Modelling Individual Growth in Random Environments

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Abstract. We have considered, as general models for the evolution of animal size in a random environment, stochastic differential equations of the form $dY(t) = b\,(A - Y(t))\,dt + \sigma dW(t)$, where $Y(t) = g(X(t))$, $X(t)$ is the size of an animal at time t, g is a strictly increasing function, $A = g(a)$ where a is the asymptotic size, $b > 0$ is a rate of approach to A, σ measures the effect of random environmental fluctuations on growth, and W_t is the Wiener process. The transient and stationary behaviours of this stochastic differential equation model are well-known (Braumann(2005)). We have considered the stochastic Bertalanffy-Richards model ($g(x) = x^c$ with $c > 0$) and the stochastic Gompertz model ($g(x) = \ln x$). We have studied the problems of parameter estimation for one path (Filipe et al. (2007)) and also considered the extension of the estimation methods to the case of several paths, assumed to be independent (Filipe and Braumann (2007)). We used numerical techniques to obtain the parameters estimates through maximum likelihood methods as well as bootstrap methods. The data used for illustration is the weight of "mertolengo" cattle of the "rosilho" strand and was provided by Carlos Roquete (ICAM-UE).

Keywords: growth models, stochastic differential equations, estimation, cattle weight.

References

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