

BOSTON UNIVERSITY MATHEMATICS COLLOQUIUM

# Multiscale Perturbation Methods for Portfolio Choice Problems

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SCI 117

**Abstract:** Optimal investment in an environment of uncertain and changing market volatility is an issue where mathematics and statistics can and does play a guiding role. We review the Merton portfolio optimization problem, which has been a success story of stochastic control since 1969 in the case when volatility is assumed constant. We then study it in the presence of stochastic volatility using asymptotic approximations when the volatility process is characterized by its time-scales of fluctuation. When volatility is fast mean-reverting, this leads to a regular-singular perturbation problem for a nonlinear Hamilton-Jacobi-Bellman PDE. The asymptotics shares remarkable similarities with the linear option pricing problem, using the properties of the Merton risk-tolerance function, particularly that it satisfies a fast diffusion PDE. We give examples in the family of mixture of power utility functions, and also we use the asymptotic analysis to suggest a “practical” strategy which does not require tracking the fast-moving volatility factor. We also discuss extensions involving transaction costs, which entails perturbation analysis of an eigenvalue problem.

From 2:30 - 3:30 pm there will be a pre-colloquium talk in MCS 148 by Siragan Gulius. Title: A Look at Multiscale SDEs and Small Noise. Abstract: Multiscale SDEs are widely used to model phenomena whose dynamics exhibit several characteristic scales. This talk will provide a first look at multiscale SDEs by way of concrete example, and, if time allows, touch upon the problem of drift estimation in the context of a multiscale model with small noise.

There will be a tea in MCS 144 from 3:30 - 4:00.