QUANTITATIVE MANAGEMENT- Assignment 2

Problem One

Back Savers is a company that produces backpacks primarily for students. They are considering offering some combination of two different models—the Collegiate and the Mini. Both are made out of the same rip-resistant nylon fabric. Back Savers has a long-term contract with a supplier of the nylon and receives a 5000 square-foot shipment of the material each week. Each Collegiate requires 3 square feet while each Mini requires 2 square feet. The sales forecasts indicate that at most 1000 Collegiates and 1200 Minis can be sold per week. Each Collegiate requires 45 minutes of labor to produce and generates a unit profit of $32. Each Mini requires 40 minutes of labor and generates a unit profit of $24. Back Savers has 35 laborers that each provides 40 hours of labor per week. Management wishes to know what quantity of each type of backpack to produce per week.

1. Defining the decision variables:

P1 : Number of Collegiate bags

P2: Number of Mini bags

Z(max): Maximum Profit

Q1: Time required to make Collegiate bags (in minutes)

Q2: Time required to make Mini bags(in minutes)

R1: Material required to make Collegiate bags (in sq feet)

R2: Material required to make Mini bags(in sq feet)

2. Objective Function:

Maximizing the profit of the company, can be denoted by

$$32\ P1 + 24\ P2 = Z(max)$$

3. Constraints:

Backsavers is planning to sell collegiate bags and mini bags.

Let, Collegiate bags be P1

Number of Mini bags be P2

Area of material required for Collegiate : 3sqft

Area of material required for Mini: 2sqft Backsavers receives 5000sqft/week.

So , the equation will be:

3 R1 + 2 R2 < 5000 sqft

Collegiate bags makes 32$ profit and require 45 mins to be prepares and Mini Bags makes 24$ profit and requires 40 mins to produce. The total labours for the company is 35 and works for 40hrs/week. Therefore,

Total Labour time in mins= 40 X 24 X 35 = 84000 mins.

45 Q1 + 40 Q2 < 84000mins

Sales forecast predicts that at most 1000 Collegiates and 1200 Mini bags could be sold. So,

P1<1000 P2<1200

4.Full mathematical formulation :

32 P1 + 24 P2 = Z(max) (1)

3 R1 + 2 R2 < 5000 sqft) (2)

45 Q1 + 40 Q2 < 84000mins) (3)

P1<1000) (4)

P2<1200) (5)

PROBLEM 2

```
library(lpSolveAPI)

## Warning: package 'lpSolveAPI' was built under R version 4.1.3

lpec1<-make.lp(0,9)
set.objfn(lpec1,c(300,300,300,360,360,360,420,420,420))
lp.control(lpec1,sense='max')

## $anti.degen
## [1] "fixedvars" "stalling"
##
## $basis.crash
## [1] "none"
##
```

```
## $bb.depthlimit
## [1] -50
##
## $bb.floorfirst
## [1] "automatic"
##
## $bb.rule
## [1] "pseudononint" "greedy"       "dynamic"      "rcostfixing"
##
## $break.at.first
## [1] FALSE
##
## $break.at.value
## [1] 1e+30
##
## $epsilon
##       epsb       epsd      epsel     epsint epsperturb   epspivot
##      1e-10      1e-09      1e-12      1e-07      1e-05      2e-07
##
## $improve
## [1] "dualfeas" "thetagap"
##
## $infinite
## [1] 1e+30
##
## $maxpivot
## [1] 250
##
## $mip.gap
## absolute relative
##    1e-11    1e-11
##
## $negrange
## [1] -1e+06
##
## $obj.in.basis
## [1] TRUE
##
## $pivoting
## [1] "devex"    "adaptive"
##
## $presolve
## [1] "none"
##
## $scalelimit
## [1] 5
##
## $scaling
## [1] "geometric"   "equilibrate" "integers"
##
```

```
## $sense
## [1] "maximize"
##
## $simplextype
## [1] "dual"   "primal"
##
## $timeout
## [1] 0
##
## $verbose
## [1] "neutral"
```

```
add.constraint(lpec1,c(1,1,1,0,0,0,0,0,0),"<=",750)
add.constraint(lpec1,c(0,0,0,1,1,1,0,0,0),"<=",1200)
add.constraint(lpec1,c(0,0,0,0,0,0,1,1,1),"<=",900)
add.constraint(lpec1,c(1,0,0,1,0,0,1,0,0),"<=",750)
add.constraint(lpec1,c(0,1,0,0,1,0,0,1,0),"<=",900)
add.constraint(lpec1,c(0,0,1,0,0,1,0,0,1),"<=",450)
add.constraint(lpec1,c(12,0,0,15,0,0,20,0,0),"<=",13000)
add.constraint(lpec1,c(0,12,0,0,15,0,0,20,0),"<=",12000)
add.constraint(lpec1,c(0,0,12,0,0,15,0,0,20),"<=",5000)
Colnames<-c("X11","X21","X31","X12","X22","X32","X13","X23","X33")
Rownames<-c("z1","z2","z3","z4","z5","z6","z7","z8","z9")
dimnames(lpec1)<-list(Rownames,Colnames)
```

```
write.lp(lpec1,filename = "assignemnt 2",type = "lp")
solve(lpec1)
```

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

```
get.objective(lpec1)
```

```
## [1] 708000
```

The profit is 708000

```
get.variables(lpec1)
```

```
## [1]   0.0000 500.0000 250.0000 400.0000 400.0000 133.3333 350.0000   0.000
0
## [9]   0.0000
```

The value is 0,500,250,400,400,133.3,350,0,0