1 Gauss-Seidel Method

Solve part (a) of problem 11.1 in Chapra (2005) on page 194. Then, use Matlab to compute the inverse of the coefficients matrix $A$. Calculate the row-sum-norms of the $A$ and $A^{-1}$ matrices and use the results to compute the overall matrix condition number.

2 Review of Statistics and Probability

Do all parts of Problem 12.1 in Chapra (2005) on page 218 by hand showing all your work. You may use the software package of your choice to check your results.

3 Linear Regression

Solve Problem 12.5 in Chapra (2005) on page 218 by hand.

4 Matlab Programming

Write a Matlab function to do linear least squares regression. The function should take two one-dimensional vectors as input: an independent variable $x$ and a dependent variable $y$. The output from the function should include the regression coefficients $a_0$ and $a_1$ based on Equations 12.15 and 12.16 in Chapra (2005), the standard error of the estimate given by Equation 12.19 in Chapra (2005), and the coefficient of determination given by Equation 12.21 in Chapra (2005). You may refer to Figure 12.12 in Chapra (2005) on page 217 for help with designing your Matlab function.
To get full credit, your function must include a block of comments at the top of the program that describes what the program does and that defines all the input and output variables explicitly. You must also include comments within your program as appropriate.

Test your program by using it to solve the previous problem (Problem 12.5 in Chapra (2005)). Turn in a copy of your program and the output from your program, including a listing of the values of the output variables calculated in Matlab. Plot the data and the regression line together in a single figure and turn in the plot with your assignment.

5 Equation Transformation

Convert each of the following equations into a form that is compatible with linear regression (see pages 211-215 in Chapra (2005)). Assume \( x \) and \( y \) are the independent and dependent variables, respectively. For each of the linearized equations, write the relationship that relates the slope \( m \) and \( y \)-intercept \( b \) obtained by linear least squares regression of the transformed variables to the original parameters \( \theta_1 \) and \( \theta_2 \) (e.g. find the relationships \( \theta_i = f(m, b) \) where \( m \) and \( b \) apply to the transformed data.).

(a) \( y = \theta_1 e^{\theta_2 x} \)  
(b) \( y = \frac{\theta_1 x}{\theta_2 + x} \)  
(c) \( y = \theta_1 x^2 + \theta_2 \)  
(d) \( y = \sin(\theta_1 x + \theta_2) \)

6 Least Squares Regression

Solve Problems 12.7 and 12.10 in Chapra (2005) on pages 218 and 219. You can use the programming package of your choice to find the best model to apply to the data (e.g. exponential, linear, saturation growth, etc.). After you decide which model to apply, calculate the regression by hand showing all your work. Use Matlab to plot a figure of the data along with the best fit curve. Also calculate the coefficient of determination for the curve by hand.