IOSR Journal of Mathematics (IOSR-JM)
e-ISSN: 2278-5728, p-ISSN: 2319-765X. Volume 19, Issue 2 Ser. I (Mar. – Apr. 2023), PP 53-61
www.iosrjournals.org

Optimal Mix of Two or Moreproducts to Maximize the Contribution of Linear Programming Problem

Bhawna Agrawal[a], Mohammad shafi bhat[b]
a, b Department of Mathematics, Rabindranath Tagore University, Bhopal, India,
bhawnakhushiagrawal@gmail.com, shafimohiuddin38@gmail.com

ABSTRACT
In this paper, a mathematical model is prepared for solvingoptimal mix of two or more products to maximize the contributionof linear programming problemusing graphical method. An optimization is founded by solving LPP both by manually and technically as an excel solver software. We get the basic feasible solution of LPP and trying to maximize the production with limited time hourand limited contribution.For Linear programming based optimization problems, Solver makes Linear programming very easy. It can forget difficult Simplex methods and Graphical methods. Solver takes care of the Mathematical programs of the Linear programming problem to be able to use solver we need to ensure to solver has been installed. Number of techniques can be used but an excel solver is readily available in any windows platform with easy to use with accuracy result.

KEYWORDS
Linear programming, Graphical methods, excel solver, LPP.

Date of Submission: 05-03-2023 Date of Acceptance: 17-03-2023

I. INTRODUCTION

Linear programming is a tool for solving optimization problems in industries as diverse as banking, education, petroleum, forestry and trucking.In a linear programming model the decision variables should completely describe the decision to be made.

An Operation research deals with optimum feasible result by number of methods which saves time, costs, less raw material. Operation research is a business based model.Optimization is a relevant topic and can be said as a way or root of life with finite resources and limited time. For solving supply chain problems uses time productively we use optimization. It is interesting and key topic for data science.

Let us consider a problem maze Furniture's makes chairs and tables that have to be processed through two machines M1 and M2. The time in hours required to make one table and one chair are given below.

Total of 200 hours are available on Machines M1 and 400 hours on M2. Contribution from the sale of a chair is Rs 30 and from a table is Rs 40. Determine the optimal mix of tables and chairs so as to maximize the contribution.

Formulate the problem:
Maximize $Z = 40x + 30y$
Subject to constraint
$7x + 4y \leq 200$
$5x + 5y \leq 400$
$x \geq 0, y \geq 0$

Manually solved
To solve above we need to understand that this is classical and simple LPP.
The objective is clear we need to maximize the contribution the decision variables, number of tables and chairs to be made and the constraints of the capacity of machines M1 and M2.

Given

x	y		
7	4	≤	200
5	5	≤	400

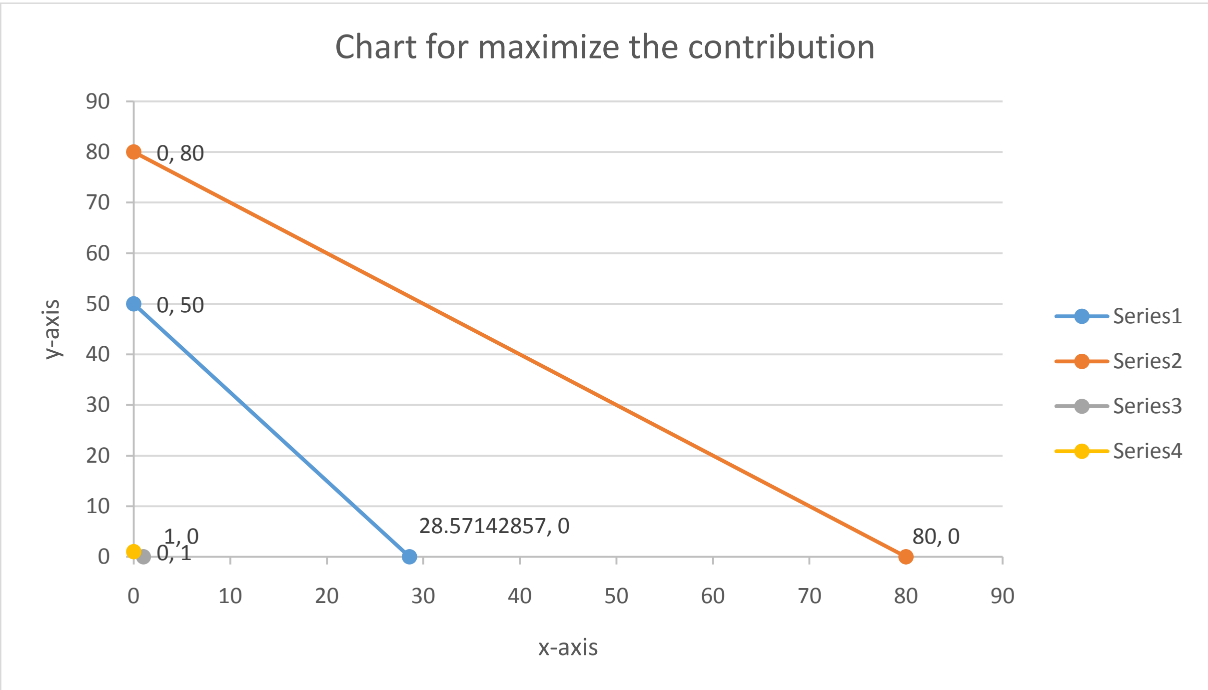
1	0	≥	0
0	1	≥	0

Convert all the constraints inequality to equality.

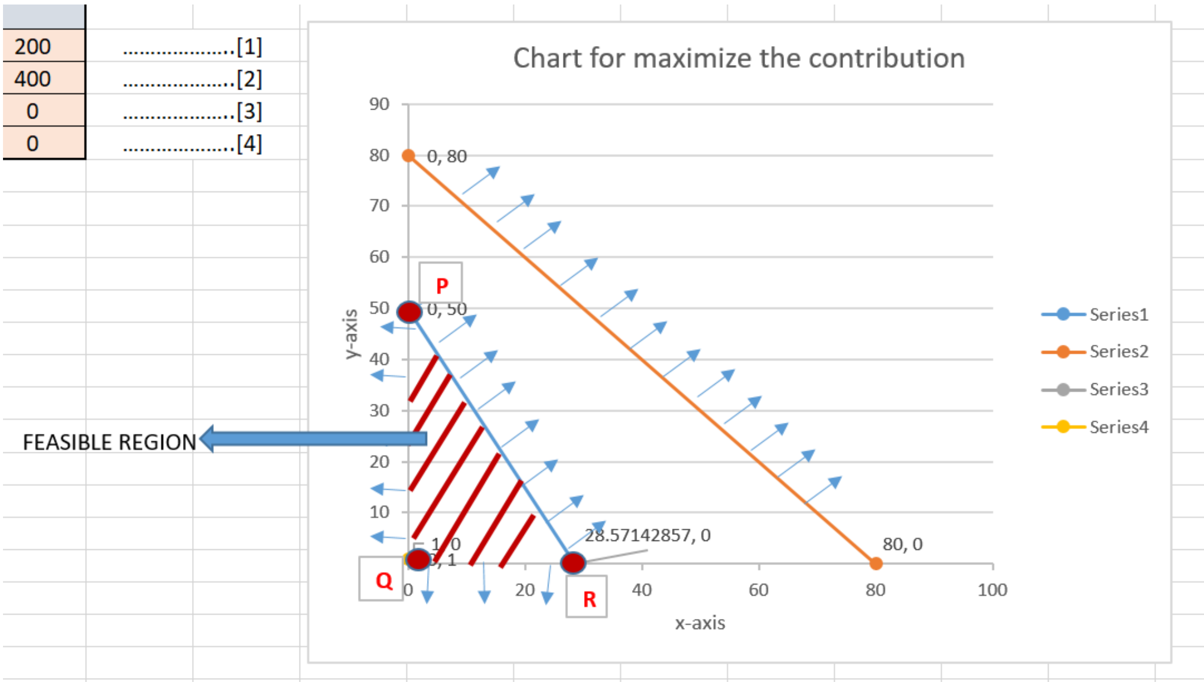
x	**y**			
7	4	=	200	………………..[1]
5	5	=	400	………………..[2]
1	0	=	0	………………..[3]
0	1	=	0	………………..[4]

INTERCEPTS

x	Y
0	50
28.57143	0
0	80
80	0
1	0
0	1



Using excel-sheet feasible solution is founded by plotting graph of all three equations.
Series 1 shows equation [1] with blue line
Series 2 shows equation [2] with orange line
Series 3 shows equation [3]with gray line



POINT----P

X	7	4	≤	200
Y	0	1	≥	0

X	28.57143
Y	0

POINT----Q

X	1	0	≥	0
Y	0	1	≥	0

X	0
Y	0

POINT----R

X	7	4	≤	200
Y	1	0	≥	0

X	0
Y	50

Maximize Z = 40 x + 30 y

	X	Y	Z
P	28.571	0	**1142.84**
Q	0	0	**0**
R	0	50	**1500**

Thus by manually we obtained contribution of Rs 1500.

Now by Excel Solver

Machine	Table	Chair
M1	7	4
M2	5	5

[A] Formulate part

Step 1. Initially put decision variables.

	Table	Chair	Total
Decision Variable			
Contribution	40	30	
M1	7	4	200
M2	5	5	400

Step 2. Now to Formulate. Next contribution that has been given to us i.e., tables makes us 40 Rs and chair makes us 30 Rs. Total contribution is equal to contribution of one table multiply by number of tables to contribution of one chair multiply by number of chairs.

	Table	Chair		Total
Decision Variable				
ontribution	40	30		0
M1	7	4		200
M2	5	5		400

=C59*C58+D59*D58

Step3. First contribution is the capacity of machine M1-----
Each table on M1 needs 7 hours and each chair on M1 needs 4 hours. The total capacity used is equals to the time taken by 1 table multiply by number of tables addition with time taken by 1 chair multiply by number of chairs.

Similarly,
Each table on M2 needs 5 hours and each chair on M2 needs 5 hours. The total capacity used is equals to the time taken by 1 table multiply by number of tables addition with time taken by 1 chair multiply by number of chairs.

	Table	Chair		Total
Decision Variable				
Contribution	40	30		0
M1	7	4		0
M2	5	5		0

=C61*C58+D61*D58

=C62*C58+D62*D58

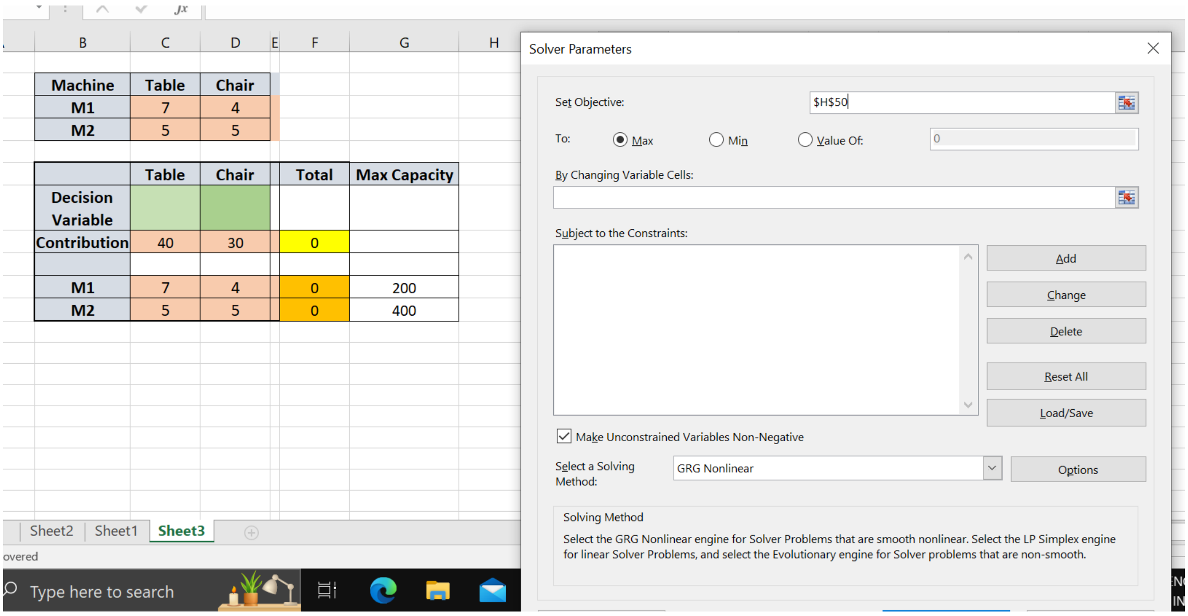
Thus we obtained;

	Table	Chair		Total
Decision Variable				
Contribution	40	30		0
M1	7	4		0
M2	5	5		0

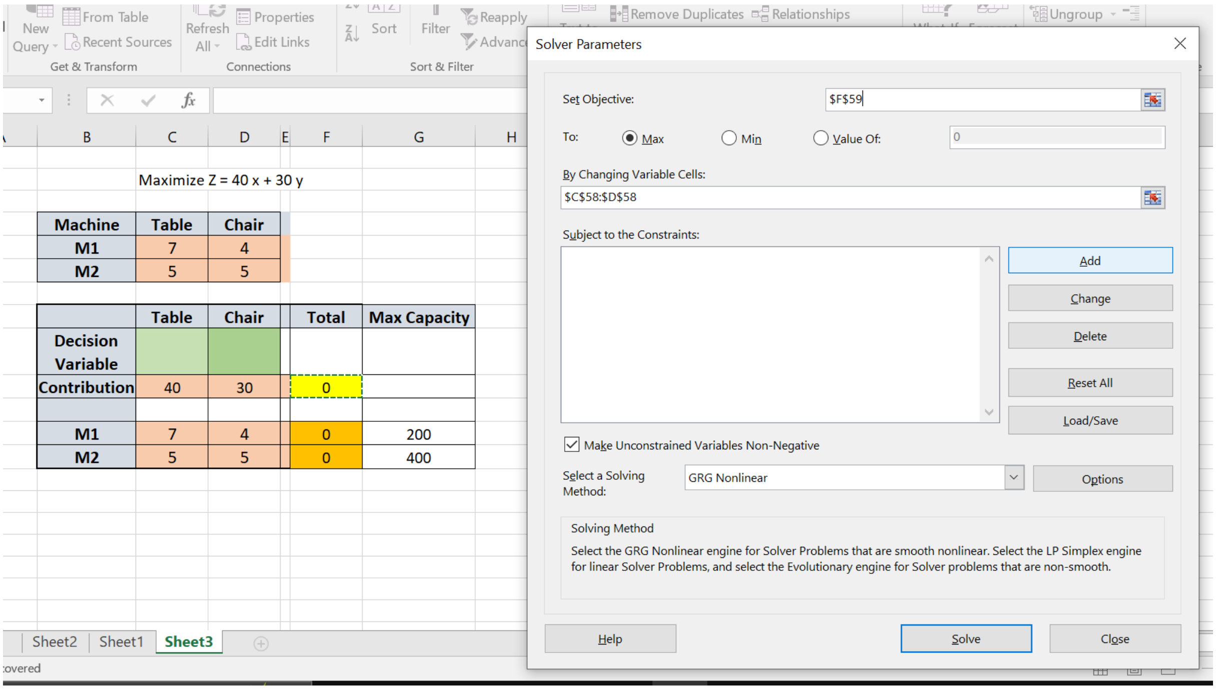
*Step 4. Now Add the available capacity*i.e., maximum capacity of M1 is 200 and M2 is 400.

	Table	Chair		Total	Max Capacity
Decision Variable					
Contribution	40	30		0	
M1	7	4		0	200
M2	5	5		0	400

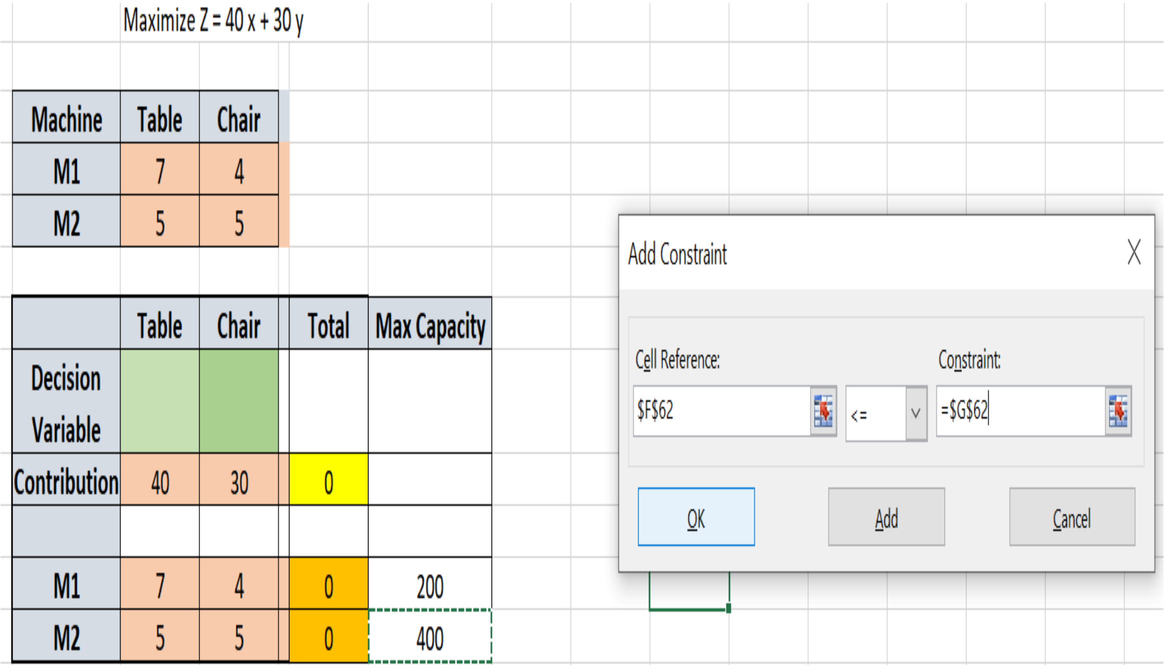
Step 5. ***Now the solver part on excel-sheet***
Move to Data in menu-bar then click to solver we get



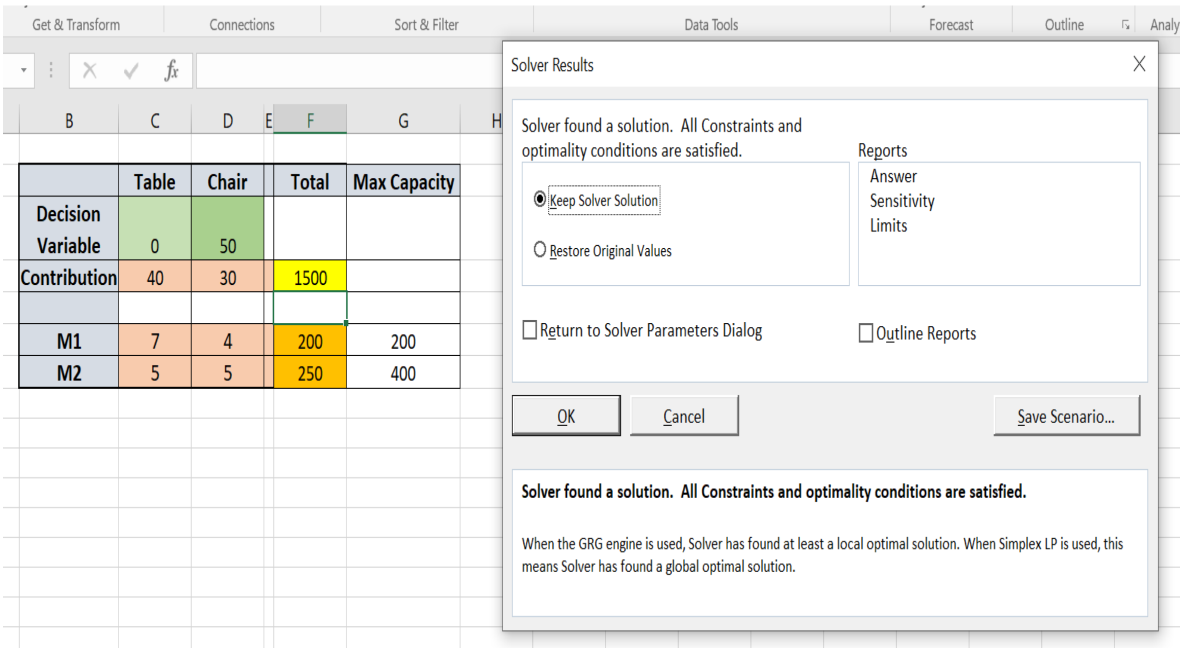
Next
For set objective Total cost is maximize i.e., yellow portion
Also for changing variable cell select table and chair of decision variable i.e., green portion



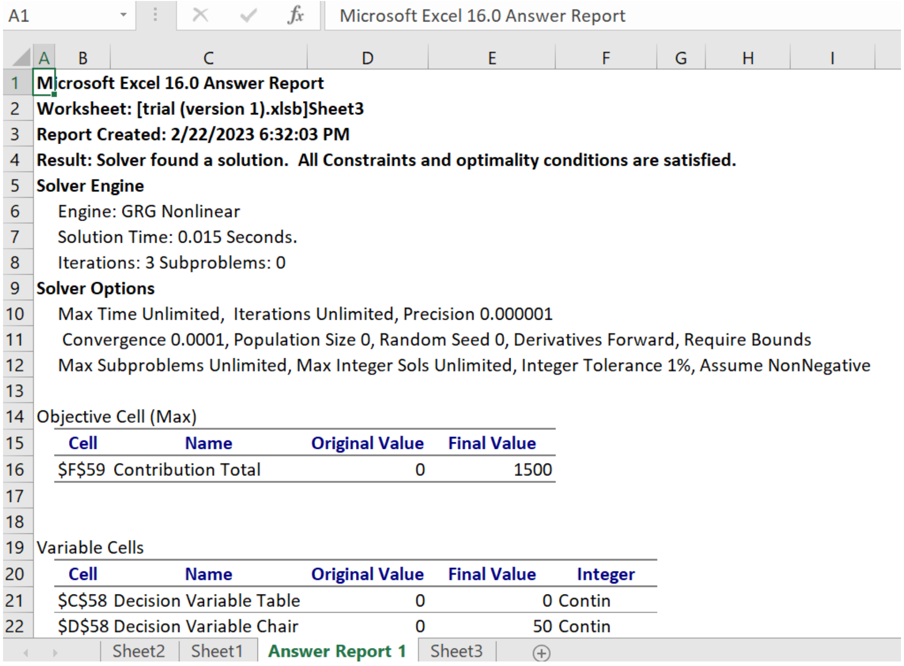
Press Add



Then after we obtained after pressing ok button.



Answer Report



A1 Microsoft Excel 16.0 Answer Report

Microsoft Excel 16.0 Answer Report
Worksheet: [trial (version 1).xlsb]Sheet3
Report Created: 2/22/2023 6:32:03 PM
Result: Solver found a solution. All Constraints and optimality conditions are satisfied.
Solver Engine
Engine: GRG Nonlinear
Solution Time: 0.015 Seconds.
Iterations: 3 Subproblems: 0
Solver Options
Max Time Unlimited, Iterations Unlimited, Precision 0.000001
Convergence 0.0001, Population Size 0, Random Seed 0, Derivatives Forward, Require Bounds
Max Subproblems Unlimited, Max Integer Sols Unlimited, Integer Tolerance 1%, Assume NonNegative

Objective Cell (Max)

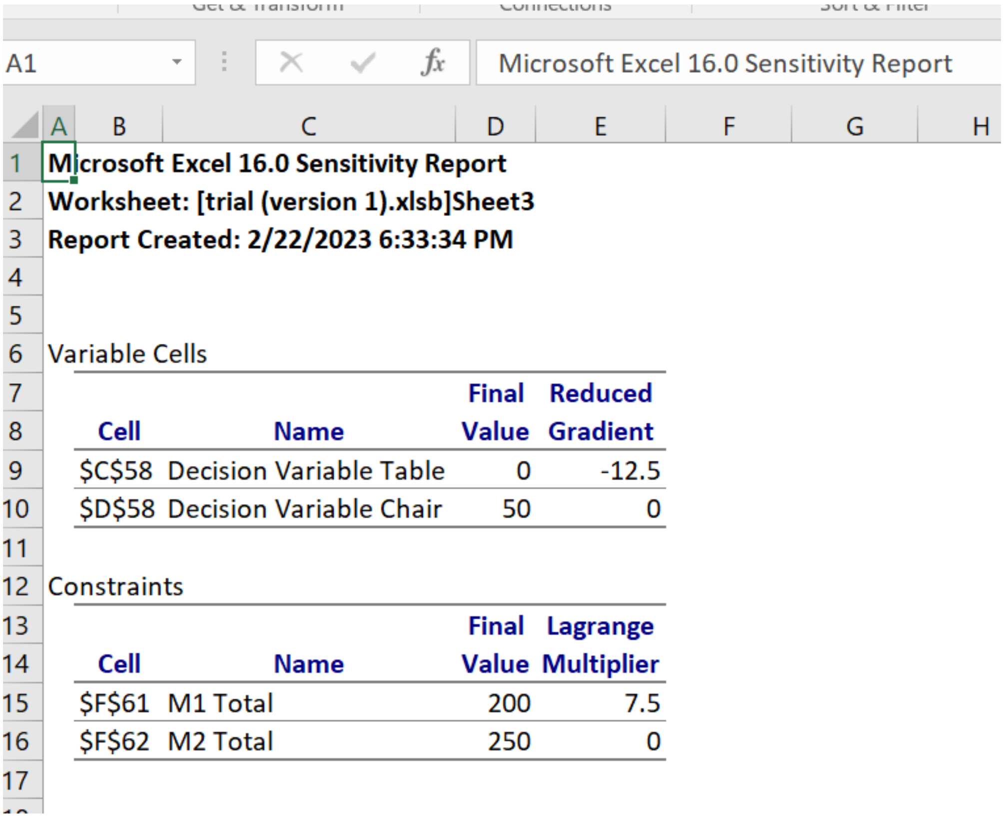
Cell	Name	Original Value	Final Value
F59	Contribution Total	0	1500

Variable Cells

Cell	Name	Original Value	Final Value	Integer
C58	Decision Variable Table	0	0	Contin
D58	Decision Variable Chair	0	50	Contin

Sheet2 | Sheet1 | Answer Report 1 | Sheet3

Sensitive Report



A1 Microsoft Excel 16.0 Sensitivity Report

Microsoft Excel 16.0 Sensitivity Report
Worksheet: [trial (version 1).xlsb]Sheet3
Report Created: 2/22/2023 6:33:34 PM

Variable Cells

Cell	Name	Final Value	Reduced Gradient
C58	Decision Variable Table	0	-12.5
D58	Decision Variable Chair	50	0

Constraints

Cell	Name	Final Value	Lagrange Multiplier
F61	M1 Total	200	7.5
F62	M2 Total	250	0

Limit Report

Microsoft Excel 16.0 Limits Report
Worksheet: [trial (version 1).xlsb]Sheet3
Report Created: 2/22/2023 6:34:39 PM

Cell	Objective Name	Value
F59	Contribution Total	1500

Cell	Variable Name	Value	Lower Limit	Objective Result	Upper Limit	Objective Result
C58	Decision Variable Table	0	0	1500	0	1500
D58	Decision Variable Chair	50	0	0	50	1500

II. CONCLUSION

Usingmathematical model, we have contributed less amount with limited time to get good production of furniture's. As per solution we should make 50 chairs and no table and we will have the contribution of Rs 1500.We will completely utilize the capacity on machine M1 and we will utilize 250 out of 400 hours available on M2. Thus we obtained Answer report, sensitive report and limited report.

Thus the optimal mix of tables and chairs so as to maximize the contribution is done with graphical and solver method for solving LPP.

REFERENCES

[1]. Adukia, K. L., Agrawal, B. (2022). OPTIMAL SOLUTION OF ASSIGNMENT PROBLEM WITH THE HELP OF LEAST VALUE ALGORITHM. International Journal of Research and Analytical Reviews, 9(4), pp.335-341. http://ijrar.org/viewfull.php?&p_id=IJRAR22D2981 **DOI (Digital Object Identifier) -** http://doi.one/10.1729/Journal.32536

[2]. Adukia, K. L., Agrawal, B. (2022). Optimal solution of fuzzy linear programming problems for trapezoidal number by using method of matrix inversion. ©IJEDR 2022, 10(4), pp.80-84.https://www.ijedr.org/archive.php?vol=10&issue=4#IJEDR2204012

[3]. Agrawal, B., Kumar, S., & Sharma, G. OPTIMUM SOLUTION OF A TRANSPORTATION PROBLEM WITH AN EXCEL SOLVER. International Journal of Research and Analytical Reviews, 9(3), pp.892-901. http://ijrar.org/viewfull.php?&p_id=IJRAR22C1598 **DOI (Digital Object Identifier) -** http://doi.one/10.1729/Journal.33184

[4]. Agrawal, B., Kumar, P. (2022). AN APPROACH OF L.P.P METHOD-GAME PROBLEM USING SIMPLEX METHOD. International Journal of Research and Analytical Reviews, 9(4), pp.927-935.http://ijrar.org/viewfull.php?&p_id=IJRAR22D2939 **DOI (Digital Object Identifier) -** :http://doi.one/10.1729/Journal.33185

[5]. Agrawal, B., Singh, P. (2022). LINEAR PROGRAMMING IN AN OPERATION RESEARCH FOR OPTIMUM BEST SOLUTION IN REAL WORLD PROBLEM USING EXCEL SOLVER. International Journal of Research and Analytical Reviews, 9(4), pp.34-40. http://ijrar.org/viewfull.php?&p_id=IJRAR22D1602 **DOI (Digital Object Identifier) -** http://doi.one/10.1729/Journal.33183

[6]. Barnhart, C., Belobaba, P., &Odoni, A. R. (2003). Applications of operations research in theair transport1 industry. *Transportation Science*, *37*(4), pp. 368–391.

[7]. Gangrade, A., Agrawal, B., Kumar, S., &Mansuri, A. (2022). A study of applications of graph colouring in various fields. International Journal of Statistics and Applied Mathematics, 7(2), pp.51-53. DOI: 10.22271/maths.2022.v7.i2a.795.

[8]. Haider, Z., Fareed, R., Tariq, M. B., Usman, S., Uddin, N., & Khan, S. (2016). "Application of Linear Programming for Profit Maximization": A Case of Paints. *International Journal of Management Sciences and Business Research*, *5*(12), pp. 144–151.

[9]. Jain, Amit Kumar, et al. "Application of Linear Programming for Profit Maximization of a Pharma Company." *Journal of Critical Reviews* 7.12 (2020): pp. 1118-1123.

[10]. Kiok, L. T. (2009, June). Practical operations research applications for healthcare managers. *Annals of the Academy of Medicine Singapore*.

[11]. MohdBaki, S., & Cheng, J. K. (2021). A Linear Programming Model for Product Mix Profit Maximization in a Small Medium Enterprise Company. *International Journal of Industrial Management*, *9*, pp. 64 – 73.

[12]. Robinson, Lawrence W. "Baseball playoff eliminations: An application of linear programming." *Operations Research Letters* 10.2 (1991): pp. 67-74.

[13]. Shivlani, N. (2019). Applications of Operations Research in the food delivery industry. International Journal of Advance Research, 5(5), pp. 396–400.

[14]. Shrivastava, B., Agrawal, B., & Kumar, S. (2022). Fuzzy linear programming problem with α-cut and roubast ranking methods. International Journal of Statistics and Applied Mathematics, 7(2), pp.57-62.DOI: 10.22271/maths.2022.v7.i2a.797.

[15]. Soni, Kiran, and K. Saxena. "A study of applicability of waiting line model in health care: a systematic review." *Operation Research* 19.1 (2011): pp. 75-91.

[16]. Tewari, P., & Agrawal, B. (2022). A study of linear programming technique. International Journal of Statistics and Applied Mathematics, 7(2), pp 54-56. DOI: 10.22271/maths.2022.v7.i2a.796.