UNIVERSITÀ DI PISA

PROJECT PLANNING
(LOGISTICS PROJECT)

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We are given a problem to formulate an ILP model to decide what projects to develop to maximize the return, subject to a few constraints.

Project summary:

(Amount in thousands)

Project Number	Estimated Project Return	Operators Requirement	Capital Requirement
1	\$650	7	\$250
2	\$550	6	\$175
3	\$600	9	\$300
4	\$450	5	\$150
5	\$375	6	\$145
6	\$525	4	\$160
7	\$750	8	\$325

So, as clear from the table above, we have 7 projects and the total budget for these projects is \$950,000.

Decision Variable:

$$X_i = \{0, 1\}$$

1 if project is selected, 0 otherwise

Objective Function:

$$MAXIMIZE\!: \ 650X_1 + 550X_2 + 600X_3 + 450X_4 + 375X_5 + 525X_6 + 750X_7$$

Constraints:

1. Available budget \$950,000.
$$250X_1 + 175X_2 + 300X_3 + 150X_4 + 145X_5 + 160X_6 + 325X_7 \le 950{,}000$$

2. Available operators 20.
$$7X_1 + 6X_2 + 9X_3 + 5X_4 + 6X_5 + 4X_6 + 8X_7 \le 20$$

3. Linked projects constraint (if both projects 2 and 6 are selected, then project 4 must be necessarily selected)
$$X_2 + X_6 - X_4 \le 1$$

4. The decision variables in this problem are binary variables that stand for whether or not to develop each project. They are denoted as X_1, X_2 ,X_3 ,X_4 ,X_5 ,X_6 ,X_7.
$$X_i \in \{0,1\}\ \forall i$$

Model Implementation:

We are implementing the proposed model by the AMPL language and solve it using the optimization solver CPLEX.

DATA:

```
data;
set projects := 1 2 3 4 5 6 7;
set Resources := operators capital;
param Availabilities :=
    operators 20
    capital 950000;
param Requirement: 1 2 3 4 5 6 7:=
    operators 7 6 9 5 6 4 8
    capital 250000 175000 300000 150000 145000 160000 325000;
param Profit:=
    1 650000
    2 550000
    3 600000
    4 450000
    5 375000
    6 525000
    7 750000
```

MODEL:

```
set Resources;
set projects;

param Availabilities {Resources};
param Requirement {Resources, projects};
param Profit{projects};

var Taking {projects} binary;


maximize Total_Profit: sum {j in projects} Profit[j] * Taking [j];

subject to ConstrAvail{i in Resources}:
    sum {j in projects} Requirement [i,j]*Taking[j] <=Availabilities[i];

subject to project: Taking[2] + Taking [6] - Taking [4]<=1;
```

RUN:

```
reset;
model Project_planning.mod;
data Project_planning.dat;
option solver cplex;
solve;
display Taking;
display Total_Profit;
#include Project_planning.run
```

SOLUTION:

```
ampl: include Project_planning.run
CPLEX 20.1.0.0: optimal integer solution; objective 1925000
5 MIP simplex iterations
0 branch-and-bound nodes
Taking [*] :=
1  1
2  0
3  0
4  0
5  0
6  1
7  1
;

Total_Profit = 1925000
```

RESULT:

After modelling the data through AMPL and solving it using the CPLEX solver we figured out that selecting Projects 1, 6 and 7 is the best solution of the problem.

The Total Profit is estimated to be $19,25,000