

IF4-ALG2 - TD d'optimisation

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13 avril 2018

1 Investmements

Consider the private investment company BHW. This company is considering four potential investments, with associated costs and expected gains expressed in this matrix :

	Investment cost	Estimated gain
1	€5 000	€16 000
2	€7 000	€22 000
3	€4 000	€12 000
4	€3 000	€8 000

BHW can invest €14 000. Each investment can only be done once. We want to maximize returns.

1. Formulate the problem as a binary linear programming problem.
2. Solve with branch and bound *by hand*
3. Verify your solution with Excel or Open-Office.

2 Couple

A young couple, Alice et Benoît, constantly argue with respect to domestic chores (and they don't even have children yet!). In order to solve the problem, as good mathematicians, they try to find the most equitable way to share the chores. After a lot of research, they draw the following tableau :

	Groceries	Cooking	Dishwashing	Laundry
Alice	4.5h	7.8	3.6	2.9
Benoît	4.9h	7.2	4.3	3.1

They decide to each only take care of two tasks, which cannot be shared. In order to both minimize their working hours.

1. Formulate this problem as an IP.
2. Solve the LP relaxation
3. Solve the IP with Excel / OpenOffice
4. What if they had decided that they should have the most *equitable* workload irrespective of efficiency, how would you formulate the problem?

3 Processors

A processor manufacturer wants to reinvent their product line. To help with their product line decision, the following tableau is given :

	Product 1	Product 2	Product 3	Product 4
Starting costs	€50 000	€40 000	€70 000	€60 000
Revenue/unit	€70	€60	€90	€80

Denoting x_i is the production of i , we want to maximize the profit (i.e. revenues - costs), knowing that :

- At most two products can be fabricated.
- Product 3 or 4 require the production of one of product 1 or 2.
- There exist production limits, expressed thus :

$$\begin{aligned}
 5x_1 + 3x_2 + 6x_3 + 4x_4 &\leq 6000 && \text{or} \\
 4x_1 + 6x_2 + 3x_3 + 5x_4 &\leq 6000
 \end{aligned}$$

1. Model the problem as a mixed linear-integer program.

4 TSP

Consider the Travelling SalesPerson (note the politically correct denomination), with the following cost matrix :

	city 1	city 2	city 3	city 4	city 5
city 1	0	132	217	164	58
city 2	132	0	290	201	79
city 3	217	290	0	113	303
city 4	164	201	113	0	196
city 5	58	79	303	196	0

We would like to visit the 5 cities coming back to the starting point, and to minimize travel costs.

1. Propose a relaxation formulation of the problem as an assignment problem.
2. Solve the actual TSP by branch-and-bound *by hand* using Excel or OpenOffice to solve the assignment problem
3. *Optional* : Write a Matlab program to solve this TSP.