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LECTURE NOTES — MONOGRAPH SERIES

EXTREME VALUES FOR A CLASS OF SHOT-NOISE PROCESSES

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Abstract

The distribution of the maximum of a shot-noise process based on amplitudes which are heavy tailed and follow a chain-dependent structure is analysed. Asymptotic results are obtained. The process is seen to have a strong local dependence and its extremal index is computed. A simulation study shows the finite sample size performance of an asymptotic approximation to the distribution of the maximum.

1 Introduction

In the paper we are concerned with the asymptotic behavior of the extreme values for a class of shot noise processes. Shot noise processes provide a wide class of stochastic models that are particularly well suited to modeling time series with sudden jumps. Such processes have been applied to modeling river flow data where a rise in the riverflow level could, for example, be attributed to rainfall, Lawrance and Kottegoda (1977) and Weiss (1973). Moreover, rainfall data, itself, has been modeled via shot noise processes, Waymire and Gupta (1981). The basic model under study here takes the form

$$X(t) = \sum_{\tau_k \leq t} A_k h(t - \tau_k), \quad t \geq 0$$

where $\{A_k\}$ is a sequence of random amplitudes, $\{\tau_k\}$ forms a point process of event times and h is the impulse response function, typically, taken to be nonincreasing with support in $[0, \infty)$. In the current investigation, we take the $\{A_k\}$ to be a stochastic process of heavy-tailed random variables. In applications the sequence of shocks or amplitudes exhibits dependence. It may be that large shocks tend to occur in succession followed by periods