

## INSTRUCTIONS FOR MATH SHEET

1. Go to my home page (<http://www.math.ubc.ca/~sjer>), or to the course home page (<http://www.math.ubc.ca/~sjer/math101sec201>), and click on the link to MathSheet. The MathSheet home page will then appear on your screen.
2. On this page you will find several links to other pages. For example you can (and should) read the documentation. You also have 2 choices for MathSheet: you can choose to run it as an applet in your browser or you can download it. The recommendation is that you open it as an applet.
3. After choosing the applet version you will see another page that has an open button. Click on it. This will open a spread sheet which you should immediately resize (put your mouse pointer on the bottom right hand corner and drag).
4. Next you should login so that any files you create can be saved. Go up to the File menu and select Log in. Your login id will be the first 8 characters, lower case, of your names in the order: first name, middle name(s), last name. For example, my login id would be deniskar (for Denis Karmen Sjerne). If there are fewer than 8 characters in all of your names then use all of them (for example the id for Ann Lui would be annlui). For these purposes use the names that are on the registrar's list. Your password is your student number.
5. Now you are logged in and ready to go.

As an exercise we will graph  $y = x^2$  over the interval  $1 \leq x \leq 3$  and also graph the rectangles associated to the left hand rule using 20 steps. Select cell  $a_0$  in the spread sheet, type 1 and then enter it. You should see 1.000 entered in cell  $a_0$  and cell  $a_1$  will be selected. In cell  $a_1$  type  $a_0 + 0.1$  and then enter (why 0.1?). Now you should see 1.1000 entered in cell  $a_1$ , and cell  $a_2$  will be selected. Go back to cell  $a_1$ , put the mouse pointer over the small square in the lower right hand corner of  $a_1$  and drag down to  $a_{20}$  (all the time holding the left mouse button down). Release the mouse button once you are at cell  $a_{20}$ . This will put the subdivision points  $x_0, x_1, \dots, x_{20}$  in cells  $a_0, \dots, a_{20}$ .

Now select cell  $b_0$  and enter the formula for the function (i.e.  $x^2$ ) by typing  $a_0^2$ . Go back to cell  $b_0$  and drag down to  $b_{20}$ . In column  $b$  you will now see the squares of the entries in column  $a$ . Now you should save your work by going up to the file menu and selecting save. This will open a dialogue box asking you to give the spread sheet a name. Say we choose ms (for MathSheet).

Next comes the graphing part. Click on Graph in the menu bar at the top of the spread sheet and select Open. This will open a parameter window with default values for min x, max x, etc. The function we want to graph is  $y = x^2$  on the interval  $1 \leq x \leq 3$  so we want min x to be 1, max x to be 3, min y to be 1 and max y to be 9. Enter these values and click on OK. Now go up to New on the menu bar at the top and select XY plot. The data for graphing is in the spread sheet. Specifically we enter  $a_{0..20}$  for the x range and  $b_{0..20}$  for the y range. Then click OK. You should see the graph of  $y = x^2$  on the interval  $1 \leq x \leq 3$ .

Remember to save your work from time to time. To create the bar graph for the left hand rule go to New on the menu bar and select Bar graph. For the y range enter  $b_{0..19}$  (why not  $b_{0..20}$ ?), for the initial x value enter 1 and for the increment enter 0.1. Click OK. This gives the rectangles in solid black, a rather boring color. Let's change the color to pumpkin. Choose Edit from the menu and then select Bar graph. The color sliders can be moved. For example, we can put the mouse over the left hand side of the red spectrum and move the slider all the way to the right. Try it. Likewise for the blue and green sliders. Try experimenting with the sliders until you come up with pumpkin. When you think you have the correct color click OK. Remember to save.

You should now have a beautiful graph, except there are some problems with it. For example, the rectangles should go all the way down to the x axis, but they don't. The reason is that when we selected the y range in the parameter window we chose  $\min y=1$ . It should have been  $\min y=0$ . Go up to the Edit menu and select Graph parameters. Then change  $\min y$  to 0 and click OK. It is now close to perfect.

The last step is to put some annotation on the graph. Go up to New and select Label. In the text window type  $y=x^2$ ,  $x=1..3$ , left hand rule,  $n=20$ . Click OK and then put the cursor where you want your annotation to start. If the annotation is not quite where you want it, move the mouse pointer to another location and click again. Finally Click OK and save. Before closing down choose Print from the menu so you can print your graph. There are 2 choices, depending on the software installed on your computer: to PDF or to PostScript. Choose what works for your computer.

Now comes the acid test. Close all windows down and repeat the steps from the beginning. After you login you will see the spread sheet window. Resize it and go up to the file menu and select Load. If you have properly saved your work you will be able to load the ms file. Try it.

The last thing we will do is some numerical integration (left hand rule, right hand rule, midpoint rule and trapezoidal rule). For this we load the spread sheet we saved. Let's put the answer for the left hand rule in cell  $c_0$ . To do this select  $c_0$  and type  $\text{sum}(b_{0..19}) * 0.1$  and then enter. You should see 8.2700 in cell  $c_0$ , the answer for the left hand rule. Cell  $c_1$  should be selected so we type  $\text{sum}(b_{1..20}) * 0.1$  and then enter. This puts 9.0700 into cell  $c_1$ , the answer for the right hand rule. The trapezoidal rule is just the average of the left hand and right hand rules.

For the midpoint rule we must first enter the midpoints and then the values of the function at the midpoints. In the d column put the midpoints, starting with the first midpoint 1.0500 in cell  $d_0$ . Do it now. You should now see 1.0500 in cell  $d_0$  and cell  $d_1$  should be selected. In cell  $d_1$  enter  $d_0+0.1$  and drag down to  $d_{19}$  (why do we stop at this cell and not  $d_{20}$ ?). Put the values of the squaring function in column e by entering  $d_0^2$  in cell  $e_0$  and dragging down to  $e_{19}$ . Now we can compute the midpoint rule.

One word of caution. It is not possible to do separate graphs from a single spread sheet. Thus you will need separate spread sheets to plot the bar graphs for the left hand rule, right hand rule, etc; that is you will need a spread sheet for the left hand rule, another for the right hand rule, and so on.