Risk models in a heterogeneous time-dependent population

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Abstract

Epidemics introduce a structured and dynamic form of heterogeneity into insured populations, as individuals' risk profiles depend on their health status and its evolution over time. In particular, the coexistence of infected and non-infected subpopulations gives rise to substantially different claim arrival intensities, claim size distributions, and temporal dependence structures. This challenges classical insurance risk models, which typically rely on homogeneity assumptions and independence across insured individuals. Motivated by this phenomenon, I will present actuarial risk models in which the claim process is directly linked to an underlying stochastic population dynamics. I will propose both collective and individual modeling frameworks that track the evolving composition of the insured population and its impact on aggregate claims. The risks associated with each subgroup are modeled by Lévy processes with distinct characteristics, and we consider general stochastic population dynamics without any Markovianity assumption. For these models, I will present scaling limits and provide bounds and approximations for ruin probabilities. Applications in an epidemiological SIS context will also be presented.

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