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AN INNOVATIVE STATISTICAL APPROACH TO RESTRICTED TRANSPORTATION PROBLEMS

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The transportation problem, which aims at minimizing the total transportation cost while delivering goods from multiple sources to various destinations, is a fundamental optimization problem. Classical methods, such as the Least Cost Method, Vogel's Approximation Method, Row Minima Method, Column Minima Method, and North-West Corner Method, are frequently used to find an initial basic feasible solution. To achieve the optimal solution, techniques like the Stepping Stone Method and the Modified Distribution Method are typically employed. This research focuses on the restricted transportation problem, which arises when certain routes are restricted due to regulatory, safety, or logistical constraints. First, the balance of the given transportation problem is examined. If it is unbalanced, a dummy row or column with zero transportation costs is added to ensure that the total supply equals the total demand. Subsequently, the arithmetic mean and the standard deviation of the cost matrix are calculated, excluding the large costs assigned to restricted routes and all zero-cost entries. Next, each valid cost is transformed into its corresponding cumulative distribution function (CDF) value of the log-normal distribution. Then, the geometric mean for each row and column is computed, excluding zero-cost values. Afterwards, the row or column is identified with the lowest geometric mean, and the maximum possible quantity is allocated to the cell with the lowest CDF value in that row or column. Thereafter, the corresponding supply and demand are updated by eliminating any fully satisfied row or column. After that, the CDF matrix is revised accordingly, and the allocation process is repeated until all supply and demand requirements are met. Finally, the total transportation cost is determined using the original cost matrix and the final allocation plan. Benchmark instances validate the effectiveness of the proposed method in minimizing transportation costs while satisfying restricted conditions. A comparative analysis is performed with traditional approaches to demonstrate the superior accuracy of this statistical approach.

Keywords: Geometric mean, Log-normal distribution, Optimal solution, Restricted transportation problem