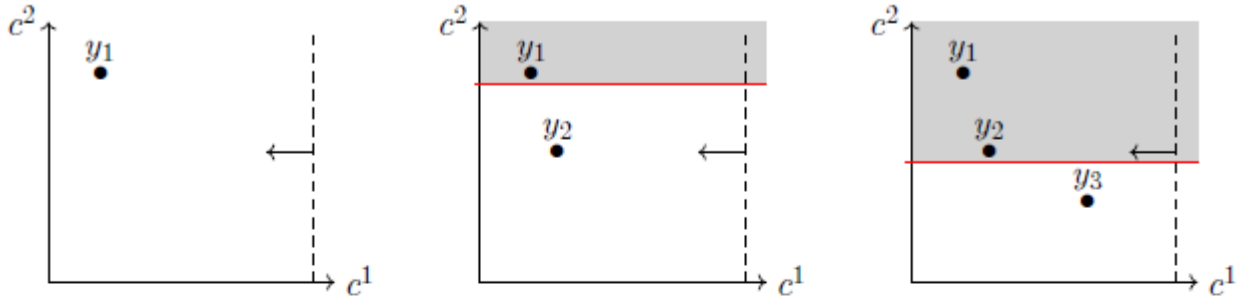
MOO method

Simple limit (ex of FINE)

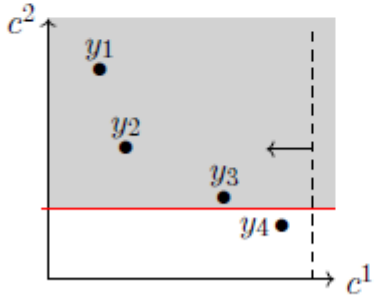
- Only one objective function
- Second one defined as a variable
- Constraint on the varaible
- Declining at every step



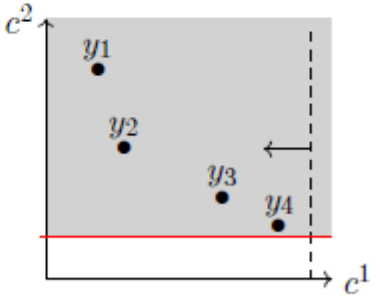
(a) Initialisation : recherche du point c^1-extrême y_1.

(b) Itération 1 : ajout de la contrainte ε et obtention de y_2.

(c) Itération 2 : modification de la contrainte ε et obtention de y_3.



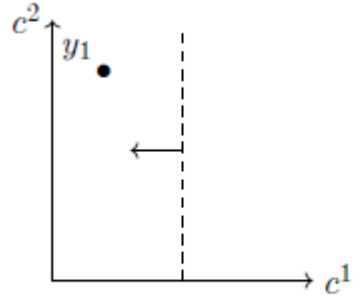
(d) Itération 3 : modification de la contrainte ε et obtention de y_4.



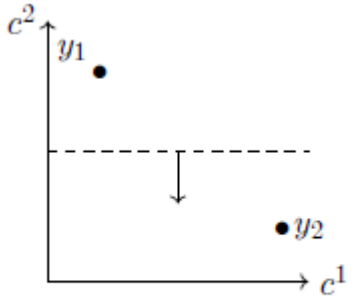
(e) Itération 4 : Pas de nouveau point obtenu avec modification de la contrainte ε.

Sigma-constraint (ex of code from scratch)

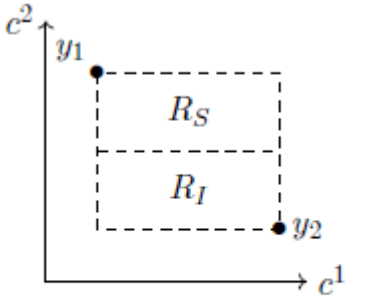
- Definition of functions A and B
- Deactivation of function A, activation of function B
- **Optimization**: max of function A registered
- Activation of function A, deactivation of function B
- **Optimization**: min of function A registered
- Deactivation of function A, activation of function B
- **Optimization** with constraint of function A between min and max
- Plot of the Pareto front



(a) Initialisation : recherche du point c^1-extrême y_1.



(b) Initialisation : recherche du point c^2-extrême y_2.



(c) Itération 1 : division de la région de recherche définie par y_1 et y_2.

Sigma-constraint: different options

- while loop
  - while the minimum value that we know has not been reached

- Official sigma-constraint method
  - Calculate a fixed number of value that will be used as constraints
  - $\boldsymbol{step} = \frac{\boldsymbol{Max} - \boldsymbol{Min}}{\boldsymbol{\alpha}}$ then go through $\boldsymbol{list}\left(\boldsymbol{range}(\boldsymbol{Min}, \boldsymbol{Max}, \boldsymbol{step})\right) + \boldsymbol{Max}$
  - Conventionnal method: simple ≤ sign
  - Augmented method:
    - $Objectivef = costs + \delta * s$ to minimize
    - $emissions - s = e$ new constraint

  - (difference is relevant for GLPK, not for gurobi)

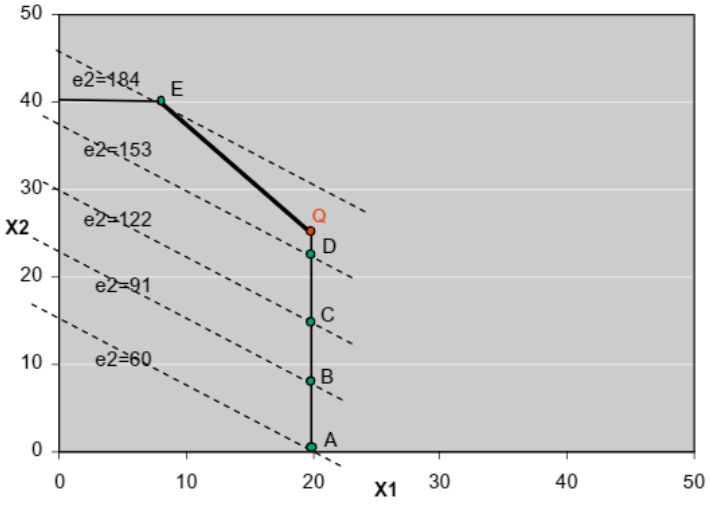


Fig. 2. Results of the conventional ε-constraint method.

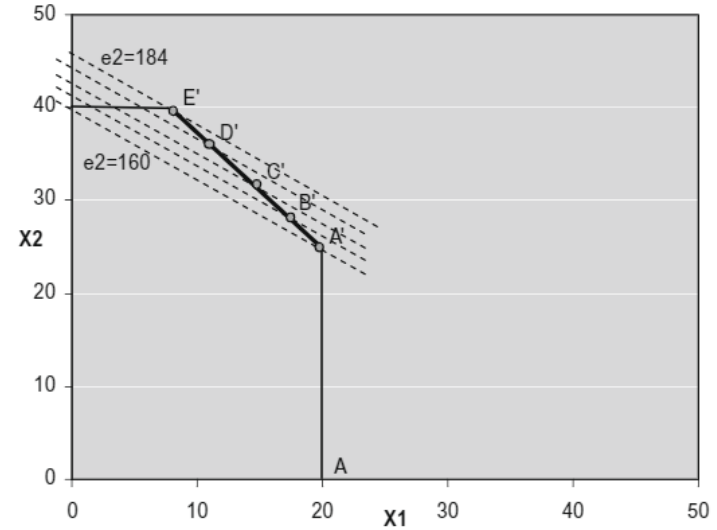
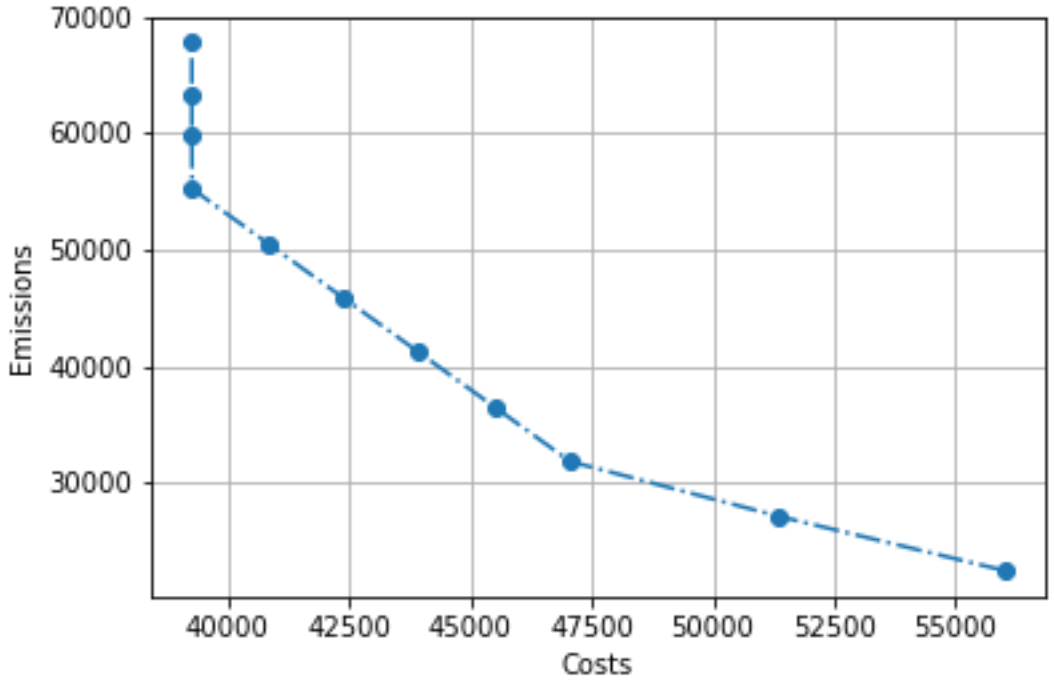


Fig. 3. Results of the ε-constraint method from model using lex-optimization in the payoff table.

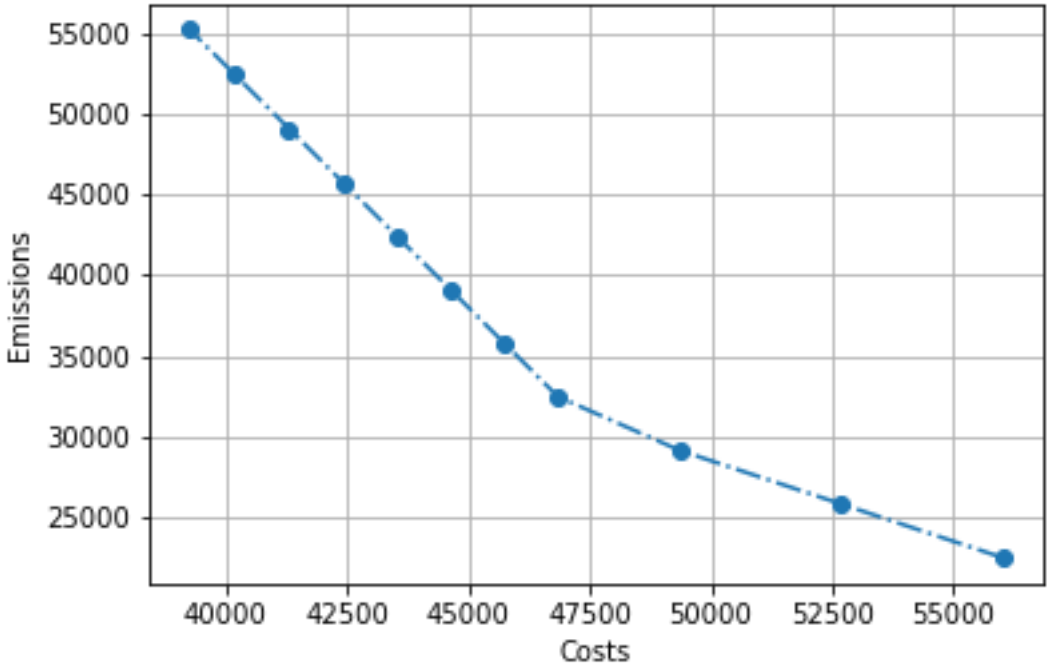
Augmented method of sigma-constraint

Conventionnal method with GLPK :



Augmented method with GLPK,

Both methods with Gurobi :



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- Méthodes exactes pour les problèmes combinatoires bi-objectif : Application sur les problèmes de tournées de véhicules - TEL - Thèses en ligne (archives-ouvertes.fr)