IMPLEMENTATION OF OPTIMIZATION MODEL THROUGH MEDIA SELECTION

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **MOHANAPRIYA.V(39630007)** who carried out the project entitled "**IMPLEMENTATION OF OPTIMIZATION MODEL THROUGH MEDIA SELECTION**" under our supervision from **January 2021** to **April 2021.**

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DECLARATION

I **MOHANAPRIYA.V (39630007) hereby** declare that the Project Report entitled **"IMPLEMENTATION OF OPTIMIZATION MODEL THROUGH MEDIA SELECTION"** done by me under the guidance of **Dr. S. Maheswari** (Internal) at **Sathyabama Institute of Science and Technology** is submitted in partial fulfillment of the requirements for the award of Master of Science degree in Mathematics.

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ABSTRACT:

A Linear Programming Problem is formulated for a company whose advertising alternatives include Social media, Television, Newspaper and radio. Proposed problem gives maximum audience to the company through media selection. Solution of a problem is obtained by using the classical optimization technique simplex method and also by Tora software.

Key words:

Social media, Television, News paper and Radio

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CHAPTER-1

1. INTRODUCTION:

1.1 OPERATION RESEARCH:

The term Operations Research discovered during Second World War when U.S.A. and Great Britain's Armed Forces sought the assistance of Scientists to solve very complex strategical and tactical problems of warfare. Operations research employs mathematical logic to complex problems. Operations research mainly involves in solving diverse business problems and in planning and investigation of major operational decisions. Operations Research defines research on operations. Operations research is the organized application of modern science, mathematics and computer techniques to complex military, government, business or industrial problems arising in the direction and management of large systems of transport, materials and machines. The purpose is to provide the management with optimal solution, understanding and assessment of complex situation for arriving at best decisions. It is a method of mathematically based analysis for providing a quantities basis for management decisions. The application of scientific and especially mathematical methods to the study and analysis of problems involving complex systems also we can find out most economical distribution of the products to various centres from various warehouses. These techniques can be applied to determine best mix of the products for a plant with available resources, to allocate various jobs to different machines We can apply this technique to maximise cultivator's profit, involving cultivation of number of items with different returns and cropping time in different type of lands having variable fertility. Many financial decision making problems can be solved by using linear programming technique

1.2 LINEAR PROGRAMMING PROBLEM:

In Mathematics, **linear programming** is a method of optimizing operations with some constraints. The main objective of linear programming is to maximize or minimize the numerical value. It consists of linear functions which are subjected to the constraints in the form of linear equations or in the form of inequalities.

Linear programming is considered as an important technique which is used to find the optimum resource utilization. The term "linear programming" consists of two

words such as linear and programming. The word “linear” defines the relationship between multiple variables with degree one. The word “programming” defines the process of selecting the best solution from various alternatives.

Linear Programming is widely used in Mathematics and some other field such as economics, business, telecommunication, and manufacturing fields. In this article, let us discuss the definition of linear programming, its components, a simplex method with linear programming problems.

Table of Contents:

- Definition
- Components
- Characteristics
- Linear programming Method
- Simplex Method
- Graphical Method
- Applications
- Uses

Linear Optimisation may be defined as the problem of maximizing or minimizing a linear function which is subjected to linear constraints. The constraints may be equalities or inequalities. The optimisation problems involve the calculation of profit and loss. Linear programming problems are an important class of optimisation problems, that helps to find the feasible region and optimise the solution in order to have the highest or lowest value of the function.

Linear programming is the method of considering different inequalities relevant to a situation and calculating the best value that is required to be obtained in those conditions.

Some of the assumption taken while working with linear programming are:

- The number of constraints should be expressed in the quantitative terms
- The relationship between the constraints and the objective function should be linearAnd,

- The linear function (i.e., objective function) is to be optimised

Components of Linear Programming:

The basic components of the LP are as follows:

- Decision Variables
- Constraints
- Data
- Objective Functions

1.3 SIMPLEX METHOD

The Simplex Method or Simplex Algorithm is used for calculating the optimal solution to the linear programming problem. In other words, the simplex algorithm is an iterative procedure carried systematically to determine the optimal solution from the set of feasible solutions.

Firstly, to apply the simplex method, appropriate variables are introduced in the linear programming problem, and the primary or the decision variables are equated to zero. The iterative process begins by assigning values to these defined variables. The value of decision variables is taken as zero since the evaluation in terms of the graphical approach begins with the origin. Therefore, x_1 and x_2 is equal to zero.

The decision maker will enter appropriate values of the variables in the problem and find out the variable value that contributes maximum to the objective function and removes those values which give undesirable results. Thus, the value of the objective function gets improved through this method

LINEAR PROGRAMMING SIMPLEX METHOD

The simplex method is one of the most popular methods to solve linear programming problems. It is an iterative process to get the feasible optimal solution. In this method, the value of the basic variable keeps transforming to

obtain the maximum value for the objective function. The algorithm for linear programming simplex method is provided below:

Step 1: Establish a given problem. (i.e.,) write the inequality constraints and objective function.

Step 2: Convert the given inequalities to equations by adding the slack variable to each inequality expression.

Step 3: Create the initial simplex tableau. Write the objective function at the bottom row. Here, each inequality constraint appears in its own row. Now, we can represent the problem in the form of an augmented matrix, which is called the initial simplex tableau.

Step 4: Identify the greatest negative entry in the bottom row, which helps to identify the pivot column. The greatest negative entry in the bottom row defines the largest coefficient in the objective function, which will help us to increase the value of the objective function as fastest as possible.

Step 5: Compute the quotients. To calculate the quotient, we need to divide the entries in the far right column by the entries in the first column, excluding the bottom row. The smallest quotient identifies the row. The row identified in this step and the element identified in the step will be taken as the pivot element.

Step 6: Carry out pivoting to make all other entries in column is zero.

Step 7: If there are no negative entries in the bottom row, end the process. Otherwise, start from step 4.

Step 8: Finally, determine the solution associated with the final simplex tableau.

CHAPTER-2

2.1 Literature Survey:

- ✓ M.L. Vidale, H.b.WolfeOR(1957)

  An operations Research study of sales response to advertising

  This paper presents the results of studies for major industrial concerns on the sales response to advertising. A simple model of the interaction of advertising and sales is described that is consistent with the results of controlled experiments performed on a large number of products and several media. The model is based on three parameters Sales Decay Constant, Saturation Level, and Response Constant. It has proved useful for analyses of advertising campaigns and for allocations of advertising appropriations.

- ✓ Bass F.a(1966)

  "An exploration of linear programming in media selection" Journal marketing Research

  This article explores operational details of the application of linear programming to advertising media selection. The influence of weighting systems used to adjust audience data and various restraint systems is examined with actual data as inputs.

- ✓ Kerney,R.L.(1994)

  "using values in operation research"

  Values pervade the field of operations research. Expressed as objectives, goals, criteria, performance measures, and/or objective functions, they are necessary in theoretical operations research models and in applications. Because of their critical role, it is useful to develop these expressions of values from basic principles. This paper outlines how to identify values for a specific decision problem, how to structure these values to facilitate thinking and analysis, and how to quantify values. Since values provide the basis for interest in a problem, these same values should guide all of our effort on that problem. Two important uses of values are to create better alternatives for decision problems and to define decision problems that are more

appealing than those that confront us. On another level, the operationsresearcher's values are crucial in selecting the research and applications that he or she pursues. I illustrate this with a brief summary of a few projects concerning both life-threatening risks and the storage of nuclear waste. The presentation concludes with a challenge to operations researchers to consider devoting some effort and talent to what I think of as the mega-risks facing

- ✓ Les, A..M and Burkart A.J.(1960)

"some optimization problem in advertising media planning, Operational Research quarterly"

This is an account of the first stage of a multi-stage research programme in the planning of advertising media schedules. The problems of securing maximum impact and maximum coverage in an intense campaign of short duration for a fixed outlay are discussed. A precise solution of the Impact problem and an approximate solution of the Coverage problem are outlined. These solutions are currently being used, but test results are not yet available. This is, therefore, an interim statement and not a completed case history.

- ✓ Douglas B Brown and warshawmarfin.R(1965)

"media selection by linear programming" Journal of marketing

Linear programming models for media selection have limited application because the function describing the aggregate response to additional inputs of advertising effort is generally non-linear. The authors present a general media mix model which assumes linear response and illustrate how the model can be modified to accommodate non-linearity while still using the revised simplex method as a solution algorithm.

- ✓ Aaker, David 1975 ADMOD;

An advertising decision model Journal of marketing Research

ADMOD is an advertising decision model which is designed to address simultaneously the budget decision, the copy decision, and the media-

allocation decision. The model, which focuses upon specific consumer decisions that advertising is attempting to precipitate, is illustrated with an example

✓ Brown, D B and M R warshaw 1965

media selection by linear programming. Journal of marketing Research

Because efficient media selection is a complex process, and because media costs are essentially linear, the most promising technique for media selection is linear programming. To improve its usefulness, it will first be necessary to collect more detailed readership data and to utilize more realistic restraints.

✓ Rust Roland T. 1985

“selecting network television advertising schedules Journal of Business Research

A model is presented that is designed to select television advertising schedules. Emphasis is placed on the ways in which the model accommodates practical managerial considerations in the advertising schedule selection process. The formulation of the model is reviewed, and its operationalization is illustrated using a readily available syndicated data source. All advertisers face the problem of how to allocate their advertising budgets. In recent years, a well-developed stream of research has emerged, with the goal of making these decisions more scientific. Especially significant have been the media allocation models of Little and Lodish [16, 171, Gensch [9, 111, and Aaker [l]. These models have served to provide an increasingly sophisticated view of the considerations with whichadvertisers explicitly and implicitly concern themselves. These models havetypically been designed for use with any or all of the common advertisingmedia and thus could not incorporate the special characteristics of any one medium.

✓ Akarro R.R.J (1999)

“Advertising media selection in HIV/AIDS spread”. A case study of Dar es salaam janzanial faculty of arts and social science

The evidence base and theoretical frameworks for mass media HIV-prevention campaigns in the United States are not well-developed. We describe an intervention approach using culturally sensitive mass media messages to enhance protective beliefs and behavior of African American adolescents at risk for HIV. This approach exploits the potential that mass media messages have, not only to reach a large segment of the adolescent population and thereby support normative change, but also to engage the most vulnerable segments of this audience to reduce HIV-associated risk behaviors. The results from an ongoing HIV-prevention trial implemented in 2 medium-sized cities in the United States illustrate the effectiveness of this intervention approach.

✓ Gensch, D.H.(1967)

“ A computer simulation model for media selection “ph.D Thesis, North western university

The Ad-Me-Sim model describes a decision system for selecting the appropriate media vehicles for a given advertising message. Five sets of weeklyand cumulative outputs are used as criteria for determining which vehicles are most appropriate. The model also contains a heuristic subroutine that suggests appropriate media schedules when given the advertising goals of the user.

CHAPTER-3

3.1 AIM AND CONSTRUCTION OF MATHEMATICAL MODEL:

IMPLEMENTATION OF THE OPTIMIZATION MODEL

Objective: To find the maximum audience for a companyusing advertisement through media selection

PARAMETER:

- S = no of advertisement in social media
- T = no of advertisement in television
- N = no of advertisement in news paper
- R = no of advertisement in radio

ANALYSIS OF AN OPTIMIZATION PROBLEM

PROBLEM STATEMENT

The advertising alternatives for a company include social media, television, radio and newspaper advertisements. The costs and estimates for audience coverage are given in table

	Social media	Television	News paper	Ratio
cost per advertisement	$2500	$2000	$600	$300
Audience per	150000	100000	40000	18000

advertisement				

The local newspaper limits the number of weekly advertisement from a single company to ten.Moreover in order to balance the advertising among the four types of media, no more than half of the total numbers of advertisement should occur on the radio, and at least 10% should occur on socialmedia. The weekly advertising budget is $22,300. How many advertisement should be run in each of four types of media to maximize the total audience?

Objective constraints:

$$\max z = 1{,}50{,}000s + 1{,}00{,}000t + 40{,}000n + 18{,}000r$$

Subject to:

$$2500s + 2000t + 600n + 300r \leq 22300 \quad /100$$

$$25s + 20t + 6n + 3r \leq 223$$

$$n \leq 10$$

$$-s - t + n + r \leq 0$$

$$-9s + t + n + r \leq 0$$

$S, t, n \& r \geq 0$

CHAPTER-4

4.1 SOLUTION METHODOLOGY:

The stated problem can be solved by simplex method.The solution of the problem can be applied by simplex method.By introducing the new variable slack and is denoted by s1,s2,s3&s4

max z=150000s+100000t+40000n+18000r

The LPP becomes,

max z=150000s+100000t+40000n+18000r+0s1+0s2+0s3+0s4

subject to,

25s+20t+6n+3r+s1≤223

n+s2≤10

-s-t+n+r+s3≤0

-9s+t+n+r+s4≤0

and s, t, n,r,s1,s2,s3&s4≥0

		C_j	**150000**	100000	40000	18000	0	0	0	0	
C_B	Y_B	X_B	S	T	N	R	S1	S2	S3	S4	Ratio
0	S1	223	25	20	6	3	1	0	0	0	223/25 =8.92
0	S2	10	0	0	1	0	0	1	0	0	10/0
0	S3	0	-1	-1	1	1	0	0	1	0	0/-1
0	S4	0	-9	1	1	1	0	0	0	1	0/-9
			-150000	-100000	-40000	-18000	0	0	0	0	

TABLE:-1

X1 enters and s1 leaves

Key values=25

		C_J	150000	100000	40000	18000	0	0	0	0	
C_b	Y_B	X_B	S	T	N	R	S1	S2	S3	S4	Ratio
150000	S	223/25	1	4/5	6/25	3/25	1/25	0	0	0	223/6=37.2
0	S2	10	0	0	1	0	0	1	0	0	10/1
0	S3	223/25	0	-1/5	31/25	28/25	1/25	0	1	0	223/31=7.1935
0	S4	2007/25	0	-14/5	79/25	52/25	9/25	0	0	1	2007/25=25.405
		3345000	0	20000	-4000	9000	6000	0	0	0	

Table-:2

X3 Enters and s3 leaves

Key value=31/25

		C_J	150000	100000	40000	18000	0	0	0	0
C_B	Y_B	X_B	S	T	N	R	S1	S2	S3	S4
150000	S	223/31	1	26/31	0	3/31	1/31	0	-6/31	0
0	S2	27/25	0	1/5	-6/25	-28/25	-1/25	1	-1	0
40000	N	223/31	0	-5/31	1	28/31	1/31	0	25/31	0
0	S4	1984/31	0	270/31	0	24/31	8/31	0	-397/31	
		1366774	0	19354	0	32645	6129	0	0	0

TABLE:-3

Since z_j-c_j≥0

The above iteration is optimal

max z=1366774

s=223/31=7

N=223/31

The another method to find solution Tora software

lpp
Iteration No.: 3
ctive Value (Max) =1366774.

Next Iteration | All Iterations | Write to Printer

able	Value	Obj Coeff	Obj Val Contrib
	7.	150000.	1079032.
	0.	100000.	0.
	7.	40000.	287742.
	0.	18000.	0.

straint	RHS	Slack-/Surplus+
	223.	0.
	10.	3.-
	0.	0.
	0.	58.-

Sensitivity Analysis

able	Current Obj Coeff	Min Obj Coeff	Max Obj Coeff	Reduced Cos
	150000.	126923.	166667.	0
	100000.	-infinity	119355.	19355
	40000.	36000.	160000.	0
	18000.	-infinity	21613.	3613

straint	Current RHS	Min RHS	Max RHS	Dual Price
	223.	0.	310.	6129
	10.	7.	infinity	0
	0.	-9.	3.	3226
	0.	-58.	infinity	0

TORA

MAXZ=1366774

S=7

N=7

CHAPTER 5

5.1 CONCLUSION:

Linear Programming Problem has been proposed to find the maximum audience of a company, by advertisement through Media selection. Advertising alternatives include Social media, television, newspaper and Radio. Solution of the problem is obtained by using one of the classical optimization method and TORA software for LPP.

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