



Mathematica

140.776 Statistical Computing

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What is Mathematica?

Mathematica is a high level scientific and mathematical programming environment. The program consists of two components:

- The **front-end** or **notebook** lets you interact with Mathematica in an editor-like format. You can type your input expressions, comments, format the text and see the output of the execution inside the notebook.
- The core engine of Mathematica that does all the computation is the **kernel**.

Note: in contrast to pretty much every other software product introduced in this course, Mathematica is a commercial product for which you need to obtain a license (and it is not cheap). Currently, Johns Hopkins Biostatistics has a license, running Mathematica on ATHENA.

Running Mathematica

There are two interfaces for Mathematica:

- The **Notebook Interface**:
 - Double-click the Mathematica icon (GUI).
 - Type `mathematica` from the command line.
 - Choose the `Quit` menu item to quit.
- The **Text Based Interface**:
 - Type `math` to start.
 - Type `Quit`, `<Ctrl> D`, or `<Ctrl> Z` to end the session.

Although the details of running Mathematica differ from one computer system to another, the structure of Mathematica calculations is the same in all cases. You enter input, then Mathematica processes it, and returns a result.

Notebook Interfaces

On most computers, Mathematica supports a notebook interface in which you interact with Mathematica by creating interactive documents:

- When Mathematica starts up, it gives you a blank notebook.
- You enter Mathematica input into the notebook, then use the key combination `<Shift> <Return>` to make Mathematica process your input (hold down the `Shift` key, and then press `Return`.)
- You can use the standard editing features of your graphical interface to prepare your input, which may go on for several lines. `<Shift> <Return>` tells Mathematica that you have finished your input.

Notebook Interfaces

After you send Mathematica input from your notebook, Mathematica will label your input with `In[n] :=` . It labels the corresponding output `Out[n]=` . For example:

```
In[1] := 2+2
```

```
Out[1]= 4
```

On a technical note: Notebooks are part of the front end to Mathematica. The Mathematica kernel which actually performs computations may be run either on the same computer as the front end, or on another computer connected via some kind of network or line. In most cases, the kernel is not even started until you actually do a calculation with Mathematica.

Text Based Interfaces

With a textbased interface, you interact with your computer primarily by typing text on the keyboard.

- This kind of interface is available for Mathematica on almost all computer systems.
- When Mathematica has started, it will give you the the prompt `In[1] :=` , signifying that it is ready for your input. You can then type your input.
- On any system, you can tell Mathematica that you have finished giving input by typing `<Shift> <Return>`. On some systems, `<Return>` or `<Enter>` alone is sufficient. Mathematica will then process the input, and generate a result.
- If it prints the result out, it will label it with `Out[1]=` .

Cells

- Mathematica uses the concept of **cells** to hold or display all the data. A cell can be of type input, output, text or any of the various other types that Mathematica offers (see `Format` → `Style` on the menu bar).
- By default, whatever you type in a new cell is of type input. To enter comments or to describe your code, you should change the cell style to `Text` using the menu. You can document your programs so that they can be easily read and used by others or yourself at a later time.
- Mathematica labels each input cell and the corresponding output cells by unique numbers to keep track of all the evaluations made. After the evaluation, the input cells are designated by `In` and the output cells are designated by `Out`.

Getting Help and Information

- If you run Mathematica with a notebook interface, click on the `Help` link in the upper right corner. There are demos how to get started and some information about the product itself, among other useful links.
- Most important is the `Help Browser`. Take a tour of Mathematica! The browser is an electronic version of *The Mathematica Book* by the creator of Mathematica, Stephen Wolfram (click on `Mathematica Book`). The paper version costs about \$50, and eventually it will be outdated.
- Click through `Help` → `Mathematica Book` → `Contents` → `About the Author` to see that Mr. Wolfram thinks rather highly of himself.