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## Estimation of the Infection Rate of Epidemics in Multilayer Random Graphs: Comparing Classical Methods with XGBoost

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We address the problem of estimating the infection rate of an epidemic from observed counts of the number of susceptible, infected and recovered individuals. In our setup, a classical SIR (susceptible/infected/recovered) process spreads on a two-layer random network, where the first layer consists of small complete graphs representing the households, while the second layer models the contacts outside the households by a random graph. Our choice for the latter is the polynomial model, where three parameters control how the new vertices are connected to the existing ones: uniformly, preferentially, or by forming random triangles.

Our aim is to estimate the infection rate  $\tau$ . We apply two different approaches: the classical method uses a formula based on the maximum likelihood estimate, where the main information comes from the estimated number of the SI edges. The second, machine learning-based approach uses a fine-tuned XGBoost algorithm. We examine by simulations, how the performance of our estimators depend on the value of  $\tau$  itself, the phase of the epidemic, and the graph parameters, as well as on the possible availability of further information.

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### Keywords

SIR model, two layer random graph, xgboost

### Classification

Both methodology and application

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