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Hybrid Analytical Approach to Solving a Typhoid Fever Model: Laplace-Adomian Decomposition with Sensitivity Analysis

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In this study, we develop a mathematical model to understand how typhoid fever spreads within a population. The model is built using a system of five ordinary differential equations (ODEs), and we carefully analyze it to confirm that it behaves reliably and makes sense both mathematically and in real-world epidemiological terms. To find approximate solutions, we apply the Laplace-Adomian Decomposition Method, which breaks the system into a series that converges quickly. We also perform a sensitivity analysis to explore how different parameters affect the transmission of the disease. The analysis reveals that the contact rate plays a major role which implies that reducing interactions with infected individuals or contaminated sources can significantly curb the spread of typhoid. Using MATLAB, we run simulations to visualize how the disease responds to various control measures. The results show that timely treatment of infected people and proper handling of contaminated environments are key to effective disease control. Finally, we find that using a fractional-order version of the model offers a more accurate picture of typhoid's dynamics compared to traditional methods.
Keywords: Memory effects, Typhoid fever, Mathematical modeling, Ordinary Differential Equations (ODEs), Fractional-order Analysis, Sensitivity analysis

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