

# Multidimensional Nonlinear Boundary Crossing Problems with Applications

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## Abstract

In this talk, we present the first passage time of a multidimensional simple random walk crosses a certain type of nonlinear boundary. Under some regularity conditions, we derive asymptotic expansions for the ruin probability and the expected value. The evaluation of the expected value is through an innovative device that first rewrite the problem as an one dimensional Markov random walk crossing a linear boundary, and then approximate this Markov random walk by a sequence of uniformly ergodic Markov random walks. For this purpose, we also study renewal theory for a sequence of Markov random walks. Numerical simulations as well as applications to credit default in quantitative finance, multidimensional CUSUM in industrial statistics and sequential multi-sensor change point detection are given to illustrate the results.

Joint work with Chu-Lan, Michael Kao.