CS310 & NEEP271 **Assignment 6** Fall 1999

Prof. Blanchard Due date: Dec. 14, 1999
Prof. Strikwerda Due date: Dec. 15, 1999

This assignment has to do with using Matlab to interpolate and fit one-dimensional and two-dimensional data using splines and polynomials.

All the files you need are in the Matlab subdirectory of the course directory.

Problem 1 (10 points)

This problem has to do with fitting curves to data. The data file is curve1 and the columns are (x_k, y_k) points that are to be interpolated or fitted.

There is a Matlab program, spline_poly.m that fits a spline and polynomials of different degree to the data. You are to run this Matlab program to do this problem. You will have to make minor modifications to this program to do the problem.

a. Modify the plot of the spline curve to show the data points marked with a +. Using the data on curve1, print the plot of the spline fit.
b. Fit the data on curve1 with polynomials of several degrees through the maximum possible degree for the interpolating polynomial. Using plots for three values for the degree of the polynomial, show for this data that high degree polynomials can fit the data quite well. What is the maximum possible degree?

Hand in plots of the spline curve and three polynomial fits and a short discussion of the results.

Problem 2 (10 points)

This problem is the same as Problem 1, but with data that has a small amount of random noise added to the data on curve1. The data file is curve2. Repeat Problem 1, but show that in this case, the high degree polynomials give a poorer fit.

Problem 3 (20 points)

The file surface1 contains three columns of numbers that are triples (x_k, y_k, z_k) that give points approximating a surface to be described by $z = F(x, y)$.

The file surface_fit.m contains a Matlab program that fits a quadratic polynomial

$$z \approx c_1 + c_2 x + c_3 y + c_4 x^2 + c_5 y^2 + c_6 xy$$

to the data on surface1 using the QR decomposition.

You are to modify this Matlab program to obtain the least squares fit for the cubic polynomial of the form

$$z \approx c_1 + c_2 x + c_3 y + c_4 x^2 + c_5 y^2 + c_6 xy + c_7 x^3 + c_8 x^2 y + c_9 x y^2 + c_{10} y^3$$

For both the quadratic and cubic fits, compute the residual as done in surface_fit.m.

Evaluate the fitting polynomial at $x = 0.5$ and $y = 0.5$ for both the quadratic and cubic fits.

Hand in the values of the coefficients c_j, the residual, and a plot of the surface for the cubic fit. Is the cubic fit better than the quadratic fit? Why or why not?