Derivation of an SDE system for sunspot activity and SPDEs for stock-price distributions, reaction-diffusion problems, and neutron transport

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ABSTRACT. A procedure is reviewed for deriving stochastic ordinary and partial differential equations (SDEs) and (SPDEs) for randomly-varying problems in biology, physics, and finance. The equations are derived from basic principles, i.e., from the changes in the system which occur in a small time interval. In the derivation procedure, a discrete stochastic model is first constructed. As the time interval decreases, the discrete stochastic model leads to a system of Ito SDEs. Next, Brownian sheets replace the Wiener processes and the resulting equations infer an SPDE. Several examples illustrate the procedure. In particular, a system of SDEs is derived for sunspot activity and SPDEs are derived for stock-price distributions, reaction-diffusion problems, and neutron transport.

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