

# 119<sup>th</sup> ESGI

## EUROPEAN STUDY GROUPS WITH INDUSTRY IN PORTUGAL

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Politécnico do Porto (ESTGF & ESEIG)

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# PT MATHS IN

rede portuguesa de matemática para a indústria e inovação

## working groups

### CHALLENGE 1

#### Time Reduction of the Packaging Process

industry\_ **Savana**  
sector\_ **Footwear**



Savana is a company in the footwear sector which has more than 27 years old and has more than 150 employees. This company specializes in children's footwear and sells shoes from size 18 to 40. Each pair of shoes is individually packed in a cardboard box customized for each client. The ideal size of each box size depends on the shoe model and the position in which is placed within the box. These boxes are ordered from an external supplier that has only a few available measures, so it will have to use the same size boxes for various sizes and models. Savana challenges ESGI's participants to study their packaging process, in order to reduce the variety of box sizes, the empty waste of space inside the boxes and to eliminate the need to perform testing, thereby reducing the time and increasing the efficiency of the packaging process.

Furthermore, the orders of each customer are packed in larger cardboard box. Within one of these big boxes various designs and sizes to be delivered to a single client can be included. In this context, Savana intends to determine automatically the size of the big boxes to send to each customer and how to dispose the individual boxes for each client's order.

### CHALLENGE 2

#### Revenue Management Pricing in Douro Hotels

industry\_ **Douro Palace / Douro Royal Valley**  
sector\_ **Hospitality and Tourism**



The volume of data available in most hotel and tourism units allows, through the application of various Statistical techniques, for example, to identify patterns of guests that did not repeat stays; booking cancellations; bookings in advance; expenditure patterns of "loyal" customers; consumption of food and beverages due to the segmentation of the guests. In addition, it is also possible to identify the relationship between revenues and costs versus occupation / guest segmentation; to make forecasts of demand / occupancy and revenue of other departments depending on guest's segmentation. The company intends to find an algorithm that generates the ideal price to practice for a given date, based on the Hotel records of previous years and in the occupation and prices of the competition. Reservations already confirmed for future dates, the existence of events in the guests town or in the hotel area, bank holidays, popularity ratings on hotel search engines, among others, may also be considered. Ideally, the algorithm should react whenever significant changes occur in the competition prices. The final goal is to move towards price management automation in these Hotel units.

### CHALLENGE 3

#### Pattern simulation

industry\_ **EDP**  
sector\_ **Energy**



EDP – Energias de Portugal, with nearly 14 000 MW (2012 update and excluding wind power) of installed capacity in the MIBEL (Iberian Electricity Market), is the only company in the Iberian Peninsula with generation, distribution and supply (both electricity and gas) activities in Portugal and Spain.

We are interested in simulating electricity prices not only for risk measures purposes but also for scenario analysis in terms of pricing and strategy. The daily market electricity prices  $Y_t = [y_{1t}, y_{2t}, \dots, y_{nt}]$ ,  $t=1, 2, \dots$  is a strip of prices (one for each hour of the day), that can be interpreted as a multivariate normal random variable with an inner variance-covariance matrix (constant in time) and with an autoregressive structure for time dependence. Although simulating multivariate normal distributions is a straightforward exercise we need to simulate it subject to restrictions on the sum of  $Y_t$ .

### CHALLENGE 4

#### Improving the grape reception process – Harvest

industry\_ **Aveleda**  
sector\_ **Wine**



Preserving until today its family-oriented, Aveleda is a world leader in the production of "vinho verde", annually exporting more than half of its production to over 70 countries worldwide. In all harvest periods and especially at certain hours of the day, Aveleda faces extensive waiting lines of its suppliers for discharging the grapes. Most worrying is the fact that the processing capacity of wine house is far from its maximum processing capacity, since the grape flow is not regular throughout the day.

There are many aspects to consider when trying to minimize the waiting queues and manage the unused capacity of the wine house in less "crowded" hours. The aim is to mathematically model this problem and point improvements of the existing process.

### CHALLENGE 5

#### Optimization of Production Planning

industry\_ **PRIMAVERA BSS**  
sector\_ **Manufacturing Software**



For nearly 10 years, PRIMAVERA BSS has had in its product portfolio a standard industrial production management solution for which covered key features across various industries. It is a very competitive solution in regards to logistics, product engineering, budgeting, MRP and MES. However, although it offers a good user experience and it is an agile tool in a graphical environment, it is also somewhat limited in the manufacturing planning aspect, both in terms of the optimization criteria and in setting production priorities.

Given a set of jobs, operation times and costs, delivery dates, available resources, work centers, time schedules and calendars, the objective is create the algorithms and heuristic data that can provide the best response to a combination of optimization criteria, such as minimizing the lateness in deliveries, the makespan, and the setup times, or maximizing the load level of the work centers, and the throughput rate, also by considering one or more sorting rules (earliest due dates, shortest processing times, ...).

PRIMAVERA BSS wants to find an effective scheduling algorithm that can add new features to their software, with a good performance (being able to run in less than 10 minutes), and that can be sufficiently generic and adaptable to be used by different industries (metal, furniture, wood, textile, and food industry).

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