MA5710: Mathematical Modelling in Industry

Assignment-2

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References Used

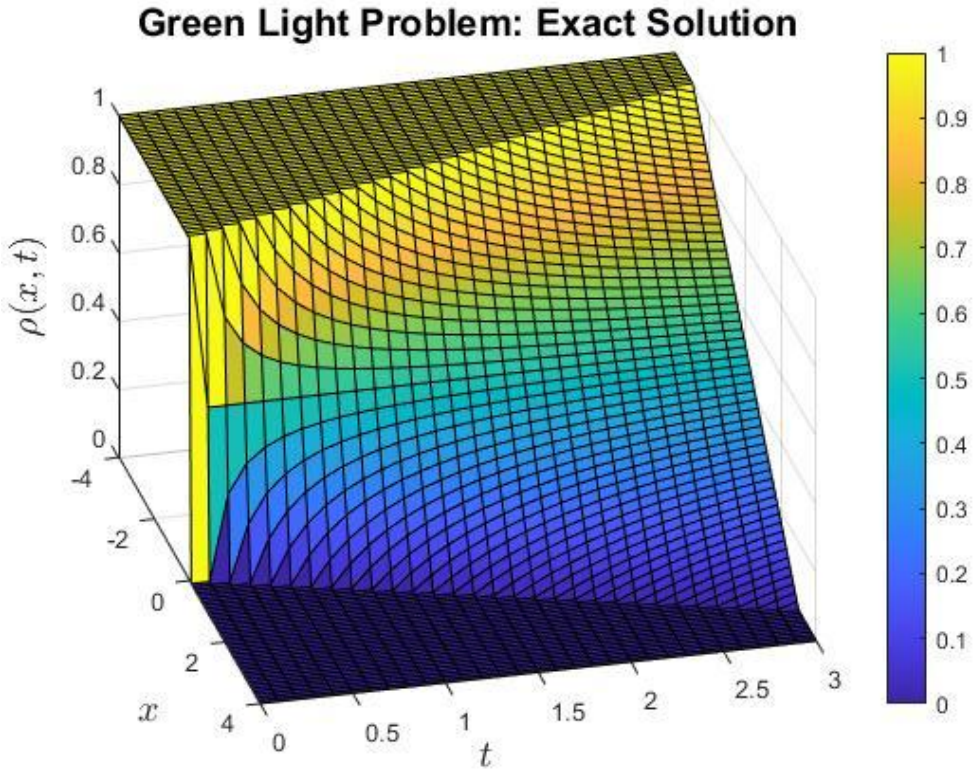
1. Professor Sundar's Classnotes
2. *Mathematical Modelling: A Case Studies Approach Volume 27* by Reinhard Illner, C.Sean Bohun, Samantha McCollum, Thea van Roode **(Chapter-9: Traffic Dynamics: Macroscopic Modelling)**
3. *Principles of Mathematical Modeling Second Edition* by Clive L.Dym **(Chapter-6: Traffic Flow Models)**

Solution for Question 1

We were asked to draw the Plot for:

$$\rho(x,t) = \begin{cases} 0 & \text{for } x > t, \\ \frac{1}{2}\left(1 - \frac{x}{t}\right) & \text{for } -t < x \leq t, \\ 1 & \text{for } x \leq -t, \end{cases}$$

when x ∈ [-4, 4] and t ∈ [0, 3]. The plot is given as follows:



Please check the accompanying MATLAB Code and figure files to see how this plot was generated.

Solution for Question 6

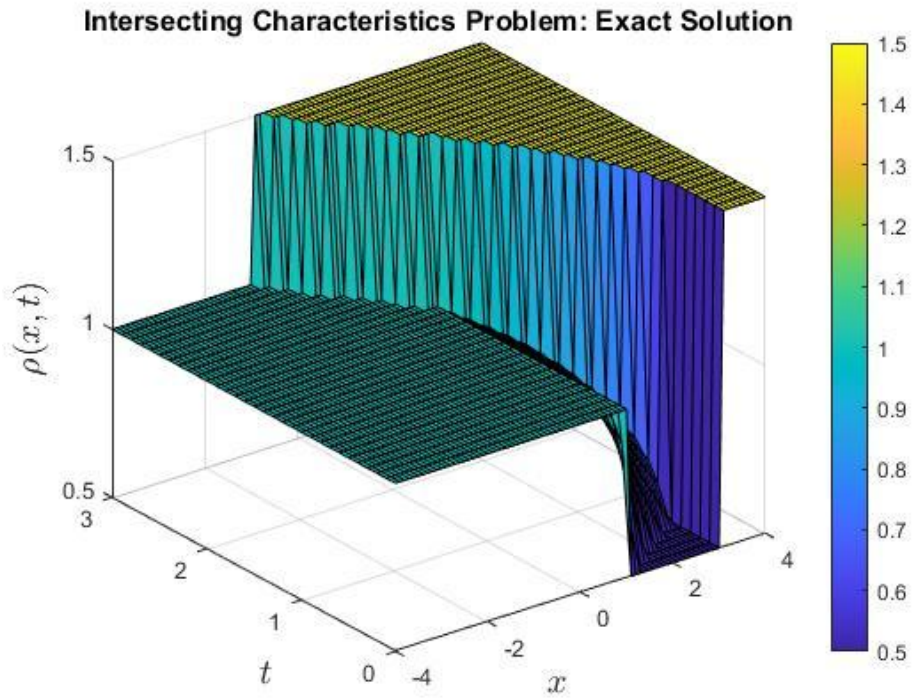
Using the calculations done in questions: 4 and 5, the complete explicit solution of the problem can be given as:

$$0 \le t \le 1/2: \quad \rho(x,t) = \begin{cases} 1 & \text{for } x \le 1, \\ 1 - \frac{x-1}{8t} & \text{for } 1 < x \le 1+4t, \\ 1/2 & \text{for } 1+4t < x \le 3, \\ 3/2 & \text{for } x > 3; \end{cases}$$

$$1/2 < t \le 2: \quad \rho(x,t) = \begin{cases} 1 & \text{for } x \le 1, \\ 1 - \frac{x-1}{8t} & \text{for } 1 < x \le 1+4(\sqrt{2t}-t), \\ 3/2 & \text{for } x > 1+4(\sqrt{2t}-t); \end{cases}$$

$$t > 2: \quad \rho(x,t) = \begin{cases} 1 & \text{for } x \le 5-2t, \\ 3/2 & \text{for } x > 5-2t, \end{cases}$$

The plot is given as:



Please check the accompanying PDF, MATLAB Code, and MATLAB figure files to see how this plot was generated.