Mathematics 251: Lab 0 INTRODUCTION TO MAPLE

This lab is intended to introduce you to some of the basic features of Maple and to give you practice preparing a Maple worksheet. Most of the information you need to do this lab is contained in the handout **Instructions for Use of Maple in Mathematics 251**. You can also learn more about the relevant Maple commands by using the **Help** feature of Maple described in that document, paying particular attention to the examples at the end of each **Help** page.

Although this lab is for practice only, it is important that you learn how to prepare your Maple worksheet in the way you will be asked to do it in future assignments on which you will be graded. Be sure to include explicit answers to all questions asked, using the **text** feature of Maple to insert them in the worksheet. Also use the **text** feature of Maple to include your name and section number before each problem (do NOT write any of this material in by hand). Use the editing capabilities of Maple to remove from the worksheet any extraneous material such as any errors you have made.

First login to your *eden* account. If you get a *unix* prompt, you can start up Maple by typing **xmaple &** (note that "xmaple" is in lower case; typing the & allows you to continue using your xterm window for other purposes while Maple is running). A Maple window will open and you can begin typing Maple commands at the Maple prompt.

In some cases, after you login, you may get a set of menus, rather than a *unix* prompt. In this case, first type *u* (for **userinfo**). At the next menu, type *r* (for **revert**). Hit the **ENTER** key when asked, and at the next two menus, type *q* for **quit**. Click on the box to logout and then login again. You should now get the *unix* prompt.

Problems

1. In 1706, Machin discovered the following formula for π, which he used to compute π to 100 decimal places. (This can be done by using the fact that the right hand side can be approximated by Taylor series expansions which converge fairly rapidly.)

$$\pi = 16\arctan(1/5) - 4\arctan(1/239).$$

Use Maple's `evalf` command to see that Maple's approximations to the two sides of the equation agree to 100 decimal places. To do this, first type `evalf(Pi,100);`. Then type `evalf(16*arctan(1/5) - 4*arctan(1/239),100);` and see whether the two results are the same. Note that * must be used when two terms are multiplied.

2. Use Maple's `simplify` command to simplify the expression

$$\frac{9x^2y - 4y^3}{3x^3y + x^2y^2 - 2xy^3}.$$

3. Use Maple's `subs` command to evaluate the expression of Problem 2 at the point $x = 2$, $y = 3$.

4. Use Maple's **plot** command to determine if the function x^x has any local maxima or minima on the interval $0 \le x \le 4$; look particularly closely at what happens for small values of x. Use the **text** feature of Maple to place a statement in your Maple worksheet stating your findings. The plot or plots in your Maple worksheet should support your findings. (Note: x^x is not defined for $x = 0$, but its limiting value as x approaches 0 is 1; Maple will not be confused.)

5. Find the first, second, and third derivatives of the function $g(x) = \sin(x^2)\ln(x)$. (First define an expression for g and then use Maple's **diff** command.)

6. Use Maple's **fsolve** command to find a root of the function $f(x) = x - \cos x$ in the interval $0 \le x \le 1$. Check that your answer is reasonable by obtaining a plot of f.

7. Use Maple's **int** command to find the indefinite integral $\int x^2 \ln(x)\,dx$ and the definite integral $\int_1^2 x^2 \ln(x)\,dx$. Combine the **evalf** and **int** commands to find a value for this definite integral in decimal form.

8. Maple's **plot** command can also be used to plot parametric equations. For example, the command `plot([2*sin(t),2*cos(t),t=-Pi..Pi])` plots a circle of radius 2. Use this feature to plot (in your worksheet) the equations

$$x(t) = \cos(t)(1 - 2\sin(3t)), \qquad y(t) = \sin(t)(1 - 2\sin(3t)) \qquad \text{for } 0 \le t \le 2\pi.$$

Then try this one:

```
a:=sqrt(17);
plot([(a-1)*cos(t) + cos((a-1)*t), (a-1)*sin(t) - sin((a-1)*t),
t=0.. 30*Pi]);
```

9. To obtain three-dimensional plots, it is first necessary to issue the Maple command `with(plots):`. Do so, then use the Maple command **plot3d** to obtain a plot (in your worksheet) of the function $z = y(1-10xy)e^{-x^2-y^2}$ over the range $-3 \le x \le 3$, $-3 \le y \le 3$. Rotate the plot until you get a good view of the surface. Then change the **Axes** option to **Boxed** to get a better idea of the function values. Rotate the plot again until you are able to estimate (to about one decimal place) the maximum value of the function. Enter this value into your Maple worksheet (with a sentence stating what it is) using the **text** feature of Maple.

10. The Maple command **implicitplot3d** computes the three dimensional plot of an implicitly defined surface, i.e., a surface in which z is not given explicitly as a function of x and y as in the previous problem. Use this command to obtain a plot of the surface defined by

$$x^3 + y^3 + z^3 + 1 = (x + y + z + 1)^3$$

over the region $-2 \le x \le 2$, $-2 \le y \le 2$, $-2 \le z \le 2$.