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# MARKOVIAN EVOLUTIONS: PROBABILITY DISTRIBUTION AND ITS APPLICATIONS

DESCRIPTION FOR THE GENERAL PUBLIC

The present research project is devoted to the study of the distributions appearing in some Markov evolutions and their applications in analysis and physics.

Within this research theme analyse a stochastic process $X_t$ that evolves as a Markov process $Y_t$ between Poisson epochs and at this epochs it experiences a partial or full resetting. Evans and Majumdar seem to be the first ones who used the term *'stochastic resetting'* as the stochastic interruption of a random motion, resetting the particle to its initial position and starting the process anew. In case when the evolution is performed on non-negative real half-line and $Y_t = t$, then the process $X_t$ is called as an additive-increase and multiplicative-decrease process (aka growth-collapse or stress-release process); see Figure 1. This process has various applications. For example, it appears as the fluid limit scaling for some queueing models (with binomial catastrophe rates) used in modeling population growth subject to mild catastrophes. Such processes can be viewed as a particular example of the so-called shot noise model, which is used in models of earthquakes and of the layers of sedimentary material accumulated in depositional environments but not subjected to subsequent erosion. It can model avalanches or neuron firings as well. Moreover, this process is also used in the AIMD algorithm to model the Transmission Control Protocol, the dominant protocol for data transfer over the internet. Other applications of stochastic resetting have been also discussed in the context of backtrack recovery by RNA polymerase, enzymatic velocity, pollination strategies, enzymatic inhibition, stochastic thermodynamics and quantum mechanics. The subject of resetting or restart has been in the limelight recently due to so-called search processes which corresponds to random search strategies when prior information about the target is lacking or when the searcher itself can only move diffusively, such as molecular reactants. Realization of stochastic resetting was confirmed in switching holographic optical tweezers as well. The risk process with resetting has been found to be an indispensable part of modelling mortgage lending and so-called micro-insurance polices.

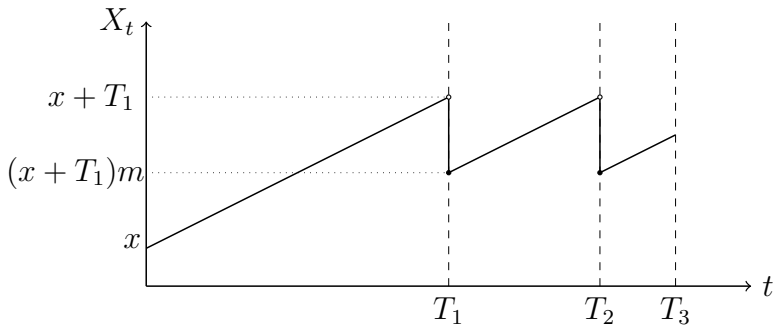


FIGURE 1. Additive-increase and multiplicative-decrease process path

In the project we plan to focus on analyzing so-called a non-equilibrium stationary state (NESS) phenomenon. Such phenomenon is very important in studying the asymptotics behavior of the evolutions.

The analysis of distributions and all kind of properties of Markov evolutions is an active field of the present-day probability theory. The richness and timeliness of stated questions and variety of open problems, coming from theory-oriented questions and behaviour of Markov processes, stimulates development of, among others, theory of stochastic processes, potential theory, and various applications. There are also numerous and deep links with other areas of mathematics. In particular, the outcome of the project will be significant for the probability, the theory of non-local partial differential equations, as well as for physics, biology, actuarial science and queueing theory.