Airplane

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#summary - The supply of the engines for the months 1,2,3,4 are 25,35,30,10 - The demand for the first four months are 10, 15, 25 and 20 - The production cost for month 1 is 1.08 Now if an item produced in month 1 and it is help for month 2 . The cost for the production = month 1 cost + Unit Cost of the storage

```
1.08 + 0.015 = 1.095
```

It was similar for all the months cost of the production - 1- 1.095 2- 1.11 3- 1.125 The total production cost was - 77.3 - The cost is expressed in millions

- To reduce the costs the production must be higher in the first months and they can be utilised in the following months
- Sensitivity analysis for the Objective Function: The sensitivity analysis enables us to evaluate the impact of changes in production and storage costs on total cost.
- Sensitivity analysis shows how modifications to important variables affect the costs related to shifting production levels. Shadow prices offer information about the effects of changing production levels.More details about the sensitivity of the objective function to changes in the objective coefficients are revealed by reduced costs.

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. Objective - Minimizing the cost of production

min : 1.080 x11 + 1.095 x12 + 1.110 x13 + 1.125 x14 + 45x21 + 1.110 x22 + 1.125 x23 + 1.140 x24 + 45 x31 + 45 x32 + 1.100 x33 + 1.115 x34 + 45 x41 + 45 x42 + 45 x43 + 1.130 x44 ; ***

```r
library(lpSolveAPI)
```

```r
airpln <- read.lp("airplane.lp")
airpln
```

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

```r
solve(airpln)
```

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

```r
get.objective(airpln)
```

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

```r
get.variables(airpln)
```

```
##  [1] 10 15  0  0  0  0  5  0  0  0 20 10  0  0  0 10  0 30  0  0
```

```r
get.sensitivity.rhs(airpln)
```

```
## $duals
##  [1]  1.080  1.095  1.070  1.085  0.000  0.015  0.030  0.045 -1.095  0.000
## [11]  0.000  0.000  0.000 43.905  0.000  0.000  0.000 43.930 43.915  0.000
## [21]  0.000 43.915 43.900 43.885  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+30  1.5e+01  2.5e+01  2.0e+01
##  [9]  3.0e+01 -1.0e+30 -1.0e+30 -1.0e+01 -1.0e+30  0.0e+00  0.0e+00 -1.0e+30
## [17] -2.0e+01  0.0e+00  0.0e+00 -1.0e+30 -1.0e+30  0.0e+00  0.0e+00 -1.0e+01
## [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+30 1.5e+01 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 1.0e+30 5.0e+00 1.0e+01
## [19] 1.0e+01 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] 2.0e+01 1.0e+01
```

```r
get.sensitivity.obj(airpln)
```

```
## $objfrom
##  [1] -1.000e+30 -1.000e+30 -1.000e+30  1.125e+00  1.095e+00  1.110e+00
##  [7]  1.115e+00  1.140e+00  1.070e+00  1.085e+00  1.100e+00  1.115e+00
## [13]  1.085e+00  1.100e+00  1.115e+00 -1.000e+30 -1.500e-02 -1.000e+30
## [19] -2.500e-02 -1.000e-02
##
## $objtill
##  [1] 4.4985e+01 1.0950e+00 1.1100e+00 1.0000e+30 1.0000e+30 1.0000e+30
##  [7] 1.1250e+00 1.0000e+30 1.0000e+30 1.0000e+30 1.1000e+00 1.1150e+00
## [13] 1.0000e+30 1.0000e+30 1.0000e+30 1.1400e+00 1.0000e+30 1.0000e-02
## [19] 1.0000e+30 1.0000e+30
```