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Food demand management model

Developed by the City of Porto

Short Introduction

In the City of Porto, the social economy sector and the tourism sector are major producers of avoidable food waste. To provide them with better tools to reduce food waste, this model has been developed to predict food waste in the social economy and tourism sectors. The model is based on historical data on food served and provides information on expected food demand depending on a set of explanatory variables, namely the menu offered, day of the week, and others. The use of the tool will help stakeholders in these sectors in the daily management of food demand and supply fluctuations. With this information, procurers are able to adjust procedures to the needs of the market based on the forecast provided.

Target groups
- Local Governments (Catering)
- Social Economy Sector
- Tourism Sector

Keywords
- #Data Analysis
- #Predictive models
- #Decision Making
- #Reduce
- #Recycle

Format
- Pseudocode and software

Current status
- In development

Deployment

How will you be using this tool in your city – both in the demonstration actions and beyond?
The tool under development is expected to be used by city stakeholders (Hotel and IPSS pilots) selected for the demonstration actions. For each of the entities selected, the models developed will be tuned to the available data.
After the demonstration period, the pseudocode used to support the models will also be provided to any entity interested in implementing the models, as well as an application software. This application aims at being flexible and adaptable to different realities.

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Replication

- *How could other cities use this tool?*

The pseudocode and application software will be available to any city/stakeholder interested in adopting this forecasting tool. The application's flexibility will allow any stakeholder to generate their forecasts given a set of explanatory variables.

- *Would they need to develop their own version, which aspects of the tool are adaptable to other contexts, and which ones are unique to your city/context?*

The tool can be transposed to any context. However, for it to be used, it is necessary to gather and structure the historical information that is input to the model. The model developed data-driven, and consequently it implies first the definition of the explanatory variables of demand, as well as their collection. Having done this collection and corresponding data structuring and preprocessing, the tool may be used.

- *Which advice would you share with others who would make use of this tool?*

For those interested in using the tool, the most relevant aspect is to store demand historical data, as well as data regarding the characteristics of the menus used in each unit.
Another issue has to do with people's acceptance of the models. To promote this, I believe that sharing the project results in other cities/units may be very relevant.

Development

- *How was the tool developed?*

Statistical techniques enable developing a descriptive analysis of the data and identifying relationships between the variables considered. Machine learning techniques such as neural networks, support vector machines, and regression trees support the prediction models' construction. The prediction performance of the models introduced will be compared with the performance of classical forecasting models based on univariate time series and with the estimated demand based on managers' judgment. Machine learning techniques will also support determining each variable's importance in estimating each menu item's demand.

- *Which data sources were used for this?*

The data sources used to develop this tool are those provided by the food services, namely historical data on the number of menus served. The information on the menus offered is also used in this project. Besides these, we use some external data, such as data on the weather. The number of students with classes each day is also used in the case of university canteens and this data is provided by the academic institutions.

- *Which stakeholders were involved?*

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Until this moment, three food services companies operating in university canteens were involved. We also involved a hospitality school. We'll also involve restaurants and hotels, however due to COVID-19, it wasn't still possible involve them and get information from this kind of establishment.

Barriers:

- *Which difficulties occurred in the development of the tool?*
  - Difficulty in find food services available to collaborate, given the actual pandemic context;
  - Some food services do not have detailed historical data for at least 3 years;
  - Most companies do not store information regarding the quantity of food lost.

- *How did you solve this issues, which solutions did you find?*
  - We have tried to enlarge the network of stakeholders with potential interest in the tool;
  - We have developed a simple version of the model that is not that demand in what regards historical data;
  - We have defined a naïve approach that aims at simulating the potential demand estimated by the food service and, from this, we infer the quantity of food waste.

- *Which difficulties to you expect/have you encountered in using this tool?*
  - The results are so impressive in what regards the potential prevention of food waste that some stakeholders may be tempted to distrust the solution.

Additional Information

For example:
- *Contact points*
- *Next steps*
  - To find a hotel and a restaurant to support the development of a tool dedicated to these sectors
- *References*
  - *Muriana, C. (2017) A focus on the state of the art of food waste/losses issue and suggestions for future researches. Waste management, 68:557-570*
  - *Ciccullo, F., Cagliano, R., Bartezzaghi, G., Perego, A. (2021) Implementing the circular economy paradigm in the agri-food supply chain: The role of food waste prevention technologies. Resources, Conservation and Recycling, 164: 105-114.*