Abstract

Accounting for interference, or spillover, is important for accurate estimation of causal effects when untreated individuals are connected to a response through a physical or social process. This is a difficult computational problem when treatments are continuous, such as with the intensity of disease management in agricultural fields. Here, we show that recently developed methods that account for continuous treatment interference on networks can be extended to inferred disease transmission networks with spillover estimated as directed edge weights. Using a well-described dataset of powdery mildew of hop (*Podosphaera macularis*), we estimate causal exposure response functions that describe how growers' monthly fungicide inputs and costs change in response to the incidence of disease. Generalized regression models were fit for three time transitions to estimate the probability of disease in given yard as a nonlinear function of autoinfection due to preexisting disease, susceptibility to two races of the fungus, the number of fungicide applications, and disease spread from other yards as influenced by their source strength, fungicide applications, distance, and wind run and direction in the preceding month. Interference from disease in potential source yards was then estimated by summing outward-directed edge weights after covariate weighting by the covariate balancing propensity score. We show that failure to account for interference can lead to nonsensical relationships or misestimation of exposure response functions when field-to-field disease spread drives epidemics. In our empirical application, accounting for spillover was especially critical during time periods of rapid disease development due to inoculum exogenous to a given yard.