Chem/Stat3240: Homework 1a
Matlab

September 1, 2015

1. An oblate spheroid such as the Earth is obtained by revolving an ellipse about its minor axis. In everyday terms, it is the shape of a slightly compressed beach ball. The Earth's equatorial radius is about 20km longer than its polar radius.

   The surface area of an oblate spheroid is given by

   $$A(r_1, r_2) = 2\pi \left(r_1^2 + \frac{r_2^2}{\sin(\gamma)} \log \left(\frac{\cos(\gamma)}{1 - \sin(\gamma)} \right) \right) \tag{1}$$

   where r_1 is the equatorial radius, r_2 is the polar radius, and

   $$\gamma = \arccos \left(\frac{r_2}{r_1} \right) \tag{2}$$

   We assume $r_2 < r_1$. Write the code (a script for the body of the template function) that takes r_1 and r_2 as given (the function inputs) and computes $A(r_1, r_2)$. Also compute the surface area approximation given by

   $$A(r_1, r_2) \approx 4\pi((r_1 + r_2)/2)^2 \tag{3}$$

2. An ellipse with the semi axes a and b is specified by

   $$\left(\frac{x}{a} \right)^2 + \left(\frac{y}{b} \right)^2 = 1 \tag{4}$$

   If $r = a = b$, then this defines a circle whose perimeter is given by $P = 2\pi r$. Unfortunately, if $a \neq b$, then there is no simple formula

for the perimeter, and we must resort to approximation. Numerous possibilities have been worked out:

$$P1 = \pi\sqrt{2\left(a^2+b^2\right) - \frac{(a-b)^2}{2}} \qquad P2 = \pi\left(a+b\right)\left(1+\frac{h}{8}\right)^2$$
$$P3 = \pi\left(a+b\right)\frac{256-48h-21h^2}{256-112h+3h^2} \qquad P4 = \pi\left(a+b\right)\left(\frac{3-\sqrt{1-h}}{2}\right)$$

Here,

$$h = \left(\frac{a-b}{a+b}\right)^2 \tag{5}$$

can be regarded as a departure from "circle hood". Write the code that computes each of the four approximations given the ellipse parameters a and b.

Remember to comment your code.