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MASTER’S IN INDUSTRIAL ENGINEERING AND SMART INDUSTRY

##### MASTER THESIS

FORECASTING ELECTRICITY PRICES WITH NEURAL ODE

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Introduction

EPF

The goal of forecasting is to provide smaller and smaller gaps between predictions and actual values.

The disruptive introduction of renewable energies in the energy mix equation has made electricity price forecasting (EPF) more difficult to predict than ever. In the last years we have seen a more volatile price related to several spikes that has presented at certain times, a negative value.

With more accurate predictions, the utility companies, which are very dependent on the electricity price, can obtain an optimal production schedule.

In the last decade, there have been major advancements in this field. The methods that have been discussed range from Machine Learning Methods to sophisticated hybrid or multi-stage solutions

However, it is still unclear how relevant the comparisons are between them as each model uses different datasets, is implemented on a different software, and works with different error measures. Various studies have hardly provided any indications as to how to reproduce it.

State of the art

Over the years, may models have been created to tackle the EPF problem.

One of the approaches is the classical approach.

DNN

Motivation

We introduce a new family of deep neural network models. Instead of specifying a discrete sequence of hidden layers, we parameterize the derivative of the hidden state using a neural network. The output of the network is computed using a black-box differential equation solver. These continuous-depth models have constant memory cost, adapt their evaluation strategy to each input, and can explicitly trade numerical precision for speed. We demonstrate these properties in continuous-depth residual networks and continuous-time latent variable models. We also construct continuous normalizing flows, a generative model that can train by maximum likelihood, without partitioning or ordering the data dimensions. For training, we show how to scalably backpropagate through any ODE solver, without access to its internal operations. This allows end-to-end training of ODEs within larger models.

Very recently, a new family of deep neural network models has been introduced.

(Paper del ODE)

Objectives of the project

The goal of this project is to apply a neural ODE to forecast the time-evolution of the electricity price in Spain. The Spanish electricity day-ahead market will be used

as a case study. The results coming from the neural ODE in Python will be compared to existing models such as ARIMA and its extensions or recurrent neural networks.

Alignment with the SDGs

This project is aligned with the seventh SDG: Ensuring access to affordable, reliable, sustainable, and modern energy for all.

En un mundo cada vez más comprometido con el medio ambiente, resulta clave crear modelos que predigan mejor los recursos para ayudar en la toma de decisiones del mix energético.

Earth Overshoot Day marks the date when humanity has used all the biological resources that Earth regenerates during the entire year. This year 2022 it landed on the 28th July, meaning the resources are being demanded almost twice as fast as they should to be sustainable.

The first target of SDG7 is “to ensure universal access to affordable, reliable and modern services by 2030”.

The second target of SDG7 is “to increase substantially the share of renewable energy in the global energy mix by 2030”.

Through a better prediction of the electricity price,

Work methodology

Resources to be used

To develop this thesis, the used programming language will be Python.