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SPEAKERS

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Welcome. What we're doing in this lecture is that so E to the KX is this very important function that shows up a lot. But it's also one that students will make mistakes differentiating and integrating a lot. So I know that you've already seen everything we're going to do here, but hopefully, by seeing me go through it carefully, and highlighting kind of where students ought to make mistakes with it, it'll help prevent you from making the same mistakes or to like, identify when and where you're making them. So here we go. So we do already know we know that the derivative with respect to X of, so if we have here, E to the X, right, we know that what we're going to get is going to be E to the X. We also, if we have, so we also have or know that if I want to take the derivative, or sorry, the integral of E to the X. And I want to take this integral with respect to X, that what I'm going to get is going to be so this is going to be E to the X plus C.

Okay, so these are two things we know. But then, and these look like so simple and easy. But please be careful. And I'll show you what I mean. But please be careful in how you apply these rules. So here I'll show you, okay. So when differentiating, we're going to need to use the chain rule, okay? So need to use the chain rule when differentiating.

Okay, so let's see. So if I take the derivative with respect to X. So if I take the derivative with respect to X of, and then I have in here, you know, instead of it just being E to the X, I actually have E to the KX. I didn't mean to make that orange. There we go. I meant to, I know normally I would make that orange. But I'll show you, you'll see why in a second, I didn't want to. I meant to make that blue. And hopefully, this will actually highlight the fact that I erased something there will hopefully highlight what's going to happen here. Because what I want to make orange here is this is the inside, right? Because we do have a chain circumstance, right? This isn't just an X here, if this was just an X here, then you know, it wouldn't be good to correlate those, but it's not. This, so what we're going to get here is we're going to get, right, so now use the chain rule, and we get E to the KX. Right? The derivative of the outside, but then we have to take the derivative of the inside and now, right, so this is a derivative with respect to X of this KX. Okay? So we had to use the chain rule like this. And so you would have been tempted possibly to forget to do this part, but you can't forget to do that part. Because then what you're going to end up getting is that this is going to equal, so I'm going to get E to the KX times, well, this is just a constant times X. So this is just K. So this is equal to KE to the KX,

or to put something nice in a box down below we have that the derivative with respect to X of, and then I have E to the KX is my function that this is going to equal KE to the KX . And the reason that that K shows up is because I was careful, and I remembered to use the chain rule. Okay? Put a nice box around this. Okay, now what about with integrating? So just like we had to use the chain rule here, we need to use substitution when integrating. So need to use substitution when integrating.

Here we go. So I have the integral of, and I have here E to the KX . So this is U DX is going to equal, okay, well now we need to do our whole U substitution deal. So I have U equals KX . So then that gives me that when I take my differential, so DU is going to equal, so I have KDX , right. And then usually I want to isolate, because I want to be able to replace everything in here until it's in terms of U , so remember I need to replace the DX . So I've got to move this over. So I have I have DU divided by K is going to equal DX . Right, and then this is going to go in for that right, so this is what goes in for that. So what I'm going to get here is that this is going to equal, so now I have the integral of, and now it's just E to the U .

And I can use this part to replace that. So I get DU , DU , and then divided by K , right? I just replaced DX there. Okay, and I can pull this K out, right, because this is, with integration I'm allowed to do that. So this is just 1 over K , right? Maybe you even write it like that. So I have 1 over K . Okay, I already started pulling it out, I have 1 over K times the integral of E to the U , DU . Everything's in terms of U , this is now this looks exactly like that, except that I have U instead of X . And so this is perfect, I can actually just go ahead and do this. So I get this is going to equal, so I still have this 1 over K . And then I have E , right, just looking at it from over there. I'm like, okay, this is cool, I can do this. So I have E to the U plus C . But then I know my original integral had X 's instead of U 's. So I need to put this U back in here. So I get 1 over K times E to the KX plus C .

Okay? So what I end up getting is the integral of, and I have E to the KX DX is going to equal 1 over K times E to the KX plus C , right? With the key part being in here, right, what's the, the new special part is this 1 over K , right, that would not have shown up if we didn't use substitution like we were supposed to.

Okay? So in both of these circumstances, right, in the first one, we had to use chain rule. And that's how we end up with a K in front, right? And in this one, we had to use substitution, which is how we end up with a 1 over K in front. But if you don't kind of use these rules, you're going to end up with the wrong answers. And you're going to also, you know which can have a real impact if you're trying to actually figure out how much something has grown or something like that. And you are missing a constant out in front. If the constant's, big, you know, if it's not very close to 1 , this could have a significant impact on your answer. And so you actually won't get the correct thing. So this is just, I know that this is stuff that, and sometimes you've seen before, but I want to do it carefully just to make sure that you can have, have the correct eye to make sure that you're not making these mistakes. So I did hope that made some sense, and it will be helpful, and I'll see you in the next lecture.