AI2S
Artificial Intelligence Student Society

CYBERTEC
ZUCCHETTI

HACKATHON 2025

AI2S, Cybertec, Ecosistema della Formazione

MULTI-FACILITY PRODUCTION WITH GLOBAL MARKET

Introduction

The context of this competition relates to a manufacturing company with multiple production facilities in different countries that sells to customers worldwide.

Production planning and forecasting are very complex tasks, especially in a globalized environment. Manufacturing companies with multiple facilities and international markets must balance production and demand considering:

- Local demand
- Transportation costs
- Customs tariffs
- Exchange rate fluctuations
- Efficient Supply Chain management

1 Problems

1.1 Exercise 1: Market Demand Forecasting

Objective: Calculate demand forecasts for each market using available historical data.

Input:

- 01_input_history.csv: Historical demand data with columns Country—Product—Month—Quantity

Required Output:

- 01_output_prediction_CODE.csv: Demand forecasts for each market and product for the next 12 months (the same format as the input is required).

Evaluation: The quality of forecasts will be calculated using the following metric

$$\text{Loss}(Y^{\text{pred}}, Y^{\text{true}}) = \frac{1}{N}\sum_{i=1}^{N} L_i \tag{1}$$

where L_i is defined as:

$$L_i = \begin{cases} \frac{(y_i^{\text{pred}} - y_i^{\text{true}})^2}{y_i^{\text{true}}}, & \text{if } y_i^{\text{true}} \neq 0 \\ \frac{(y_i^{\text{pred}} - y_i^{\text{true}})^2}{1 + y_i^{\text{true}}}, & \text{if } y_i^{\text{true}} = 0 \end{cases} \tag{2}$$

the predicted quantities must be positive integers, the forecast must be made for all Country-Product-Month triples, it is important to respect the format found in Month.

```
python score.py prediction <groundTruthFilePath> <solutionFilePath>
```

1.2 Exercise 2: Production Balance Between Facilities

Objective: Determine the amount of production to allocate to each facility while respecting production capacities and satisfying market demand.

Important Note

Market demand must be satisfied in the same month, transfers occur in the same month, and it is not possible to accumulate products for subsequent months.

Important Note

This problem might be simpler than it seems!

Input:

- 02_input_target.csv: Market demand (Country—Product—Month—Quantity)
- 02_input_capacity.csv: Production capacity of individual facilities (Country—Monthly Capacity)

Required Output:

- 02_output_productionPlan_CODE.csv: Production plan (Country—Product—Month—Quantity)
- 02_output_shipments_CODE.csv: Product transfers (Origin—Destination—Product—Month—Quantity)

Evaluation: Quality of balance, calculated using the same metric as in point 1 between product availability and market demand.

```
python score.py balance <DemandFilePath> <capacityFilePath> <productionPlanFilePath>
<shipmentsFilePath>
```

1.3 Exercise 3: Optimization of Production and Transfer Costs

Objective: Same as the previous exercise with cost optimization: moving products involves a cost, which must be considered during the optimization process.

Input: Same as Exercise 2, plus:

- 02_03_input_shipmentsCost.csv: Transfer costs (Origin—Destination—Unit Cost)
- 03_input_productionCost.csv: Production costs (Country—Product—Unit Cost)

Required Output: The format is the same as Exercise 2, the files will be

- 03_output_productionPlan_CODE.csv: Production plan (Country—Product—Month—Quantity)
- 03_output_shipments_CODE.csv: Product transfers (Origin—Destination—Product—Month—Quantity)

Evaluation: Quality of balance (RMSSE close to 0), cost optimization (lower total costs) and execution time.

```
python score.py cost <DemandFilePath> <capacityFilePath> <productionCostFilePath>
<shipmentsCostFilePath> <productionPlanFilePath> <shipmentsFilePath>
```

Important Note

Make sure you have solved Exercise 2! The quality of balance weighs much more than cost optimization.

2 Scoring System

For each exercise, a ranking will be established with the following scores:

- 1st place: 9 points
- 2nd place: 8 points
- 3rd place: 7 points
- 4th place: 6 points
- 5th place: 5 points
- 6th place: 4 points
- 7th place: 3 points
- 8th place: 2 points
- 9th place: 2 points

The final score will be the sum of the points obtained in the three exercises. If two scores are equal, the same position will be assigned to the teams! (example: 2 teams in 4th position will both receive 6 points).

Tiebreaker: In case of a tie, the number of first places achieved will be considered. If the tie persists, the ranking in Exercise 3 will be decisive.

3 Intermediate Deliveries

During the day, there will be moments when teams can submit intermediate outputs. This will allow for viewing provisional rankings and following the progress of the competition. The first partial score will be Saturday at 19:00, the second will be Sunday at 9:00, and the last will be at the end of the competition.

4 Final Presentation

In addition to the technical solution, each team must prepare a brief presentation of their solution, which will be evaluated by the judges. The presentation should include:

- Description of the reasoning followed
- Strategies and algorithms used
- Challenges encountered and solutions adopted
- Methods of collaboration and division of work within the team
- Results obtained and their interpretation

The quality of the presentation will influence the overall evaluation of the team.

5 Final Submission

Each team must submit to the email yuripaglierani@gmail.com, indicating in the subject the name of the team and in the body of the email a brief description of the content:

1. The output files required for each exercise
2. The source code used
3. A presentation in digital format
4. Any supporting documents

6 Team ID

Your identification code is

This code must be used for all submissions and should not be communicated outside your team. It should be included in the file names and replaced with ”CODE”.

Good luck!