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Preface

Supply chain logistics planning is the key issue of supply chain management. Supply chain logistics planning optimization mainly involves a reasonable arrangement of each node enterprise in the supply chain for its raw materials or products purchase quantity, production quantity, inventory quantity, and transport quantity under a myriad of constraints so that the operations of supply chain logistics system is optimized during the planning period. In the practical operation of supply chain, there exist many uncertain factors that influence the supply chain logistics planning. This uncertainty mainly includes parameter randomness, fuzzy randomness, and so on. Therefore, the uncertainty of parameters should be fully considered when a supply chain logistics planning is made. The book, based on the research of customer demand forecasting techniques, will work over the decision-making model of supply chain logistics planning under uncertain environment, including the three-level strategic-alliance supply chain, decentralized control supply chain in which the nodes have been unlimited expansion, and the three-level mixed control supply chain. At the same time, different hybrid intelligent algorithms will be designed for solving these models.

In many cases, customer demand forecasting should be made first in the decision-making of the supply chain logistics planning. On considering the conditions of customer demand, and on the basis of some hypotheses, the dynamic equation model of customer demand was established by using the theory of differential equation to reflect the changing law of customer demand in supply chain logistics system, the method to determine the parameters in the model was presented, and the method of parameter estimation and hypothesis testing of the error of the forecasting model was discussed. Furthermore, in order to improve the forecasting precision of customer demand in the supply chain and obtain satisfactory forecasting results, fuzzy consistent judgment matrix was applied to solve the weights allocation problem of different forecasting methods in the combination forecasting. As regards the three-level strategic-alliance supply chain, the model of supply chain logistics planning was established with stochastic expected value programming theory under the market prices and the market requirements of finished products as random variables, and the hybrid intelligence algorithm of solution this model was

designed. Considering that the decision-makers do not always care the expected revenue maximization, but consider how to achieve the optimal income under the probability meaning, and as for the supply chain logistics planning issue with upstream business's market supply price of raw materials and downstream business's market demand price of finished products as random variables in supply chain cell of decentralized control supply chain in which the nodes have been unlimited expansion, the stochastic programming model under chance-constrained was established with the stochastic chance-constrained programming theory in order to express how to obtain optimal decision-making in a certain confidence level, and the hybrid intelligence algorithm to solve model was designed. Particularly for the three-level mixed control supply chain, supply chain logistics planning model was established by using fuzzy stochastic programming theory under customer demand as fuzzy random variables, and the hybrid intelligent algorithm to solve this model was designed.

In conclusion, the book brings forth some new and challenging topics that are listed as follows. (1) Aiming at the customer demand forecasting problem in the supply chain logistics planning, the dynamic equation model of customer demand forecasting of supply chain logistics system is put forward, the weights allocation method of combination forecast is presented, and the correctness and reliability of the forecasting models and weights allocation methods are testified with numerical examples. (2) The book proposes the stochastic expected value programming model of purchase-production-inventory-transport integrated logistics planning of three-level multi-product strategic-alliance supply chain under the environment of random market price and random demand of finished products, and designs a hybrid intelligent algorithm based on random simulation to solve the model, and the effectiveness of the model and algorithm is illustrated with numerical examples. (3) Aiming at the coordination problem of multi-level and multi-product decentralized control supply chain planning under uncertain environment, the supply chain cell is defined, and the stochastic chance-constrained programming model for multi-level and multi-product decentralized control supply chain logistics planning that includes purchase, production, inventory, and transportation under random supply prices and random demand prices among the node enterprises in the supply chain is put forward, the hybrid intelligence algorithm based on random simulation is designed, and the effectiveness of the model and algorithm is illustrated with numerical examples. (4) Aiming at the coordination problem of three-level multi-product mixed control supply chain planning under uncertain environment, the fuzzy random expected value programming model for the three-level and multi-product mixed control supply chain logistics planning that includes purchase, production, inventory and transportation under fuzzy stochastic customer demand environment is put forward, the hybrid intelligence algorithm based on fuzzy stochastic simulation and neural network and genetic algorithm is designed, and the effectiveness of the model and algorithm is illustrated with numerical examples.

It takes nearly 4 years (2012–2015) to publish the book, from the birth of the general idea to the final printing. During this period, relevant professional groups

have achieved substantial cognition of the true value of logistics both in developed and developing countries. In the standpoint of professional technique to observe this change, we know that this change should be mainly credited to a lot of effective and successful work done by many outstanding scholars and business managers. In this sense, we are standing on the shoulders of our predecessors, but it is a pity that the author has not enough wisdom to see farther. The book gained support from Humanities and Social Sciences Planning Fund of Chinese Ministry of Education under Grant No. 12YJA630097 and China Post-doctoral Science Foundation under Grant No. 20110491567.

It should be noted that although the author has done some work on the optimization of integrated supply chain logistics planning, the work is too shallow and rough. Moreover, this is a rudimentary theory research of supply chain management based on practical data, so there is a considerable gap between the established integrated supply chain logistics planning model, its solution algorithm, and the current enterprises practice; in particular, there is a great difficulty in collecting data of more successful businesses in practice to verify this model. Therefore, the guidance value of this research results upon practice can only be verified through simulation. It is the happiest thing for the author if a word or two in this book can revoke even a little inspiration and resonance in the heart of a thinking reader.

Limited by the author's vision and scholarly attainments, there may be some inaccuracies and omissions in this book; please feel free to give your valuable comments and corrections.

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First of all, our heartfelt gratitude goes to Professor Xiangyi Xu from School of Management of Shandong University, and Professor Shaohua Dong and Professor Sujian Li from the Logistics Research Institute of Beijing University of Science and Technology because they not only gave us valuable comments and suggestions in the course of study but also generous help for the work in the later stage.

We would also like to thank the authors of references for their research results. The study of this work made us feel that our vision and knowledge are not enough, and the wise results of these authors give us constant inspirations, and the details about their research results are indicated in the part of quotations and in the references.

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As the first author and corresponding author of the monograph, I am very grateful to my family, including my aged parents, my wife Lihua Wu and daughter Jingjie Shao. Without their understanding and support, it is hard to imagine that I would have more time to carry out the research. So this book is dedicated to my

family in order to express my deeply love and gratitude for everything they have done for me.

In a word, this work has been finished with the help and support from many people. As we could not list all of their names, please forgive us and accept our greatest respect and deepest thanks!

April 2015 Juping Shao

Contents

Symbols

ξ, η	Stochastic (fuzzy) variables
$\boldsymbol{\xi}$, $\boldsymbol{\eta}$	Stochastic (fuzzy) vectors
$\mathrm{Pr}\{\cdot\}$	Probability measure
$Pos\{\cdot\}$	Possibility measure
$Nec\{\cdot\}$	Necessity measure
$Cr\{\cdot\}$	Credibility measure
E	Expected value operator
$(\Omega, \mathrm{A}, \mathrm{Pr})$	Probability space
$(\Theta, \mathrm{P}(\Theta), Pos)$	Possibility space
ϕ	Empty set
$\Re$	Set of real numbers
$\Re^n$	n-dimensional real vector set
$\wedge$	Mini operator
$\vee$	Max operator