A Phase-Type Distribution for the Sum of Two Concatenated Markov Processes. Application to the Analysis Survival in Bladder Cancer.

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Abstract

Stochastic processes are very useful and have a very important role in modeling the evolution of processes that take different states over time, a situation frequently found in fields like Medical Research and Engineering. In a previous paper and within this framework, we developed the sum of two independent phase-type (PH) distributed variables, each of them being associated with a Markovian process of one absorbing state. In that analysis, we computed the distribution function, and its associated survival function, of the sum of both variables also PH–distributed. In this work, in one more step, we have developed a first approximation of that distribution function to avoid the calculation of an inverse matrix due to the possibility of bad conditioning of the matrix involved in the expression of the distribution function in the previous paper. Next, in a second step, we improve this result, giving a second more accurate approximation. Two numerical applications, one with simulated data and the other one with bladder cancer data, are used to illustrate the two proposed approaches to the distribution function. We compare and argue the accuracy and precision of every one of them using their error bounds and the application to real data of bladder cancer.

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