Mathematical Biosciences and Engineering

MBE, 19(9): 9291–9294.
DOI: 10.3934/mbe.2022431
Received: 22 June 2022
Revised: 22 June 2022
Accepted: 22 June 2022
Published: 23 June 2022

http://www.aimspress.com/journal/MBE

Preface

Special Issue: Mathematical Problems in Production Research

Guest editors: Daniel Alejandro Rossit[1], Fernando Tohmé[2], Máximo Méndez-Babey[3], Mariano Frutos[4], Diego Broz[5] and Diego Gabriel Rossit[1]

[1] Department of Engineering, Universidad Nacional del Sur, Argentina and INMABB, CONICET, Argentina
[2] Department of Economics, Universidad Nacional del Sur, Argentina and INMABB, CONICET, Argentina
[3] Universidad de Las Palmas de Gran Canaria (ULPGC), Instituto Universitario SIANI, Spain
[4] Department of Engineering, Universidad Nacional del Sur, Argentina and IIESS, CONICET, Argentina
[5] Faculty of Forestry, Universidad Nacional de Misiones, Argentina and CONICET, Argentina

* **Correspondence:** Email: daniel.rossit@uns.edu.ar, ftohme@criba.edu.ar, maximo.mendez@ulpgc.es, mfrutos@uns.edu.ar, diego.broz@fcf.unam.edu.ar, diego.rossit@uns.edu.ar.

The special issue webpage is avaiable at: http://www.aimspress.com/mbe/article/5799/special-articles.

Production Research has contributed substantially to improve current social life, giving guidelines for the efficient provision of goods, services and food. Production processes encompass a number of procedures at different stages, giving rise to a large number of problems, that can be naturally addressed using engineering and mathematics tools. These problems arise in different contexts, involving the supply chain, human resources management, prices, planning, etc.

The contributions to this Special Issue present different advances and developments in the field of production research grounded on sound mathematical approaches. This Special Issue is an outlet for contributions presented at the ICPR-Americas 2020 international conference, which took place in December 2020 in virtual form, hosted by the Universidad Nacional del Sur in Bahía Blanca, Argentina. During that conference, more than 200 articles were presented by authors from all over the Americas as well as from other regions of the world. A selected number of the papers presented at ICPR-Americas 2020 have been included in this Special Issue. Other members of the scientific community have also contributed to this Special Issue by submitting their papers. All the articles published here have been evaluated accordingly to the high standards of this journal by renowned experts in the field.

These articles address a wide spectrum of problems associated with production, including some arising in production planning, personnel management, logistical or energy problems and recycling, among others. The common features of all of them is the emphasis on decision-making processes and on finding optimal or efficient solutions to the aforementioned problems by using mathematical programming and evolutionary computing, among other approaches.

This Special Issue contains 11 articles. *Evolutionary game analysis on the recycling strategy of household medical device enterprises under government dynamic rewards and punishments* (Authored by Z. Liu et al.) [1], addresses the recycling of domestic medical devices, with the aim of reducing the environmental impact generated by discarded devices. To do this, the authors develop an evolutionary game model between the government and domestic medical device companies based on dynamic punishment and dynamic subsidy measures adopted by the government. Different strategies and choices that the government can adopt to establish the balance point in such a way as to favor recycling are studied.

In *Routing in waste collection: A simulated annealing algorithm for an Argentinean case study* (Authored by D. G. Rossit et al.) [2], a simulated annealing algorithm is proposed to address the problem of designing the routes of waste collection vehicles. The proposed algorithm is compared to a commercial solver based on a mixed-integer programming formulation and two other metaheuristic algorithms, i.e., a state-of-the-art large neighborhood search and a genetic algorithm. The evaluation is carried out on both a well-known benchmark from the literature and real instances of the Argentinean city of Bahía Blanca. The proposed algorithm was able to solve all the instances, having a performance similar to the large neighborhood procedure, while the genetic algorithm showed the worst results. The simulated annealing algorithm was also able to improve the solutions of the solver in many instances of the real dataset.

Scheduling deferrable electric appliances in smart homes: a bi-objective stochastic optimization approach (Authored by D. Rossit et al.) [3], presents an optimization model to schedule deferrable appliances in households, which simultaneously optimize two conflicting objectives: the minimization of the cost of electricity bill and the maximization of users' satisfaction with the consumed energy. Since users' satisfaction is based on human preferences, it is subjected to a great variability and, thus, stochastic resolution methods have to be applied to solve the proposed model. Two different algorithms are proposed: a simulation-optimization approach and a greedy heuristic. Both methods are evaluated over problem instances based on real-world data, accounting for different household types. The obtained results show the competitiveness of the proposed approach, which are able to compute different compromising solutions accounting for the trade-off between these two conflicting optimization criteria in reasonable computing times.

A two-stage stochastic optimization model for the retail multiskilled personnel scheduling problem: a k-chaining policy with $k \geq 2$ (authored by Y. A. Mercado et al.) [4], addresses a problem of sizing the human resources staff necessary to meet the needs of a service. These human resources can be multiskilled or not, and their use is planned in order to maximize the level of service provided. To do this, a deterministic linear integer mixed model is first developed, and then, different stochastic versions of it are proposed. In this way, different scenarios are analyzed, allowing dimensioning the amount of multiskilled human resources that are required for achieving certain service level respecting the reliability demanded.

Evaluation of different strategic planning approaches in a forest plantation in the North of Misiones Province, Argentina (authored by D. Broz et al.) [5], presents a forest planning problem. To

solve this problem, two approaches to forest plantation planning based on Model type I are proposed. In the first one, the aim is to regulate production and, in the second, to maximize economic benefit. The proposed models give satisfactory results and allow different forest management scenarios to be explored efficiently. This approach shows the importance of addressing forest planning problems through optimizing models.

Objective space division-based hybrid evolutionary algorithm for handing overlapping solutions in combinatorial problems (authored by B. González et al.) [6] presents a hybrid MOEA for handling overlapping solutions that combines the classic NSGA-II with a strategy based on objective space division using the nadir solution and which is calculated in each generation of the algorithm. The presence of overlapping solutions reduces the exploration capacity of MOEAs, preventing them from having a good diversity in their population. A study on 0-1 MOKP-2.500 shows that the proposed method offers very good performance when compared to the classic NSGA-II, MOEA/D and Global WASF-GA algorithms.

D-optimal design of the additive mixture model with multi-response (authored by Z. Gong et al.) [7] studies problems of mixture experiments where the answers can be varied. In particular, a D-optimal methodology is designed, which allows to ensure levels of reliability of the results of the experiments according to the specified conditions.

Multiskilled personnel assignment problem under uncertain demand: A benchmarking analysis (authored by C. A. Henao et al.) [8], addresses a new multiskilled personnel management problem, but in this case, studying the training needs of the personnel and their associated costs. Again, the approach used by the authors is stochastic programming, and they develop the models that allow them to minimize the costs in the increase of personnel and their training.

Due date assignment scheduling with positional-dependent weights and proportional setup times (authored by X. Wang et al.) [9], studies of a production scheduling problem. Namely, a single-machine problem aimed at minimizing the sum of the weighted lateness of the jobs. The authors carry out a theoretical approach to the problem and find particular properties, which they then exploit in an algorithm that solves the problem in polynomial time.

Order batching and order picking with 3D positioning of the articles: solution through a hybrid evolutionary algorithm (authored by F. M. Miguelet al.) [10], addresses simultaneously the order batching (OBP) and the order picking (OPP) problems. The problem involves deciding how articles must be picked-out from a depot and taken to an area in which they must be consolidated in packages to satisfy the orders placed by the customers of a firm. The issue is to determine the optimal sequence of visits to storage site. The paper presents a model and a hybrid evolutionary algorithm to solve 3D placement instances of the joint OBP/OPP.

Finally, *Measuring the mobility impact on the COVID-19 pandemic* (authored by T. C. C. Nepomuceno, T. V. Garcez et al.) [11], develops a multicriteria approach to select the best model to predict the aggregate dynamic impact of mobility on each socioeconomic category depending on the levels of COVID-19. This makes possible to estimate the time interval between contagion and the disclosure of data for decision-making by public authorities. This study is based on data gathered at Brazil.

References

1. Z. Liu, L. Lang, L. Li, Y. Zhao, L. Shi, Evolutionary game analysis on the recycling strategy of household medical device enterprises under government dynamic rewards and punishments, *Math. Biosci. Eng.*, **18** (2021), 6434–6451. https://doi.org/10.3934/mbe.2021320
2. D. G. Rossit, A. A. Toncovich, M. Fermani, Routing in waste collection: A simulated annealing algorithm for an Argentinean case study, *Math. Biosci. Eng.*, **18** (2021), 9579–9605. https://doi.org/10.3934/mbe.2021470
3. D. G. Rossit, S. Nesmachnow, J. Toutouh, F. Luna, Scheduling deferrable electric appliances in smart homes: a bi-objective stochastic optimization approach, *Math. Biosci. Eng.*, **19** (2021), 34–65. https://doi.org/10.3934/mbe.2022002
4. Y. A. Mercado, C. A. Henao, V. I. González, A two-stage stochastic optimization model for the retail multiskilled personnel scheduling problem: a k-chaining policy with k $\geqslant$ 2, *Math. Biosci. Eng.*, **19** (2021), 892–917. https://doi.org/10.3934/mbe.2022041
5. D. Broz, M. López, E. Sanzovo, J. Arce, H. Reis, Evaluation of different strategic planning approaches in a forest plantation in the North of Misiones Province, Argentina, *Math. Biosci. Eng.*, **19** (2021), 918–935. https://doi.org/10.3934/mbe.2022042
6. B. González, D. A. Rossit, M. Méndez, M. Frutos, Objective space division-based hybrid evolutionary algorithm for handing overlapping solutions in combinatorial problems, *Math. Biosci. Eng.*, **19** (2021), 3369–3401. https://doi.org/10.3934/mbe.2022156
7. Z. Gong, X. Zhu, C. Zhang, D-optimal design of the additive mixture model with multi-response, *Math. Biosci. Eng.*, **19** (2021), 4737–4748. https://doi.org/10.3934/mbe.2022221
8. C. A. Henao, A. Batista, A. F. Porto, V. I. González, Multiskilled personnel assignment problem under uncertain demand: A benchmarking analysis, *Math. Biosci. Eng.*, **19** (2021), 4946–4975. https://doi.org/10.3934/mbe.2022232
9. X. Wang, W. Liu, L. Li, P. Zhao, R. Zhang, Due date assignment scheduling with positional-dependent weights and proportional setup times, *Math. Biosci. Eng.*, **19** (2021), 5104–5119. https://doi.org/10.3934/mbe.2022238
10. F. M. Miguel, M. Frutos, M. Méndez, F. Tohmé, Order batching and order picking with 3D positioning of the articles: solution through a hybrid evolutionary algorithm, *Math. Biosci. Eng.*, **19** (2021), 5546–5563. https://doi.org/10.3934/mbe.2022259
11. T. C. C. Nepomuceno, T. V. Garcez, L. C. e Silva, A. P. Coutinho, Measuring the mobility impact on the COVID-19 pandemic, *Math. Biosci. Eng.*, **19** (2021), 7032–7054. https://doi.org/10.3934/mbe.2022332