Unit 4 Group Work
MultiV 2021-22 / Dr. Kessner

No calculator! Have fun! Please finish at home and turn in next class.

1. In $\mathbb{R}^3$, find the distance from the origin to the plane $y + z = 1$, using 3 different different methods:

a. Use projection (dot product).

b. Minimize the squared distance to the origin $f(x, y, z) = x^2 + y^2 + z^2$, subject to the constraint $y + z = 1$. Solve the constrained optimization problem using substitution.

c. Solve the constrained optimization problem using Lagrange multipliers.

2. You are designing a cylindrical container to hold a given volume of liquid (say 1000π ml). The container has a circular bottom, but the top is open. You want to minimize the amount of material you use for the container (the surface area).

a. Write the volume V as a function of its radius r and height h. Since your volume is given and fixed, this gives you a constraint equation. Write the surface area A as a function of r and h. This is the function you want to minimize.

b. Minimize the surface area for the given volume. Solve the constrained optimization problem using substitution.

c. Solve the constrained optimization problem using Lagrange multipliers.

3. Maximize the function $f(x, y) = 2x + 3y$ on the unit circle $x^2 + y^2 = 1$ using two different methods:

a. Solve the constrained optimization problem using Lagrange multipliers.

b. Parametrize the circle.