

Problem Set 10

UMC 202

November 2, 2023

1. Use the Linear Finite-Difference Algorithm with $N = 9$ to approximate the solution to the boundary value problem

$$y'' = -\frac{2}{x}y' + \frac{2}{x^2}y + \frac{\sin(\ln x)}{x^2}, \\ 1 \leq x \leq 2, y(1) = 1, y(2) = 2$$

and compare the results to those obtained using the linear shooting method for the same problem.

2. Consider the boundary value problem

$$y'' = -(x+1)y' + 2y + (1-x^2)e^{-x}, \quad 0 \leq x \leq 1, \quad y(0) = 1, \quad y(1) = 0.$$

Use $N = 9$ and $N = 19$ respectively and apply the Linear Finite-Difference Algorithm with $N = 9$ to approximate the solution to the above boundary value problem.

3. Use the Linear Finite-Difference Algorithm with $N = 4$ to approximate the solution of the boundary value problem,

$$y'' + 4y = \cos x, \quad 0 \leq x \leq \frac{\pi}{4}, \quad y(0) = 0, \quad y\left(\frac{\pi}{4}\right) = 0,$$

and compare the results to the actual solution where the actual solution is given by

$$y(x) = -\frac{1}{3} \cos 2x - \frac{\sqrt{2}}{6} \sin 2x + \frac{1}{3} \cos x.$$