



Bilkent University

IE400 TERM PROJECT

Section: 3 | Group: 39

GROUP MEMBERS:

MERT ÜNLÜ - 22003747

BARIŞ TAN ÜNAL - 22003617

UMUT EGE ÖZDEMİR - 21802251

23.12.2022

PART A: Win the Election

Question #01

Fixed Values:

- $E[i,j]$: expected investment amount of city $[i,j]$

Decision Variables:

- $X[i,j]$: amount of investment in city $i=0,1,2,3,4; j=0,1,2,3,4,5,6$
- $W[i,j] = 1$ if we win the city $[i,j]$
 $= 0$ otherwise

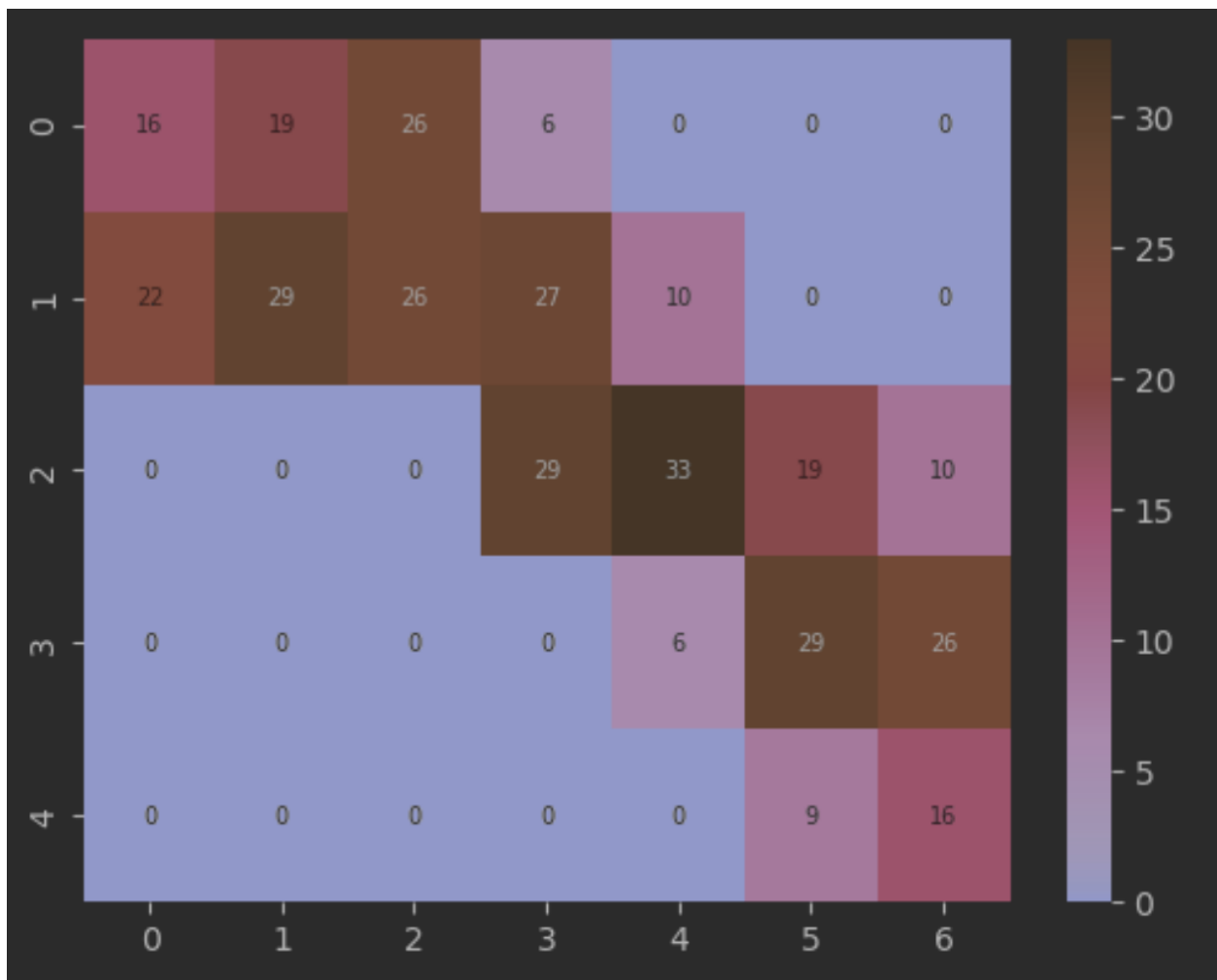
Objective Function:

- $\min(\sum_{i=0}^4 \sum_{j=0}^6 X[i,j])$

Constraints:

- $\sum_{i=0}^4 \sum_{j=0}^6 W[i,j] \geq 18$
- $W[i,j] \leq W[i-1,j] + W[i+1,j] + W[i,j-1] + W[i,j+1]$
for any $[i,j]; i=0..4, j=0..6$; where out of bounds indexes are 0.
- $15W[i,j] \leq \frac{(X[i-1,j]+X[i+1,j]+X[i,j-1]+X[i,j+1])}{4}$ for any $[i,j]; i=0..4; j=0..6$;
where out of bounds indexes are 15.
- $E[i,j] - X[i,j] \leq Mz$ for any $[i,j]; i=0..4, j=0..6$
- $W[i,j] \leq M(1 - z)$ where $z \in \{0, 1\}$ and $M = 30$

Question #02



- All the cities with non-zero investment has voted for us with a total of 18.
- None of the cities without investment has voted for us (trivial).

PART B: Region Partitioning – I

Question #01

E	F	F	F	F	F	G
E	B	B	B	C	C	G
E		B				G
E	A	A		D		G
E	A	A		D	D	G

Question #02

Fixed Values:

- $W[i,j] = 1$ if we win the city $[i,j]$ (fixed from part A)
 $= 0$ otherwise

Decision Variables:

- $S_X[i,j] = 1$ if the city $[i,j]$ is in the region $X=\{0,1,2,3,4,5,6\}$
 $= 0$ otherwise (where 0:A, 1:B, 2:C, 3:D, 4:E, 5:F, 6:G)
- $R_X = 1$ region $X=\{0,1,2,3,4,5,6\}$ is won
 $= 0$ otherwise

Objective Function:

- $\max(\sum_{i=0}^6 R_X)$

Constraints:

- $\sum_{i=0}^4 \sum_{j=0}^6 S_X[i,j] = 5$ for any $X=\{0,1,2,3,4,5,6\}$
- $\sum_{x=0}^6 S_X[i,j] = 1$ for any $i=\{0,1,2,3,4\}; j=\{0,1,2,3,4,5,6\}$
- $3 - \sum_{i=0}^4 \sum_{j=0}^6 (S_X[i,j] * W[i,j]) \leq Mz$
- $R_X \leq M(1 - z)$ where $z \in \{0, 1\}$ and $M = 3$
- $S_E[i,0] = 1$ for $i=\{0,1,2,3,4\}$
- $S_F[0,j] = 1$ for $j=\{1,2,3,4,5\}$
- $S_G[i,6] = 1$ for $i=\{0,1,2,3,4\}$
- $S_A[i,j] = 1$ for $[i,j]=\{ [3,1], [3,2], [4,1], [4,2] \}$
- $S_B[i,j] = 1$ for $[i,j]=\{ [1,1], [1,2], [1,3], [2,2] \}$
- $S_C[i,j] = 1$ for $[i,j]=\{ [1,4], [1,5] \}$
- $S_D[i,j] = 1$ for $[i,j]=\{ [3,4], [4,4], [4,5] \}$

PART C: Region Partitioning - II

Fixed Values:

- $W[i,j] = 1$ if we win the city $[i,j]$ (fixed from part A)
 $= 0$ otherwise

Decision Variables:

- $S_X[i,j] = 1$ if the city $[i,j]$ is in the region $X=\{0,1,2,3,4,5,6\}$
 $= 0$ otherwise (where 0:A, 1:B, 2:C, 3:D, 4:E, 5:F, 6:G)
- $R_X = 1$ region $X=\{0,1,2,3,4,5,6\}$ is won
 $= 0$ otherwise

Objective Function:

- $\max(\sum_{i=0}^6 R_X)$

Constraints:

- $\sum_{i=0}^4 \sum_{j=0}^6 S_X[i,j] = 5$ for any $X=\{0,1,2,3,4,5,6\}$
- $\sum_{x=0}^6 S_X[i,j] = 1$ for any $i=\{0,1,2,3,4\}; j=\{0,1,2,3,4,5,6\}$
- $3 - \sum_{i=0}^4 \sum_{j=0}^6 (S_X[i,j] * W[i,j]) \leq Mz$
- $R_x \leq M(1 - z)$ where $z \in \{0, 1\}$ and $M = 3$