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12. Probability and Statistics

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Stopping times and Large-Deviation Principles

Consider a sequence of processes $(X^n)_n$ whose trajectories are in the Skorokhod space $D = D([0,\infty[,\mathbb{R})$. Assume that each process X^n is adapted to a filtration $\mathbb{F}^n$. Then the following criterion on Large Deviations holds:

Theorem. *The sequence $(X^n)_n$ admits a subsequence which satisfies a Large Deviation Principle whenever the two hypotheses below are satisfied:*
(H1) For any $N \geq 1$ and all $\alpha > 0$ there exist numbers $n_0 \geq 1$ and $a > 0$ such that $\mathbb{P}(\sup_{t\leq N}|X^n_t| > a) \leq \exp(-n\alpha)$, for all $n \geq n_0$;
(H2) Given any $N \geq 1$, $\beta, \epsilon > 0$ and, in addition, any arbitrary sequence of stopping times $(T^n)_n$ bounded by N; any sequence $(\delta^n)_n$ of strictly positive real numbers decreasing to 0, there exists an $n_0 \geq 1$ such that $\mathbb{P}(|X^n_{T^n+\delta^n} - X^n_{T^n}| > \epsilon) \leq \exp(-n\beta)$, for all $n \geq n_0$.