**W1 V5 Thinking at the Margin**

0:10  
In this video, we're gonna talk finally get to this difference between marginal costs and total costs and marginal benefits and total benefits and show you quickly how to calculate them.

0:19  
And then we'll finally get to decision making right when we have this quantity dimension.

0:23  
And it's not just benefit versus opportunity cost.

0:26  
Now when we have multiple benefit and cost calculations to do, it is so much better to start off initially with a willingness to pay versus price because at least one side of the equation is really straightforward to do in that sense that it's just price and I can pull it from, from the market and makes my calculations a lot easier, OK.

0:45  
So typically when we're doing these marginal calculations, we're implicitly using willingness to pay versus price.

0:52  
Sometimes we say it explicitly, sometimes we're not.

0:55  
But that's kind of the frame and work that we're working with.

0:57  
OK, so now let's go back to the granola bars example.

1:01  
You walk in a metro, you're like, should I buy granola bars or not?

1:04  
Well, to compare costs and benefits, you first need to figure out how many granola bars you're buying, and that's how we model it, right?

1:10  
We always approach it by from back the last decision you make.

1:15  
So if you haven't yet decided if I'm going to buy it or not, but if I was to buy it, how many would I buy?

1:20  
S 1st I make my quantity choice.

1:23  
Then I take a step back and say, do I want to buy granola bars or not?

1:27  
Do I want to buy this quantity or not?

1:29  
OK, it's not just true for granola bars, AKA may think, so how many workers to hire?

1:33  
It's not like you're going to set up, wake up in the morning and say, oh, do I want to hire labor or not.

1:37  
It's like how many workers do I want to hireright?

1:39  
If I'm going to be hiring, then decide do I want to hire these workers or not Study, Same thing in there.

1:45  
It's going to seem intuitive because it's going to seem like you're walking into Metro and just choosing granola bars and then choosing how many.

1:52  
But when we look at the data and we look at how people make decisions, this is effectively what the data is showing us that they first choose quantity and then they back into a total by or not.

2:02  
But that's how we're going to model it.

2:04  
OK?

2:04  
Now when we say extra granola bar or not, it's pretty straightforward because it's like 1 granola bar or not.

2:10  
Sometimes it's not as simple as that, right?

2:13  
Sometimes if we example, if you're thinking about how many hours to study, should I put an extra minute into 101 or not, right?

2:20  
And sometimes you can get really tiny bits.

2:22  
So we are going to think about this conceptually.

2:25  
And when you get to the second year and beyond, you'll use calculus because we're thinking about really tiny bits.

2:29  
But when we talk about it, we typically use one extra unit or not, mostly for intuition.

2:35  
So get the intuition and 101 using one extra unit and then when you go to the second year, you'll be able to use calculus without any problem.

2:42  
OK.

2:43  
But theoretically, when we're thinking about marginal thinking, we're thinking about a teeny tiny extra, OK, Now you're standing on that.

2:51  
You're looking at every extra granola bar and you're looking at the extra benefit from this granola bar and the extra cost.

2:59  
OK, really hard to work with.

3:01  
So you're manipulating this to think about the extra willingness to pay versus the extra price of this granola bar.

3:07  
And you want to buy it if the benefit is at least as high as the cost, because that's a good thing, right?

3:11  
You get surplus or what we call surplus on it.

3:15  
OK.

3:15  
Now the way we kind of write this down is, suppose I'm thinking about granola bars and I already have 5 granola bars in my basket and I'm thinking about buying the extra granola bars, which will give me a total of 6 granola bars.

3:31  
So I have 5.

3:32  
I'm adding the 6th in and I'm thinking about what the marginal cost and benefit is for that 6th unit.

3:41  
OK.

3:42  
Marginal cost is the increase in cost margin means extra extra cost for the extra unit.

3:50  
For the 6th unit I have 5:00, I'm going to six.

3:55  
The cost of the sixth unit is the total cost of 6 units.

4:00  
So the bill for six units, right.

4:04  
I can use bill because my mother in the willingness to pay and I'm only going to get price here and this is the bill for 5 units.

4:12  
The difference in the bill cost of the sixth unit, sometimes it's the same as cost for the 5th unit, 4th unit sometimes it's not.

4:20  
So pay attention to that.

4:21  
OK.

4:22  
Benefit also the same right benefit now is written as willingness to pay, but we'll just call it marginal benefit because we know that, you know, whenever I use the word marginal for benefit, it's already done the willingness to pay calculation.

4:35  
OK.

4:36  
Here I'm going to be looking at the total benefits of my willingness to pay for 6 units.

4:42  
This is my total willingness to pay the benefit for five units.

4:50  
Any difference?

4:51  
Extra benefit, extra willingness to pay for the 6th unit, right?

4:56  
Just that extra bit now.

4:58  
So if I'm thinking about extra, extra, extra, I'm going to keep going as long as something is higher or giving me a higher benefit or not, as long as the marginal benefit is at least as high as the marginal cost.

5:07  
I keep going.

5:08  
Some point I need to stop, right?

5:09  
When do I stop?

5:10  
When this equation changes.

5:12  
So if it is equal, you're like, oh, I'm indifferent, Should I buy it?

5:19  
Our default assumption here is that you just do whatever we want you to do, right?

5:22  
Because that's easier for us to work with.

5:24  
OK, so if it is greater than keep going, keep going.

5:28  
If it's exactly equal, also buy the extra unit.

5:30  
But the second it switches and marginal benefit becomes less than marginal cost, you say, no, stop, go back, OK.

5:40  
So we keep going until we reach that point where the benefit cost equation switches.

5:46  
Sometimes we say stop at the largest quantity.

5:48  
And I'll show you in the next slide on a graph why we use this term.

5:53  
But it's mostly relevant when we've got kind of weirdly behaving marginal cost of benefits.

5:58  
And I'll explain what that is in a in a later thing.

6:01  
But intuitively here's what we're doing.

6:03  
We're saying keep going when it switches, stop.

6:07  
So let's think about here.

6:09  
This is my quantity of granola bars, OK, 1234, you can think about it as discrete, whatever it is on the Y axis, I'm going to put marginal costs and marginal benefits.

6:23  
OK.

6:23  
So what I'm going to ask you is what's the cost of an extra granola bar?

6:27  
Make my life really simple.

6:28  
Let me just think about the cost of every granola bar being $3, right?

6:33  
So every extra granola bar cost me.

6:36  
The marginal cost is $3 every extra granola bar.

6:41  
What's the benefit?

6:42  
Now that's up to you.

6:43  
You get to tell me that.

6:44  
But typically it makes sense that the first granola bar is really tasty and you keep eating the second one.

6:49  
The third one, the 4th one, you're like first one was really great.

6:53  
Second one, yeah, great, but less than before.

6:56  
Right?

6:57  
Now, why is it less than before?

7:00  
Well, one, because you know every extra unit not so great as before, right?

7:04  
You kind of get full there.

7:06  
So you're thinking about kind of the extra unit, not as tasty as the previous unit.

7:10  
But remember, you're also thinking about willingness to pay, and that includes the next best alternatives.

7:15  
So the more granola bars you get, you're giving up the chance to buy something else, right?

7:18  
Maybe if you buy too many granola bars, you're starting to give up money for that you could use for food, right?

7:23  
So typically most cases that we're thinking of, your marginal benefit follows a pattern like this, right?

7:31  
Starts off high and then every subsequent unit gets lower and lower and lower.

7:34  
In that sense, if this is what the typical pattern is, our previous rule works out really well.

7:41  
First unit, I'll say great.

7:44  
Marginal benefit, marginal cost, benefit higher than cost, keep going.

7:48  
Second, unit benefit cost, keep going, keep going, keep going, right.

7:52  
If it's exactly equal, also buy it.

7:55  
But the second it switches to where the cost is higher than the benefit.

7:59  
I don't want to go there.

8:00  
It cost me more than it's going to benefit me.

8:02  
Why would I buy?

8:03  
I've moved back.

8:04  
So here I'm moving in this direction.

8:06  
Here I'm moving in this direction.

8:07  
And then typically I'm going to stop at.

8:10  
If it's equal, great, I know exactly where I'm stopping.

8:12  
If it's not equal, then I get as close as I can to that equality point as long as the benefit is not lower than the cost.

8:20  
And we say magic, this is the quantity that I want to buy.

8:24  
That's how many granola bars I'm going to buy if I'm buying.

8:29  
And this is the typical case.

8:30  
And so we kind of are good here.

8:32  
But sometimes we have weird marginal costs and benefits.

8:36  
I'm going to show you that by looking at this example.

8:40  
So here you're walking in to buy something.

8:42  
The price is $10 per unit.

8:45  
So in that sense if you would just focus on the price of $20 per unit, you would be saying OK, first granola bar $10.00 for granola bar twenty 30-40.

8:58  
And that's the calculation you're doing in your head because each granola bar cost you $10 more.

9:03  
But then you look at the sign and it says guess what, you got a $20 discount if you buy three or more.

9:10  
So in that case, now the 1st 2 units is that then when you go in here, you are now going to get a $20 discount.

9:18  
So you're going to go in there, the bill is going to be $30.00, but you're going to only pay 80% of that, which means that your bill is going to be $24.00.

9:30  
And the same in here, you're going to pay $32 for your extra granola bar.

9:37  
Oh sorry, for your the total bill, we use the totals to then back up the marginals.

9:42  
So marginal cost for the first one bill was nothing, $10 first to second.

9:50  
First I was paying total of 10, Second I'm paying a total of $2010.00.

9:55  
Now here's where it gets interesting.

9:57  
If I'm going to the third granola bar right, the increase in my cost is only $4.00.

10:04  
So the marginal cost of the third bar, because I'm getting the discount on every single bar is lowest only $4.00 and then here it's $8 right?

10:13  
Marginal benefit.

10:14  
I ask you a valuation of granola bars.

10:16  
You tell me that first one is $11.00, second one is 11 to $29.00 and so on.

10:24  
OK, so my writing is pretty bad, so I'm going to put the numbers in there to make it look pretty straightforward.

10:32  
So now if I'm thinking about my decision, what I'm doing is I'm comparing marginal cost to marginal benefit because quantity.

10:38  
I ignore the totals.

10:39  
I look at marginal first unit, I say benefit is 1110, great, buy it, keep going.

10:47  
Second unit, I'm going to come and say 09 versus 10, right?

10:51  
If I was following the rule from before, Brindley, I would say no.

10:54  
You know what?

10:54  
I don't want this go back right?

10:57  
Because the benefit is lower than the cost.

10:59  
And so I would stop here and I would get one granola bar with a net benefit comparing total benefit and total cost of $1.00.

11:08  
But I'm going to say, watch out, you've got a weird pattern of marginal cost in here because you've got this discount playing in later, so you've got this weird pattern.

11:15  
Then just keep going and just check.

11:17  
So stand and scan right?

11:20  
Anytime you've got weird stuff, scan to see you're not missing anything.

11:24  
So if I said, OK, let's just keep going.

11:26  
So I buy the second unit.

11:28  
Then when I come to the third unit, guess what?

11:31  
I now have a benefit of seven compared to a cost of four.

11:34  
I really want to buy this third unit, but I can't get to the third unit without buying the second unit.

11:40  
So I've got to suffer a little bit of a loss, right?

11:43  
I'm losing $1.00 here, right?

11:46  
Because I'm buying that second unit, but it's more than made-up for by the extra $3 I get on the third unit.

11:54  
So I'm losing -1 here, but I'm getting plus $3 here.

12:03  
So on the whole I'm actually doing good by ignoring that first one and going after the third, which I would not have seen if I was stuck at one.

12:10  
Do I want to keep going to 4th?

12:13  
No, right?

12:14  
I want to stop at 3.

12:15  
Now again, I would say scan for more, but I don't have more data, so I'm going to stop at 3:00 and notice if I'm comparing 2 total costs and benefits.

12:24  
Actually stopping here is even better for me from a total perspective because I now have $3 worth of net benefit compared to if I stopped at 1:00.

12:34  
So here I'm going to buy 3 units and not one.

12:40  
So that's what I meant in a subtlety is just watch out for this.

12:42  
This general rule that we had on the previous slide works really well.

12:46  
If I've got nice behaved marginal cost and marginal benefits, anytime I have some weird stuff in here with the marginal cost and benefits, stop where you think you want to stop, Scan around, look for something, it's not working fine, go back, but always check.

13:01  
OK, So marginal costs and benefits determine quantity.

13:05  
If you were to buy, we still need to take a step back and decide whether I actually want to buy this or not.

13:10  
That's going to be based on total benefit and total cost, right?

13:14  
So you always want to make sure you do that, because it could be that you don't actually want to do that in the end.

13:22  
Here's another example to convince you that marginal thinking is important if we just focus on total thinking.

13:28  
Here's me and my son, OK, you asked us, we want to watch this TV series together.

13:34  
It's two hours long, two episodes, right?

13:37  
And you ask us, how is your total benefit from 2 episodes?

13:41  
We're gonna both tell you our total benefit is $50.

13:44  
OK?

13:46  
How much does each hour cost?

13:47  
Let's say even for simplicity, both of us have the same opportunity cost of time, expressed in dollars of $15.00 an hour.

13:54  
Why 'cause we're both gonna do dishes and we both have the same opportunity cost.

13:59  
OK, so now the question is, are you gonna predict that both of us watch the same amount of episodes?

14:05  
Well, the answer is maybe not right.

14:07  
So for example, if this is me, my first hour, I value really a lot, right?

14:15  
Really stressed and tired.

14:16  
That first hour I value at $40.

14:19  
Second hour, I only value at $10, right?

14:24  
So if you're asking me the marginal benefit of the first hour, I'll say $40.

14:30  
Really want to watch that second hour, $10 total is still 50, right?

14:35  
And my son is going to give you the opposite, his marginal benefit.

14:39  
He's going to say $25, $25.

14:42  
I value both of them equal both $50.00.

14:45  
But now if I'm comparing that to the marginal cost which is $15.00, right, I will buy a watch one hour and my son is going to watch two hours.

14:59  
So thinking at the margin is really important.

15:01  
Please don't focus on totals to predict quantity.

15:04  
You always want to make sure to start with quantity first and then move on to totals.

15:10  
OK, now why do we have these things to talk about?

15:13  
Changes.

15:13  
So anything that changes your marginal benefit and marginal cost value changes.

15:17  
Cost of the good changes.

15:19  
Next best alternative changes that's going to change your quantity chosen.

15:24  
We'll explore this a lot, especially when we do things like demand and supply, which is coming in module 3.

15:31  
OK, so always start with quantity.

15:36  
If there is a quantity dimension, always check.

15:39  
If there's a quantity dimension, determine your quantity based on marginal cost and marginal benefit.

15:43  
Typically that's the largest quantity where marginal benefit is at least as high as marginal cost.

15:48  
But you want to watch out for weird scenarios, so you want to always scan around and look based on the data that you have.

15:54  
OK?

15:55  
And then we decide whether to buy this or not based on total, so we take a step back.

15:59  
Once I have the quantity, I use the quantity to calculate totals.

16:03  
I can't figure out how much I value 5 hours of time unless I know that I'm going to stop at five hours of time, right?

16:09  
Because the value of five hours of time is different from six hours of time.