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9. Slicing and partial derivatives

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Lecture due Aug 4, 2021 20:30 IST Completed

Synthesize

Geometry of partial derivatives revisited, part 1

1/1 point (graded)

Recall that when we take a partial y derivative, at a point (a,b) we fix the x-coordinate at a, and differentiate with respect to the y variable.

Which of the following best describes fixing the x-coordinate at the value a?

- ○ Intersecting the graph of the surface $z = f(x,y)$ with the xy-plane
- ○ Intersecting the graph of the surface $z = f(x,y)$ with the xz-plane
- ○ Intersecting the graph of the surface $z = f(x,y)$ with the yz-plane
- ○ Intersecting the graph of the surface $z = f(x,y)$ with the plane $y = b$
- ● Intersecting the graph of the surface $z = f(x,y)$ with the plane $x = a$

✔

Solution:

Fixing the x-coordinate at $x = a$ is equivalent geometrically to intersecting the graph of the surface $z = f(x,y)$ with the plane $x = a$, which is parallel to the yz-plane.

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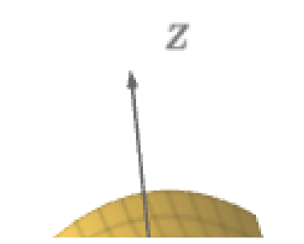
Answers are displayed within the problem

When we consider the partial y derivative of a function $z = f(x,y)$ at a point (a,b), we can approximate it by the slope of the secant line

$$f_y(a,b) \approx \frac{f(a,b+\Delta y) - f(a,b)}{\Delta y} = \frac{\Delta z}{\Delta y}$$

That is, it is well approximated by the slope of the the secant line of the single variable function $z = f(a,y)$.

▸ **The partial y derviative**



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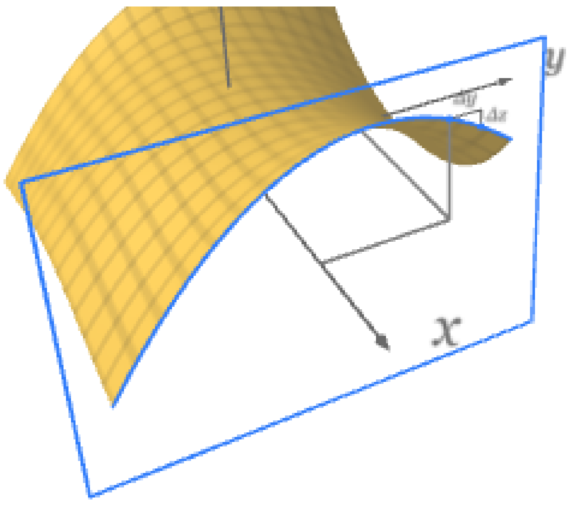
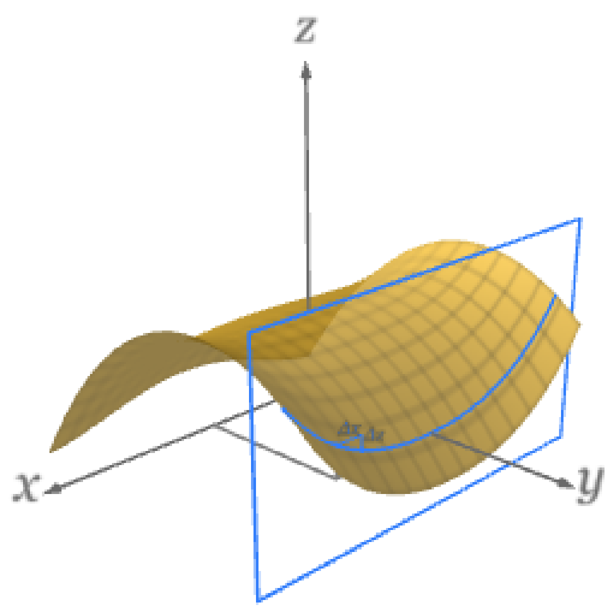


Similarly the partial x derivative of a function $z = f(x, y)$ at a point (a, b) is well approximated by the slope of the secant line of the function $f(x, b)$.

$$f_x(a, b) \approx \frac{f(a + \Delta x, b) - f(a, b)}{\Delta x} = \frac{\Delta z}{\Delta x}$$

▶ **The partial x derivative**



Geometry of partial derivatives revisited, part 2

2.0/2 points (graded)

Suppose we want to find the derivative in a direction that is not Δx or Δy.

If the graph of $z = x^3 - 2xy^2 + xy + 1/x$ is intersected with the plane given by $2(x-1) + (y-3) = 0$, what is the slope of the resulting curve at the point $(x, y) = (1, 3)$?

First find the equation of the curve that is obtained by intersecting the graph function with the plane. Enter the equation for this curve as a function of x only.

$z =$ -7*x^3+38*x^2-45*x+1/x ✔ **Answer:** -7*x^3 + 38*x^2 - 45*x + 1/x

Next find the derivative at $x = 1$.

9 ✔ **Answer:** 9

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? INPUT HELP

Solution:

First we use the equation of the plane to find an equation for y in terms of x:

$$2(x-1)+(y-3) = 0 \tag{2.45}$$
$$2x-2+y-3 = 0 \tag{2.46}$$
$$y = -2x+5 \tag{2.47}$$

Next we plug this formula for y into the equation for our function to find a formula restricted to the plane.

$$z = x^3-2x(-2x+5)^2+x(-2x+5)+1/x \tag{2.48}$$
$$= x^3-2x(4x^2-20x+25)-2x^2+5x+1/x \tag{2.49}$$
$$= x^3-8x^3+40x^2-50x-2x^2+5x+1/x \tag{2.50}$$
$$= -7x^3+38x^2-45x+1/x \tag{2.51}$$

To find the derivative, which is the slope at the point $x=1$, we differentiate this formula with respect to x and then plug in $x=1$.

$$z'(x) = -21x^2+76x-45-1/x^2 \tag{2.52}$$
$$z'(1) = -21+76-45-1=9 \tag{2.53}$$

Submit You have used 2 of 10 attempts

Answers are displayed within the problem

9. Slicing and partial derivatives

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  I got a question here if somebody could help The curve produced by the intersection of the plane and the function, how could it be i...
- [Peers] Hint/Help for Part 2: Thanks to dennisk50 — 1
- Geometry of part revisited II — 2
  What should we do if x was given as 0? I mean what modification need to be done if the value is outside function domain? And shall ...
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  I've computed the partial derivatives and see the connection between the plane and the point, but haven't gotten myself any further...
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  These last few problems have really made me feel like I'm not understanding these concepts. Wanted to share in case others are fee...
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  Are you sure that the posted solution to the question is correct? Using slope = "rise/run," I get the same numerator as in the solution,...
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? Derivative in arbitrary direction 2

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