# Report 2 – Operations Research

Willian de Souza Soares – 2014.1.08.034

March 9, 2020

**Abstract**

A simple presentation of the solutions and thoughts about *Container's* problem, using *CPLEX* and *Java*.

## 1 Finding the optimal values

The majority of the instances were easy and fast to find it's optimal value. On the instances *00* and *01*, the optimal value were found both in Integer and Real models. In contrast, only the Real optimal value was found on the *02* instance.

### 1.1 The problem with *Instance 02*

One of the problems with the instance 02 it's the size. Whensoever the instances *00* and *01* has, respectively, 10 and 50 items, the instance *02* has 500 items, with mixed profit, weight and volume.

Although the size contribute to increase the complexity of the items, the major factor it's the $b$ value, which indicates the maximum number of times that same item can be put in a container. This increase the complexity by many magnitudes, slowing down the algorithm, specially on the Integer solution, which the *CPLEX solver* couldn't find the optimal solution in a reasonable time.

### 1.2 The solution

The simplest solution was taken: A time limit to find the optimal solution was set. An arbitrary value of 600 seconds (10 minutes) was set. Since the *gap* of the optimal solution was under 1%, it was an acceptable value, given the nature of the problem.

Table 1: Results for a Integer model

| Instance | Profit | Gap | Optimal | Time Limit |
|---|---|---|---|---|
| 00 | 42.92491516324943 | 0% | Yes | N/A |
| 01 | 91.3135124472273 | 0% | Yes | N/A |
| 02 | 508.26966170662337 | 0.61% | No | 600s |

Table 2: Results for a Real model

| Instance | Profit | Gap | Optimal | Time Limit |
|---|---|---|---|---|
| 00 | 49.571868896306285 | 0% | Yes | N/A |
| 01 | 95.89502739170803 | 0% | Yes | N/A |
| 02 | 511.45921634552246 | 0% | Yes | N/A |

# 2 Conclusions

The problem that once was rather hard to find a solution, now it's simple with the mathematical modeling of *CPLEX*. Given the circumstances, the difference between an sub-optimal value that is found in minutes is better than a optimal one.