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SUMMARY KEYWORDS

function, ln, inputs, equal, variable, output, evaluated, natural log, square root, temperature, write, utility function, location, altitude, pi, represent, square, utility, talk, parentheses

SPEAKERS

Catherine Pfaff

Welcome. In this lecture, we're going to talk a little bit about multivariable functions. So, in what we've done so far, we've always talked about functions where you have one input, and then that gives you an output. But we want to talk about functions where you can have multiple inputs, and then get an output. So sometimes a function, so sometimes your function outputs, right, are actually depend on multiple function inputs, so depend on. And for now, we'll still do it as orange, because we have for a while been doing inputs as orange, but then there's going to be multiple, so we'll need multiple color for them. So they depend on multiple function inputs, depend on multiple function inputs.

But now, actually, all of these colors are going to possibly be inputs, because we're going to have multiple inputs. But that's kind of the color scheme we've been using. But now we have like new situations. So let's just kind of get started. So examples. So let's say I have a function, which is, so it's F of, and then I have inside the function, so this is going to, I'm going to have three inputs, so we're going to call them X, Y, and Z. And I guess the colors I'll use for them are like X, and then Y, and Z. Okay, and let's say that my function then is defined to equal, so I'm going to take that X, and I'm going to square it. And then I'm going to take my Y, I just multiply that X squared by it, and then add Z and multiplied by cosine of Y.

Okay, well now what happens? Let's look at what happens when we actually evaluate it at something. So let's say this is going to be evaluated at so evaluated at, and then let's say, you know, I have these three variables. And let's say they happen to be E, and pi, and, I'll give myself a little more room for that one, because this one's a little bit bigger. Actually, it's only proper to erase that. And so I have a LN of the square root of 2. LN of the square root of 2. Okay, so what happens when I evaluate that function at this point? Well, you can kind of think of it, it's just like before where I put parentheses for the variable, except then I have to put different parentheses for the different variables, and I'll just use different colors for that. So we have F of, so you know, I'm like putting that in, so it's Fof E, pi, and then the not the natural log of the square root of 2. And when I'm going, what's going to happen? Well, I can see that is I'm going to take my first variable, and I'm going to square it. And then I'm going to multiply that by my second variable, and then add to that my third variable and then cosine of my second.

Okay? So my first variable I put in every time I was supposed to have X so I have parentheses for that. Every time I was supposed to have Y, I have my parentheses for pi. And then every time I was supposed to have Z, I have my parentheses for my, oh my, I'm not leaving myself a lot of room for this LN of the square of 2. Okay, so that is, there's no way you can see that. Let me fix that a little bit so you can see a little bit better. So we can do a better job of that. So this is going to meet plus, and then I'm going to do here, I'm going to try this one might write a little bit thinner. So whoops, wrong marker, so let's use this one. So you can have LN of the square root of 2. Hopefully that's a little easier to see. Okay? So now we have, so all I did was I took, you know, I put my first coordinate in there, I put my second coordinate in there and there and then I put my third coordinate in there. So let's try one more. Here's another example. So I have G of, and it's okay that I'm calling it G. And I can call my variable something else too if I want. So I'm going to call them U and V. And let's say that this is equal to E to the UV.

Okay, so this is my function, and I'm going to evaluate it at, so this is going to be evaluated at, so evaluated at. I'm kind of standing in front of that. So it's going to be evaluated at, and then you know, I'm going to write this a little bit different, I'm going to write this as U is going to equal, so I have the natural log of 3. And V is going to equal negative 2. Okay, and then we get, so what happened, so this is G of the natural log of 3, and then minus 2, right? because this is my U. And this is my V. So my first one is LN of 3, my second one is minus 2. So then I can kind of close that up. So this is going to equal, so this is E to the, and then I have, right, my first is this LN of 3. And then my second is V, so that's going to be my minus 2. Okay? Which is actually just to remind you of how these things work, just to give a little practice, right? This is a product in the exponent, which means I can take E to this power, and then to that power, so and I actually want to do that I want to go E, and why do I? Because these are inverse functions, E and the natural log are, so that there are nice things that I can simplify this a lot better. That's to the minus 2 power, but when I have E to the natural log of 3, because those are inverse functions, I just get out 3 to the minus 2, which we know is, right, so this is 1 over 3 squared, which is equal to 1 over 9. Okay, and this was my answer here. Right? Okay, so what's happening in each of these circumstances, right, we're putting in these variables just, you know, there's just multiple places that things need to be put in. Okay, and just to kind of, yeah, so this is where we list all of our input variables and then those go into our functions. So now let's look at some situations where these arise, so some situations where arise.

Okay, so for the input, so and we'll do inputs over here. So let's start with, so maybe the first one will be the utility function. So one will be the utility function. And in the utility function, I'm not going to exactly give these functions. But the, so maybe I'll do my inputs in orange just because. So, in the utility function, we have my inputs, so X one up to X K are going to represent of quantities of K different goods, so quantities of K different goods. And then my output is going to be, so I'll list all my outputs over here. So my output in this circumstance is going to be the level of utility. So I'm going to write these in green even though sometimes that's also one of the inputs. So this is the level of, so my output I'm just going to decide to do green here. Okay, so this is the level of utility, and there's a function that would compute that for you. Another one is the production function. So another one is going to be the production function.

Input so it's clear that the inputs are what I'm writing in orange. So the production function. And here, so my inputs are, so I have maybe X equals labor or somehow another represents your labor and X

so my inputs are, so I have maybe X equals labor or somehow another represents your labor and Y represents your capital somehow or another okay? And then this is going to lead to, so my output you know by this function is going to be the level of production. Okay, and then we have the, this green is getting a little funny. So we have the altitude function or what one might call the altitude function. Okay, and the inputs for this maybe X equals, this is one example, could be that maybe X equals a latitude and Y equals longitude. And then what is my function spit out? it spits out the altitude at that you know location. How high are we? Are we on the mountain or below sea level at that location. Okay, and we have the temperature. Just keep on rotating through these.

So, here's a temperature function. And so my input might look like X, Y, Z, T, so I have as my inputs X, Y, Z, T, where we have this point x, y, z is the location in the room. And T equals the time we're evaluating at, right, the temperature is evaluated at. Okay? And then what ends up happening is that when you put this into your function, you're going to get the temperature at that location at that time, so temperature at that location at that time. Okay, so the main point of this really is that, you know, I mean, in the earlier part, I wanted to show you how you really are just taking each of these variables, and you're plugging them in, kind of like we've been doing before. So if you have more ones, you have to kind of keep track of what's going where. And then the other part of it that we're doing is that I just wanted to give you an idea that there's a lot of different functions like this. Your inputs can vary a lot as to what they represent. And then your outputs, also, right, now we're doing ones that have only a single output, but they can be anything from utility to temperature. Okay? So, I hope that makes some sense and I will see you in the next lecture.