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Modelling the effect of social distancing on spreading and controlling infectious disease with Point Pattern Process

This work explores the spatial dynamics of disease transmission using Point Pattern Processes (PPPs) and distance-dependent infection rate within a Susceptible-Infectious-Removed-Susceptible (SIRS) framework. By modeling individuals as points in a continuous space, we examine how social distancing and spatial separation influence the spread of the virus. The infection rate is not uniform but varies with the distance between individuals, simulating the real-world effects of reduced contact through interventions like social distancing. We use mathematical models and point pattern analysis to investigate different spatial configurations, from clustered (high transmission risk) to dispersed (reflecting effective social distancing). The pair correlation function $g(r)$ is employed to capture spatial clustering, while pair approximation simplifies the modeling of spatial interactions by considering the effect of pairwise interactions. Prior to social distancing, high P_I probability of infection values are observed due to frequent close contacts, leading to clustered transmission patterns. After implementing social distancing, P_I decreases as individuals are more dispersed, reducing the likelihood of infection. This approach allows us to quantify the impact of public health measures on transmission dynamics, providing insights for optimizing interventions to control the spread of disease.