Proceeding Series of the Brazilian Society of Computational and Applied Mathematics, v. 7, n. 1, 2020.

Trabalho apresentado no XXXIX CNMAC, Uberlândia - MG, 2019.

Proceeding Series of the Brazilian Society of Computational and Applied Mathematics

Forecasting Endogenous and Exogenous Time Series generated by P-model Algorithm using the Keras Machine Learning API

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1 Introduction

The kinetic energy dissipation in turbulent-like eddies cascading process can be modeled using the so-called P-model approach [3]. The P-model energy distribution of a multiplicative cascade is based on the special case of weighted probability transfer where $p = 0.5$ describes the homogeneous distribution. The p-model algorithm procedure given by Davis et al. [1] can produce stochastic time series from only three input parameters: (i) the size of the series, N, (ii) the spectral index based on the autocorrelation function of the signal (β) and (iii) the multifractality factor, p, that together with beta can define if the nonhomogeneous stochastic fluctuation is endogenous (strongly auto correlated) or exogenous (weakly auto correlated). In this work, we apply machine-learning techniques to test predictions of extreme events (endogenous and exogenous) simulated from the P-model. Keras API [2] was used in conjunction with the TensorFlow API in Python to obtain a methodology that uses machine learning with deep neural networks [4]. Preliminary results have shown precise criteria for classification and forecasting of endogenous versus exogenous extreme events patterns. The forecast performance will be analyzed based on the power spectrum density values of endogenous and exogenous model time series. This result will be reported later.

Keywords. P-model Algorithm, Multiplicative Information Cascade, Machine Learning, Social Sciences.

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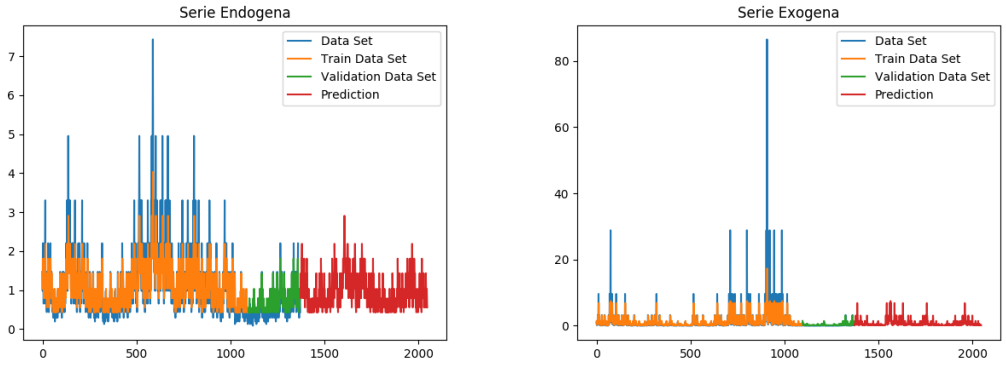
2 Preliminary Results

Figure 1 shown the preliminaries results on the Keras prediction for the exogenous and endogenous time series with 2048 points generated with P-model algorithm for nonhomogeneous multiplicative cascades.



(a) Endogenous Time Series

(b) Enxogenous Time Series

Figure 1: Predictions Endogenous and Exogenous Time Series.

References

[1] A. Davis, A. Marshak, R. Cahalan and W., Wiscombe, *The Landsat scale break in stratocumulus as a three-dimensional radiative transfer effect: Implications for cloud remote sensing.* Journal of Atmospheric Science, 54(2),241-260,1997,(to appear).

[2] A. Gulli and S. Pal, *Deep Learning with Keras: Implemennting deep learning models and neural networks with the power of Python.* Packt Publishing, 320 pages, 2017, ISBN: 978-1787128422.

[3] C. Meneveau and K. R. Sreenivasan, *Simple Multifractal Cascade Model for Fully Developed Turbulence.* Phys. Review Lett., 59(13), 1424-1427, 1987, DOI: 10.1103/PhysRevLett.59.1424.

[4] P. Norvig and S. Russell, *Artificial Intelligence: A Modern Approach. 3a Edição.* Pearson, 1152 pages, 2016, ISBN: 9781292153964.

[5] R. R. Rosa, J. Neelakshi, G. A. L. L. Pinheiro, P. H. Barchi and H. Shiguemori; Modeling social and geopolitical disasters as extreme events: a case study considering the complex dynamics of international armed; conflicts. *Towards Mathematics, Computers and Environment: A Disasters Perspective*, Capítulo 12; 2019.