A Continuous State Branching Process with Population Dependent Branching Rates

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Abstract: Consider the following stochastic differential equation

$$X_t = \sigma \int_0^t \sqrt{\gamma_1(X_{s-})} dB_s + \int_0^t \int_0^\infty \int_0^{\gamma_2(X_{s-})} x\tilde{N}(ds, dx, du),$$

where $\tilde{N}(ds, dz, du)$ is a compensated Poisson random measure on $[0, \infty) \times (0, \infty) \times [0, \infty)$ with compensator $ds\pi(dz)du$ such that $\int_0^\infty z \wedge z^2 \pi(dz) < \infty$ and B is an independent Brownian motion. Such a process X can be treated as a critical continues state branching process with branching rates depending on the population size. We find conditions on functions γ_1 and γ_2 under which the process X hits 0 with probability one or stays positive with probability one, respectively. It generalizes a result in [1].

References

[1] L. Wang, X. Yang & X. Zhou (2016). A distribution-function-valued SPDE and its applications, preprint.