Stochastic models for non-stationary data

Consider a sequence of positive random variables $\{J_i\}_{i=1}^{\infty}$ with the meaning of inter-event durations and another sequence of (not-necessarily positive) random variables $\{X_i\}_{i=1}^{\infty}$ with the meaning of jumps. Define the following two random walks:

$$T_n := \sum_{i=1}^{n} J_i,$$

and

$$Y_n := \sum_{i=1}^{n} X_i.$$

Introduce the counting process $N(t)$ as

$$N(t) = \max\{n : T_n \leq t\},$$

and define the following random sum of random variables

$$Y(t) := Y_{N(t)} = \sum_{i=1}^{N(t)} X_i.$$

A lot is known on $Y(t)$ and its functional limits under appropriate scaling when the J_is and the X_is are independent and identically distributed random variables and they are mutually independent. Little is known when these hypotheses are not satisfied and, moreover, when these variables are non-stationary as a function of their index i. We want to systematically study this situation.

Two recent papers on this are `arXiv:1601.03965 [math.PR]` as well as `arXiv:1711.08768 [math.PR]`.

Key words: Non-stationary stochastic processes, functional limit theorems, large deviations, moderate deviations.