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So far in this module, we have talked a lot about dependent difference rate events, where one doctrines of one events influences the probability of another. Now, the opposite of that is independent event, something which we had covered in the previous module. But just to remind you, so independent events are one in which the occurrence of one event does not impact that of another. Okay, so let's do an example of that. So, so even a has no influence on the occurrence of event B, right? If the probability of B given A right, the probability of B conditional A is the same as the probability of B. So what it means is that whether a occurs or does not occur, it does not change this probability of B occurring, it remains the same. So that's the definition of an independent event, whether A occurs or not, does not have any impact on P of B, the P of B remains the same, independent of whether A has occurred. Now in terms of the probability of A intersection B, remember, we have this general multiplication rule, right, so this is P of B given A times P of A. In the case of independent, this is equal to just p of P. Right? So then in this case, it just becomes P of B times P of A. Right? So this is in the case of independent events. So if events A and B are independent, then the probability of their intersection is P of A times B of B, or P of B times P of A. The thing is, though, like the tool that we have been using so far, in our, in our module, the probability tree that can still work. So So let's do an example like that. So remember, in the previous module I talked about, about the theory that stock market movements are independent from day to day. So that means what happened yesterday, does not have any influence when whether the stock market's value will go up, or go down today, or what's happening today is not going to have an impact on the probability of the stock market going up or down to more. Right. So this is called the random walk hypothesis. That means stock market movements are random and not influenced, but what happened the previous day or the day before. So let's do an example along these lines. So consider a stock. Okay, so here's a stock whose value can go up or down by $1 each day. But the outcome does not depend on what happened the previous state. So it does not depend. So how do we actually depict this? Right? So here is a probability table, what it means is that if the stock was up today, the probability that it is up tomorrow is point eight, so there is an 80% chance of it going up, or there is a 20% chance of it going down. Now, the other possibility is that the stock was down today. But even then, it's the same probability 80% of it going up to or going down tomorrow. So what happened? So probability of up tomorrow? Right, given that the stock is up today, so given that the stock is up today, is the same as the probability of it being up tomorrow, given that the stock is down today, right. So what happened today does not have any impact on the probability of the stock going up. It's always 80% chance of going up 20% chance of going down. So how would we debate This in a in a probability tree. Right? So here is the probability tree. Right? So let's think of D one and D two. So think of D one is today. So there is an 80% chance of the stock going up 20% chance of it going down. Now, suppose it has gone up today, what's the probability of it going up tomorrow? It's the same. It's point eight. Going down point two. Right? If it has gone down today, right? What's the probability of it going up? It's the same point eight. Right? So this is different from what we saw in the basketball free throws, whether you missed or succeeded in the first throw, had an impact on the probability of success or failure in the second throw. Here, it's not the case, it doesn't do that. But you can still use the probability tree. And now once you have the probability tree, you can ask questions like this that suppose the stock is up today? What's the probability that it will be up the next two days? Right? So what's the probability that it will be up on D one, and on day two? Right? As we have done before, it's going to be the multiplication of the probability along this arm times this. All right, so it's going to be point eight times point eight, which is point six, four, right? So the probability that the stock will be up the next two days is 64%. Now similarly, you can ask the question that suppose the stock is up today. What is the probability that it returns to today's value after two days? Right, say the stock today is $10. Right? What's the probability that after two days, it will also it will return to $10? So now, in this case, what can happen? How can it return to today's value? Right? There are two possibilities that either it can be up today and down tomorrow, right? Remember, the stock goes up and down by $1? Every day, right? So it can go up to 11. And then again, down to 10. Right? Or it can go down to nine, and then pick up the next day and return to 10. Then misspoke, right? It's this arm times this arm right up and down. Or it could be down and up. Right, so the first one up and down is 0.8 times 0.2, right? So that's this times this. And the second one is this one, it's point two, times point eight. So that's point one, six, plus point one, six, which is point three. So that means there's a 32% chance that the stock will return to today's value after two days. So you can so the basic point of this exercise here was to show that you can use probability trees even when events are independent. Now the next thing I'm going to do is that if you recall all the examples that we have done so far with dependent events, right? I've told you what that conditional probability is, when I've told you that if, if the stock went up yesterday, then the probability of it's going up today is 80%. Or if the person missed the first free throw, what's his probability of making the second right I'm given those two? Now, sometimes, if you're not given that, right, how would you find the conditional probability? So so the next few examples we'll be doing is trying to figure out the conditional probability. And then we'll also give you a different insight into conditional probability. Apart from like this time, like so far, most of our examples have been about timing right first, free throws Second free throw stock going up on day one and day two, right. We can look at conditional probability even in fact, irrespective of time, right, and the next few examples will introduce you to that So the first example I'll start out with is, is the labor force is a labor force survey. Right? So if you look, if you hear in the news, things about the Canadian unemployment rate was this or it went up or went down, so on, right, what people are talking about is the Canadian Labor Force Survey is Statistics Canada and this labor force survey, where they sample about 56,000 households, so about 100,000 people altogether. And then they do it every month, I think, or every couple of months. Now, I think it's everyone, and where the survey is. About 100,000. People ask them about their employment status. Right. And from there, they figure out how many people were employed, how many people are looking for a job and so on. And so let's do an example along that line. So let's say there is a labor force surveys conducted of 1000 people. Right. And in there, they find that there are 110 people of have that 1000 are unemployed. And when asked about the education status, 300 of them are university educated. And 24 people are university educated and unemployed. So now you can depict this in a Venn diagram, right? So we have two categories here, university educated and unemployed. So there are 24 people who are both university educated and unemployed. So let me write that here. Now, there are total of 110 unemployed, right? So of them 24 are here, right? So the remaining will be in this part of the Venn diagram. So that's 110 minus 24. That will be 86. Right? So 86 People will be here. And there are 300, university educated. So 24 are unemployed. So the remaining so that's 300 minus 24. That 276 are here. Okay, so that's our Venn diagram, depicting this situation. Right? So the people outside, right, so think about who are the people outside, right? So if you count these three things up to 76 plus 24, that's 300 plus 86. So there are 386. So, so total, 1000 people were surveyed, right 386 are in this segment. So outside it are the remaining, which is 1000 minus 386. So there are 614 people. So try to think about who these people are. Right? So these people they are neither unemployed, nor are they university educated. Right. So these are people who are employed, and, and no university education. So now, right, so that's our Venn diagram here. Right. And now we can ask the questions based on this survey, right? What's the unemployment rate? And what's the overall unemployment rate? So that's fairly easy, right? Because unemployment rate here is 110 people are unemployed, out of 1000. So this will be point one, one, so this is an 11% unemployment rate. So I think I borrowed these figures from June 2020, where unemployment this was middle of the pandemic and unemployment was very high. Right? Was so this is about an 11% unemployment rate, which is extremely high. But the type of question other questions that you may want to ask using the same data is what The unemployment rate among the university educated. Right? So the question is what's the probability of being unemployed? Given university educated? So this here is a conditional probability, right? conditional on being university educated, what's the probability that someone is unemployed? So this is the type of thing that we'll try and figure out in this example. So I'm going to stop the clip here, and I'm going to start from here. In the next