A Mathematical Model for Understanding and Predicting Dynamics of Depression as an Epidemic

Bianca Linares[1,*], Alonso G. Ogueda[2], Padmanabhan Seshaiyer[3]

[1]*Department of Mathematics, George Mason University, Fairfax, VA 22030*

b@thelinares.com

Depression is a serious and common medical mental illness. It impacts how people feel, think, and act on a daily basis. Awareness of how interacting with those that are depressed can help those who have depression generate a better understanding of the cause of the illness, which will help them find appropriate treatment. Therefore, this study introduces a novel mathematical model to understand and predict the dynamics of depression as an epidemic. This integrated compartmental model combines a modified SEIR (Susceptible, Exposed, Infected, Removed) epidemiological model and neural networks to determine optimal transmission and recovery parameters. The system of ordinary differential equations demonstrates the flow between vulnerable, depressed, treated, and recovered groups impacted by a social factor. We employ a novel Disease Informed Neural Network approach to identify and understand the impact of the social factor.

This model was trained using synthetic data, and the accuracy of the model parameters ranged from 83% and 99%. In order to achieve better accuracy, the hyperparameters, iterations and neurons, were altered. However, results proved that the alteration did not impact the model parameters. This integrated model is quick and an extensible tool for understanding depression over time. We hope to include more social factors to improve the robustness and reliability of the model and apply it to real data-sets.