主 論 文 要 旨

論文題名　A study on the density and sensitivity analysis concerning the maximum of SDEs

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主論文要旨

In this thesis, we give some results on the existence of density functions and sensitivity analysis concerning the maximum of some stochastic differential equations (SDEs). The Malliavin calculus plays an important role to obtain the results of this thesis.

In Chapter 1, we present the introduction of this thesis and the preliminary of Malliavin calculus.

In Chapter 2, we consider an m-dimensional SDE with coefficients depending on the maximum of the solution. First, we prove the absolute continuity of the law of the solution. Then we prove that the joint law of the maximum of the ith component of the solution and the ith component of the solution is absolutely continuous in a particular case.

In Chapter 3, we give a decomposition formula to calculate the vega for options depending on the extrema of a one-dimensional model and study its behavior. Moreover, we compare the vega obtained in this model with the one in Black-Scholes model. Our mathematical and numerical results provide three interesting properties of the vega for barrier type options in the one-dimensional model: First, the vega can be decomposed into three components which can be called extrema sensitivity, terminal sensitivity and drift sensitivity.
Second, using an example of up-in call options, we show that there is a barrier value at which the importance of extrema and terminal sensitivity are reversed.
Third, extrema sensitivity is important only for options with short maturity as far as the vega is concerned. The comparison of the vega in two different models clarifies that the behavior of the vega in the model considered here is far away from that in the Black-Scholes model.
In the case of binary barrier options, each component of the decomposition formula involves the Dirac delta functionals. Kernel methods are used to estimate the vega in this setting.