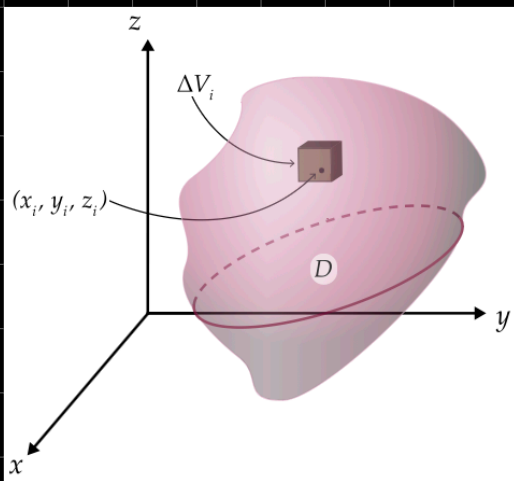Double integrals are used for boundaries in R2

Triple integrals are used for boundaries in R3

(Both are used for *figures* in any number of dimensions; the dimension of the boundary is restrictive)

Riemann sum:

$$\sum_{i=1}^{n} f(x_i, y_i, z_i) \Delta V_i$$

Definition: Integrable

A function $f(x, y, z)$ which is bounded on a closed bounded set $D \subset \mathbb{R}^3$ is said to be **integrable** on D if and only if all Riemann sums approach the same value as $\Delta P \to 0$.

Definition: Triple Integral

If $f(x, y, z)$ is integrable on a closed bounded set D, then we define the **triple integral** of f over D as

$$\iiint_D f(x, y, z) \, dV = \lim_{\Delta P \to 0} \sum_{i=1}^{n} f(x_i, y_i, z_i) \Delta V_i$$