Chapter 19
Theory and Applications of the Software-Based PSK Method for Solving Intuitionistic Fuzzy Solid Assignment Problems

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ABSTRACT

The real-life optimization problem, namely, the intuitionistic fuzzy solid assignment problem (IFSAP), is solved using the PSK (P. Senthil Kumar) method here. The mathematical model of IFSAP and its classifications are presented. Some standard results are provided. To find the optimal assignment of IFSAPs, many supporting theorems and corollaries are proved with the PSK method. Numerical examples and graphical illustrations are provided to illustrate the proposed model and theorems and the effectiveness of the method. The programming packages, namely, Matlab and Lingo, are used with the PSK method to solve the IFSAPs and to find out the optimum assignment and objective value. Additionally, the fruitfulness of the proposed method is illustrated through 3 numerical examples, and the results are compared with other methods and different software. Finally, the limitations of the proposed method and recommendations for the scope of future work are presented. It is useful for researchers, the public, and especially, governments to govern operations because it deals with real-life problems.

INTRODUCTION AND BACKGROUND

The assignment problem (AP) is a real-life problem and it is a special case of the transportation problem (TP) in which the aim of the decision-maker (DM) is to assign *n* number of machines to *n* number of jobs at a minimum time/cost (or maximum profit/production). An AP can be viewed as a TP in which all supplies and demands equal to 1. AP is used worldwide in solving real-world problems. An AP plays a vital role in assigning of the following.

- accountants → accounts of the clients

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- trucks → drivers
- contracts → bidders by systematic bid-evaluation
- jobs → persons
- routes → trucks
- research teams → problems
- sales/marketing people → sales territories
- machines → operators
- police vehicles → patrolling areas.

An AP has been used in the variety of application contexts, namely: resource allocation, manpower planning and personnel scheduling. The standard AP consists of assigning the number of tasks to an equal number of agents. Each agent is assigned to exactly 1 task and each task has exactly 1 agent assigned to perform it in such a way that minimizes the overall cost/time of assigning agents to tasks. When the standard AP is considered with the minimization of assignment time/cost as the objective function, it is called the time/cost minimizing AP. The well- studied Hungarian method developed by (Kuhn, 1955) is recognized to be the 1st practical method for solving the standard 2-D AP.

To solve the typical AP using Hungarian method, one should know time of completion/cost of making all the possible assignments. Each AP has the 2-D table, persons/machines to be assigned are expressed in the columns and jobs/tasks one wishes to assign are represented in the rows. Cost/time for each particular assignment is in the numbers in a 2-D table. Always, this table is referred as cost/time matrix of the 2-D AP or typical AP. Hungarian method is based on the principle that if a constant is added / subtracted to the elements of cost/time matrix, the optimum solution/assignment of the AP is the same as the original problem. Original cost/time matrix is reduced to another cost/time matrix by adding/subtracting a constant value to the elements of rows and columns of the cost/time matrix where the total cost/completion time of an assignment is 0. Moreover, this assignment is referred as the optimum/optimal assignment since the optimal assignment remains unchanged after the reduction.

Let us consider n machines (e.g. M_1, M_2, …, M_n) and n jobs (e.g. J_1, J_2, …, J_n) (1 job to 1 machine). Let c_{ij} be the unit cost of assigning i^{th} machine to the j^{th} job and let x_{ij} denotes that j^{th} job is to be assigned to i^{th} machine. Our goal is to determine the assignment of machines to jobs so that the total cost of completing all the jobs is minimum. We can write this as a mathematical model as follows.

Minimize $Z = \sum_{i=1}^{n} \sum_{j=1}^{n} (c_{ij}) \times (y_{ij})$ (i)

s.t.

$$\sum_{j=1}^{n} y_{ij} = 1, (i = 1,2,\ldots,n)$$

(Rows or jobs restrictions) (1)

$$\sum_{i=1}^{n} y_{ij} = 1, (j = 1,2,\ldots,n)$$

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