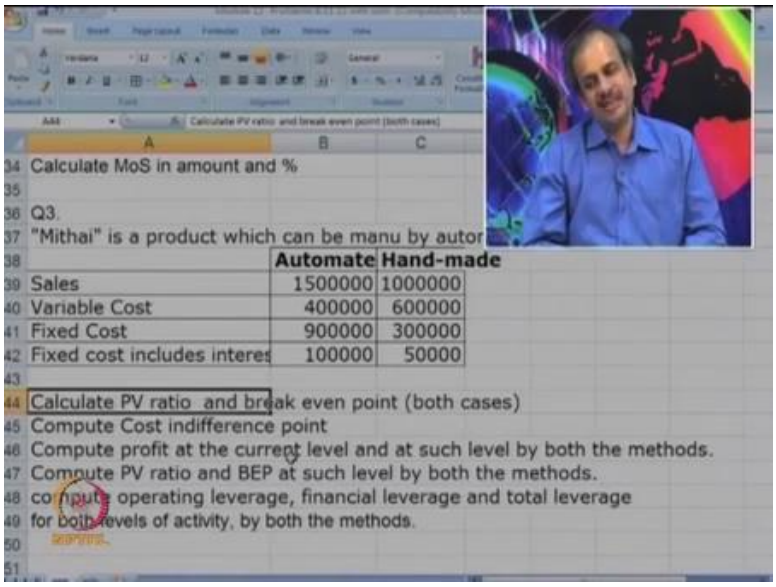
Managerial Accounting
Prof. Dr. Varadraj Bapat
Department of School of Management
Indian Institute of Technology, Bombay

Lecture - 35
Cost Volume Profit Analysis - Cost Indifference Point and Leverage

Dear students, in the last session we were discussing fundamentals of CVP. We have done a revision and we have also started some cases. First let us continue with that. So, for those who have missed the last session, we would do a very brief revision of concepts. So, what do you understand by contribution per unit, what is the formula? It is sales minus variable costs.

What is PV ratio? Contribution upon sales, that leads us to BEP. So, what is the formula for BEP, fixed cost upon contribution per unit or fixed cost upon PV ratio. Using these fundamental concepts, we have seen how we can take variety of decisions. Like product mix decisions, like whether to outsource or not type of decision or to decide on the level of activity and so on. In the last session, we were doing a case on calculation of cost in difference point and also calculation of leverages. Please read the case, once again carefully.

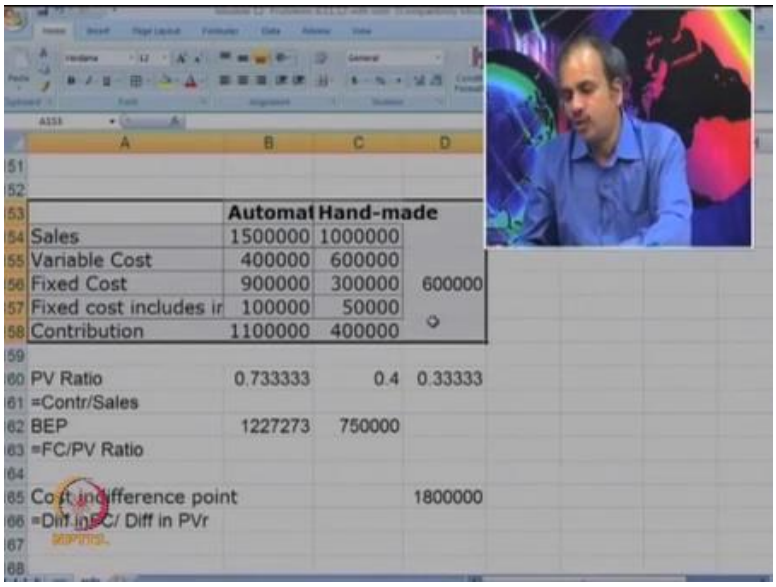
(Refer Slide Time: 01:38)



So, you can see here, Mithai is a product which can be manufactured, by automated system or by hand. Then, the data is given about sales, variable cost, fixed cost. This

fixed cost includes interest expenses, that is also given. We have to compute PV ratio, BEP cost indifference point. Then, profit at the current level and at the cost indifference point level. Then, PV ratio and BEP, operating leverage, financial leverage and total leverage, at both the levels by both the methods. So, how to proceed those who have seen the earlier video would have known up to a certain point, which we have done. So, first is very simple, we will try to calculate PV ratio and BEP.

(Refer Slide Time: 02:41)



That I think all of you are very much familiar. So, PV ratio is contribution upon sales. We have first calculated contribution; we got a PV ratio of 0.73 for automated system and 0.4 for handmade system. BEP is FC upon PV ratio. We know the fixed cost, do not consider this interest right now. We will need it, but we will need it when we go for calculation of leverages. Now we take the total fixed cost of 9 lakhs and divide it by PV ratio of 0.73.

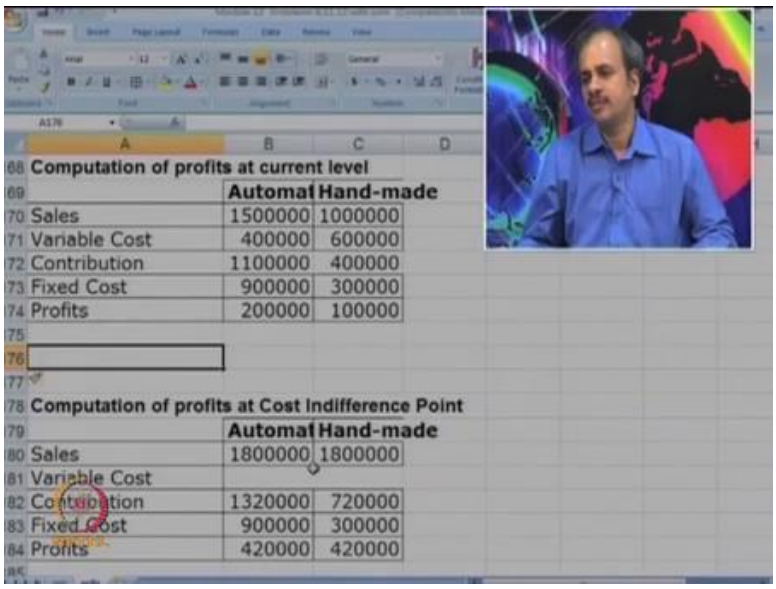
So, BEP becomes 1227000 and by handmade system, it is 750000. Why is BEP lower in a handmade system, because handmade system has lower fixed cost, it is just 3 lakhs. So, BEP is also low. In other words, handmade system is preferable, when demand is low. And automated system is preferable, when the demand is high. Now, the question is, up to what level of sales is handmade system preferable.

So, what will be your answer is, it preferable up to 750000 or up to 12 lakhs. Because, below 750 by both the methods, we are in losses, at 750 handmade starts making some

profit. At 1227000 automated systems starts making some profit. But, still the profit from the handmade will be higher. So, we will have to calculate that point of sales, where the profit by both the methods is same.

And that is known as cost indifference point. So, at that point, we are indifference to both the technologies, whether handmade or automated it makes no difference. But, if sales exceed that level, it is better to go for automated system. So, let us try to calculate the cost indifference point now the formula is very similar to that of BEP. In BEP, we did FC upon PV ratio. Now, will do difference in FC upon difference in PV ratio. So, you can see here, we have tried to calculate the difference. So, fixed cost, there is a difference of 600000. In PV ratio, there is a difference of 0.333. So, cost indifference point is FC upon PV ratio. So, we get 18 lakhs correct, up to this we had in the last session. Now, let us go to the next part.

(Refer Slide Time: 05:39)



Now, we are asked to calculate the profit at the current level. And at cost indifference point level. So, now, if the sales are 18 lakhs, what will be the profitability? That is something, we would try to calculate. If you are able to do it, please take pen and paper and try to do it on your own, because it is very simple. So now, how the profits are calculated in CVP.

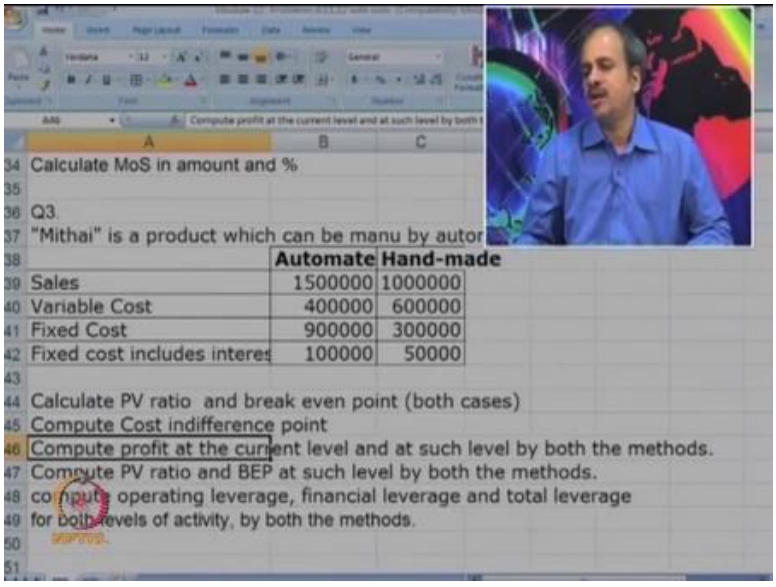
Usually, we start with contribution and subtract fixed cost. So, same thing will do. So, we have already calculated contribution. So, sale less variable cost, we get contribution,

we do not need interest etcetera right now. So, profits are contribution minus fixed cost. So, profit is 2 lakhs from automated and 1 lakh from handmade. So, the first part of the question was, compute the profit at the current level and at such level by both the methods.

So, computation of profit at current level is something we have done right now. Now, let us use the same structure and try to compute the profit at cost indifference point. How much is the cost indifference point, we have just calculated it to be 18 lakhs. So, let us put 18 lakhs here and at that point, naturally both the sales are going to be constant. How much will be the variable cost, we know that variable cost is sales into PV ratio.

So, variable cost will be 13 lakh 20 and 7 lakhs 20. Contribution is sales into PV ratio. So, this is not variable cost, what we have done right now is a contribution. Variable cost is actually, we need not worry about. So, are you able to get it. So, our contribution will be 13 lakhs 20 from automated system and 720 from handmade system minus fixed cost profit is 420 and it is same, it has to be. By definition, cost indifference point was such point, where the profits are same and the revenue is also same.

(Refer Slide Time: 09:28)



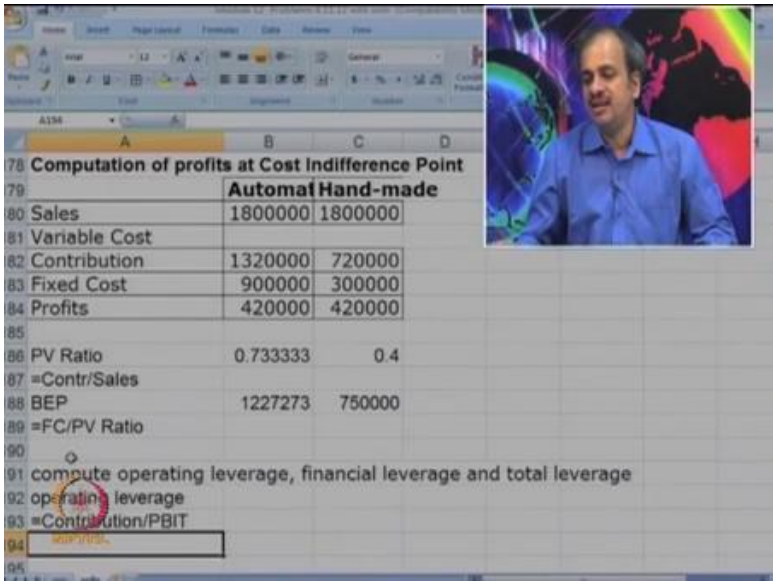
Now, let us go to the next part. So, we have computed the profit at current level and at cost indifference point. Now, compute the PV ratio and BEP at such levels by both the methods. So, how much will be the PV ratio and BEP for each of them. Current level, we have already calculated how much it will be for cost at a cost indifference point. Is it

going to change, of course, it would not change, it is just asked to test are you able to do it.

So, at cost indifference point or at whatever point, the PV ratio does not change. PV ratio will remain at 0.73 and 0.44. Same way, BEP will also not change; it is fixed cost divided by PV ratio. So, it is 1227 and 750 as was before. So, this question is, not required, but to just test your knowledge. So, at such level, that is at cost indifference point. This is the PV ratio and BEP.

Now, compute operating leverage, financial leverage and total leverage. So, what is the formula for operating leverage? Are you able to remember? So, in operating leverage, we try to know the relationship between the contribution and profit before interest and taxes.

(Refer Slide Time: 11:38)



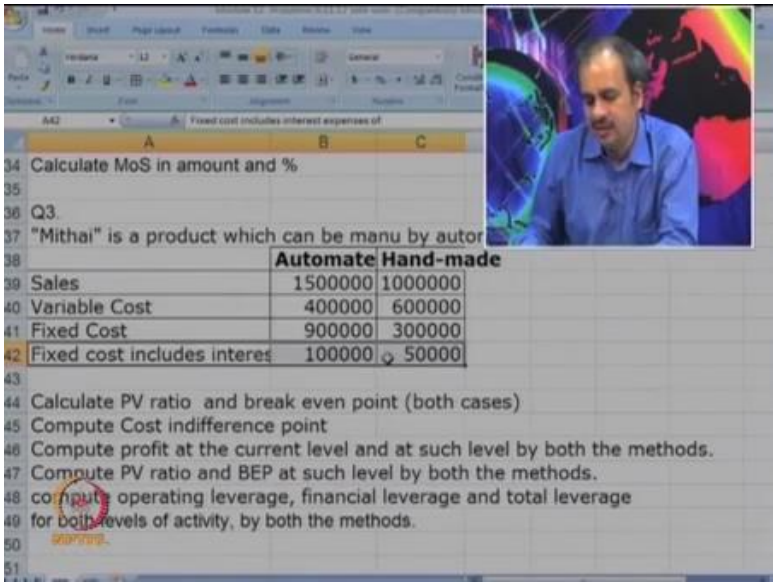
So, to do it, first let us write the formula, contribution upon PBIT. So, to do it we need to know the PBIT now. So, far we have ignored completely ignored the interest, but now we will use the interest information and try to calculate it. So, let us push this format down. Now, let us start with the current level, we know the profit as of now. So, I am just taking it again.

So, profit at the current level this was the structure, but we are given that fixed cost includes interest of 1 lakh and 50,000 respectively. So, now, this fixed cost, we would like to break into operating items and interest. So, here I am just qualifying that. Now, I

will consider fixed cost, other than interest. So, interest of 1 lakh and 150, which was included. Now, needs to be excluded.

So, fixed cost, which was 9 earlier. Now, becomes 8 lakhs and for handmade system, it becomes 250. And the profit, which was calculated, is actually PBIT correct. Now, from this PBIT, we would like to compute PBT. So, we had already calculated earlier the PBT that will remain same. But, we have added one more level and try to calculate PBIT correct.

(Refer Slide Time: 14:25)

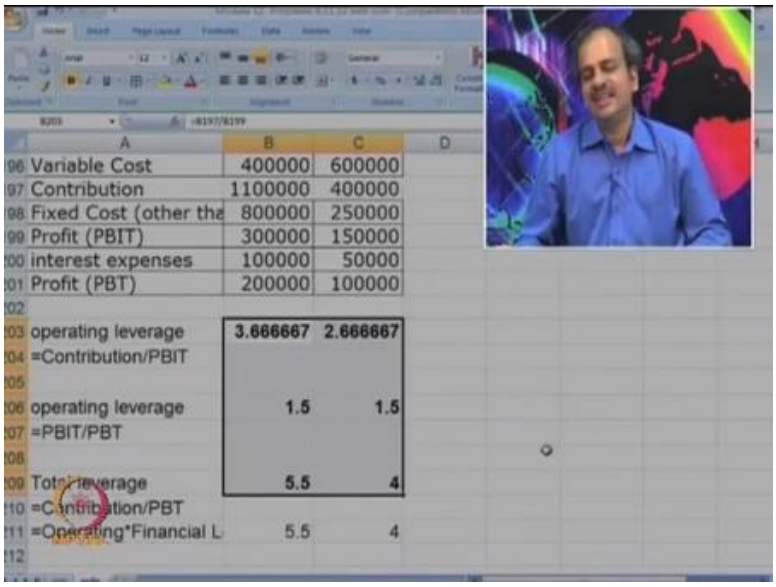


Now, calculate operating leverage using these data. So, our formula for operating leverage is contribution upon PBIT. So, we know contribution is 11 lakhs divided by PBIT. So, we get 3.66 in automated, in handmade system, it is 2.66. Now, in the same way, let us try to calculate financial leverage, what is a formula, do you remember the formula. It is PBIT upon PBT.

So, in operating leverage, we where linking contribution minus PBIT, the difference between fixed costs. Now, it is PBIT minus PBT, the difference between these 2 figures is interest. So, it is now 3 lakhs upon 2 lakhs. We have been asked to calculate, I will go back to the problem, operating leverage, financial leverage and total leverage, add would level of activities.

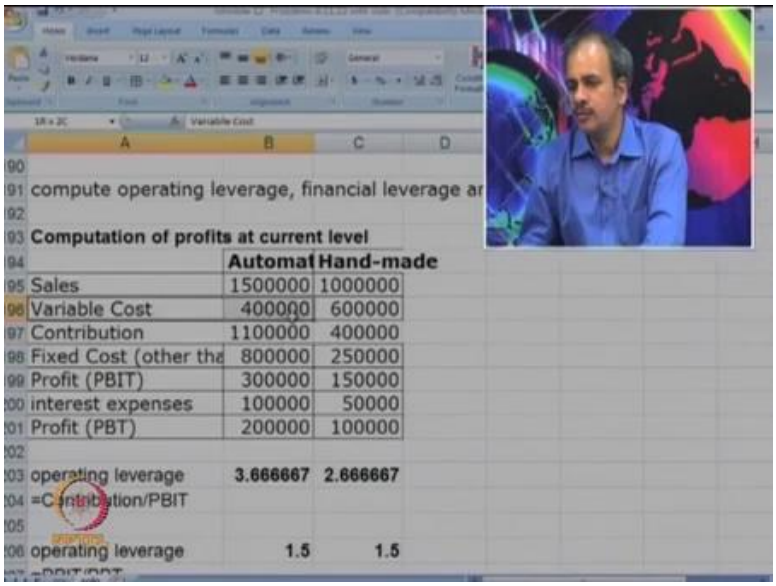
So, we would also try to calculate the total leverage, do you remember the formula for total leverage. It is a combination of the two leverages. So, now, it is contribution upon PBT. So, it is 11 lakhs divided by 2 lakhs. You can also cross check it, because it is nothing but a product of the two leverages. So, it is 366 into 1.5. So, either you can multiply the two leverages and get it or you can get it by a formula. Either way, it is possible; I will just show you by the other method also.

(Refer slide Time: 17:12)



So, we have got all the three leverages at the current level. Let us repeat the same process, if we do it at the breakeven point level. Now, I think it is very simple, I am just copying it. But, you try to do it by pen and paper. So, now, instead of the current level of sales 15 lakhs and 10 lakhs, what level of sales will put? We would try to go for cost indifference point level, which is 18 lakhs. Now, variable cost will change, it will not remain same. So, how much will be the variable cost at this level it has been computed. So, we can take it now.

(Refer Slide Time: 18:26)



So, I am pasting the values, now the variable cost is 1320 and 720. So, we get a contribution of 480 and 10 lakhs 80,000 fixed cost remains 8 lakhs and 250. So, at 18 lakhs, I will just recheck the contribution, we have taken it from this figure. So, which is, b 180 into b 160. So, b 160 was the PV ratio. So, you do not have to recalculate the contribution. That is something, which is causing problem.

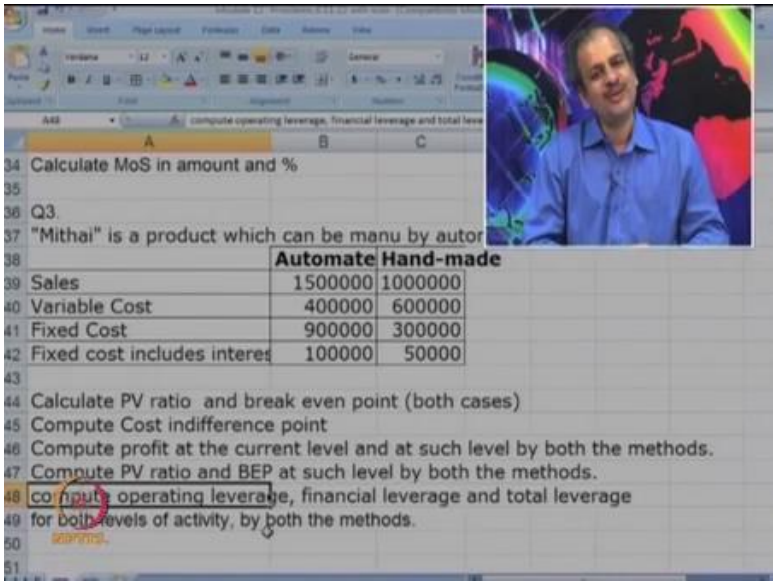
So, we know it is 1320 and 720, the fixed cost are 8 lakhs and 250. So, PBIT is 520 and 470. We deduct interest expenses and we get PBT, which is same, which we had already seen. What we are trying to learn is, what is the leverage? Keep in mind, that leverage does not remain same. Unlike, PV ratio and BEP, the earlier case, we were asked to calculate PV ratio and BEP at cost indifference point and it was same, because at any level of activity PV ratio and BEP remains constant.

But, that is not the case with the leverages. So, leverages have to be recalculated. So, now, they are recalculated, you can see it is contribution upon PBIT operating leverage. So, it was 3.66. Now, it has come down, here it was 2.66, this also has come down. So, we do operating leverage, I think here by mistake, I have written operating leverage only again, this was the financial leverage.

So, I will just correct it, the formula is correct, financial leverages PBIT upon PBT. So, now financial leverage, which was 1.5, 1.5 each had become 1.23 and 1.11. And the total

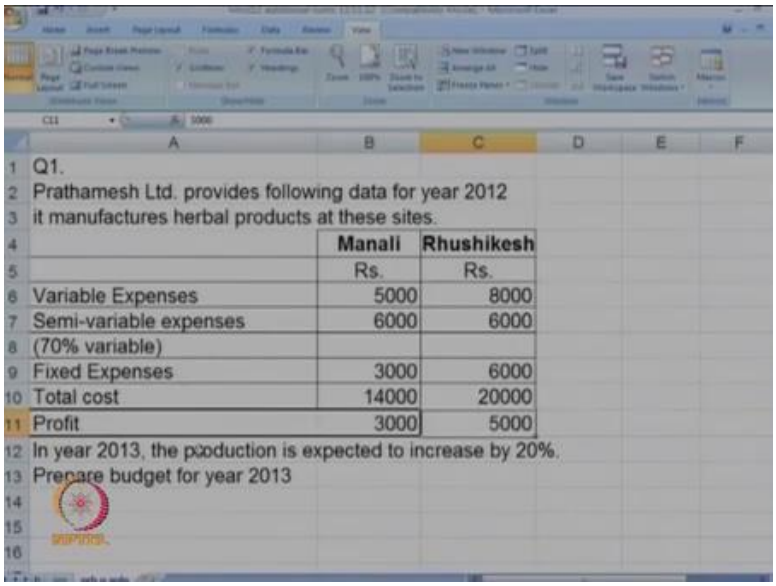
leverage, this is nothing but the multiplication of operating into financial. We get 2.34 and 1.71.

(Refer Slide Time: 21:14)



So, please look at the whole case, is it clear to you. In this case, we have tried to learn the cost indifference point and we have also tried to learn, what are the leverages? So, I hope now, these things are properly revised for you. Dear students, let us do a few more sum on CVP, BEP analysis.

(Refer Slide Time: 21:45)

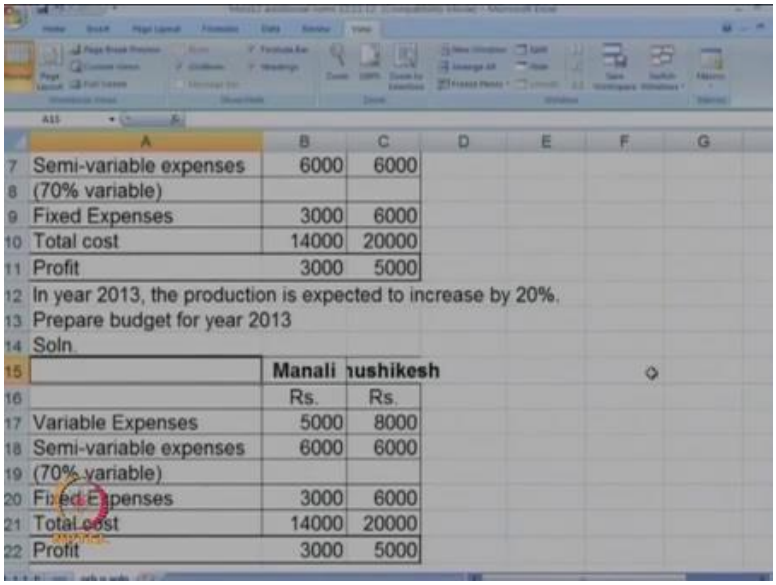


So, have a look at the problem Prathamesh limited provides the following data for year 2012. It manufactures herbal products at these two sites. Manali and Rushikesh, data is available variable expenses are 5000, 8000. Semi variable is 6000 each, fixed expenses are 3000, 6000. Total cost 1420, profits are 3000 and 5000. In year 2013, the production is expected to increase by 20 percent.

Prepare the budget for year 2013, so how to make it, can you think over, this is slightly a different problem, because the information about two sites are given. So, they have two production facilities at two sites, budget for a particular year, 2012 is available. Now, we have been asked to make a budget for 2013. So, how to proceed, it has been given, that production is expected to increase by 20 percent. That data, we should use and with the help of that data, we would like to proceed for preparing of the next budget.

So, let us look at the variability of the cost. We will realize that, first 5000 rupees is specifically given us a variable cost. Next 6000 is given as semi variable expenses with 70 percent variable. So, we need to first break that down and calculate, how much are the variable cost. We also need to calculate, how much are the sales?

(Refer Slide Time: 23:34)



So, I am just showing you, how exactly it can be done. I request you also to solve along with me. So, that, you actually get the feel of doing a problem. So, now, first see, how we can calculate the sales. So, anyone can give a hint, how sales can be calculated. Think

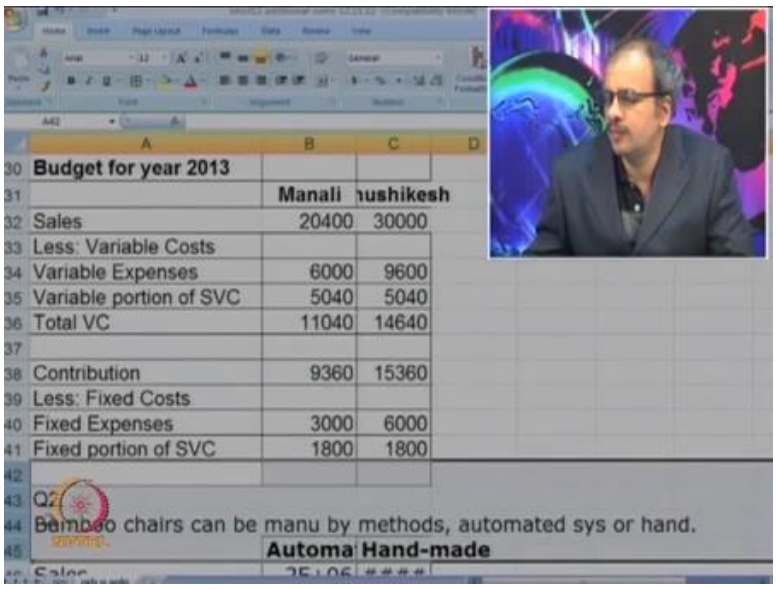
over, how sales can be calculated. We have been given all the cost, we also know the profit. So, the easiest thing for us is to start with calculation of sales.

So, sales, you know it total cost plus total profit. So, sales are 17,000 and 25,000 respectively for Manali and Rushikesh sites. Now, with this information, let us try to break up the semi variable cost into variable and fixed. Now, how to do that, how to break the semi variable, it has been mentioned that 70 percent is variable. So, how much is the variable portion, it will be 70 percent of 6000.

So, 4200 for both the sides, the cost is same. So, I have worked out 4200. Now, the remaining naturally is a fixed portion. So, look at the fixed portion also. So, 1800, I think you can do it orally as well. 1800 is a fixed portion of semi variable cost. Now, let us try to present the cost structure properly. Giving out variable and fixed cost, what we are doing, right now are working notes. So, please give specifically that these are working notes.

Now, let us try to prepare the budget for 2013 as has been asked. I am doing it slightly, slowly; I hope you are able to pick up with me you are able to do with me. Because, we have done, number of sums now.

(Refer Slide Time: 26:02)



Usually, a budget will start with sales. So, we would try to start with sales, we are making it for the two sides Manali and Rushikesh. So, please mention that. Now, we

know the value of sales in the current year. That data we would like to use for the preparation of budget for 2013. In 2013, it is given that production is expected to increase by 20 percent, there are no stocks. So, all productions is assume to have been sold.

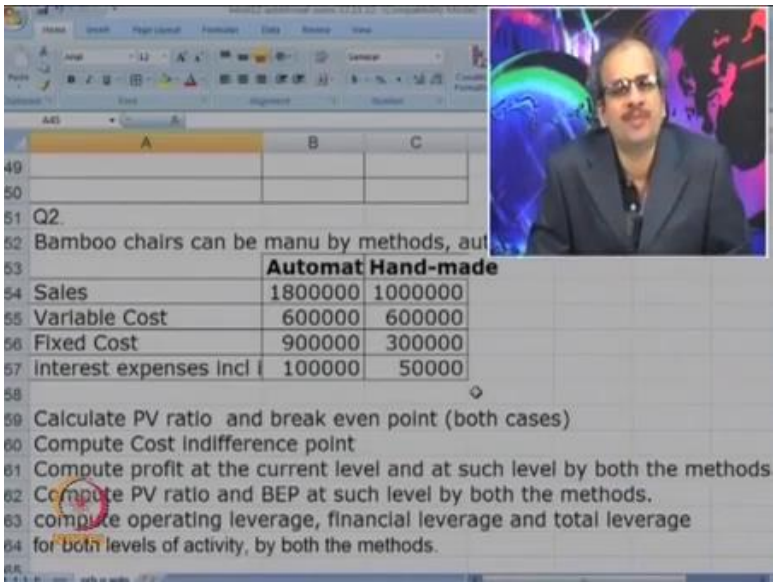
So, now let us try to calculate the sales. So, we know the sales for the year 2013, for 2012, which is 17 and 25000. Let us try to use that information for calculating sales for 2013. Now, we know that, there is a 20 percent rise in the sales. So, it is 17000 into 1.2. So, we get 20,400 and in the Rushikesh side, it is 30,000. That is the value of sales, we are looking for, less, first let us deduct, which cost you will deduct form sales.

I think you have guessed it right; we will first deduct variable cost, because sales and variable cost both are variably in nature. And sales minus variable cost is, what it is nothing but the contribution. Now, you can see in the last year, the variable cost was 5000 and 8000. So, that cost will naturally increase by 20 percent. So, 5000 into 1.2. So, we get 6000 and 9600 for Manali and Rushikesh side.

Same way, we also take variable portion of semi variable cost, because variable portion of semi variable cost is also a part of variable cost, it is 4200. So, we multiplied by 1.2, it becomes 5040 for both Manali and Rushikesh. Now, this total would be the total VC. So, 11040 and 14640. Now, sales minus variable cost gives us contribution. So, I hope you remember that, we have done that, contribution is a prime source for earning profit. So, from 20,400 minus 11040, you get 9360 and 15,360 as a contribution.

From contribution, we would deduct fixed cost. Now, fixed expenses are given as 3000 and 6000. They are fixed, they would not change. Apart from that, there is a fixed portion of SVC; that also we will deduct. So, total FC is 4800 and 7800. Now, contribution minus fixed cost 4560 and 7650 is my profit. Now, the question which was asked was from the given data prepare the budget for 2013. So, we have prepared the budget starting from sales to profits, is it clear to all.

(Refer Slide Time: 30:59)



Now, let us look at the next case. Now, in the next case, please have a look at it and read it carefully. Bamboo chairs can be made by two methods, either by using automated system or by handmade system. The data is like this, sales for automated is 18 lakhs for manmade it is 10 lakhs; variable cost is six lakhs each. At that level fixed cost is 9 lakhs, 3 lakhs, interest expenses included are 10, 000 and 5000.

Calculate PV ratio and BEP also compute cost in difference point and compute the profit at current level and at such level by both methods. Now, similar problem we have done earlier. So, I hope you can do it very fast, let us please try to practice and do it with me. So, we have to calculate first the PV ratio and BEP, so how to calculate. So, we have been given variable cost, which is 86 and 6.

So, we can definitely calculate contribution sales minus VC. We get contribution as 12 lakhs and 4 lakhs respectively. Now, from contribution, we can calculate PV ratio. The question, which is asked, is calculated PV ratio and breakeven point. So, first answer, we get is PV ratio. I hope, you all know the formula, it is contribution upon sales. So, we get 0.667 and 0.4. The fixed cost, again are given 9 lakhs and 3 lakhs. So, fixed cost is 9 and 3.

Now, interest expenses included in fixed cost is 1 lakh and 150. But, right now, we are not concerned about it. So, we can directly calculate breakeven point, what is the formula of BEP? It is FC upon PV ratio. So, fixed cost is 9 lakhs divided by PV ratio. We get 13

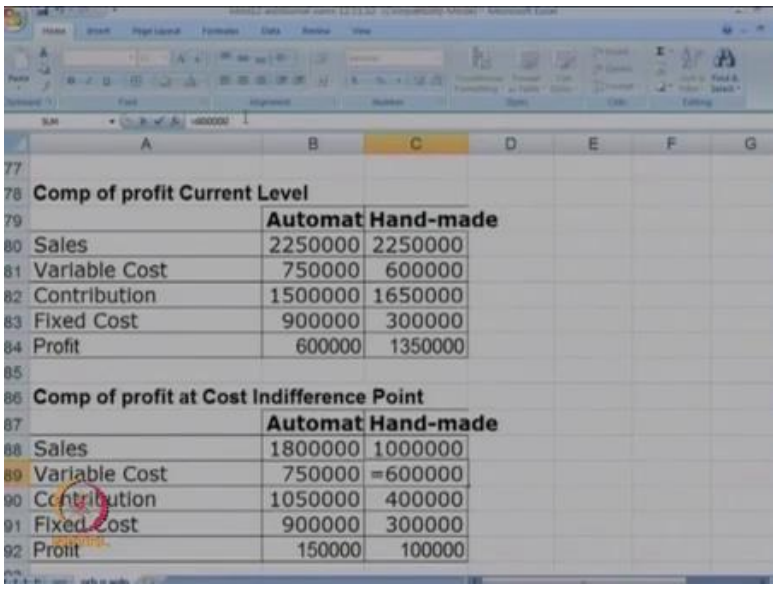
lakhs 50,000 and 7 lakhs 50,000 for automated and handmade system. So, our question first part is, compute the PV ratio and BEP in the both the cases, that we have done.

Next is, calculate cost in difference point. So, what is the formula for cost in difference point, take a guess, we have just done it in earlier problem. So, cost in difference point is difference in FC upon difference in PV ratio. This is very simple and very similar to breakeven point. In breakeven point formula, we have FC upon PV ratio here; we take the difference in those figures.

So, we would try to calculate the difference, which is 0.226 and difference in FC is, you can orally see, it is 6 lakhs. Cost in difference point is 6 lakhs divided by 0.2667. So, we get 22 lakhs 50,000 as cost in difference point. Next, they have asked compute profit at the current level and at such level by both the methods. So, current level profitability first will try to calculate. We have already have all the data. So, we can immediately know the profit.

So, you know that, the variable cost is 12 lakhs, variable cost minus fixed cost; we will immediately get the profit. So, 12 minus 9, we have 3 lakhs and 1 lakh as a profitability at a current level. Now, let us see how much is a profit at cost in difference point.

(Refer Slide Time: 35:50)



	A	B	C	D	E	F	G
77							
78	**Comp of profit Current Level**						
79		**Automat**	**Hand-made**				
80	Sales	2250000	2250000				
81	Variable Cost	750000	600000				
82	Contribution	1500000	1650000				
83	Fixed Cost	900000	300000				
84	Profit	600000	1350000				
85							
86	**Comp of profit at Cost Indifference Point**						
87		**Automat**	**Hand-made**				
88	Sales	1800000	1000000				
89	Variable Cost	750000	=600000				
90	Contribution	1050000	400000				
91	Fixed Cost	900000	300000				
92	Profit	150000	100000				

So, this is computation of profit at current level. So, at cost in difference point, we need to take sales of 22 lakhs 50,000, and then we will try to calculate the profit at that level.

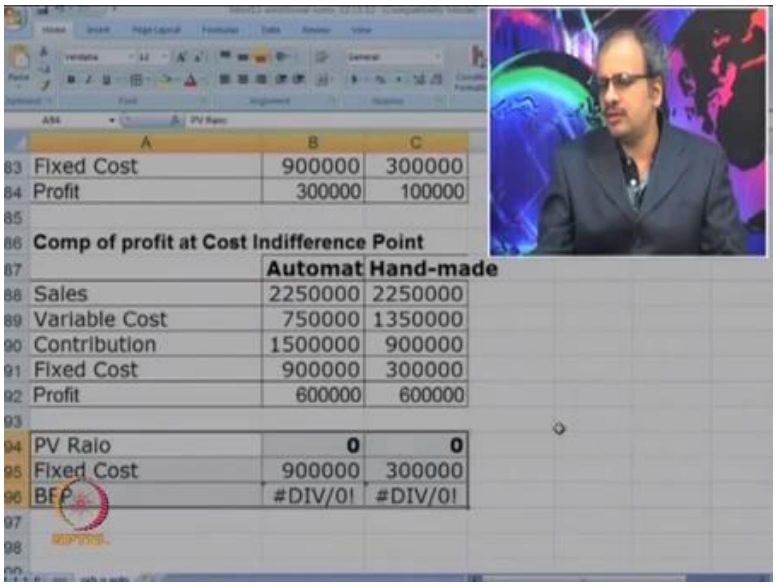
Now, you will observe that we need to revise our variable cost because variable cost will change with the level of activity, currently, it is 6 lakhs each. So, 6 lakhs into 2250 divided by 18 lakhs; that is 1800. This will be the new variable cost. So, it comes to 7 lakhs 50,000 for both, it will be same.

So, you can see here that, for 18 lakhs of sale of automated the variable cost was 6. So, here we have revised it correctly, but when it comes to handmade, we have to take it as 2250 upon 10 lakhs. So, variable cost is 13 lakhs 50,000 contribution is 1509 and so profits are 6 lakhs each. So, this is what, we were trying to look at. So, now, this is the profit at cost in difference point. I will have changed it at a current itself. So, I will just make a small revision.

So, the profit over variable cost over here at cost in difference point has to be 2250 upon 10 lakhs. So, it becomes 13 lakhs 50,000. The contribution is sales minus VC. So, it comes to 1050 and sales are 18 lakhs now. So, are you able to get it? So, here originally our sales was 18 lakhs and 10 lakhs and variable cost was 6 each. So, the contribution was 12 lakhs and 4 lakhs and our fixed cost was 9 and 3 respectively. So, profit was 3 lakhs and 1 lakh.

Now, at cost in difference point we are at a sale level of 22 lakhs 50,000 and that gives me a variable cost of 750 and 1350 minus fixed cost of 9 and 6. We get exactly the profit of 6 lakhs; you are able to get it through. So, the question was compute the profit at the current level and at cost level in difference point next is compute PV ratio and BEP, I think you know that PV ratio and BEP do not change with the level of activity. So, they will remain constant, then need not be calculated again.

(Refer Slide Time: 3957)



But, we will just show it, for you for more clarity. So, PV ratio which is 0.66 will remain unchanged and a BEP also remain unchanged. Now, next question is, compute operating leverage, financial leverage and total leverage, again we have done it. So, I hope you remember it, in case of operating and financial leverage. We will need to breakdown our fixed cost into interest portion and common portion. So, first let us do that, and then we can easily calculate the operating and financial leverage.

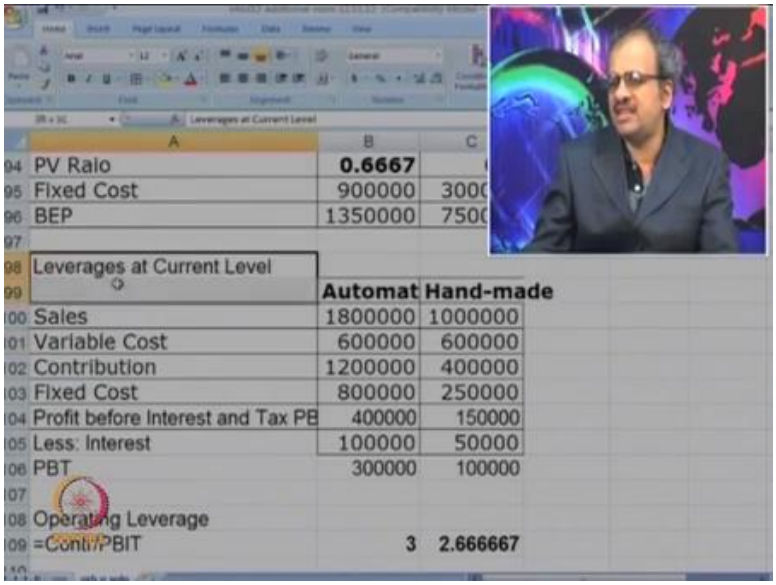
So, now we know that, the fixed cost includes interest of 1 lakh and 50,000 each. So, now instead of taking 9 and 3, we will reduce the fixed cost as we have taken here 9 lakhs, we will take it 8 lakhs. And instead of 350, we will take instead of 300 we will take 3 fifty. So, we get profit before tax, profit before interest and tax, popularly known as PBIT. I will just expand the size. Now, from these, we need to deduct interest cost.

Now, the interest cost is given to us which is, 1 lakh and 50,000. So, this gives us PBT or profit before tax, so 3 lakhs and 1 lakh. So, the profitability at the level has remained same, we have just shown it in a different format. Now, we have to calculate operating financial and total leverage. Now, what is the formula for operating leverage, do you remember? Yes, anyone would like to make a try operating leverage, I hope, you are all getting it. It is PBIT upon PBT. That is financial leverage.

Operating leverage is contribution upon PBIT, but I am just writing it for your benefit. So, we get 3 and 2.66. Now, financial leverage, this is PBIT upon PBT, so 1.33 and 1.5

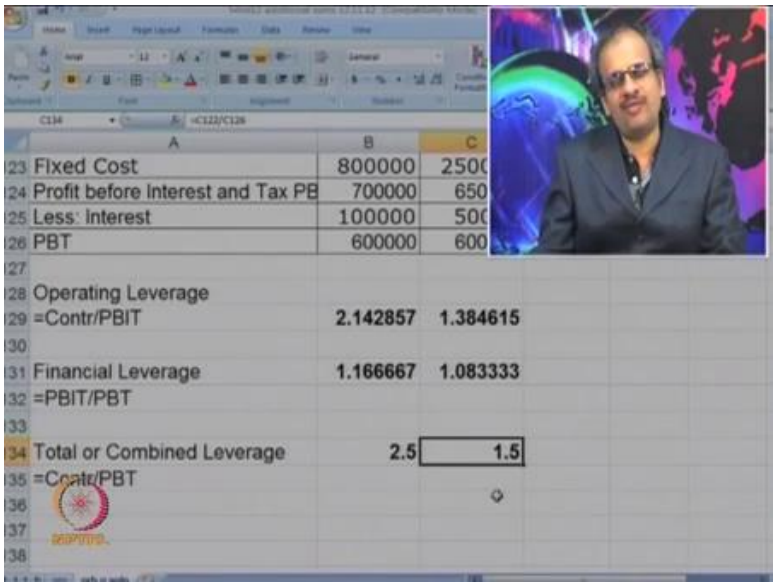
and total or the combined leverage. So, the formula is similar to the earlier one, it is contribution upon PBT now. So, it is 4 and 4 for both. Now, this is the leverage at the current level. Now, they have asked compute operating financial and total leverage at both the levels by both the methods. So, right now we have calculated leverages at the current level.

(Refer Slide Time: 45:01)



Now, let us do the leverage calculation at cost indifference point. All of you please try to do it with me. Now, cost indifference point you are aware, the total sales are 22 lakhs. So, total sales are 2250 contribution is 750 and 1350 and we have PBIT of 7 lakhs and 650 each. PBT is 8 lakhs and 6 lakhs.

(Refer Slide Time: 46:03)



This figures you can immediately see these formulas are already there. So, now, the combined leverage is 2.5 and 1.5. So, I hope now the concept of leverages is clear to you, more in detail. So, in today's session, we have done a few extra sums on CVP and BEP analysis. I hope the fundamentals are reinforced; now in your mind, I will do a quick revision for the benefit of everyone.

The first concept which you should be aware is of the variable cost and fixed cost. So, variable cost are those costs, which change with the level of activity in the direct proportion. Fixed cost, do not change with the level of activity at all. All semi variable cost we break down into VC and SVC. Then, sales minus variable cost, we get contribution. From contribution, we can calculate PV ratio, which is contribution upon sales or it can also be contribution per unit upon selling price per unit.

Then, we did breakeven point; breakeven point has two definitions or two equations. In terms of quantity, it is fixed cost divided by contribution per unit or breakeven point in value is fixed cost upon PV ratio. From that, we have gone to a point as cost indifference point. This is the point at which the profits are same at a particular level of activity and that level of activity is called as cost indifference point.

So, the formula is, difference between fixed costs upon difference between PV ratio. We have also seen a concept known as margin of safety. So, margin of safety is nothing but current sales minus break even sales. We can also have it at a percentage. So, the margin

of safety in percentage is current sales minus breakeven sales divided by current sales. Now, margin of safety tells you, that how much you are sales can fall before we which you can go in losses.

So, if MOS is 25 percent; that means, a loss of up to 25 percent of sales is tolerable, we will still not go into loss. So, that much of decline in sales, the company can do with without going into losses. Now, all this fundamentals are very much useful to decision making. So, we have also done a few problems on decision making, for example, we have looked at product mix decisions.

So, we do calculate the contribution per unit and based on the contribution per unit. If you do ranking, that tells us, which products is better, which product is to be concentrated. Suppose, there is a restriction on total sales in terms of value, instead of contribution per unit, we go by PV ratio. Sometimes, some factor or some resource of production is in short supply, for example, say let us say, raw material.

If raw material is in short supply, we calculate contribution per kg of raw material or unit of raw material and that contribution is used for ranking the products. So, CVP analysis is helpful in product mix, it is also helpful in profit planning. We have done a case on calculating the budget. So, based on last year's budget, we can make the current budget. We can also decide at what level of activity, we need to operate to earn a certain level of sales; it is also useful to make flexible budgets.

So, we may operate at thousand units or 1100 units or 1200 units or 1300 units. So, we can make budgets for the respective levels. That also will be facilitated by CVP analysis. Like this, CVP analysis has variety of uses and it is very much useful to the management at various levels.

Thank you so much.