

ABSTRACT

Malliavin calculus in the modelling of financial processes

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The Malliavin calculus was originally created as a tool for studying the regularity of densities of solutions of stochastic differential equations.

The Wiener-Itô chaos expansion is a convenient starting point for the introduction of several important stochastic concepts, like Malliavin calculus. Then we give an introductory presentation of the theory of Malliavin calculus. After a precise construction we show through examples how the Malliavin derivative operator and rules of the calculus works.

In recent years it has become clear that there are various applications of Malliavin calculus. Among the fields where those techniques can become very useful it is worth to mention finance. We apply the Malliavin calculus to the simulation of Greeks in finance. We do this to European type contingent claims where formulas can be computed explicitly and therefore can serve as testing ground.

The central tool in Malliavin calculus is the integration by parts formula. We will present an abstract approach for this formula in the one dimensional and in the multidimensional case. In the latter case we will examine the Malliavin-Thalmaier formula. Last, but not least we approximate the density function of the Heston stochastic volatility model with the help of these formulas.