Abstract. For a $\psi$-mixing stationary process $\xi_0, \xi_1, \xi_2, \ldots$ we consider the number $N_N$ of multiple recurrences $\{\xi_{q_i(n)} \in \Gamma_N, i = 1, \ldots, \ell\}$ to a set $\Gamma_N$ for $n$ until the moment $\tau_N$ (which we call a hazard) when another multiple recurrence $\{\xi_{q_i(n)} \in \Delta_N, i = 1, \ldots, \ell\}$ takes place for the first time where $\Gamma_N \cap \Delta_N = \emptyset$ and $q_i(n) < q_{i+1}(n), i = 1, \ldots, \ell$ are nonnegative increasing functions taking on integer values on integers. It turns out that if $P\{\xi_0 \in \Gamma_N\}$ and $P\{\xi_0 \in \Delta_N\}$ decay in $N$ with the same speed then $N_N$ converges weakly to a geometrically distributed random variable. We obtain also a similar result in the dynamical systems setup considering a $\psi$-mixing shift $T$ on a sequence space $\Omega$ and study the number of multiple recurrences $\{T_{q_i(n)} \omega \in A^a_m, i = 1, \ldots, \ell\}$ until the first occurrence of another multiple recurrence $\{T_{q_i(n)} \omega \in A^b_m, i = 1, \ldots, \ell\}$ where $A^a_m, A^b_m$ are cylinder sets of length $m$ constructed by sequences $a, b \in \Omega$, respectively. We consider also $\phi$-mixing shifts which are important since they allow to include some Young towers and Markov shifts with countable state space. In this case we obtain geometric limit law for the number of single returns to a cylinder until the first return to another cylinder and the case of multiple returns under $\phi$-mixing remains open. This work is motivated by a number of papers on asymptotics of numbers of single and multiple returns to shrinking sets, as well as by the papers on open systems studying their behavior until an exit through a “hole”.

GEOMETRIC LAW FOR MULTIPLE RETURNS
UNTIL A HAZARD

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