Modeling, Analysis, and Simulation of High School Student Mental Health using Compartmental Models and Physics Informed Neural Networks

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In the context of a rapidly changing world inundated with big data and social media, the ubiquitous issues of stress and anxiety have pervaded both physical and virtual spaces, profoundly affecting individuals. In a 2022 CDC survey, a concerning 37 percent of US high school students reported poor mental health, highlighting the urgency to comprehend the spread and dynamics of stress and anxiety within this population. This project aims to achieve this by employing a modified SIR mathematical model, originally devised for infectious diseases, to analyze the influences and dissemination of high-school stress and anxiety. In this project, an SEITR compartmental model was considered that incorporates both an Exposed and a Treatment compartment. Specifically, the research focuses on the transition from susceptibility to recovery within this group by solving a system of non-linear coupled differential equations. Parameter identification techniques and physics-informed neural networks (PINN's) were employed to estimate optimal parameters for prescribed data to validate the model. Integrating the effects of social media and in-person interaction within the SEITR model provides a comprehensive understanding of factors influencing the propagation of stress and anxiety in high-school populations. It highlights how social media can exacerbate these conditions through curated lives, cyberbullying, and unrealistic expectations, while in-person interactions within high-school settings significantly contribute to elevated stress and anxiety levels. By shedding light on these dynamics using predictive analytics, this study sought to improve the overall stress and anxiety outcomes of high-school students and guide future research and policy initiatives into mental health studies.