Fuzzy Decision of Enterprise Human Resources Planning under Demand Exceeding Supply

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Abstract. It is important for enterprises to make human resources planning scientifically. Ranking criteria of triangular fuzzy numbers was introduced simply and a model of fuzzy integer linear programming decision on demand exceeding supply of human resources was established based on cost minimizing in this paper. Then an example was given to demonstrate this method. And the proposed approach is simple, scientific and feasible to transform triangular fuzzy numbers ranking criteria into the classic linear programming problem on fuzzy decision of enterprise human resources planning under demand exceeding supply.

Keywords: Human resources planning, fuzzy decision, integer linear programming, demand exceeding supply.

1 Introduction

There’s no doubt one of the most important resources is human resources in the 21st century, so it is significant to ensure a certain number of suitable human resources with good quality for enterprises’ development. The most prominent feature of the 21st century is the fact that the world is changing constantly, and thus the demand exceeding supply of enterprise human resources will become a common phenomenon due to the rapid change of external environment. The shortage of enterprise human resources means miss of opportunities, loss of income, a waste of other resources and inefficiency. Generally, enterprises have many measures for the shortage of human resources, such as work overtime, job rotation, training, external recruitment, external lease, purchasing efficient equipments, business outsourcing, and those measures with different features are applicable to different conditions [1].

Literature [1] proposed the lowest cost decision-making model of the shortage of human resources, which was solved by constructing a precise integer programming. But in reality, the system environment that a decision problem faces is uncertain. Since 1970, Bellman and Zadeh proposed the concept of fuzzy decision-making, the fuzzy optimization has been a focus on research field for scholars. According to the objective reality, this paper comes up with the ambiguous processing to the question in literature [1].
The problem is defined as: enterprises are proposing measures including work overtime, job rotation, training, external recruitment, external lease, purchasing efficient equipments, business outsourcing and others when human resources are in short supply. With uncertainty costs of each measure, the matter is which portfolio of measures above we should take to solve the problem of shortage and achieve minimum cost. The matter belongs to asymmetric fuzzy programming problem, more precisely, fuzzy objective coefficient linear programming problem [2,3].

The assumptions of constructing model are as follows:

**Assumption 1:** Costs include fixed costs and variable costs;

**Assumption 2:** Purchasing efficient equipments is only calculated in depreciation costs within the financial cycle based on a unified financial period;

**Assumption 3:** Fixed costs and variable costs are triangular fuzzy numbers.

## 2 Ranking Criteria of Triangular Fuzzy Numbers

Since the 1970s, people began to study how to determine the sequence of fuzzy numbers. So far, more than 20 kinds of methods have been raised to determine the sequence of fuzzy numbers, but no method is universally recognized as the best. At the same time, domestic and foreign scholars put forward a variety of numerical methods for fuzzy linear programming. Literature [4] proposed a ranking criteria of fuzzy numbers, and literature [5] introduced the ranking criteria of L-R fuzzy numbers; furthermore, literature [6] came up with an approach to change linear programming of triangular fuzzy coefficient into a conventional linear programming on condition that membership degrees of the fuzzy coefficients in the objective function and constraints can take different values. This paper introduces the ranking criteria triangular fuzzy numbers recommended in literature [7] for fuzzy decision of human resource planning, which are described as follows.

Define $\tilde{A} = (a, b, c)$ as triangular fuzzy numbers, and $\lambda$-cut sets of $\tilde{A}$ are expressed as $A(\lambda) = [A_L(\lambda), A_R(\lambda)]$, $0 \leq \lambda \leq 1$. Meanwhile, define $A_L(\lambda) = a + (b - a)\lambda$ as left terminal point of the $\lambda$-cut sets, and $A_R(\lambda) = c - (c - b)\lambda$ as the right terminal point. Set $F_N = \{(a, b, c) | \forall a < b < c, a, b, c \in R\}$.

Introduce definitions that are:

**Definition 1.** Define signed distance of $\lambda$ level fuzzy interval $[A_L(\lambda), A_R(\lambda)]$ as:

$$d[A_L(\lambda), A_R(\lambda)] = \frac{1}{2}[a + c + (2b - a - c)\lambda]$$

(1)

**Definition 2.** Assume triangular fuzzy number as $\tilde{A} = (a, b, c)$, and define signed distance of $\tilde{A}$ as:

$$d(\tilde{A}) = \int_0^1 d[A_L(\lambda), A_R(\lambda)]d\lambda = \frac{1}{4}(2b + a + c)$$

(2)