Affine processes under parameter uncertainty

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This paper develops a notion of affine processes under parameter uncertainty, called *nonlinear affine processes*. This is done as follows: given a set Θ of parameters for the process, we construct a corresponding nonlinear expectation on the path space of continuous processes. By a general dynamic programming principle, we link this nonlinear expectation to a variational form of the Kolmogorov equation, where the generator of a single affine process is replaced by the supremum over all corresponding generators of affine processes with parameters in Θ. This nonlinear affine process yields a tractable model for Knightian uncertainty, especially for modelling interest rates under ambiguity.

We then develop an appropriate Itô formula, the respective term-structure equations, and study the nonlinear versions of the Vasiček and the Cox–Ingersoll–Ross (CIR) model. Thereafter, we introduce the nonlinear Vasiček–CIR model.

This model is particularly suitable for modelling interest rates when one does not want to restrict the state space a priori and hence this approach solves the modelling issue arising with negative interest rates.

Numerical implementations relying on Machine-Learning techniques show that the introduced complexity still can be handled very efficiently.