Optimal Cooking Scheduling in Mass Cooking Facilities Considering Hygiene and Operational Constraints

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Abstract

  Mass cooking facilities, such as school lunch centers and central kitchens, must prepare hundreds to thousands of meals within a limited time. Recently, these workplaces have faced a severe labor shortage. As a result, it has become difficult to maintain efficient and hygienic operations with a limited number of staffs. To solve this problem, it is essential to create a cooking schedule that optimizes worker allocation, task order, and time distribution. In mass cooking facilities, sanitation control based on HACCP is mandatory. HACCP-based control requires the prevention of food contamination. It also requires the management of work areas in accordance with hygiene standards. Manual preparation of a schedule that satisfies these hygiene requirements requires expertise and time. The aim of this study is to propose an optimization model that automatically creates cooking schedules satisfying hygiene requirements and achieve efficient operations. The model considers task precedence, staff working hours, and minimization of sanitation risks caused by worker movement. The scheduling problem is modeled as a combinatorial optimization problem. The objective function of the problem is the weighted sum of makespan and task start times. An exact optimal solution of the problem is obtained using a mathematical optimization solver. Numerical experiments are conducted using real data provided by a contract food service cooperation in Japan. The results show the proposed method shortens schedule creation time in comparison with manual creation. An expert of schedule creation in the company evaluated the schedules created by the proposed method as comparable to those created manually.

Keywords
Mass Cooking Facilities, Cooking Scheduling, Combinatorial Optimization, Exact Solution Method, HACCP.

Biographies
Yuki Ozaki is with the Department of Industrial Engineering and Management, Graduate School of Engineering, Kanagawa University. His research focuses on the automatic generation of work schedules in large-scale cooking facilities using mathematical optimization. He entered Kanagawa University in 2021 and joined the Management Systems and Engineering Laboratory. After receiving his undergraduate degree in Industrial Engineering and Management in 2025, he continued his studies at the Graduate School of Engineering, Kanagawa University. He

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Hideki Katagiri is a Professor of Department of Industrial Engineering and Management at Kanagawa University, Japan. He earned his B.E., M.E. and Ph.D. in Engineering at Osaka University in 1995, 1997 and 2000, respectively. He was the Chair of IEEE SMC Hiroshima Section Chapter (2008-2010) and a Visiting Scholar at the University of Chicago Booth School of Business (2014-2015). He was a Visiting Professor of Hiroshima University (2016-2020). His research and teaching activities are in the areas of operations research and soft computing, especially, multi-objective optimization under uncertainty and data analysis using machine learning techniques. He is the author or co-author of more than 100 refereed journal papers and several co-authored or co-edited books in English.