The Economic Analysis and Evaluation of the Investment projects with special References to the fuzzy Approach

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Abstract: In evaluating the economic projects by using the classical methods, the exact amounts are used. But, according to the fact that the financial exchanges/cash flows and the rate of the projects' profit are not clearly stated, the results of such evaluations won't be a real one. Thus, the alternative method to do such evaluations has been stated to be fuzzy sums/numbers. In other words, instead of using on exact number, a triangular fuzzy number can be used. Such numbers are capable of showing an exact number in three different statuses: The smallest possible value, the most value. The net present value (NPV) techniques, the yearly monotonous value, and the relativity of the expenses to our profit have been processed and developed by the use of the fuzzy approach. The final results- instead of being the exact numbers- will be the fuzzy numbers which will enable the decision malcers to attain a broad and wider insight about the probable outputs. Because the results are shown in fuzzy numbers, comparing the different projects won't be done in classical ways. The ranking method, which will be introduced in this essay, will compare different projects in their fuzzy status and will also help the decision makers to choose the best project.
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1. Introduction

The economic analysis of a project includes the techniques of recognition and comparing and choosing the best choice- among other choices- according to the economic conditions. Using and applying such analysis would be of great importance because our profits or losses are the direct. Consequences of the choices made according to the analysis. It is worth mentioning that because a lot of economic analysis will be used in the future decision making and in acting upon future events, therefore, the most important part in every economic analysis would be about the quantities related to the future.

1.1. Statement of the problem:

Today, the economic techniques of analysis are of great significant in every organizational decision making. Managers-with the help of such. Analysis analysis- should identify the most preferable/profitable project. In other words, in analyzing all investment projects. The followings should be considered:

I.O of all the investment projects- considering the present limitations –should be identified and the necessary data should also be collected.

II. O of in formations should be analyzed and the most economic project must also be identified.

2.1. The Necessity of the Research

In the common techniques of the economy of engineering, it is supposed that the parameters are clear and exact. Although, the sensitivity analysis studies the changes in the parameters. There exists a presupposed assumption about the parameters' certainty and exactness. Here, by considering the fact that in – every decision, there is always some uncertain ties/vagueness; the economic researches will be discussed in the light of these uncertainties. For instance, it has been assumed that the primary information's for every project are constant/fixed (eg. The yearly income of 100/000), but the projects in the real world are not always containing the fixed/an changed information's. Changes and transformations are the unknown factors in the almost every managerial and engineering activity. The following examples can be stated:

I. Human resources are becoming more and more experienced every day.

II. By the process of time the materials usefulness will change, i.e. a change in their use wills occur.

III. The machineries- high would be similar at the first look- appear to possess different capabilities.

Political and economical factors are also effective in the transformation of the future parameters. Although, identifying the changes is not a difficult task, their application in economic analysis would be a problematic one. By considering the uncertainties on the way, it is so hard to gain the exact information necessary for the evaluation of a project.

Thus, the results won't be so much acceptable. In other words, when there exists uncertainties in the economic evaluation of a project, the present methods will study them in a way that they contain exact/clear/certain information. According to what has been stated, the measurement of the amount of the basic variables is one of the issues in analyzing the investment projects. In most cases, the evaluation of the numeric amounts of such variables depends on the researcher's point of view: they are subjective. In such cases, the fuzzy logic has the capability to help the decision makers by noticing the applying language variables. In fact when a decision maker faces with statement such as, "around 30 years", "almost between 36.000 and 40.000", "nearly 9.000", the fuzzy logic can play an important role in such circumstances.

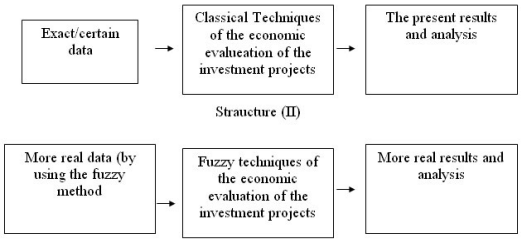
3.1. Research's Aims

The aim of this study is to use the capabilities of the fuzzy logic in providing a space for the evaluation of the investment projects in uncertain situations. In other words, by mixing the fuzzy concepts with the economic evaluations' techniques, the study aims at finding and bringing an approach to put together and blend science and experience. In most cases, the scholars' judgments about the application of the false information will produce better results, a point which is ignored by the classical techniques of the projects' economic evaluations. Moreover, the economic evaluation at the project considers only quantitative factors and forgets about the qualitative feature (eg. Political, cultural, etc.).

1.3.1. The Research's Theoretical Framework

A variable which is of great importance in this research is the dependent variable or the results of the economic analysis of the investment projects. Independent variables are the primary data (inputs) of the investment projects: variables such as the primary expenses, fixed yearly expenses, the capital return rate, etc. The techniques of the economic evaluation of the projects are considered as mediator variables.

According to what have been stated, the study's aim is to go beyond the structure (I) and arrive at the structure (II):



4. 1.The Research's Field of study

A. subject of study: this research aims at evaluating investment projects when the air is filled with uncertainty.

B. situational: The instructions presented in this research can be used in economy, banking, etc.

1.4.1. The Economic Evaluation of the project

The economic comparison between different projects. Is the most significant decision for every Manager? A manager, by choosing one of the economy of engineering techniques and its application, will present the most profitable project (Kahraman, C., Ruan, D., Tolga, E.(2002)).

Net present value method: it is one of the most important techniques of the economy of engineering, and is considered as a base. For other techniques, calculating the present value of a financial interaction is to change the future value of all the income and payment into the present value. In the net present value for a project is less than zero ($NPV \leq 0$), that project would be regarded as an unprofitable/uneconomical one. NPV<0 show the fact that the present expenses are greater than the present income. But, if the $NPV \geq 0$ is greater than or equals zero, that project would be an economical one. A project which has got more net present value is more economical.

Example I: comparing two projects (A,B) by using the present value method %15.

Table 1: Data

Table I, Data

Primary expences	A	B
	2500	3500
Yearly expences	900	700
Relinquishing value	200	350
The useful life	5	5

PVA=2500+900 (P/A,10%,5)-200 (P/F,10%,5)=5788

PVB=3500+700(P/A, 10%,5)-350(P/F,10%,5)=5936

The A would be selected, because its present value of expenses is less than B (PVA<PVB).

5.1. Fuzzy Approach

In fuzzy logic, the certain/an changed concepts of black and white are replaced by a gray color in which black and white are blended: no certainty can attain voice. In fuzzy logic one can use statements and modifiers such as:"It's almost right", "It's almost impossible", "scarcely", etc.

In this way, the fuzzy logic uses a flexible system of language use (Zimmermann, H.J (1996)). Fuzzy Numbers LR (left and Right).

Definition: The fuzzy number (M) is one of LR, if a function, e.g. L (for left) and R (for right), and scalar numbers $(\alpha, \beta > 0)$ are above zero

$$\mu_{\tilde{m}}(x) = \begin{cases} L(\frac{m-x}{\alpha}) & x \le m \\ R(\frac{x-m}{\beta}) & x > m \end{cases}$$

In this way, m is a real number and is equal with the average of $\tilde{M}$. α , and β are left and right span. $\tilde{M}$ Is shown as (m, α, β) LR (Zimmermann, H.J (1996)). The functions of LR have the following features:

1. R and L are reductive functions: $R^+ \to [0,1]$
2. L (0) = R(0)=1
3. L(x)<1. R(x)>0 $\forall x > 0$
4. L (x)>0. R(x)>0 $\forall x < 1$
5. L (1) = R(o)=0

Definition: The triangular fuzzy number $\tilde{M} = (\alpha_1, \alpha_2, \alpha_3)$ and is shown as follow (Zimmermann, H.J (1996)).

$$\mu_{\tilde{M}}(x) \begin{cases} 0 & x < a_1 \\ \frac{x-a_1}{a_2-a_1} & a_1 \le x \le a_2 \\ \frac{a_3-x}{a_3-a_2} & a_2 \le x \le a_3 \\ 0 & x > a_3 \end{cases}$$

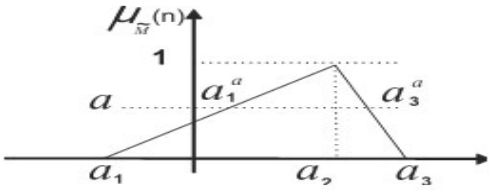


Figure 1: A triangular fuzzy number

6.1. The relationship between classical Economic Evaluation and the fuzzy Theory

The classical analysis of the economy of engineering is useful only if the available data be exact /certain. But, in the real world, the decision makers are faced with data which are uncertain/vague, g. high risk, law profit, etc. In other words, the uncertainties a head of us need alternative methods in which the human experience can be transformed into the mathematic language. One of the basic problems would be the measurement of the key variables of the analysis. In most cases, the evaluation of numeric variables is closely under the impression the individual's judgments of the analyzer. To put it in another way, because the decision makers are obliged to make decisions without enough knowledge about the problem, they are willing to present their evaluations according to the personal knowledge and experience. The statements like, "around 30 gears, almost between 36.000 and 40.000" and "nearly 9%" are examples of such a problem. Another point to be discuassed here is the question of how such uncertain/vague statements can be used in economic analysis. The fuzzy logic and the theory of fuzzy sums (fuzzy numbers) play a significant role here. In this way, the fuzzy susytem can make the basic imput about the income expences can be shown – instead of an exact number- in form of a triangular fuzzy number. A trainglar fuzzy number which can be shown as ($x=x_1\ x_2\ x_3$) states a fuzzy event in which x1 is the smallest possible value, x3;the largest possible value, and x_2 can be regarded as the most promising value. The most promising value. The results of evaluations made by fuzzy numbers are also shown by fuzzy numbers. This makes the analyzers to have wider views about the probable aoutputs (Liang, 1995m 79).

7.1. The research's methodology

In this study, an approach which includes a way of mixing the scholars ideas will be presented. This approach would be used in forecasting future events when the situation is filled with uncertainty. By the help of this method, the fuzzy data which are the inputs will be obtained. Then, by adding fuzzy sums with the classical techniques of economical evaluations, the fuzzy technique of economical evaluation of investment projects will be introduced.

Section one: making the project's input, fuzzy the method of fuzzy Delphi is the generalization of the classical method of long- term forecasting.

If it is known in managerial science as Delphi method. The basics of Delphi method are as follow:

1. Scholars are asked to separately give their opinions about a subject, e.g. the yearly expense of an investment project. It is also probable to ask them to forecast the overall situation of the market economy, etc.
2. Then the information are collected and analyzed, and after that the results will be returned to those scholars.
3. Scholars will study the results and give new premonitions.

4. This process is repeated again and again in order to reach a homogenized solution.

The decisions which would be made according to the scholars' analysis are abstract and imaginative. Thus, it is more acceptable to describe the information in terms of the fuzzy numbers. Triangular fuzzy numbers consist of the smallest, the largest and the most promising value.

According to what has been stated, fuzzy Delphi includes the following stages:

I. scholars (Ei, i=1, 2, n) are asked to state clarify their opinions about a project in terms of the smallest (a_1^i), the most promising (a_m^i), and the largest possible value (a_2^i). The information given by the scholars are changed in fuzzy numbers by the scholars (Ei):

Ai= (a_1^i, a_m^i, a_2^i), i=1, 2…,n

II. The average of Ais ($A_{ave}(m_1,m_m ,m_2)$) will be calculated, then the deviation A_i from A_{ave} would be determined, they are shown in a triangular number. Finally, the deviation between a ave - Ai will be reported to the scholars in order to be tested.

III. Each scholar (Ei) gives a new triangular number $Bi = (b_1^i \;\; b_m^i \;\; b_2^i)$

When the second stage starts, this process will be repeated. The triangular average (Bm) is calculated, but this time a_1^i, a_m^i, a_2^i are replaced by b_1^i, b_m^i, b_2^i. If necessary, the new triangular numbers $C_i=(c_1^i, c_m^i, c_2^i)$ will be produced and the average will be calculated. This process will be repeated again and again.

TV, If new discoveries reveal important and unnoticed information, forecasting will be tested according to the same process (stages 1 to 3). Fuzzy Delphi is one way among others to mix different ideas.

8.1. Sensitivity Analysis

Before applying the results attained from the above calculations, in analyzing cash flow, we have to notice the fact that the boundaries of the final fuzzy number is a base upon which the decisions are made. In other words, if this boundary is small and not so wide, choosing the preferable item will be an easy task .But, if the boundary is wide and large, the final decision in choosing the preferable case would generate some difficulties. The aim of sensitivity analysis is to determine the factors which will mostly affect the final fuzzy number. In other words, sensitivity analysis is one of the ways of reducing the final fuzzy number's boundary. After the sensitivity analysis, the decision maker will attain and collect information about the sensitivity rate of the result of the problem. This information will help him/her to give a more accurate definition of the data.

9.1. Fuzzy Net present value

In order to reach a formula of fuzzy net present value the following concepts should be defined: Net present value (NPR), left, the smallest possible value (L); mean, the most promising value (M); right, the largest possible value; catch flown (F), Interest rate (i), Time (n ,t).

It is worth mentioning that in fuzzy investment projects one is just allowed to use (SPPWF), Present value.

This present value will determine the amount of data (F) after (n) years and rate of (i) percent. (P/F, i%, n)= $\frac{1}{(1+i)^n}$ (14)

The final formula of fuzzy net present value (FNPR) is derived from methods of cash flow reduction and fuzzy mathematics:

$$NPV_L = F_0^L + \sum_{t=1}^{n} F_t^L \begin{cases} \prod_{t=1}^{n} (P/F, i_t^L\%, 1) & F_t^L < 0 \\ \prod_{t=1}^{n} (P/F, i_t^R\%, 1) & F_t^L > 0 \end{cases} \quad (2.4)$$

$$NPV_M = F_0^M + \sum_{t=1}^{n} F_t^M \prod_{t=1}^{n} (P/F, i_t^M\%, 1) \quad (3.4)$$

$$NPV_R = F_0^R + \sum_{t=1}^{n} F_t^R \begin{cases} \prod_{t=1}^{n} (P/F, i_t^L\%, 1) & F_t^R > 0 \\ \prod_{t=1}^{n} (P/F, i_t^R\%, 1) & F_t^R < 0 \end{cases} \quad (4.4)$$

$$FNPV = (NPV_L, NPV_M, NPV_R) \quad (5.4)$$

If you want to compare the (FNPV) for several projects, we can use the method of arranging the fuzzy member's shich will be discussed below. Another point to be mentioned here is the calculation of the difference between two fuzzy values (FNPV), in order to do that one can use the formulas below:

The distance between two triangular fuzzy numbers of $\tilde{M} = (a_L, a_M, a_R)$ and $\tilde{N} = (b_L, b_M, b_R)$ would be calculated as:

$$S(\tilde{M}, \tilde{N}) = \frac{(a_l + 2a_m + a_R) - (b_L + 2b_m + b_R)}{4} \quad (6.4)$$

$S(\tilde{M}, \tilde{N})$ Is the algebraic distance between $\tilde{N}$ and $\tilde{M}$ witch can be negative, positive or zero.

10.1. The Order of Fuzzy Number

In discussing fuzzy numbers, their arrangement and order is one of the key issues. There are different ways of arranging fuzzy numbers, here; one of them will be discussed. In this method, three

standards have been presented. These standards must be used carefully one after the other. (Lee. S. M., Lin. K. L., Gupta. S (1994).

I. for Every triangular number $\widetilde{M} = (a_L, a_M, a_R)$, the following formula must be used:

$$S(\widetilde{M}, O) = \frac{a_L, 2a_m + a_R)}{4} \quad (7.4)$$

Category, you can arrange them by applying the standard. In this way the most promising value of each one is compared with others.

III. Still, there may be some numbers belonging to the same category. By using the domain criteria, we can reach the linear order of the fuzzy numbers. The larger the difference between the smallest and the largest possible value in each triangular number gives it a height rank /position among others.

11.1. Numeric Example

Consider a 3 years investment project. Cash flow and preferable rate have been shown in the below figure. Net present value of this project will be calculated as:

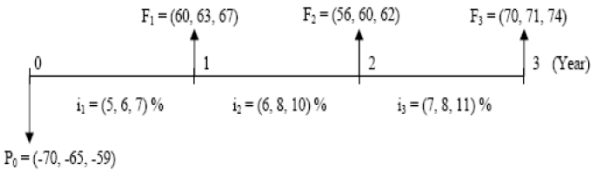


Figure2: Cash flow and preferable rate

By using the classical techniques, net present value is 104. But, by using fuzzy formulas the triangular fuzzy number will be (87,104,123).

2. Discussions

In the first section, a technique for making the uncertain data capable of becoming fuzzy has been thoroughly discussed. Data such as the primary capital, return rate, capital, etc. will be considered in evaluating the projects.

In the second part, the formula for calculating the fuzzy net present value was presented. This formula has the capability to take the fuzzy data of the investment projects and give the results in the form of a fuzzy number. In this formula, the most promising value is exactly the same as the result of the classical evaluation. Then, for calculating the largest possible value, some of the primary was use. The same method can be used for identifying the smallest possible value.

In the third part, a method for arranging the fuzzy numbers- which would be used in choosing the best project-was introduced.

In this research, the application of the triangular fuzzy numbers presents a good approach to the cash flows in the economic analysis of the projects

By considering the analysis, one can surmise that the given methods of fuzzy approach are more fruitful /desirable. Using this approach helps the decision makers to have more information about the possible results. The results reached by fuzzy system are more reliable even if the primary data (input) change. Finally, find in designs of this research can help solving the problems of evaluating the investment projects, such as the uncertainties around the impute data and also lack of exact information.

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