Welcome Home Workshop 2014

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TITOLO: Parameter inference from hitting times for perturbed Brownian motion

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Abstract

A latent internal process describes the state of some system, e.g. the social tension in a political conflict, the strength of an industrial component or the health status of a person. When this process reaches a predefined threshold, the process terminates and an observable event occurs, e.g. the political conflict finishes, the industrial component breaks down or the person dies. Imagine an intervention, e.g., a political decision, maintenance of a component or a medical treatment, is initiated to the process before the event occurs. How can we evaluate whether the intervention had an effect?

To answer this question we describe the effect of the intervention through parameter changes of the law governing the internal process. Then, the time interval between the start of the process and the final event is divided into two subintervals: the time from the start to the instant of intervention, denoted by S, and the time between the intervention and the threshold crossing, denoted by R. The first question studied here is: What is the joint distribution of (S, R)? The theoretical expressions are provided and serve as a basis to answer the main question: Can we estimate the parameters of the model from observations of S and R and compare them statistically? Maximum likelihood estimators are calculated and applied on simulated data under the assumption that the process before and after the intervention is described by the same type of model, i.e. a Brownian motion, but with different parameters. Also covariates and handling of censored observations are incorporated into the statistical model, and the method is illustrated on lung cancer data.