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Selection of Digital Investment Instruments Applying the Multi-Objective Optimization by Ratio Analysis Method

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Abstract. Choosing a digital investment instrument to make digital investments is not easy because behind the expected profits are also accompanied by balanced risks. Therefore, not a few novice investors are confused to determine the choice of digital investment instruments that are most appropriate for use in the long term. In this study the authors applied the decision support system method (Multi-Objective Optimization by Ratio Analysis) to facilitate the decision-making process in choosing digital investments for novice investors. The results of this study indicate that Alternative A4 (Trading) with a value of 0.17097 has the highest value compared to other alternatives, so Alternative A4 (Trading) is the most recommended digital investment instrument for use by novice investors.

Keywords: Digital Investment Instrument, Multi-Objective Optimization by Ratio Analysis, Decision Support System

1 Introduction

Nowadays, public interest in investment shows a very significant development. Investment is one of the ways that people can do to get passive income [1,2]. One of the investment models that many people are interested in today is digital investment [3,4]. However, the selection of digital investment instruments to make digital investments is not easy because behind the expected benefits are also accompanied by balanced risks [5]. Not a few novice investors are confused to make decisions in determining the choice of digital investment instruments that are most appropriate for use over a long period of time [6]. Therefore, to choose a digital investment instrument, decision-making analysis assistance is needed that can minimize investor losses in running a digital investment business.

A decision support system is a computer-based system that can be used to assist the decision-making process in solving semi-structured or unstructured problems by utilizing certain data and methods [7–9]. Decision support systems have been widely used by previous researchers to help solve decision-making problems [10–14]. There are many methods that can be applied to a decision support system to help make decisions, such as Multi Attribute Utility Theory [15], WASPAS [16], OCRA, ROC [17], SMART [18], Profile Matching [19], MOORA [20], Etc.

The decision support system method applied to facilitate the decision-making process in choosing digital investment instruments for novice investors in this study is the MOORA (Multi-Objective Optimization by Ratio Analysis) method. The MOORA method has a mathematical calculation system that is easy to implement and is able to help make decisions with targeted results [21]. In addition, the MOORA method has been widely used to support decision-making in various fields, such as the selection of majors in higher education [22], material selection of camshafts [23], evaluating Turkey's health tourism performance [24], selection of oil palm seedlings [25], elect the chairman of the PSPM cooperative of Padre Pio Parish [26], Etc.

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2 Research Method

2.1 Research Stages

In this research, the author uses 5 (five) stages to solve the decision-making problem in choosing a digital investment instrument, which is in accordance with the image displayed below:

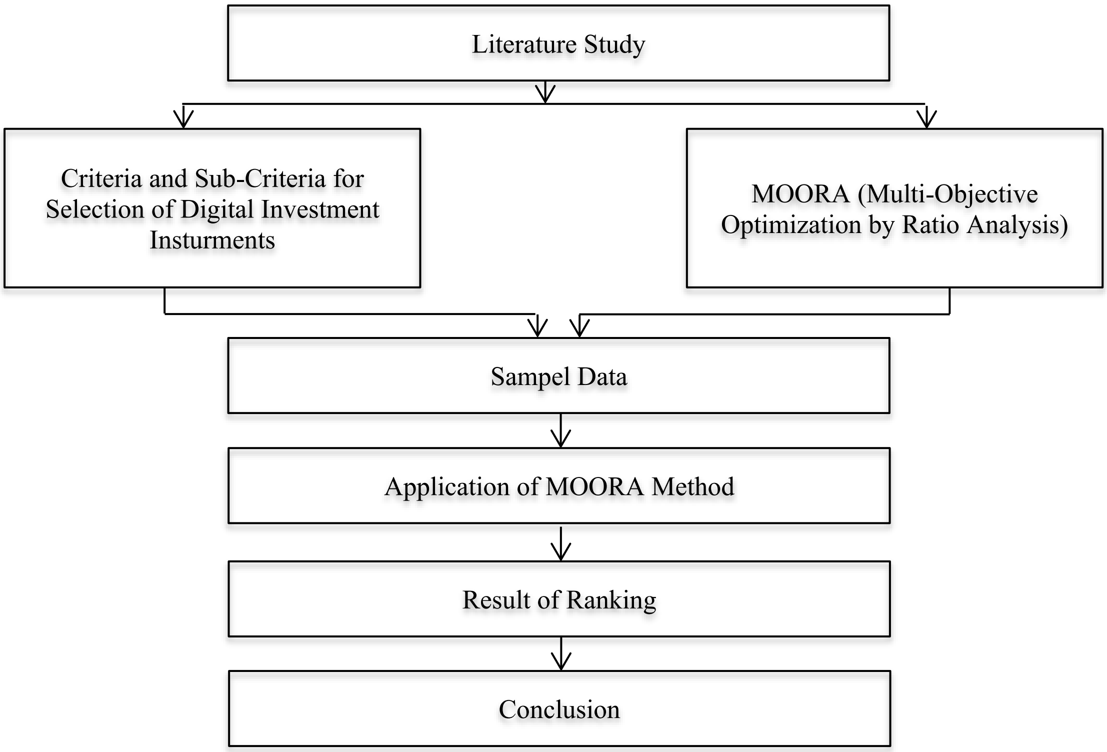

Figure 1. Research Stages

2.2 Multi-Objective Optimization by Ratio Analysis (MOORA)

The Multi-Objective Optimization by Ratio Analysis (MOORA) method, first introduced by Brauers and Zavadkas [24–26]. The MOORA method has a mathematical calculation system that is easy to implement and is able to help make decisions with targeted results. The following are the stages carried out in the Multi-Objective Optimization by Ratio Analysis (MOORA) method to solve decision-making problems [21]:

a. Determination of Criteria, Sub Criteria, and Alternatives

b. Matrix Formation

$$X = \begin{bmatrix} X_{11} & X_{12} & X_{1n} \\ X_{21} & X_{22} & X_{2n} \\ X_{31} & X_{32} & X_{3n} \end{bmatrix} \quad (1)$$

c. Determination of the Normalization Matrix

$$\mathrm{X} *_{ij=xij} / \sqrt{\left[\sum_{i=1}^{m} X_{ij}^{2}\right]} \quad (2)$$

d. Optimization of Attributes

$$\mathrm{Y}_i = \sum_{j=1}^{g} - \sum_{j=g+1}^{n} X_{ij}^{x} \quad (3)$$

$$\mathrm{Y}_i = \sum_{j=1}^{g} W_j X_{1j}^{*} - \sum_{j=g+1}^{n} W_j W_{ij}^{*} \quad (4)$$

e. Ranking of Alternatives

The alternative with the highest yi value is the best alternative, while the alternative with the lowest yi value is the worst alternative.

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3 Result and Discussion

3.1 Research Data Results

Based on the data collection process carried out to solve problems in the selection of digital investment instruments using the Multi-Objective Optimization by Ratio Analysis (MOORA) method in this study, the following data are obtained:

a. Criteria and Sub Criteria Data
Data criteria and sub criteria used to solve the problem of selecting digital investment instruments using the Multi-Objective Optimization by Ratio Analysis (MOORA) method in this study, namely:

Table 1. Digital Investment Instrument Selection Criteria

Code	Criteria	Weight	Description
C01	Starting Capital	0,23	Cost
C02	Time Period	0,22	Benefit
C03	Profit	0,20	Benefit
C04	Risk	0,18	Cost
C05	Fluctuation	0,17	Benefit

Table 2. Digital Investment Instrument Selection Sub Criteria

Code	Criteria	Sub Criteria	Weight
C01	Starting Capital	1.000.000 <	8
		1.000.000 – 5.000.000	7
C02	Time Period	1 Year <	7
		1 –5 Years	6
		> 5 Years	5
C03	Profit	High	6
		Medium	5
		Low	4
C04	Risk	High	4
		Medium	5
		Low	6
C05	Fluctuation	High	5
		Medium	4
		Low	3

b. Digital Investment Instrument Selection Data Sample

Table 3. Digital Investment Instrument Selection Data Sample

No	Code	Alternative	Criteria				
			C01	C02	C03	C04	C05
1	A1	Gold	1.000.000 – 5.000.000	> 5 Years	Low	Low	Low
2	A2	Mutual Fund	1.000.000 <	1 – 5 Years	Low	Low	Medium
3	A3	Foreign Exchange	1.000.000 <	1 Year <	Medium	Medium	Low
4	A4	Trading	1.000.000 <	1 Year <	High	High	High

3.2 Multi-Objective Optimization by Ratio Analysis

The results of the analysis of solving the problem of selecting digital investment instruments using the Multi-Objective Optimization by Ratio Analysis (MOORA) method in this study, namely:

a. Matrix Formation
The results of matrix formation for solving the problem of selecting digital investment instruments using the Multi-Objective Optimization by Ratio Analysis (MOORA) method in this study, namely:

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$$X = \begin{bmatrix} 7 & 5 & 4 & 6 & 3 \\ 8 & 6 & 4 & 6 & 4 \\ 8 & 7 & 5 & 5 & 3 \\ 8 & 7 & 6 & 4 & 5 \end{bmatrix}$$

b. Determination of the Normalization Matrix

The results of matrix normalization for solving the problem of selecting digital investment instruments using the Multi-Objective Optimization by Ratio Analysis (MOORA) method in this study, namely:

C1 = $\sqrt{7^2 + 8^2 + 8^2 + 8^2}$
= $\sqrt{49 + 64 + 64 + 64}$
= $\sqrt{241}$
= 15,5241747
$A_{11} = 7/15{,}5241747$ = 0,45091
$A_{21} = 8/15{,}5241747$ = 0,51532
$A_{31} = 8/15{,}5241747$ = 0,51532
$A_{41} = 8/15{,}5241747$ = 0,51532
C2 = $\sqrt{5^2 + 6^2 + 7^2 + 7^2}$
= $\sqrt{25 + 36 + 49 + 49}$
= $\sqrt{159}$
= 12,60952021
$A_{11} = 5/12{,}60952021$ = 0,39653
$A_{21} = 6/12{,}60952021$ = 0,47583
$A_{31} = 7/12{,}60952021$ = 0,55513
$A_{41} = 7/12{,}60952021$ = 0,55513
C3 = $\sqrt{4^2 + 4^2 + 5^2 + 6^2}$
= $\sqrt{16 + 16 + 25 + 36}$
= $\sqrt{93}$
= 9,643650761
$A_{11} = 4/9{,}643650761$ = 0,41478
$A_{21} = 4/9{,}643650761$ = 0,41478
$A_{31} = 5/9{,}643650761$ = 0,51848
$A_{41} = 6/9{,}643650761$ = 0,62217
C4 = $\sqrt{6^2 + 6^2 + 5^2 + 4^2}$
= $\sqrt{36 + 36 + 25 + 16}$
= $\sqrt{113}$
= 10,63014581
$A_{11} = 6/10{,}63014581$ = 0,56443
$A_{21} = 6/10{,}63014581$ = 0,56443
$A_{31} = 5/10{,}63014581$ = 0,47036
$A_{41} = 4/10{,}63014581$ = 0,37629
C5 = $\sqrt{3^2 + 4^2 + 3^2 + 5^2}$
= $\sqrt{9 + 16 + 9 + 25}$
= $\sqrt{59}$
= 7,681145748
$A_{11} = 3/7{,}681145748$ = 0,39057
$A_{21} = 4/7{,}681145748$ = 0,52076
$A_{31} = 3/7{,}681145748$ = 0,39057
$A_{41} = 5/7{,}681145748$ = 0,65094

$$Xij = \begin{bmatrix} 0{,}45091 & 0{,}39653 & 0{,}41478 & 0{,}56443 & 0{,}39057 \\ 0{,}51532 & 0{,}47583 & 0{,}41478 & 0{,}56443 & 0{,}52076 \\ 0{,}51532 & 0{,}55513 & 0{,}51848 & 0{,}47036 & 0{,}39057 \\ 0{,}51532 & 0{,}55513 & 0{,}62217 & 0{,}37629 & 0{,}65094 \end{bmatrix}$$

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c. Optimization of Attributes
The results of attribute optimization for solving the problem of selecting digital investment instruments using the Multi-Objective Optimization by Ratio Analysis (MOORA) method in this study, namely:
C1
$A_{11} = 0{,}45091 * 0{,}23 = 0{,}10371$
$A_{21} = 0{,}51532 * 0{,}23 = 0{,}11852$
$A_{31} = 0{,}51532 * 0{,}23 = 0{,}11852$
$A_{41} = 0{,}51532 * 0{,}23 = 0{,}11852$
C2
$A_{11} = 0{,}39653 * 0{,}22 = 0{,}08723$
$A_{21} = 0{,}47583 * 0{,}22 = 0{,}10468$
$A_{31} = 0{,}55513 * 0{,}22 = 0{,}12213$
$A_{41} = 0{,}55513 * 0{,}22 = 0{,}12213$
C3
$A_{11} = 0{,}41478 * 0{,}20 = 0{,}08296$
$A_{21} = 0{,}41478 * 0{,}20 = 0{,}08296$
$A_{31} = 0{,}51848 * 0{,}20 = 0{,}10370$
$A_{41} = 0{,}62217 * 0{,}20 = 0{,}12443$
C4
$A_{11} = 0{,}56443 * 0{,}18 = 0{,}10160$
$A_{21} = 0{,}56443 * 0{,}18 = 0{,}10160$
$A_{31} = 0{,}47036 * 0{,}18 = 0{,}08466$
$A_{41} = 0{,}37629 * 0{,}18 = 0{,}06773$
C5
$A_{11} = 0{,}39057 * 0{,}17 = 0{,}06640$
$A_{21} = 0{,}52076 * 0{,}17 = 0{,}08853$
$A_{31} = 0{,}39057 * 0{,}17 = 0{,}06640$
$A_{41} = 0{,}65094 * 0{,}17 = 0{,}11066$

$$Xwj = \begin{bmatrix} 0{,}10371 & 0{,}08723 & 0{,}08296 & 0{,}10160 & 0{,}06640 \\ 0{,}11852 & 0{,}10468 & 0{,}08296 & 0{,}10160 & 0{,}08853 \\ 0{,}11852 & 0{,}12213 & 0{,}10370 & 0{,}08466 & 0{,}06640 \\ 0{,}11852 & 0{,}12213 & 0{,}12443 & 0{,}06773 & 0{,}11066 \end{bmatrix}$$

Based on the value of the Xwj matrix, the calculation of the Yi value can be seen in the description below:
Preference Value Yi A1 = (-0,10371) + 0,08723 + 0,08296 - 0,10160 + 0,06640 = 0,03128
Preference Value Yi A2 = (-0,11852) + 0,10468 + 0,08296 - 0,10160 + 0,08853 = 0,05605
Preference Value Yi A3 = (-0,11852) + 0,12213 + 0,10370 - 0,08466 + 0,06640 = 0,08905
Preference Value Yi A4 = (-0,11852) + 0,12213 + 0,12443 - 0,06773 + 0,11066 = 0,17097

d. Ranking of Alternatives
The results of ranking alternatives based on the Preference value Yi obtained from the previous calculation process, namely:

Table 4. Ranking of Alternatives

Code	Alternative	Preference Value Yi	Ranking
A1	Gold	0,03128	4
A2	Mutual Fund	0,05605	3
A3	Foreign Exchange	0,08905	2
A4	Trading	0,17097	1

4 Conclusion

a. The application of the Multi-Objective Optimization by Ratio Analysis (MOORA) method can determine the best choice of digital investment instruments in the alternative ranking results in Table 4 based on the highest Yi preference value compared to other alternatives, namely A4 (Trading) with a value of 0.17097.

b. The Multi-Objective Optimization by Ratio Analysis (MOORA) method can help decision making in the selection of digital investment instruments objectively and transparently.

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