Lab 4: Solids of Revolution

In this lab we use *Mathematica* to graph solids of revolution and to find their volumes. Refer to Section 8.2 in Stein and pages 168-174 in Crooke & Ratcliffe.

Step 1

Before you access the Lab4 notebook, ensure that your File Viewer looks like this:

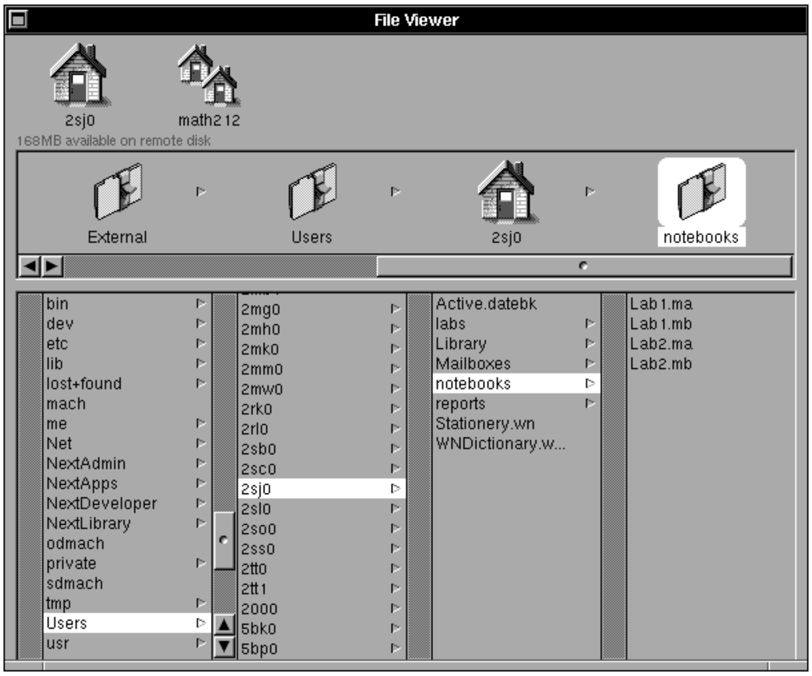

Figure 1 Your File Viewer should look like this

If it doesn't, work through Steps 1-2 of Lab 2 now to make it so.

Step 2

Now copy the **Lab4.ma** notebook file into your own **notebooks** subdirectory If you don't remember how to do this, review Step 3 of Lab 2.[1] After opening the main cell, it should look like Fig. 2.

Working through this lab. Be sure to ***open all subcells*** and ***execute all Mathematica commands*** in the order in which they appear.

[1] Or ask someone.

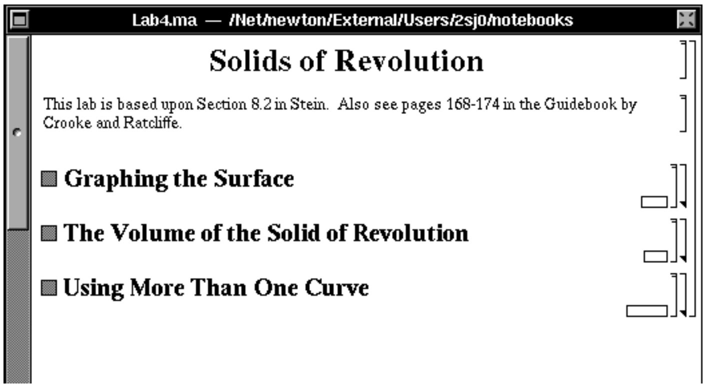

Figure 2 The main sections of **Lab4**

In the first section, a definition is given for a command named `Surface`. Once this definition has been executed, you will be able to graph surfaces of revolution the same way you graph ordinary functions.[2]

In the second section you will be checking some of the integrals that you did on Homework Assignment #13 and on Quiz 4.

The third section shows how to do the same graphics and volume calculations for solids that are bounded by more than one surface of revolution. The first command in this section loads the external package `Graphics/FilledPlot.m` into *Mathematica*. This, along with all the other external Mathematica packages are located in the `NextLibrary/Mathematica/Packages` directory. You can view their contents by double-clicking on their file names.

Watch the surfaces as they are drawn. You will be able to see the insides of the solids before their boundaries are completed. It will give you a better understanding of their shapes.

You can save time on the exercises by copying[3] the block of commands from the Example section down into each Exercise cell. Then just edit the definitions of `f`, `g`, `a`, and b, and then execute the entire block.

A good view point for some of the surfaces in the last section is `(8,7,1)`.

Step 3

After you and your lab partner have finished working through the notebook, prepare to write your own lab reports describing what you have learned.[4] Use the *WriteNow* word processor to do this. Refer to Step 5 of Lab2. Be sure to illustrate your work with examples.[5]

Don't forget to save your work regularly.[6]

2 If you **quit** *Mathematica*, you will have to execute this definition each to you launch *Mathematica*.
3 Use Command-c for Copy and Command-v for Paste.
4 You should study the "sample" lab reports for Lab1 and Lab2 in the **math212/reports** directory.
5 Note that the examples used in the "sample" lab reports are all taken from the notebook exercises.
6 Use Command-s.

Step 4

Here are some ideas to consider when writing your report:

Graphing the Surface

1. What do you think *Mathematica* is really doing when it graphs a surface?

The Volume of a Solid of Revolution

1. What *is* a solid of revolution?
2. What is the “Disk Method,” and why is it called that?

Using More Than One Curve

1. How does the `FilledPlot` work?
2. What is an “external package,” and how is it used?
3. How can *Mathematica* graph a solid that is bounded by more than one surface?
4. How can *Mathematica* show you the graph from different angles?
5. How does *Mathematica* use the Disk Method to obtain the volume of a solid bounded by more than one surface of revolution?

Step 5

After you finish writing your Lab report, mail it to **math212**. Be sure that the *WriteNow* icon for your report is in the Send window before you click on the Deliver button.

Appendix: *Mathematica* Commands

Here are some of the *Mathematica* commands that are used in this lab:

`Plot[ f[x], {x,1,2} ]`	Draws the graph of **`y = f[x]`** for **`x`** in the range **`1`** to **`2`**.
`Surface[ f[x], {x,1,2} ]`	Draws the graph of the surface obtained by revolving about the x-axis the graph of **`y = f[x]`** for **1** ≤ **`x`** ≤ **2**.
`Integrate[ f[x], {x,a,b} ]`	Produces the definite integral of **`f[x]`** for **`a`** ≤ **`x`** ≤ **`b`**.
`Simplify[%]`	Simplifies the previous output.
`Factor[%]`	Factors the previous output.
`FilledPlot[ {f[x],g[x]}, {x,a,b} ]`	Draws the graphs of both functions and then shades the region(s) bounded by them.
`s1 = Surface[ f[x], {x,1,2} ]`	Draws the surface and names it **`s1`**.
`Solve[ s1, s2 ]`	Draws the two surfaces together in the same space.
`ViewPoint -> {8,7,1}`	An option used within the **`Show`** command to change the point of view.