4%	104.0	108.2	112.5	117.0
Operating Cost	4%	52.0	54.1	56.25	58.5
Cash Flow	-	52.0	54.1	56.25	58.5
NPV at 14%	**159.8**	45.61	41.61	37.96	34.61
Non-Inflated Values (real)					
Revenue	0%	100	100	100	100
Operating Cost	0%	50	50	50	50
Cash Flow	-	50.0	50.0	50.0	50.0
NPV at 9.61%	**159.8**	45.61	41.61	37.96	34.61

which is 34.63. And if you calculate the present value of or net present value of all these present values.

So, you just add it up and this becomes 159.82. And, and you can see if you sum it up everything together, ah, you can see for both the cases, ah, where either we calculate, ah, using, ah, nominal rate of interest or real rate of interest if we, if we get this, ah, done with, ah, our, ah, real rate of, ah, real rate calculations. So, in both the cases, ah, it is, you know, 159 point. 2 that is what we can get, but if you say like, you know, our real rate of interest i r equal to let us say i minus i i which is 14 percent minus 4 percent is 10 percent. So, if you calculate, you will get a different value of, you know, NPV here, ah, which is 158.5 which is not the real case.

So, you have to take care of the, you know, real values. We have to calculate the real rate of interest to solve our mining problem. So, this ends our class today, and in the next lecture, we will see a few more examples on inflation.