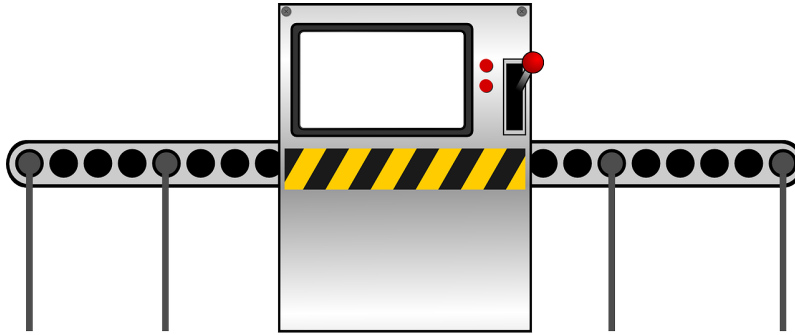


Exercise - Robust optimization

19-03-2019

Production planning



You work for a production company and support them with optimizing their capacity and production schedule for a new factory.

The company has $p \in P$ different products that are produced on different machine types $m \in M$. Not each product can be produced on each machine, i.e., parameter $a_{p,m} = 1$, if product p can be produced on machine type m and $a_{p,m} = 0$ otherwise. As you are opening a new factory, you also have to decide how many machines of type m you want to buy. The price is c_m^M for one machine of type $m \in M$. Each machine of type $m \in M$ provides T_m hours of production.

The production costs are c_p^P for each $p \in P$. The targeted production quantities d_p for each product $p \in P$ for the next year are given. Because we consider the entire year, we approximate the production quantities as continuous values.

The production time of product $p \in P$ on machine type $m \in M$ is uncertain. You know that the expected production time is $\bar{t}_{p,m}$ and the deviation (positive and negative) can be up to $t_{p,m}$. From experience from other factories, we can conclude that for each machine type $m \in M$ not more than 30% of the products that can be produced on machine type m will have a deviation from the expected production time.

Task

Formulate a robust optimization model that decides the number of machines and production quantities for each product and machine to have minimal cost and cover the demand in all cases of production time deviation. Use a budget of uncertainty.

Hint: Start with writing down the deterministic model with $\tilde{t}_{p,m}$ as placeholder for the uncertain parameter, before introducing the budget of uncertainty.

Solve your robust model with GAMS using the file `robust_model.gms` which already has some data input. Compare the solution to the following cases:

- no deviation from the expected production time is included in the model ($\Gamma_m = 0$)
- full deviation from the expected production time is included in the model (all products on that machine type can deviate at the same time)