

The unit ball in four-dimensional space is $\{(x, y, z, w) \in \mathbb{R}^4 : x^2 + y^2 + z^2 + w^2 \leq 1\}$. For each point (x, y, z) in \mathbb{R}^3 , compute the length of the line segment whose endpoints are on the unit ball that goes through $(x, y, z, 0)$. Integrate this length over $x^2 + y^2 + z^2 \leq 1$ in \mathbb{R}^3 to compute the (4-dimensional) volume of the unit ball in \mathbb{R}^4 .