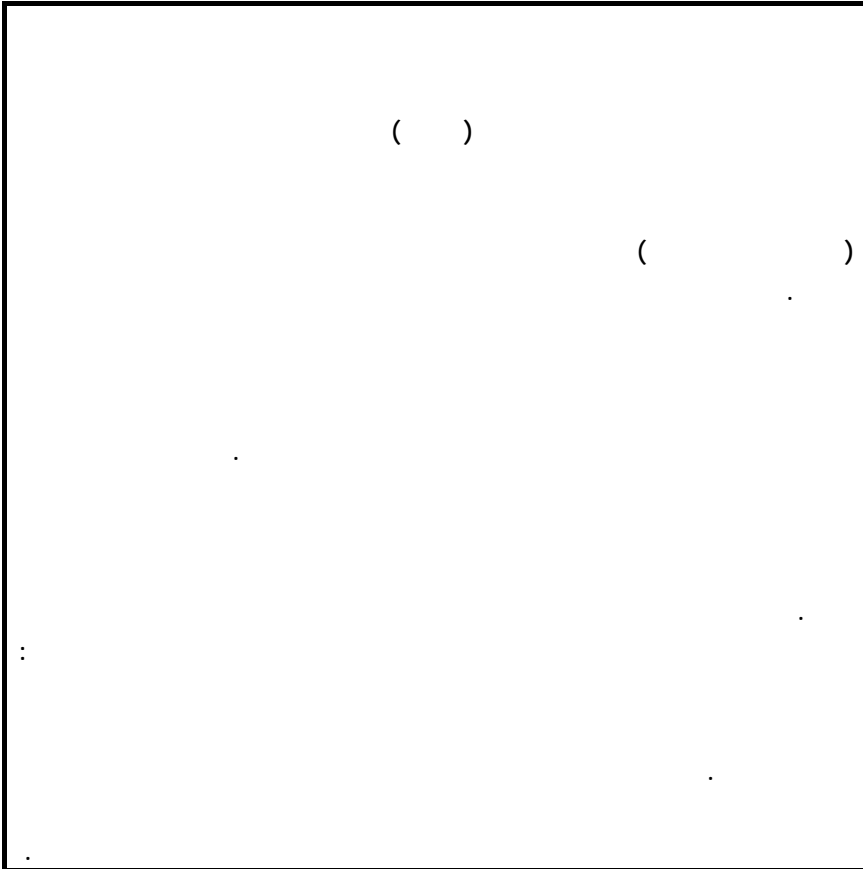


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(1.5)

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- 1

(15)

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3000

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(Bushnak)⁽¹⁾

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(Charnes)⁽²⁾

(Al-Yafi)⁽³⁾

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2 - 1

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(Objective Function)

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60%

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- 8

(11)

17

7.3

11

0.76

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7.32

3.66

8

12

12

(1.6)

A	
B	
C	
D	
E	

$$Z_i = \left(\frac{HP_i}{N_i} \right) \quad (i)$$

$i = A, B, C, D \text{ and } E$

$$Z_a = 1$$

Z_i : Capacity of a vehicle in mode I (Persons/vehicle) where $i = A, B, C, D \text{ and } E$ unless noted otherwise note that $Z_a = 1$

$$N_i = \left(\frac{HP_i}{Z_i} \right) \quad (i)$$

$$N_a = 12 \quad 12$$

$$N_b = 8 \quad 8$$

$$N_c = N_d = N_e = 3 \quad 3$$

N_i : number of lanes of mode i in any road

$$N_a = 12, \quad N_b = 8, \quad n_c = n_d = n_e = 3$$

$$: \quad (i) \quad \left(\frac{HP_i}{Z_i} \right)$$

H_i

$$\left(\frac{HP_i}{Z_i} \right)$$

H_i : flow of vehicles (vehicles/hour per lane) in mode i

$$: \left(\frac{HP_i}{Z_i} \right) \quad (i)$$

HP_i

$$HP_i = H_i \times N_i \times Z_i$$

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HP_i : flow of persons (persons/hour per road) in mode i where

$$HP_i = H_i \times N_i \times Z_i$$

$$W_i = \left(\frac{TP}{ES} \right) \quad (i)$$

W_i : number of exclusive rodas allocated to mode i

$$ES = \left(\frac{TP}{W_i} \right)$$

ES : evacuation time since sunset

TP

TP : total number of pilgrims.

$$V_i = \left(\frac{PG_i}{Z_i} \right) \quad (i)$$

V_i : number of vehicles to be used in mode i

$$PG_i = \left(\frac{V_i \times Z_i}{R_i} \right) \quad (i)$$

PG_i : number of pilgrims to take mode i

$$R_i = \left(\frac{V_i \times Z_i}{PG_i} \right)$$

$i = D \text{ and } E$

R_i : number of round trips for buses where $i = D$ and E

$$T_i : \text{round trip time for buses where } i = D \text{ and } E$$

$$i = D \text{ and } E$$

$$i, e. T_i = 50 \text{ min}$$

T_i : round trip time for buses where $i = D$ and E

$$i, e. T_i = 50 \text{ min}$$

$$(i) \quad /$$

$$C_i$$

C_i : cast of transportation / pilgrim in mode i

$$MV_i : \text{maximum available vehicles of mode } i, \text{ where } i = A, B, C, D$$

MV_i : maximum available vehicles of mode i , where $i = A, B, C, D$

$$MV_D$$

MV_D : Modified buses may be obtained from MV_D

$$M_W$$

M_W : Maximum number of roads i. e. $M_W = 11$
 $i = A.$

$$M_W = 11$$

COST

$$\text{maximize } y = \sum HP_i W_i$$

$$\sum_i C_i PG_i \leq \text{cost}$$

$$V_i - ESH_i N_i W_i = 0$$

$$i = A, B, \text{ and } C$$

(3)

$$R_i - ESH_i N_i W_i = 0$$

$i = D \text{ and } E$:	- 4
$V_i \leq MV_i$:	- 5
$V_D + V_E \leq MV_D$ ()	4-5	
	:	- 6
$R_i - ESV_i/T_i \leq 0$		
ES	:	- 7
$PG_i - Z_i V_i = 0$ $i = A, B \text{ and } C$:	- 8
$PG_i - Z_i R_i = 0$ $i = D \text{ and } E$:	- 9
$\sum PG_i \geq TP$ $i = A, B, C, D \text{ and } E$:	- 10
$W_A + W_B + W_C + 2 W_D + 2 W_E \leq M_W$ () ()	:	- 11
$PG_i, W_i, V_i, R_i \geq 0$ $i = A, B, C, D \text{ and } E$:	- 12
W_i	:	
$W_A + W_B + W_C + 2 W_D + 2 W_E < M_W$ ()		

(0)

:

: 0, 2, 4, 6, 8, 10

$$PG_i \cdot W_i \cdot V_i \cdot R_i > 0$$

W_i is integer

()

: -10

E

D

H_i

(1)

: (4) (Hamberger)

(Carter)

(1)

I	A	B	C	D	E
N_i	12	8	3	3	3
Z_i	1	1	8	42	72
H_i	2500	2460	2000	1250	1250
HP_i	30000	19680	48000	157500	270000
MV_i	50000	180000	70000	20000	
C_i	8.00	40.50	6.30	3.20	5.35

(6) white

C_i

()

$PG_A > 180000$

(2)

Lindo Soft Ware

ES TP = 1800000

$2.9 \leq ES \leq 6.30$

2,9 ES

6.30

(2)

$2.9 \leq ES \leq 6.30$ ()

ES	2.9	3	4	5	6.30
W_A	4	4	4	3	3
W_B	0	0	0	0	0
W_C	0	0	0	0	0
W_D	0	1	2	3	2
W_E	3	2	1	0	0
$\sum HP_i W_i$	930000	817500	705000	562500	405000
Cost/pilg	5.2	4.8	4.1	3.8	2.9
V_A	265500	282000	412000	320000	358000
V_B	0	0	0	0	0
V_C	0	0	16500	0	0
V_D	0	2020	4040	8080	6060
V_E	8080	6060	2020	0	0
R_D	0	7310	18560	46400	41900
R_E	26760	21810	9280	0	0

: - 11

:

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6.30 2.9

ES

-1

C_B

ES

-2

$\Sigma C_i PG_i$

(2)

cost/pilg

(5)

ES

Cost/Pilg

/ ΣPG_i

(2)

- 3

2.9

6

930000

(

3)

3.31

8080

26760

5.2

94336479

2.596

115062

TP

8 7

i. e. PG_i

- 4

- 5

- 6

11

(E D)

2.9 3.2

. 58
2.29

5.29

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-1

-2

-3

- 4

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- : - A
- . 1985 : . -1
- . 1990 : . -2
- . 1991 : . -3
- : . -4
- .1991
- .1992 : . -5
- : - B
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