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Scientific Computing 372
Exercises 4: Interpolation and Curve Fitting

1. (a) Use the natural cubic spline to determine y at $x = 1.5$. The data points are as follows:

x	1	2	3	4	5
y	0	1	0	1	0

(b) Find the zero of $y(x)$ from the following data:

y	0	0.5	1	1.5	2	2.5	3
x	1.8421	2.4694	2.4921	1.9047	0.8509	−0.4112	−1.5727

(c) Use Neville's method to compute y at $x = \pi/4$ from the following data points:

x	0	0.5	1	1.5	2
y	−1.00	1.75	4.00	5.75	7.00

(d) Given the the following data, find y at $x = \pi/4$ and $x = \pi/2$. Use the method that you consider to be most convenient.

x	0	0.5	1	1.5	2
y	−0.7854	0.6529	1.7390	2.2071	1.9425

(e) The table shows the drag coefficient c_D of a sphere as a function of the Reynolds number Re. Use the natural cubic spline to find c_D at Re = 5, 50, 500, and 5000. *Hint:* Use the log-log scale.

Re	0.2	2	20	200	2000	20 000
c_D	103	13.9	2.72	0.800	0.401	0.433

2. (a) Fit a straight line to the following data, and compute the standard deviation.

x	0.0	1.0	2.0	2.5	3.0
y	2.9	3.7	4.1	4.4	5.0

(b) The relative density ρ of air was measured at various altitudes h (in km). The results are:

h	0	1.525	3.050	4.575	6.10	7.625	9.150
ρ	1	0.8617	0.7385	0.6292	0.5328	0.4481	0.3741

Use a quadratic least-squares fit to determine the relative air density at $h = 10.5$ km.

(c) Fit a straight line and quadratic to the follow data.

x	1.0	2.5	3.5	4.0	1.1	1.8	2.2	3.7
y	6.008	15.722	27.130	33.772	5.257	9.549	11.098	28.828

(d) The intensity of radiation of a radioactive substance was measured at half-year intervals. The results are

t	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5
y	1.000	0.994	0.990	0.985	0.979	0.977	0.972	0.969	0.967	0.960	0.956	0.952

where t is the time in years and y is the relative intensity of radiation. Knowing that radioactivity decays exponentially with time, $y(t) = ae^{-bt}$, estimate the radioactive half-life of the substance.