



Guest editorial on “data-driven operations management”

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Introduction

As a field that focuses on optimizing resource utilization to improve operational efficiency and effectiveness, operations management (OM) has attracted increasing attention from researchers in the past decades. In the context of big data, management activities are characterized by high frequency real-time data integration across organizational boundaries and multi-agent decision making. Information communication technology (ICT), enterprise resource planning (ERP), cloud computing, Internet of Things, social media, and other technologies related to big data are being applied by more and more enterprises and organizations in their operations. The nature of management in this operational environment leads to data-driven OM, which is an unprecedented challenge and an opportunity for OM research and practice.

In this connection, this special issue seeks to publish high-quality and peer-reviewed papers from the OM and artificial intelligence communities to focus on and understand new data-driven OM models, methodologies, and analytical frameworks to advance the development of data-driven OM. Our call for papers attracted in total 23 submissions, 15 of which have been finally accepted for publication in this special issue after a peer-review process.

Data-driven operations management

We can roughly divide the accepted 15 papers into four groups according to their topics: data-driven supply chain management [1–4], data-driven process scheduling [5–8], data-driven healthcare operations management [9–11], and other data-driven operations management problems [12–15]. In the following, we formally introduce related works in detail.

Data-driven supply chain management

There are four papers that addressed the data-driven supply chain management.

In the first paper, “Dynamic sourcing strategies for supply disruptions under consumer stockpiling” [1], the authors studied a make-to-order system under random supply failure. They considered the contingent sourcing strategy for the manufacturer to cope with the disruption. Specifically, they first discussed the optimal post-disruption stockpiling decision for customers by considering three types of stockpiling behavior are analytically provided for the customers: non-stockpiling, gradual stockpiling, and instantaneous stockpiling. They then developed a model to find the joint decision of contingent sourcing time and quantity to maximize the profit expectation. Through numerical analysis, specific managerial suggestions on how to adapt dynamic contingent sourcing strategies to alleviate different disruptions under different market environments and customer behaviors were derived.

In the presence of transportation disruptions, which will lead to uncontrollable delivery lead time, the authors in the second paper, “Strategic rationing and freshness keeping of perishable products under transportation disruptions and demand learning” [2], studied strategic rationing and freshness keeping of perishable products. To answer whether it is always optimal to satisfy those customers who are willing to purchase during disruption, the authors first presented the dynamics of post-disruption inventory and demand which takes into account the demand learning effect facilitated from negative word-of-mouth during disruption and the demand

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recovery after disruption ends, and then developed a model to achieve the optimal selling strategy for maximizing post-disruption profit which identifies the joint decision of the rationing period and freshness-keeping effort. The numerical results demonstrate that the developed three types of selling strategies are visualized to hedge the interruption of different lengths.

In the third paper, “DP-TABU: an algorithm to solve single-depot multi-line vehicle scheduling problem” [3], the authors considered the multi-line scheduling problem of single depot to unified dispatch of vehicles to execute the schedule of multiple routes with the objective of reducing the resources of public vehicles. They developed a DP-TABU algorithm to solve the problem, and applied this algorithm to the three lines S105, S107, and S159 of Zhengzhou Public Transport Corporation. The results showed that the algorithm is effective by comparing with manual scheduling and simulated annealing algorithm.

Considering the uncertainty of order ready time and customer satisfaction level, the authors in the fourth paper, “Hybrid evolutionary optimization for takeaway order selection and delivery path planning utilizing habit data” [4] studied an integrated order selection and delivery problem for deliverymen. They estimated the uncertain order ready time and customer satisfaction level based on historical habit data of stores and customers using a machine learning approach, and devised a hybrid evolutionary algorithm combining water wave optimization metaheuristic and tabu search to solve the problem. Experimental results on real food delivery application data demonstrated the superiority of the proposed algorithm compared to a set of popular metaheuristic optimization algorithms.

Data-driven process scheduling

There are four papers that concentrated on the data-driven supply chain management.

In the first paper, “An enhanced group teaching optimization algorithm for multi-product disassembly line balancing problems” [5], the authors investigated a stochastic multi-product disassembly line balancing problem with maximal disassembly profit while meeting disassembly time requirements to achieve the global optimization of disassembling multiple products simultaneously. They fitted the past collected data into stochastic distributions of parameters by applying big data technology, developed a chance-constrained programming model, and presented an enhanced group teaching optimization algorithm incorporating a stochastic simulation method to solve the model. Results of the real-life case study showed the excellent performance of the designed method in solving the considered problem.

In the second paper, “EHEFT-R: multi-objective task scheduling scheme in cloud computing” [6], the authors studied a multi-objective task scheduling scheme in cloud computing with the objective of simultaneously optimizing the task execution efficiency, quality of service and energy consumption, and developed an enhanced heterogeneous earliest finish time algorithm based on rule to solve the problem. They generated initial solutions by using prioritized rules, and improved the solutions by using the developed algorithm. Results of simulation experiments verified the effectiveness and superiority of the developed method.

In the third paper, “Storage assignment optimization for fishbone robotic mobile fulfillment systems” [7], the authors proposed a storage assignment optimization model for Fishbone Robotic Mobile Fulfillment Systems with the objectives of maximizing operation efficiency and balancing aisle workload. They developed an Adaptive Genetic Algorithm (AGA) to solve the proposed model, and designed a variety of scenarios with different task sizes and storage cells to verify the effectiveness of the developed AGA. The results showed that AGA outperforms other four well known algorithms, and that the proposed storage assignment model can efficiently reduce goods movement and travel distance and improve the order picking efficiency.

Considering uncertain processing times and urgent orders, the authors in the fourth, “Dynamic scheduling for semiconductor manufacturing systems with uncertainties using convolutional neural networks and reinforcement learning” [8], addressed integrated release control and production scheduling problems, and proposed a convolutional neural network and asynchronous advanced actor critic-based method (CNN-A3C), where actor-critic networks are trained to predict the evaluation of scheduling decisions and to output the optimal scheduling decision in the training phase, and the most appropriate release control and scheduling decisions are periodically generated according to the current production status based on the networks in the deployment phase. The experimental results showed that the proposed method outperforms the unimproved A3C-based method and the common dispatching rules under the new uncertain scenarios.

Data-driven healthcare operations management

There are three papers that focused on the data-driven healthcare operations management. In the first paper, “Nursing rescheduling problem with multiple rescheduling methods under uncertainty” [9], the authors developed a stochastic programming model and a distributionally robust model for the nurse rescheduling problem with uncertain demands. They conducted a study on three joint hospitals in Chengdu, Chongzhou, and Guanghan, Sichuan Province to illustrate the applicability and validity of the proposed model. The

results showed that the stochastic programming model and the distributionally robust model achieve cost saving by up to 78.71% and 38.92%, respectively.

In the second paper, “Optimal scheduling in cloud health-care system using Q-learning algorithm” [10], the authors studied a resource scheduling problem with multi-stations queueing network in CHS, and developed a Markov decision model to optimize the match process of patients and scarce resources. The objective is to minimize the total medical costs consisting of three conflicting sub-costs, i.e., medical costs, waiting-time costs and the penalty costs caused by unmuting choice behavior of patients. They designed a three-stage dynamic scheduling method incorporating with an improved Q-learning algorithm to solve the proposed mode, and the numerical results showed that the developed algorithm significantly outperforms two traditional scheduling algorithms, which can efficiently balance the three conflicting objectives.

To accurately predict the survival status of cancer patients, the authors in the third paper, “A two-stage stacked-based heterogeneous ensemble learning for cancer survival prediction” [11], developed a two-stage stacked-based heterogeneous ensemble learning for cancer survival prediction. Specifically, a priori knowledge- and stability-based feature selection (PKSFS) method was introduced to obtain the optimal feature subsets from the high-dimensional cancer datasets to guide the subsequent model construction, and then a novel two-stage heterogeneous stacked ensemble learning model (BQAXR) was devised to generate five high-quality heterogeneous learners, and integrate them in two stages through the stacked generalization strategy based on optimal feature subsets. Extensive numerical experiments on the real survival datasets of gastric cancer and skin cancer from the Surveillance, Epidemiology, and End Results (SEER) database of the National Cancer Institute, showed that PKSFS has marked advantages over popular feature selection methods in processing high-dimensional datasets, and that the BQAXR is superior to some mainstream machine learning methods.

Other data-driven operations management problems

There are four papers that studied other data-driven operations management problems, such as resource allocation, revenue management, and so on.

In the first paper, “Robust programming for basin-level water allocation with uncertain water availability and policy-driven scenario analysis” [12], the authors developed a robust water life cycle model to reduce the risks of inappropriate estimations of water availability within a river basin, and conducted a policy-driven scenario analysis to provide managerial implications in terms of ongoing water-saving policies. The results on case study of Min-Tuo River basin

showed that equity is a necessity when considering the water allocation in a river basin, which enables a more sustainable mode of local water use, and that local citizens’ willingness to follow the policies is key to relieve the water pressure.

In the second paper, “Portfolio optimization model with uncertain returns based on prospect theory” [13], the authors developed an uncertain revenue portfolio optimization model from the perspective of expected utility maximization based on the prospect theory. Considering the complex non-smooth and nonconcave characteristics of the model, they devised an improved grey Wolf optimization (GWO) algorithm. The numerical results showed that the developed algorithm outperforms the particle swarm optimization algorithm and genetic algorithm, and is suitable for processing similar non-concave and non-smooth complex models.

In the third paper, “Using context-dependent DEA to analyze the efficiency of highly funded scientists in China” [14], the authors sought to measure the efficiency in using the research funding resources of highly funded scientists based on DEA. They collected a dataset which contains research funding and other information from 345 highly funded scientists in Mainland China, and used the dataset to measure the efficiency of highly funded scientists based on the data envelopment analysis. The results showed that highly funded scientists have relatively high efficiency in three kinds of projects, such as the Major Research Plan, and that the career length and career start year have a limited impact on the highly funded scientists.

In the fourth paper, “A metaheuristic-based framework for index-tracking with practical constraints” [15], the authors introduced a framework with a joint approach based on metaheuristics to solve the comprehensive index tracking problem, which involves the sparsity, weights, assets under management (AUM), transaction fees, the full share restriction, and investment risk diversification. The developed framework enabled the constructed model to fit future data and facilitated the application of various metaheuristics, which were verified by the numerical experiments.

Conclusion

We would like to take this opportunity to thank all the authors who sent their papers for consideration in this special issue, and all the referees for their valuable time and effort in the reviewing process. We are also very grateful to all the editors, for their strong encouragement and support to publish this special issue.

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References

- Li S, He Y, Salling M (2021) Strategic rationing and freshness keeping of perishable products under transportation disruptions and demand learning. *Complex Intell Syst.* <https://doi.org/10.1007/s40747-021-00492-w>
- Li S, He Y, Zhou L (2021) Dynamic sourcing strategies for supply disruptions under consumer stockpiling. *Complex Intell Syst.* <https://doi.org/10.1007/s40747-021-00520-9>
- Li Y, Wang H, Wang N, Zhang T (2022) Optimal scheduling in cloud healthcare system using Q-learning algorithm. *Complex Intell Syst.* <https://doi.org/10.1007/s40747-022-00776-9>
- Li Y, Zhou B, Tan Y (2021) Portfolio optimization model with uncertain returns based on prospect theory. *Complex Intell Syst.* <https://doi.org/10.1007/s40747-021-00493-9>
- Liang P, Fu Y, Gao K, Sun H (2021) An enhanced group teaching optimization algorithm for multi-product disassembly line balancing problems. *Complex Intell Syst.* <https://doi.org/10.1007/s40747-021-00478-8>
- Liu J, Qiao F, Zou M, Zinn J, Ma Y, Vogel-Heuser B (2022) Dynamic scheduling for semiconductor manufacturing systems with uncertainties using convolutional neural networks and reinforcement learning. *Complex Intell Syst* (**Accepted**)
- Long Z, Wen X, Lan M, Yang Y (2021) Nursing rescheduling problem with multiple rescheduling methods under uncertainty. *Complex Intell Syst.* <https://doi.org/10.1007/s40747-021-00554-z>
- Wang Y, Man R, Zhao W, Zhang H, Zhao H (2022) Storage assignment optimization for fishbone robotic mobile fulfillment systems. *Complex Intell Syst.* <https://doi.org/10.1007/s40747-021-00597-2>
- Xiang K, Liang H, Guo Z, Dong Y (2021) Using context-dependent DEA to analyze the efficiency of highly funded scientists in China. *Complex Intell Syst.* <https://doi.org/10.1007/s40747-021-00481-z>
- Yan F, Feng Y (2022) A two-stage stacked-based heterogeneous ensemble learning for cancer survival prediction. *Complex Intell Syst.* <https://doi.org/10.1007/s40747-022-00791-w>
- Yao L, Su Z, Hou S (2021) Robust programming for basin-level water allocation with uncertain water availability and policy-driven scenario analysis. *Complex Intell Syst.* <https://doi.org/10.1007/s40747-021-00415-9>
- Yuen M-C, Ng S-C, Leung M-F, Che H (2021) A metaheuristic-based framework for index-tracking with practical constraints. *Complex Intell Syst.* <https://doi.org/10.1007/s40747-021-00605-5>
- Zhang H, Wu Y, Sun Z (2021) EHEFT-R: multi-objective task scheduling scheme in cloud computing. *Complex Intell Syst.* <https://doi.org/10.1007/s40747-021-00479-7>
- Zhao X, Sun H, Li J, Li Z (2021) DP-TABU: an algorithm to solve single-depot multi-line vehicle scheduling problem. *Complex Intell Syst.* <https://doi.org/10.1007/s40747-021-00443-5>
- Zhang M, Wu J, Wu X, Zheng Y (2021) Hybrid evolutionary optimization for takeaway order selection and delivery path planning utilizing habit data. *Complex Intell Syst.* <https://doi.org/10.1007/s40747-021-00410-0>

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