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A Markov chain approximation framework for discretely-monitored barrier options under Markov processes

Steve Taylor from MTSM at NJIT

Date/Time: 4/10/2019 at 1:00

Location: Leir Conference Room, CAB 3052

Abstract:

We propose a novel explicit closed-form approximation formula for the pricing of discretely monitored double barrier options whose underlying asset evolves according to a generic one dimensional Markov processes. This framework stems from utilizing the integral equation method, the $\mathcal{Z}-$transform technique, and a continuous-time Markov chain approximation of the underlying Markov process. This formula does not require one to perform intermediate numerical quadrature or related potentially runtime intensive or error prone procedures procedures (e.g. an inverse Laplace transform or inverse $\mathcal{Z}-$transform). Rather, the price and Greeks of the discretely-monitored double barrier options may be expressed in terms of rudimentary linear algebra operations. One may also incorporate time-dependent barriers and nonuniform observation time intervals seamlessly into this framework. In addition, runtime and memory requirements increase logarithmically with the monitoring frequency. Hence, in addition, we obtain a highly accurate closed-form formula for the price and Greeks of a continuously-monitored barrier option under a general Markov processes by limiting the monitoring frequency to a large value. We provide numerous numerical examples that demonstrate the accuracy and efficiency of the proposed method as well as its ability to reproduce existing pricing results in the relevant literature.

Speaker Bio: Stephen Taylor joined the Martin Tuchman School of Management at NJIT after working in industry for seven years as a quantitative research analyst. He has worked at Tudor Investment Corporation, Hutchin Hill Capital, Morgan Stanley, and Bloomberg on a variety of quantitative projects including developing hedging algorithms and implementing risk and performance metric monitoring software. In addition, he was a Technical Staff member at MIT Lincoln Laboratory where he worked on developing radar compression algorithms. His research focuses on the application of non-traditional mathematical and statistical methods to quantitative finance problems with a focus on risk and valuation. He is excited to join NJIT, is looking forward to interdisciplinary collaboration with the mathematics, engineering, and computer science departments, and helping the MTSM's efforts to promote data science and quantitative finance education for business school students.

This talk is part of the MTSM Business Data Science PhD Program Seminar Series