

13. (*expires Feb 25*) On the [Wikipedia page on interpolation](#) is an example of a cubic spline interpolating several points on an [epitrochoid](#). An epitrochoid can be written in parametric form as

$$x(t) = (a+b)\cos(t) - c\cos\left(\left(\frac{a}{b}+1\right)t\right), \quad y(t) = (a+b)\sin(t) - c\sin\left(\left(\frac{a}{b}+1\right)t\right).$$

The file [epidata.txt](#) defines a list of points [epipts](#) on an epitrochoid, evaluated at each of the corresponding t -values given in the list [tvals](#). Use [CurveFitting\[Spline\]](#) to determine the cubic splines interpolating the given points, and then produce a plot showing both the interpolating curve and the points, analogous to the one on [Wikipedia](#). Plot your spline for $0 \leq t \leq 4\pi$. It is irrelevant for doing the problem, but the epitrochoid used has $a = 5$, $b = 2$, and $c = 5$.

14. (*expires Feb 25*) Fit the points

$$(-1.9, -4.7), (-0.8, 1.2), (0.1, 2.8), (1.4, -1.2), (1.8, -3.5)$$

with a quadratic function $f(x) = ax^2 + bx + c$, using the least square method. You can load these data points from the web via the link at [fitquad.txt](#) which defines a list [fitquad](#) containing them.

15. (*expires Feb 25*) The file [fitexp.txt](#) defines a list [expdata](#) with 21 data points approximating an exponential curve of the form $y = ae^{bx}$. Find a and b by taking an appropriate logarithm, then use [CurveFitting\[LeastSquares\]](#) to find the resulting “best” line. Then transform this line appropriately to get an exponential curve which approximates the given data. The [map](#) command might be helpful. Plot the exponential and the points from [expdata](#) on the same axes, and write the approximating exponential in the form $y = ae^{bx}$.

16. (*expires Feb 25*) Fit the set of points

$$(1.021, -4.30), (1.001, -2.12), (0.99, 0.52), (1.03, 2.51), (1.00, 3.34), (1.02, 5.30)$$

with a line, using the least square method. Plotting these points and the line on the same graph shows that this is not a good fit. Think of a better way to find a line which is a good fit and use Maple to do it. Explain in your solution why you think your better way is indeed an improvement. In case you don't want to retype them, the file [badfit.txt](#) defines a list [fitme](#) containing these points.

17. (*expires Feb 25*) In this problem we will estimate the charge of the electron. If an electron of energy E is thrown into a magnetic field B which is perpendicular to its velocity, the electron will be deflected into a circular trajectory of radius r . The relation between these three quantities is

$$Bre = \frac{E}{2m^2c^4} \sqrt{E^2 - m^2c^4}. \quad (1)$$

The rest mass of the electron is defined by $E_0 = mc^2$, and is about equal to 8.817×10^{-14} Joules. In our experimental set-up the energy of the emitted electrons is set to be $E = 2.511E_0$. The file [electron.txt](#) defines a list called [electron](#). Each element of the list is a pair of the form $[B_i, r_i]$; these quantities are expressed in Teslas and meters. Use least square fitting to determine the best value for e .

Hint: Notice that the right hand side of the equation is just a constant—calculate it once and for all and give it a name. Then the equation becomes linear in the unknown e . To verify your solution: $e \approx 1.602 \times 10^{-19}$ Coulomb.