Intuitive Way

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If we change the variables for the integration, we need to multiply the integrand by the absolute value of the determinant of the Jacobian matrix. There is an intuitive way to explain this.

Here, we consider changing the variables from $(x_1, x_2, \cdots, x_n)$ to $(y_1, y_2, \cdots, y_n)$.

The volume in the latter variables is: