

Modeling, Analysis, and Control of Student Loan Debt using Epidemiological Models

Kavya Ravishankar^{1*} and Padmanabhan Seshaiyer²

¹University of Pennsylvania, Philadelphia, Pennsylvania, USA

²George Mason University, Fairfax, Virginia, USA

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Abstract

Student loan debt is a debilitating problem that threatens a large subset of the American population. As of February 2019, the total amount of debt in the U.S. due to student loans amounted to \$1.56 trillion. This paper works to mathematically model the student debt situation from the lens of an infectious disease contagion model. The study describes a belief proliferation model. Specifically, the spread occurs through the unfounded external reassurance to students that the value of their college education will amount to a future job that will enable them to pay off their loans in full and on time. Built on the classical SEIR compartmental model of epidemiology, this study analyses the movement of individuals in the study set from the susceptible stage to recovered stage using interconnected differential equations. We additionally consider an enhanced model to study the potential effect of an educational awareness program and the financial strain of the COVID-19 pandemic through respective optimal control variables. Utilizing Pontryagin's maximum principle, the augmented model determines the ideal control value to mitigate the rate of students refinancing their loans when unable to meet the required payments. This enhanced model uses a combination of the Forward-Backward Sweep and Implicit Euler's method method to generate results that are tested against the traditional Forward-Backward Sweep method.

Keywords: COVID-19, Compartmental Model, Social Behavior

*Corresponding Author: K. Ravishankar Email: kavya24@wharton.upenn.edu