Numerical Methods for Conservation Laws

Assignment 3 (system of nonlinear equations 2)

Extend *both* first and second order methods used previously for linear system of equations to

1. Inviscid Euler equations; shock tube problem (Sod). Plot ρ, u, p at $t = 0.25$. Consider 101 points in domain.

$$\rho_l = 1, u_l = 0, p_l = 1 \tag{1}$$

$$\rho_r = 0.125, u_r = 0, p_r = 0.1 \tag{2}$$

Domain is $[0, 1]$ with initial discontinuity at $x = 0.5$.

2. Inviscid Euler equations; modified shock tube problem. Plot ρ, u, p at $t = 0.25$. Consider 101 points in domain.

$$\rho_l = 1, u_l = 0.75, p_l = 1 \tag{3}$$

$$\rho_r = 0.125, u_r = 0, p_r = 0.1 \tag{4}$$

Domain is $[0, 1]$ with initial discontinuity at $x = 0.3$.

3. Calculate L_1 and L_2 norms of error based on density using 101, 1001, 10001 points for both schemes with CFL $= 0.5$ for problem 1. Analytical solution is available in literature,