Iwin Yeung
UID: 304885047
CEE / MAE M20
April 9th 2019

Homework 01

1 Describing Oblate Spheroid Surface Areas & Calculations

1.1 Introduction:

The goal in this problem is to develop a script that inputs the equatorial and polar radii and displays both the surface area of an oblate spheroid given by an exact formula and its approximation. A standard radius of A= (6378.137, 6356.752) will be applied. The results will be displayed to 10 digits and the discrepancies will be discussed.

1.2 Model and Theory

The applicable equations for this particular problem are:

$$A(r_1,r_2) = 2\pi (r_1^2+r_2^2/\sin(\gamma)* \ln(\cos(\gamma)/1-\sin(\gamma)))$$

Where
r_1 = equatorial radius
r_2 = polar radius
$\gamma = \arccos(r_2/r_1)$

1.3 Methods and Pseudo-code

The flow of calculate should be as follows:
1.Ask user for radius 1
-Error check user input for viability (e.g. no negative, complex, or imaginary radius)
2.Ask user for a radius 2 less than radius 1
-Error check user input for viability
3.Calculate surface area using exact and approximation formulas
4.Compare the Area values from two calculations

1.4 Calculations and Results

With an example switch of 0, the resulting output from the script is:

```
Enter the homework problem, either 1 or 2, you wanna test out: 0
Error, please enter 1 or 2 and restart program
```

With an example (r1, r2) = (6378.137, 6356.752), the resulting output from the script is:

```
Enter the homework problem, either 1 or 2, you wanna test out:
1
Please enter radius 1
6378.137
Please enter radius 2 less than r_1
6356.752
Using exact formula the surface area is: 296102777.4351647496
Using approximation formula the surface area is: 509495321.6397447586
```

1.5 Discussions and Conclusions

It can be shown that the value of the surface area varies according to the radius 1 and radius 2. Using the Earth data, (r1, r2) = (6378.137, 6356.752) reveals a very large discrepancy that the exact formula displays a surface area that is 0.581 times that of the surface area using the approximation formula. The value of the surface area is displayed 10 digits after the decimal place to reveal further discrepancy.

2 Describing Ellipse Perimeter & Calculations

2.1 Introduction:

The goal in this problem is to develop a script that measures and calculates the perimeter of an ellipse. Ideally, the script should solicit values a and b and print values of P1…..P8 in a way that facilitates comparison. The value of h will also be displayed. Using this script, the output should display discrepancies among perimeter formula as the ellipse becomes more oblong in shape.

2.2 Model and Theory

$$P_1 = \pi(a+b)$$

$$P_2 = \pi\sqrt{2(a^2+b^2)}$$

$$P_3 = \pi\sqrt{2(a^2+b^2) - \frac{(a-b)^2}{2}}$$

$$P_4 = \pi(a+b)\left(1+\frac{h}{8}\right)^2$$

$$P_5 = \pi(a+b)\left(1+\frac{3h}{10+\sqrt{4-3h}}\right)$$

$$P_6 = \pi(a+b)\frac{64-3h^2}{64-16h}$$

$P_7 = \pi(a+b)\,\frac{256-48h-21h^2}{256-112h+3h^2}$

$P_8 = \pi(a+b)\,(\frac{3-\sqrt{1-h}}{2})$

Where:

P_1,....P_8 are approximations for various perimeters

$h = (\frac{a-b}{a+b})^2$

a - one of the semi-axes

b - another of the semi-axes

2.3 Methods and Pseudo-code

1.Prompt user to input value for a

2.Prompt user to input value for b

-Error check user input for viability

3.Calculates h

4.Calculates perimeter for P1,….P8

2.4 Calculations and Results

With an example a=b=1 the resulting output from the script is:

```
Enter the homework problem, either 1 or 2, you wanna test out:
2
Enter a number for a:
1
Enter a number for b:
1

h =
0
Perimeter of circle P_1:
6.2831853072
Perimeter of circle P_2:
6.2831853072
Perimeter of circle P_3:
6.2831853072
Perimeter of circle P_4:
6.2831853072
Perimeter of circle P_5:
```

```
6.2831853072
Perimeter of circle P_6:
6.2831853072
Perimeter of circle P_7:
6.2831853072
Perimeter of circle P_8:
6.2831853072
```

With an example with either a or b =0, the resulting output from the script is:

```
Enter the homework problem, either 1 or 2, you wanna test out:
2
Enter a number for a:
1
Enter a number for b:
0
Error, please enter a nonzero integer for a and b
```

With an example with varying a and b accordingly, the resulting output from the script is:

(a,b) = (1,1)	(a,b) = (1,0.9)	(a,b) = (1,0.8)	(a,b) = (1,0.7)
h=0 Perimeter of circle P_1: 6.2831853072 Perimeter of circle P_2: 6.2831853072 Perimeter of circle P_3: 6.2831853072 Perimeter of circle P_4: 6.2831853072 Perimeter of circle P_5: 6.2831853072 Perimeter of circle P_6: 6.2831853072 Perimeter of circle P_7:	h = 0.00277008310249307 Perimeter of circle P_1: 5.9690260418 Perimeter of circle P_2: 5.9772876735 Perimeter of circle P_3: 5.9731582860 Perimeter of circle P_4: 5.9731604320 Perimeter of circle P_5: 5.9731604325 Perimeter of circle P_6: 5.9731604325	h =0.0123456790123457 Perimeter of circle P_1: 5.6548667765 Perimeter of circle P_2: 5.6896662851 Perimeter of circle P_3: 5.6722932177 Perimeter of circle P_4: 5.6723335360 Perimeter of circle P_5: 5.6723335778 Perimeter of circle P_6: 5.6723335777	h =0.0311418685121107 Perimeter of circle P_1: 5.3407075111 Perimeter of circle P_2: 5.4232297679 Perimeter of circle P_3: 5.3821268024 Perimeter of circle P_4: 5.3823683436 Perimeter of circle P_5: 5.3823689815 Perimeter of circle P_6: 5.3823689786

6.2831853072 Perimeter of circle P_8: 6.2831853072	Perimeter of circle P_7: 5.9731604325 Perimeter of circle P_8: 5.9731625830	Perimeter of circle P_7: 5.6723335778 Perimeter of circle P_8: 5.6723742723	Perimeter of circle P_7: 5.3823689815 Perimeter of circle P_8: 5.3826162737
(a,b) = (1,0.6)	(a,b) = (1,0.5)	(a,b) = (1,0.4)	(a,b) = (1,0.3)
h =0.0625 Perimeter of circle P_1: 5.0265482457 Perimeter of circle P_2: 5.1812473374 Perimeter of circle P_3: 5.1044838739 Perimeter of circle P_4: 5.1053948582 Perimeter of circle P_5: 5.1053997726 Perimeter of circle P_6: 5.1053997280 Perimeter of circle P_7: 5.1053997720 Perimeter of circle P_8: 5.1063551630	h = 0.111111111111111 Perimeter of circle P_1: 4.7123889804 Perimeter of circle P_2: 4.9672941329 Perimeter of circle P_3: 4.8415194364 Perimeter of circle P_4: 4.8441976999 Perimeter of circle P_5: 4.8442241081 Perimeter of circle P_6: 4.8442236721 Perimeter of circle P_7: 4.8442240986 Perimeter of circle P_8: 4.8471420015	h = 0.183673469387755 Perimeter of circle P_1: 4.3982297150 Perimeter of circle P_2: 4.7851313682 Perimeter of circle P_3: 4.5957538466 Perimeter of circle P_4: 4.6025076557 Perimeter of circle P_5: 4.6026224901 Perimeter of circle P_6: 4.6026192371 Perimeter of circle P_7: 4.6026223696 Perimeter of circle P_8: 4.6104269194	h = 0.289940828402367 Perimeter of circle P_1: 4.0840704497 Perimeter of circle P_2: 4.6385059658 Perimeter of circle P_3: 4.3700897606 Perimeter of circle P_4: 4.3854696760 Perimeter of circle P_5: 4.3859097438 Perimeter of circle P_6: 4.3858889139 Perimeter of circle P_7: 4.3859084687 Perimeter of circle P_8: 4.4053845116
(a,b) = (1,0.2)	(a,b) = (1,0.1)	X	X
h =0.444444444444445 Perimeter of circle P_1: 3.7699111843	h =0.669421487603306 Perimeter of circle P_1: 3.4557519189	X	X

Perimeter of circle P_2: 4.5308693597 Perimeter of circle P_3: 4.1677936304 Perimeter of circle P_4: 4.2004257331 Perimeter of circle P_5: 4.2020053303 Perimeter of circle P_6: 4.2018801742 Perimeter of circle P_7: 4.2019926954 Perimeter of circle P_8: 4.2499038303	Perimeter of circle P_2: 4.4650420928 Perimeter of circle P_3: 3.9924192049 Perimeter of circle P_4: 4.0582875864 Perimeter of circle P_5: 4.0639272100 Perimeter of circle P_6: 4.0631510073 Perimeter of circle P_7: 4.0637936840 Perimeter of circle P_8: 4.1901690518		

2.5 Discussions and Conclusions

It can be shown that the values of a and b have an impact on the various approximations of the eight formulas provided. By plugging pre-set values into a and b we can determine the discrepancies between each of the approximations. For the values, a does not equal to b, even though there is no exact formula for the perimeter of the ellipse, the numerous possibilities have been inputted and input values (a,b) = (1,1),(1,0.9),...,(1,0.1) have been evaluated accordingly.