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Persistence of Stochastic Power Law Logistic Model

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Abstract

In our study we consider power law logistic model in modelling population growth. We perturb the power law logistic model, $dx(t) = \text{diag}(x_1(t), \ldots, x_n(t))C(x^s(t) - \bar{x}^s)$ that has equilibrium state $\bar{x} = (\bar{x}_1, \ldots, \bar{x}_n)^T$ with Brownian noise, $\sum_{j=1}^{n} \varphi_{ij}(x_j^s(t) - \bar{x}_j^s)\dot{w}(t)$. The resulting Itô stochastic differential equation is $dx(t) = \text{diag}(x_1(t), \ldots, x_n(t))[C(x^s(t) - \bar{x}^s) + \varphi(x^s(t) - \bar{x}^s)dw(t)]$. We show that this Itô stochastic differential equation is persistent stochastically.

Keywords: Stochastic persistence, Itô stochastic differential equation, stochastic power law logistic model, Brownian motion.

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