13. (*expires 9/30*) 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 $\{x(t) = (a+b)\cos(t) - c\,\cos\big((a/b+1)t\big),\ y(t) = (a+b)\sin(t) - c\,\sin\big((a/b+1)t\big)\}$. 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 $0 \le t \le 4\pi$.

    It is irrelevant for doing the problem, but the epitrochoid used has $a = 5$, $b = 2$, and $c = 5$.

14. (*expires 9/30*) 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 9/30*) 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 9/30*) 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. (This is most apparent if you have a plot with, say, $0 < x < 2$ and $-5 < y < 6$.) 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 9/30*) 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:
    $$B\,r\,e = \frac{E^2}{m^2c^4}\sqrt{E^2 - m^2c^4}, \tag{1}$$
    where e and m are, respectively, the charge and the mass of the electron, and c is the speed of light ($2.9979 \times 10^8\ \frac{\text{meter}}{\text{sec}}$). 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 eqn (1) is just a constant—calculate it once and for all and give it a name. Then eqn (1) becomes an equation which is linear in the unknown e. To verify your solution: $e \approx 1.602 \times 10^{-19}$ Coulomb. Physical constants courtesy of N.I.S.T.