EXTREMES AND UPCROSSING INTENSITIES FOR P-DIFFERENTIABLE STATIONARY PROCESSES

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Given a stationary process $\{\xi(t)\}_{t\in\mathbb{R}}$ that is differentiable in probability, we express the asymptotic behaviour of $\mathbf{P}\{\sup_{t\in[0,1]}\xi(t)>u\}$ for large u through a certain functional of the conditional distribution $(\xi'(1)|\xi(1)>u)$. Under technical conditions this expression reduces to the upcrossing intensity $\mu(u)$ of the level u by $\xi(t)$. However, by not making explicit use of $\mu(u)$ we avoid the usually hard-to-verify technical conditions required in the calculus of crossings and to relate upcrossings to extrema.

We also provide a useful criterion for verifying a standard tightness condition used in the literature on extremes. This criterion is of independent value.

Although we do not use crossings theory, our approach has some impact on this subject. Thus we complement existing results due to e.g., Leadbetter (1966) and Marcus (1977) by providing a new and sometimes useful set of technical conditions which ensure the validity of Rice's formula $\mu(u)=\int_0^\infty z\,f_{\xi(1),\xi'(1)}(u,z)\;dz$.