Calculus Lab Reference Guide

Department of Mathematics

Basic SageMath Operations

Below are some basic operations that will be used frequently in SageMath.

- To execute a command cell, press **Shift + Enter**. Simply pressing **Enter** will go to the next line in the same command cell and will not execute the code.
- To insert either a command cell (cell for executable code) or a Markdown cell (cell for basic text), click **Insert** in the toolbar at the top and choose **Insert Cell Above** or **Insert Cell Below** to add a cell directly above or below the currently selected cell. A shortcut for adding a cell below is to simply click + in the toolbar. By default, an added cell will be a command cell. To change to a Markdown cell, select the cell. Then click the arrow to the right of **Code** in the toolbar, and choose Markdown.
- To remove a cell, simply select the cell and click ✄.
- Don't forget that even though SageMath executes every line in a command cell, it will only display the last line. Also, SageMath does not display anything when you assign a variable or create a function. If you want to display multiple lines in a single command cell, simply enclose each line you wish to display with either **print(. . .)** or **show(. . .)**.
- If you are using an installed version of SageMath and not Binder, then you can save the file by choosing **File** and then **Save and Checkpoint**. A shortcut for this is **Ctrl + S** on Windows and **Cmd + S** on Mac.
- If you are using Binder, then you cannot save your work. Instead, you must download the IPython Notebook (.ipynb) file once you are finished working. Choose **File** → **Download as** → **Notebook (.ipynb)**.
- To turn your notebook into a PDF for submission, first choose **File** → **Print Preview**. Once on the Print Preview screen, look over your file and make sure that all important information is there and did not get chopped off. If information did get chopped off, you can adjust this in the Print Window. To open the Print Window, press **Ctrl + P** on Windows or **Cmd + P** on Mac. Here you can adjust the margins of the page and change the zoom percentage so that none of the document gets chopped. Lastly, choose **Save as PDF** (or the appropriate option for your browser) and choose the desired location.

Common SageMath Commands

Below is a table of SageMath commands which appear regularly.

Command	**Description**	**Example**
show(. . .)	Displays the argument in an intelligent way	**show**(3/5) **show**(plot(f(x)) + plot(g(x)))
print(. . .)	Outputs the argument	**print**("Hello") **print**(1 + 1)
*function***?**	Displays the documentation for the function or constant	*plot***?**
var('*letter*')	Makes the letter or word a variable	h = **var**('h')

def **f(x):**
return *expression*
	Creates the function $f(x)$ = expression	def **f(x):**
		return x∧2

Further Details on Accessing SageMath

Recall that there are three ways to access SageMath. Some pros and cons for each method are given below.

1. The first method is to use SageMath 9.2 on the lab computers.

   Pros
   - You do not have to install any programs.
   - All necessary packages will already be installed.

   Cons
   - You cannot work on files outside of the lab classroom.
   - In order to keep files, you must make sure they are saved in either your Z: drive, a thumb drive, or to an online storage drive.

2. The second method is the Binder server.

   Pros
   - You do not have to install any programs.
   - You can access the lab files outside of the lab classroom.

   Cons
   - The Binder server can take a long time to load and may crash unexpectedly.
   - You cannot save your files on the Binder server. Instead, you must download the file as an IPython Notebook file. If you need to work on the file later, you must either transfer it to a computer which has SageMath installed and run it there or you can upload it into the Binder Workspace and make edits. Instructions on how to use the Binder Workspace are given in the following section.

3. The third method is to download SageMath 9.2 on your personal computer.

   Pros
   - You do not have to worry about losing your files.
   - You have access to SageMath at all times, including after the course ends.

   Cons
   - Depending on your computer, the installation process may be a hassle; however, you only have to install the program one time.

Creating and Uploading Files in SageMath

In order to create or upload your own files into SageMath, first run the notebook via the SageMath application on your computer. To create a new SageMath file, simply click on **New** in the top right of the screen and choose SageMath 9.2. To upload an existing file to Binder, simply click **Upload** and navigate to where the file is saved on your computer.

Creating and Uploading Files in Binder

In order to create or upload your own files into Binder, first visit the Binder Workspace. You can do so by either clicking the previous link or choosing the link on the calculus lab webpage. To create a new SageMath file, simply click on **New** in the top right of the screen and choose SageMath 9.2. (You may see only SageMath 9.1, but it will work the same.) To upload an existing file to Binder, simply click **Upload** and navigate to where the file is saved on your computer. The file should be an IPython notebook (.ipynb) file. These instructions are also located in the workspace.

The Notebook Kernel

The notebook *kernel* is the part of the notebook which is responsible for executing code. Sometime the kernel crashes unexpectedly. When this happens, it will usually reconnect itself within a few seconds. If it does not, then you can manually reconnect the kernel by choosing **Kernel** → **Reconnect**. If the kernel still does not reconnect, then you must restart it with **Kernel** → **Restart**. The downside to restarting the kernel is that you will lose all assigned variables and function and any imported function, so you will have to re-execute all assignment and import commands. Sometimes restarting the kernel can be usefull if you have accidentally overwritten a built in function or variable such as pi and sin.