Charles E. Schmidt College of Science
Department of Mathematical Sciences
Florida Atlantic University

The FAU-SIAM student chapter invites you to a talk by

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An Epidemic Compartment Model for Economic Policy Directions for Managing Future Pandemic

Thursday October 21st, 2021, 11:00am EST

Open to all

Live on Zoom (Meeting ID: 726 327 6757, passcode: Fall2021)

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Abstract

There is a renewed attention to the SIR (susceptible, infected, recovered) and other compartmentalized models in search of one that guides public policy to address the pandemic. In this research, we develop a framework to analyze the interaction between the economy and the disease dynamics. At the outset, we assume there are two health related investments including general medical expenditures and the other for a direct investment for controlling the pandemic. When managing pandemic, learning would occur which contribute to the effective management of the pandemic in the future. Hence, we incorporate the learning dynamics associated with the management of the virus into our model. Given that the labor force in a society depends on the state of the epidemic, we allow birth, death, and vaccination to occur in our model and assume labor force consists of the susceptible, vaccinated, and recovered individuals.We also assume parameters in our epidemic compartmental model depend on investment amount earmarked for directly controlling the epidemic, the health stock of individual representative agents in the society, and the knowledge or learning about the epidemic in the community. By controlling consumption, the general medical expenditure, and the direct investment of funds for controlling the epidemic, we optimize the utility realized by the representative individuals because of consumption. This problem is nontrivial since the disease dynamics results in a nonconvex optimization problem. The research contributes to the existing literature in that we prove the existence of the solution to the social planner problem under the dynamics of disease, economics, and learning. Using Hamiltonian, we show the path result from necessary condition is optimal. We also calculate the steady-state solutions, show that both disease-free and endemic states exist and stable, and prove these solutions are optimal. We show that there exists unique disease-free steady state where zero general health expenditure and zero direct investment to control the epidemic become optimal. Under the endemic state, we show that multiple steady states such as zero general health expenditure but positive direct investment to control epidemic may exist depending on parameters. However, these steady states cannot occur at the same time. We further characterized the steady states using exogenous parameters birth rate and discount rate

About the speaker

Vajira A Manathunga is an assistant professor at Middle Tennessee State University (MTSU). He received his PhD in Mathematics from the University of Tennessee Knoxville in 2016, MSc in Mathematics from Middle Tennessee State University in 2010, and BSc in Mathematics from the University of Colombo, Sri Lanka in 2005. He is a faculty member of the actuarial science program at MTSU, which recently won a prestigious University Award from the Casualty Actuarial Society. His research interest lies in mathematical modeling of actuarial science problems, applications of epidemic compartmental models to actuarial science and economy. He is interested in becoming an associate of the Society of Actuaries.