

Question 7

*Code located at "gulana-q7.py"

=> As we alter Δx , the solution should converge as Δx decreases

=> I take a value of $\Delta t = 0.001$ and an initial value of Δx as 0.1. The value will then decrease in this order

$$\Delta x, \Delta x/2, \Delta x/4, \Delta x/8$$

and the graph is zoomed in between $x = -1$ and $x = -0.6$.

with these values of Δx and Δt , the CFL ≤ 1 and never negative. Δx is altered by altering J.

Note (change J by changing input into fn. at end of code to reproduce results)

The plots are located in the following files:

$dx = 0.1$ plot \Rightarrow "gulana-q7-dx-0.4.jpeg"
($J=5$)

$dx = 0.05$ plot \Rightarrow "gulana-q7-dx-0.2.jpeg"
($J=10$)

$dx = 0.025$ plot \Rightarrow "gulana-q7-dx-0.1.jpeg"
($J=20$)

$dx = 0.0125$ plot \Rightarrow "gulana-q7-dx-0.05.jpeg"
($J=40$)

The plots show the values getting closer to the exact solution (given in the Choi et. al, 2024 paper), demonstrating convergence.

note

$$b_k = \begin{bmatrix} 0.7703829, 0.57331959, \\ 0.86436473, 0.82221663 \end{bmatrix}$$