The Transportation Model - Assignment - 2

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Summary

- By implementing the calculated strategy, our objective of minimizing total production and storage costs was achieved, reducing it to $77.3 million.
- Introducing a dummy coefficient of “100” in the objective function was instrumental in achieving the minimum cost.
- The decision variable “Xij” denotes months from 1 (i) to 2 (j), where “i<=j”. The linear equation comprises 20 decision variables and 9 constraints.
- Notably, the decision variables, now expressed numerically, demonstrate specific month-to-month values: X11=10, X12=15, X23=5, X33=20, X34=10, X44=1.

Problem Statement

The NORTHERN AIRPLANE COMPANY builds commercial airplanes for various airline companies around the world. The last stage in the production process is to produce the jet engines and then to install them (a very fast operation) in the completed airplane frame. The company has been working under some contracts to deliver a considerable number of airplanes in the near future, and the production of the jet engines for these planes must now be scheduled for the next four months.

To meet the contracted dates for delivery, the company must supply engines for installation in the quantities indicated in the second column of Table 9.7. Thus, the cumulative number of engines produced by the end of months 1, 2, 3, and 4 must be at least 10, 25, 50, and 70, respectively. The facilities that will be available for producing the engines vary according to other production, maintenance, and renovation work scheduled during this period. The resulting monthly differences in the maximum number that can be produced and the cost (in millions of dollars) of producing each one are given in the third and fourth columns of Table 9.7 (that was shown in class).

Because of the variations in production costs, it may well be worthwhile to produce some of the engines a month or more before they are scheduled for installation, and this possibility is being considered. The drawback is that such engines must be stored until the scheduled installation (the airplane frames will not be ready early) at a storage cost of $15,000 per month (including interest on expended capital) for each engine,1 as shown in the rightmost column of Table 9.7.

The production manager wants a schedule developed for the number of engines to be produced in each of the four months so that the total of the production and storage costs will be minimized.

Loaded Required Library

```
library(lpSolveAPI)
```

Readed the Northern Airplane lp file

```
x <- read.lp("Northern_Airplane.lp")
x
```

```
## Model name:
##   a linear program with 20 decision variables and 9 constraints
```

Solved the lp model

```
solve(x)
```

```
## [1] 0
```

```
get.objective(x)
```

```
## [1] 77.3
```

```
get.variables(x)
```

```
##  [1] 10 15  0  0  0  0  0  5  0  0 25  5  0  0  0 10  0 30  0  0
```

```
get.constraints(x)
```

```
## [1] 25 35 30 10 10 15 25 20 30
```

```
get.sensitivity.objex(x)
```

```
## $objfrom
##  [1] -1.000000e+30 -4.051286e+16  1.110000e+00  1.125000e+00  1.095000e+00
##  [6]  1.110000e+00  1.125000e+00  1.130000e+00  1.070000e+00  1.085000e+00
## [11] -1.000000e+30  1.115000e+00  1.085000e+00  1.100000e+00  1.115000e+00
## [16] -1.000000e+30 -1.500000e-02 -2.296821e+00 -2.500000e-02 -1.000000e-02
##
## $objtill
##  [1] 9.985e+00 1.095e+00 1.000e+30 1.000e+30 1.000e+30 1.000e+30 1.000e+30
##  [8] 1.140e+00 1.000e+30 1.000e+30 1.100e+00 1.140e+00 1.000e+30 1.000e+30
## [15] 1.000e+30 1.140e+00 1.000e+30 1.000e-02 1.000e+30 1.000e+30
##
## $objfromvalue
##  [1] -1e+30 -1e+30  0e+00 -1e+30  0e+00  0e+00  5e+00 -1e+30  0e+00  0e+00
## [11] -1e+30 -1e+30  0e+00  0e+00  1e+01 -1e+30  0e+00 -1e+30  5e+00  1e+01
##
## $objtillvalue
##  [1] NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
```

```
get.sensitivity.rhs(x)
```

```
## $duals
##  [1]  1.095  1.110  1.085  1.100 -0.015  0.000  0.015  0.030 -1.110  0.000
## [11]  0.000  0.000  0.000  8.905  0.000  0.000  0.000  8.930  8.915  0.000
## [21]  0.000 98.915 98.900  8.885  0.000  0.015  0.000  0.025  0.010
##
## $dualsfrom
##  [1]  2.5e+01  3.5e+01  3.0e+01  1.0e+01  1.0e+01 -1.0e+30  2.5e+01  2.0e+01
##  [9]  3.0e+01 -1.0e+30 -1.0e+30 -5.0e+00 -1.0e+30  0.0e+00  0.0e+00 -5.0e+00
## [17] -1.0e+30  0.0e+00  0.0e+00 -1.0e+30 -1.0e+30  0.0e+00  0.0e+00 -5.0e+00
## [25] -1.0e+30 -5.0e+00 -1.0e+30 -5.0e+00 -5.0e+00
##
## $dualstill
##  [1] 2.5e+01 3.5e+01 3.0e+01 1.0e+01 1.0e+01 1.0e+30 2.5e+01 2.0e+01 3.0e+01
## [10] 1.0e+30 1.0e+30 0.0e+00 1.0e+30 5.0e+00 5.0e+00 5.0e+00 1.0e+30 5.0e+00
## [19] 5.0e+00 1.0e+30 1.0e+30 1.0e+01 1.0e+01 1.0e+01 1.0e+30 0.0e+00 1.0e+30
## [28] 5.0e+00 1.0e+01
```