DISCUSSION

## Comments on: Multicriteria decision systems for financial problems

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The paper provides an overview of the types of decision support systems, many of which are quite sophisticated, that have been developed or are in development in an effort to keep pace with the many types of financial problems possessing multiple criteria and models designed to address them that have been arriving on the scene in recent years with increasing frequency. Two particular areas are focused on as examples of this. They are portfolio selection and corporate performance evaluation. To keep my comments limited, I will concentrate only on things that have been taking place in portfolio selection, and this leads me to think along the following lines.

In world history, we have the (new contemporary) term Common Era, abbreviated CE, as an alternative for AD, and BCE, which stands for Before Common Era, as the alternative for BC. In finance, we actually have something similar in that financial history can be divided into two distinct parts. We can have the designation Pre-1952 for the time before the publication of the famous paper by Markowitz (1952), and Post-1952 for the time since.

In finance, 1952 is the dividing line because prior to this date there was no coherent theoretical basis on how to form collections of investments called portfolios. At best, all that was available was sensible advice gained from experience such as that given in Graham and Dodd (1951). Prior to 1952, everyone knew that in trying to maximize the portfolio return random variable, expected return, risk and diversification were involved, but no one had been able to tie them all together until Markowitz did so elegantly with his proposed efficient frontier.

In Markowitz, investing is reduced to selecting one's most preferred risk-return trade-off solution from the set of all possibly optimal risk-return trade-off solutions

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given precisely by the efficient frontier. Also, a part of Markowitz's theory is that one investor's optimal solution need not be anywhere near another investor's optimal solution on the efficient frontier. While it may be hard to imagine now, all of this shook the foundations of finance, made major changes in the directions of research, and ushered in the era often given by the name Modern Portfolio Theory (MPT). Starting in 1952, this makes, as of this writing, MPT sixty-one years old. Given the dramatically different models and systems described in the paper as some of what has been happening of late in financial decision making, the relevance of the term "Modern" in MPT no longer appears as compelling as it used to be.

This I feel is in large part due to the impact that the field of multiple criteria decision making (MCDM), an umbrella term used to also include multiple criteria decision aid (MCDA) and multi-attribute utility theory (MAUT), has begun to have on finance. Because of the growing influence of MCDM in finance, I feel that, over the sixty-one years of MPT, I see another break point, or at least an offshoot. Not as sharp as in 1952, I would place the point at around the year 2000. My rationale is that even though MCDM has been around since the early 1970s, it was not until about 2000 that MCDM really began to gain traction in a critical mass fashion, as documented in Steuer and Na (2003), in finance.

For instance, since 2000, it seems that the most important articles in portfolio selection have almost entirely been along the lines of multiple criteria (with probably the most frequently considered additional criteria beyond risk and return being dividends, liquidity, and sustainability). Unless MCDM in finance is just a passing fancy, MCDM in finance presents a challenge to the continued use of the word "Modern" in Modern Portfolio Theory. With MPT wedded to the idea that all concerns are priced in finance, there is a potential for a major conflict on principles with MPT. Whereas traditional finance allows only one objective, that being wealth maximization, multicriteria finance allows additional objectives, not all of which need even be financial (social responsibility being one objective). That is, in multicriteria finance, additional utility is gained from returns to other criteria. If one such criterion were the number of securities in a portfolio, I don't think it could ever be priced.

Another break that multicriteria finance makes with the tradition of MPT is that with additional criteria, the efficient frontier becomes a surface, and few tools for dealing effectively with efficient surfaces are in the traditional finance arsenal. About the only one that might be considered is the epsilon-constraint method, but with about 30 times as many points necessary for each additional criterion to achieve about the same representation density, the method quickly becomes impractical on other than tiny problems. Thus, other methods which come from MCDM, many of which are unfamiliar to traditional finance, are necessary.

In this regard let us quickly review the a priori/progressive articulation/a posteriori classification of methods for solving a multicriteria problem put forth by Hwang and Masud (1979). The classifications depend upon when preference information is elicited from the decision maker. In an a priori method, preference information is ascertained ahead of time, and then using it, a problem is solved to generate a supposedly optimal solution. This is the only solution a decision maker sees. In a progressive articulation method (an interactive procedure), preference information is elicited iteratively over the course of the solution procedure. Here, the decision maker maybe sees a dozen or so solutions, which may not be enough, before having to make a final decision. Furthermore, there is no assurance that major portions of the efficient surface might not have been missed. In an a posteriori method, the full efficient set is computed first. Then it is conveyed to the decision for the selection of an optimal solution. Of course, computing the efficient surface may be too difficult to carry out in many situations, in which case one might have to revert back to an interactive procedure, but if possible this would be the way to go.

A posteriori methods are important because in many situations in finance (particularly in portfolio selection), it is often, if not almost always, not possible for a decision maker to recognize an optimal solution in the absolute. It seems that a decision maker will always want more return, less risk, etc. Consequently, when a solution is finally selected, it is usually not selected because of its greatness. It is selected because all other solutions are worse, and to be able to know this, one must be able to see (in some fashion) all other solutions. This is why a priori methods almost never live up to their promise.

A good example of a priori vs. a posteriori, in my opinion, is that in 1952 two outstanding papers were published basically in competition with one another. One was the aforementioned paper by Markowitz, and the other was by Roy (1952). They were both brilliant in simultaneously coming up with the efficient frontier, but why did Markowitz's paper go on to so much more fame—because Markowitz's method is an a posteriori approach and Roy's approach for solving the portfolio selection problem is an a priori approach. In Roy's approach, all you get is the "safety first" point. It's a great point, but coming to the decision maker in a vacuum, it is hard to put it in perspective. However, in Markowitz's approach, one gets to see all contenders for optimality, and then gets to pick one for which it can be seen that all others are worse, and this is thus a point one can act on.

Even though they are much harder, I would like to see more effort and attention paid to a posteriori methods and decision support systems for accommodating them in the future. Methods are getting better and computers are getting faster, so it is likely that the amount of a posteriori work that can be accomplished in the future will only increase. I'm sure that, like me, the authors recognize that this is something more easily said than done, but we should at least not let it fall from mind.

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