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BACKWARD DIFFERENTIATION FORMULA BASED NUMERICAL METHOD TO SOLVE FISHER EQUATION

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Abstract: This paper presents a novel numerical approach, which is based on the Method of Lines. This method semi-discretizes the problem and produces a system of ordinary differential equations (ODEs) in time. To solve this system, a stiff solver, BDF2, is used, which yields very precise results. The linearization is handled by the Taylor series method. To validate the numerical method, various test examples are considered. These formulas find extensive applications across various scientific and engineering domains.

Keywords and Phrases: Fisher equation; Taylor series; Backward differentiation formula; Method of lines.

2020 Mathematics Subject Classification: 65M20, 92D25, 65L06, 65L07.

1. Introduction

In this paper, we focus on the one-dimensional Fisher equation,

$$\frac{\partial u}{\partial t} = D\frac{\partial^2 u}{\partial x^2} + \alpha u(1-u), \quad 0 \le x \le 1, \quad t > 0, \tag{1}$$