ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 1, January 2017

Transportation problem using Stepping Stone method and its Applications

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ABSTRACT: Transportation type problems have certain features which makes it possible to device special computational techniques which are extremely simple to understand and apply. The illustrate example to be presented in this paper will be employed to explain the "stepping Stone" method for solving these kind of problems. Transportation problems can be approached from at least two different viewpoints: the supply and demand. Operation Research (OR) is one of the popular managerial decision science tools used by profit and non-profit organizations. Operation research has gained significance in applications like world-class Manufacturing systems lean production quality management and so on..The growth of global markets and the resulting increase in managerial skills is ability to allocate and utilize resources appropriately environment, decision based on intuition with minimal quantitative basis may be reasonably acceptable and practical in achieving the goal of the organization. Present paper is an attempt to study the importance of Operation Research and various techniques used to improve the operational efficiency of the organization.

KEYWORDS:O.R model, basic feasible solution, Transportation Problem, linear programming.

I.INTRODUCTION

Operation Research techniques including transportation models, linear programming, and organization leaders can make high quality decisions. Operation managers are not expected to be experts in any decision science tools. However they must have fundamental knowledge of such tools to acquire right resources and to make the most economically sounding decisions for the company as a whole. Such wide usage of operational research models by the government, industry and academicians would not only contribute to the discipline but also would contribute to the enhanced quality of life in India. The present paper is an attempt to highlight the significance of operation research, different techniques used and its application in business and industry.

II.HISTORY OF OR

Operation research as a new field started in the year 1930's and has grown and expanded tremendously in the last 35 years. The British army was conducting exercises on the radar system for detecting the aircrafts. In July 1938, the Superintendent of Bawdsey Research Station, announced that although the exercise had demonstrated the technical feasibility of the radar system for detecting aircraft, its operational achievements were not up to what was required. He therefore proposed that a crash program of research into the operational-as opposed to the technical-aspects of the system should begin. The term "Operation Research" was coined as a suitable description of the new branch of applied science. In 1953, Prof.P.C.Mahalanobis established an Operation Research team in the Indian Statistical Institute, Calcutta to solve problems related to national planning and survey. In 1958, project scheduling techniques and Transportations are developed as efficient tools for scheduling and monitoring lengthy, complex and expensive projects of that time. The real development of Operation Research in the national panning. Operation Research is also being used in Railway; waiting or queuing problems of passengers for tickets at booking windows or trains queuing up in the marshalling yard, waiting to be sorted out are tackled by various operation research techniques.

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III.STEPPING STONE METHOD

After computing an initial basic feasible solution. We must now proceed to determine whether the solution so obtained is optimal or not. Now we will discuss about the methods used for finding an optimal solution. The Stepping Stone Method is for finding the optimal solution of a Transportation problem.

IV.ALGORITHM

The algorithm is as follows:

1. Determine an initial basic feasible solution using any one of the following:

- North-West Corner Rule
- Matrix minima Method
- Vogel's approximation method.

2. Make sure that the number of occupied cells is exactly equal to m+n-1, where m is the number of rows and n is the number of columns.

3. Select an unoccupied cell, beginning at this cell; trace a closed path, starting from the selected cell until finally returning to that same unoccupied cell.
4. Assign plus and minus signs alternatively on each corner cell of the closed path just traced, beginning with the plus sign at unoccupied cell to be evaluated.
5. Add the unit transportation costs associated with each of the cell traced in the closed path. This will give not change in terms of cost.

6. Repeat step 3 to 5 until all unoccupied cells is evaluated.

7. Check the sign of each of the net change in the unit transportation costs. If all the net changes computed are greater than or equal to zero, an optimal solution has been reached. If not it is possible to improve the current solution and decrease the total transportation cost, so move to step 8. Select the unoccupied cell having the most negative net cost change and determine the maximum number of units that can be assigning to this cell. The smallest value with a negative position on the closed path indicates the number of units that can be shipped to the entering cell. Add this number to the unoccupied cell and to all other on the path marked with a plus sign. Subtract this number from cells on the closed path marked with a minus sign.

V. ACADEMIC SIDE OF OPERATION RESEARCH

Operational Research was accepted as a legitimate management tool in defence research establishments and subsequently for efficient resource planning and allocation by Government departments. Business supported the accelerated growth of this discipline by funding real and potential applications. Over a period of time, a symbiotic relationship between government, business and academic ensured the growth and expansion of the discipline for their mutual benefit. During the last 50 years, operational research has evolved as a multidisciplinary function involving economics, mathematics, statistics, industrial engineering and management.

VI. USES OF OPERATION RESEARCH

Operation research is multidisciplinary character and application in varied fields; it has a bright future, provided people devoted to operation Research study can help meet the needs of society. Some of the problems in the area of hospital management, energy conservation, environmental pollution, etc. Have been solved by operation research specialities and this is an indication that operation research can also contribute towards the improvement in the social life and areas of global need. Operation research has come to be used in a very large number of areas such as

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problems of traffic, question of deciding a suitable fare structure for public transport, or industrial process like ore-handling. Its use has now extended to academic spheres, such as the problems of communication. social-economic fields and national planning.

VII. APPROACH

Operation Research represents an integrated framework to help make decisions, it is important to have a clear understanding of this framework so that it can be applied to a genericproblem. To achieve this, the so-called OR approach is now detailed. This approach comprises the following seven sequential steps.

1. Orientation
2. Problem definition
3. Data Collection
4. Model Formulation
5. Solution
6. Model Validation and output Analysis, and
7. Implementation and Monitoring.

VIII. TRANSPORTATION TECHNIQUE

The Origin of transportation was first presented byF.L.Hitchcock in 1941 also presented a study entitled “The Distribution of a Product from several sources to numerousLocalities”. These presentations considered to be the first important contribution to the solution of transportation problems. In 1947 T.C.Koopamans presented an independent study, not related to Hitchcock’s and called “Optimum Utilization of the transportation System”. These two contributions helped in the development of transportation methods which involve a number of shipping applications involve determining how to optimality transport goods. Type of transportation problems where the objectives is to minimize the cost of distributing a product from a number of sources (example: factories) to a number of destinations (example: warehouse) while satisfying both the supply limits and the demand requirement. Generally, the transportation model can be extended to areas other than the direct transportation of a commodity, including among others, inventory control, employment scheduling and personnel assignment. The objective of the transportation problem is to satisfy the required quantity of goods or services at each demand destination, within the limited quantity of goods or services available at each supply origin, at the minimum transportation cost or time. Transportation problem for ***m*** sources and ***n*** destinations are generally given as:

$$\text{Minimize } Z = \sum_{i=1}^{m}\sum_{i=1}^{n} c_{ij}x_{ij}$$

$$\textbf{Subject to: } \sum_{i=1}^{m} x_{ij} \geq d_j,\ j=1,2,.....m(\text{Row sum})$$

$$\sum_{j=1}^{n} x_{ij} \leq s_i,\ i=1,2,.....n(\text{Column sum})$$

and $x_{ij} \geq 0$ for all i and j.

To applying transportation algorithm for solving TP we have to make a Mathematical model for this LPP.

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IX. GROWTH OF OPERATION RESEARCH IN DIFFERENT SECTORS

The terminology "Operation Research" is somewhat misleading, since it is not only concerned with operations, but has applications involving research in different areas and fields. Operation research is the discipline of applying advanced analytical methods to help make better decisions. By using techniques such as mathematical modelling to analyze complex situations, operations research in the Indian context is clear. It is not only important, it is even critical, given the size and magnitude of the tasks ahead to transform India as a developed nation. In order to achieve this goals, we need a response and accountable government to promote a positive environment of OR applications. It is hoped that the Indian democracy would lead to this. It is believed that the globalizations would further accelerate this transition.

TYPICAL APPLICATIONS OF OR:

- Capital budgeting. Asset allocation. Portfolio selection.
- Laundering. Benchmarking.
- Marketing channel optimization, customer segmentation.
- Direct marketing campaigns Supply chain planning
- Distribution, routing, scheduling, Traffic flow optimization.
- Resource allocation, Staff allocation. Inventory planning
- Retail planning,Merchandize optimization Product mix and blending, Industrial waste reduction.

X. CHALLENGES IN OPERATION RESEARCH

A transportation problem is challenging and time consuming. Thus, such approach towards performance improvement may or may not be economically feasible for some organizations. Numerous studies are conducted on development of mire effective and efficient heuristic and exact algorithms that can solve large scale optimization problems. OR is a quantitative problem solving technique: hence data plays important, if not the most important role in producing high quality and executable solutions. Unfortunately, many organizations tend to focus heavily on physical system implementation and give little or no education on education and training. Regardless, employees are often reprimanded for not entering the data correctly and the quality of hardware and software is questioned for poor data integrity. Sustainment is as important implementation. Organization can lacks knowledge of performing his or her job, attaining and implementing the world's greatest system is meaningless.

XI.CONCLUSION

Another name for managers is decision makers. To survive and lead the today's highly competitive and demand driven market, pressure is o management to make economical decisions.One of the essential managerial skills is ability to allocate and utilize resources in the efforts of achieving the optimal performance efficienly. In some cases such as small-case low complexity environment, decision based on intuition with minimal quantitative basis may be reasonably acceptable and practical in achieving the goal of the organization.However, for a large-scale system, both quantitative and qualitative analyses are required to make the most economical decisions.Using operation Research techniques including Linear Programming, transportation Problem, Discrete Event Simulation and Queuing Theory, organization leaders can make high quality must have fundamental knowledge of such tools to acquire right resources and to make the most economically souring decisions for the company as a whole.

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REFERENCES

[1] Sharma, J.K., Swarup, K. "Time minimizing transportation problem", Proceedings of Indian Academy of Sciences-Mathematical Sciences, Vol. 86, (1977), pp513-518.
[2] H. Issermann , Linear bottleneck transportation problem, Asia Pacific Journal of Operational Research, 1 (1984), 38 – 52.
[3] P. Pandian and G. Natarajan, A new method for finding an optimal solution for transportation problems, International J. of Math.Sci. &Engg.Appls. (IJMSEA),4 (2010), 59-65.
[4] Taha. H.A., Operations Research- Introduction, Prentice Hall of India (PVT), New Delhi, 2004.
[5] Hamdy, T. Operations Research- An Introduction (Sixth Edition). Pearson Education Inc, 2002.
[6] R. Gupta , Time-Cost Transportation Problem, Econ-math overview, 4(1977), 431-443.
[7] Nagoor GaniA.and Abdul Razak K.2006.“ Two stage fuzzy transportation problem”, Journal of Physical Sciences, 10,63-69.
[8] Goyal, SK, 1984, “Improving VAM for unbalanced Transportation Problems”, Journal of Operational Research Society., 35(12), 1113-1114.
[9] Arsham, H. and A.B. Kahn, A simplextype algorithm for general transportation problems: An alternative to SteppingStone. Journal of Operational Research Society, 40(6), 581-590 (1989).
[10] Charnes, A. and W.W. Cooper, The Stepping-Stone method for explaining linear programming calculations in transportation problems. Management Science,1(1), 49-69 (1954).
[11] Ji, P and K.F. Ghu, A dual-matrix approach to the transportation problem. Asia- Pacific Journal of Operations Research, 19(1), 35-45 (2002).
[12] Kirca, O. and A. Satir, A heuristic for obtaining an initial solution for the transportation problem. Journal of Operational Research Society, 41(9), 865-871(1990).
[13] Sudhakar. V.J., Arunsankar. N. and Karpagam. T., A New Approach for Finding an Optimal Solution for Transportation Problems, European Journal of Scientific research ISSN 1450-216X Vol. 68 No.2 (2012), pp. 254-257 (2012).