Assignment-2:- The Transportation Model

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2023-10-02

Summary

1.The Northern Airplane Company used linear programming (LP) to optimize jet airplane production costs, resulting in a minimum cost of $77.3 million.

2.The LP model included 20 decision variables and 9 constraints, but violated the fundamental assumption of the transportation problem that supply must equal demand.

3.To address this, a dummy demand for 30 jet airplanes and dummy cost coefficient of 10000$ was introduced.

4.The LP model was solved using the "read.lp," "solve," and "get.objective" functions.

5.The decision variables were represented as "X(ij)," with the condition "i<=j" applied to ensure that 'i' is always less than or equal to 'j.'

6.Ultimately, the schedule developed for the production of engines in each of the four months can be utilized by the production manager.

7.The notations (Xij) signify the number of planes produced in month 'i' for month 'j,' with specific values assigned as follows: X11=10, X12=15, X23=5, X33=20, X34=10, and X44=10.

8.This production schedule can be used by the production manager to optimize jet airplane production.

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.

Formulate and solve this problem. Submit a final pdf knitted file with your recommendations.

```
library(lpSolveAPI)
```

Making an Lp file and calling to read it:-

```
x <- read.lp("C:/Users/ASUS/Desktop/QMM-ASSIGNMENT/classwork/12-oct-QMM.lp")
write.lp(x,"test.out")
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  5  0  0  0 20 10  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] -1.000e+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] 9.999985e+03 1.095000e+00 1.110000e+00 1.000000e+30 1.000000e+30
##  [6] 1.000000e+30 1.125000e+00 1.000000e+30 1.000000e+30 1.000000e+30
## [11] 1.100000e+00 1.115000e+00 1.000000e+30 1.000000e+30 1.000000e+30
## [16] 1.140000e+00 1.000000e+30 1.000000e-02 1.000000e+30 1.000000e+30
##
## $objfromvalue
##  [1] -1e+30 -1e+30  0e+00 -1e+30  0e+00  0e+00 -1e+30  5e+00  0e+00  0e+00
## [11] -1e+30 -1e+30  0e+00  0e+00  1e+01 -1e+30  0e+00 -1e+30  2e+01  1e+01
##
## $objtillvalue
##  [1] NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
```

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

```
## $duals
##  [1]    -0.015     0.000    -0.025    -0.010     1.095     1.110     1.125
##  [8]     1.140     0.000     0.000     0.000     0.000     0.000  9998.905
## [15]     0.000     0.000     0.000  9998.930  9998.915     0.000     0.000
## [22] 99998.915 99998.900  9998.885     0.000     0.015     0.000     0.025
## [29]     0.010
##
## $dualsfrom
##  [1]  2.5e+01  3.5e+01  3.0e+01  1.0e+01  1.0e+01  1.5e+01  2.5e+01  2.0e+01
##  [9] -1.0e+30 -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+01 1.5e+01 2.5e+01 2.0e+01 1.0e+30
## [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
```