Bare Essentials

At the end of this chapter you should be able to

1. Identify the criteria for obtaining a least squares fit. (What is minimized?)
2. Manually evaluate the formulas for the slope and intercept of a line fit to data.
3. Derive the transformations for fitting data to $y = c_1 e^{c_2 x}$ and $y = c_1 x^{c_2}$.
4. Manually compute the R^2 statistic for a line fit.

To perform basic solutions of linear systems with MATLAB you will need to

5. Use the `linefit` function in the NMM Toolbox to obtain a least squares line fit to data.
6. Use the `linefit` function in the NMM Toolbox to obtain least squares line fits to linearized transformations of $y = c_1 e^{c_2 x}$ and $y = c_1 x^{c_2}$.
7. Use the built-in `polyfit` function to obtain a least squares fit to a polynomial in x. Use the built-in `polyval` function to evaluate the polynomial obtained from `polyfit` at any x.
8. Plot a comparison of a least squares fit and the data used to obtain the fit.

An Expanded Core of Knowledge

After mastering the bare essentials you should move on to a deeper understanding of the fundamentals. Doing so involves being able to

1. Form the overdetermined system of equations equations for an linear combination of arbitrary basis functions.

To perform more advanced solutions of linear systems with MATLAB you will need to

2. Use the `fitnorm` and `fitQR` functions from the NMM Toolbox to obtain least squares fits to linear combinations of arbitrary basis functions.
3. Assign the elements of the matrix `A` of the overdetermined system for a given choice of basis functions. Given this matrix and a vector of y data, obtain the coefficients of the fit by solving the normal equations.
4. Repeat the steps in the previous bullet, but obtain the least squares fit directly with the backslash operator.
5. Given the matrix of the overdetermined system for the fit, and a vector of y data values, use the \ operator to obtain the coefficients that minimizes $\|r\|_2$ for the overdetermined system.

Developing Mastery

Working toward mastery of solving systems of equations you will need to

1. Identify the primary properties of the QR factorization that enable the least squares solution to be obtained with the Q and R matrices.