Transformed-linear Models for Time Series Extremes

Daniel Cooley[1]; Nehali Mhatre[1]

[1] Colorado State University

Abstract:

In order to capture the dependence in the upper tail of a time series, we develop non-negative regularly-varying time series models that are constructed similarly to classical non-extreme ARMA models. We first investigate consistency requirements among the finite-dimensional collections of the elements of a regularly-varying time series. We define the tail pairwise dependence function (TPDF) to quantify the extremal dependence between two elements of the regularly-varying time series, and use the TPDF to define the concept of weak tail stationarity for regularly-varying time series. To develop our non-negative regularly-varying ARMA-like time series models, we use transformed-linear operations. We show existence and stationarity of these models and develop their properties, such as the model TPDF's. Motivated by investigating conditions conducive to the spread of wildfires, we fit models to hourly windspeed data and find that the fitted transformed-linear models produce better estimates of upper tail quantities than non-extreme linear models and also standard linear heavy-tailed time series models.

Keywords:
ARMA; Regular Variation; Fire Risk