A PROPOSED NOVEL POLYNOMIAL-TYPE INVERSE BASIS INTEGRATION FOR BIOLOGICAL MODELS

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Abstract.   This study introduces and extensively analyzes a Ninth-order Integrator (NI9) designed to solve biological models involving first-order Ordinary Differential Equations (ODEs). This method employs inverse polynomial-type basis functions for the construction. The NI9 method's accuracy, consistency, linear stability, zero stability, and convergence properties are thoroughly investigated and documented. To validate its efficacy, the NI9 method was applied to solve six numerical examples, including five epidemiological problems and a nonlinear logistic model. A comparative analysis with the fourth-order Runge-Kutta method (RK4) demonstrated that the NI9 method produced solutions nearly identical to those of RK4 for epidemiological problems, thereby establishing its reliability in terms of accuracy. Furthermore, when tested using the nonlinear logistic model, the NI9 method not only matched the exact solution but also demonstrated superior efficiency compared with RK4. This study concludes that the NI9 method is a robust and reliable tool for solving first-order ODEs in diverse scientific and engineering applications, as it significantly reduces errors and computational costs, making it especially effective for analyzing complex disease dynamics.