Introduction to Maple

Objective The purpose of this initial lab is to help you become familiar with the CSM computer network and the Maple software package.

Background Maple is a powerful computer algebra system. We will be using Maple to help visualize mathematical concepts introduced in this course. Maple is available on many computers on campus, including all CoSM, Engineering, and dormitory computer labs.

To begin to learn to use Maple, the **Discussion** section of this lab assignment presents and illustrates some of the algebraic, graphical, and numerical features that will be used repeatedly throughout this course.

In particular, you will learn to use the following Maple commands: `factor`, `plot`, `solve`, `evalf`. For the homework you will need to discover the Maple command for factorials.

The **Questions** section contains a few questions that you should be able to answer after you successfully complete the examples in the **Discussions** section.

Your lab report must be submitted as a separate document. You are strongly encouraged to prepare your lab report as a Word document. Information from Maple, including pretty-printed output and graphics, can be copied and pasted into a Word document. Be sure that you answer each question and that your answers are written with complete English sentences.

Discussion Enter, and execute, the following Maple commands in a Maple worksheet. Note that anything that appears after a # is a comment; it is not necessary to enter this in your worksheet.

Example 1: Arithmetic with Maple

> `restart;` # clear Maple's memory
> `1/2 + 1/50;` # note that Maple's answer is exact
> `1/(2 + 1/50);` # parentheses and grouping are impo
> `2 + (3/4 * 5/6);` # note that the `*` is required for mult

Example 2: Assignments and Discontinuities

> `x := Pi/2;` # assign a value to `x`
> `sin( x );` # compute exact value of $\sin(\frac{\pi}{2})$
> `tan( x );` # compute exact value of $\tan(\frac{\pi}{2})$
> `tan( x/2 );` # attempt to evaluate tan at disconti
> `y := cos( x/2 ):` # result is not displayed because com
> `y;` # exact value of $\cos(\frac{\pi}{4})$
> `y^2;` # exact value of $\cos^2(\frac{\pi}{4})$

Example 3: Floating-Point Approximations

> `Pi;` # the mathematical constant π
> `evalf( Pi );` # default computations are with 10 d
> `evalf[20]( Pi );` # approximate value of π with 20 dig

Example 4: Algebraic Manipulations

```
> x;                                  # remember that x has an assigned va
> unassign( 'x', 'y' );               # remove assigned values from x and
> x;                                  # now x can be used as a variable
> F := a*x^2 + b*x + c;               # define a general quadratic
> solve( F=0, {x} );                  # Maple knows the quadratic formula
> G := x^10 - 1;                      # a 10th degree polynomial
> factor( G );                        # ask Maple to factor the polynomial
> solve( G=0, {x} );                  # there are 10 solutions, 8 are comple
> fsolve( G=0, {x} );                 # only real-valued solutions are retur
> fsolve( G=0, {x}, complex );        # all 10 solutions as floating-point nu
```

Example 5: Simple Plots

```
> F := (u-1)*(u-4)*u;                 # cubic w/roots u = 0, u = 1, and u =
> plot( F );                          # ERROR – no domain given
> plot( F, u=-3..6 );                 # plot of y = F(u) on [-3,6]
> plot( F, u=-3..6, y=-20..20 );      # same plot with window [-3,6] x [-20
```

Example 6: Symbolic Trigonometry

```
> one := sin(x)^2 + cos(x)^2;         # names can have more than one cha
> simplify( one );                    # Maple knows trigonometric identiti
```

Notes

(1) Working with 20 digits does *not* mean that all 20 digits are correct. To get the correct 20-digit approximation to π, ask Maple to work with a few additional digits.

(2) A complete Maple worksheet with more details about the topics addressed by the above discussion is available on the WWW at

`http://www.math.sc.edu/~meade/141L-F03/misc/week1.mws`.

Questions

(1) Let $f(x) = x^4 - 32x^3 + 187x^2 + 160x - 960$. Find all values of x where $f(x) = 0$. (*Give exact values.*)

(2) Use a suitable graph of $f(x)$ from Question 1 to approximate the point(s), (x, y), where f attains its largest and smallest values on the interval $-5 \leq x \leq 5$.

(3) Find the decimal digit in the 25^{th} digit to the right of the decimal point in π.

(4) Find the smallest integer, n, such that $n!$ has exactly 10 trailing zeros, i.e., $n!$ is divisible by 10^{10} and not divisible by 10^{11}.

(5) Does $n!$ ever have exactly 11 trailing zeros? (*Justify your answer using complete English sentences. Be brief, but complete.*)