Interval linear programming based decision making on market allocations

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Abstract

A market allocation decision is related to the choice of media effectiveness, media budget etc. especially when advertising is required in a market. Usually in real decision making problems related to advertising, the goals, the constraints and the outcomes of actions are uncertain. In this paper we investigate the problem of choice of suitable media options and allocation of the available advertising budget amongst them. The problem is formulated as interval linear programming problem where uncertain environment is described by interval numbers. Sensitivity analysis of the proposed decision model is performed.

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1. Introduction


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find optimal allocation of the budget. Multicriteria decision making approach is used by Jha and Aggarwal (2012) for optimal allocation of advertising media under fuzzy uncertainty.

State-of-the-art of existing works shows that research results on decision making on suitable media options and allocation of advertising budget under uncertain environment is very scarce.

In this paper we investigate the problem of choice of suitable media options and the related allocation of the available advertising budget. The paper is organized as follows. In Section 2 some preliminaries about interval numbers and interval programming are presented. Then the statement of the decision problem of market allocation is described in Section 3. Model of the optimization of choice of media options and budget allocation is designed in Section 4. In Section 5 we present solution of the problem and sensitivity analysis of the model. Section 6 concludes.

2. Preliminaries

*Interval number* (Dawood, 2011) Let's \( x, \bar{x} \in R \) such that \( x \leq \bar{x} \). An interval number \([x, \bar{x}]\) is a closed and bounded nonempty real interval, that is

\[
[x, \bar{x}] = \{x \in R | x \leq \bar{x} \}. \tag{1}
\]

Here \( x = \min([x, \bar{x}]) \) and \( \bar{x} = \max([x, \bar{x}]) \) are the lower and upper endpoints of \([x, \bar{x}]\).

*Addition.* Assume that two intervals \([x, \bar{x}]\) and \([y, \bar{y}]\) are given. Interval addition is formulated as

\[
[x, \bar{x}] + [y, \bar{y}] = [x + y, \bar{x} + \bar{y}]. \tag{2}
\]

*Multiplication.* Two interval numbers \([x, \bar{x}]\) and \([y, \bar{y}]\) are given. Interval multiplication is defined as

\[
[x, \bar{x}] \times [y, \bar{y}] = [\min\{xy, \bar{x}y, \bar{y}x, \bar{x}\bar{y}\}, \max\{xy, \bar{x}y, \bar{y}x, \bar{x}\bar{y}\}] \tag{3}
\]

*Negation.* For \([x, \bar{x}]\) interval negation is defined as

\[-[x, \bar{x}] = [-\bar{x}, -x]. \tag{4}\]

*Subtraction.* Assume that interval numbers X and Y are given. Interval subtraction is defined by

\[X - Y = X + (-Y) \tag{5}\]

*Division.* For any two interval numbers X and any Y division is defined as

\[
X / Y = X \times (Y^{-1}), \ 0 \not\in Y. \tag{6}
\]

*Interval Width.* The width of \([x, \bar{x}]\) is defined as

\[
\omega([x, \bar{x}]) = \bar{x} - x. \tag{7}
\]

*Distance.* The distance (metric) between \([x, \bar{x}]\) and \([y, \bar{y}]\) is defined as

\[
d([x, \bar{x}], [y, \bar{y}]) = \max(||x - y||, ||\bar{x} - \bar{y}||). \tag{8}
\]

Assume that the interval numbers \(A = [a, \bar{a}]\) and \(B = [b, \bar{b}]\) are given. The satisfaction functions
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