World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:9, No:08, 2015

Application of the Concept of Comonotonicity in Option Pricing

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Abstract : Monte Carlo (MC) simulation is a technique that provides approximate solutions to a broad range of mathematical problems. A drawback of the method is its high computational cost, especially in a high-dimensional setting, such as estimating the Tail Value-at-Risk for large portfolios or pricing basket options and Asian options. For these types of problems, one can construct an upper bound in the convex order by replacing the copula by the comonotonic copula. This comonotonic upper bound can be computed very quickly, but it gives only a rough approximation. In this paper we introduce the Comonotonic Monte Carlo (CoMC) simulation, by using the comonotonic approximation as a control variate. The CoMC is of broad applicability and numerical results show a remarkable speed improvement. We illustrate the method for estimating Tail Value-at-Risk and pricing basket options and Asian options when the logreturns follow a Black-Scholes model or a variance gamma model.

Keywords : control variate Monte Carlo, comonotonicity, option pricing, scientific computing
Conference Title : ICMSSC 2015 : International Conference on Mathematics, Statistics and Scientific Computing
Conference Location : Vancouver, Canada
Conference Dates : August 06-07, 2015