Lévy processes with adaptable exponent

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Abstract

In this paper we consider Lévy processes without negative jumps, reflected at the origin. Feedback information about the level of the Lévy process ("workload level") may lead to adaptation of the Lévy exponent. Examples of such models are queueing models in which the service speed or customer arrival rate changes depending on the workload level, and dam models in which the release rate depends on the buffer content. We first consider a class of models where information about the workload level is continuously available. In particular, we consider dam processes with a two-step release rule and M/G/1 queues in which the arrival rate, service speed, and/or jump size distribution may be adapted depending on whether the workload is above or below some level $K$. Secondly, we consider a class of models in which the workload can only be observed at Poisson instants. At these Poisson instants, the Lévy exponent may be adapted based on the amount of work present. For both classes of models we determine the steady-state workload distribution.

Keywords: Reflected Lévy process; adaptable exponent; workload distribution; scale functions; Laplace inversion; M/G/1 queue; storage process.

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