A LIMIT THEOREM FOR AN ASYMMETRIC RANDOM WALK WITH RANDOM SPEED CHANGE

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For a positive sequence $w = \{w(x)\}_{x\in\mathbb{Z}}$ and a probability distribution $p(y)$ on $\mathbb{Z}$ let $(X(t), P_x^w)$ be a Markov process on $\mathbb{Z}$ generated by

$$Af(x) = w(x)^{-1} \sum_{y\in\mathbb{Z}} p(y)(f(x+y) - f(x)) \quad (x \in \mathbb{Z}),$$

and we denote by $\Xi^w(t)$ the distribution of $X(t)$ under P_0^w at time t. If $\{w(x)\}$ are random, $\Xi^w(t)$ is a random probability distribution (shortly, RPD).

Assuming that $p(y)$ has a positive drift and $\{w(x)\}$ is an i.i.d. random sequence whose distribution belongs to the domain of attraction of a κ-stable distribution with $0 < \kappa < 2$, we prove a scaling limit theorem of $\Xi^w(t)$ as $t \to \infty$. Then the limiting RPD is described in terms of Poisson integrals which are introduced by Shiga–Tanaka[1].

References

[1] T. Shiga and H. Tanaka. Infinitely divisible random probability distributions with an application to a random motion in a random environment. *Electron. J. Probab.*, 11:1144–1183, 2006.