CD2007 Semana 02 Soluciones de Casos

Juan Carlos Martinez Ovando

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Case 1

Set up a problem in R to maximize

$$x_1 + 9x_2 + x_3$$

subject to

$$\begin{aligned} x_1 + 2x_2 + 3x_3 &<= 9 \quad (1) \\ 3x_1 + 2x_2 + 2x_3 &<= 15. \quad (2) \end{aligned}$$

Solution

```
I.rule <- "max"
II.fobj <- c(1,9,1)
III.Acon <- matrix(c(1,2,3,3,2,2), nrow = 2, byrow = TRUE)
IV.dir <- c("<=","<=")
V.bound <- c(9,15)

library("lpSolve")
case1.sol <- lp(I.rule,
                II.fobj,
                III.Acon,
                IV.dir,
                V.bound)

case1.sol$objval
```

```
## [1] 40.5
```

```
case1.sol$solution
```

```
## [1] 0.0 4.5 0.0
```

Case 2

Part 1: Solution

We define the `decision variables` (label and order) as follows:

$$(q_1, q_2, q_3, q_4, s_1, s_2, s_3, s_4).$$

The matematical specification of this sitiation sondires:

- **Optimization rule.-** Since we are dealing with costs, we define the target of minimizing the aggregated costs, i.e.

$$\min$$

- **Objective function.-** This is defined as the aggregated costs over the four months, considering the balance between `production` and `stock`, i.e.:

$$\sum_{i=1}^{4} \left(12q_i + 2s_i\right).$$

- **Constraint functions.-** This is defined in two blocks, one for the side of `demand` and another for `working hours` required.
- on the `demand` side

$$\begin{aligned} q_1 - s_1 &= 100 && (3)\\ s_1 + q_2 - s_2 &= 200 && (4)\\ s_2 + q_3 - s_3 &= 150 && (5)\\ s_3 + q_4 - s_4 &= 400, && (6) \end{aligned}$$

since stock at month 0 is $s_0 = 0$; whereas

- on the `working hours` side

$$\begin{aligned} q_1 &<= 400 && (7)\\ q_2 &<= 400 && (8)\\ q_3 &<= 300 && (9)\\ q_4 &<= 300. && (10)\\ & && (11) \end{aligned}$$

Accordinly, the specification for the `lpSolve` inputs and solution of the `LP` problem are given by:

```
I.rule <- "min"
II.fobj <- c(12,12,12,12,2,2,2,2)
III.Acon <- matrix(c(1,0,0,0,-1,0,0,0,
                     0,1,0,0,1,-1,0,0,
                     0,0,1,0,0,1,-1,0,
                     0,0,0,1,0,0,1,-1,
                     1,0,0,0,0,0,0,0,
                     0,1,0,0,0,0,0,0,
```

```
                    0,0,1,0,0,0,0,0,
                    0,0,0,1,0,0,0,0),
                  nrow = 8,
                  byrow = TRUE)
IV.dir <- c("=","=","=","=","<=","<=","<=","<=")
V.bound <- c(100,200,150,400,400,400,300,300)

library("lpSolve")
case2.sol <- lp(I.rule,
                II.fobj,
                III.Acon,
                IV.dir,
                V.bound)

case2.sol$objval
```

```
## [1] 10400
```

```
case2.sol$solution
```

```
## [1] 100 200 250 300   0   0 100   0
```