

Exercise 1: Basic programming in R

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Part 1: Matrix and vector operations.

1. Solve the following system:

$$\begin{bmatrix} a_1 & b_1 & & & 0 \\ c_1 & a_2 & b_2 & & \\ & \ddots & \ddots & \ddots & \\ & & & a_{99} & b_{99} \\ 0 & & & c_{99} & a_{100} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_{100} \end{bmatrix} = \begin{bmatrix} d_1 \\ d_2 \\ \vdots \\ d_{100} \end{bmatrix}$$

where

$$a_j = j, \quad b_j = 1/j, \quad c_j = 1, \quad d_j = \sin(j\pi/200)$$

and print $x_1, x_2, \dots, x_5$.

Part 2: For loops.

1. Write a function that uses a `for` loop to calculate the following with a sequence of m , and generate a plot for m verses E_m . Avoid using a `for` loop, can you complete the same task?

$$E_m = 1 + \frac{1}{2} + \dots + \frac{1}{2^m} - \log(2^m)$$