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A TWO-STEP TRANSSHIPMENT MODEL WITH FUZZY DEMANDS AND SERVICE LEVEL CONSTRAINTS

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Abstract
We consider a distribution network composed of one supplier and several non-identical locations characterized by fuzzy customer demands and service level constraints. These locations could cooperate together via product transfer known as transshipment. The transshipment problem consists in determining the replenishment quantities that minimize the total inventory cost where a specific transfer policy is practiced. Our objectives in this paper are to identify an inter-location transfer policy that participates to satisfy the service level constraints and to determine the approximate replenishment quantities. To achieve these objectives we propose: (1) a new transshipment model based on the chance constrained programming, (2) a two-step transshipment policy that differs from classic ones by product transfer from locations in need to others also in need and (3) a hybrid algorithm based on fuzzy simulation and genetic algorithms to approximate replenishment quantities.
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Key Words: Transshipment Problem, Service Level Constraints, Fuzzy Customer Demands, Fuzzy Simulation, Genetic Algorithm

1. INTRODUCTION

The supply chain is a network of suppliers, manufacturers, distributors and consumers. It ensures mainly two types of functions: (1) *physical functions* consisting in product transformation, storage and transportation and (2) *mediation functions* consisting in matching demand and supply in a dynamic and uncertain environment [1]. The supply chain managers' aim is to ensure a good trade-off between cost and realized service level. This trade-off depends on the nature of customer demands. In fact, Fisher [1] identified mainly two product classes: *functional* and *innovative* products. The first class satisfies customer basic needs. It includes products recognised by predictable and stable demands, a long life cycle and low profit margin. However, the second class includes products characterised by a short life cycle and a high profit margin. In order to ensure the trade-off between costs and service level, several methods could be adopted such as collaborative inventory management known as *transshipment* [2]. This method allows the regulation of the inventory level to face the unexpected customer demand fluctuation. A reduced inventory level causes the non satisfaction of customer requirements and an inventory excess generates holding costs. This task becomes more complex when it concerns several locations. Transshipment is widely used in practice to reduce inventory costs and to improve the customer service level [3]. It provides an effective mechanism for correcting discrepancies between the locations observed customer demands and their available inventories [4].

The transshipment problem consists in determining the replenishment quantities where a specific transfer policy is practiced [5]. This problem has been largely studied where several configurations and parameters were considered. Literature identifies mainly two transshipment configurations [6]: (1) *emergency transshipment* where the product transfer is

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