Physics with Mathematica Fall 2019   Exercise #9   30 Oct 2019

The mass of the Sun from planetary orbits

The gravitational force between two objects of masses m and M is GmM/r^2, where r is the distance between the masses. If $m \ll M$, then to a good approximation r is also the radius of the circular orbit that m follows about M.

Use this to calculate the mass of the Sun from the orbits of the planets, including Pluto. You can look up the orbital periods and the (approximate) orbital radii using PlanetData. For Pluto you will need to use Entity["MinorPlanet", "Pluto"]; check the documentation for the usage. You can get G and the solar mass using Quantity.

Of course, the planetary orbits are not circular, but low eccentricity ellipses. It is best to use the semi-major axis of the orbit for r.

Make a plot of the $M_{\mathrm{Calc}}/M_{\mathrm{Sun}} - 1$ versus the base 10 logarithm of the orbital radius for each of the nine values. There is a systematic deviation that will be obvious. What do you suppose is the reason for that?

Send the grader an email with your notebook as an attachment.