Transportation Problem

Prasad Gaikwad EE18MTECH11001
Nisha Akole EE18MTECH11002
P. Swetha Rani EE18MTECH11006

IIT Hyderabad

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Q.5.4

Problem

Consider the following transportation problem. The entries inside the cells denote per unit cost of transportation from the origins to the destinations. Find the optimal cost of transportation.

S/D	1	2	3	SUPPLY
1	4	3	6	20
2	7	10	5	30
3	8	9	7	50
DEMAND	10	30	60	

Solution

Problem

The given problem is Balanced Transportation Problem as Supply is equal to Demand.
By solving,

1)Northwest Corner Cell Method: Rs.670
Optimized using UV method : Rs.590
2)Least Cost Cell Method: Rs.590

3)Vogel's Approximation Method: Rs.590

Solution

Declaring each entry of matrix as variable and declaring constraints

$4x11 + 3x12 + 6x13 \leq 20$
$7x21 + 10x22 + 5x23 \leq 30$
$8x31 + 9x32 + 7x33 \leq 50$
$-4x11 - 7x21 - 8x31 \leq -10$
$-3x12 - 10x22 - 9x32 \leq -30$
$-6x13 - 5x23 - 7x33 \leq -60$
$-x11, -x12, -x13 \leq 0$
$-x21, -x22, -x23 \leq 0$
$-x31, -x32, -x33 \leq 0$

Code

```python
from cvxopt import matrix
from cvxopt import solvers
import numpy as np

V = matrix([[1 ,1 ,1 ,0 ,0 ,0 ,0 ,0 ,0 ]
[0 ,0 ,0 ,1 ,1 ,1 ,0 ,0 ,0 ],
[0 ,0 ,0 ,0 ,0 ,0 ,1 ,1 ,1 ],
[-1 ,0 ,0 ,-1 ,0 ,0 ,-1 ,0 ,0 ]
[0 ,-1 ,0 ,0 ,-1 ,0 ,0 ,-1 ,0 ],
[0 ,0 ,-1 ,0 ,0 ,-1 ,0 ,0 ,-1 ],
[-1 ,0 ,0 ,0 ,0 ,0 ,0 ,0 ,0 ],
[0 ,-1 ,0 ,0 ,0 ,0 ,0 ,0 ,0 ],
[0 ,0 ,-1 ,0 ,0 ,0 ,0 ,0 ,0 ,
[0 ,0 ,0 ,-1 ,0 ,0 ,0 ,0 ,0 ],
[0 ,0 ,0 ,0 ,-1 ,0 ,0 ,0 ,0 ],
[0 ,0 ,0 ,0 ,0 ,-1 ,0 ,0 ,0 ],
```

Code

```
[0 ,0 ,0 ,0 ,0 ,0 ,-1 ,0 ,0 ],
[0 ,0 ,0 ,0 ,0 ,0 ,0 ,-1 ,0 ],
[0 ,0 ,0 ,0 ,0 ,0 ,0 ,0 ,-1 ]])
S = matrix([20, 30, 50, -10, -30, -60, 0, 0,0,0,0,0,0,0,0])
C=matrix([4, 3, 6, 7, 10, 5, 8, 9, 7])
sol = solvers.sdp(C, V.T, S)
print(sol['x'])
print(sol['primal objective'])
```

Code

Console 1/A

```
Python 3.7.0 (default, Jun 28 2018, 07:39:16)
Type "copyright", "credits" or "license" for more information.

IPython 7.2.0 -- An enhanced Interactive Python.

In [1]: runfile('/Users/ruchiakole/Downloads/Optimization/Q54.py', wdir='/Users/
ruchiakole/Downloads/Optimization')
     pcost       dcost       gap    pres   dres   k/t
 0:  5.9107e+02  5.9107e+02  1e+03  5e-01  7e-01  1e+00
 1:  5.8437e+02  5.8656e+02  4e+02  2e-01  2e-01  2e+00
 2:  5.8808e+02  5.8894e+02  5e+01  2e-02  3e-02  9e-01
 3:  5.9035e+02  5.9043e+02  3e+00  2e-03  2e-03  8e-02
 4:  5.9000e+02  5.9000e+02  3e-02  2e-05  2e-05  9e-04
 5:  5.9000e+02  5.9000e+02  3e-04  2e-07  2e-07  9e-06
 6:  5.9000e+02  5.9000e+02  3e-06  2e-09  2e-09  9e-08
Optimal solution found.
[ 1.40e-08]
[ 2.00e+01]
[-3.01e-08]
[ 4.88e-07]
[ 1.44e-07]
[ 3.00e+01]
[ 1.00e+01]
[ 1.00e+01]
[ 3.00e+01]

590.0000003369175

In [2]:
```