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Case Report

Proposal of a Methodology for Ranking Stocks by Multicriteria Methods: A Practical Approach Case of the Stocks Exchange Tunis

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Abstract: Multicriteria decision is one of the most complex areas, given the large number of criteria to assess the difficulty of quantifying some qualitative criteria and the requirement to integrate the decision-maker himself in the process of decision making through multi-criteria methods. The choice of methods depends on several variables in one of them is the type of scope; The management of stock portfolio is one of the modern fields of the application of multi-criteria methods. This article proposes the establishment of a stock portfolio via multi-criteria methods, the portfolio is made up from all the listed companies of Tunis (TSE).

Keywords: The Multiple Criteria, Multi-criteria Methods, Building a Stock Portfolio, The Tunis Stock Exchange

1. Introduction

As such the problem of multi-criteria constitution and stock portfolio management is diced in one of the areas of interest of applied mathematical methods have several model was adopted to solve this problem, starting with its famous model Markowitz mean-variance from the model of balance of financial assets CAPM, APT Theory of arbitration, ending with the multi-criteria models. The article deals with this problem by using multi-criteria methods, the case study is that of the stock exchange in Tunis.

2. The Previous Studies (Multi-criteria) for the Equity Portfolio of Incorporation

Christian Hurson and Constantin Zopounidis 1997(W. Halimi & Co 2010)

2.1. Multiattribute Utility Theory

2.1.1. The Study of Saaty, Rogers and Pell (1980)

The authors study both the problem of evaluation of stocks and the determination of a portfolio. The proposed methodology is that of the Analytic Hierarchy Process approach (AHP) due to Saaty (1980). The authors consider that the actions should be compared according to the criteria that influence their prices and objectives of the investor, and the influence of global criteria depend influencing factors. In this way, they define a hierarchy of causal links between actions, objectives (or criteria of influence) and the influencing factors. The model proposed by the authors includes three hierarchies; one based on extrinsic factors to the firm, based on the objectives of the investor. The AHP is to be weighted according to their importance for each hierarchy, the factors of influence and criteria; for weighting and storage firms, as well as the proposal of each firm selected in the portfolio. Note the important effort done to use all influencing factors. However, the effort investor demand is very high, which can only limit the number of considered actions. The AHP is descriptive in nature.

2.1.2. The Study of Evrard and Zisswiller (1983)

The study of the problem is based on the evaluation of actions and the proposed methodology is that of the theory of utility multiattribute. The purpose of this article is to show

how it is possible to develop models that link the attributes of the shares to the preferences of the investor. The authors decided to use the four most commonly used by a group of 22 investors criteria: performance, risk, the PER and earnings per share. Two approaches were used. In the first, based on phantom shares 16 well differentiated, investors' preferences are studied by estimating the relative points and partial utility functions of each criterion. In the second, based on 20 actual actions of the French market, the weight of each attribute is estimated from the preferences expressed on the shares. Here, although no pattern of risk behavior is required, the approach remains descriptive. Using a study of phantom shares and a study of actual actions shows how investor behavior can be disruptive by their perception of the situation of the issuing companies, the intuition, their reactions facing a real risk in a given situation.

2.1.3. The Study of Rio-Rio-Insua and Garcia (1983)

The problem studied is that of the creation of a portfolio of shares, the proposed multi-criteria approach is that of the theory of expected utility multiattribute and mathematical programming has multiple objectives. The first proposal of the other is the use of the theory of expected utility multiattribute. The authors therefore consider the possibility of revising the decision. They then propose the use of mathematical programming under probabilistic constraints, no interactivity character. It is not a question of a real study but simple research proposals. These proposals are in line with the classical theoretical approach and remain very prescriptive. It will guide the interesting idea of using the Bayesian econometrics to review the decision and a draft development of the classical theoretical approach to integration in the utility function of several evaluation criteria.

2.2. The Outranking Methods

2.2.1. The Study of Mariel, Khoury and Bergeron (1988)

The authors argue for a multi-criteria approach to risk, based on the use of the upgrade approach I ELECTRE methods (Roy, 1968) and II ELECTRE (Roy and Bertier, 1973) for selecting portfolios. The methodology is applied to two portfolios selected by a portfolio manager. The methods do not allow to compose portfolios, the authors generated from actions included in these two portfolios. The criteria used are the yield, the logarithmic variance, the price / earnings ratio and market liquidity criterion. The goal is to determine which portfolio best meet the criteria of decision and to assess whether the selected portfolios are consistent with those criteria. The results show that the first decision is consistent with the criteria used, not the second; they also show that the studied storage portfolios varies greatly with the value of the relative weights of the criteria. The upgrade approach, to which belong the ELECTRE methods used here is constructive inspiration.

2.2.2. The Study by Khoury, Martel and Veilleux (1993)

This study proposes a multi-criteria method of selection of international portfolios. The methods used are ELECTRE II (Roy and Skalta, 1984) and ELECTRE III (Roy 1978). The authors generate 19 portfolios from market indices of 16 countries. The criteria used are the yield and its standard deviation, the cost of transactions, country risk, direct coverage available to foreign currencies and the currency risk. This study is the only one, to our knowledge, has an interest in international portfolios. Therefore, it mainly considers the international component of risk, and shows that it is also multi-dimensional and multi-criteria decision support then seems better suited to this problem that the conventional approach.

2.2.3. The Study of Szala (1990)

The problem is the trafficking of evaluation of shares. This study was conducted in collaboration with a French stockbroker. Initially, author and financial analysts identify the criteria used by the stockbroker and select attractive shares. The multi-criteria used methods are ELECRE III and the interactive system PREFCALC (calculated Preferences, Jacquet-Lagrèze, 1983-1990). For financial analysis, Szala ELECTRA III uses the method to get a share ranking. Traders and portfolio managers manage in general too many shares to be able to examine them according to many criteria. Regarding them, Szala has decided to consolidate the financial criteria in a test system has obtained from the PREFCALC system. This criterion of synthesis is used with the effort to use all portfolio management interest criteria. However, the high number of criteria can be a disadvantage by making it difficult MCA. In this regard, we note the interesting idea of using UTA interactive approach to build a synthetic criterion.

2.3. Interactive Methods

2.3.1. The Study of Nakayama, Takegushi and Sound

The problem deals with the creation of a portfolio. The authors consider that the problems using a multi-criteria decision are often poorly structures and subjective, involving criteria that are neither digital nor defined. Using an easy to interpret graphical information then appears to them more effectively. The authors propose an interactive method based on graphic information to build a portfolio. Everything depends on the ability of the graphic information represented the multi-criteria nature of the problem. This graphics information is composed of the average of the variance and the performance rise curve. This information can in no way claim to represent the different influence factors that affect stock prices, let alone allow MCA workable compromise.

2.3.2. The Study by Lee and Chesser (1980)

This article presents a model of Goal Programming (GP) preemptive which helps the decision maker to select the portfolio that meets, as far as possible, has its objectives. GP allows the investor to simply define its investment desires, consistent with the search for an efficient portfolio, including the GP that can naturally integrate diversification principles that are fundamental management wallet. In addition, GP provides an analysis of feasible compromise between the

criteria, which is the ultimate goal of portfolio selection. The targets used are compliance with the budget constraint, the search for a minimum return; minimization of risk (measured by beta), diversification objectives and personal goals is the investor. For their study, the authors accept the hypothesis of efficiency of the market and therefore offer a passive management as part of the traditional approach. The multidimensional nature of the risk is not exploited.

2.3.3. The Study of Colson and Bruyn (1989)

The authors address both the problem of assessing the actions and the selection of a portfolio. The heart of the system is presented the comparison of operational objectives: to achieve a given level of gain; keep portfolio risk below a certain level; reach a level of minimum gain in the form of dividends or interest; ensure sufficient diversification, effective control, or need cash.

Both models are built, the SDM model (Single Decision Model) for the sale or purchase of securities and the MMS model (Simultaneous Management Model) regarding the creation of a portfolio. The SDM leads to storage of securities in several statistical criteria. In SDM, information from correspondents (financial analysts, consultants, etc.) are integrated. MMS is a GP model of the same type as that of Lee and Chesser. Note integrating a multi-criteria analysis in the opinion of correspondents that seems particularly interesting. In this study, which is still descriptive inspiration, the perception of risk is reduced to its probabilistic component, however the intervention of the corresponding can be a way to take account of other influential variables.

2.4. The Approach to the Disintegration of Preferences

2.4.1. Studies of Colson and Zeleny (1980)

The purpose of the study Colson and Zeleny (1979) is building an efficient frontier on more realistic basis as the MV model. For this, they propose the use of a vector of three components called criteria Prospect Ranking vetor. The first component is the probability of not achieving a minimum return, the second component is the return hope and the third is the probability of exceeding maximum efficiency.

The study of Colson and Zeleny has restricted the probabilistic dimension of risk and shows that even at this level, it is advantageous to use a multidimensional measure of risk including gain opportunities. He then seemed interesting to see how we could resume work Colson and Zeleny, not in order to determine the set of efficient portfolios, but in a selection goal. To do so, the PRV requires some modifications in order to provide the most comprehensive risk measures. As far as risk of loss is currently divided into two components: the first is designed to protect against very heavy losses and the second is to consider smaller losses, but still significant. In terms of saving opportunities, the probability of exceeding a maximum level of performance is replaced by the probability of getting a significantly higher yield average. The multiple criteria decision then can integrate these risk measures, along with other criteria of interest, in a process using multi-criteria decision.

2.4.2. The Study of Zopounidis, Despotis and Kamaratou (1993)

Other studies add to earlier, including that of Zopounidis, Despotis and Kamaratou (1993), which propose the use of interactive system ADELAIS (question system to Advanced Linear Decision by question-structuring of preferences) for the creation of a portfolio of shares, on which method we used to come to end of our case study on the establishment of a stock portfolio on the securities market in Tunis.

3. Selection a Set of Attractive Shares on the Stocks Market of Tunis

In what follows we represent the application of the UTA+ method and ELECTRE TRI followed by a mathematical programming has multiple objectives resolved through the LINDO software for selecting a set of attractive shares for a storage problem we UTA + and apply the method ELECTRA TRI, which is a method of on-classification, for a sorting problem; These two methods belong to the constructive approach and it is a major reason for their choice.

What to note that this is a methodology for multi-criteria decision support in terms of stock selection and not a model for forecasting yields such as CAPM (Evaluation Model of financial assets) or APT (Arbitrage pricing theory).

3.1. Construction of Evaluation Criteria

The database includes 53 Tunisian companies, stock and financial data (balance sheet, income statement, action prices, dividends,...) cover a period from December 2009 to July 2013. From this database we will proceed in the evaluation of a number of criteria.

Seven criteria were selected, four fellows (yearly or monthly as appropriate) and three financial analysis (annual):

Table 1. *Evaluation criteria.*

Criteria	Criteria for financial analysis	Criteria stock
The average monthly performance		Who is a stock standard
Le price earnings ratio monthly to minimize		In case of losses this test is negative so the action will be placed at the top so it would be better to maximize the reverse of this criterion 1 / RIP.
Earnings per share or EPS Annual		maximizing earnings per share.
The return on equity	Who is a return on capital, criteria to maximize clean.	
Current ratio	Or liquidity test in the strict sense that must be maximized.	

Criteria	Criteria for financial analysis	Criteria stock
Cash flow ratio / debt	Who is a solvency test, must be maximize.	
Le ßêta-1		Minimizing the absolute value of this test represents a portfolio manager who prefers actions ßeta close to 1 and follows a passive management strategy (the cautious attitude)

The companies in the sample are all listed companies, so the entire population is considered.

3.2. The Application of UTA + Methods, ELECTRE III and Mathematical Programming

3.2.1. Ranking Actions by Their Degree of Usefulness (Application of UTA +)

This method is based on finding a utility function for storage of stocks, may face two situations:

1. There is a function of additive separable utility that meets the established order by the decision maker, then F = 0. In this case, there are actually an infinite number of utility functions that comply with this order and post-optimality analysis is used to select an "average" function to represent.
2. There is no additive of separable utility functions that respects the order, then F> 0. In this case the role of variables σ gap is to enable the estimation of a utility function. The program solution is unique and a utility function is obtained which better respect the preferences of the decision maker according to the criterion in question.

In this case (the case study) looking for a utility function that best respect the preferences of the decision maker (in the absence of decision maker, we will play its role) is provided here by the UTA + v.1 software 40 (designed by Poznan University of Technology- Laboratory of Intelligent Decision Support Systems).

This research is based on the assumption of the existence or not of a set of actions for which there is or is not a utility function that according to the Kendall coefficient τ if it is less than 0.7 function usefulness of a partner (that best represents the preferences of the decision maker) does not exist, if the coefficient is equal to or greater than 0.7 (approaching 1) there is a utility function that meets best the preferences of decision maker. So we conducted a series of tests checking each time the value of this ratio still below 0.7 for all 54 companies and then for the 53 remaining for the 52, the 51, the 50,....., 15. For all of the first 23 actions bringing together companies: Amen Bank, SCB, TJL, GIF, SPDIT, BT, ARTES, SOTET, TLNET, STPIL, TINV, TLAIT, TLS, TREJ, CIL, TPR, SOPAT, PGH, ATL, SIAME, PLTU ASSAD, STEQ. The coefficient of Kendall τ = 0.82 for which there is an additive utility function, the results are shown by the graphs of marginal utility of each of the following criteria:

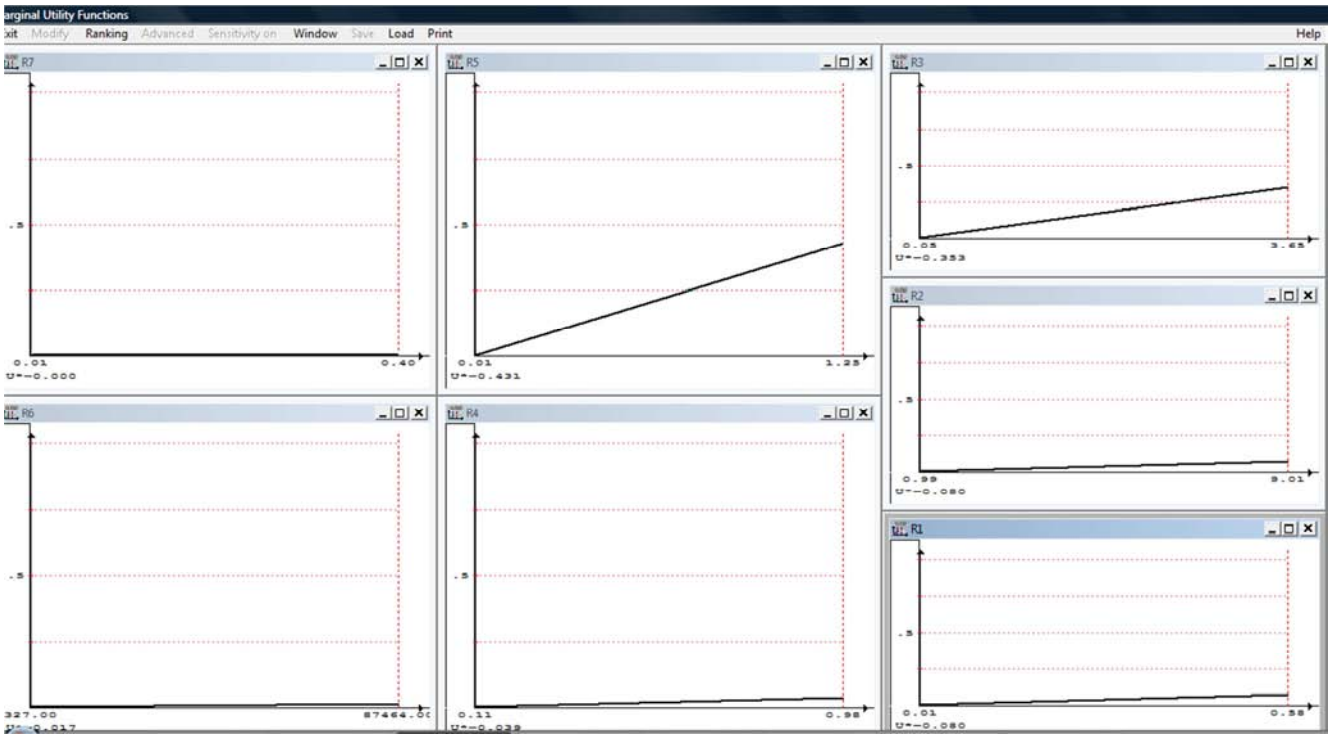

Figure 1. *Marginal utility function (R1, R2, R3, R4, R5, R6, R7).*

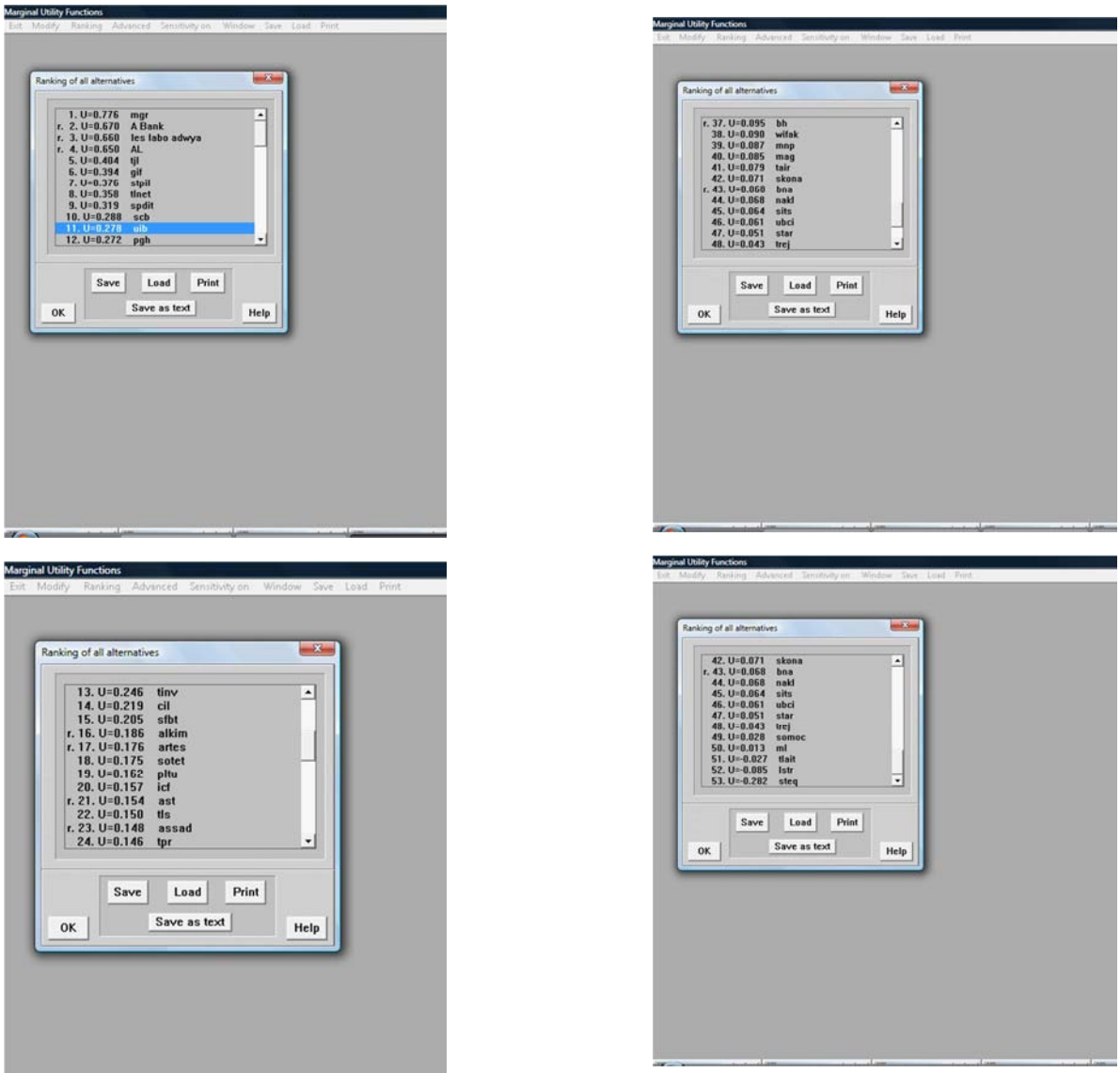

Figure 2. *Ranking of all alternatives.*

DR: is the portfolio manager and the storage MR: storage is compared to the overall utility of each reference action. The value of the coefficient of Kendall $\tau = 0.82$ shows that the utility function estimated compliance at best and not perfectly the order established by the portfolio manager.

The marginal utility curves of the eight criteria are shown in the following figures, given that the storage of the portfolio manager is in agreement with the model we can pass to the total and final classification phase

Table 2. *Total and Final Standings.*

MR	DR	Global Utility	Actions
1	1	23.786	AMEN BANK
2	2	1.152	SCB
3	3	0.986	TJL
4	4	0.641	GIF
5	5	0.607	SPDIT
6	6	0.557	BT
7	7	0.542	ARTES
8	8	0.469	SOTET

MR	DR	Global Utility	Actions
9	9	0.460	TLNET
10	10	0,434	STPIL
11	11	0,433	TINV
12	12	0,413	TLAIT
13	13	0,410	TLS
14	14	0,407	TREJ
15	15	0,362	CIL
16	16	0,356	TPR
17	17	0,355	SOPAT
18	18	0,338	PGH
19	19	0,328	ATL
20	20	0,312	SIAME
21	20	0,312	PLTU
22	21	0,310	ASSAD
23	22	0,308	STEQ
24	23	0,275	MNP
25	24	0,253	ALKIM
26	25	0,235	ATB
27	26	0,228	STB
28	27	0,204	LES LABO ADWYA
29	28	0,200	SFBT
30	29	0,182	BNA
31	30	0,172	BIAT
32	31	0,166	SOKNA
33	32	0,163	SOMOC
34	33	0,161	LSTR
35	34	0,153	AST
36	35	0,151	STAR
37	36	0,148	TJARI
38	37	0,140	TAIR
39	38	0,136	SITS
40	39	0,129	UIB
41	40	0,118	WIFAK
42	41	0,113	MGR
43	42	0,111	SALIM
44	43	0,097	SIMPA
45	44	0,091	NAKL
46	45	0,084	SIPHA
47	46	0,050	ML
48	46	0,050	AL
49	47	0,045	ICF
50	48	0,043	BH
51	49	0.032	BTE
52	50	0,023	UBCI
53	51	0,019	MAG

3.2.2. The Use of ELECTRE TRI Method to the Equity Allocation in Predefined Categories

The application of this method is to establish tolerance thresholds that will sort and classify alternative in three predefined categories:

Category 3 corresponding to the most attractive shares;

Category 2 corresponding to the shares to be analyzed more closely;

Category 1 corresponds to the actions to be rejected.

Then enter the data into the software ELECTRE TRI 2.0a and to allocate these actions in the said categories

The profiles of references used, the parameters defining (for each criterion and each profile) representation model of the preference system of the Portfolio Manager are presented in the following tables.

Successful evaluation criteria are the same criteria used previously.

i. Conception reference profiles

The assignment of different actions to different categories is based on the comparison of the performance of such shares to that considered normative and assigned to borders profiles (between classes) reference. Since the number of feature is of the order of three reference profiles to be defined will be two (border profiles).

With statistics previously calculated, we designed these reference profiles borders (which are two in number) as PRO01> Pro02 and therefore ordered three categories of performance possible 3> 2> 1. The pessimistic assignment procedure shall rank as follows:

- Ai S Pro01 then Ai is assigned to Category 3: the action Ai outperforms 01 profile that is up or top profile then the action will be assigned to Category 3, which represents all attractive actions.
- Ai S Pro02, but not so Ai S Pro1, Ai is assigned to category 2: the action Ai outclasses profile 02 that the bottom or lower profile but do not outperform 01 profile that is up or top profile, then the Action will be assigned to category 2, which shows all the actions to be analyzed.
- Not so Ai S Pro02, Ai is assigned to Category 1 action Ai no profile 02 that outperforms the bottom or lower profile then the action will be assigned to Category 1, which shows all the actions to be rejected.

We must hold the inter-criteria information that is the relative importance of criteria and their veto thresholds. This is the last will prohibit the procedure pessimistic, sort of an alternative in a category if for at least one criterion, the evaluation is for the low profile of this class with a difference greater than the value the corresponding veto threshold.

As λ cutting threshold is the minimum number of criteria that must be over ranking, reasonable cutting line is therefore in the range of from (0.55, 0.64, 0.73, 0.82, 0.91, 1) representative succession favorable criteria 6, 7, 8, 9, 10 criteria and unanimously. We believe that taken as a basis threshold $\lambda = 0.76$ the default threshold that gives the software would be quite wise.

ii. Application of ELECTRE TRI method and analysis of results

We retain only the pessimistic assignment procedure because it will not affect in the right categories those actions whose qualities are well established, rejecting those which may have a doubt in the wrong categories. Use a decision-maker interested who wishes to preserve a caution.

We believe the pessimism of the decision maker (investor) must be based on the following premise: "the listed companies tend to do better dress their balance sheets and present a good image compared to what it really seems" so c is pessimistic assignment that will do.

In the absence of decision maker for the choice of the relative weights, the system used in ELECTRA TRI corresponds to an equi-weighting. Indifference thresholds and preferably being thresholds of perception, the differences between these thresholds for both profiles are not important. The veto thresholds are different in nature, they include the

effect of prohibiting, in the pessimistic procedure, sort of an action in a category if for at least one criterion, the evaluation is for the low profile this category with a difference greater than the value of the corresponding veto threshold. The attractive category have been designed to include not only actions that can be considered a priori to be sufficiently attractive in the portfolio, we decided to use veto thresholds for high profile to exclude from this category, in the worst cases, shares with one or more criteria for a particularly low valuation. For cons, the category "analyze" has been designed to include actions whose uncertain value requires a thorough examination, the presence of veto thresholds "active" on the low profile does not seem justified. These are attached to a value close to the maximum of the relevant criteria, it is also the default value of the veto threshold, so that no criteria cannot be vetoed.

The default value of $\lambda = 0.76$ cutting level is the value that we decided to use the results of pessimistic and optimistic assignments (by category, the most interesting alternative for that matter) are represented in the following:

Table 3. *Alternative Allocation.*

Categories	λ = 0.76
3	X3, X7, X15, X24, X25
2	X2, X4, X5, X6, X8, X9, X10, X13, X14, X17, X19, X23, X26, X27, X28, X29, X31, X35, X37, X39, X41, X43, X44, X45, X47, X49, X52, X53
1	X1, X11, X12, X16, X18, X20, X21, X22, X30, X32, X33, X34, X36, X38, X40, X42, X46, X48, X50, X51

We can draw the following conclusions:

1. Five actions can be qualified as attractive action (the X3 shares, X7, X15, X24, X25).
2. Category 2 includes X2, X4, X5, X6, X8, X9, X10, X13, X14, X17, X19, X23, X26, X27, X28, X29, X31, X35, X37, X39, X41, X43, X44, X45, X47, X49, X52, X53.
3. The Category 1 includes: X1, X11, X12, X16, X18, X20, X21, X22, X30, X32, X33, X34, X36, X38, X40, X42, X46, X48, X50, X51.

a. Allocation by category:

- Category attractive actions:

Table 4. *Attractive Category.*

Category	Pessimistic assignment	Optimistic assignment
Attractive	X3, X7, X15, X24, X25	X1, X2, X3, X4, X5, X6, X7, X17, X19, X20, X21, X22, X23, X24, X25, X26, X27, X28, X29, X30, X31, X32, X33, X34, X35, X36, X37, X38, X39, X41, X43, X44, X45, X47, X48, X49, X50, X51, X52, X53

- Category: to analyze actions

Table 5. *Analyze Category.*

Category	Pessimistic assignment	Optimistic assignment
Analyze	X2, X4, X5, X6, X8, X9, X10, X13, X14, X17, X19, X23, X26, X27, X28, X29, X31, X35, X37, X39, X41, X43, X44, X45, X47, X49, X52, X53	X42

- Category: to reject

Table 6. *Category to reject.*

Category	Pessimistic assignment	Optimistic assignment
Reject	X1, X11, X12, X16, X18, X20, X21, X22, X30, X32, X33, X34, X36, X38, X40, X42, X46, X48, X50, X51	X18, X40, X46

b. Allocation by Alternative

Table 7. *Assignment by alternative.*

Alternatifs	Pessimistic assignment	Optimistic assignment
X1	Reject	attractive
X2	Analyze	attractive
X3	Attractive	attractive
X4	Analyze	attractive
X5	Analyze	attractive
X6	Analyze	attractive
X7	Attractive	attractive
X8	Analyze	attractive
X9	Analyze	attractive
X10	Analyze	attractive

Alternatifs	Pessimistic assignment	Optimistic assignment
X11	Reject	attractive
X12	Reject	attractive
X13	Analyze	attractive
X14	Analyze	attractive
X15	Attractive	attractive
X16	Reject	attractive
X17	Analyze	attractive
X18	Reject	Reject
X19	Analyze	attractive
X20	Reject	attractive
X21	Reject	attractive
X22	Reject	attractive
X23	Analyze	attractive
X24	Attractive	attractive
X25	Attractive	attractive
X26	Analyze	attractive
X27	Analyze	attractive
X28	Analyze	attractive
X29	Analyze	attractive
X30	Reject	attractive
X31	Analyze	attractive
X32	Reject	attractive
X33	Reject	attractive
X34	Reject	attractive
X35	Analyze	attractive
X36	Reject	attractive
X37	Analyze	attractive
X38	Reject	attractive
X39	Analyze	attractive
X40	Reject	Reject
X41	Analyze	attractive
X42	Reject	Analyze
X43	Analyze	attractive
X44	Analyze	attractive
X45	Analyze	attractive
X46	Reject	Reject
X47	Analyze	attractive
X48	Reject	attractive
X49	Analyze	attractive
X50	Reject	attractive
X51	Reject	attractive
X52	Analyze	attractive
X53	Analyze	attractive

According to this assignment all 44 Alternative are changing the category depends on the assignment procedure in question (pessimistic or optimistic). Including 27 alternative are assigned to the category "analyzed" by the pessimistic procedure and attractive category by the optimistic procedure which means that these alternative are preferred at the bottom and unmistakable profile with the high profile, they can be considered relatively attractive. 16 are assigned to the Alternative category to reject the pessimistic assignment procedure and attractive category by the optimistic procedure, these alternative are incomparable with the two profiles at a time, so this alternative that present an evaluation Multi incurred, and whose assignment is difficult. An alternative is assigned to the category to reject the pessimistic assignment procedure and analyzed by category of optimistic allocation procedure that means that the high profile is preferred for this alternative and that is incomparable with low profile This alternative can be considered unattractive.

c. Assigning Statistics

Table 8. *Summary of assignments.*

Category	Pessimistic assegnment	Optimistic assegnment
Attractive	9% [5 de 53]	92 % [49 de 53]
Analyze	53 % [28 de 53]	2 % [1 de 53]
Reject	38 % [20 de 53]	6 % [3 de 53]

Analyses sensitivity of the results

In ELECTRE TRI, allocation of shares depends primarily on the value of the cutting level and withholding allocation procedure. It is important to check whether the results are sufficiently stable, because the evolution of allocation based on the λ value provides information on accurately estimate the characteristics of an action and the strength of its assignment. Thus, the analysis of the sensitivity (a robustness test) of the results is a sensitivity analysis of the results obtained if we modify some parameters of the problem. We performed a sensitivity analysis does not change the weight of the criteria, but using: nicknames criteria without veto on all profiles, pseudo-criteria with veto only on the high-profile, real criteria. Among the different types of change that may intervene those which the passage of the third category to the first category, or otherwise, are more troublesome than any other type of change, we distinguish two types of changes:

- hanges in type I: corresponding to a difference of a category, from Level 3 to 2 or 2 to three or vice versa.
- Type II changes: corresponds to a gap of two categories, a portion of Class 3 to 1 or vice versa.

The results and the importance of changes from the change in cutting levels were more stable with pessimistic assignments, the different thresholds gives cutting results that assess the importance of changes that occurred from an assignment to another.

Table 9. *Summary of different assignments for different cutting levels.*

	λ =0.5	**λ =0.55**	**λ =0.6**	**λ =0.65**	**λ =0.75**	**λ =0.85**	**λ =0.9**	**λ =1**
C3	X3, X4, X6, X7, X15, X24, X25, X28, X37, X45, X47	X3, X6, X7, X15, X24, X25, X28, X37, X45, X47	X3, X6, X7, X15, X24, X25, X28, X45, X47	X3, X6, X7, X15, X24, X25, X28, X45, X47	X3, X6, X7, X15, X24, X25, X28	X3, X15, X25	X3, X25	X3
C2	X1, X2, X5, X8, X9, X10, X11, X12, X13, X14, X16, X17, X19, X21, X22, X23, X26, X27, X29, X30, X31, X32, X33, X34, X35, X38, X39, X41, X43, X44, X48, X49, X50, X51, X52, X53	X1, X2, X4, X5, X8, X9, X10, X11, X12, X13, X14, X16, X17, X19, X22, X23, X26, X27, X29, X30, X31, X32, X33, X34, X35, X38, X39, X41, X43, X44, X48, X49, X50, X51, X52, X53	X1, X2, X4, X5, X8, X9, X10, X11, X13, X14, X16, X17, X19, X22, X23, X26, X27, X29, X30, X31, X32, X33, X34, X35, X37, X38, X39, X41, X43, X44, X48, X49, X50, X51, X52, X53	X1, X2, X4, X5, X8, X9, X10, X11, X13, X14, X16, X17, X19, X22, X23, X26, X27, X29, X30, X31, X33, X34, X35, X37, X38, X39, X41, X43, X44, X48, X49, X50, X51, X52, X53	X2, X4, X5, X8, X9, X10, X13, X14, X17, X19, X23, X26, X27, X29, X30, X31, X35, X37, X39, X41, X43, X44, X49, X50, X52, X53	X2, X4, X5, X6, X7, X9, X13, X17, X24, X26, X27, X28, X29, X31, X37, X41, X43, X45, X47, X52	X6, X7, X13, X24, X37, X41, X43, X45, X47, X52	X6, X7, X24, X25, X45, X47
C1	X18, X20, X36, X40, X42, X46	X18, X20, X21, X36, X40, X42, X46	X12, X18, X20, X21, X36, X40, X42, X46	X12, X18, X20, X21, X32, X36, X40, X42, X46	X1, X11, X12, X16, X18, X20, X21, X22, X30, X32, X33, X34, X36, X38, X40, X42, X46, X48, X51	X1, X8, X10, X11, X12, X14, X16, X18, X19, X20, X21, X22, X23, X32, X33, X34, X35, X36, X38, X39, X40, X42, X44, X46, X48, X49, X50, X51, X53	X1, X2, X4, X5, X8, X9, X10, X11, X12, X14, X15, X16, X17, X18, X19, X20, X21, X22, X23, X26, X27, X28, X29, X30, X31, X32, X33, X34, X35, X36, X38, X39, X40, X42, X44, X46, X48, X49, X50, X51, X53	X1, X2, X4, X5, X8, X9, X10, X11, X12, X13, X14, X15, X16, X17, X18, X19, X20, X21, X22, X23, X26, X27, X28, X29, X30, X31, X32, X33, X34, X35, X36, X37, X38, X39, X40, X42, X43, X44, X46, X48, X49, X50, X51, X52, X53

Alternative X3 remains constant head list of maintaining its presence in Category 3, even if one of best performance of the alternative is required on all criteria (λ = 1), this alternative has gradually come to join X25 alternative (C2 to C3 for cutting level 0.9), X15 (C1 to C3 for λ = 0.85), X6, X7, X24, X 28 (C2 to C3 to λ = 0.75), X45 and X47 (C2 to C3 to λ = 0.65), no change to a level of cut λ = 0.6, X37 (C2 to C3 to λ = 0.55) and X4 (C2 to C3 for λ = 0.5). These

alternative that migrated to other categories may be considered as alternative coming in second place but the case of the alternative X15 that migrated to a better category (C1 to C3) and thanks to the easing of conditions assignment. C2 category contains alternative X6, X7, X24, X25, X45, X47 (for λ = 1), these alternative migrate for a relaxation of the conditions of assignment to a better category (C3) gradually giving way to other alternative that will shelter (category C1) and always because of the decline of the cutting level λ, X13 (C1 to C2 to λ = 0.9), similar to X37, X41, X43, X52. For λ = 0.85 was X2, X4, X5, X9, X17, X26, X27, X28, X 29 and X 31 which migrate in category C1 to C2 to λ = 0.75: X8, X10, X14, X19, X23, X30, X35, X39, X44, X49, X50, X53 (C1 to C2), for λ = 0.65 X1, X11, X16, X22, X33, X34, X38, X48, X51 (C1 to C2) to λ = 0.6: X32 (C1 to C2), for λ = 0.55: X12 (C1 to C2), for λ = 0.5: X21 (C1 to C2). For the C1 category: this category includes a large number of alternatives for cutting level λ = 1 (unanimity), these alternative migrate (the majority) gradually towards the higher categories for more flexible λ cutting levels.

Table 10. *The assignment error.*

Type de changement (erreur)	λ =1	λ =0.9	λ =0.85	λ =0.75	λ=0.65	λ=0.6	λ =0.55	λ=0.5
I	31	27	22	12	11	3	2	1
II	0	0	1	0	0	0	0	0
Total des Changements	31/53	27/53	23/53	12/53	11/53	3/53	2/53	1/53

The stability of the results of assignments is measured by the number and type of changes made to λ = 0.75 and λ = 0.65 (close to the reference value. The lower the value of λ corresponds to 9 Type I changes and 0 changes Type II pessimistic procedure that present results fairly well since the sensitivity of income remains low for lower cutting threshold values at 0.6, storytelling upward the λ value of the number of changes made becomes important especially with a change Type II, the result of sensitivity becomes important since the majority of alternative undergo changes which is quite reasonable, since the higher the level of cut is high over the over-classification of condition is demanding. We can say that the sensitivity the allocation depends on the initial value of λ, this denotes a stability results and robustness of the methodology.

3.3. Linear Programming Lindo

Finally we should define the percentage contribution of alternative chosen in the constitution of the stock portfolio and that based on the results of the application of UTA + and ELECTRE TRI in the absence of a decision maker we will choose ten alternative, this is the seven alternative top ranked by UTA +: AMEN BANK (X1), SCB (X27), TJL (X46), GIF (X16) SPDIT (X37), BT (X13), ARTES (X5); plus three other alternative: CIL (X15), PGH (X24), PLTU (X25), those who have been affected in the category Attractive ELECTRE TRI software and both pessimistic and optimistic procedures.

3.3.1. Modeling

It is absolutely necessary to formulate a multi-objective linear programming model to question the portfolio construction: decision variables, objective functions and constraints. In the present case the decision variables are the proportion of capital invested in each alternative, which will be denoted Xi, knowing that i is the selected alternative number. To construct the objective functions, the choice fell on the four equity criteria used in the evaluation of alternative multiple criteria including: performance, the absolute value of the beta-1, the PER and earnings per share. In terms of constraints, we have the budget constraint, and for each selected alternative, a maximum proportion of 20% and a minimum proportion of 5% of the amount invested to ensure adequate portfolio diversification

(1) The objective functions

- We begin with the objective of maximizing returns where the coefficients are only the corresponding alternative yields: MAX 0.471302 g1 + 0.5136 X1 X46 + X27 + 0.569142 0.67695 0.683596 X16 + X15 + X24 + 0.3343805 0.851443 0.21889 X25 + X37 + X13 + 0.4805 0.1458125 X5
- The second objective is the maximization of profit (profit coefficients corresponding alternative): MAX 342 g2 X1 X46 + 4232 + 4592 + 5655 X16 X27 X15 + 57248 + 11347 + 1076 X25 X24 X37 + 654 + 703 + 35812 X13 X5
- Third goal is the maximization of 1 / PER: the coefficients are the inverse of the PER corresponding alternative MAX g3 0.164251 0.865235471 X46 + X27 + X1 + 0.061331 0.254241 0.091623 X16 + X15 + X24 + 0.095011 0.156092 0.066514 + X37 X25 X13 +0.027213 + 0.325348 X5
- To keep consistency with the multi-criteria evaluation, it will define the strategy that follows the Portfolio Manager, in the present case the strategy is passive and the goal is to achieve a beta that is equal to 1, the objective function takes then the following form: MIN g4 + D + D

Under stress:

X46 0.122 + 0.012 + 0.185 X1 X27 X16 + 0.014 + 0.025 + 0.143 X24 X15 X25 + 0.312 + 0.645 + 0.067 X13 X37 + X5 + 0.165 + D + D = 1

(2) Constraints

- The budget constraint assumes that the total budget is invested, the sum of the proportions must be equal to one: X46 + X1 + X27 + X16 + X15 + X24 + X25 + X37 + X13 + X5 = 1
- The constraints corresponding to the maximum of 20% invested and the minimum amount of 5% of each

alternative are: X46 ≤ 0.2, 0.2 ≤ X1, X27 ≤ 0.2, ≤ 0.2 X16, X15 ≤ 0.2, ≤ 0.2 X24, X25 ≤ 0.2, ≤ 0.2 X37, X13 ≤ 0.2, 0.2 ≤ X5; X46 ≥ 0.05, ≥ 0.05 X1, X27 ≥ 0.05, ≥ 0.05 X16, X15 ≥ 0.05, ≥ 0.05 X24, X25 ≥ 0.05, ≥ 0.05 X37, X13 ≥0.05, X5 ≥ 0.05...

3.3.2. Results

Table 11. *The contribution of each variable.*

Alternatif	Contribution	Organisme
X46	0,05	TLAIT
X1	0,05	AMEN BANK
X27	0,05	SCB
X16	0,05	GIF
X15	0,185328	CIL
X24	0,05	PGH
X25	2,584028	PLTU
X37	0,2	SPDIT
X13	0,05	BT
X5	0,2	ARTES

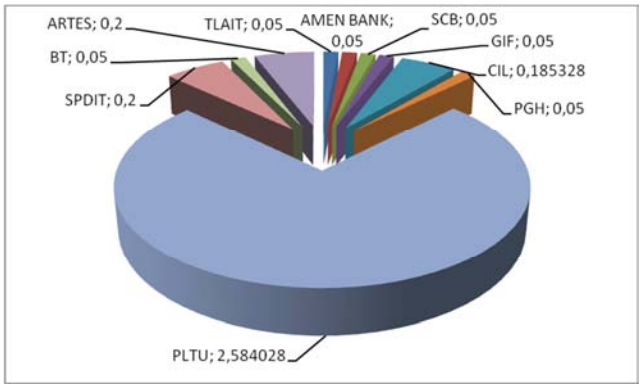

Figure 3. *The contribution of each choice.*

4. Conclusion

The dynamic nature of the stock markets in combination with the plethora of internal and external factors that affect the performance of the shares and the huge volume of financial and stock market information that is available to investors and stock analysts, all contribute to the complexity the evaluation issue of stocks, the large number of point of view of criteria to be taken into account for the assessment of the stocks it is in this context that this article is inscribed, dedicated to the application of multi-criteria methods an attempt assessing actions for building a stock portfolio in the stocks market of Tunis, the use of UTA+ was to achieve a classification of actions according to their marginal utilities, this same classification has been refined through the use of ELECTRE TRI by assigning different actions predefined category. It remains to determine the percentage (contribution) of each stock in the portfolio was (shares classified as "best" by both methods), this stain raised interest in the field of multi-objective programming.

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