

# Optimization Technique And Advances

## Home Care problems Bachelor of Technology in Computer Science And Engineering

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**The LNM Institute of Information Technology  
Jaipur, India**

**CERTIFICATE**

This is to certify that this project submitted by Group-13 of A2 batch in requirement of Optimization Technique And Advances course of Computer Science Engineering, is a bonafide record of work carried out by them at the Department of Computer Science Engineering, The LNM Institute of Information Technology, Jaipur, (Rajasthan) India, during the 3rd semester under my supervision and guidance and the same has not been submitted elsewhere .

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Date

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Dr.Jayaprakash Kar

## **ACKNOWLEDGEMENTS**

This project of ours would not have been a success without the helping hands of our fellow friends and patient mentors. We would like to thank a few of them for their selfless work with us. First and foremost, we would like to express our gratitude towards our mentor and distinguished faculty Dr.Jayaprakash Kar who had been a continuous support since the inception of the project. Also, we would like to thank our some friends and batchmates who always helped us whenever we were stuck anywhere.

# INTRODUCTION

## What is Home Care?

Home care includes any professional support services that allow a person to live safely in their home. In-home care services can help someone who is aging and needs assistance to live independently; is managing chronic health issues; is recovering from a medical setback; or has special needs or a disability. Professional caregivers such as nurses, aides, and therapists provide short-term or long-term care in the home, depending on a person's needs.

Home care can be the key to achieving the highest quality of life possible. It can enable safety, security, and increased independence; it can ease management of an ongoing medical condition; it can help avoid unnecessary hospitalization; it can aid with recovery after an illness, injury, or hospital stay—all through care given in the comfort and familiarity of home. Home care can include:

- Help with daily activities such as dressing and bathing
- Assistance with safely managing tasks around the house
- Companionship
- Therapy and rehabilitative services
- Short- or long-term nursing care for an illness, disease, or disability—including tracheostomy and ventilator care

## About Homecare Problem

By providing care to patients in their home, we can reduce the hospitalisation costs, improve the patient's quality of life (thus impacting them socially in addition to giving them economic advantage). This is focussed at optimizing the life expectancy of patient who receive home care. We aim to minimize the cost of treatment.

In this problem, a patient has been prescribed by the doctor to go through two treatment therapies namely therapy 1 and therapy 2 for his treatment from home. Each therapy needs medicines of two types say medicine A and medicine B. Using these medicine reduces the risk factor by some percentage . The patient can afford to pay only Rs.60,000 for Therapy 1 and Rs. 71,000 for Therapy 2 and needs to go through at least 28 hours of Therapy 1 and 70 hours of Therapy 2. Based on this optimize life expectancy, number of caretakers and total number of hours of therapy required per day.

### Problem Statement 1.

A patient needs to go through two therapies for his treatment from home as prescribed by his doctor. Therapy needs medicines of two types say medicine A and medicine B. Using these medicine reduces the risk factor by some percentage data given in the table. Total life expectancy is the sum of expectancy by Medicine A and Medicine B. Maximize the total life expectancy.

	Percentage of risk reduction factor by Medicine A.	Percentage of risk reduction factor by Medicine B.	Average Life Expectancy
Therapy 1	1.8	2.5	0.90
Therapy 2	1.3	2.4	0.95

#### Formulation:

Let  $Z_1$  : Life expectancy by medicine A.

$Z_2$  : Life expectancy by medicine B.

#### Optimization function:

$$\text{Max } Z = Z_1 + Z_2$$

Subject to :

$$1.8Z_1 + 2.5Z_2 \leq 0.90$$

$$1.3Z_1 + 2.4Z_2 \leq 0.95$$

$$0 \leq Z_1 \leq 1$$

$$0 \leq Z_2 \leq 1$$

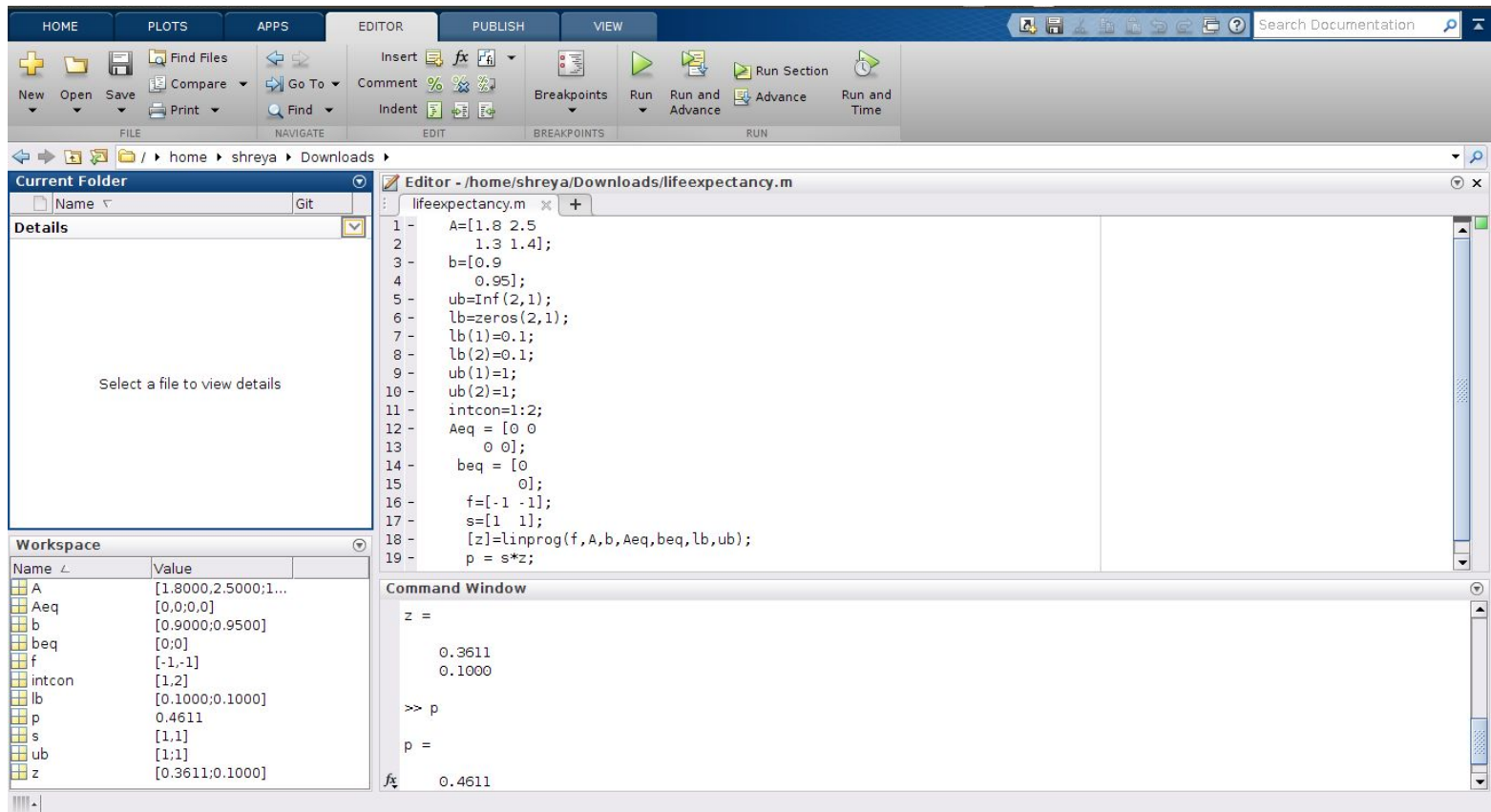
**Name of Method Used:** Linear Programming

**Code :**

```
A = [1.8  2.5  
     1.3  1.4];  
B = [0.9  
     0.95];  
ub = Inf(2,1);  
lb = zeros(2,1);  
lb(1) = 0.1;  
lb(2) = 0.1;  
ub(1) = 1;  
ub(2) = 1;  
intcon=1:2;  
Aeq = [0  0  
       0  0];  
beq = [0  
       0];  
f = [-1  -1];  
p = [1  1];  
[z] = linprog(f,A,b,Aeq,beq,lb,ub);
```

**Result :**

```
Z1=0.3611  
Z2=0.1  
p=0.461
```



## Problem Statement 2.

Patient can afford to pay only Rs.60,000 for Therapy 1 and Rs. 71,000 for Therapy 2.

Minimize the number of caretaker needed. The number of caretakers of Agency 1 should be atleast 1.5 times more than the number of caretakers of Agency 2 .Find out the number of caretakers needed from each agency in order to minimize the total number of caretaker needed.

	Caretaker charges of Agency 1	Caretaker charges of Agency 2	Max. amount patient can afford
Therapy 1	4,000	5,000	60,000
Therapy 2	6,000	3,700	71,000

**Formulation:**



Let  $X_1$  : No. of caretakers of Agency 1

$X_2$  : No. of caretakers of agency 2

**Optimization function :** Minimize  $Z = X_1 + X_2$

Subject to :

$$4000X_1 + 5000X_2 \leq 60,000$$

$$6000X_1 + 3700X_2 \leq 71,000$$

$$1 \leq X_1 \leq 10$$

$$1 \leq X_2 \leq 12$$

$$2X_1 - 3X_2 \geq 0$$

**Name of Method :** Integer Programming

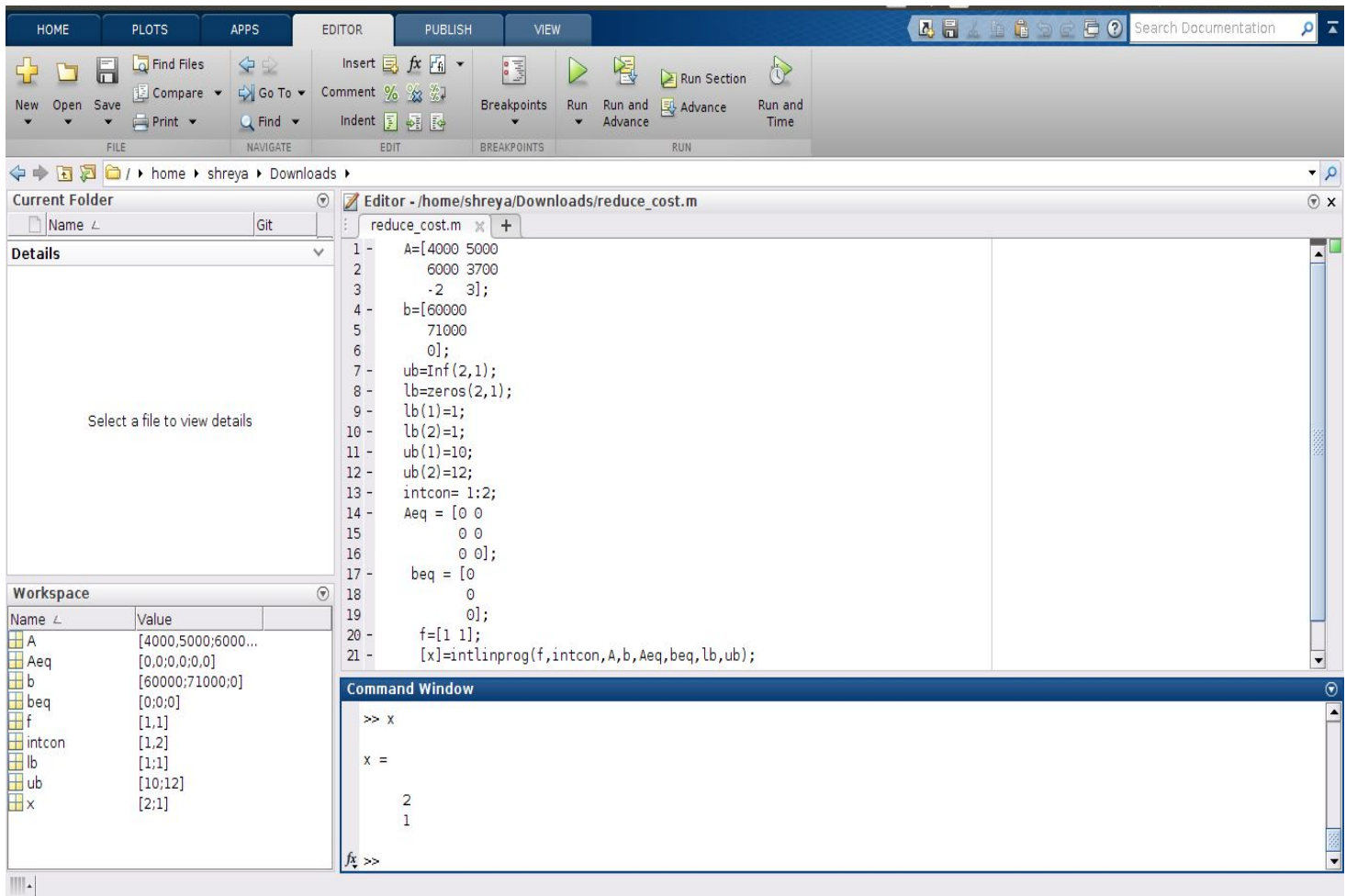
**Code :**

```
A=[4000 5000
    6000 3700
    -2    3];
b=[60000
    71000
    0];
ub = Inf(2,1);
lb = zeros(2,1);
lb(1) = 1;
lb(2) = 1;
ub(1) = 10;
ub(2) = 12;
Intcon = 1:2;
Aeq = [0 0
        0 0
        0 0];
beq = [0
        0
        0];
f = [1 1];
[x] = intlinprog(f,intcon,A,b,Aeq,beq,lb,ub);
```

**Result :**

$$X_1=2$$

$$X_2=1$$



### Problem Statement 3.

The patient needs to go through at least 28 hours of Therapy 1 and 70 hours of Therapy 2 in a week. Minimize the total number of hours the patient has to go through a therapy in a day.

	Caretaker A (day/week)	Caretaker B (day/week)	Total time that can be spent on therapies (hours/week )
Therapy 1	4	5	28

Therapy 2	3	4	70
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**Formulation:**

Let  $Y_1$  : Number of hours per day caretaker 1 does a therapy

$Y_2$  : Number of hours per day caretaker 2 does a therapy

**Optimization function:**

$$\text{Min } Z = Y_1 + Y_2$$

Subject to :

$$4Y_1 + 5Y_2 \geq 28$$

$$3Y_1 + 4Y_2 \geq 70$$

$$1 \leq Y_1 \leq 12$$

$$1 \leq Y_2 \leq 12$$

**Name of Method :** Integer Programming

**Code :**

```
A=[-4 -5
    -3 -4];
b=[-28
    -70];
ub = [12;12];
lb = [1;1];
intcon=1:2;
Aeq = [0 0
        0 0];
beq = [0
        0];
f = [1 1];
[y] = intlinprog(f,intcon,A,b,Aeq,beq,lb,ub);
```

**Result :**

$$Y_1=8$$

$$Y_2=12$$

The image shows the MATLAB R2019a interface. The top menu bar includes HOME, PLOTS, APPS, EDITOR, PUBLISH, and VIEW. The Editor tab is active, showing a script named 'therapy.m' located at '/home/shreya/Downloads/therapy.m'. The script contains the following code:

```

1 - A=[-4 -5
2     -3 -4];
3 - b=[-28
4     -70];
5 - ub=[12;12];
6 - lb=[1;1];
7 - intcon=1:2;
8 - Aeq = [0 0
9         0 0];
10 - beq = [0
11         0];
12 - f=[1 1];
13 - [y]=intlinprog(f,intcon,A,b,Aeq,beq,lb,ub);
14

```

The Workspace panel on the left shows the following variables and their values:

Name	Value
A	$\begin{bmatrix} -4 & -5 \\ -3 & -4 \end{bmatrix}$
Aeq	$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$
b	$\begin{bmatrix} -28 \\ -70 \end{bmatrix}$
beq	$\begin{bmatrix} 0 \\ 0 \end{bmatrix}$
f	$\begin{bmatrix} 1 \\ 1 \end{bmatrix}$
intcon	$\begin{bmatrix} 1 \\ 2 \end{bmatrix}$
lb	$\begin{bmatrix} 1 \\ 1 \end{bmatrix}$
ub	$\begin{bmatrix} 12 \\ 12 \end{bmatrix}$
x	$\begin{bmatrix} 0.3611 & 0.1000 \end{bmatrix}$
y	$\begin{bmatrix} 8 & 12 \end{bmatrix}$
z	$\begin{bmatrix} 0.3611 & 0.1000 \end{bmatrix}$

The Command Window at the bottom shows the output of the script:

```

>> y
y =
    8.0000
   12.0000

```

## Conclusion

1. The total life expectancy after therapy is 0.4611.
2. The optimum number of the caretaker needed for caretaker agency 1 is 2 and for caretaker agency 2 is 1.
3. The total hours per day of each therapist required are 8 and 12 respectively.

## Working Contribution :

- ❑ Problem definition : Kajol Choudhary (16ucs224), Rakshita Porwal(16ucs153), Parul Shandilya(16ucs126), Priyansi Singh(16ucs143), Shreya Chawla(16ucs176)
- ❑ Formulation : Kajol Choudhary(16ucs224), Rakshita Porwal(16ucs153)
- ❑ Source Code : Priyansi Singh(16ucs143)
- ❑ Report layout : Parul Shandilya(16ucs126), Shreyansh Jain(16ucs177), Priyansi Singh(16ucs143), Shreya Chawla(16ucs176)