Tutorial AMPL

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Summary

LP – Example 3

AMPL Model:

- Consider a factory that produces N products (n) in a serial pipeline.
- For each product n, a profit p_n is made on each unit sold, there is a weekly demand d_n and a throughput of r_n units per hour.
- We wish to determine the weekly production x_n, for each product n, so as to maximize the total profit in sales, given that the factory has a total number of T hours per week.
- Model the problem in linear programming.

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LP – Example 3

Linear programming model:

$$\max \quad \sum_{n=1}^{N} p_n \cdot x_n$$

$$\text{s.t.}: \sum_{n=1}^{N} \frac{1}{r_n} \cdot x_n \leq T$$

$$0 \leq x_n \leq d_n, \; n = 1 \ldots N$$

LP – Example 3

- Complete the AMPL model **example3.mod** according with your mathematical programming model.

```
# Part 1 – Variable Declaration (var, set, param, etc)
param N;
param T;
set Products := {1..N};
set InfoType := {p,r,d};
param data {Products,InfoType};
```

- Create a file **example3.run**.
- Use the file **example3.dat**. To this end, just issue the command "**data example3.dat;**" after the command that includes the .mod file in **example3.run**.

LP – Example 3

example3.dat:

```
param N := 4; #Number of products
param T := 40; #Number of working hours per week
# Data Matrix
param data_base:
p  r   d   :=
1  1   40  1000
2  1.5 30  900
3  1   50  500
4  1.5 20  800
;
```

LP – Example 3

example3.mod:

```
# Part 1: Variable Declaration (var, set, param, etc)
param N;
param T;
set Products := {1..N};
set InfoType := {'p','r','d'};
param data_base{Produto,InfoType};
var x{Products} >= 0;
# Part 2: Objective Function
maximize Profit: sum{n in Products} data_base[n,'p']*x[n];
# Part 3: Constraints
subject to available_working_hours:
    sum{n in Products} (1/data_base[n,'r'])*x[n] <= T;
subject to demand{n in Products}: x[n] <= data_base[n,'d'];
```

LP – Example 3

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LP – Example 3

example3.run:

```
# Reset Memory
reset ;
# Load Memory
model example3.mod;
# Load Data
data exemple3.dat;
# Change Configurations (optional)
option solver cplex;
# Solve Problem
solve;
# Show Results
display x;
```

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Dual – Example 4

Obtain the dual model in linear programming for Example 3

$$\max \quad \sum_{n=1}^{N} p_n \cdot x_n$$

$$\text{s.t.}: \sum_{n=1}^{N} \frac{1}{r_n} \cdot x_n \leq T$$

$$0 \leq x_n \leq d_n, \; n = 1 \ldots N$$

Dual – Example 4

Dual of Example 3

$$\begin{aligned} \min \quad & T \cdot w + \sum_{n=1}^{N} d_n \cdot y_n \\ \text{s.t.}: \; & \frac{1}{r_n} \cdot w + y_n \geq p_n, \; n = 1 \ldots N \\ & w, \; y_n \geq 0 \end{aligned}$$

Create files example4.mod, example4.dat and example4.run
Hint: Copy the content of the file example3.dat to example4.dat.

Challenge 1

Minimum Cost Network Flow Problem

- a directed graph $G = (V, A)$ with a set of vertices (nodes) and a set of arcs;
- unit cost c_{ij} for transportation in arc (i, j);
- lower bound l_{ij} and upper bound u_{ij} for flow in arc (i, j); and
- Flow b_i that must be injected or consumed at node i:
  - if $b_i > 0$, then i is a supplier node;
  - if $b_i < 0$, then i is a consumer node; and
  - if $b_i = 0$, then i is a transshipment node.

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Challenge 1

Model in mathematical programming:

$$\text{Minimize} \quad \sum_{(i,j)\in A} c_{ij}x_{ij}$$

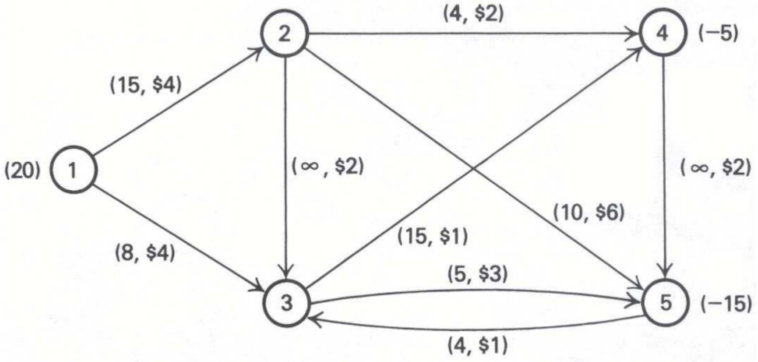
Subject to:

$$\sum_{\{j:(i,j)\in A\}} x_{ij} - \sum_{\{j:(j,i)\in A\}} x_{ji} = b_{ij}, \forall i \in V$$

$$l_{ij} \leq x_{ij} \leq u_{ij}, \forall (i,j) \in A$$

Challenge 1

Describe the following problem in AMPL. Create .dat, .mod and .run files.



Tutorial AMPL

- Thank you for attending this lecture!!!