COMPUTER PROJECT 7
Centroid, Center of Mass, and Moment of Inertia

DUE: 03/22/2021

Instructions: Use *Mathematica* to solve the following problems. You will need to email your notebook file to me at *byoung@wyomingseminary.org*. Use "Mathematica Project 7" as the subject line of your email.

For all three parts below, you have been given a solid region which is inside a sphere centered at the origin and above a paraboloid. This region is different for each student and can be found on the page following these instructions.

PART I: Compute the centroid of the region *using cylindrical coordinates*. (HINT: Two of the coordinates should be trivial.)

PART II: You have been given a density function $\delta = \delta(x, y, z)$. Find the center of mass for the solid region if the material it is made from has density given by δ.

PART III: Compute the moment of inertia tensor for your given region (assuming a constant density of 1) based at its centroid.

PART IV: Compute the moment of inertia tensor for your given region with density given by $\delta = \delta(x, y, z)$ based at its center of mass. If the resulting matrix is not diagonal, find its principal moments of inertia by computing the eigenvalues (you may want to get these numerically).

Project 7 Data

Student	Sphere	Paraboloid	Density $\delta = \delta(x, y, z)$
Yiqing Cao	$x^2 + y^2 + z^2 = 9$	$z = \frac{1}{8}(x^2 + y^2)$	$\delta = 3x^6y^2z^5$
Hyewon Jo	$x^2 + y^2 + z^2 = 16$	$z = \frac{\sqrt{3}}{2}(x^2 + y^2)$	$\delta = 8x^4y^8z^9$
Yifei Liu	$x^2 + y^2 + z^2 = 25$	$z = \frac{1}{24}(x^2 + y^2)$	$\delta = 3x^2y^8z^5$
Kaiqi Shen	$x^2 + y^2 + z^2 = 36$	$z = \frac{\sqrt{2}}{6}(x^2 + y^2)$	$\delta = 9x^4y^2z^7$
Xiyue Tan	$x^2 + y^2 + z^2 = 49$	$z = \frac{1}{48}(x^2 + y^2)$	$\delta = 6x^6y^2z^7$
Roy Wang	$x^2 + y^2 + z^2 = 36$	$z = \frac{1}{5}(x^2 + y^2)$	$\delta = 4x^2y^6z^9$
Yiheng Yan	$x^2 + y^2 + z^2 = 25$	$z = \frac{\sqrt{3}}{10}(x^2 + y^2)$	$\delta = 5x^2y^2z^5$
Tiange Yang	$x^2 + y^2 + z^2 = 16$	$z = \frac{1}{6}(x^2 + y^2)$	$\delta = 7x^2y^2z^5$
Zherui Zhang	$x^2 + y^2 + z^2 = 9$	$z = \frac{\sqrt{2}}{3}(x^2 + y^2)$	$\delta = 2x^4y^6z^3$