1. Find the area of the triangle in the plane with vertices $(0,0)$, $(1,0)$, and $(1,1)$, weighted by the function $f(x,y) = 8xy$.
2. Find the flow of the vector field $F(x,y) = (x, y^2)$ about the triangle in the plane with vertices $(0,0)$, $(1,0)$, and $(0,1)$, oriented counterclockwise.
3. Find the flux of $F(x,y,z) = (z, 4y, x)$ through the surface
$$\begin{aligned} S\colon [0,1]^2 &\to \mathbb{R}^3 \\ (u,v) &\mapsto (v, uv, u). \end{aligned}$$
4. What is the area of the surface parametrized by
$$\begin{aligned} S\colon [0,1]^2 &\to \mathbb{R}^3 \\ (u,v) &\mapsto (v, uv, u) \end{aligned}$$
weighted by the function $f(x,y,z) = xz$?
5. Find the flux of $F(x,y,z) = (y^2, \cos(xz), x^2 + 3z)$ through the unit sphere centered at the origin.
6. What is the length of the curve $C(t) = (t, t^2)$ for $0 \le t \le 1$, weighted by $f(x,y) = x$?
7. What is the flow of $F(x,y) = (-y, y^3)$ around the circle $C(t) = (\cos(t), \sin(t))$ for $0 \le t \le 2\pi$?