ESSEC-CentraleSupélec DSBA master

MasterClass **Case study "Decision analytics for sustainable development" 15/3/2021**
Prof. L. Alfandari

A firm is blamed for the atmospheric pollution generated by its production process, in a context of growing societal concern on climate change. In what follows we consider only 2 products and 3 pollutants. The current situation is summarized in the following table:

	Emissions induced by the production of 1 ton of Product 1	Emissions induced by the production of 1 ton of Product 2
NO2 (m3)	24	36
SO2 (m3)	8	12
Particles (kg)	100	50

The unitary profit associated with the production and sale of one ton of product 1 (resp. 2) is equal to 1200 K€ (resp. 1500 K€). There is no problem for selling whatever quantity of products. It takes 5 (resp. 6,5) hours to produce one ton of product 1 (resp. 2), and the factory capacity is 130 hours per week. The firm has to adapt to new pollution standards, requiring not to reject more than 550 m^3 of NO2, 180 m^3 of SO2 and 1250 kg of particles in the air.

Two antipollution systems, which can be combined, enable to decrease emissions. For every ton of product produced, one can either not treat its emissions, or treat them with one of the two systems, or both. The two antipollution systems have the following characteristics:

	System 1	System 2	Systems 1+2
NO2 (m3)	12	3	14
SO2 (m3)	0	45	44
Particles (kg)	54	2	54
Slowing down factor	1,1	1,05	1,35
Cost/ton	100	150	350

Therefore, producing one ton of product 1 or 2 using system 2 enables to reject only (1 – 45%) = 55% of the SO2 quantity that would have been rejected without any system. Producing one ton of product 1 or 2 using system 2 generates extra costs of 150 K€. Production of product 1 or 2 with system 2 slows down the production process and makes the production time equal to 1,05 times the production time without any system.

Formulate the problem as a (linear) optimization program for making the best decision (prescriptive analytics).