Project Management for Managers
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Lecture - 22
Stand - Alone Risk Analysis- I

Good morning everyone, I welcome you all in the session. The topic for the session is standalone risk analysis though we have seen couple of things about this topic in previous session as well we will quickly go through those things and then will look at what are different methods of standalone risk analysis.

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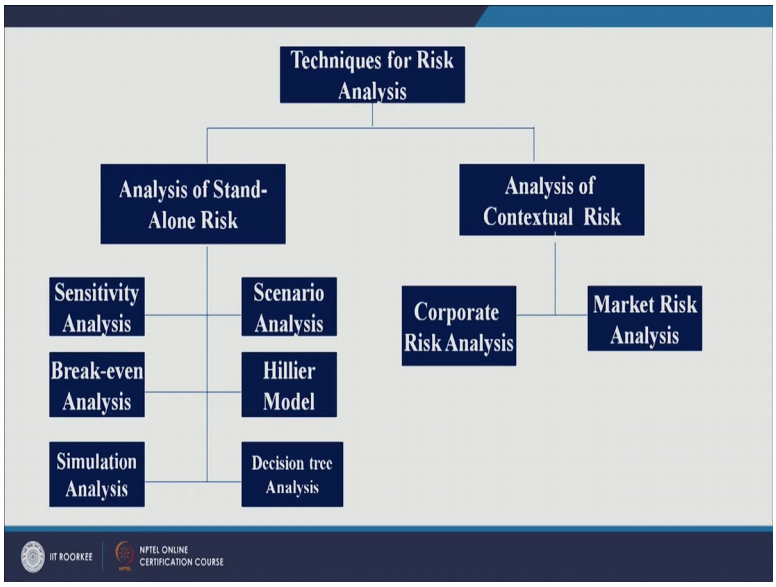

So, these are 2 broad categories you have got analysis of standalone projects and analysis of contextual risk. So, in contextual risk you can have let us say you are you are analyzing all the projects which are there in that particular form and you are also analyzing effect of market forces on those projects right. If you look at analysis of standalone risk we have got sensitivity analysis break even analysis simulation analysis scenario analysis Hillier model of risk calculation very important model and then decision tree analysis right.

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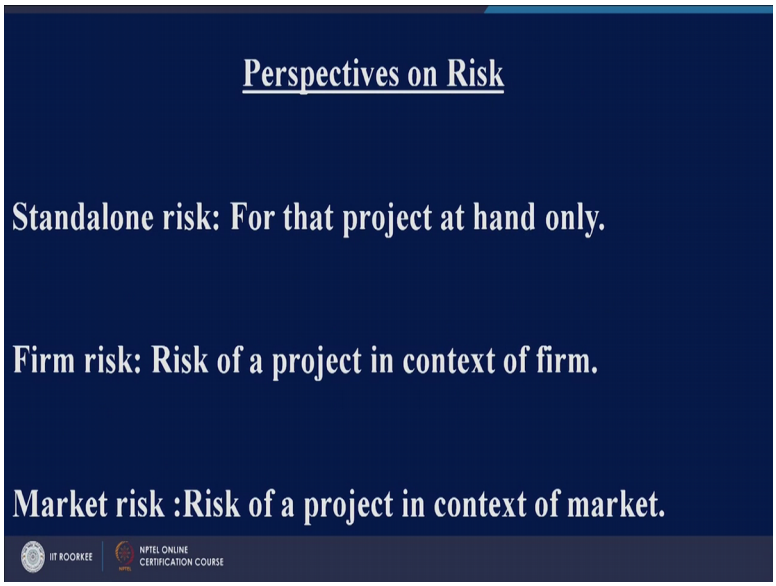

So, we will look at these things in previous class we have also seen couple of sources of risk those are technical competitive industry specific market and international risk. All these things we have discussed in previous class right when we talked about measures of risk we did discuss range standard deviation coefficient of variation and semi variance.

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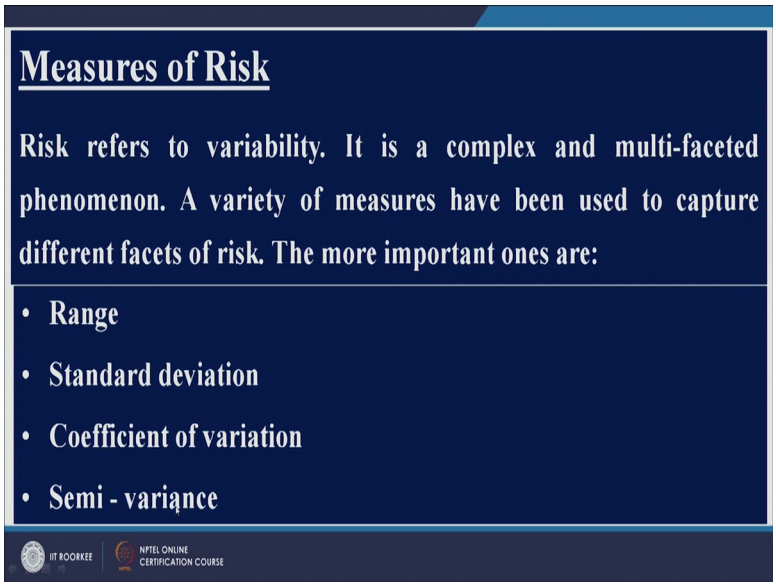

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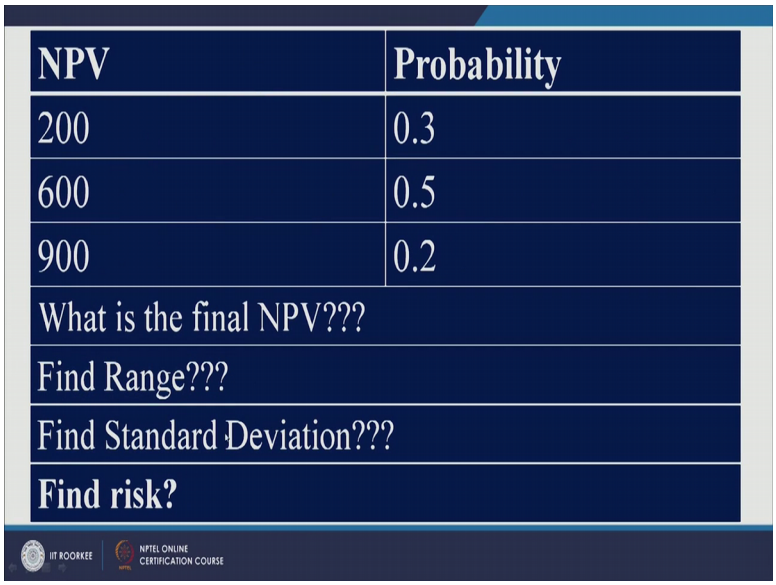

So, this was our question and we found our final NPV was multiplication of NPV multiplied by probability plus this into this plus this into this. So, that was final NPV right and their range was also calculated right.

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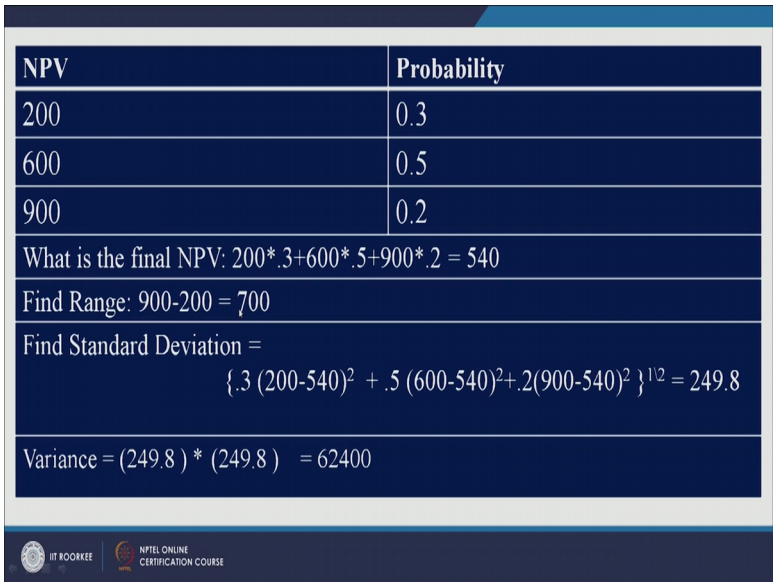

So, we will I will show you those values. So, NPV was 540; right. So, this was our final NPV range was 700 as I said my range is the difference between maximum and minimum NPV standard deviation also we calculated; it was 249.8 and variance is just square of standard deviation right.

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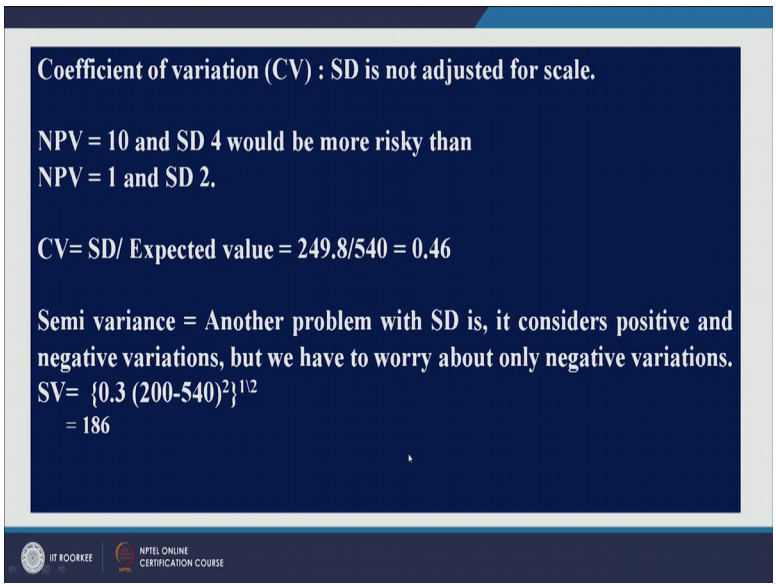

Now, the other measures which we have seen or let us say coefficient of variation right actually the problem with standard deviation is that it is not adjusted for scale. So, what

we do to compare 2 projects we take we will calculate coefficient of variation which is the ratio of min to standard deviation right.

So, NPV of a project is 10, but standard deviation is 4 while NPV of second project is one and standard deviation is 4. So, we will calculate coefficient of variation.

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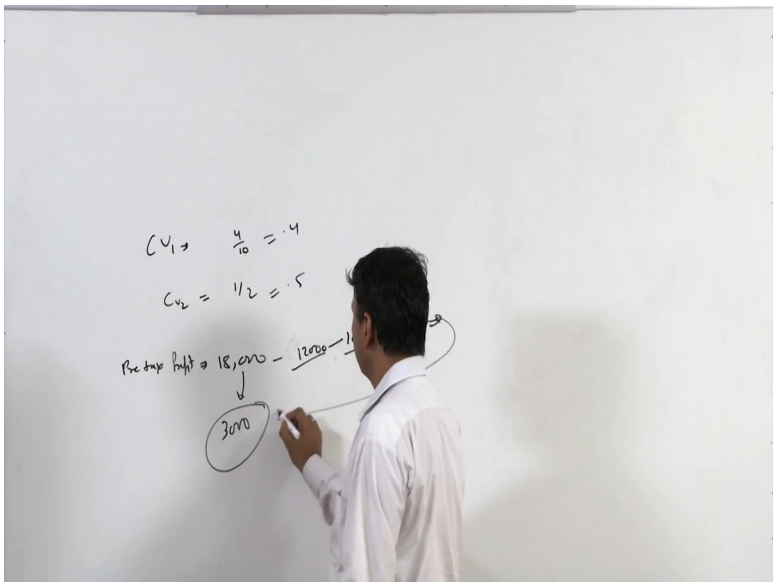

Like this for first it is 4 by 10 and for second it is 1 by 2. So, this is 0.4 and this is 0.5. So, let us look at external coefficient of variation in our example to a standard deviation 249.58; 249.8 divided by NPV which is 0.46 right. So, coefficient of variation for our example is 0.46 now they the other problem with the standard deviation is that it takes into account all positive and all negative variances, but we are interested in only in negative variance and we want to minimize those negative variances. So, that negative variances point 3 into 2 hundred minus 540 whole square and under root of this right. So, it is 186 we do not want semi variance to be more and more right it should be 0 right preferably.

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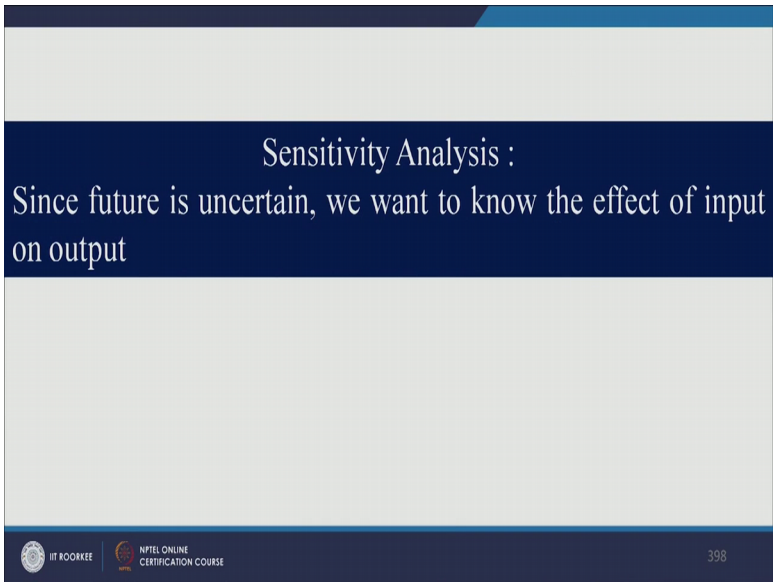

Now, after looking at those measures let us look at some other methods of measuring risk of standalone projects. So, this second method is sensitivity analysis sensitivity analysis is a process of finding change in output whenever we make some changes in input why we do though do. So, because future is very uncertain we want to know how things will work out if we change some of the things which are there with us. So, this is sensitivity analysis we want to know the effect of input on your final result.

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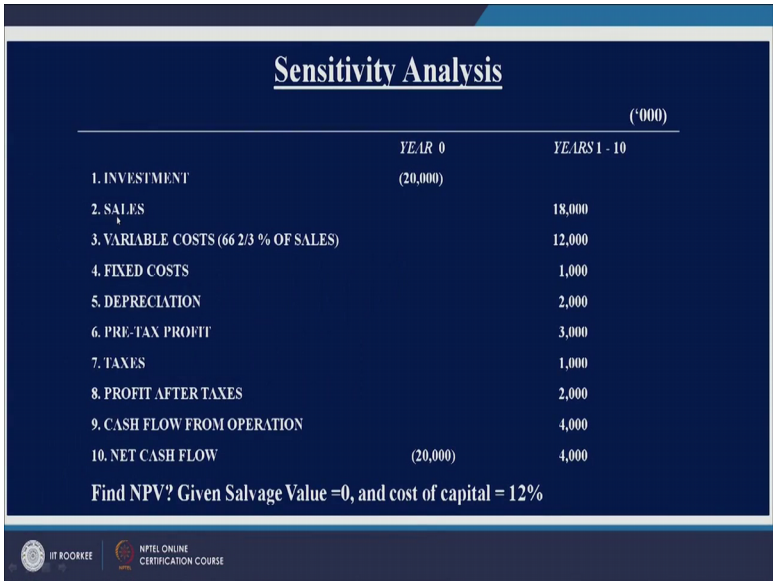

Let us look at this example this is there is a project investment is 20000 sales 18000 variable cost is 66.666 percentage of sales right. So, just 18000 multiplied by 0.667 right you will get 12000 fixed cost is 1000 rupees depreciation is 2000 rupees pretax profit is 3000. Now how to calculate this pretax profit pretax profit pretax of profit is whatever is your sales which is 18000 minus variable cost or you can do like this also minus variable cost minus fixed cost minus depreciation which is 3000 this comes out to be its 12, 13, 15 right. So, remaining is 3000 right. So, this is 3000 and which is given here right pretax profit is 3000 right. So, keep in this formula for calculation of pretax profit taxes 1000 rupees profit after tax is very simple just subtract taxes from pretax profits.

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Present value of an annuity of ₹ 1 paid for period t at a rate $k = [1 - 1/(1 + k)^t]/k$

	Rate																			
Period	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.713	1.690	1.668	1.647	1.626	1.605	1.585	1.566	1.547	1.528
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.444	2.402	2.361	2.322	2.283	2.246	2.210	2.174	2.140	2.106
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170	3.102	3.037	2.974	2.914	2.855	2.798	2.743	2.690	2.639	2.589
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.696	3.605	3.517	3.433	3.352	3.274	3.199	3.127	3.058	2.991
6	5.795	5.601	5.417	5.242	5.076	4.917	4.767	4.623	4.486	4.355	4.231	4.111	3.998	3.889	3.784	3.685	3.589	3.498	3.410	3.326
7	6.728	6.472	6.230	6.002	5.786	5.582	5.389	5.206	5.033	4.868	4.712	4.564	4.423	4.288	4.160	4.039	3.922	3.812	3.706	3.605
8	7.652	7.325	7.020	6.733	6.463	6.210	5.971	5.747	5.535	5.335	5.146	4.968	4.799	4.639	4.487	4.344	4.207	4.078	3.954	3.837
9	8.566	8.162	7.786	7.435	7.108	6.802	6.515	6.247	5.995	5.759	5.537	5.328	5.132	4.946	4.772	4.607	4.451	4.303	4.163	4.031
10	9.471	8.983	8.530	8.111	7.722	7.360	7.024	6.710	6.418	6.145	5.889	5.650	5.426	5.216	5.019	4.833	4.659	4.494	4.339	4.192
11	10.368	9.787	9.253	8.760	8.306	7.887	7.499	7.139	6.805	6.495	6.207	5.938	5.687	5.453	5.234	5.029	4.836	4.656	4.486	4.327
12	11.255	10.575	9.954	9.385	8.863	8.384	7.943	7.536	7.161	6.814	6.492	6.194	5.918	5.660	5.421	5.197	4.988	4.793	4.611	4.439
13	12.134	11.348	10.635	9.986	9.394	8.853	8.358	7.904	7.487	7.103	6.750	6.424	6.122	5.842	5.583	5.342	5.118	4.910	4.715	4.533
14	13.004	12.106	11.296	10.563	9.899	9.295	8.745	8.244	7.786	7.367	6.982	6.628	6.302	6.002	5.724	5.468	5.229	5.008	4.802	4.611
15	13.865	12.849	11.938	11.118	10.380	9.712	9.108	8.559	8.061	7.606	7.191	6.811	6.462	6.142	5.847	5.575	5.324	5.092	4.876	4.675
16	14.718	13.578	12.561	11.652	10.838	10.106	9.447	8.851	8.313	7.824	7.379	6.974	6.604	6.265	5.954	5.668	5.405	5.162	4.938	4.730
17	15.562	14.292	13.166	12.166	11.274	10.477	9.763	9.122	8.544	8.022	7.549	7.120	6.729	6.373	6.047	5.749	5.475	5.222	4.990	4.775
18	16.398	14.992	13.754	12.659	11.690	10.828	10.059	9.372	8.756	8.201	7.702	7.250	6.840	6.467	6.128	5.818	5.534	5.273	5.033	4.812
19	17.226	15.678	14.324	13.134	12.085	11.158	10.336	9.604	8.950	8.365	7.839	7.366	6.938	6.550	6.198	5.877	5.584	5.316	5.070	4.843
20	18.046	16.351	14.877	13.590	12.462	11.470	10.594	9.818	9.129	8.514	7.963	7.469	7.025	6.623	6.259	5.929	5.628	5.353	5.101	4.870

So, 3000 minus 1000 which is 3000 right cash flow from operations is 4000 right and net cash flow is 4000. So, this question is given to you and you have to calculate NPV net present value of this project given salvage value is 0 and cost of capital has 12 percent right you just try this question I hope all of you would be able to solve.

So, let me also solve this question for you. So, here cash flow from operations is 4000 rupees. So, this is annuity for next 10 years right this is sequential flow. So, this is an annuity right and you know cost of capital 12 percent salvage value 0. So, you have got this table present value of annuity table. So, just look at what is the period; it is 10 years right. So, look at this particular value 10 years and rate is 12 percent.

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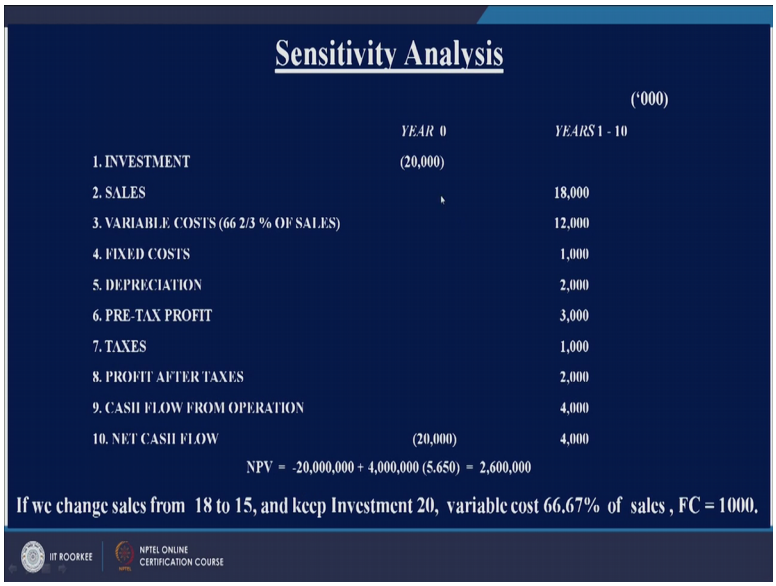

So, intersection of these 2 is 5.65 right. So, NPV is this 20000000, we have all these values are again in thousands right. So, NPV is 2 6 double 0 tribal 0 right. So, this is very simple way of calculating NPV right; how did you get this 5.65 from this particular table right. So, 12 percent and tenth year right; so, 5.650 right 5.650 right. Now this is NPV now in sensitivity analysis as I said we keep when we change one of the inputs and we see the effect of that change on output and here output is nothing, but NPV right. So, if you change sales from 18000 if you change sales from 18000 to 15000, but we keep other important input variables constant namely investment same 20000 variable cost 66 percent of the sales and fixed cost 1000 right. So, how our NPV will change right that is the question.

So, you just do one thing instead of 18000 right here 15000 right and then calculate NPV.

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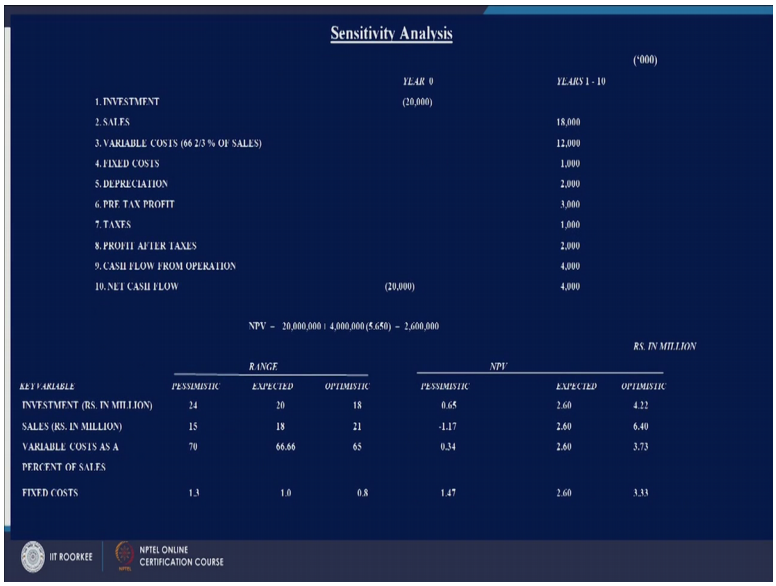

So, for this for this question these are different outputs and these outputs I have done in excel sheet also. So, let me directly go to excel sheet then you will understand from where did I get all these NPVs right. So, let us move onto excel sheet.

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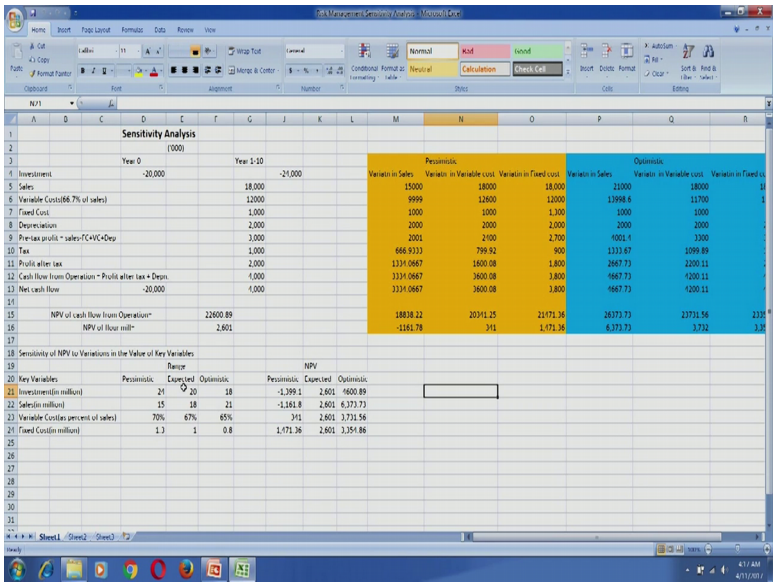

So, this is our excel sheet and this is our question right. So, as I said investment twenty thousand sales 18000 pretax profit is 3000. So, this is pretax profit and NPV is this. So, NPV you can just write a macro over here is equal to NPV 12 percent and this 4000 10

times right. So, you will also get NPV in this way also right and NPV for our question is 2601 right.

So, let us now perform sensitivity analysis. So, what we have to do we have to. So, in this particular case there are 3 scenarios given pessimistic scenario optimistic scenario and normal scenario or expected scenario right pessimistic scenario means you are assuming that everything will go wrong everything is against you right optimistic scenario everything would be positive for your project right and expected scenario is normal scenario right the way things move normally right. So, our recent sales is 18000 right and let us say if sales comes down to 15000 what will happen to NPV right. So, this is our pessimistic scenario and variation in sales is now 15000 since variation in sales is now 15000 what would be the variable cost since variable cost is 66 percent of sales. So, 15000 into 0.66; so, we will get tribal this 9999 right approximately 10000, very simple.

Fixed cost as I said they all other input variables will remain same except sales right. So, fixed cost is same depreciation is same of course, your pretax profit will change because you are variable cost is come down right; so, 15000 minus this 3 right. So, 15000 minus this 3 you will get 3000 one this is nothing, but pretax profit when your sales is 15000 right tax is this much.

It is 666.93 then profit after tax its very simple whatever is tax multiplied by tax subtract it from subtract tax from pretax profit right you will get profit after tax cash flows from operations is also can be calculated and this is your net cash flow right and this value is your final NPV right for this particular project its minus double 161. So, where is this point is written here. So, what is NPV when sales is 15000; it is here right this point right. So, this is the NPV when we changed sales from 18000 to 15000. Now let us see what happens if we change if there is a change in variable cost right and let us say changing variable cost is now 70 percent right pessimistic scenario. So, you are cost has increased right let us see what happens; so, variation in variable cost.

So, say now other things will remain constant right other things means sales investment right and fixed cost right. So, you can easily calculate variable cost is now seventy percent of the sales right in this case it was 66.66. Now this is 70 percent fixed cost thousand depreciation remains same pretax profit its very simple you can calculate in a way which we calculated earlier right tax is this much profit after tax 1600 cash flow

from operations net cash flow is this and this is your NPV 341 right which is here what is the third input variable fixed cost now let us change fixed cost right now earlier fixed cost was 1000; now it is 1300 right.

So, how NPV will change because of this? So, now, sales is same cost is same initial variable cost which is 66 percent of sales right all other values you can be calculated easily and this is your NPV 1471 which is this right. So, what we have done we have taken a pessimistic scenario and we calculated our NPVs like this right similarly if scenario is optimistic you can are calculated you can calculate NPVs right. So, let us look at just one case of optimistic scenario.

Now, your original in our original problem sales is this much right 18000, but now scenario is optimistic right. So, sales is now 21000 right. So, this is 21000, but variable cost will remain same right fixed cost depreciation pretax profit tax profit after tax and this is your cash flow from operations and finally, this is your NPV 6373 right this one isn't it. Similarly for other variables also you can find out NPVs right. So, this is nothing, but sensitivity analysis. Now I hope that you would have understood how to do sensitivity analysis. So, let me check where these values are there where these values are in our PPT right. So, this is minus double 161 yeah. So, this somewhere here right. In fact, these values are exactly correct right. So, just take these values as finals values right.

So, let us move on to next analysis before going for scenario analysis let us look at what are the problems and what are the merits of sensitivity analysis. So, the merits are sensitivity analysis will tell you how robust your project is right or how vulnerable your project is because as I said future is uncertain if some something changes then your project would be affected right. So, it is good to go for sensitivity analysis a priory right before things actually change right.

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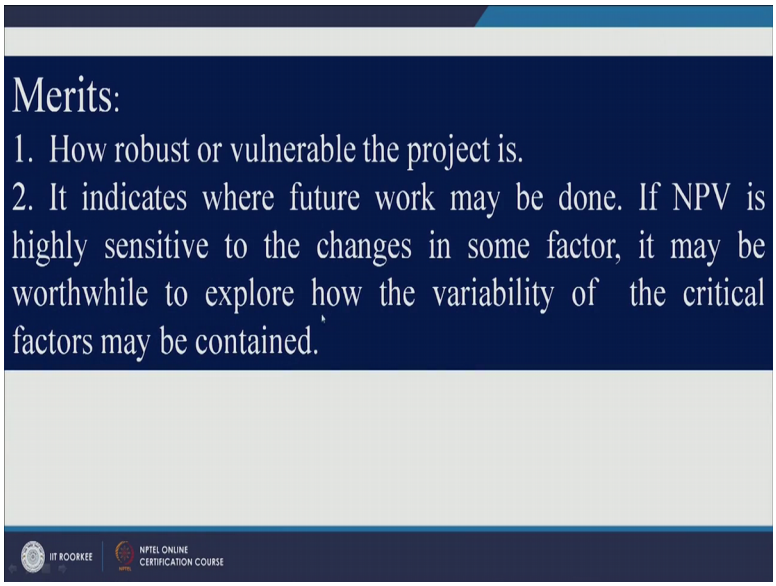

So, it indicates where future work may be done if NPV is highly sensitive to changes in some factor it may be worthwhile to explore how the variability of the critical factors may be contained right. So, you know a priory that if sales are coming down my NPV will be reduced to this much value right. So, you should start working on improving your sales right or let us say if costs are going to increase and how NPV will come down right. So, it is good to contain cost right. So, you will get an idea on and in which area you are supposed to work to maintain your NPV right.

So, these 2 are merits of sensitivity analysis, but there are couple of short comings as well right the most important shortcoming are limitation is it considers only one variable at a time. So, you can change only one variable at a time and see the effect of that change on your NPV right, but in real life generally many variables change at a time and there is interrelationships also amongst those input variables right. So, that picture cannot be captured through sensitivity analysis; another shortcoming is subjectivity in interpretation of different projects right. So, since you have got different projects and let us say and due to increase in cost NPV is coming down in one project and in another project also it is coming down. So, there would be lot lots of subjectivity.

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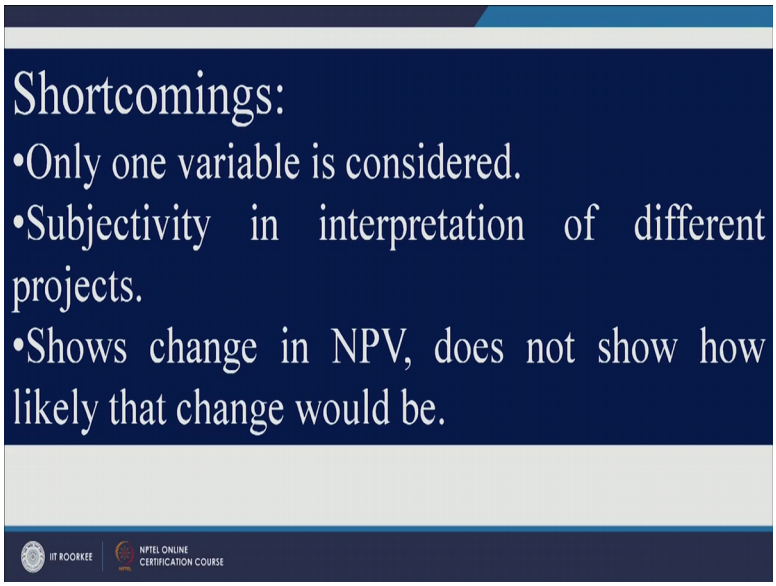

Shows change in NPV does not show how likely that change would be we really do not know whether that much change in NPV will be there or not what is the probability of that much decrease or increase in NPV. So, that is that that is another shortcoming of sensitivity analysis right. So, this was sensitivity analysis.

Let us look at another method of analyzing risk in standalone project and this method is scenario analysis right now is as we have seen that the one of the shortcomings of sensitivity analysis that there we could change only one input variable right, but in scenario analysis there is a possibility of changing more than one input variables simultaneously and we will see the effect of those changes on our NPV or whatever is the output right. If I ask you a question how many scenarios are possible. So, in previous question also we have seen that there were only 3 scenarios optimistic most likely are expected or normal scenario right and the third one is pessimistic right. So, there are only 3 scenarios possible right. So, we will take of course, you can take an example and you can change your input variables and you can also see the effect of those changes on output variable right.

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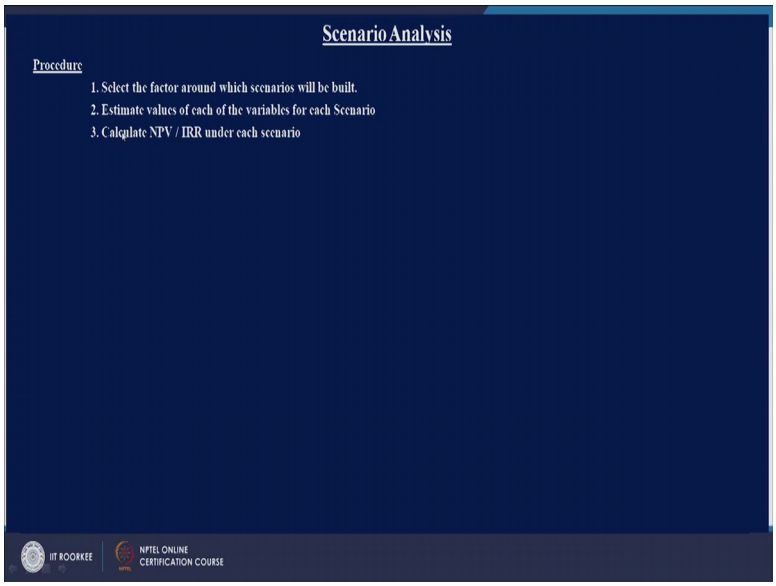

So, procedure is there select the factor around which see scenarios will be built estimate value of each of the variables for each scenario calculate NPV are IRR payback period or whatever it is your output right.

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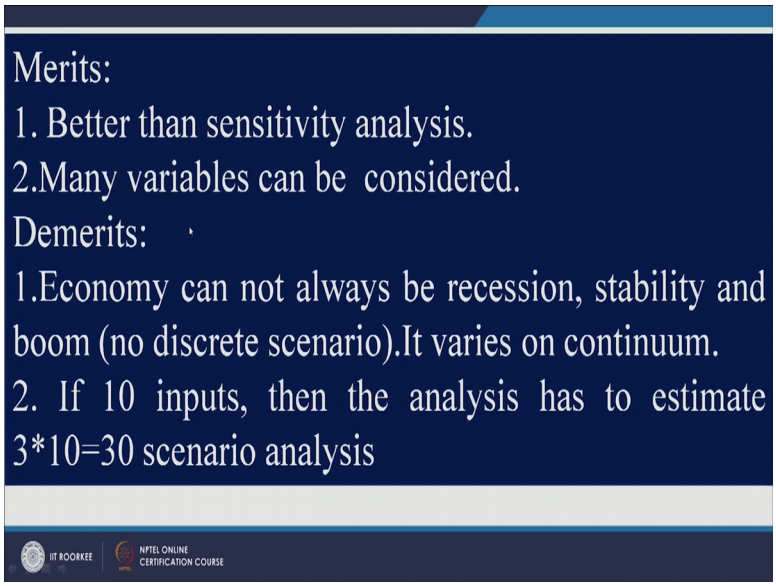

Let us look at couple of merits of scenario analysis it is better than sensitivity analysis because we can consider many variables, but there are demerits as well economic and yeah, this is very important point we think that there are only 3 scenarios. But in real life you will have a combination of them right there will be you will have combination of

them will have interaction amongst them and there are several possibilities. So, you will not have only these 3 scenarios right you will have several scenarios right. So, so you can say that you do not have a discreet scale right you cannot say that this is optimistic this is pessimistic and this is expected.

It is basically continuous variable right. So, you have to look at these particular demerits this particular demerit very carefully right. So, let us say for example, if there are 10 input and if we take let us say 3 scenarios right then the analysis has to estimate 3 into 10 total thirty scenario right because of 10 input variables and you have considered 3 scenarios right. So, total 330 outputs will be there right.

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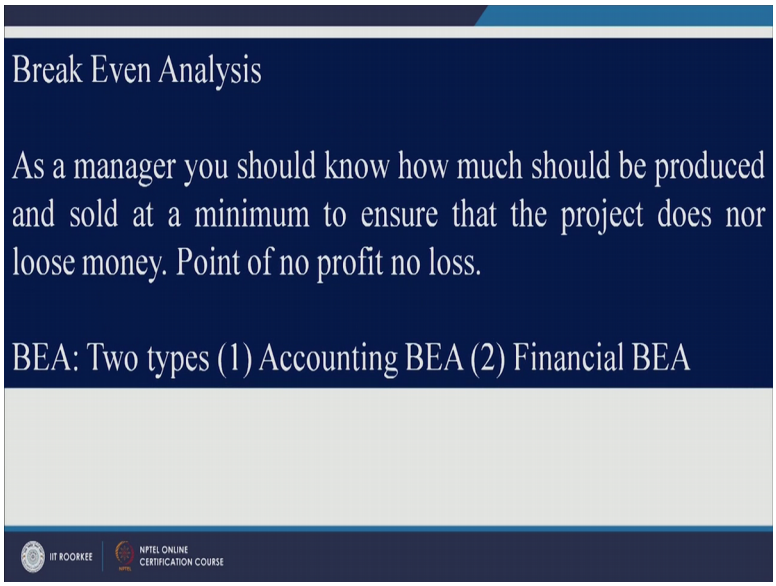

So, it is difficult to calculate also now let us move on to next method of assessing risk in standalone project and this is break even analysis break even analysis is basically a kind of analysis which is which gives you a situation where there is no profit and no loss right. So, sorry it is good to go for going dead zone where profit occurs right because initially what happens you are you are investing in a project after sometime once your product is ready or if your project is ready it starts earning right. So, after certain time after some time you will reach at a point where cost is equal to revenue and that point is known. So, as a breakeven point right. So, as a manager you should know how much should be produced and sold at a minimum to ensure that project does not lose money right.

So, there are 2 types of break even analysis you have got accounting break even analysis and financial break even analysis. Now when I say accounting breakeven analysis I am not I am talking only about accounting profit.

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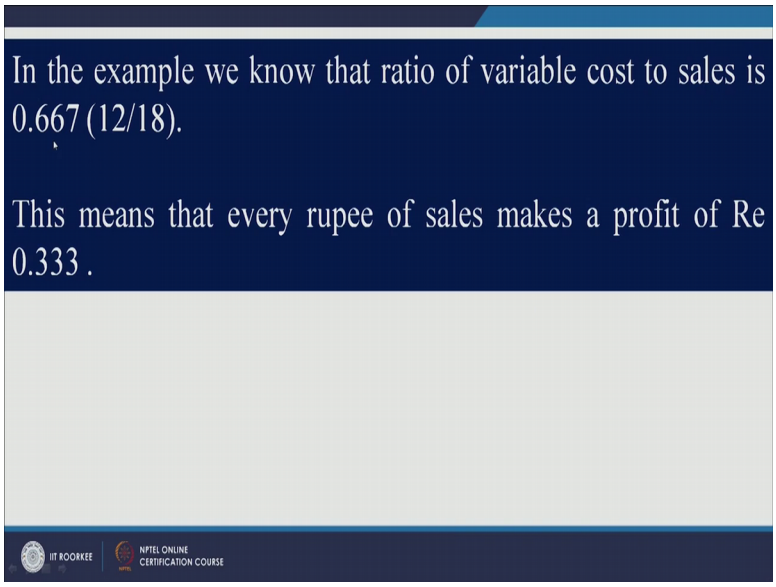

So, let us take an example where; there the ratio of variable cost to sales is 0.66 ratio of variable cost to sales. So, let us say sales is 18000 and variable cost is 12000 right. So, this the ratio of cost to sales in other words we can say that for every rupee of sales makes a profit of 0.33. So, when you sale product of 100 rupees you would be making 33 rupees profit that is the meaning of this ratio right.

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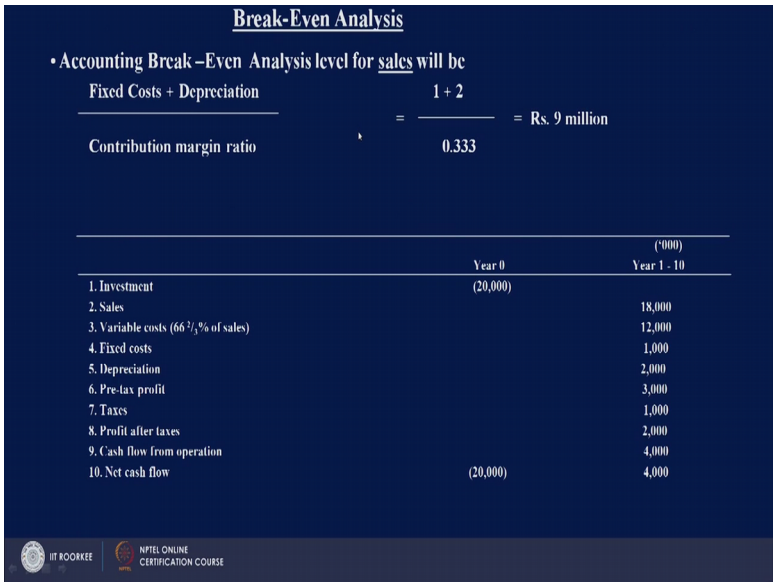

So, break even analysis let us for sales is this fixed cost plus depreciation divided by contribution margin ratio right. So, what is contribution margin ratio it is 33.33 percentage right and how did we calculate it is a ratio of variable cost to sales right.

So, fixed cost and this is the question for which we are finding out accounting breakeven point right. So, fixed cost 1000 depreciation 3000 and contribution margin ratio is 0.3 right. So, 9 million; so, when sales is sales is of rupees 9 million then only you will achieve accounting breakeven point right.

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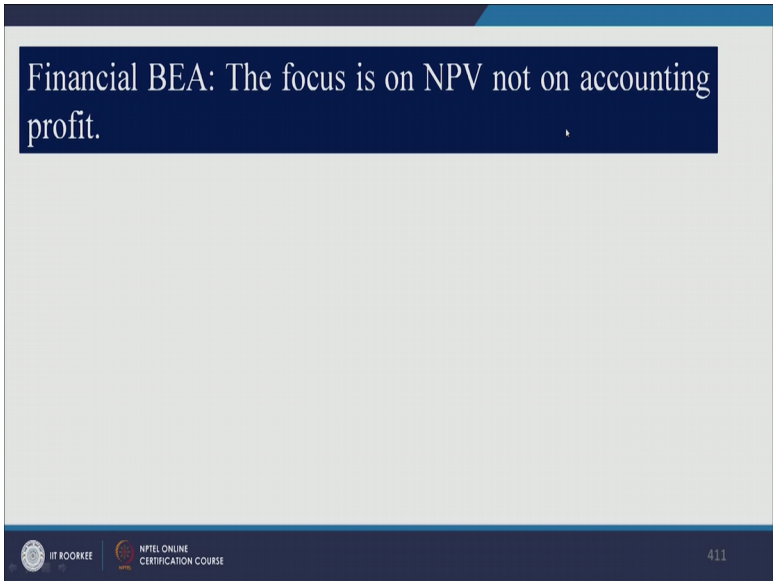

Now let us look at financial breakeven analysis the focus here is on NPV not on accounting profit right. So, you can also calculate what would be the financial break even analysis for sales in other words at what point you will get a breakeven point when sales will have certain value right. For example, in this case when sales was 9 million you achieved break even analysis right. So, in this question for some other value of sales you will achieve break even analysis right.

So, let us summarize what we have done so far in this class. We have seen different methods of project risk analysis we have seen sensitivity analysis we have seen scenario analysis we have seen break even analysis and in next class we will see some other methods of assessing risk in standalone projects.

Thank you very much.