Real-time prediction of severe influenza epidemics using Extreme Value Statistics

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Influenza viruses are responsible for annual epidemics, causing more than 500,000 deaths per year worldwide and also lead to high morbidity which puts substantial strain on public health systems. A crucial question for resource planning in public health is then to predict the morbidity burden of extreme epidemics. We say that an epidemic is extreme whenever the influenza incidence rate exceeds a high threshold for at least one week.

Our objective is to predict whether an extreme epidemic will occur in the near future, say the next couple of weeks. To that purpose, we collected the weekly numbers of influenza-like illness (ILI) incidence rates in France publised by the Sentinelles network since 1985.

A main goal of Extreme Value Theory is to assess, from a series of observations, the probability of events that are more extreme than those previously recorded. Building on the approach presented in [2, 1], we first fit a 3-dimensional generalized Pareto distribution. Estimates of the probability of exceeding a high value are then obtained as the conditional distribution of the previously fitted model. The predictions are assessed on simulated and real data.

References

[1] A. Kiriliouk, H. Rootzén, J. Segers, and J. L. Wadsworth. Peaks over thresholds modeling with multivariate generalized Pareto distributions. *Technometrics*, 61:123–135, 2019.

[2] H. Rootzén, J. Segers, and J. Wadsworth. Mutlivariate peaks over threshold models. *Extremes*, 21:115–145, 2018.