Multi-Mode Robust Appointment Scheduling for Uncertain Service Time and Random No-Show Using Min-Max Optimization

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Abstract

The appointment scheduling issue has been widely used in a variety of service industries, including healthcare, finance, and legal advice. Uncertainty of processing time and job no-shows make the problem more challenging. Most of the current literature makes unrealistic assumptions about real-world scenarios, such as constant service time, and they use a vast quantity of data to view the service time distribution or failure to account for work no-shows. In this research project, a robust appointment scheduling model is developed to generate appointment dates for a multi-mode system while considering customer no-shows and uncertain service times. The objective is to minimize the total expected cost of the job waiting time and service provider's idling and overtime for the worst-case scenario under any realization of the processing time of the jobs. The advantage of the suggested methodology is that distributional data about the uncertain service time are not required. Only the extreme boundaries of the uncertain parameters need to be accounted for. Thus, this approach can be employed irrespective of the stochastic nature of the variables being addressed. Mathematical programming is used to solve the model. Test cases are utilized to quantify the impact of the problem parameters on the end of the day, the job waiting time, server idle time, and total overall cost.

Keywords
Robust Optimization, Max-Min Optimization, Appointment Scheduling, Multi-mode Model.

Biographies
Anik Chandra Dash is a master's student in the department of Industrial Engineering at the University of Windsor. He received his B.Sc. degree in Industrial and Production Engineering from Shahjalal University of Science and Technology, Bangladesh, in December 2018. His current research areas are operation research and healthcare system. Before joining the University of Windsor, he worked as an Industrial Engineer and Production Planner in the apparel Industry in Bangladesh.

Dr. Hany Osman received the Ph.D. degree in Industrial Engineering from Concordia University, Montréal, QC, Canada. He is an Assistant Professor at the Systems Engineering Department, College of Computer Sciences and Engineering, King Fahd University of Petroleum and Minerals, KSA. His research interests include data mining, operations research, and operations management. Specifically, his research focuses on investigating problems related to production scheduling, inventory control, transfer line balancing, knowledge extraction from datasets and application of data mining in systems engineering. He has developed efficient algorithms by using mathematical programming, decomposition techniques, and nature-inspired metaheuristics.

Dr. Ahmed Azab, PEng., received his bachelor's and master's from the University of Cairo in Production Engineering; he earned his doctorate in Industrial & Manufacturing Systems Engineering from the University of Windsor. He is the Director of the Production & Operations Management Research (POM) Lab and a Professor in the Department of Mechanical, Automotive, and Materials Engineering. Dr. Azab is an adjunct professor at Nile University, Egypt. He has been a recipient and nominee for international and national research awards. Dr. Azab's research has been sponsored by National and Provincial granting agencies and direct industrial research funds. Dr. Azab is an editor for Expert Systems with Applications— an established journal ranked 8th /87 in Operations Research & Management Science (Q1). He sits on the editorial board for another two journals and is a reviewer for a number of top journals. He has been chairing a symposium on Competitive Manufacturing at the annual ASME Manufacturing Science and Engineering Conference (MSEC) for the past five years. His scholarly h-index is currently 20. He is a registered Professional Engineer in the province of Ontario.

Dr. Fazle Baki is Co-Director Director of the Production & Operations Management Research Lab at the University of Windsor. He joined the Odette School of Business in the year 2000. He is cross appointed with the Department of Industrial and Manufacturing Systems Engineering since 2003. He was involved with an industrial research project in Daimler Chrysler as a Summer Professor Intern in 2004 and 2005. Previously, he served the Institute of Business Administration, University Dhaka, Bangladesh from 1992 to 1993. His research interest is to carefully look into systems and processes and find some improvement opportunities with the development of new and improved algorithms. The improvement may be found in the requirement of resources such as capital assets, human resources, time requirement, etc. The improvement may also be found in the quality of service delivered. The systems and processes he look into are usually large and complicated as the optimization problems may often be classified as "NP-hard." Finding a good and efficient algorithmss for such problems is generally difficult. However, a mathematically rigorous investigation into the variables, parameters, constraints and objectives may provide some models and algorithms, which are acceptable to the contemporary researchers and practitioners. The algorithms he develops are usually based on mixed integer linear programming, dynamic programming, goal programming, and metaheuristic methods. In the past, he published papers on manufacturing, scheduling and traveling salesman problem. Recently, he is working in the areas of inventory management and healthcare.