OTA PROJECT

GROUP:
19

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PROJECT PROBLEM:
Contract Awards -
Award contracts to suppliers who have bid certain prices to supply products to facilities in several states - allow for bids specifying a minimum size for each state.

SUBMITTED TO:
Dr. Jayaprakash Kar

OBJECTIVE - 1

QUESTION:

The health department of India (HDI) wants to send some health supplies for helping people fight the crisis of coronavirus (COVID 19) till some vaccine is discovered. The supplies include masks and hand sanitizers. It needs to be sent to 3 states which include Rajasthan, Delhi, and Bangalore in hope that it will reach the underprivileged people and help them fight against the pandemic. Three manufacturers have placed certain bids to supply these supplies. HDI needs to minimize the cost so that the underprivileged people can afford it.

The following tables are for the same.

MANUFACTURERS	RAJASTHAN		DELHI		BANGALORE	
	Sanitizer	Mask	Sanitizer	Mask	Sanitizer	Mask
Manufacturer - 1	150	90	165	96	155	95
Manufacturer - 2	145	98	155	104	150	92
Manufacturer - 3	155	75	145	70	148	80

This table shows prices(in Rupee) offered by manufacturers for different states

MANUFACTURERS	LIMIT	
	Masks	Sanitizer
Manufacturer - 1	125000	90000
Manufacturer - 2	125000	80000
Manufacturer - 3	125000	70000

This table shows the stock of supplies with the manufacturers

	RAJASTHAN		DELHI		BANGALORE	
	Masks	Sanitizer	Masks	Sanitizer	Masks	Sanitizer
Contract (Single Unit)	1000	800	700	550	1200	1050
TOTAL REQUIRED	100000	60000	70000	35000	120000	85000

This table shows the required number of supplies of each state and quantity of supplies in a single contract

SOLUTION:

FORMULATION:

For the formulation of the above problem, we need to define some notations that are given below:-

Notations	Definition
M1R	Contracts awarded to manufacture 1 in Rajasthan
M2R	Contracts awarded to manufacture 2 in Rajasthan
M3R	Contracts awarded to manufacture 3 in Rajasthan
M1D	Contracts awarded to manufacture 1 in Delhi
M2D	Contracts awarded to manufacture 2 in Delhi
M3D	Contracts awarded to manufacture 3 in Delhi
M1B	Contracts awarded to manufacture 1 in Bangalore
M2B	Contracts awarded to manufacture 2 in Bangalore
M3B	Contracts awarded to manufacture 3 in Bangalore

OBJECTIVE FUNCTION:

HDI needs to minimize the cost for the underprivileged people.

Minimize:

Z = 210000*M1R + 214000*M2R + 199000*M3R + 157950*M1D + 158050*M2D + 128750*M3D + 276750*M1B + 267900*M2B + 251400*M3B

Subject to Constraints:

- 1000*M1R + 700*M1D + 1200*M1B <= 125000

Total supply of masks by manufacturer-1 cannot exceed 125000

- 800*M1R + 550*M1D + 1050*M1B <= 90000

Total supply of sanitizers by manufacturer-1 cannot exceed 90000

- 1000*M2R + 700*M2D + 1200*M2B <= 125000

Total supply of masks by manufacturer-2 cannot exceed 125000

- 800*M2R + 550*M2D + 1050*M2B <= 80000

Total supply of sanitizers by manufacturer-2 cannot exceed 80000

- 1000*M3R + 700*M3D + 1200*M3B <= 125000

Total supply of masks by manufacturer-3 cannot exceed 125000

- 800*M3R + 550*M3D + 1050*M3B <= 70000

Total supply of sanitizers by manufacturer-3 cannot exceed 70000

- 1000*M1R + 1000*M2R + 1000*M3R >= 100000

Total masks supply in Rajasthan is at least 100000

- 800*M1R + 800*M2R + 800*M3R >= 60000

Total sanitizers supply in Rajasthan is at least 60000

- 700*M1D + 700*M2D + 700*M3D >= 70000

Total masks supply in Delhi is at least 70000

- 550*M1D + 550*M2D + 550*M3D >= 35000

Total sanitizers supply in Delhi is at least 35000

- 1200*M1B + 1200*M2B + 1200*M3B >= 120000

Total masks supply in Bangalore is at least 120000

- 1050*M1B + 1050*M2B + 1050*M3B >= 85000

Total sanitizers supply in Bangalore is at least 85000

- M1R,M2R,M3R,M1D,M2D,M3D,M1B,M2B,M3B >= 0

Method Used: Integer Linear Programming
Reason: Here we used INTEGER LINEAR PROGRAMMING because the number of contracts awarded to a particular manufacturer should be an integer value.

RESULT:

Z = 210000*M1R + 214000*M2R + 199000*M3R + 157950*M1D + 158050*M2D + 128750*M3D + 276750*M1B + 267900*M2B + 251400*M3B

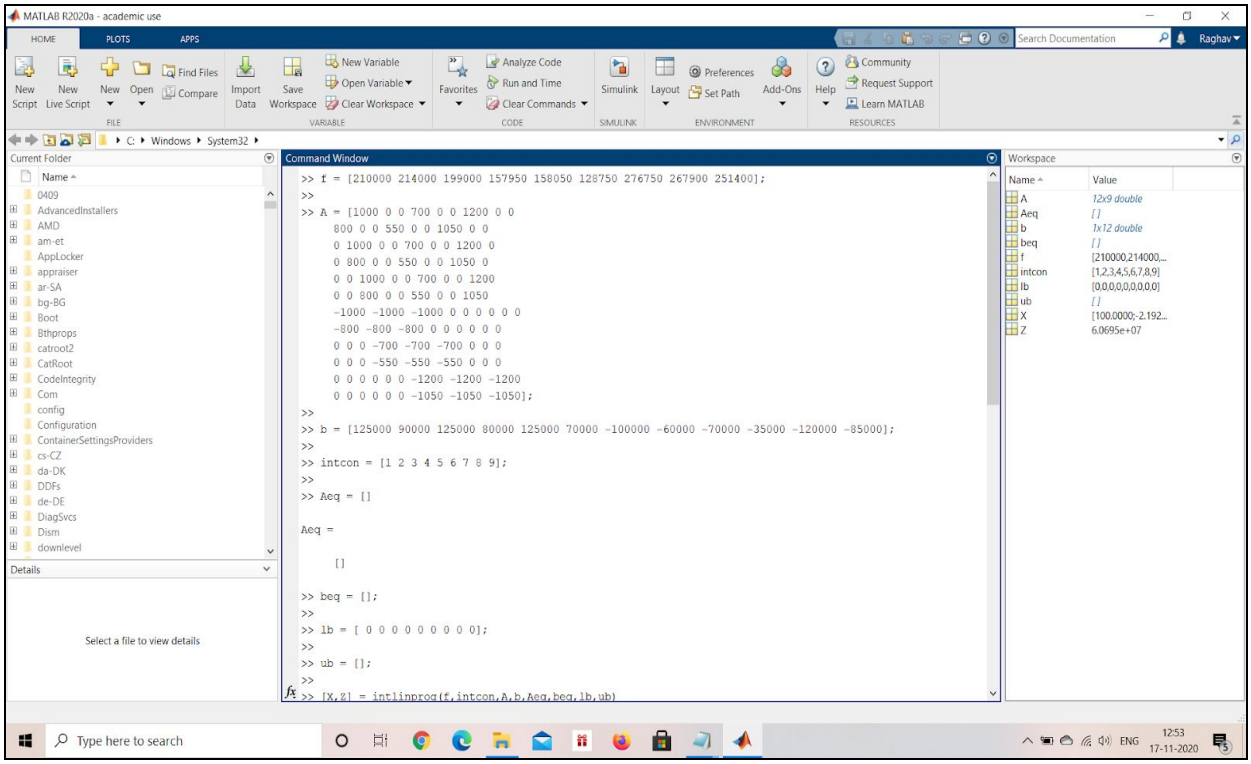
M1R = 100, M2R = 0, M3R = 0,
M1D = 1, M2D = 8, M3D = 91,
M1B = 9, M2B = 72, M3B = 19

min Z = 210000*100 + 214000*0 + 199000*0 + 157950*1 + 158050*8 + 128750*91 + 276750*9 + 267900*72 + 251400*19

min Z = 60694750

The minimum cost of the sale is **Rs. 6,06,94,750**

MATLAB CODE: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Current Folder
Name
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AMD
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AppLocker
appraiser
ar-SA
bg-BG
Boot
Bthprops
catroot2
CatRoot
CodeIntegrity
Com
config
Configuration
ContainerSettingsProviders
cs-CZ
da-DK
DDFs
de-DE
DiagSvcs
Dism
downlevel
Details
Select a file to view details
Command Window
>> f = [210000 214000 199000 157950 158050 128750 276750 267900 251400];
>>
>> A = [1000 0 0 700 0 0 1200 0 0
800 0 0 550 0 0 1050 0 0
0 1000 0 0 700 0 0 1200 0
0 800 0 0 550 0 0 1050 0
0 0 1000 0 0 700 0 0 1200
0 0 800 0 0 550 0 0 1050
-1000 -1000 -1000 0 0 0 0 0 0
-800 -800 -800 0 0 0 0 0 0
0 0 0 -700 -700 -700 0 0 0
0 0 0 -550 -550 -550 0 0 0
0 0 0 0 0 0 -1200 -1200 -1200
0 0 0 0 0 0 -1050 -1050 -1050];
>>
>> b = [125000 90000 125000 80000 125000 70000 -100000 -60000 -70000 -35000 -120000 -85000];
>>
>> intcon = [1 2 3 4 5 6 7 8 9];
>>
>> Aeq = []
Aeq =
[]
>> beq = [];
>>
>> lb = [0 0 0 0 0 0 0 0 0];
>>
>> ub = [];
>>
>> [X,Z] = intlinprog(f,intcon,A,b,Aeq,beq,lb,ub)
Workspace
Name
Value
A
12x9 double
Aeq
[]
b
1x12 double
beq
[]
f
[210000,214000,...
intcon
[1,2,3,4,5,6,7,8,9]
lb
[0,0,0,0,0,0,0,0,0]
ub
[]
X
[100.0000;-2.192...
Z
6.0695e+07
Type here to search
ENG
12:53
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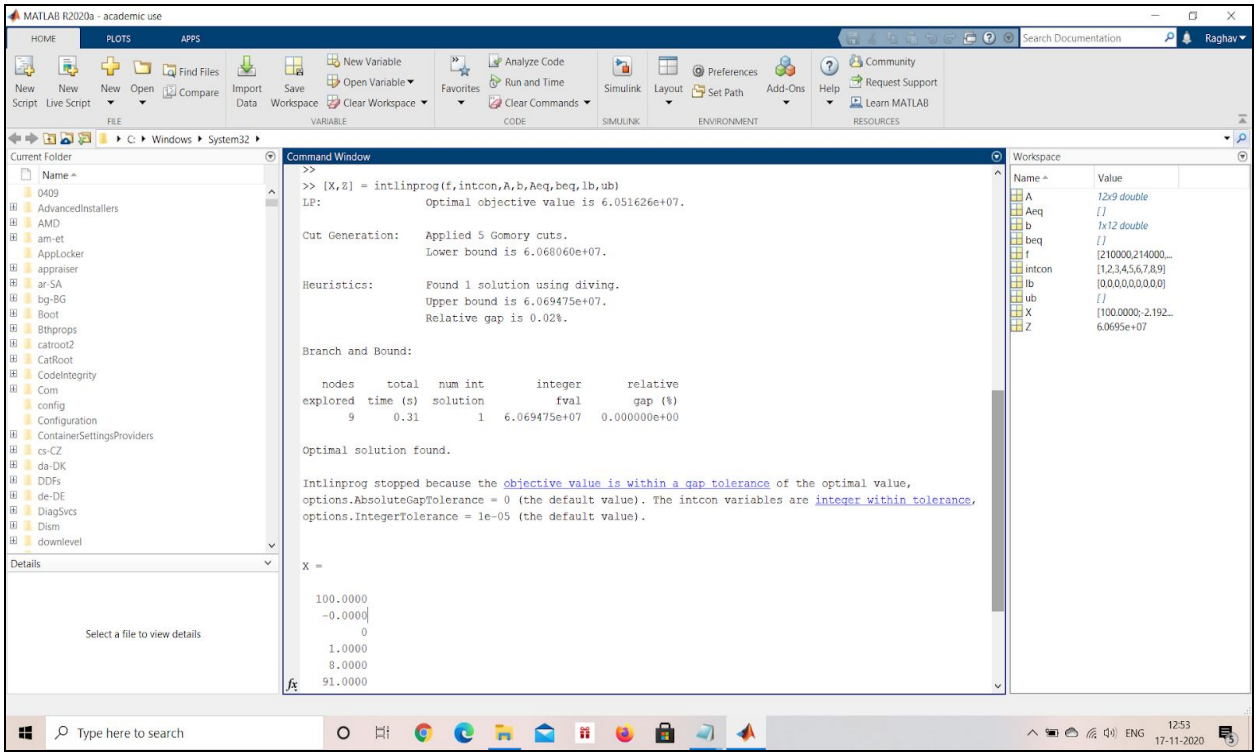
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New Script
New Live Script
New
Open
Find Files
Compare
Import Data
Save Workspace
New Variable
Open Variable
Clear Workspace
Favorites
Analyze Code
Run and Time
Clear Commands
Simulink
Layout
Preferences
Set Path
Add-Ons
Help
Community
Request Support
Learn MATLAB
FILE
VARIABLE
CODE
SIMULINK
ENVIRONMENT
RESOURCES
C: ▸ Windows ▸ System32 ▸
Current Folder
Name
0409
AdvancedInstallers
AMD
am-et
AppLocker
appraiser
ar-SA
bg-BG
Boot
Bthprops
catroot2
CatRoot
CodeIntegrity
Com
config
Configuration
ContainerSettingsProviders
cs-CZ
da-DK
DDFs
de-DE
DiagSvcs
Dism
downlevel
Details
Select a file to view details
Command Window
>>
>> [X,Z] = intlinprog(f,intcon,A,b,Aeq,beq,lb,ub)
LP: Optimal objective value is 6.051626e+07.
Cut Generation: Applied 5 Gomory cuts.
Lower bound is 6.068060e+07.
Heuristics: Found 1 solution using diving.
Upper bound is 6.069475e+07.
Relative gap is 0.02%.
Branch and Bound:
nodes total num int integer relative
explored time (s) solution fval gap (%)
9 0.31 1 6.069475e+07 0.000000e+00
Optimal solution found.
Intlinprog stopped because the objective value is within a gap tolerance of the optimal value,
options.AbsoluteGapTolerance = 0 (the default value). The intcon variables are integer within tolerance,
options.IntegerTolerance = 1e-05 (the default value).
X =
100.0000
-0.0000
0
1.0000
8.0000
91.0000
Workspace
Name
Value
A
12x9 double
Aeq
[]
b
1x12 double
beq
[]
f
[210000,214000,...
intcon
[1,2,3,4,5,6,7,8,9]
lb
[0,0,0,0,0,0,0,0,0]
ub
[]
X
[100.0000;-2.192...
Z
6.0695e+07
Type here to search
ENG
12:53
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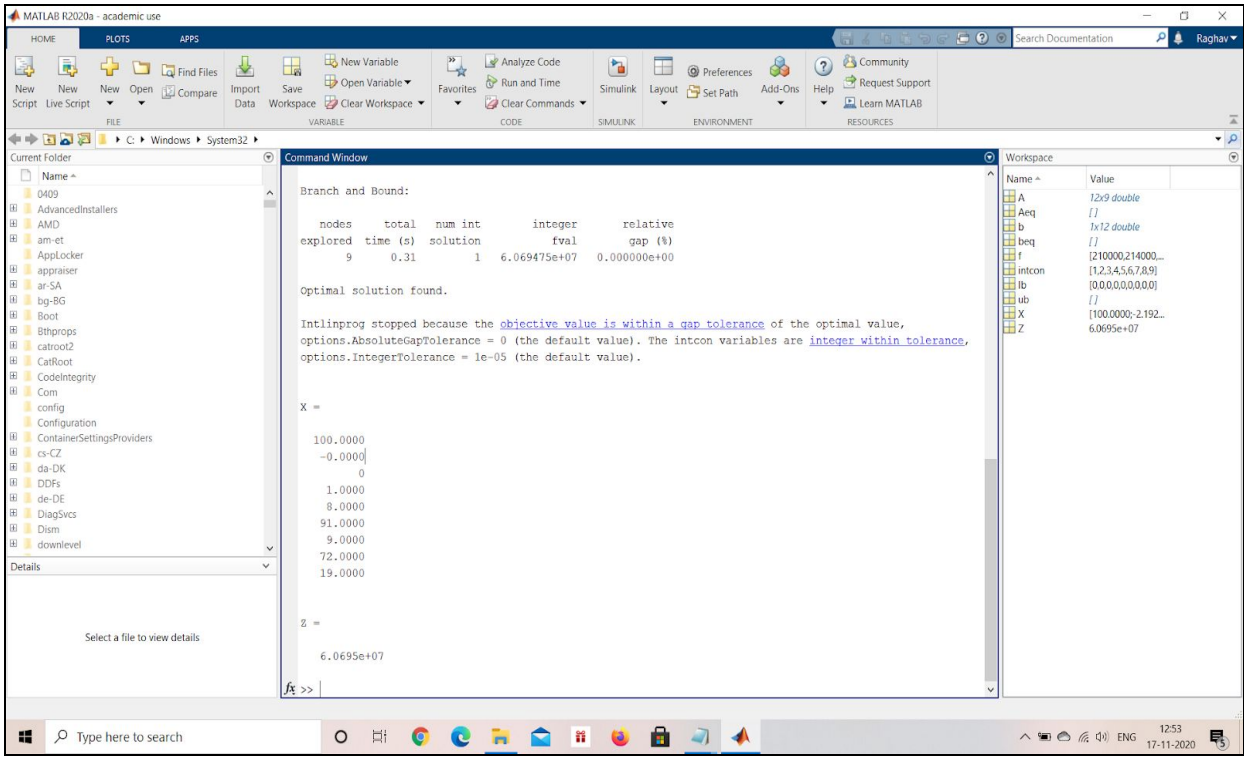


- f = Coefficient of Variables in Objective function (Matrix of 1 x 9)
- A = Coefficient of Variables of Constraints (Matrix of 12 x 9)
- b = Limits of Constraints (Matrix of 1 x 12)
- Aeq = Coefficient of Variables of Constraints having equality sign(Null matrix)
- beq = Limits of Constraints having equality sign (Null matrix)
- intcon = Variables having integer values (Here all variables should be an integer)
- lb = Lower Bound of all Variables (All have 0 lower bounds)
- ub = Upper Bound of all Variables (All have infinity)
- X = Values of Variables at Optimal Solution
- Z = Value of Objective function at Optimal Solution

OBJECTIVE - 2

QUESTION:

Now the Transport department of India (TDI) wants to transport the awarded contracts of manufacturers from their respective warehouses to their corresponding states. Two transporters have placed certain bids to transport these supplies. TDI needs to minimize the cost.

The following tables are for the same.

Transporter	RAJASTHAN	DELHI	BANGALORE
Transporter 1	390	550	445
Transporter 2	400	490	450

This table shows prices(in Rupee) offered by transporters for different states

Transporter	LIMIT
Transporter 1	150
Transporter 2	150

This table shows the limit of contracts transported by each transporter

SOLUTION:

FORMULATION:

For the formulation of the above problem, we need to define some notations that are given below:-

Notations	Definition
T1R	No. of contracts transported by transporter 1 in Rajasthan
T2R	No. of contracts transported by transporter 2 in Rajasthan
T1D	No. of contracts transported by transporter 1 in Delhi
T2D	No. of contracts transported by transporter 2 in Delhi
T1B	No. of contracts transported by transporter 1 in Bangalore
T2B	No. of contracts transported by transporter 2 in Bangalore

OBJECTIVE FUNCTION:

TDI needs to minimize the cost.

Minimize:
Z = 390*T1R + 400*T2R + 550*T1D + 490*T2D + 445*T1B + 450*T2B

Subject to Constraints:

- T1R + T2R = M1R + M2R + M3R

No. of transported contracts must be equal to no. of awarded contracts

- T1D + T2D = M1D + M2D + M3D

No. of transported contracts must be equal to no. of awarded contracts

- T1B + T2B = M1B + M2B + M3B

No. of transported contracts must be equal to no. of awarded contracts

- T1R + T1D + T1B <= 150

Total contracts transported by transporter-1 cannot exceed 150

- T2R + T2D + T2B <= 150

Total contracts transported by transporter-2 cannot exceed 150

- T1R,T2R,T1D,T2D,T1B,T2B >= 0

Method Used: Integer Linear Programming
Reason: Here we used INTEGER LINEAR PROGRAMMING because the number of contracts transported by a particular transporter should be an integer value.

RESULT:

Z = 390*T1R + 400*T2R + 550*T1D + 490*T2D + 445*T1B + 450*T2B

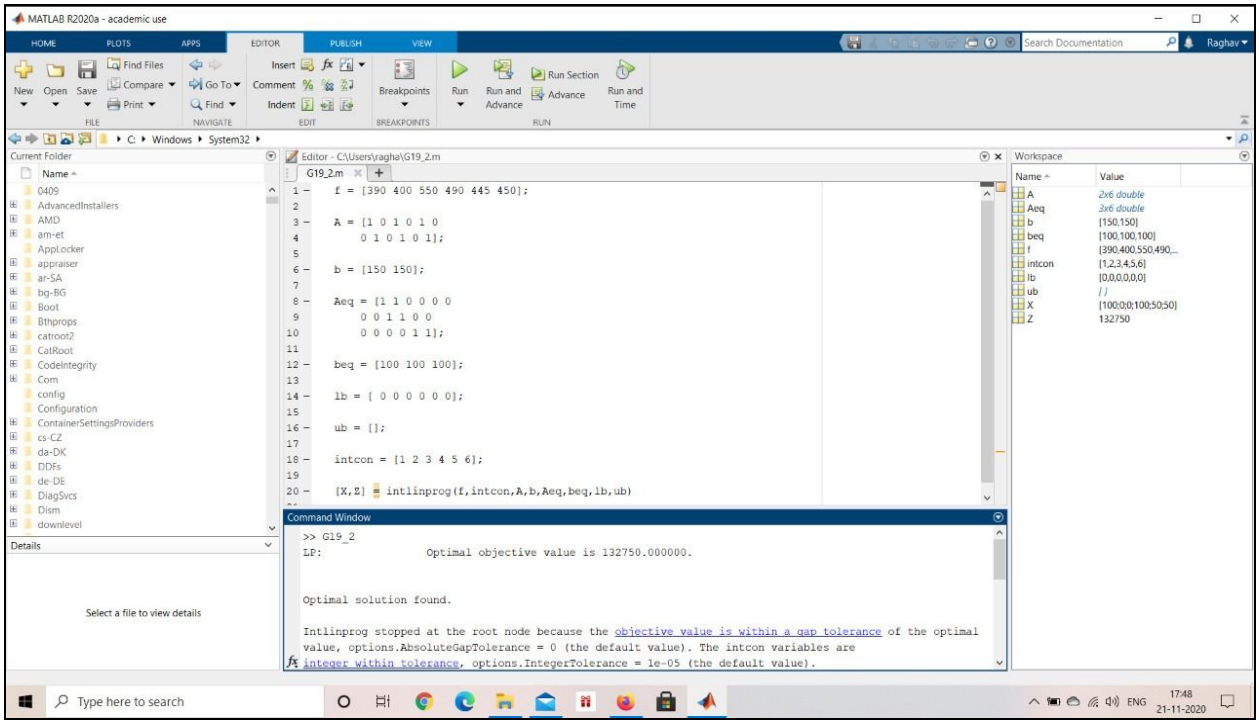
T1R = 100, T2R = 0,
T1D = 0, T2D = 100,
T1B = 50, T2B = 50

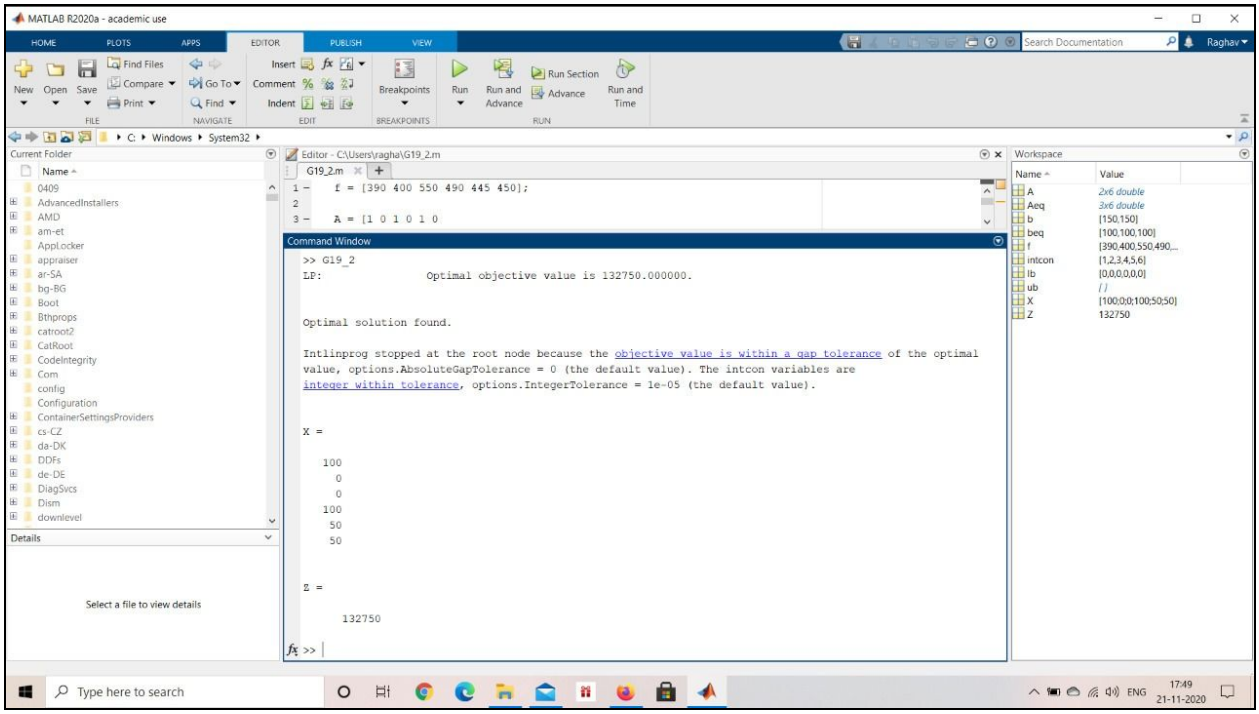
min Z = 390*100 + 400*0 + 550*0 + 490*100 + 445*50 + 450*50

min Z = 132750

The minimum cost of the sale is **Rs. 1,32,750**

MATLAB CODE:





- f = Coefficient of Variables in Objective function (Matrix of 1 x 6)
- A = Coefficient of Variables of Constraints (Matrix of 5 x 6)
- b = Limits of Constraints (Matrix of 1 x 5)
- Aeq = Coefficient of Variables of Constraints having equality sign(Null matrix)
- beq = Limits of Constraints having equality sign (Null matrix)
- intcon = Variables having integer values (Here all variables should be an integer)
- lb = Lower Bound of all Variables (All have 0 lower bounds)
- ub = Upper Bound of all Variables (All have infinity)
- X = Values of Variables at Optimal Solution
- Z = Value of Objective function at Optimal Solution