PROBLEM FORMULATION & INTERPRETATION   by Kevin George

Sets:-

Time – Set of Time; $\{1_{(10AM)}, 2_{(11AM)}, 3_{(12Noon)}, 4_{(1PM)}, 5_{(2PM)}, 6_{(3PM)}, 7_{(4PM)}, 8_{(5PM)}, 9_{(6PM)}, 10_{(7PM)}\}$

Full – Set of fulltime shift; { F1,F2,F3}

Part- Set of Part time Shift; {P1,P2}

Parameters:-

Fullpay_i= salary of full time employee in each fulltime shift i, i ∈ Full {160,160,160}

Partpay_i= salary of part time employee in each Part time shift i, i ∈ Part {75,75}

Checks_i = checks processed in hour i , i ∈ Time

MaxMachine_i= maximum number of machine in each time i, i ∈ Time

Received_i= max checks received in each time i, i ∈ Time

$Iteration1_{i,j}$=presence used for full time worker for all i ∈ time and j ∈ Full

$Iteration2_{i,j}$= presence used for part time worker for all i ∈ time and j ∈ Part.

Minworker = min number of full time worker.

Decision Variable:-

F_i = number of full time worker in each full time shift i , i ∈ Full

P_i = number of part time worker in each part time shift i , i ∈ Part

I_i= number of inventory of check in each hour i , i ∈ Time

Objective Function:-

Mincost=$\sum F_j * \text{Fullpay}_j + \sum P_i * \text{Partpay}_i$ ∀ j in Full , i in Part.

Constraints:-

1) $\sum F_i >$ Minworker ∀ i in Full {min number of full time worker constraint}
2) $\sum_{j\epsilon\text{Full}} Iteration1_{i,j} * F_j + \sum_{k\epsilon\text{Part}} Iteration2_{i,k} * P_k <= \text{MaxMachine}_i$ ∀ i in Time {max number of workers in each hour constraint}
3) <u>If: i=1 ,i in Time</u>
   $\sum_{j\epsilon\text{Full}} Iteration1_{i,j} * F_j * \text{Checks}_i + \sum_{k\epsilon\text{Part}} Iteration2_{i,k} * P_k * \text{Checks}_i = \text{Received}_i - I_i$
   ∀ i in Time {checks processed by full&part time people in first hour = Difference of check received in first hour and the inventory leftover of first hour }
   <u>else:</u>
   $\sum_{j\epsilon\text{Full}} Iteration1_{i,j} * F_j * \text{Checks}_i + \sum_{k\epsilon\text{Part}} Iteration2_{i,k} * P_k * \text{Checks}_i = \text{Received}_i - I_i + I_{i-1}$ ∀ i in Time {checks processed by full&part time people in remaining hour = Difference of check received in each hour and the inventory leftover of that hour + previous inventory}
   <u>i=10 ,i in Time</u>
   $I_{10} = 0$

Interpretation:-

1) Objective function -The minimized cost is 1215

```
1 Objective Declarations                                          Objectives:
   minCostObj : Size=1, Index=None, Active=True                      minCostObj : Size=1, Index=None, Active=True
      Key  : Active : Sense   : Expression                              Key  : Active : Value
      None :  True : minimize : 160*F[F1] + 160*F[F2] + 160*F[F3] + 75*P[P1] + 75*P[P2]    None :   True : 1215.0
```

2) F3=3(F1,F2=0) Number of fulltime worker is 3 and works in 3rd shift ie. Noon to 8pm.
3) P2=9.8(P1=0) Number of par time workers =10 and works in 3-8pm shift

```
Variables:
  F : Size=3, Index=Full
        Key  : Lower  : Value  : Upper  : Fixed  : Stale  : Domain
        F1  :       0  :    0.0  :  None  : False  : False  : NonNegativeReals
        F2  :       0  :    0.0  :  None  : False  : False  : NonNegativeReals
        F3  :       0  :    3.0  :  None  : False  : False  : NonNegativeReals
  P : Size=2, Index=Part
        Key  : Lower  : Value  : Upper  : Fixed  : Stale  : Domain
        P1  :       0  :    0.0  :  None  : False  : False  : NonNegativeReals
        P2  :       0  :    9.8  :  None  : False  : False  : NonNegativeReals
```

4) Inventory of checks at the end of each hour is tabulated below

```
 1 :  5000.0
 2 :  9000.0
 3 : 10500.0
 4 : 13000.0
 5 : 14000.0
 6 : 10600.0
 7 :  8200.0
 8 :  6300.0
 9 :  3400.0
10 :     0.0
```

5) So only Fulltime workers working from noon to 8 and part time workers working from 3pm to 8pm is employed to meet the constraints and minimize the cost of objective function.

6) The number of machine and corresponding people worked is tabulated below.

Time set	Time period	Machines worked	Number of people worked	Comments (people worked)
1	10am-11am	0	0	
2	11am-noon	0	0	
3	noon-1pm	3	3	F3
4	1pm-2pm	3	3	F3
5	2pm-3pm	3	3	F3
6	3pm-4pm	13	13	F3+P2
7	4pm-5pm	13	13	F3+P2
8	5pm-6pm	13	13	F3+P2
9	6pm-7pm	13	13	F3+P2
10	7pm-8pm	13	13	F3+P2