Math 251: Computational Lab 5

Fall 2019, Sections 1-3

Instructor:	Matt Charnley
Recitation Instructor:	Some TA
Due Date:	September 1, 2019

Introduction

You are encouraged to discuss this assignment with other students and with the instructor/recitation instructor, but the work you hand in should be your own. See the website

`http://math.rutgers.edu`

for more information as well as helpful background information and commands for completing the assignment.

This lab will introduce the concept of center of mass and use the computer system to compute the integrals needed for these calculations. This is a topic that can show up in physical problems as an application of multiple integrals.

Your Task

For this lab, the individualized data from your instructor will consist of a function $\rho(x, y)$, two functions $f(x, y)$ and $\rho(x, y, z)$, and a sphere radius rad. From this, you will need to:

- Compute the center of mass of the square $-1 \leq x \leq 1$, $-1 \leq y \leq 1$ with uniform density 1.
- Compute the center of mass of the square $-1 \leq x \leq 1$, $-1 \leq y \leq 1$ with density $\rho(x, y)$.
- Draw the region between the graphs of $y = L(x)$ and $y = f(x)$ and compute the center of mass of this region if it has density 1.
- Draw the region between the graph of $z = f(x, y)$ and the sphere of radius rad centered at the origin, and compute the volume and total mass of this region.

Deliverable

Your code should consist of the following:

1. Computation of the center of mass of the square if the density is the constant function 1. **In words**, why does this answer make sense?

2. Computation of the center of mass of the square with density $\rho(x, y)$.

3. Computation of the center of mass of the region between $y = L(x)$ and $y = f(x)$ with constant density 1. To help you with this, the area of this region has been provided with your individualized data. Verify this value to make sure that you are using the correct region.

4. A figure (or two) of the region between $z = f(x, y)$ and the sphere of radius rad centered around the origin.

5. Verification of the volume of this region. It should match the 3D Volume value given in your individualized data.

6. Computation of the total mass of this region if it has density $\rho(x, y, z)$.

Print all of your code (after removing all of the incorrect lines) and the desired images from above and put them into a single stapled packet. This assignment is due on **September 1, 2019** in recitation.

Tips

Some of these integrals might be tricky to do on the computer. You may need to first work out by hand what the integral looks like in a different coordinate system and have the computer system carry out that integral. If you do this, you can put a discussion about it in a comment before you do the integral calculation.

Rubric

This lab is worth a total of 15 points.

- 3 points for including the supporting code for all of the points below.
- 1 point for finding the center of mass of the square with density $\rho \equiv 1$
- 1 point for an explanation as to why this makes sense.
- 3 points for computing the center of mass of the square with density $\rho(x, y)$. 1 point for the total mass, 1 point for the x-moment and y-moment, and 1 point for the answer.
- 1 point for drawing the graph of the two-dimensional region between $L(x)$ and $f(x)$.
- 2 points for the center of mass of this region. 1 point for the moments, and 1 point for the answer.
- 2 points for sketching the three-dimensional region.
- 2 points for computing the total mass of this region.