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Procedia Computer Science 221 (2023) 718–725

Procedia Computer Science

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10th International Conference on Information Technology and Quantitative Management

Selection of Agroindustry Real Estate Funds, based on the AHP-Gaussian, for an Investment Portfolio

Daniel Augusto de Moura Pereira[a], Alexandre Chaves Araújo[a], Guilherme Nascimento Araújo[a], Mateus José de Siqueira Silva[a], Bruno Pereira Diniz[a], João Cavalcanti Neto[a], Pedro Paulo Mendes Tomaz[a], Jordan Matheus Barbosa Araújo[a], Marcos dos Santos[d], Carlos Francisco Simões Gomes[c], David de Oliveira Costa[b], Danillo Marcus Farias Marinho do Monte[d] *

[a]*Federal University of Campina Grande, Campina Grande, PB 58428-830, Brazil*
[b]*Federal University of Pernambuco, Recife, PE, 50740-600, Brazil*
[c]*Fluminense Federal University, Niterói, RJ 24210-240, Brazil*
[d]*Military Institute of Engineering, Urca, RJ 22290-270, Brazil*

Abstract

One of the problems faced by investors in the stock market is the difficulty in choosing good assets, since, for investors without adequate knowledge, it becomes a subjective and non-quantitative process, which makes it difficult to assess whether the asset is good or not. In this sense, selecting the best FIAgro fund, based on the AHP-Gaussian multicriteria decision method, to compose a diversified investment portfolio. The collection of data referring to FIAgro was based on investment brokerages in data from the Brazilian Stock Exchange. After modeling the AHP-Gaussian method, the result indicated RZAG11 as the best FIAgro and PLCA11 the worst.

Keywords: "Investment; FIAgro; Multicriteria Decision Analysis Method; AHP-Gaussian."

* Corresponding author. Tel.: + 55 (83) 99912-7417.
E-mail address: danielmoura@ufcg.edu.br

1877-0509
10.1016/j.procs.2023.08.043

1. Introduction

In recent days the number of individual investors has grown rapidly in Brazil, much of it influenced by the recent pension reform and the recent confrontation of a period of low interest rates, forcing investors to seek new alternatives to monetize their savings [1].

According to [2], define FIIs as an organization that gathers resources from third parties in an organized, professional and transparent way, in order to apply these resources in real estate businesses of the most varied types, so that investors can be offered better investment options if they invest in isolation. It is important to note that this type of investment is regulated and supervised by the CVM - Brazilian Securities and Exchange Commission.

In this sense, the present work aims to identify the best real estate funds in the Agroindustrial sector from the use of the AHP-Gaussian Decision Analysis Multicriteria method, to compose a diversified investment portfolio.

2. Theorical Framework

2.1. Real Estate Funds

Indirect real estate investment has been gaining great focus in recent years, as it is a market that offers several benefits when compared with direct real estate investment and other types of investments. In addition to being an easily accessible market for all types of investors, be they individual investors, institutional investors, insurers and investment managers [3].

Real estate funds are characterized as a form of fundraising through quotas representing variable income securities. These quotas are parcels of non-redeemable values, to reacquire the investment would have to sell them to third parties in the secondary market [4].

Another important advantage presented by this type of asset is the exemption from income tax on the proceeds distributed by it to individuals, provided that the quotas of this fund are traded on stock exchanges, have at least 50 quotaholders, do not own 10% of the total quotas issued by a fund [5].

2.2. Investment Funds in Agro-Industrial Production Chains – FIAgro

The Investment Funds in Agroindustrial Production Chains (FIAgro) as exposed in the Explanatory Memorandum of PL n. 5191/2020 were created with the objective of making available to the investing public a safe and flexible investment vehicle, which will bring the financial and capital markets closer to agribusiness, significantly increasing the amount of credit and resources for investments in this important sector of our economy [6].

According to [7], "The Investment Funds in Agroindustrial Production Chains (FIAgro) bring flexibility, accessibility and comprehensiveness to private credit in agro."

2.3. Multicriteria Decision Concepts

The Multicriteria Decision Markup (MDCM) approach plays an important role in selecting non-dominant alternatives from among several viable alternatives evaluated against various criteria in real-life decision-making involving uncertainty issues ([8];[9]).

The following aspects should be involved in decision making (DM) ([9];[10];[11]):

- A perception of the DM regarding the necessity and appropriateness of the decision, considering marketing, operational, technological, strategic, financial variables, etc;
- The adoption of a methodology or combination of methodologies, enabling the identification of the variables and a rational analysis of the information;
- The assessment of the necessity and feasibility of sharing the decision-making process to ensure the required engagement in the deployment of the chosen alternative.

According to Pereira et. al. [12], "Despite the diversity of MCDM approaches, methods and techniques, the essential ingredients of MCDM are a finite or infinite set of actions (alternatives, solutions, courses of action, etc.), at least two criteria, and at least one DM".

For Drumond et. al. [13], "It is essential to use a Multi-Criteria Decision Support (AMD) method to support the classification process".

The decision-making process must meet the important objective according to which, whatever option is chosen, the best opportunity must be seized, without harming the strategic position of the decision-maker ([14];[15]).

2.4. AHP Method

The AHP is a multicriteria decision aid method created by the American mathematician and professor Thomas Lorie Saaty during the 1970s, whose objective is, in summary, the support to prioritize the alternatives of a given decision problem, considering two or more predefined criteria for this ([16];[17];[18]).

According [19], presented a synthesis of the functioning of AHP in six basic steps, namely:

1. Structure the decision situation in a hierarchy: once the scope of the problem is defined.
2. The next way to represent the problem input data, using the decision situation, is the decision matrix. It assigns reference values to each alternative criterion and is a format that will be used for the next steps of the model.
3. Building the matrix for comparisons: The decision maker needs to record a preference statement for each pair of elements compared. This step is performed with the support of constructing a matrix of size N x N, or N equal to the number of criteria.
4. Determination of the weights assigned to each parity relation of the matrix. For each pair of elements, an index is applied to the relationship. The index in question should be based on the Fundamental Saaty Scale.
5. When the CI value found in Equation (1) is less than or equal to zero, it is assumed that the equal weights assigned by the decision maker have consistency. Otherwise, the review is necessary, as there is an indication that the weightings are not consistent [19].

$$p = \frac{\sum_{j=1}^{n} x_{ij}}{\sum_{i=1}^{n} \sum_{j=1}^{n} x_{ij}} \tag{1}$$

where, x: is the matrix of parity comparisons.

From the weight vector obtained, it is possible to perform the last step, which is to obtain the significance index, for each alternative from Equation (2).

$$f(a) = \sum_{c=1}^{n} p_c \,.\, v_c(a) \tag{2}$$

where PC: is the weight of criterion C; vc: equivalent to the reference value of criterion c for alternative a, in the decision matrix; and f(a): is the output of the model to alternative a.

6. Determination of the final ordering, for the pre-established criteria: applying Equation (2) for the problem, one has the final output in the form of a weighting vector called the priority vector of the alternatives. Ordering it in descending order, you have the list of alternatives, organized from the best alternative – the most recommended, even the least recommended.

2.5. AHP-Gaussian Method

The multicriteria method Analytic Hierarchy Process –Gaussian (AHP-Gaussian) was introduced by [20], where it aims at a new approach to the original AHP method, which is based on a sensitivity analysis from the Gaussian factor.

With this approach it is possible to obtain the weights of the attributes from quantitative inputs of the alternatives in their respective attributes, from the data entered in the decision matrix [20].

Stages of the AHP-Gaussian method ([21];[22];[23]):

1. The first step of the method is to establish the decision matrix, with the alternatives and criteria to be judged in the decision-making process;

After establishing the decision matrix, the normalization of the attributes is performed, for values that are to be maximized, monotonic profit, the Formula 3 is used.

$$N = \frac{a_{ij}}{\sum a_{ij}} \tag{3}$$

For values that you want to minimize, cost monotonic, the Formula 4 is used.

$$N = \frac{\left(\frac{1}{a_{ij}}\right)}{\left(\frac{a_{ij}}{\sum a_{ij}}\right)} \tag{4}$$

2. The second step is to calculate the average of the alternatives;
3. The third step is to calculate the standard deviation of each alternative for each criterion;
4. The fourth step is to calculate the Gaussian factor for each criterion;
5. The fifth step is to multiply the Gaussian factor by the decision matrix
6. The sixth stage consists in the normalization of the results; and
7. In the seventh stage, the ordering of alternatives is obtained

3. Methodology

This article is a quantitative analysis. Figure 1 presents the methodological summary of the work.

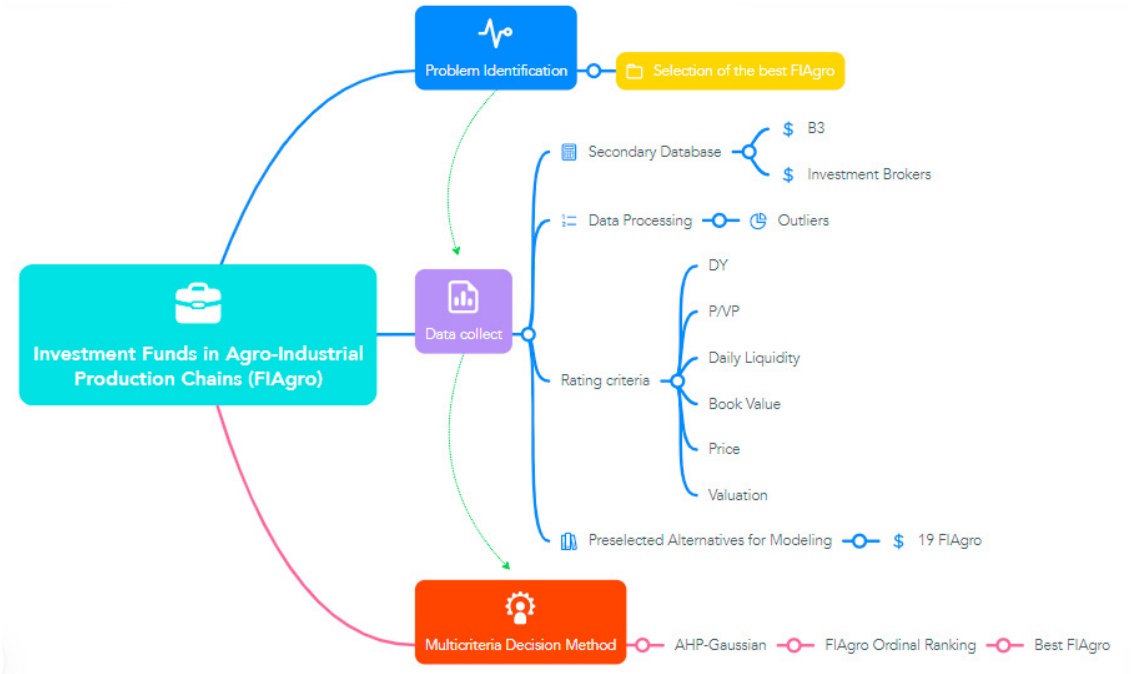

Fig. 1. Methodological procedure used

The first stage of the methodology consisted in the identification of the problem. This time, it was observed the difficulty in choosing the best FIAgro for the formation of a diversified investment portfolio and without taking great

risks, that is, tending towards a conservative portfolio, since there are many FiAgro options, with fundamental indicators with various values.

For data collection, secondary databases from three major investment brokerages in Brazil were used. Initially, 22 FIAgro were chosen for the composition of the dataset for pre-analysis. It was noticed that of the 22 pre-selected FIAgros, 3 presented inconsistency of values and/or information necessary to become alternatives, so that these were removed from the initial dataset, thus remaining 19 Funds for analysis, namely: VGIA11, OIAG11, NCRA11, PLCA11, AGRX11, DCRA11, LSAG11, JGPX11, EGAF11, GCRA11, RZAG11, XPCA11, FGAA11, SNAG11, BBGO11, RURA11, KNCA11, CPTR11, NCRA11 E VCRA11.

The choice of criteria took into account the fundamental indicators for the choice of a FIAgro, namely: Dividend Yield DY) (%), Price over Equity Value (P/VP), Daily Liquidity (LD) (millions), Equity Value (VP) (millions), Quota (R$) and Valuation Yield in the last 12 months (VR12) (%). Finally, to select the best FIAgro, the AHP-Gaussian Multicriteria Decision Model was used, based on the 19 alternatives and criteria mentioned above.

4. Results and Discussions

4.1. Application of AHP-Gaussian

For the modeling of the AHP-Gaussian methods [24], 19 FIAgro alternatives were considered, all listed on the São Paulo Stock Exchange (B3). The DY, P/VP, LD, VP and VR12 criteria are classified as monotonic of benefit, so they should be maximized. The Quota criterion is classified as cost monotonic, so it should be minimized. Figure 2 illustrates the modeling of the AHP-Gaussian base.

Tipo	MAX	MAX	MAX	MAX	MIN	MAX
	DY(%)	P/VP (%)	LD (millions)	VP (millions)	Quota (R$)	VR12(%)
VGIA11	0,1767	1,03	4,88	698,37	9,81	0,2
OIAG11	0,1086	1,05	0,09952	41,13	10,36	-0,19
NCRA11	0,1598	0,97	0,20159	43,34	91,41	3,82
PLCA11	0,0652	1,02	0,03185	52,96	93,12	-3,38
AGRX11	0,0679	0,99	0,0173	56,36	10,51	4,37
DCRA11	0,1426	0,96	0,26074	64,84	9,08	2,25
LSAG11	0,1444	1,07	0,03472	81,34	104	-3,49
JGPX11	0,1318	1	0,1125	81,44	97	1,17
EGAF11	0,1876	1,02	0,82884	93,81	101,98	4,5
GCRA11	0,1551	0,98	0,25576	171,46	95,1	-0,18
RZAG11	0,148	0,99	2,24	662,24	9,73	3,18
XPCA11	0,1598	1,04	1,41	298,18	9,9	2,17
FGAA11	0,1718	1,04	1,13	328,11	9,96	1,33
SNAG11	0,0649	1	2,03	303,13	100,49	0,89
BBGO11	0,0035	0,83	0,22828	389,41	78	-1,42
RURA11	0,1106	1,04	0,74224	795,43	10,48	1,07
KNCA11	0,1467	1,08	2,16	982,87	106,95	-0,69
CPTR11	0,1213	1	1,73	408,49	98,48	1,59
EGAF11	0,1876	1,02	0,82884	93,81	101,7	4,5
NCRA11	0,1598	0,97	0,20159	43,34	91,4	3,82
VCRA11	0,1041	1,07	0,28218	237,16	107,2	1,35
PLCA11	0,0652	1,02	0,03185	52,96	93,12	-3,38

Fig. 2. Modeling of the AHP-Gaussian base

Figure 3 depicts the normalized decision matrix of the AHP-Gaussian model. From it is possible to visualize the criteria, already with their normalizations, the measures of variability, Gaussian factor of the sample group.

	C1	C2	C3	C4	C5	C6
VGIA11	0,063492634	0,046417305	0,247241334	0,116780766	0,107484104	0,008517888
OIAG11	0,039022637	0,047318612	0,005042102	0,006877719	0,101777902	-0,008091993
NCRA11	0,05742005	0,043713384	0,010213398	0,007247273	0,011535052	0,162691652
PLCA11	0,023427955	0,045966652	0,001613655	0,008855921	0,011323229	-0,1439523
AGRX11	0,024398132	0,044614691	0,000876491	0,009424465	0,100325315	0,186115843
DCRA11	0,051239669	0,043262731	0,013210186	0,010842483	0,116125447	0,095826235
LSAG11	0,051886453	0,048219919	0,001759061	0,013601597	0,010138645	-0,148637138
JGPX11	0,047358965	0,045065345	0,005699723	0,013618319	0,0108703	0,049829642
EGAF11	0,067409271	0,045966652	0,041992522	0,015686819	0,010339469	0,19165247
GCRA11	0,055731225	0,044164038	0,012957878	0,028671378	0,011087477	-0,007666099
RZAG11	0,053180022	0,044614691	0,113487825	0,110739142	0,108367838	0,135434412
XPCA11	0,05742005	0,046867959	0,071436533	0,049861375	0,106506976	0,09241908
FGAA11	0,061731944	0,046867959	0,057250555	0,054866241	0,105865368	0,056643952
SNAG11	0,023320158	0,045065345	0,102848342	0,05068911	0,010492776	0,0379046
BBGO11	0,001257636	0,037404236	0,011565625	0,065116769	0,013518193	-0,060477002
RURA11	0,039741286	0,046867959	0,037605002	0,133011046	0,100612506	0,045570698
KNCA11	0,0527129	0,048670572	0,109434689	0,164354585	0,009858991	-0,029386712
CPTR11	0,043586058	0,045065345	0,087649079	0,068307308	0,010706936	0,067717206
EGAF11	0,067409271	0,045966652	0,041992522	0,015686819	0,010367936	0,19165247
NCRA11	0,05742005	0,043713384	0,010213398	0,007247273	0,011536314	0,162691652
VCRA11	0,037405677	0,048219919	0,014296426	0,039657669	0,009835999	0,057495741
PLCA11	0,023427955	0,045966652	0,001613655	0,008855921	0,011323229	-0,1439523

Average	0,045454545	0,045454545	0,045454545	0,045454545	0,045454545	0,045454545
Standard deviation	0,01729245	0,002353181	0,058986346	0,046749399	0,046857067	0,106234516
Gaussian Factor	0,38043389	0,051769975	1,297699619	1,028486787	1,030855481	2,337159342

G factor. Norm.	0,062	0,008	0,212	0,168	0,168	0,381

Fig. 3. Normalized decision matrix

Figure 4 shows the ranking of alternatives according to the output of the AHP-Gaussian method. The ranking for the AHP-Gaussian Method indicated the following alternatives, by ordinary: RZAG11, EGAF11, AGRX11, VGIA11, XPCA11, NCRA11, DCRA11, RURA11, FGAA11, CPTR11, SNAG11, VCRA11, KNCA11, JGPX11, OIAG11, GCRA11, BBGO11, NCRA11, LSAG11 and PLCA11.

	C1	C2	C3	C4	C5	C6	AHP-G	RANK
VGIA11	0,063492634	0,046417305	0,247241334	0,116780766	0,107484104	0,008517888	0,097646	2
OIAG11	0,039022637	0,047318612	0,005042102	0,006877719	0,101777902	-0,008091993	0,019084	17
NCRA11	0,05742005	0,043713384	0,010213398	0,007247273	0,011535052	0,162691652	0,071321	8
PLCA11	0,023427955	0,045966652	0,001613655	0,008855921	0,011323229	-0,1439523	-0,04934	21
AGRX11	0,024398132	0,044614691	0,000876491	0,009424465	0,100325315	0,186115843	0,091542	3
DCRA11	0,051239669	0,043262731	0,013210186	0,010842483	0,116125447	0,095826235	0,064262	11
LSAG11	0,051886453	0,048219919	0,001759061	0,013601597	0,010138645	-0,148637138	-0,04871	20
JGPX11	0,047358965	0,045065345	0,005699723	0,013618319	0,0108703	0,049829642	0,027654	16
EGAF11	0,067409271	0,045966652	0,041992522	0,015686819	0,010339469	0,19165247	0,090956	5
GCRA11	0,055731225	0,044164038	0,012957878	0,028671378	0,011087477	-0,007666099	0,010333	18
RZAG11	0,053180022	0,044614691	0,113487825	0,110739142	0,108367838	0,135434412	0,11621	1
XPCA11	0,05742005	0,046867959	0,071436533	0,049861375	0,106506976	0,09241908	0,080642	6
FGAA11	0,061731944	0,046867959	0,057250555	0,054866241	0,105865368	0,056643952	0,06499	10
SNAG11	0,023320158	0,045065345	0,102848342	0,05068911	0,010492776	0,0379046	0,04835	13
BBGO11	0,001257636	0,037404236	0,011565625	0,065116769	0,013518193	-0,060477002	-0,00702	19
RURA11	0,039741286	0,046867959	0,037605002	0,133011046	0,100612506	0,045570698	0,067473	9
KNCA11	0,0527129	0,048670572	0,109434689	0,164354585	0,009858991	-0,029386712	0,044905	14
CPTR11	0,043586058	0,045065345	0,087649079	0,068307308	0,010706936	0,067717206	0,060756	12
EGAF11	0,067409271	0,045966652	0,041992522	0,015686819	0,010367936	0,19165247	0,090961	4
NCRA11	0,05742005	0,043713384	0,010213398	0,007247273	0,011536314	0,162691652	0,071321	7
VCRA11	0,037405677	0,048219919	0,014296426	0,039657669	0,009835999	0,057495741	0,036005	15
PLCA11	0,023427955	0,045966652	0,001613655	0,008855921	0,011323229	-0,1439523	-0,04934	21

Fig. 4. Result of the AHP-Gaussian

In view of the above, it is possible to perceive that the AHP-Gaussian method indicated as the best alternative the RZAG11 fund. On the other hand, the method indicated that the worst alternative purchase is the PLCA11 model. With this, the decision-maker already knows which are the best assets in this segment, and consequently gains many facilities when making the decision about which assets should compose his portfolio in a way that compacts with his investment strategy.

5. Final Considerations

In this paper has been presented the application of the AHP-Gaussian Multicriteria Method to select the best FIAgro on the Brazilian stock exchange. According to the research carried out, 19 alternatives were found of FIAgro funds, of which 6 evaluation criteria were established. Thus, after processing the AHP-Gaussian, the FIAgro classification from best to worst was obtained. In which the best purchase alternative was the RZAG11 fund, in turn, the worst purchase alternative was the PLCA11 fund. It is important to emphasize that, in order to obtain greater assertiveness, a very in-depth analysis of the criteria to be used, as well as the alternatives to be pointed out, is fundamental. It is worth noting that the results obtained here may vary from one month (or even daily, depending on the behavior of the economy) to another depending on the price of the FIAgro quota. However, this type of investment is for the long term, and choosing a good fund does not just depend on the value of your quote.. However, the foundation of the application will remain the same.

The result of this work highlights the importance of using Multicriteria Methods in decision making in the area of investments, thus being able to make better and more assertive decisions.

For future work, other approaches are recommended for structuring the problem and multicriteria support approaches are suggested for the decision to order real estate funds by another type of segment.

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