

A Potential Outcomes Approach to Monitoring Target Processes Interacting with Observation Processes

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Abstrakt:

The motivating real data example is estimating the prevalence of COVID-19 on campus (the target process) using a longitudinal once-per-week testing and isolation program (the observation process). Even in the absence of confounding factors or preferential testing due to symptoms or contact tracing, the proportion of positive results among all tests overestimates the daily prevalence because the time since last test influences both the probabilities of being infectious and of being tested at the current time. A potential outcomes approach links data from the realized observation process to a counterfactual observation process from a hypothetical world in which we have intervened to prevent infection. This link allows us to estimate the prevalence of disease by modeling the *testing* process, possibly nonparametrically, without modeling the *transmission* process, even though the two affect each other. We will discuss links to concepts in survey sampling, causal inference, and survival analysis, as well as applications to more complex testing processes (including symptomatic testing and contact tracing) and other fields such as sensor network recalibration and manufacturing quality control.