

“OPTIMIZATION TECHNIQUE IMPLEMENTATION IN EDUCATIONAL CAMPUS”

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ABSTRACT:

Optimization is defined as a mathematical discipline that concerns the finding of the extreme of numbers i.e. minima or maxima. The Importance of optimization techniques in every Business management process or any types of organization. This paper is based on the Importance of optimization models. Assignment problem method finds numerous applications in production planning, telecommunication Very Large Scale Integration design, economic etc. Now, this paper defines the importance of optimization models in Management Institutes for staff-class allocation by using Hungarian Assignment Method. The research is used to find the optimal assignment schedule of staff-class allocation for A.Y.2017-18 in Management Institute & that will helps for Class Coordination & Teaching Learning Processes thereby improving the educational quality. Therefore, the Management Institute may benefit from the proposed approach for selection of staff to respective and appropriate class for optimal result.

KEYWORDS: *Assignment Problem, Staff-Class, Optimization Technique, Optimal Solution, Management etc.*

OBJECTIVES:

1. To study the importance of optimization models in Educational Organization.
2. To find the optimal schedule of staff-class allocation by using Hungarian Assignment.

1. INTRODUCTION

Optimization Technique is the act of achieving the best possible result under given circumstances. The Optimization Technique is used for management decision making process. The main objective of all such decisions is either to minimize effort or to maximize benefit. The benefit can be usually expressed as a function of certain design variables i.e. (x, y) . Hence, optimization is the process of finding the conditions that give the maximum or the minimum value of a function. In optimization Technique a number of methods have been developed for solving different types of problems because no single method available for solving all optimization problems efficiently. Optimization technique process is classifying our optimization model, since algorithms for solving optimization problems are tailored to a particular type of problem i.e. Linear Programming Problem, Assignment Models, Transportation Models, Markov Chains & Simulation Techniques, Decision Theory, Game Theory, Queuing Theory & CPM & PERT etc.

Assignment is a typical optimization technique practically useful in a situation where a certain number of task are required to be assigned to an equal number of facilities on a one to one basis so that the resultant effectiveness is optimized. The Assignment problem is one of the most useful optimization model methods to find the optimal solution. Every assignment problem has a rows & columns and is called as matrix or table.

2. LITERATURE REVIEW

Previous research was one of the studies on the Optimal Assignment Schedule of Staff-Subject Allocation in Journal of Mathematical Finance, 2017 by Suleiman Kabiru, Bello Malam Saidu, Abdullahi Zubairu Abdul, Uba Ahmad Ali. This research mainly focused on assignment schedule in science subjects. The researcher is used two different methods i.e. the Hungarian method (Algorithm) and linear interactive & discrete optimization (LINGO) technique. The Teacher Assignment Problem for a University in Indonesia was published by Aldy Gunawan, K. M. Ng & H. L. Ong, for Information and Management Sciences in 2008. The objective of the assignment model is to maximize education quality. The assignment problem was developed by Farida Hanum, Mira A. Romliyah & Toni Bakhtiar in 2015 on topic “Exam Invigilators Assignment Problem: A Goal Programming Approach” the researcher focused on invigilator-exam assignment model which formulated in the form of non-preemptive goal programming framework.

3. ASSIGNMENT METHODS

There are many situations where the assignment of peoples, machines and so on. The assignment of workers to job for manufacturing industry, Salesmen to different sales areas for marketing & Teachers to different subject/class allocations for education system are typical examples of these. Four methods of assignment problem are as follows:

1. Complete Enumeration Method
2. Transportation Method
3. Simplex Method
4. Hungarian Method/Floods Technique

Above all methods are useful but the Hungarian Method is easy to understand for a balanced assignment problem (i.e. $m \times n$ where, m is rows & n is columns).

With the available information considered the C_{ij} for each task/job (i) & facility (j) combination

Where $i=1,2,3,\dots,n$ & $j=1,2,3,\dots,n$ for n number of task and facilities

3.1 MATHEMATICALLY FORMULATED AS:

Let, $X_{ij}=1$, if a task i is assigned to the j facility and

$X_{ij}=0$, if a task i is not assigned to the j facility

Then the objective is to optimize i.e. minimize or maximize total payoff

$$Z = \sum_{i=1}^n \sum_{j=1}^n C_{ij} X_{ij}$$

		Activity				Available
		A_1	A_2	.....	A_n	
Resource	R_1	c_{11}	c_{12}	.....	c_{1n}	1
	R_2	c_{21}	c_{22}	.....	c_{2n}	1
	\vdots	\vdots	\vdots	\vdots	\vdots	\vdots
	\vdots	\vdots	\vdots	\vdots	\vdots	\vdots
	R_n	c_{n1}	c_{n2}	.....	c_{nn}	1
Required		1	1	.....	1	

Table No.1: Assignment Problem Matrix/Table

The problem is to determine the assignment of the n tasks to the n facilities such that total payoff is optimized.

3.2 SUBJECT TO CONSTRAINTS

I. Every Task is to be assigned to one & only one facility.

$$X_{i1} + X_{i2} + \dots + X_{in} = 1,$$

For $i=1,2,3,\dots,n$

II. Every facility must be assigned to one & only one task.

$$X_{1j} + X_{2j} + \dots + X_{nj} = 1,$$

For $j=1,2,3,\dots,n$

III. $X_{ij} = 0$ or 1 ,

For all i and j

This problem can be solved more efficiently and quickly by using an assignment problem method known as the “**HUNGARIAN METHOD OF SOLUTION**”. This method also considered two types i.e. Balanced and Unbalanced assignment

- **Balanced Assignment:** Assignment problem is said to be balanced if there is equal number of rows and column.
- **Unbalanced Assignment:** The assignment problem is said to be unbalanced if it is not balanced.

3.3 ASSIGNMENT PROBLEM (HUNGARIAN METHOD) ALGORITHM:

1. Find the Cost matrix & check the given problem is balanced or not, if it is unbalanced then first convert the cost matrix into balanced by adding dummy row or column.
2. In the given ($n \times n$) assignment table /matrix, Subtract the smallest element in each row from every element in that row. i.e. **ROW REDUCTION**
3. Subtract the smallest element in each column from every element in that column i.e. **COLUMN REDUCTION**
4. Mark minimum number of lines row wise and column wise to cover all zeros (0), start with row or column having maximum number of zeros to mark the lines.
- If Number of mark lines is equals to number of rows/columns, then the solution is optimum & go to step 5

- If Number of mark lines is not equals to number of rows/columns, then the solution is not optimum. Then go to step 6
- 5. If Solution is Optimum**
- Check Row successively and mark a square around a single Unmarked zero in row & cancel all other zeros in its column.
 - Check Column successively and mark a square around a single Unmarked zero in Column & cancel all other zeros in its Row.
 - Repeat above both steps until all zeros are cancelled out.
 - Then go to step 7
- 6. If Solution is not Optimum**
- Select smallest element among all uncovered elements in reduced matrix and subtract it from all uncovered element and add it to the element at the intersection of the lines and other elements unchanged.
 - Then go to step 4
- 7. Find the optimum solution.**

4. ANALYSIS AND RESULTS

In Management Institutes the head of department has the problem of allocating teachers/staffs to five different classes which includes: OPERATION, SCM, MARKETING, FINANCE & HUMAN RESORCE. The management Head of Department has availability of six staffs named i.e. MBA-A, MBA-B, MBA-C, MBA-D, and MBA-E. The staffs have been evaluated on the basis of a weekly training program separately on topic General Management with respect to all classes with effective points from 0 to 75. The effective points are shown in the *Table No.2*.

The problem now is how the management head of department should assign his staff to the class on one to one basis so as to maximize the educational quality of Management Institute. If management head of department decide to apply the Hungarian method (Optimization Model) as a criterion for judging who should handled each Class. Since the assignment problem deals with minimization problems & the minimization problem by finding the opportunity or regret matrix, as shown in the *Table No.3*.

Table No.2: Staff Effective Points

STAFF	CLASS				
	OPERATION	SCM	MARKETING	FINANCE	HUMAN RESOURCE
MBA-A	30	37	40	28	40
MBA-B	40	24	27	21	36
MBA-C	40	32	33	30	35
MBA-D	25	38	40	36	36
MBA-E	29	62	41	34	39

Step 1: Given matrix is balanced (No. Rows = No. Columns)

Step 2: Here, the highest value is 62. So we subtract each value from 62.

Table No.3: Reduced Cost Matrix

STAFF	CLASS				
	OPERATION	SCM	MARKETING	FINANCE	HUMAN RESOURCE
MBA-A	32	25	22	34	22
MBA-B	22	38	35	41	26
MBA-C	22	30	29	32	27
MBA-D	37	24	22	26	26
MBA-E	33	0	21	28	23

Step 3: Row Reduction: Subtract the smallest element in each row from every element in that row.

Table No.4: Row Reduction

STAFF	CLASS				
	OPERATION	SCM	MARKETING	FINANCE	HUMAN RESOURCE
MBA-A	10	3	0	8	0
MBA-B	0	16	13	15	4
MBA-C	0	8	7	6	5
MBA-D	15	2	0	0	4
MBA-E	33	0	21	24	23

Step 4: Column Reduction: Subtract the smallest element in each column from every element in that column.

Table No.5: Column Reduction

STAFF	CLASS				
	OPERATION	SCM	MARKETING	FINANCE	HUMAN RESOURCE
MBA-A	10	3	0	8	0
MBA-B	0	16	13	15	4
MBA-C	0	8	7	6	5
MBA-D	15	2	0	0	4
MBA-E	33	0	21	24	23

Step 5: Cover all zeros Row wise & Column wise with a minimum number of lines.

Table No.6: Cover all zeros Row wise & Column wise

STAFF	CLASS				
	OPERATION	SCM	MARKETING	FINANCE	HUMAN RESOURCE
MBA-A	10	3	0	8	0
MBA-B	0	16	13	15	4
MBA-C	0	8	7	6	5
MBA-D	15	2	0	0	4
MBA-E	33	0	21	24	23

i.e. There are 4 lines required to cover all zeros

Number of line is not equal to Number of Rows/ Columns ($4 < 5$)

- Therefore, Not Optimum Solution
- Therefore, improve it by using smallest uncovered element 4.

Step 6: We subtract smallest uncovered element 4 from all uncovered elements and add it to all elements that are covered twice (Intersection of two lines).


Table No.7: 1ST Improvement

STAFF	CLASS					Mark Lines to Covered all Zeros
	OPERATION	SCM	MARKETING	FINANCE	HUMAN RESOURCE	
MBA-A	14	3	0	8	0	1 st Line
MBA-B	0	12	9	11	0	4 th Line
MBA-C	0	4	5	2	1	3 rd Line
MBA-D	19	2	0	0	4	2 nd Line
MBA-E	37	0	21	24	23	5 th Line

i.e. There are 5 lines required to cover all zeros

Number of line is equal to Number of Rows/ Columns

- Therefore, Optimum Solution

Step 7: Check Row/Column successively and mark a square  around a single Unmarked zero in

Row/Column & cancel all other zeros in its column.

Table No.8: Optimal Assignment

STAFF	CLASS				
	OPERATION	SCM	MARKETING	FINANCE	HUMAN RESOURCE
MBA-A	14	3	0	8	0
MBA-B	0	12	9	11	0
MBA-C	0	4	5	2	1
MBA-D	19	2	0	0	4
MBA-E	37	0	21	24	23

The above matrix or table is optimal assignment because there are 5 lines required, the zeros cover an

Optimal assignment

Therefore, Number of zeros=Number of Rows=Number of Columns

5. FINDING

The following table shows that, the total optimal value and staff effective points with respect to Class.

Table No.8: Assignment Problem Solution

STAFF	CLASS	Result/ Staff Effective Points
MBA-A	MARKETING	40
MBA-B	HUMAN RESOURCE	36
MBA-C	OPERATION	40
MBA-D	FINANCE	36
MBA-E	SCM	62
Total Optimal Value		214

CONCLUSION

In this paper, the Staff-Class allocation problem of Management Institute has been addressed. The research paper focused on importance of optimization technique in educational campus. The used of optimization techniques in educational campus is improving the result of teachers effectiveness & learning quality. It is used to generate information on student development with good coordination. The assignment method will find optimum solution in less time & maximize the total effectiveness of teaching-learning process & learning Quality in management institute. The Hungarian algorithm was used to solve the staff-Class allocation problem. The research focused on the use of the assignment problem for selection of staffs as a coordinator or mentor in order to obtain the best quality results from a teacher. The use of Hungarian algorithm approach gives a systematic and transparent solution

as compared with Information Technology. The Management Institute may benefit from the proposed approach for selection of staff to respective and appropriate class for optimal result. Therefore, I think that the assignment problem model should be adopted by the management institutes in staff-class allocation process.

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