

1 Calculus A, Lab 1

These problems are aimed principally at familiarizing you with Maple, though I also think that at least some of them might help you to learn something useful and beautiful.

You probably need to work in pairs, rather than in larger groups. Please take turns using the keyboard so that each person has a chance to get a feel for the program. Start out by working through enough of my Maple overview to feel comfortable, then answer the following questions. Turn in a writeup on Monday.

0. Compute 30 digits of π , 30 digits of $\cos(37^\circ)$, and 30 digits of $\sin(1.3 \text{ rad})$.

1. Plot $y = x^4 - 2x^2 + x$. Pick ranges for the x and y axes that show as many important and interesting features of the function as possible.

2. Do the same thing with

$$y = x^3 + \frac{1}{(x-1)^2} - \frac{150}{1+(x+3)^4}.$$

3. In the mid-17th century, Pierre de Fermat conjectured that for every $n = 0, 1, 2, \dots$ the number $2^{(2^n)} + 1$ would be prime. (A prime is a whole number having no positive divisors except itself and 1.) He had noticed, for instance, that if $n = 0$, then $2^{(2^0)} + 1 = 2^1 + 1 = 3$ is a prime, and that when $n = 1$, then $2^{(2^1)} + 1 = 2^2 + 1 = 5$ is a prime.

Roughly a century later, Leonard Euler finally showed whether or not Fermat was right. (Both these men were the greatest mathematicians of their day.) Was Fermat right?

4. Do the curves $y = x^4 - 2x^2 + x$ and $y = 10x - 11$ intersect? If so, where and how often. If not, why not?

5. Let $f(x) = x^3 - 3x$.

(a) Compare the graphs of $f(x)$, $f(x) + 2$, $f(x) - 1$. Can you generalize your observations? In other words, can you find a rule for describing the graph of $f(x) + k$ in terms of the graph of $f(x)$ which would work for any function f and any constant k ?

(b) Compare the graphs of $f(x)$, $f(x+2)$, $f(x-1)$. Can you generalize your observations?

(c) Compare the graphs of $f(x)$, $3f(x)$, $f(x)/2$. Can you generalize your observations?

(d) Compare the graphs of $f(x)$, $f(3x)$, $f(x/2)$. Can you generalize your observations?