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A Study of Pair Formation Disease Models with a Two Phase Infection

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Over the years, classical epidemic models have been developed as a dynamical system for individuals involved in casual sexual relationship. We expand upon the standard pair formation model developed by Kretzschamar and Heijne (Infectious Disease Modeling, 2017) and Leng and Keeling's (Epidemic, 2018) pair formation model including casual relationships. Our work divides the infection stage of the pair formation models with an acute and chronic stage of infection. Ultimately, we produce a reproduction number that is compared to Gurski's long-term partnership model and classic pair formations models. With this research, we focus on computing reproduction numbers using a next generation method with combined infected singles and pairs. We present a system of nonlinear ordinary differential equations and Mathematica to carry out computations. We develop two $SI_1(\text{acute})I_2(\text{chronic})$ models, one with monogamous pairs, and one with additional casual relationships for singles and pairs. This adds a measure of concurrency to the system. We present results with HIV and HSV-2 parameters.