

# Differential of the function

The differential of a multivariable function is given by

$$dz = \frac{\partial z}{\partial x} dx + \frac{\partial z}{\partial y} dy$$

$\frac{\partial z}{\partial x}$  is the partial derivative of  $f$  with respect to  $x$

$\frac{\partial z}{\partial y}$  is the partial derivative of  $f$  with respect to  $y$

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## Example

Find the differential of the multivariable function.

$$z = 6x^2y - 4 \ln y$$

Before we can use the formula for the differential, we need to find the partial derivatives of the function with respect to each variable.

$$\frac{\partial z}{\partial x} = 6(2x)y$$

$$\frac{\partial z}{\partial x} = 12xy$$

and

$$\frac{\partial z}{\partial y} = 6x^2 - 4 \left( \frac{1}{y} \right)$$



$$\frac{\partial z}{\partial y} = 6x^2 - \frac{4}{y}$$

We'll plug the partial derivatives into the formula for the differential.

$$dz = (12xy)dx + \left(6x^2 - \frac{4}{y}\right) dy$$

$$dz = 12xy \, dx + 6x^2 \, dy - \frac{4}{y} \, dy$$

This is the differential of the function.

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