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# Evaluation of Greek Construction Companies' Securities Using UTADIS Method

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**Abstract**

*The evaluation of stocks and the selection of the 'best' ones is an important step in the process of constructing an optimal portfolio. This study proposes the multicriteria method UTADIS (UTilités Additives DIScriminantes) for the sorting of stocks in categories incorporating, not only quantitative measures, but also the knowledge as well as the preferences of experts. The study illustrates the application of the method on the construction industry stocks in Athens Stock Exchange, using the financial characteristics of the companies. The model developed is evaluated according to its usefulness in a decision process. Further research and the application of the method in other industries' stocks can establish the method as an important tool in stock evaluation and the relative decision making process.*

**Key Words:** Multicriteria analysis, Evaluation of stocks, Financial ratios

## Introduction

The construction of a profitable portfolio of stocks has been always the target of the investors of any kind in the stocks market. One of the closely related problems is the evaluation of stocks in the market and the selection of the 'best' stocks'. Researchers have faced the theme of the construction of a portfolio of stocks by using various techniques. Elton and Gruber [1] presented a review of the techniques used in the past. More recently, researchers used other techniques like expert systems (c.f. [2]) and multicriteria methods (c.f. [3] and [4]).

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This study proposes the multicriteria method UTADIS for the construction of a model for the evaluation of the common stocks of the construction industry in the Athens Stock Exchange (ASE). These companies represent a very important and promising part of the Greek economy. Public investments and EC financing of constructions of high importance as well as the constructions related to the Olympic Games of Athens at 2004 provides an ideal business environment for construction companies in Greece. In spite of the good perspectives of the Greek construction companies, investors are suspicious about the future of their stocks due to the instability of them in the past.

For the evaluation of the stocks were used financial ratios of the companies as well as stock indices. An expert on evaluation of stocks in ASE was employed for the application of the method. This expert was asked to provide groups of stocks and evaluation criteria for this grouping. Therefore, it was possible to obtain an analysis of the investment decision and an assessment of the importance of the criteria used for the evaluation of the stocks. Next paragraphs present UTADIS method, the construction's industry companies in ASE, the application of the method, the model and an evaluation of the model's results.

## 1. UTADIS method

UTADIS (UTilités Additives DIScriminantes) method is a member of the UTA multicriteria methods family based on the pioneering work of Jacquet-Lagreze and Siskos [5]. Multicriteria methods have been applied in the past in various problems of financial analysis like risk of failure, financing of firms, venture capital decisions, etc. (cf. [6]). Multicriteria methods have been used in the field of financial decision making since the decade of 80s (cf. [7]). These methods are very useful as:

- they are free of statistical hypotheses and restrictions,

- they can incorporate the knowledge and preferences of the decision makers in the decision analysis process and modeling,
- they can make use quantitative or qualitative criteria as well as combination of them, and
- the models can be easily reviewed, taking into account the dynamic nature of the decision process and the changes in decision maker's preferences.

UTADIS method was presented by Doumpos and Zopounidis [**8**] is a monotone regression method. Given of a grouping of the objects under examination, the target of the method is to provide an additive utility function and the utility thresholds that provide a grouping of the objects with the minimum error

If $g_1$, $g_2$, ..., $g_m$ is a set of m evaluation criteria, and $A = \{\alpha_1, \alpha_2, ..., \alpha_n\}$ a set of objects to be grouped in Q groups named $C_1$, $C_2$, ..., $C_Q$, a priori defined as:

$$C_1 \; \boldsymbol{P} \; C_2 \; ... \; C_{Q-1} \; \boldsymbol{P} \; C_Q$$

where $\boldsymbol{P}$ stands for strict preference of a group over another.

The global utility $U(\alpha)$ of an object $\alpha \in A$ is of the form:

$$U(\alpha) = \sum_{i=1}^{m} u_i[g_i(\alpha)],$$

where $u_i[g_i(\alpha)]$ is the marginal utility of object $\alpha$ for criterion $g_i$. Marginal utilities represent the relative importance of the criteria in the model.

The calculation of the marginal utilities $u_i[g_i(\alpha)]$ and the utility thresholds $u_k$ is made through the solution of the following linear program (cf. [9]):

$$[\text{minimize}] \; F = \sum_{\alpha \in C_1} \sigma_\alpha^+ + \sum_{\alpha \in C_k} [\sigma_\alpha^+ + \sigma_\alpha^-] + \sum_{\alpha \in C_Q} \sigma_\alpha^-$$

under the constraints:

$$\sum_{i=1}^{m} u_i \left[ g_i(\alpha) \right] - u_1 + \sigma^+(\alpha) \geq 0 \qquad \forall \alpha \in C_1$$

$$\sum_{i=1}^{m} u_i \left[ g_i(\alpha) \right] - u_{k-1} - \sigma^-(\alpha) \leq -\delta \qquad \forall \alpha \in C_k$$

$$\sum_{i=1}^{m} u_i \left[ g_i(\alpha) \right] - u_k + \sigma^+(\alpha) \geq 0 \qquad \forall \alpha \in C_k$$

$$\sum_{i=1}^{m} u_i \left[ g_i(\alpha) \right] - u_{Q-1} - \sigma^-(\alpha) \leq -\delta \qquad \forall \alpha \in C_Q$$

$$\sum_{i=1}^{m} \sum_{j=1}^{a_i - 1} w_{ij} = 1$$

$$u_{k-1} - u_k \geq s \qquad k = 2, 3, \ldots, Q-1$$

$$w_{ij} \geq 0, \quad \forall \sigma^+(\alpha) \geq 0, \quad \forall \sigma^-(\alpha) \geq 0,$$

where δ is a small positive real number that is used in order to define the strict inequality of $U(\alpha)$, of $u_{k-1}$ ($\forall \alpha \in C_k$, $k>1$) and of $u_{Q-1}$ ($\forall \alpha \in C_Q$). Threshold s is used to express the strict preference between the utility thresholds ($s > \delta > 0$).

The utility thresholds $u_i$ (where $u_1 > u_2 > \ldots > u_{Q-1}$ ) that the method calculates are used for the grouping of objects. The global utility of any new object is compared to the utility thresholds and the object is classified according to the scheme:

$$U(\alpha) \geq u_1 \qquad \Rightarrow \alpha \in C_1$$
$$\ldots \ldots \ldots$$
$$u_k \leq U(\alpha) < u_{k-1} \qquad \Rightarrow \alpha \in C_k$$
$$\ldots \ldots \ldots$$
$$U(\alpha) < u_{Q-1} \qquad \Rightarrow \alpha \in C_Q$$

Except from the sorting of the objects it is important that the method provides a ranking of the objects into any group, according to their global utilities.

## 2. Model Development

### 2.1 The data

Construction industry is one of the more important for the Greek economy. The industry consists of more than 2.200 companies, of various sizes and corporate body kinds. About 400 of them are of the form of S.A. and the securities of only thirty-one of them are traded in ASE. The industry employs about 7% of the Greek labor force. During the last decade is responsible for 10% up to 15% of the GNP and presents high rates of growth. The most important characteristic of the industry is the very high number of companies that leads to a high competition between them during a period where a specific number of public construction projects is under procurement.

The financial data of these corporations indicate the development of an industry that experienced a long period of little progress. The change in the legislation about the process of execution of public constructions and the more sharp competition between construction firms lead to a lower profit margin for them.

In this study the financial and market data of the construction companies in ASE for 1995 were collected. The names of them are coded are coded in the form of E1, E2, ..., E24.

Data were collected from (a) the yearly bulletin of ASE that contains balance sheet and income statement's data of corporations in ASE as well as other information and (b) the yearly statistical publications of ASE for 1995 and 1996 that contains data and information on the transactions for each year.

At first, fifteen financial ratios for the 24 construction companies in ASE for 1995 were calculated. These ratios belong to all categories defined in the study of Courtis [10] as follows:

**A. RETURN RATIOS**

1. Gross profit / Sales

2. EBT / Sales
3. EBT / Shareholders Equity
4. EBIT / Total Assets
5. Sales / Fixed Assets
6. Sales / Total Assets
7. EBT / Number of employees

**B. VULNERABILITY RATIOS**

1. Current Assets / Short term debt
2. (Current Assets – Inventories) / Short term debt
3. Capital/ Total Assets
4. Total debt / Shareholders Equity
5. Total debt / Total Assets

**C. MANAGEMENT EVALUATION RATIOS**

1. Fixed Assets / Total Assets
2. Depreciation / Total Assets
3. Fixed Assets / Shareholders Equity

First, a principal component analysis was performed on the 1995 data in order to support the criteria selection process. This process was carried out by a decision-maker (DM), a high level manager of a Greek company that is a member of ASE. All the data described above were presented to the DM together with a statistical analysis. The DM selected four financial ratios. The ratios selected were:

1. EBT / Shareholders Equity
2. Current Assets / Short term debt
3. Total debt / Shareholders Equity
4. Fixed Assets / Total Assets

Next, the DM added to this set of financial indexes – criteria some other criteria. These criteria were four financial market indexes and one index important, according to his opinion, for the

evaluation of construction companies' securities. More information on the financial market indexes provide Alexander and Sharpe [11] as well as Copeland and Weston [12].

The "Total value of the non-completed part of contracts / Sales volume" index expresses the number of years for which a construction company has the ability to obtain a sales volume similar to the present one, according to the non-completed part of contracts and, consequently, to make profits at least similar to the present ones.

The set of criteria is presented in Table 1. The same table indicates the increasing or decreasing preference for each criterion, that is symbolized by '↑' or '↓' respectively. Preference is characterized increasing when the higher the value on the criterion then the higher the preference and preference is characterized decreasing when the lower the value on the criterion then the higher the preference.

### 2.2 UTADIS method application

UTADIS method was applied for the evaluation of the construction industry common securities in ASE. As already mentioned, the sample consists of 24 construction companies' securities, grouped by the DM into four categories. These categories are defined as follows:

- Group A: securities of leader companies in the industry, companies that drive the progress of the industry. These securities are considered as 'blue chips' in ASE.
- Group B: acceptable securities of rather stable and profitable companies with good perspectives.
- Group C: uncertain securities of companies having not clearly good perspectives that need careful study before investing on them.
- Group D: not accepted securities.

The 24 securities were classified into the four groups, as follows: Group A consists of 5, group B of 11, group C of 5 and group D of 3 securities.

### 2.2.1 First step

The global utility function weights in the first application of the UTADIS method are presented in Table 2.

The sorting of the securities, according to their utilities, as well as the cutoff utilities are presented in Table 3. On the basis of this sorting one can observe that there was a concordance of 95,83% between the model and the DM's preorder. In practice, only the security E17 is placed by the model to a different group. Specifically, security E17 was placed to Group B instead of Group C where was placed by the DM. After the DM was informed, he accepted to change the preorder by placing security E17 to group B. It has to be mentioned that this change was not so difficult for the DM as he already had the doubt where to classify the security from the beginning of the process.

### 2.2.2 Second Step

Next, the utility function was recalculated using the new preorder. The weights for each criterion of the utility function are presented on Table 4. Figure 1 presents the marginal utilities of the criteria. The new grouping of the securities is presented in Table 5.

In this step, there was a precision of 100% in the grouping. This means that there were no differences between the models grouping and the preorder.

The most important criterion was G11, the Sales Volume, which obtained a weight of 27,27%, although Sales Volume is not a ratio but just a number in the Income Statement indicating the volume of the business for a company. This criterion is followed by criterion G10 (Marketability) that obtained a weight of 21,35% (mar-

ketability is an index the for the ability to find a buyer for the security in the market) and criterion G6 (Market value / accounting value) that obtained a weight of 17,78% (this ratio is affected by the return of the corporation). Next criteria are G8 (Unexecuted contracts' value / Sales volume) that obtained a weight of 12,80% (an index of the future return of the firm), G1 (Earnings before Taxes / Shareholders' Equity) and G4 (Fixed Assets / Total Assets) that obtained weights of 10,55% and 9,49% respectively. The rest criteria are of very low importance, while criteria G2 (liquidity) and G3 (debt ratio) are not taken into account as the obtained a zero weight.

## 3. Model Evaluation

For the evaluation of the model, it was applied on the data of the construction companies' securities of ASE, for the next year (1996). The grouping of the firms, according to their utilities, the cutoff thresholds and the initial grouping are presented in Table 6.

These results were presented to the DM who had some comments on them. According to his opinion, the fact that no securities are assigned to group A is rather reasonable. Construction companies presented a decreasing in profits in 1996, and subsequently they didn't follow the increasing of the capital market. About the grouping, he proposed to remove securities E25, E12 and E18, in the initial ranking from group B to group C, deteriorating the total number of securities in group B. Therefore, the agreement between the DM and the grouping by UTADIS model was 88%. The most important reason for this change was the increasing in their liabilities. Debt-related criteria were not really included in the proposed model.

## 4. Conclusions

In this study, the UTADIS method was applied for the evaluation of the securities of the construction companies in ASE. For the application of the method, 11 criteria coming out from the financial and/or market data were used to reflect the preferences and knowledge of a decision-maker and a preorder of the securities, also provided by the decision-maker.

The application of the method provided the capability to analyze the investment decision, and to evaluate the criteria used for the selection of securities of the construction industry companies. Also, this application provided a basis for the verification of the method's capability to correlate the criteria with the preferences of the decision-maker that was employed to provide a preorder of the securities. The capability of the model developed for the evaluation of the construction industry securities in ASE was validated by the application of the model on next years' data.

In summary, UTADIS method provides the ability to construct a model for security evaluation based on the preferences and decision policy of the decision-maker. The extended application of the method on the securities of other industries in ASE can establish the method as an important and useful tool for securities evaluation and successful decision making. Specially, in the case of embodying the method to decision support systems, the method can strength importantly the ability of the system to provide profitable suggestions to financial services companies or any investor.

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**Table 1:** *Criteria and preferences*

| **Criteria** | **Preference** |
|---|---|
| G1: EBT / Shareholders Equity | ↑ |
| G2: Current Assets / Short term debt | ↑ |
| G3: Total debt / Shareholders Equity | ↓ |
| G4: Fixed Assets / Total Asset | ↑ |
| G5: P/E | ↓ |
| G6: Capital market value / Accounting value | ↑ |
| G7: Growth / (P/E) | ↑ |
| G8: Total value of the non-completed part of contracts/Sales volume | ↑ |
| G9: Dividend yield | ↑ |
| G10: Marketability | ↑ |
| G11: Sales volume | ↑ |

**Table 2:** *Global utility function weights in the first step*

| Criteria | Weights |
|---|---|
| G1 | 8,150 |
| G2 | 2,327 |
| G3 | 0,899 |
| G4 | 4,104 |
| G5 | 3,267 |
| G6 | 27,211 |
| G7 | 8,661 |
| G8 | 10,113 |
| G9 | 2,674 |
| G10 | 8,576 |
| G11 | 24,020 |

**Table 3:** *First grouping results*

| Securities | Initial Group | Utility | Proposed group |
|---|---|---|---|
| E1 | A | 0,6872 | A |
| E2 | A | 0,6872 | A |
| E3 | A | 0,6872 | A |
| E4 | A | 0,6872 | A |
| E5 | A | 0,6873 | A |
| Cutoff utility u1 | | *0,6872* | |
| E6 | B | 0,5796 | B |
| E7 | B | 0,5359 | B |
| E8 | B | 0,4872 | B |
| E9 | B | 0,4872 | B |
| E10 | B | 0,4872 | B |
| E11 | B | 0,6216 | B |
| E12 | B | 0,6862 | B |
| E13 | B | 0,5901 | B |
| E14 | B | 0,6116 | B |
| E15 | B | 0,5163 | B |
| E16 | B | 0,4872 | B |
| Cutoff utility u2 | | *0,4872* | |
| E17 | C | 0,5254 | B |
| E18 | C | 0,4167 | C |
| E19 | C | 0,4862 | C |
| E20 | C | 0,4862 | C |
| E21 | C | 0,4849 | C |
| Cutoff utility u3 | | *0,2872* | |
| E22 | D | 0,2862 | D |
| E23 | D | 0,2304 | D |
| E24 | D | 0,2862 | D |

**Table 4:** *Global utility function weights in the second step*

| Criteria | Weights |
|---|---|
| G1 | 10,549 |
| G2 | 0,000 |
| G3 | 0,000 |
| G4 | 9,493 |
| G5 | 0,001 |
| G6 | 17,777 |
| G7 | 0,755 |
| G8 | 12,803 |
| G9 | 0,001 |
| G10 | 21,349 |
| G11 | 27,270 |

**Table 5:** *Second grouping results*

| Securities | Initial Group | Utility | Proposed group |
|---|---|---|---|
| E1 | A | 0,6907 | A |
| E2 | A | 0,6901 | A |
| E3 | A | 0,6909 | A |
| E4 | A | 0,7817 | A |
| E5 | A | 0,6924 | A |
| Cutoff utility u1 | | *0,6811* | |
| E6 | B | 0,5618 | B |
| E7 | B | 0,5408 | B |
| E8 | B | 0,4841 | B |
| E9 | B | 0,4913 | B |
| E10 | B | 0,4918 | B |
| E11 | B | 0,6360 | B |
| E12 | B | 0,6733 | B |
| E13 | B | 0,5462 | B |
| E14 | B | 0,6339 | B |
| E17 | B | 0,6797 | B |
| E15 | B | 0,5479 | B |
| E16 | B | 0,4950 | B |
| Cutoff utility u2 | | *0,4811* | |
| E18 | C | 0,3738 | C |
| E19 | C | 0,4798 | C |
| E20 | C | 0,4801 | C |
| E21 | C | 0,4780 | C |
| Cutoff utility u3 | | *0,2811* | |
| E22 | D | 0,2801 | D |
| E23 | D | 0,2686 | D |
| E24 | D | 0,2800 | D |

**Table 6:** *Grouping results for 1996*

| Securities | Initial Group | Utility | Proposed group |
|---|---|---|---|
| Cutoff utility u1 | | **0,6811** | |
| E4 | A | 0,6680 | B |
| E11 | B | 0,6411 | B |
| E6 | B | 0,5961 | B |
| E7 | B | 0,5483 | B |
| E5 | A | 0,5475 | B |
| E25 | D | 0,5174 | B |
| E12 | B | 0,5036 | B |
| E18 | C | 0,4991 | B |
| E16 | B | 0,4972 | B |
| E2 | A | 0,4949 | B |
| E1 | A | 0,4877 | B |
| Cutoff utility u2 | | *0,4811* | |
| E3 | A | 0,4717 | C |
| E17 | B | 0,4528 | C |
| E20 | C | 0,4463 | C |
| E15 | B | 0,4432 | C |
| E14 | B | 0,4397 | C |
| E8 | B | 0,4338 | C |
| E9 | B | 0,3952 | C |
| E21 | C | 0,3864 | C |
| E13 | B | 0,3691 | C |
| E10 | B | 0,3657 | C |
| E19 | C | 0,3246 | C |
| E24 | D | 0,3131 | C |
| Cutoff utility u3 | | *0,2811* | |
| E23 | D | 0,2476 | D |
| E22 | D | 0,2388 | D |

**Figure 1:** *Marginal utilities of criteria*

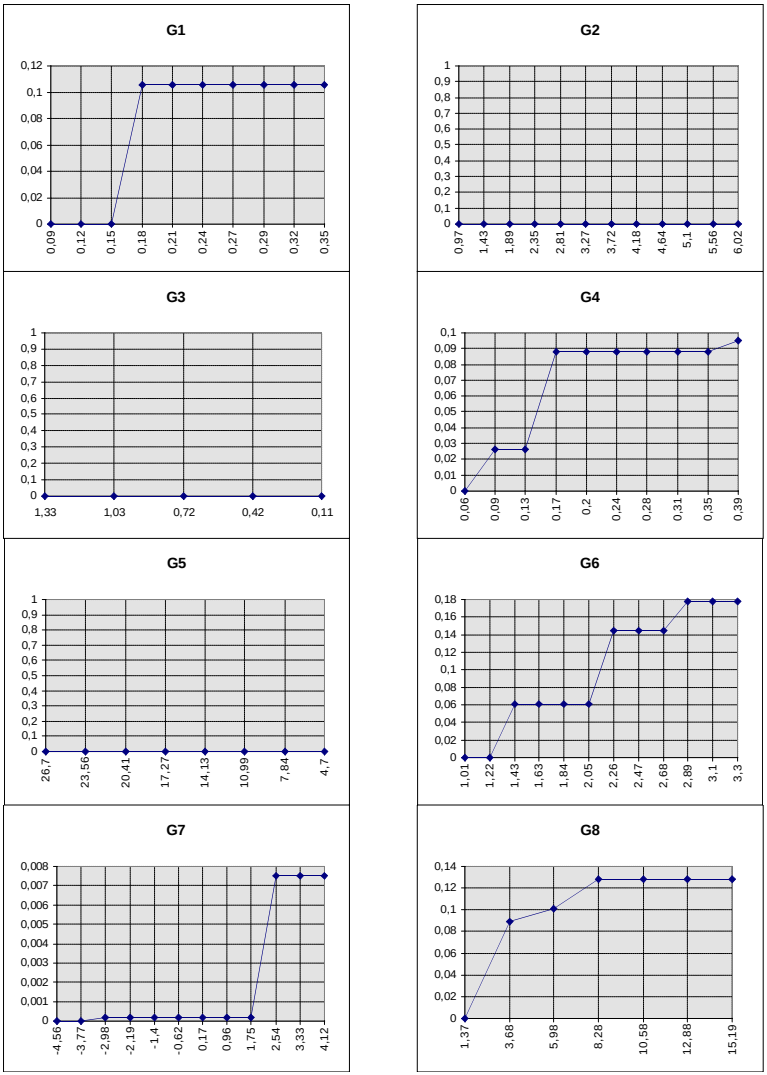

**Figure 1:** *(continued)*