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Application of LLP for maximizing the profit of Karachiwala stores

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ABSTRACT

This study focuses on linear programming, which is one of the most widely used approaches in operations research. Linear programming is a mathematical method for finding the best solution to problems in which the aim and prerequisites are both linear. During World War II, the linear programming technique rose to prominence. Following WWII, linear programming became widely used in a variety of industries. This research sheds light on the linear programming assumptions and properties. It also discusses how to turn any problem into a linear programming problem if all of the assumptions are met.

INTRODUCTION

Operations Research (OR) began in Britain shortly before World War II, with the formation of teams of scientists to investigate the strategic and tactical issues that arise during military operations. The goal was to apply quantitative methodologies to determine the most efficient use of limited military resources. Following the war, various peacetime applications arose, resulting in the application of OR and management science to a wide range of businesses and occupations.

In mathematics, a linear programming problem is a system for determining the maximum or lowest value of any variable in a function; it is also known as an optimization problem. LPP aids in the development and solution of a decision-making problem using mathematical methods. The problem is usually expressed as a linear function that must be optimised while adhering to a set of restrictions. The most common application of LPP is in counselling management on how to make the most efficient and effective use of limited resources.

There are some standard types of Linear Programming formulations and the problem mentioned in this paper can have an entirely different formulation.

Formulation of Linear programming problems.

Steps of solving an LLP:

1. Recognize the choice factors and give them symbols such as X, Y, Z, and so on. These are the quantities we're looking for now.
2. Define all constraints as inequalities in regard to the decision variable.
3. In terms of the decision variables, formulate the objective function.

4. Add the non-negativity restrictions and conditions.

Steps for solving LPP through graphical method:

Step 1: Develop the goal function as well as all of the constraints functions for the LPP problems.
Step 2: Draw a graph of the viable area and locate the corner points. Inspection or solving the two equations of the lines intersecting at that location can yield the coordinates of the corner points.

Step 3: Create a table that shows the objective function's value at each corner point.
Step 4: Using the table from step 3, choose the best option. If the problem is a maximisation (minimization) problem, the optimal LPP solution corresponds to the greatest (smallest) value of the objective function.

Limitations of Linear Programming

1.Defining a specific objective function is difficult.

2. Even if a precise objective function is defined, it may be difficult to identify the numerous technological, budgetary, and other restrictions that may be present in achieving the goal.
3. It's possible that given a certain goal and a set of constraints, the constraints aren't directly expressible as linear inequalities.
4. Even if the aforementioned issues are resolved, predicting relevant values for the numerous constant coefficients that enter into a linear programming mode, such as pricing, remains a substantial challenge.

5. This method is based on the assumption of linear input-output relationships. This means that inputs and outputs can be multiplied, split, and added together. However, input-output relationships are not necessarily linear. The majority of relationships in real life are non-linear.
6. In product and factor markets, this technique presupposes perfect competition. Perfect competition, on the other hand, does not exist.
7. The LP method is predicated on the premise that returns are constant. In reality, a company's production returns are either falling or increasing.

Mathematical Formulation

The Linear Programming problem can be put in the following

form, which is also known as standard form of LPP.

Maximize (or Minimize)

$Z= c_1x_1+c_2x_2+\ldots\ldots.+c_nx_n$

Subject to constraints

$a_{11}x_1+a_{12}x_2+\ldots\ldots..+a_{1n}x_n(\leq,=,\geq)b_1$

$a_{21}x_1+a_{22}x_2+\ldots\ldots..+a_{2n}x_n(\leq,=,\geq)b_1$

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$a_{m1}x_1+a_{m2}x_2+\ldots\ldots.+a_{mn}x_n(\leq,=,\geq)b_1$

where $x_1, x_2,\ldots\ldots\ldots ,x_n \geq 0$

OBJECTIVE

to maximize the profit of karchiwala stores by finding an solution using LPP model

The problem

In our research paper we have taken a product from Karachiwala stores based out of Vizag, Andhra Pradesh. We have selected a specific product from the store which is shampoos and we have done our research on 5 different types of shampoos. These 5 different brands of shampoos will be our 5 constraints. The brands that we have taken are Pantene, Sunsilk, Head & Shoulders, Dove and Tressemme.

The table below shows the Monthly sales and yearly stock for 180mL shampoos and the price for 180mL is Rs. 130.

(For 180 mL) Data given below

Sno	Shampoo Brand	Monthy Sales	Yearly Stock
1.	Pantene	90	1200
2.	Sunsilk	100	1350
3.	Head & Shoulders	85	1110
4.	Dove	105	1400
5.	Tressemme	70	1000

The table below shows the Monthly sales and yearly stock for 90mL shampoos and the price for 90mL is Rs. 65.

(For 90 mL) Data given below

Sno	Shampoo Brand	Monthy Sales	Yearly Stock
1.	Pantene	45	650
2.	Sunsilk	50	700
3.	Head & Shoulders	40	600
4.	Dove	60	820
5.	Tressemme	30	500

The yearly stock was found by first finding out the yearly sales and depending upon the yearly sales, we found the data for yearly stock.

Based on data from the tables given above, we have calculated the profit Margin for for both 180 mL and 90 mL.

Profit Margin for Rs.130 = 52

Profit Margin for Rs.65 = 29

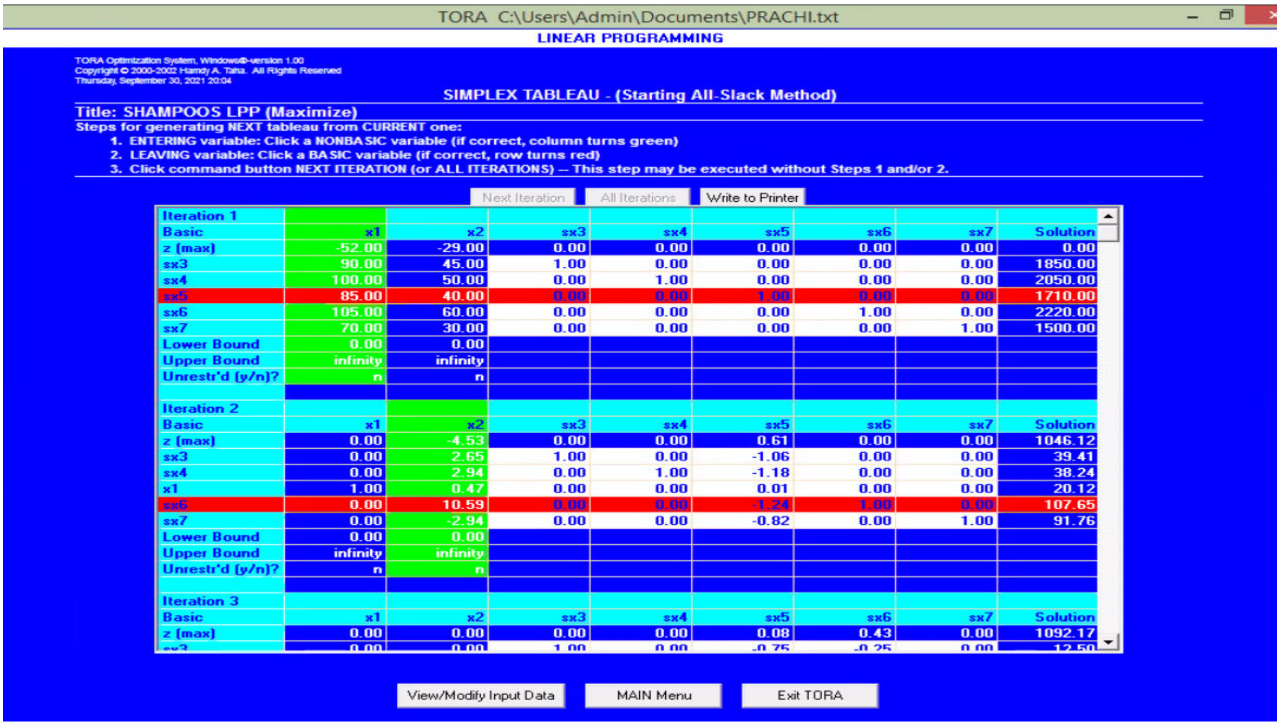
Here x_1 and x_2 are the the values by which the price needs to be increased.

So our Objective Function would be;

Max Z= $52x_1 + 29x_2$

Subject to constraints.

Sno	Shampoo Brand	Subject to Constraints
1.	Pantene	$90x_1 + 45x_2 \leq 1850$
2.	Sunsilk	$100x_1 + 50x_2 \leq 2050$
3.	Head & Shoulders	$85x_1 + 40x_2 \leq 1710$
4.	Dove	$105x_1 + 60x_2 \leq 2220$
5.	Tressemme	$70x_1 + 30x_2 \leq 1500$



TORA C:\Users\Admin\Documents\PRACHI.txt

LINEAR PROGRAMMING

TORA Optimization System, Windows®-version 1.00
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Thursday, September 30, 2021 20:04

SIMPLEX TABLEAU - (Starting All-Slack Method)

Title: SHAMPOOS LPP (Maximize)

Steps for generating NEXT tableau from CURRENT one:

1. ENTERING variable: Click a NONBASIC variable (if correct, column turns green)
2. LEAVING variable: Click a BASIC variable (if correct, row turns red)
3. Click command button NEXT ITERATION (or ALL ITERATIONS) -- This step may be executed without Steps 1 and/or 2.

Next Iteration | All Iterations | Write to Printer

Iteration 1								
Basic	x1	x2	sx3	sx4	sx5	sx6	sx7	Solution
z (max)	-52.00	-29.00	0.00	0.00	0.00	0.00	0.00	0.00
sx3	90.00	45.00	1.00	0.00	0.00	0.00	0.00	1850.00
sx4	100.00	50.00	0.00	1.00	0.00	0.00	0.00	2050.00
sx5	85.00	40.00	0.00	0.00	1.00	0.00	0.00	1710.00
sx6	105.00	60.00	0.00	0.00	0.00	1.00	0.00	2220.00
sx7	70.00	30.00	0.00	0.00	0.00	0.00	1.00	1500.00
Lower Bound	0.00	0.00						
Upper Bound	infinity	infinity						
Unrestr'd (y/n)?	n	n						
Iteration 2								
Basic	x1	x2	sx3	sx4	sx5	sx6	sx7	Solution
z (max)	0.00	-4.53	0.00	0.00	0.61	0.00	0.00	1046.12
sx3	0.00	2.65	1.00	0.00	-1.06	0.00	0.00	39.41
sx4	0.00	2.94	0.00	1.00	-1.18	0.00	0.00	38.24
x1	1.00	0.47	0.00	0.00	0.01	0.00	0.00	20.12
sx6	0.00	10.59	0.00	0.00	-1.24	1.00	0.00	107.65
sx7	0.00	-2.94	0.00	0.00	-0.82	0.00	1.00	91.76
Lower Bound	0.00	0.00						
Upper Bound	infinity	infinity						
Unrestr'd (y/n)?	n	n						
Iteration 3								
Basic	x1	x2	sx3	sx4	sx5	sx6	sx7	Solution
z (max)	0.00	0.00	0.00	0.00	0.08	0.43	0.00	1092.17
sx3	0.00	0.00	1.00	0.00	-0.75	-0.25	0.00	12.50

View/Modify Input Data | MAIN Menu | Exit TORA

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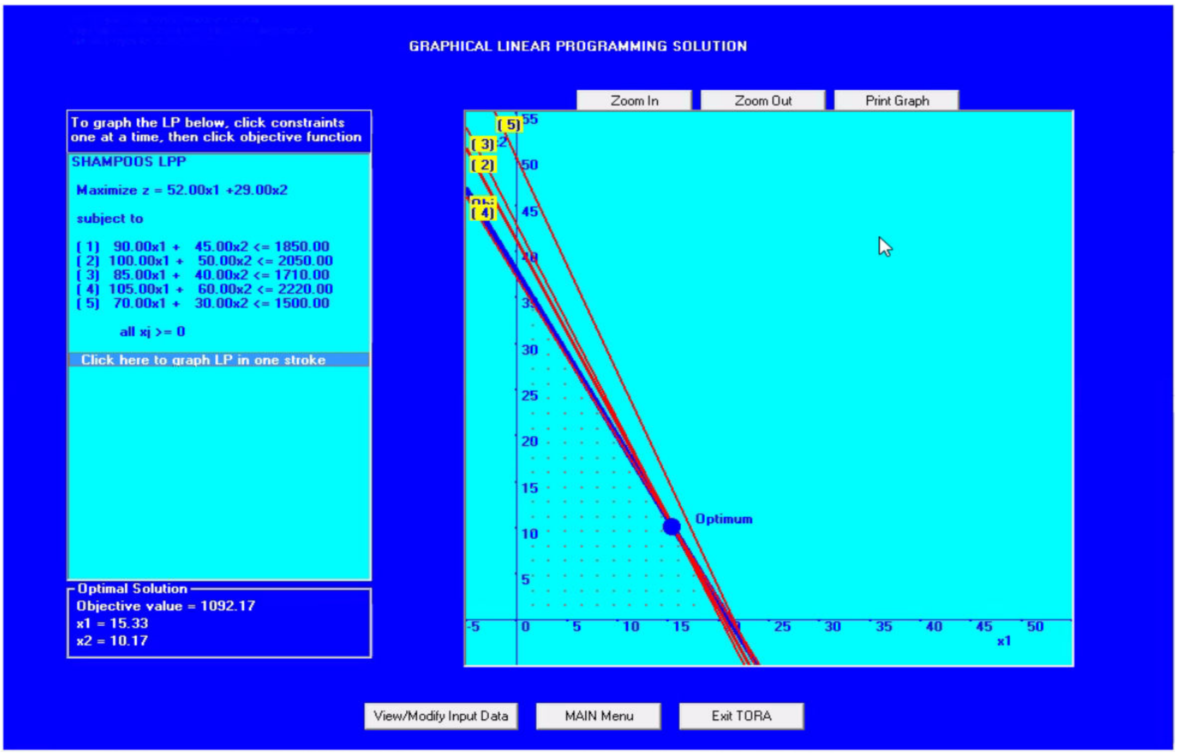
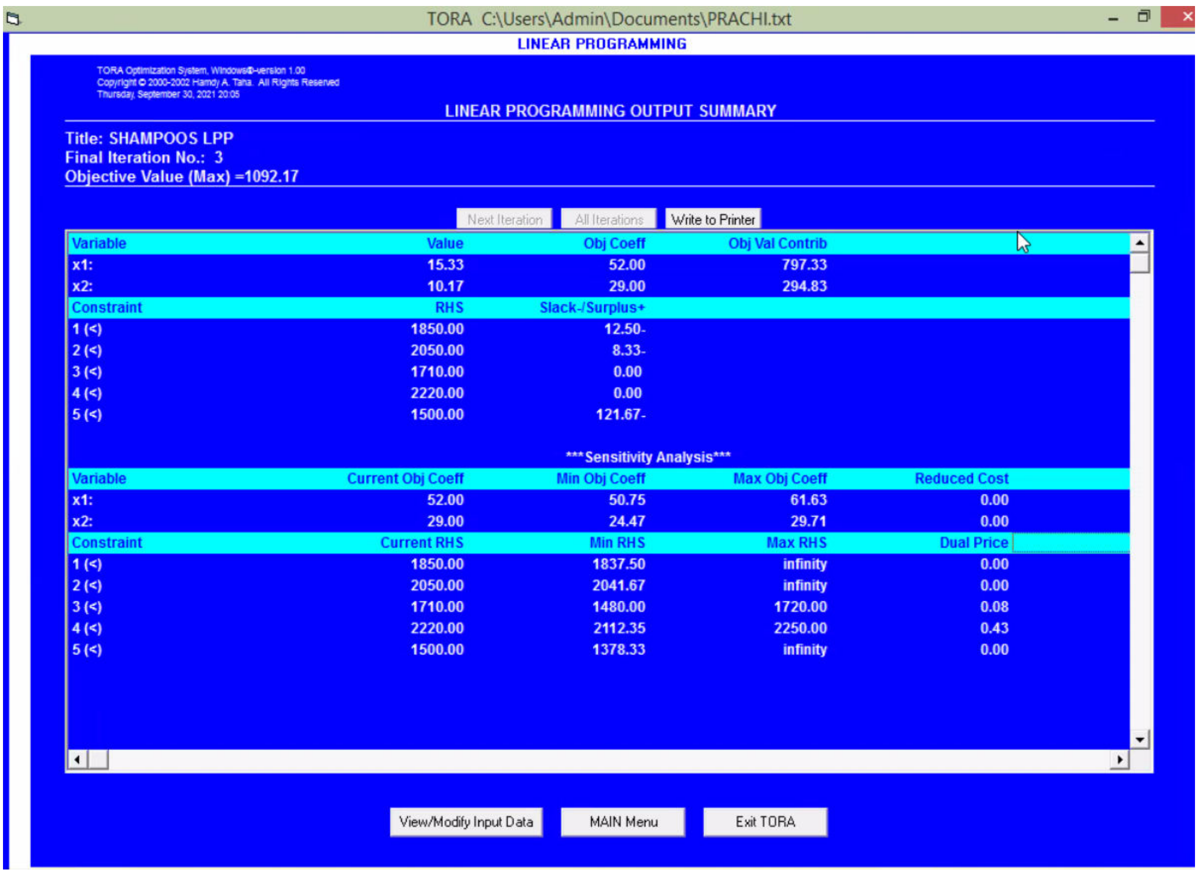


	x1	x2	Enter <, >, or =	R.H.S.
Var. Name				
Maximize	52.00	29.00		
Constr 1	90.00	45.00	<=	1850.00
Constr 2	100.00	50.00	<=	2050.00
Constr 3	85.00	40.00	<=	1710.00
Constr 4	105.00	60.00	<=	2220.00
Constr 5	70.00	30.00	<=	1500.00
Lower Bound	0.00	0.00		
Upper Bound	infinity	infinity		
Unrestr'd (y/n)?	n	n		



Variable	Value	Obj Coeff	Obj Val Contrib
x1:	15.33	52.00	797.33
x2:	10.17	29.00	294.83

Constraint	RHS	Slack-/Surplus+
1 (<)	1850.00	12.50-
2 (<)	2050.00	8.33-
3 (<)	1710.00	0.00
4 (<)	2220.00	0.00
5 (<)	1500.00	121.67-

Variable	Current Obj Coeff	Min Obj Coeff	Max Obj Coeff	Reduced Cost
x1:	52.00	50.75	61.63	0.00
x2:	29.00	24.47	29.71	0.00

Constraint	Current RHS	Min RHS	Max RHS	Dual Price
1 (<)	1850.00	1837.50	infinity	0.00
2 (<)	2050.00	2041.67	infinity	0.00
3 (<)	1710.00	1480.00	1720.00	0.08
4 (<)	2220.00	2112.35	2250.00	0.43
5 (<)	1500.00	1378.33	infinity	0.00

CONCLUSION:

the solution provided could be one of the most suitable solution to the problem and by this karachiwala stores can maximize their profit on shampoos.

References:

https://www.journalcra.com/sites/default/files/issue-pdf/28508.pdf

https://www.arsdcollege.ac.in/wp-content/uploads/2020/03/LPP-Business-Mathematics-1.pdf.