Formulas

Throughout, let $z = f(x, y)$ and let (a, b), (a_1, b_1), and (a_2, b_2) be points in $\mathbb{R}^2$. In addition, let Δx be the change from $x = a_1$ to $x = a_2$ (i.e. $\Delta x = a_2 - a_1$) and let Δy be the change from $y = b_1$ to $y = b_2$ (i.e. $\Delta y = b_2 - b_1$).

$$f_x(x, y) = \lim_{h \to 0} \frac{f(x + h, y) - f(x, y)}{h}$$

$$f_y(x, y) = \lim_{h \to 0} \frac{f(x, y + y) - f(x, y)}{h}$$

$$\Delta z = f(a_1 + \Delta x, b_1 + \Delta y) - f(a_1, b_1)$$

$$dz = f_x(a_1, b_1)\, dx + f_y(a_1, b_1)\, dy$$

$$= \frac{\partial z}{\partial x}(a_1, b_1)\, dx + \frac{\partial z}{\partial y}(a_1, b_1)\, dy$$