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1 Introduction

Within the subject of Artificial Intelligence Techniques in Forecasting and Optimization in Business Systems, we were proposed a project aimed at using forecasting and optimization techniques in a real mind problem, in this case the distribution of drinks in a company.

Throughout this document we will first analyze the beverage sales data, then we will apply forecasting techniques to predict the number of sales of each beverage, this forecast will be divided by a univariate forecast and a multivariate forecast, for both will be used the knowledge and practices acquired in class to predict successfully. Finally, we have Optimization, which consists of finding the best values in order to maximize the sales value of each drink.

2 Project Execution

This section of the document is to describe the work done by each of the elements in the group. Each description will include each of the tasks completed by each group, the effort done for this work and the time spent doing this project.

2.1 Work Done By Dong Xuyong

For this project the tasks made by this member where:

- Extract business objectives into features;
- Model prediction with LSTM;
- Reading the article “Understanding LSTM”;
- Run all rminer ML models;
- Parameter tuning for bud and stella;
- Pipeline for all model types;
- Analyze and run all models with all metrics for univariate variables, with different timelag combinations;
- Growing and Rowling window;
- Multivariate with VAR model and Arima with exogenous variables (precipitation and temperature);
- Weakly Naive probability implementation and experience;
- Fix the Weekly Naive template;
- Implement the GW with neural networks with multivariate series and 2 outputs and model tuning in Python;
- Analyze the optimization method.

This member of the group spent around 68 hours in this project;

2.2 Work Done By Pedro Silva

For this project the tasks made by this member where:

- Extract business objectives into features;
- Analysis of the exponential smoothing algorithm;
- Research in GW and RW methods;
- Search R tools;
- Formulate the validation function;
- See validation algorithms;
- Think of a strategy on how to implement this same;
- Implementation of the optimization method;
- Interface implementation.

This member of the group spent around 65 hours in this project;

2.3 Work Done By Tiago Martins

For this project the tasks made by this member where:

- Extract business objectives into features;
- Analysis of Forecasting with Holt-Winters;
- Research in GW and RW methods;
- Final document development;
- See validation algorithms;
- Implementation of the optimization method;
- Interface implementation.

This member of the group spent around 60 hours in this project;

2.4 The Work Methodology and Auto-Evaluation

For this work, we used a work methodology where, during the various meetings we held, we usually divided them into 3 parts. The first part consisted of analyzing the results of each of the team members, in case there were tasks to be done for that meeting. The second part of the meeting consists of analyzing what needs to be done in general for the next delivery, in that same time we visualized and aligned all the tasks to be done for the next presentation. Finally, the third and final part of the meeting consisted of dividing these tasks previously defined by each of the elements of the group.

We usually have at least 2 meetings in the space from one class to another, but there were situations where more than one meeting was necessary in that space of time, mainly due to doubts in the execution of the tasks, in these situations we normally gathered everyone by video call and resolved let's get to the problem.

For the Auto-Evaluation our group thinks this the grade that each element of the group deserves:

DONG	PEDRO	TIAGO
16	16	16

Figure 1: Group Auto-Evaluation

3 Dataset Description

For this project, we were provided with an excel file called "bebidas.xlsx", within which are the daily sales records of each of the two beverages made available by the company in question, within that excel file there are still other relevant data, which will be detailed afterwards.

In the following image we have a print of the columns of the dataset mentioned above:

	A	B	C	D	E	F	G
1	DATA	DIA_SEMANA	PRECIPITACION	TEMP_MAX	STELLA	BUD	
2	01/02/2019	4	6,8	30,1	53	71	
3	01/03/2019	5	0	32,9	106	235	
4	01/04/2019	6	14,2	31,8	218	42	
5	01/05/2019	7	3	27,7	180	110	
6	01/06/2019	1	0,6	29	69	15	
7	01/07/2019	2	0	31,6	18	8	
8	01/08/2019	3	0	33,2	61	10	
9	01/09/2019	4	0	31,1	38	6	
10	01/10/2019	5	0	33,2	545	26	

Figure 2: Project Dataset

The following dataset is composed of 6 columns, they being:

- DATA: This column represents the date the records are from;
- DIA_SEMANA: This column represents the day of the week, where 1 is Sunday, 2 is Monday, 3 is Tuesday, 4 is Wednesday, 5 is Thursday, 6 is Friday and 7 is Saturday;
- PRECIPITACION: This column represents the total of precipitation in mm in that day;
- TEMP_MAX: This column represents the daily maximum temperature in Celsius from that day;
- STELLA: This column represents the number of STELLA drinks that were sold in that day;
- BUD: This column represents the number of BUD drinks that were sold in that day.

These two diagrams represent the sales of each of the drinks provided in the dataset:

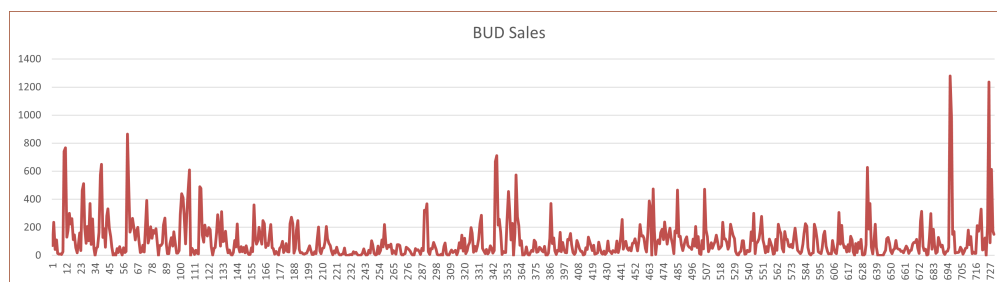


Figure 3: BUD Sales

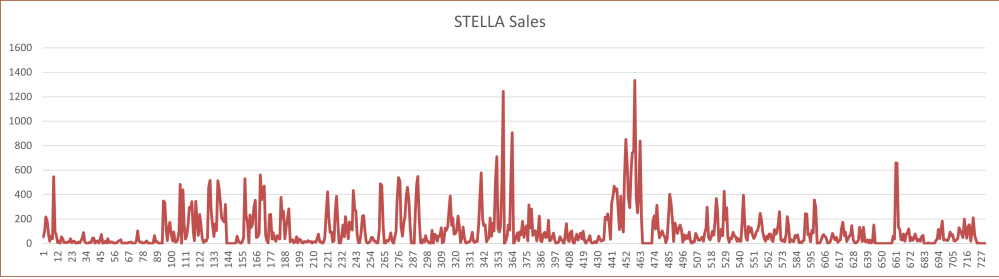


Figure 4: STELLA Sales

4 Prediction Objective

SPLIT

previsao univariado: -rminer -forecast -RW -GW

previsao multivariada (feita em Python, os resultados foram melhores)

5 Optimization Objective

6 Development System Demonstration

Where is the link for the video of the demonstration: "link do youtube".

7 Conclusions