Juraj Bodík

Abstract

This thesis is dealing with the following problem: Let us have two stationary time series with heavy-tailed marginal distributions. We want to detect whether they have a causal relation, i.e. if a change in one of them causes a change in the other. The question of distinguishing between causality and correlation is essential in many different science fields. Usual methods for causality detection are not well suited if the causal mechanisms only manifest themselves in extremes. In this thesis, we propose a new method that can help us in such a nontraditional case distinguish between correlation and causality. We define the so-called causal tail coefficient for time series, which, under some assumptions, correctly detects the asymmetrical causal relations between different time series. We will rigorously prove this claim, and we also propose a method on how to statistically estimate the causal tail coefficient from a finite number of data. The advantage is that this method works even if nonlinear relations and common ancestors are present. Moreover, we will mention how our method can help detect a time delay between the two time series. We will show how our method performs on some simulations. Finally, we will show on a real dataset how this method works, discussing a cause of electromagnetic storms.