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Editorial

Discrete Optimization for Dynamic Systems of Operations Management in Data-Driven Society

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Society is being reshaped by large volumes of data generated from various operations, and research in handling dynamic issues related to data-driven systems has greatly increased in the past decades, where most rely upon discrete optimization models for handling dynamic features contained in operations management (OM) activities. With the rapid growth in computational technologies, including data mining technologies, discrete event simulation techniques, and intelligence algorithms, OM relies more and more on optimal solutions (or their approximates) based on high-performance models and algorithms.

This special issue collects 32 original research contributions that present recent advances in models and algorithms concerning discrete optimizations on dynamic OM systems relevant to the data-driven society. In particular, the papers address the topics related to discrete optimization methodologies for stochastic OM problems, dynamic programming based exact methods for stochastic OM problems, system dynamics in behavior OM for E-commerce, data-driven risk analysis and modeling for OM decisions in dynamic contexts, data-driven models for dynamic supply chain management, etc. It is hoped that this special issue will help the integration of the latest research achievements in the relevant field.

The paper by S. Li et al. entitled "Probability Mechanism Based Particle Swarm Optimization Algorithm and Its Application in Resource-Constrained Project Scheduling Problems" proposes a new probability mechanism based particle swarm optimization (PMPSO) algorithm to solve combinatorial optimization problems by introducing new particles based on the optimal particles in the population and the historical optimal particles in the individual changes. This method is applied to solve resource-constrained project scheduling problems and the experimental results are quite encouraging.

S. Zhang et al. in the paper entitled "Omni-Channel Product Distribution Network Design by Using the Improved Particle Swarm Optimization Algorithm" construct the joint randomization planning model of location and routing for the minimization of total cost of a supply chain distribution network under uncertain customer demand.

The paper entitled "Analysis of Signal Game for Supply Chain Finance (SCF) of MSEs and Banks Based on Incomplete Information Model" by Z. Tao et al. uses a signal gaming model based on incomplete information to analyze the decisions of commercial banks and medium-size and small enterprises (SMEs) in supply chain finance business, and concludes that the returns of banks are closely relied on the probability of good SMEs join in supply chain finance business and the default cost is an important constraint for determining the strategies adopted by both SMEs and banks.

The paper by J. Hao et al. entitled "Bilevel Programming Model of Urban Public Transport Network under Fairness Constraints" presents a bilevel programming model of the public transport network considering factors such as the per capita occupancy area and travel cost of different groups to alleviate the urban transportation equity and optimize the

urban public transport network under fairness constraints. The upper layer minimizes the travel cost deprivation coefficient and the road area Gini coefficient by taking into account fairness constraints; the lower layer models the selection behavior of different groups in the optimal scheme obtained at the upper layer as a stochastic equilibrium traffic assignment problem with multimode and multiuser. An improved genetic algorithm is developed to solve the constructed model and is validated via a simple network. The experimental results show that the current model can improve significantly the transportation equity feeling of low-income groups, reduce the overall travel time via public transport network, and thus attract more high and middle income users who owned cars to use the public transport network.

S. Chen and C. Wang in the paper entitled "Incorporating a Bayesian Network into Two-Stage Stochastic Programming for Blood Bank Location-Inventory Problem in Case of Disasters" construct a Bayesian Network to describe a blood logistics network considering uncertainties and interdependences caused by earthquakes. A two-stage multiperiod stochastic programming model is developed where the first stage focuses on blood bank location and inventory planning problem and the second stage is composed of multiple periods, some of which may suffer disasters and initiate corresponding rescue operations.

The paper entitled "Evaluating the Spatial Deprivation of Public Transportation Resources in Areas of Rapid Urbanization: Accessibility and Social Equity" by C. Han et al. introduces an evaluation system with six indexes to evaluate the spatial differentiation of public transportation resources and services. SPSS is applied to analyze the data collected from a typical rapid urbanization area in China and two main factors are shown to have significant impact on the spatial deprivation associated with public transportation resources and services. The authors conclude that the public transportation situation in rapid urbanization areas is consistent with the local land-use context and the methods applied in this study are suitable for extracting spatial public transportation characteristics.

The paper by L. Huang et al. entitled "Discrete Optimization Model and Algorithm for Driver Planning in Periodic Driver Routing Problem" presents a mixed-integer linear programming model for a periodic driver routing problem with an objective of minimizing the total workload by taking into account the relationship between workload differential among drivers and total workload. A local branching based method is developed to solve large instances of the problem and numerical experiments are conducted to validate the effectiveness and efficiency of the proposed model and solution method, as well as the effect of small workload differential among drivers on the total workload.

Y. Liu et al. in the paper entitled "Research on the Scheduling Problem of Movie Scenes" consider the factors affecting the cost of movie scenes shooting in the real world and construct an integer linear programming model for the scheduling of the movie sense with an objective of minimizing the total cost. The constructed model is solved by a Tabu search based method (TSBM) and a particle swarm optimization based method (PSOBM). Both of these methods are verified to be suitable for solving small-scale problems while the former is shown to be more efficient in solving the large-scale problem according to the experimental results.

The paper entitled "Simulation Optimization of Discrete Logistics Processes: A Case Study on Logistics of an E-Commerce Enterprise in Shanghai" by X. Xu et al. introduces the simulation of the logistics distribution process of an E-commerce enterprise in Shanghai with AnyLogic Software to optimize the targeted system from three aspects, including routes selection, warehouses quantity, and warehouses layout. The results of this study can provide valuable references for practical logistics of similar E-commerce enterprise.

Y. Chen et al. in the paper entitled "Pricing Decisions on Reward-Based Crowdfunding with Bayesian Review System Facing Strategic Consumers" extend the research on the optimal pricing decision with review system for the reward-based crowdfunding. Firstly, a Bayesian analysis is established to construct consumers' belief update process in presence of review system. Secondly, the strategy without the review system is taken as a benchmark to explore the impacts of review system under preannounced pricing and responsive pricing. It is found, through the equilibrium analysis, that the review system has positive impact on the creator under responsive pricing policy and the fraction of favorable review has a large effect on the profit of preannounced pricing.

The paper entitled "Research on Supply Chain Coordination Based on Block Chain Technology and Customer Random Demand" by Y. Li et al. focuses on supply chain coordination under the combined effects of block chain technology and random demand. Firstly, both a decentralized and a centralized supply chain decision model are built in a single-cycle newsvendor random demand situation. Then, through revenue sharing contract the study designs a brand-new supply chain coordination model which is Del trust, decentralized, and traded anonymously. According to the numerical comparative analysis on the optimal decision and supply chain coordination, it is found that the whole supply chain revenue can achieve and even exceed the performance level of the centralized supply chain with effectively expanding sales market and reducing supply chain risk. When the retail price is stable and supply chain is coordinated with revenue sharing mechanism, decentralized supply chain can achieve minimum optimal revenue. Coordination results have effect on short-term revenues of block chain members only.

The paper by L. Ma et al. entitled "Adopting a QCA Approach to Investigating the Risks Involved in Megaprojects from Auditing Perspective" introduces the microscopic empirical analysis on twenty-two typical cases by adopting the quality comparative analysis (QCA) from the auditing perspective. The results reveal that there is complex multiple concurrent causation among eight conditions, and the configuration of those conditions can be divided into six types, three of which, namely, the project management risk, preliminary and construction risk, and tendering and contract management related risk, are almost eighty percent. The analysis further reveals that megaproject risks in China are caused by complicated and changeable combination

conditions, providing a new breakthrough for the researchers and practitioners to control the megaproject risks from a more systematic way.

The paper entitled "A Metaheuristic Algorithm to Transporter Scheduling for Assembly Blocks in a Shipyard considering Precedence and Cooperating Constraints" by N.-R. Tao et al. considers an optimization transporter scheduling problem for assembly blocks in shipyards with an objective of minimizing logistics time, which includes empty travel time of transporters and waiting time and delay time of block tasks. A mathematical model is constructed by considering the time windows of ship blocks, carrying capacity of transporters, and precedence relationships of tasks and is solved by a metaheuristic algorithm based on the hybrid topological graph, genetic algorithm, and Tabu search. The results show the efficiency and effectiveness of the proposed algorithm compared to the optimal results in small-size instances and several strategies in large-scale instances.

The paper entitled "Distance-Based Congestion Pricing with Day-to-Day Dynamic Traffic Flow Evolution Process" by Q. Cheng et al. describes the distance-based congestion pricing in a network considering the day-to-day dynamic traffic flow evolution process with a mini-max regret model to optimize the worst condition among the whole planning period and ameliorate severe traffic congestions in some bad days. Firstly, a piecewise linear function is adopted to formulate the nonlinear distance toll, which can be encapsulated to a day-to-day dynamics context. Then, a logit-type Markov adaptive learning model is proposed to depict commuters' day-to-day route choice behaviors. Finally, a robust optimization model which minimizes the maximum total travel cost among the whole planning horizon is formulated and a modified artificial bee colony algorithm is developed for the robust optimization model.

S. Qin et al. in the paper entitled "Applying Big Data Analytics to Monitor Tourist Flow for the Scenic Area Operation Management" use the big data technology and Call Detail Record (CDR) data with the mobile phone real-time location information to monitor the tourist flow and analyze the travel behavior of tourists in scenic areas. By collecting CDR data and implementing a modeling analysis of the data to simultaneously reflect the distribution of tourist hot spots in Beijing, tourist locations, tourist origins, tourist movements, resident information, and other data, the results provide big data support for alleviating traffic pressure at tourist attractions and tourist routes in the city and rationally allocating traffic resources. The analysis shows that the big data analysis method based on the CDR data of mobile phones can provide real-time information about tourist behaviors in a timely and effective manner. This information can be applied for the operation management of scenic areas and can provide real-time big data support for "smart tourism".

Y. Peng et al. in the paper entitled "An Improved Genetic Algorithm Based Robust Approach for Stochastic Dynamic Facility Layout Problem" deal with stochastic dynamic facility layout problem under demand uncertainty in terms of material flow between facilities with the consideration of transport device management. An improved adaptive genetic algorithm with population initialization strategy is developed to reduce the search space and improve the solving efficiency. The effectiveness of the proposed algorithm is verified by comparing it with particle swarm optimization (PSO) algorithm, and the experimental results show the good performance of the robust layout compared to the expected layout.

The paper by H. Fei and C. Zhang entitled "Optimizing the Composite Cost Involved in Road Motor-Transporting Trucks by Taking into Account Traffic Condition" focuses on the planning of road motor-transporting services by taking into account road traffic condition, especially for urban areas with an objective of minimizing the composite cost, including both the economic cost related to the driver cost and fuel consumption, and the social cost related to the vehicle emissions. The dynamic road traffic condition is imitated dynamically with a discretization technique. A metaheuristic is applied with data collected from a dense district in a huge city. Experimental results show that the proposed approach can always converge quickly to the best solution and the solution with minimal composite cost can always dominate the other solutions with classic route optimization goals.

The paper entitled "Optimal Scheme for Process Quality and Cost Control by Integrating a Continuous Sampling Plan and the Process Yield Index" by C. Li et al. presents the development of an optimal scheme for process quality and cost control to monitor the process cost and improve the process quality by taking into account four parameters: clearance number, inspecting fraction, sample size, and critical value. The Continuous Sampling Plan and the Process Yield Index are integrated to improve the output of the scheme and a case study is illustrated to validate the effectiveness and practicality of the proposed scheme.

P. Zhang and G. Liu in the paper entitled "Data-Driven Recovery Potential Analysis and Modeling for Batteries Recovery Operations in Electric Bicycle Industry" estimate the annual waste quantity of lead-acid batteries used in electric bicycles in 2000-2022 using the "market supply A model" and the "Stanford Model", respectively. Based on the proportion of raw materials contained in lead-acid batteries and the proportion between reclaimed and discarded lead-acid batteries, the authors estimate the recovery potential of such batteries in 2000-2022. The research data and results can help decision-makers make more effective and more accurate management measures and policies.

The paper entitled "Implementation Flexibility of Multi-period Rail Line Design with Consideration of Uncertainties in Population Distribution" by K. Zhang et al. introduces the investigation results related to the implementation flexibility of multiperiod rail line design in a linear monocentric city. Three alternatives (fast-tracking, deferring, and do-nothing-alternative (DNA) of a candidate rail line project) are examined, based on an in-depth uncertainties analysis of the demand side for this candidate rail line project. Conditions for the three alternatives of fast-tracking, deferring, and DNA are analytically explored and an illustrative example is given to demonstrate the application of the proposed models. Insightful findings are reported on the interrelationship between the rail line length and spatial and temporal

correlation of population distribution as well as the implication of the correlation in practice. Sensitivity analyses are carried out in several scenarios in another numerical example to show the proposed conditions of the three alternatives.

The paper by H. Hu et al. entitled "Optimization of Vehicle Routing with Pickup Based on Multibatch Production" suggests a mixed-integer programming model for the joint optimization of multibatch production and vehicle routing problems involving a pickup to reduce both transportation and inventory cost. The targeted problem is solved within two stages. In the first stage, an integrated algorithm, combining the Clarke-Wright (CW) algorithm and the Record to Record (RTR) travel algorithm, is developed to solve vehicle routing problem. In the second stage, the particle swarm optimization (PSO) algorithm is proposed to allocate vehicles to each production batch. Multiple sets of numerical experiments are performed to validate the effectiveness of the proposed model and the performance efficiency of this two-stage hybrid algorithm.

Q. Wang et al. in the paper entitled "Integrated Optimization on Assortment Packing and Collaborative Shipping for Fashion Clothing" construct an integrated optimization problem that combines fashion clothing assortment packing with collaborative shipping simultaneously. A simplified model is then derived from the original model and solved by a commercial programming solver. Numerical results show that the proposed model is beneficial to the fashion clothing assortment packing and collaborative shipping planning.

The paper entitled "Optimal Strategies for Manufacturers with the Reference Effect under Carbon Emissions-Sensitive Random Demand" by B. Zhang et al. proposes the optimal strategies for a newsvendor system with joint reference effect, carbon emissions-sensitive random demand, and strategic customers' behavior, with the purpose of determining the selling price, production quantity, and carbon emissions under exogenous and endogenous price cases, respectively. How the loss aversions affect the newsvendor's decisions is explored and the study concludes that the newsvendor has a uniquely optimal policy. Furthermore, the results show that the influence of the reference effect makes the final decisions deviate from the optimal solutions of the classical model and that the loss aversions have a great impact on the newsvendor's decisions.

The paper by C. Ma et al. entitled "A Multiobjective Route Robust Optimization Model and Algorithm for Hazmat Transportation" introduces a multiobjective robust optimization model for the routing optimization problem of hazardous materials transportation in uncertain environment by applying the Bertsimas-Sim robust optimization theory. A fuzzy C-means clustering-particle swarm optimization (FCMC-PSO) algorithm is designed, where the FCMC algorithm is used to cluster the demand points and the PSO algorithm with the adaptive archives grid is applied to calculate the robust optimization route of hazmat transportation. The numerical results verify the effectiveness of the proposed method and this study can provide basic theory support for hazmat transportation safeguarding.

J. Liu et al. in the paper entitled "Hydrological Layered Dialysis Research on Supply Chain Financial Risk Prediction under Big Data Scenario" construct a supply chain financial risk prediction method under big data by drawing on the risk management theory in economics and the distributed hydrological model in hydrology. First, a "hydrological database" is built for the risk analysis of supply chain financing under big data. Second, the risk identification models of "water circle model", "surface runoff model", and "underground runoff model" are applied to carry on the risk prediction from the overall level (water circle). Finally, the supply chain financial risk analysis from breadth level (surface runoff) and depth level (underground runoff) is performed. The results of this study can enrich the research on risk management of supply chain finance and provide feasible and effective risk prediction methods and suggestions for financial institutions.

H. Hu et al., in the paper entitled "A Metaheuristic Method for the Task Assignment Problem in Continuous-Casting Production", focus on the task assignment problem in the downstream stage within the given information resulting from the upstream stage involved in the steelmaking and continuous-casting process in integrated iron and steel enterprises. A nonlinear mixed-integer programming model is constructed, with an objective of minimizing the total tardiness within the resource constraints and time windows constraints for the tasks, and is solved by an improved solution algorithm based on particle swam optimization.

The paper by Y. Wei et al. entitled "Inventory and Production Dynamics in a Discrete-Time Vendor-Managed Inventory Supply Chain System" analyzes production and order dynamics in the context of a discrete-time VMI supply chain system composed of one retailer and one manufacturer. The authors firstly derive the lower bound and upper bound on the range of inventory fluctuations for the retailer under unknown demand and prove that the production fluctuations can be interestingly smoothed and stabilized independently of the delivery frequency of the manufacturer used to satisfy the retailer's demand, even if the retailer subsystem is unstable. The sufficient and necessary stability condition for the whole supply chain system is obtained, and the bullwhip effect under unknown demand is further explored based on a transfer function model with the purpose of disclosing the influences of parameters on production fluctuations. All the theoretical results derived with respect to inventory and production fluctuations are validated by simulation experiments.

The paper entitled "Dynamic Strategies on Firm Production and Platform Advertisement in Crowdfunding considering Investor's Perception" by Y. Ji et al. introduces a dynamic decision model for film investment by taking into account the effects of information about product quality and platform advertisement on the investor's perception. Firstly, investment desire and reference price of the investor are introduced in two dynamic settings to describe investor's perception. Then, the optimal decisions about the product quality and platform advertisement are formulated under two circumstances: the sponsor and the platform make decisions independently and they cooperate as a system. Finally, the influences of reference price and cost-sharing ratio on the optimal results are compared and the data simulation experiment verifies the necessity of the study.

J. Feng and B. Liu, in the paper entitled "Goodwill and System Dynamics Modeling for Film Investment Decision by Interactive Efforts", develop a goodwill model and system dynamic (SD) model to optimize the film investment decision considering advertising, film-making, and power of stars. The results show that advertising has great impact on absorbing moviegoers' attention, investing in film-making should be emphasized when film quality has a great impact on the movie's reputation and audience's viewing decision, and the film producer should pay more attention to the higher cost-performance stars who have more reasonable remuneration, better acting skills, and bigger box-office guarantee. It can also be concluded that rational audience contribute more than fans to a movie's box-office, bankable stars contribute more than high-profile stars to a movie's returns, and the film series yields higher profits than new theme movies although the cost of investment is the same.

The paper by D. Huang et al. entitled "An Incentive Dynamic Programming Method for the Optimization of Scholarship Assignment" proposes an incentive method inspired by dynamic programming to find the optimal scholarship assignment scheme with the highest equity considering both the practical constraints and the equity requirement. In order to assign the scholarship avoiding time- and energy-consuming application processes conducted by students, feasible assignment schemes are generated by iteratively solving a series of knapsack subproblems based on dynamic programming and adjusting the monetary value of a unit score, and then the optimal solution will be screened out by applying the Gini coefficient for quantifying the equity of each feasible scheme. The numerical results indicate that the proposed method is an efficient tool to assign scholarships to students with consideration of the equity.

The paper entitled "Optimizing Price of Credit Default Swaps for Dynamic Project System of Public-Private Partnership" by M. Wu et al. introduces a method for optimizing the price of credit default swaps (CDS) for the dynamic PPP system. This study investigates the credit risk measurement of PPP project financing and the pricing of risk mitigation instruments which are widely used in the case of immature markets in the early stage of China's PPP development. Based on the credit risk measurement theory of the corporate and debt ratings, this paper considers the differences in various credit enhancement methods in the equity-like debt agreement and determines the credit rating of the equity-like debt in PPP projects. Some optimization methods are also proposed to derive the probability of default, so as to determine the price of the credit risk mitigation instrument of CDS which is based on the equity-like debt.

The paper entitled "Complexity Analysis of Dynamic Cooperative Game Models for Supply Chain with the Remanufactured Products" by J. Chang and L. Zhao suggests coupling dynamics of the forward supply chain of Stackelberg game model constructed for the supply chain within remanufacturing production system composed of one manufacturer and one retailer, where the manufacturer is responsible for the production of both new products and remanufactured products. After performing experiments designed by taking into account some dynamic phenomena such as bifurcation and chaos, the authors conclude that the equilibrium of the system can lose stability via flip bifurcation or Neimark-Sacker bifurcation and that time-delayed feedback control is appropriate for stabilizing the chaotic behaviors of the system.

We believe that the special issue will provide useful references for the researchers and practitioners working in the discrete optimization for dynamic systems of operations management in data-driven society.

Conflicts of Interest

The editors declare that they have no conflicts of interest regarding the publication of the special issue.

Acknowledgments

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