Solution for the Mathematical Modeling of Population Growth by Spectral Methods

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Most populations of organisms tend to increase as far as their environment will allow. As a result, most populations are in a dynamic state of equilibrium. Their numbers increase in a delicate balance that is influenced by limiting factors. The Volterra model for population growth of a species within a closed system is given in terms of an integro-differential equation.

In the present work, we introduce a new computational method for solving the Volterra population model. The integro-differential equation is first converted to an equivalent nonlinear ordinary differential equation. The method is based on spectral methods in which the solution for nonlinear ordinary differential equation is approximated by the Nth degree polynomial, using Legendre-Gauss-Lobatto points as the collocation points, and Lagrange polynomials as trial functions. Properties of Legendre pseudospectral method are presented. These properties are then utilized to reduce the computation of the Volterra's population model to system of algebraic equations. Numerical examples are included to demonstrate the applicability and the accuracy of the proposed method and a comparison is made with the existing results.

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