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Solving a new bi-objective location-routing-inventory problem in a distribution network by meta-heuristics ☆

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ABSTRACT

This paper presents a novel bi-objective location-routing-inventory (LRI) model that considers a multi-period and multi-product system. The model considers the probabilistic travelling time among customers. This model also considers stochastic demands representing the customers' requirement. Location and inventory-routing decisions are made in strategic and tactical levels, respectively. The customers' uncertain demand follows a normal distribution. Each vehicle can carry all kind of products to meet the customer's demand, and each distribution center holds a certain amount of safety stock. In addition, shortage is not allowed. The considered two objectives aim to minimize the total cost and the maximum mean time for delivering commodities to customers. Because of NP-hardness of the given problem, we apply four multi-objective meta-heuristic algorithms, namely multi-objective imperialist competitive algorithm (MOICA), multi-objective parallel simulated annealing (MOPSA), non-dominated sorting genetic algorithm II (NSGA-II) and Pareto archived evolution strategy (PAES). A comparative study of the forgoing algorithms demonstrates the effectiveness of the proposed MOICA with respect to four existing performance measures for numerous test problems.

1. Introduction

Nowadays, the efficiency of industries is the bottleneck of progress in the competitive environment of marketing. That is why the companies have to increase their efficiency in all fields, specifically, in their logistics' operations. The present study considers the new integrated multi-objective model for the location-routing-inventory problem in a multi-product and multi-period supply chain system. Additionally, the model considers the probabilistic travelling time among customers. Considering these complexities make the problem more similar to real-life problems. In real world, there exist numerous industries making three location-routing-inventory (LRI) decisions and their interactions in multi-products and multi-periods system simultaneously. To the best of our knowledge, this problem has not been surveyed these assumptions altogether.

According to above-mentioned reasons, the main contributions of this paper, which distinguishes from other papers in the related literature review, are as follows:

- Considering an integrated LRI problem
- Considering a bi-objective integrated LRI problem
- Considering a multi-product supply chain system
- Considering a multi-period supply chain system
- Considering uncertainty in a multi-product and multi-period supply chain system
- Considering the probabilistic time among customers
- Considering the transportation cost consisting of the travelling distance related cost and vehicle fixed cost for determining the usage of vehicles.
- Solving the model by new multi-objective meta-heuristic algorithms (e.g., MOICA and MOPSA).
- Comparing the proposed meta-heuristics with two well-known evolutionary meta-heuristics (e.g., NSGA II and PEAS) in terms of four comparison metrics.

A logistic system consists of three important elements, namely facility location, vehicle routing and inventory control decisions. Since, these key elements are highly dependent, an integrated decision problem is considered as an integrated logistic system. This problem is represented under different assumptions in the related literature review.

Liu and Lee (2003) proposed a single product, multi-depot LRI problem and applied a two phase heuristic method to solve the

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