Contribution ID: **14** Type: **not specified**

Change-level detection for Lévy subordinators

Thursday, 19 May 2022 11:30 (20 minutes)

Let
$boldsymbol{X} = (X_t)_{t\geq 0}$ be a process behaving as a general increasing Lévy process (subordinator) prior to hitting a given unknown level m_0, then behaving as another different subordinator once this threshold is crossed. We address the detection of this unknown threshold $m_0 \in [0, +\infty]$ from an observed trajectory of the process. These kind of model and issue are encountered in many areas such as reliability and quality control in degradation problems. More precisely, we construct, from a sample path and for each $\epsilon > 0$, a so-called detection level L_ϵ by considering a CUSUM inspired procedure. Under mild assumptions, this level is such that, while m_0 is infinite (i.e. when no changes occur), its expectation $\mathbb{E}_\infty(L_\epsilon)$ tends to $+\infty$ as ϵ tends to 0, and the expected overshoot $\mathbb{E}_{m_0}([L_\epsilon - m_0]^+)$, while the threshold m_0 is finite, is negligible compared to $\mathbb{E}_\infty(L_\epsilon)$ as ϵ tends to 0. Numerical illustrations are provided when the Lévy processes are gamma processes with different shape parameters. This is joint work with Z.Al Masry and G.Verdier.

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Session Classification: Degradation models