

Script Files

Area and Volume of an Oblate Spheroid

An *oblate spheroid* such as the earth is obtained by revolving an ellipse about its minor ax-is. In everyday terms, it is the shape of a slightly compressed beach ball. The earth's equatorial radius is 6378.137 *km*, and its polar radius is 6356.752 *km*.

The volume of an oblate spheroid is given by the formula

$$V = \frac{4}{3}\pi r_e^2 r_p,$$

and its area is given by the formula

$$A = 2\pi \left(r_e^2 + \frac{r_p^2}{\sin(\gamma)} \ln \left(\frac{\cos(\gamma)}{1 - \sin(\gamma)} \right) \right),$$

where r_e represents the equatorial radius; r_p represents the polar radius; and

$$\gamma = \arccos \left(\frac{r_p}{r_e} \right).$$

We assume that $r_e > r_p$.

Write the **R** script file `oblate.r` that prompts the user for two inputs: r_e and r_p and prints the volume and the surface area of the oblate spheroid determined by r_e and r_p . This will take two of **R**'s `as.numeric(readline())` statements, one for r_e and one for r_p , and you will need to use several of **R**'s built-in functions: `sin`, `cos`, `log`, and `acos`. These represent the sine, cosine, natural logarithm (log base e), and arccosine functions, respectively.

The inputs for all the trigonometric functions in **R** are in radians. So, for instance, the **R** command

```
> sin(pi/2)
```

means that you are taking the sine of $\pi/2$ radians (or 90 degrees!). The `cos`, `log`, and `acos` are similar. In the formula, “ln” means the “natural logarithm” or “log base e.” In **R**, use the command `log`. So, the **R** command

```
> log(1000)
```

means $\ln(1000)$.

Here are several examples.

```
> source('~Documents/R Folder/oblate.r')
Please enter the equatorial radius in km 6378.137
Please enter the polar radius in km 6356.752
The surface area of the oblate spheroid is 510065605 km^2.
The volume of the oblate spheroid is 344795581635 km^3.

> source('~Documents/R Folder/oblate.r')
Please enter the equatorial radius in km 71492
Please enter the polar radius in km 66854
The surface area of the oblate spheroid is 61468931221 km^2.
The volume of the oblate spheroid is 1.431301e+15 km^3.
```

The last example was from Jupiter.