MAT331 Exercises, Spring 08 set number 2

7. (*expires 3/4*) Fit the points $(-1.9, -4.7), (-0.8, 1.2), (0.1, 2.8), (1.4, -1.2), (1.8, -3.5)$ by means of a quadratic function $f(x) = ax^2 + bx + c$, using the least square method. First, do this step by step, as we did in class; then, use the built-in `Maple` command, described in the notes. Check that the two solutions agree.

8. (*expires 3/4*) Fit the set of points

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

with a line, using the least square method we used in class. You will see that this is not a good fit. Think of a better way to do the fit and use `Maple` to do it. Explain in your solution why you think your better way is better.

9. (*expires 3/4*) 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. The rest mass of the electron is defined as $E_0 = mc^2$, 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 $E = 2.511E_0$.

Use `read` to have `Maple` load and execute the commands in the file `electron.txt`, which you can download from the class web page in the problems[1] area, or using the command

`read("/home/scott/www/mat331.spr08/problems/electron.txt").`

This defines a list called `electron`. Each element of the list is a pair of the form $[B_i, r_i]$, and 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 (1) is just a constant—calculate it once and for all and give it a name. Then (1) becomes an equation which is linear in the unknown e. To verify your solution:* $e \approx 1.602\;10^{-19}$ Coulomb].
Physical constants courtesy of N.I.S.T.

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[1] http://www.math.sunysb.edu/ scott/mat331.spr08/problems