

# Chapter LVI

## Multiattribute Methodologies in Financial Decision Aid

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### **ABSTRACT**

*This chapter introduces the capability of the numerical multi-dimensional approach to solve complex problems in finance. It is well known how, with the growth of computational resource, scientists have developed numerical algorithms for the resolution of complex systems, in order to find the relations between the different components. One important field in this research is focused on the mimic of nature behavior to solve problems. In this chapter two technologies based on these techniques, self-organizing maps and multi-objectives genetic algorithm, have been used to solve two important fields in finance: the country risk assessment and the time series forecasting. The authors, through the examples in the chapter, would like to demonstrate how a multi-dimensional approach based on the mimic of nature could be useful to solve modern complex problems in finance.*

## **INTRODUCTION**

The increasing complexity of financial problems over the past few decades has driven analysts to develop and adopt more sophisticated quantitative analysis techniques: furthermore, in the past few years, opinion is growing that the criterion to guide financial decisions has to be multi-dimensional (Zopounidis & Doumpos, 2002a).

This is the reason why mathematical models have replaced the verbal models (Spronk, Steuer, & Zopounidis, 2005). Financial institutions as well as firms acknowledge the multi-dimensional nature of financial decision problems, and an implication “is that there may be an attempt to redefine the analytical tools used to solve problems; for example, goal programming and multi-criteria decision making,” as Bhaskar said as early as 1983 (p. 616). Institutions and firms often use optimization and statistical software packages, even though many of these are not specifically designed for financial decision-making problems. Examples of such programs are the CGX system, the BANKS system, the BANKADVISER system, the INVEX system, the FINEVA system, the FINCLAS system, and the INVESTOR system (Spronk et al., 2005).

The use of mathematics and an operational research approach in finance got its start in the 1950s with the introduction of Markowitz’s portfolio theory. Since then many researchers and practitioners gave their contribution. With our work we would illustrate how a multi-dimensional approach could be useful to solve different financial problems.

In this chapter the attention has been focused on two particular aspects of financial decision making: the country risk assessment and an optimized statistical approach to modeling time series.

The country risk field includes a wide range of different problems and aspects: this is the reason for which many different definitions have been formulated (Bouchet, Clark, & Gros Lambert, 2003). We will consider it as an additional risk that is involved when business transactions occur across international borders. The assessment of country risk will be realized as a classification problem employing a multi-criteria decision-making (MCDM) approach; further, a self-organizing map (SOM) approach will be used to discover clusters of countries with similar risk patterns and understand the produced rating.

In the second part of the chapter we review the best-known statistical methodology for the time series modeling and forecasting: the ordinary least squares (OLS) model. This model, even though obsolete, is still used by many traders and asset management practitioners. Through an operational research approach and using a multi-objective genetic algorithm (MOGA), we will discuss the regression method, fixing attention on statistical hypothesis testing. It is a well-known fact that, to check the validity of the regression, there are a lot of tests (p-values for t-tests, F-test for testing the overall significance of the model, etc.) which must be satisfied or rejected: when the number of variables is high, this objective could be a very hard task. Consequently, the aim of our work is to make the investigation of feasible solutions an automatic process and to choose the best one.

## **COUNTRY RISK MULTI-DIMENSIONAL ASSESSMENT**

As explained by Meldrum (2000), when business transactions occur across international borders, they carry additional risks not present in domestic transactions. These additional risks,

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