

Department of Mathematical Sciences

Fall 2019

Colloquium Series

November 22, 2019 at 3pm in Bell Hall 143

Dr. Jerry Goldstein

University of Memphis

The PDEs of Mathematical Finance

Mathematical finance is often reviewed as a part of applied probability theory, starting from Brownian motion. But in the modern theory and in the current graduate level textbooks, two deterministic parabolic linear PDEs arise naturally. These have the form

$$\frac{\partial u}{\partial t} = \alpha x^k \frac{\partial^2 u}{\partial x^2} + (\beta x + \gamma) \frac{\partial u}{\partial z} + (\delta x + \epsilon)u$$

for $x \geq 0, t \geq 0$. Included are the Nobel-Prize winning Black-Scholes equation (BS) of stock options (with $k = 2$) and the Cox-Ingersoll-Ross equation (CIR) of zero coupon bonds (with $k = 1$) [as well as the heat equation with $k = 0$]. A self-contained discussion of these equations will be presented (in the context of semigroups of operators), including chaos for (BS) and a new kind of Feynman-Kac type representation theorem of the solution for (CIR). These terms will be explained in detail. Our approach to these results does not use probability theory.

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