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A more human-like portfolio optimization approach

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ABSTRACT

Black and Litterman proposed an improvement to the Markowitz portfolio optimization model. They suggested the construction of views to represent investor's opinion about the future of stocks' returns. However, conceiving these views can be quite confusing. It requires the investor to quantify several subjective parameters. In this article, we propose a new way of creating these views using Verbal Decision Analysis. Questionnaires were designed with the intent of making it easier for investors to express their vision about stocks. Following the ZAPROS methodology, the investor answers sets of questions allowing to determine a Formal Index of Quality (FIQ). The views are then derived from the resulting FIQ. Our approach was implemented and tested on data from the Brazilian Stocks. It allows investors to create a personal risk-return balanced portfolio without the help of an expert. The experiments show that the proposed method mitigates the impact of poor view estimation. Also, one must notice that the method is qualitative and its aim is to create a more efficient portfolio considering the investor's vision.

1. Introduction

The works of Markowitz (1952); 1959) have completely transformed the Portfolio Optimization field, and derivations from it are still used to construct almost every portfolio. Markowitz used the stocks' profitability variance as a measure of risk along with the expected returns of stocks for portfolio selection, defining an efficient frontier that determined which portfolio composition would have the highest expected value for a given level of risk.

Albeit revolutionary, Markowitz's work shows some major drawbacks in practical applications. The resulting portfolios can be counter-intuitive (Black & Litterman, 1992; Michaud, 1989), they tend to concentrate on a small subset of the available securities and do not seem to be quite diversified (Bera & Park, 2008; Tütüncü & Koenig, 2004). The optimal portfolio is also extremely sensitive to small variations in the input data (Erdogan, Goldfarb, & Iyengar, 2008; Michaud, 1989; Tütüncü & Koenig, 2004).

These practical disadvantages of the Markowitz model motivated Fisher Black and Robert Litterman to develop a new approach. Thus the Black–Litterman approach (Black & Litterman, 1991), which combines the expected equilibrium between returns estimated through the Capital Asset Pricing Model (CAPM) and views to optimize the portfolio. The views represent the investor's opinion about the stocks' future returns. This model yields more stable and diversified portfolios than the mean-variance standard model (Walters, 2011).

Black and Litterman's original paper (Black & Litterman, 1992) only explained the core aspects of their idea, leaving it to others to better explain the implication of their model. He and Litterman (2002); Satchell and Scowcroft (2000); Walters (2011) explain the Black–Litterman approach in further detail. Walters (2011) also constructed a framework[1] to use the model and other portfolio optimization techniques. Mankert (2010) sheds more light on the practical implications of the Black–Litterman approach. Other studies focus on extensions of the original model, like Fernandes, Fernandes, and Street (2013); Herold (2005); Idzorek (2007); Meucci (2008).

Also, Bertsimas, Gupta, and Paschalidis (2012) proposed a more general extension of the original Black–Litterman model that can incorporate investor opinion about volatility and construct estimators for more general notions of risk. Reinterpreting the problem through inverse optimization (Bertsimas et al., 2012) extends the traditional model creating a approach that can combine a greater variety of views.

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[1] That is available in www.blacklitterman.org

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The expression of the investor's preferences can be seen as a decision making process. Traditionally, decision-making scenarios involve the analysis of objects from several points of view and can be assisted by multi-criteria methodologies. These help generating knowledge about the decision context and, as a consequence, increase the confidence of those making decisions (Evangelou, Karacapilidis, & Khaled, 2005). There are multi-criteria methods based either on quantitative or qualitative analysis of the problem, and choosing the best approach is a great challenge. Examples of problem-solving using quantitative methods can be found in Castro, Pinheiro, and Pinheiro (2009); Pinheiro, Souza, and Castro (2008); Toncovich, Turón, Escobar, and Moreno-Jiménez (2011). Among those who apply qualitative methods, we have (Castro, Pinheiro, Dantas Pinheiro, & Tamanini, 2011; Mendes, Carvalho, Furtado, & Pinheiro, 2008; Tamanini, Carvalho, Castro, & Pinheiro, 2009; Tamanini, Castro, Pinheiro, & Pinheiro, 2011; Tamanini, Pinheiro, & Pinheiro, 2010).

The Verbal Decision Analysis is based on multi-criteria problem-solving through qualitative analysis method. One of the advantages of qualitative methods is that all the questioning in the process of eliciting preferences is made in the decision maker's native language. Moreover, verbal descriptions are used to measure preference levels. This procedure is psychologically valid, respecting the limitations of the human information processing system. This characteristic makes the incomparability cases (Tamanini, 2010) become almost unavoidable since the scale of preferences is purely verbal and consequently not an accurate way of estimating values. Therefore, the method may not be capable of achieving satisfactory results in some situations, presenting an incomplete solution to the problem.

Establishing views in the traditional quantitative way is not an easy task and an investor would need help from an expert in the process. That is why we chose a method to setting views using Verbal Decision Analysis (VDA). For this propose, we developed questionnaires that are intuitive and can be answered by anyone with basic knowledge of investment options without needing any further special training.

The propose of this paper is to develop a methodology to construct personalized portfolio base on the investor's opinions. Our problem is not a typical multi-criteria problem, being actually very different from normal VDA applications. This is one of the major difficulties that have to be overcome in order to create the Black–Litterman views.

Moreover, the desired goal is to build a technique to support the creation of customized portfolios based on an individual's preferences. That is, we are trying to identify the profile by knowing his opinion about the stocks. Therefore, a comparison among performances of portfolios, in the present case, should consider only portfolios that are aligned with the individual preference. For this purpose, in the final part of Section 4 we compare the return of investing on the investor most preferred asset with our proposed approach.

In Section 2 we present a brief explanation of the Verbal Decision Analysis (VDA) framework used in this work. Section 3 brings a review of the Black–Litterman methodology. Finally, in Section 4 we report about the experiments made with Brazilian stocks while Section 5 brings a brief discussion regarding future works.

2. Verbal Decision Analysis

A decision may be defined as the result of a process of choice when someone is confronted with a problem or with an opportunity for creation, optimization or improvement of a given situation. On the other hand, decision making is a special activity of human behavior, aimed at the achievement of a given goal. It takes place in every activity of the human world, from simple daily problems to complex situations inside an organization. The conclusion of a decision making process can be an ordination of alternatives or the selection of a single alternative from a list of possible solutions for the problem.

Establishing its preferences and interests is usually enough to allow an individual to make decisions that solve simple problems. However, individuals often find it hard to separate emotions from reason. As a result, emotions often influence the decision making process (Larichev, 2001; Machado, Menezes, Tamanini, & Pinheiro, 2011). The decisions also involves several factors, some of which may not be measurable. Thus, when a decision maker needs to solve complex problems, covering many alternatives and a large volume of information that may not be measurable nor easily comparable, some methodologies exist to support the decision making process.

In order to solve a given problem, alternative solutions are taken into consideration. Such alternatives are defined and characterized according to a set of criteria, structured around its verbal and qualitative nature. There are a huge number of practical problems which is necessary to generate an ordinal scale of alternatives (Larichev & Moshkovich, 1997). The construction of such an ordinal scale is helpful in many situations, for example, to reject less preferable alternatives from a given set.

The Verbal Decision Analysis (VDA) framework is a set of methods defined to support the decision making process through the verbal representation of problems. Some methods that constitute the Verbal Decision Analysis framework are: ZAPROS-III, ZAPROS-LM, PACOM, and ORCLASS (Larichev & Moshkovich, 1997). According to Gomes, Moshkovich, and Torres (2010), in the majority of multi-criteria problems there is a set of alternatives that can be evaluated against the same set of characteristics (called criteria or attributes). The VDA framework is structured on the supposition that most decision making processes can be qualitatively described (Chrissis, Konrad, & Shrum, 2007). Although the decision maker's ability to choose is very dependent on the occasion and the stakeholders' interest, the methods to support decision making are universal.

Moreover, in Ustinovich and Kochin (2004) the analysis of a large amount of data-processing performed by human beings has shown that the psychologically correct operations are:

- Comparison of two assessments in verbal scale by two criteria;
- Assignment of multi-criteria alternatives to decision classes;
- Comparative verbal assessment of alternatives according to separate criteria.

This last operation is the only classification methodology within the VDA framework. The goal of the Verbal Decision Analysis framework is to establish a ranking of alternatives in order of preference.

The methods belonging to the Verbal Decision Analysis framework may be evaluated in light of their objectives:

- As a tool for ordinary classification, ORCLASS was one of the first methods designed to tackle classification problems. There are several other widely known methods for solving classification problems that can be applied and analyzed for future applications (Brasil, 2010; Brasil, Pinheiro, & Coelho, 2010; 2012) but that does not belong to Ustinovich and Kochin (2004) VDA framework;
- The other objective is to organize the solutions alternatives for the problem in a rank, from the most preferable to the least preferable one. Three methods are proposed within the VDA framework: ZAPROS-LM, ZAPROS-III, and PACOM. Although they have the same final goal, they have different purposes:

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