November 27th, 2017
KAP 414
2:00 P.M. – 3:00 P.M.

Professor Frederi Viens
(Michigan State University)

"The Karhunen-Loeve Expansion for Gaussian Processes as Applied to Implied Volatility Asymptotics"

Abstract: Any continuous Gaussian process on an interval can be decomposed into its Karhunen-Loeve expansion. While the eigen-components of this expansion are not typically known, we will describe some efforts to apply this decomposition to understanding the tail behavior of integrated volatility in very precise terms. This work covers sharp asymptotic density estimates for any second-chaos random variable. We apply these estimates to the so-called integrated variance of stochastic volatility models where the volatility is an arbitrary continuous Gaussian process. Our motivation is to derive extreme-strike asymptotics for call prices and implied volatilities. Our analysis shows that the first several terms in the asymptotics depend only on the top Karhunen-Loeve coefficient (eigenvalue) and its multiplicity. Numerical investigations show that these asymptotics can result in extremely sharp calibration techniques even very far away from the strike's asymptotic range. We also apply our general theory to the case of self-similar Gaussian volatility models, including fBm. There, we derive model-free calibration formulas for the self-similarity parameter, and we investigate numerical improvements to these calibrations. This is joint work with Archil Gulisashvili and Xin Zhang.