Chem 197
Fall 2019

measurement exercise iv

The file ***eratosthenes.xlsx*** contains a record of 147 measurements of the earth's radius using a method similar to that outlined by Crease in Chapter 2 of *The Prism and the Pendulum*. The data were collected in September 2014 by students in the Czech Republic, Romania, Spain, Italy, France, Honduras, Portugal, Brazil, Mexico, Peru, Argentina, and Uruguay. You can read more details about this experiment here: https://www.eaae-astronomy.org/eratosthenes/the-eratosthenes-experiment. The data are ordered from the largest reported radius to the smallest reported radius, with values given in kilometers.

The file ***cavendish.xlsx*** contains 29 measurements of the earth's density relative to that for water, as measured by Henry Cavendish between August 1797 and June 1798, and published as "Experiments to Determine the Density of the Earth" in the *Philosophical Transactions of the Royal Society of London*, Volume 88 (1978), pp. 469–526 (a link to the paper is on the additional resources page of the course website).

Use these two sets of data to calculate the following properties of the earth: its circumference (in kilometers), its surface area (in km^3), its volume (in kiloliters), and its weight (in kilograms). Here is some potentially useful information

- although the earth is not a perfect sphere—it is an oblate spheroid that is slightly flatter at the poles—we can treat the earth as if it is a perfect sphere because the deviation is very small relative to the errors in the students' and Cavendish's measurements
- the density of water is 997 kg/m^3 at 25°C, which is equivalent to 0.977 g/cm^3 or 0.977 g/mL
- 1 kilo— is equivalent to 1000— (for example, 1 kilometer = 1000 meters), 1 milli— is equivalent to 0.001— (for example, 1 milliliter = 0.001 liters), and 1 centi— is equivalent to 0.01— (for example, 1 centimeter = 0.01 meters)
- 1 kiloliter is equivalent to 1×10^{-9} km^3

Most of the radii reported by the students are reasonable values given the method used to make measurements; some results, however, are much larger or much smaller than expected. You will want to consider how to account for these odd results.

Present your analysis of this data in a short, written report of approximately 250–500 words that explains how your arrived at the values you are reporting and how your results compare to the "accepted" values. You may assume your reader can follow a well-written argument, but you cannot assume they know details such as the relationship between a circle's radius and its circumference (or what the radius and the circumference represent). Be sure to incorporate Clark's tools for writing into your report, a hard copy of which is due in class on Wednesday, September 4th.