

Xiaoxia Huang

Portfolio Analysis

Studies in Fuzziness and Soft Computing, Volume 250

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Xiaoxia Huang

Portfolio Analysis

From Probabilistic to Credibilistic and
Uncertain Approaches

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Preface

The most salient feature of security returns is uncertainty. The purpose of the book is to provide systematically a quantitative method for analyzing return and risk of a portfolio investment in different kinds of uncertainty and present the ways for striking a balance between investment return and risk such that an optimal portfolio can be obtained.

In classical portfolio theory, security returns were assumed to be random variables, and probability theory was the main mathematical tool for handling uncertainty in the past. However, the world is complex and uncertainty is varied. Randomness is not the only type of uncertainty in reality, especially when human factors are included. Security market, one of the most complex markets in the world, contains almost all kinds of uncertainty. The security returns are sensitive to various factors including economic, social, political and very importantly, people's psychological factors. Therefore, other than strict probability method, scholars have proposed some other approaches including imprecise probability, possibility, and interval set methods, etc., to deal with uncertainty in portfolio selection since 1990's. In this book, we want to add to the tools existing in science some new and unorthodox approaches for analyzing uncertainty of portfolio returns. When security returns are fuzzy, we use credibility which has self-duality property as the basic measure and employ credibility theory to help make selection decision such that the decision result will be consistent with the laws of contradiction and excluded middle. Being aware that one tool is not enough for solving complex practical problems, we further employ uncertain measure and uncertainty theory to help select an optimal portfolio when security returns behave neither randomly nor fuzzily.

One core of portfolio selection is to find a quantitative risk definition of a portfolio investment. Another interesting feature of the book is that it introduces a new risk definition, i.e., risk curve, besides already known risk definitions of variance, semivariance, and probability of a disastrous loss level. Risk curve describes each likely loss level and the corresponding occurrence chance of each loss. So it is instinct and safe for investors to use risk curve to

control their risk. Furthermore, the book provides the extensions of the risk definitions to other types of uncertainty other than randomness.

This book consists of 5 chapters. Chapter 1 introduces general principles upon which portfolio selection problem is analyzed. Chapter 2 provides a variety of models with numerous application examples for portfolio selection with random returns. Risk curve is introduced and models based on risk curve are provided in this chapter. For better understanding of the selection ideas in random environment, fundamentals of probability theory are reviewed at the beginning of Chapter 2. Chapter 3 starts with an introduction of fundamentals of credibility theory concerning fuzzy portfolio selection and then introduces a spectrum of credibilistic portfolio selection models including mean-risk model, β -return-risk model, credibility minimization model, mean-variance model, mean-semivariance model, and entropy optimization model. Crisp equivalents of the credibilistic models are given when security returns are triangular fuzzy variables, trapezoidal fuzzy variables, normal fuzzy variables and equipossible fuzzy variables. A hybrid intelligent algorithm is also presented for solution of the credibilistic models in general cases. Chapter 4 first offers necessary knowledge about uncertainty theory which will be used in portfolio selection with neither random nor fuzzy uncertain returns. Then a series of uncertain selection models are provided and the crisp equivalents are presented. Chapter 5 offers extensions of the basic portfolio selection models such that the optimal portfolio can be dispersed enough to a required extent.

The book provides a systematic, self-contained, and up-to-date portfolio analysis method. With numerous examples and necessary remarks, it is quite readable. The book is interesting because it introduces some new quantitative risk definitions and adds to the existing tools and techniques some additional apparatus for investment optimization which will be powerful in many specific cases. It is suitable for researchers and students who are interested in the fields of portfolio selection as well as capital budgeting, investment optimization, and risk analysis, etc.

I would like to thank my parents, colleagues, friends and family members who encouraged and helped me to finish this work. I would also like to thank my graduate students Qiming Pan, Wenying Shen and Wenjing Gao who made a number of corrections. This work was supported by National Natural Science Foundation of China Grant No. 70871011 and New Century Excellent Talents in University. I owe thanks to their financial support. Finally, I express my deep gratitude to Professor Janusz Kacprzyk for his valuable comments and suggestions on the book and his generosity to allow me to publish the book in his series.

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