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## Optimal decision-making in oil extraction under imprecise information

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### Abstract

The issue on investing was examined with probabilities given in the form of interval in oil extraction. The solution ways of decision-making on investment with three alternatives and four criteria have been investigated and alternative which will be invested in has been identified. It is shown that it is more appropriate to use the method based on interval probabilities in order to carry out geological and technical measures during investing, unlikely decision-making based on the classical probabilities.

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### 1. Introduction

Various geological and technical measures are implemented in order to prevent declining in the level of oil production and to enhance it during oil extraction processes. Therefore, almost every day there is need to make a decision in oil extraction institutions. Such decision-making is associated with investing directly.

Hydraulic fracturing of formation (HFF), downhole development (DD) and applying various reagents and polymer solution into the annular space are mostly occurred among the geological and technical measures carried out to increase production in the oil fields<sup>1</sup>.

HFF event is carried out in mining conditions in the cases of a sharp decrease of permeability of the downhole area, but oil bearing capacity of the coating is still quite a lot. HFF process itself is considered as a complex operation, so using various sands containing granulometry, and splitter, carrier, vibrating fluids prepared at the well-

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head and various technical means to prepare them, including the use of pumping units which can cause high pressure required during its implementation. These all lead to the increase of costs incurred to the measure and the growth of costs investing. However, as a result of the successful completion of HFF, the production of the wells can be increased several times compared to the other measures, so it shows its efficiency.

DD method is carried out in connection with contamination of downhole area as a result of collapse of various components in the composition of the hydrocarbons extracted, decline in permeability of layer and fall in production in the long-term working process of oil-well. The sequence of systems applied in downhole area is composed of two or three processes, so incurring of general expenses is characterized with relatively low in the result of the small number of both reagents and technical means used. At the same time, the increase in production of the wells is comparatively less than the method of HFF as the result of DD application.

The most cost-effective method is applying polymer solutions into the annular space of oil wells. The essence of this method is to reduce the hydraulic losses applying various polymer solutions in downhole, thus to increase production of well, at the same time to prevent the collapse of sand in sandy wells, thereby to increase inter-repair period. The goal is to increase oil production more with little expense.

However, investing is required for the implementation of all these measures. Reasonable question arises: What should the investing direct to, which of measures listed above should be preferred? In such a condition, it is significantly important to make the right decision in order to achieve the desired result.

It is known that investment-is putting up capital in different areas and fields of economics, as well as entrepreneurial activity. As in other fields, revival of the investment climate in the oil industry causes the stable economic development of the oil-production enterprise. Such a situation leads not only to increase in long-term investments, but also application of advanced management methods of the investment activity to enhance the competitiveness<sup>2</sup>. The main objective of the investing process consists of concentration of financial resources in the areas and directions that provide the acceleration of scientific and technological advance by taking into account innovations<sup>3</sup>.

At the same time, the main purpose of investing process on any kind of investment activity is to obtain a high income. The basis of investment management is to maximize income received by investors and minimize risks on putting up capital<sup>4</sup>. There are many methods to achieve this goal; one of them is multi-criterion decision-making method in the case of interval<sup>5</sup>.

In the case of interval with superiority degree during multi-criterion decision-making, the width of intervals beside upper and lower borders of them is taken into consideration during rational and natural methods of arranging alternatives. Imprecise probabilities are widely used in case when inaccuracy should differ from alteration. At this time, inaccurate intervals are directly applied to assess the reliability based on generalized intervals<sup>6</sup>.

In this paper we consider a problem of multicriteria decision making on oil production under interval valued information on choice criteria. The rest of the paper is organized as follows. In Section 2 we provide necessary formal definitions. In Section 3 we consider a real-world problem of decision making in oil production. Section 4 concludes.

## 2. Preliminaries

**Definition 1. Interval probabilities<sup>8</sup>.** The intervals  $\bar{p}_i = [p_{*i}, p_i^*]$  are referred to as interval probabilities if for any  $p_i \in [p_{*i}, p_i^*]$  there exist  $p_1 \in [p_{*1}, p_1^*], \dots, p_{i-1} \in [p_{*(i-1)}, p_{i-1}^*], p_{i+1} \in [p_{*(i+1)}, p_{i+1}^*], \dots, p_n \in [p_{*n}, p_n^*]$  such that the following is satisfied:

$$\sum_{i=1}^n p_i = 1 \quad (1)$$

**Definition 2. The superiority degree of intervals<sup>9</sup>.** For evaluation of comparison and superiority intervals d (I, J) the following formula is used.

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