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Quickest Detection of a Sudden Change in the Law of a Compound Poisson Process

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Abstract

Compound Poisson processes are widely used in modeling the arrival streams of jobs to service systems, claims to the insurance companies, shocks to mechanical systems. If the customer satisfaction, business profitability, or system reliability has to be maximized, then service rates, insurance premiums, replacement policies should be promptly adapted to the sudden changes in the statistical law of the underlying compound Poisson arrival streams. In this talk, the quickest detection of the unknown and unobservable disorder time, when the arrival rate and mark distribution of a compound Poisson process suddenly changes, is formulated in a Bayesian setting. The detection delay penalty is assumed to be a general smooth function of the detection delay time. Under suitable conditions, the problem is shown to be equivalent to the optimal stopping of a finite-dimensional piecewise-deterministic strongly Markov sufficient statistic. The solution of the optimal stopping problem is described in detail for the polynomial detection delay penalty functions of arbitrary but fixed degree. The results are numerically illustrated for some quadratic detection delay penalty function.

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