QMM_ASSIGNMENT2

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#This notebook contains the code for Assignment The Transportation Model

#Summary: #1.Object: *The LP model is used to estimate an optimal total cost, which #represents the lowest cost the linear program with 20 decision variables and #9 constraints #One of the limitations in month 1 is actually around ten engines which Northern #Aeroplane Company may encounter when fulfilling contractual responsibilities. #This indicates that just 10 units are produced on a minimum cumulative basis in #month. #1. An accumulation of output to satisfy constraint number two, a requirement of #25 engines must be met in month. #2. This restriction establishes a minimum50 engines must be produced overall in #month 3 as a requirement. This restriction calls for the bare minimal.The total #number of engines produced in month four will be 70. #2.Sensitivity Analysis for the Objective Function:* Using the sensitivity #analysis, we can determine how changes in the price of production and storage #will affect the overall cost. Making educated decisionsregarding costmanagement #will be made easier if you experiment with production cost coefficients and #monthly storage charges to see how they effect minimum total cost. #3. LP offers a manufacturing and storage strategy that is cost-effective and #satisfies contractual requirements. A sensitivity analysis demonstrates how #modifications to important variables affect the expenses related to varying #production levels. Shadow pricing offer information on the effects of changing #production levels. #More detailson the sensitivity ofthe objective function to changes in objective #coefficients are revealed by reduced costs. Northern Aeroplane Company has the #capacity to strategic decisions regarding engineproduction and storage based on #this information.

#Load lpSolveAPI

```
library(lpSolveAPI)
```

#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 jetengines 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 #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 1 be ready early) at a storage cost of $15,000 permonth foreach #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 total of the production& storage costs will be minimized. #Formulate and solve this problem. Submit a final pdf knitted file with your #recommendations

#We now read the lp formulation using an lp file. To read about about the lp format for files, you can readthe documentation at http://lpsolve.sourceforge.net/5.5/lp-format.html

```
x<-read.lp("Northern Airplane Co.lp")
x
```

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

#Solve the lp model

```
solve(x)
```

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

get objective value

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

```
## [1] 77.5
```

#get shadow prices

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

```
## $duals
##  [1]  1.110  1.125  1.125  1.125 -0.030 -0.025  0.000 -0.010 -1.125  0.000
## [11]  0.010  0.000  0.025 93.905  0.000  0.000  0.025 93.905 93.875  0.000
## [21]  0.000 93.905 93.875 93.900  0.015  0.015  0.000  0.000  0.000
##
## $dualsfrom
##  [1]  1.500000e+01  2.500000e+01  2.500000e+01  1.421085e-14  1.000000e+01
##  [6]  1.500000e+01  2.500000e+01  2.000000e+01  3.000000e+01 -1.000000e+30
## [11] -1.000000e+01 -1.000000e+30 -1.000000e+01 -1.500000e+01 -1.000000e+30
## [16] -1.000000e+30 -1.000000e+01 -1.000000e+01  0.000000e+00 -1.000000e+30
## [21] -1.000000e+30 -1.000000e+01  0.000000e+00 -1.000000e+01 -1.000000e+01
## [26] -1.000000e+01 -1.000000e+30 -1.000000e+30 -1.000000e+30
##
## $dualstill
##  [1] 2.5e+01 3.5e+01 3.0e+01 1.0e+01 2.0e+01 2.5e+01 3.5e+01 2.5e+01 4.0e+01
## [10] 1.0e+30 1.5e+01 1.0e+30 1.0e+01 1.0e+01 1.0e+30 1.0e+30 1.0e+01 1.0e+01
## [19] 5.0e+00 1.0e+30 1.0e+30 1.0e+01 1.0e+01 0.0e+00 1.0e+01 1.0e+01 1.0e+30
## [28] 1.0e+30 1.0e+30
```

get constraint RHS values

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

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

#get values of decision variables

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

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

Retrieve the sensitivity of the objective function

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

```
## $objfrom
##  [1] -1.00000e+30  1.08500e+00 -9.27950e+01  1.10000e+00  1.09500e+00
##  [6] -1.00000e+30  1.11500e+00  1.11500e+00  1.09500e+00  1.12500e+00
## [11] -9.27750e+01 -1.00000e+30  1.09500e+00  1.12500e+00  1.10000e+00
## [16]  1.11500e+00 -1.50000e-02 -4.69375e+01 -1.50000e-02 -1.00000e+30
##
## $objtill
##  [1] 9.49850e+01 1.00000e+30 1.12000e+00 1.00000e+30 1.00000e+30 1.11000e+00
##  [7] 9.50000e+01 1.00000e+30 1.00000e+30 1.00000e+30 1.00000e+30 1.13000e+00
## [13] 1.00000e+30 1.00000e+30 1.00000e+30 1.00000e+30 1.00000e+30 1.50000e-02
## [19] 4.69375e+01 1.50000e-02
##
## $objfromvalue
##  [1] -1.0e+30  1.5e+01 -1.0e+30  1.0e+01  1.0e+01 -1.0e+30 -1.0e+30  1.0e+01
##  [9]  1.0e+01  0.0e+00 -1.0e+30 -1.0e+30  1.0e+01  0.0e+00  0.0e+00  1.0e+01
## [17]  1.0e+01 -1.0e+30 -1.0e+30 -1.0e+30
##
## $objtillvalue
##  [1] NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
```

get reduced cost

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

```
## $objfrom
##  [1] -1.00000e+30  1.08500e+00 -9.27950e+01  1.10000e+00  1.09500e+00
##  [6] -1.00000e+30  1.11500e+00  1.11500e+00  1.09500e+00  1.12500e+00
## [11] -9.27750e+01 -1.00000e+30  1.09500e+00  1.12500e+00  1.10000e+00
## [16]  1.11500e+00 -1.50000e-02 -4.69375e+01 -1.50000e-02 -1.00000e+30
##
## $objtill
```

```
##  [1] 9.49850e+01 1.00000e+30 1.12000e+00 1.00000e+30 1.00000e+30 1.11000e+00
##  [7] 9.50000e+01 1.00000e+30 1.00000e+30 1.00000e+30 1.00000e+30 1.13000e+00
## [13] 1.00000e+30 1.00000e+30 1.00000e+30 1.00000e+30 1.00000e+30 1.50000e-02
## [19] 4.69375e+01 1.50000e-02
```