

THREE-PHASED HEURISTIC ALGORITHM BASED ON INTEGER LINEAR PROGRAMMING FOR CAPACITATED VEHICLE ROUTING PROBLEM

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The Capacitated Vehicle Routing Problem (CVRP) is a special variant of the Vehicle Routing Problem (VRP) which is extensively addressed in the literature because of its vast applicability. Since the problem is NP-hard, only heuristic algorithms are capable to find satisfactory approximate solutions for relatively large problems within a reasonable CPU time. Therefore, the objective of this study is to develop a novel heuristic algorithm to find comparatively better solutions for CVRP. The first phase of the proposed heuristic algorithm is to form a pool of unique clusters that do not exceed the vehicle capacity. In the second phase, an Integer Linear Programming (ILP) model is used to construct five sets of clusters by selecting clusters from the pool. To construct five sets of clusters, five different parameters are used as the objective function of the ILP. The parameters are derived based on the area of convex hull, number of customers, total demand of customers and mean distance from the centroid of the clusters. The constraint that visits every customer exactly once by exactly one vehicle is incorporated to ensure the sets of clusters provide feasible solutions for the CVRP. Subsequently, Traveling Salesman Problems (TSPs) of unique best sets of clusters (≤ 5) are separately solved in the third phase. To solve the TSPs optimally, the Miller-Tucker-Zemlin ILP formulation is used. Statistical analysis with one-way ANOVA and the Tukey's pairwise comparison tests is used to compare the solutions of the proposed algorithm against three prominent heuristics found in the literature: the efficient two-phased heuristic algorithm, savings algorithm and genetic algorithm, using 30 well-known benchmarked instances. In the comparison, the degree of satisfaction of optimal solutions and the consumed CPU times are compared. The comparison revealed that the three-phased Heuristic algorithm reaches better near-optimal solutions by consuming competitive CPU times.

Keywords: CVRP, Heuristic algorithms, Three-phased heuristic algorithm