

# MODELING USER ADOPTION AND ABANDONMENT DYNAMICS OF ONLINE SOCIAL NETWORKS USING COMPARTMENT MODELS

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ABSTRACT. By applying disease-like dynamics to online social networks (OSNs), we propose a susceptible-infected-recovered-susceptible (SIRS) model with infectious recovery dynamics to examine the user adoption and abandonment dynamics of OSNs, where adoption is analogous to infection and abandonment is analogous to recovery. Unlike many traditional infectious disease models available in the literature, our model requires direct contact between recovered and infected members of the population in order to recover from the infected class. We prove the well-posedness of the model and discuss the existence and stability of its equilibria. More specifically, we find the user-free equilibrium and derive the reproduction number  $\mathcal{R}_0$  for the model and further prove that if  $\mathcal{R}_0 < 1$ , the user-free equilibrium is globally asymptotically stable. When  $\mathcal{R}_0 > 1$ , we establish sufficient conditions under which the model has a unique user-prevailing equilibrium and prove criteria for the local and global asymptotic stability of the user-prevailing equilibrium. We perform numerical simulations to validate the theoretic results. Finally, we demonstrate the effectiveness of the model by fitting it to the historical Facebook daily active user data and we utilize the fitted model parameter values to predict the numbers of future Facebook active users.

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