V. International Caucasus-Central Asia
Foreign Trade and Logistics Congress
September 19-10, 2019, İstanbul
http://www.ulk.ist/

Network Risk Modelling via Warped Gaussian Processes

Burcu Adıgüzel Mercangöz
Assoc. Prof.
Istanbul University
burcua@istanbul.edu.tr
Gareth W. Peters
Prof.
Heriot-Watt University,
Edinburgh, UK
g.peters@hw.ac.uk

Abstract

Many problems in Operational Research domains involve the study of risk management on a constrained topology of some form of physical network such as logistic networks or intangible networks such as banking financial networks and distributed ledger networks in modern DeFi movements. In this paper we explore an emerging class of machine learning models that can flexibly model and assess risk on a graphical or network based topology. We will focus primarily on the use of undirected graphical structures and we will develop a stochastic model representa- tion that is able to model dynamic multivariate processes on a graphical topology conditional on exogenous observable covariates. This will be achieved by extending classical Gaussian processes regressions models in machine learning to non-stationary, warped Gaussian process regression models. Since we are focused on risk management aspects of processes restricted to graphs, we note that extreme events often display heterogeneity (i.e., non-stationarity), varying continuously with a number of covariates. In the framework we develop we will be able to study and explain such extreme joint variations through the regressions structures developed and the covariance operators characterizing the process. Having proposed a class of such warped Gaussian process network regression models, we will then study Bregman super-quantiles on such networks that will allow us to develop a class of network based coherent risk measures which have the added advantage of being sub-additive, allowing one to aggregate of local graphical cliques to understand local risk behaviours.

Keywords: *Warped Gaussian Process Regression, Network extreme models, Bregman Super-Quantiles, Network Risk Management.*