Abstracts of Papers in English

PARETO SIMULATED ANNEALING FOR BALANCING THE MULTI-OBJECTIVE ASSEMBLY LINE TYPE II PROBLEM WITH SEQUENCE-DEPENDENT SETUP TIMES BETWEEN TASKS

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Abstract

Line balancing is a fundamental concept for continuous production systems. Assembly lines are present in different industrial environments and usually have a great economic impact because of their high manpower levels. A simplified view of the assembly line balancing problem (ALBP) is defined as the grouping of the tasks required to assemble the final product to the workstations conforming to the assembly line, which specifies the permissible orderings of the tasks. The main goal of the assembly line balancing problem is to assign the tasks to workstations such that the precedence relations are satisfied and some performance measure is optimized. The ALBPs are classified into two groups: simple assembly line balancing problems (SALBPs), which bear numerous simplifying assumptions, and general assembly line balancing problems (GALBPs), which are closer to reality due to the consideration of one or more realistic

conditions, like sequence-dependent setups.
In this paper, we consider the problem of optimizing simultaneously the objectives of minimizing cycle time and minimizing the overall setups in a general assembly line balancing environment with the consideration of sequence-dependent setup times between tasks. The first objective, which is referred to as the type II problem, generally occurs when the organization wants to produce the optimum number of items using a fixed number of workstations without adding new machines. The minimization of the overall setup times is important mostly for the cases when setups impose maintenance costs on tools and the prolongation of setup times would increase maintenance costs and also bring more exhaustion to workers.
This paper is intended to introduce the objective of minimizing overall setups in the class of assembly line balancing problems and solve the problem of concurrently minimizing cycle time and the overall setups. The exact method was not efficient enough to solve the innovative problem with type II problem assumptions; thus, a Pareto simulated annealing (PSA) algorithm is developed to solve such an Np-hard problem and several quantitative metrics are defined for evaluating the proposed algorithm. Computational results verified the considerable efficiency of the PSA algorithm.

Key Words: Assembly line balancing, sequence- dependent setup times, pareto simulated annealing, scheduling.

AN INTEGRATED RELIEF NETWORK DESIGN MODEL FOR LOGISTICS PLANNING UNDER UNCERTAINTY

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Abstract
Locating facilities in candidate nodes and allocating relief items to these facilities for emergency response before a disaster occurs, is a common approach to increasing the effectiveness of relief logistics. In this study, humanitarian logistics networks and network restoration are presented in the form of an integrated network, so that the damaged routes are repaired by crews using restoration equipment to distribute relief items. In this paper, a two-stage stochastic programming model is proposed in order to locate relief facilities and restoration equipment and distribute relief items to demand nodes as soon as possible.
The objective function minimizes the social costs of the problem such as deprivation cost (i.e., the cost imposed on survivors by the lack of access to critical supplies) and logistics costs under each scenario. Also, the flow of trucks carrying relief items and repair equipment on the routes is specified. In order to adapt the model to the real world, according to the nature of the effective parameters of the model, two types of structural and functional uncertainties have been considered. The first source is that some uncertain parameters may be based on future scenarios which are considered according to the probability of their occurrence. The second source is that the values of these parameters in each scenario are usually imprecise and can be specified by possibility distributions. In this regard, a robust fuzzy stochastic programming approach has been used to solve the model. Possibility theory is used to choose a solution to such a problem and a robust fuzzy stochastic programming approach is proposed that has significant advantages. The proposed model has been implemented for a case study of 39 districts of Istanbul and the computational results show the effective efficiency of this model in reducing the social costs of the humanitarian logistics problem.

Key Words: Humanitarian logistics, relief distribution and restoration networks, social costs, hybrid uncertainty.

MODELING OF THE EFFECT OF FINANCIAL INCENTIVES ON THE PENETRATION OF RESIDENTIAL SOLAR POWER USING SYSTEM DYNAMICS: EVIDENCE FROM IRAN

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Abstract

Environmentally friendly countries, although often with high potential for solar power generation, have made insignificant progress in this area, mainly due to the inefficiency of prospecting policies, access to fossil fuels with low prices, and a lack of prioritization. Environmental issues and the immaturity of related technologies and infrastructures (given that Iran also has a high source of solar energy among these countries), make Iran perform poorly in its exploitation. Therefore, in order to achieve high capacity of solar systems in the residential sector, considering subsidies by the government along with protection tariff policy can lead consumers to desire to use more of these systems and installed capacity. It can increase them significantly and have a significant effect on reducing carbon dioxide emissions. Increasing global energy demand, limited fossil fuel resources, and growing prices in recent decades, and some issues such as pollution and global warming, have led to the use of alternative energy sources, including solar energy. Least Environmentally Friendly Countries (LEFC) in contrast to their high potential for solar power generation, have made little progress, primarily due to inefficiencies in existing policies, access to low-cost fossil fuels, and environmental concerns and lack of prioritization. In this study, supportive and incentive policies for the dissemination of this technology in the intended countries were examined, and policies and measures that could be useful for Least Environmentally Friendly countries (LEFC) were evaluated and analyzed using this case study. In this regard, a system dynamics methodology was used to examine the effect of the proposed policies and actions using two subsystems of power consumption and the use of photovoltaic equipment in the residential sector through four scenarios. The results showed that although the Business As Usual (BAU) scenario is less government spending, the average cost of reducing carbon dioxide (CO_2) emissions is high and the installed capacity is much lower than the combined scenarios of feed-in tariffs and capital subsidies. However, the hybrid scenario may reduce government costs and net electricity consumption compared to other scenarios, and the amount of accumulated capacity in addition to an increase in carbon dioxide (CO_2) emissions reduction.

Key Words: Financial incentives policy, solar PV, system dynamics, iran, policy making.

DESIGNING A COORDINATING CONTRACT BASED ON TRADE CREDIT FINANCING FOR A MULTI-PRODUCT MULTI-SUPPLIER SUPPLY CHAIN UNDER FINANCIAL CONSTRAINTS

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Abstract

This study aims to solve the operational disruptions caused by some financial problems of supply chain members. Supply chain coordination is extensively used to enhance the performance and profitability of the supply chain members and the whole system. Coordination can be achieved by some techniques that persuade the members of a decentralized supply chain to participate in the supply chain optimization plan. Financial problems such as lack of liquidity, high cost of debt, limited financing capacity, and so on, can negatively impact the operational activities of a firm. In the context of the supply chain, these disruptive effects can spread throughout the supply chain and cause inefficiency for other members as well as the involved firm. So, supply chain coordination mechanisms can also be influenced by these financial constraints. However, few studies are analyzing the ability of classical supply chain coordination mechanisms to coordinate the supply chain in the presence of capital shortage and financing costs. The goal of this paper is to propose an efficient coordinating scheme based on the trade credit financing contract for a multi-product supply chain consisting of a capital-constrained manufacturer who faces financing limitations and multiple suppliers. The member's interactions are modeled as a Stackelberg game in the form of a bi-level optimization

problem in which the suppliers as leaders form a coalition at the upper level and the manufacturer acts as a follower at the lower level. Two scenarios are considered concerning the contract terms. In the first scenario, the manufacturer is obliged to pay the suppliers until a certain time before the end of the period. But, in the second scenario, it can extend the repayments to suppliers until the end of the period. The proposed model in both scenarios is solved by two population-based metaheuristics, Genetic Algorithm, and differential evolution. The results indicate that the trade credit contract in the first scenario is not able to coordinate the supply chain but if the manufacturer is allowed to postpone its payments until the end of the period, the proposed contract fully coordinates the supply chain.

Key Words: Supply chain coordination, financial constraints, trade credit financing, stackelberg game, metaheuristics.

THE ROBUST OPTIMIZATION OF MULTI-OBJECTIVE GREEN CLOSED LOOP SUPPLY CHAIN UNDER UNCERTAINTY (CASE STUDY: INDUSTRIAL BREAD)

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Abstract

Lack of resources, ecosystems at risk, and climate change have a great impact on the living environment. One of the most important issues and challenges that countries, including our country, face is the waste of resources. In the past decade, due to the increasing importance of economic competitiveness, legal pressures, environmental concerns in the context of old products, and social impacts, the issue of a closed-loop supply chain has attracted many researchers. Increasing the efficiency and effectiveness of supply chain activities is one of the sustainable competitive advantages for companies. Also, companies and organizations are not only aware of environmental factors but are also aware of the revenues of collecting and recycling their used products. The closed-loop supply chain is a way of considering the recycling of products to control environmental barriers. This research aims to develop a robust optimization approach for designing a supply chain network in industrial bread. A multi-objective integrated integer linear programming model is presented as a single-product, single-cycle, and multi-capacity. In this model, two economic and environmental objectives are examined under certainty and uncertainty conditions. A balance between the goals of the equilibrium is established and the model is tested in different sizes and uncertainties by using the Torabi and Hassini (TH) method. The results demonstrate that in all cases, the robust approach overcomes the deterministic approach based on the mean value of the objective function. Regarding the standard deviation, the robust approach in the problem of 6*10*10*6 with uncertainties ρ=0.2 and ρ=1, the problem of 9*15*15*9 with uncertainties ρ=0.2 and ρ=0.5, and the problem of 12*20*20*12 with uncertainties ρ=0.2, ρ=0.5 and ρ=1, extremely overcome but in other cases, the deterministic approach has better outcomes. A robust strategy model achieves higher quality and better performance than the deterministic strategy in large problems and higher uncertainty. Due to the size of the problem and the uncertainty, in most cases, the gap between these two approaches increases with respect to both coefficients of performance.

Key Words: Robust optimization, green closed-loop supply chain, uncertainty, the industrial bread.

RELIABILITY EVALUATION OF MULTI-STATE SERIES-PARALLEL SYSTEMS WITH MULTI-STATE PERFORMANCE SHARING MECHANISM

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Abstract

Reliability is the probability that a system will perform properly over a period of time under specified operating conditions. A Performance-sharing system has been proposed by researchers to increase and improve the reliability of a system. Recently, a new procedure for sharing surplus performance has been introduced. In this procedure, the surplus performance of each unit is shared with its adjacent unit. This mechanism is investigated in a simple series structure. But in reality, the system can have different components and more complex structures. Therefore, it is necessary to investigate this procedure in other structures such as series-parallel structures with different components. Classical reliability theory in the basic state is considered binary, in which a system or a component has only two possible states, that is, it either works or breaks down. However, many real-world systems have multiple operational performance levels. Therefore, the study of multi-state systems is of particular importance. The problem of transmission loss can be considered in various dimensions such as power systems, mechanical tools, etc. If transmission loss is not considered in performance-sharing systems, system reliability is overestimated. Therefore, it is important to consider the transmission loss between lines of this system. In this study, a series-parallel multi-state system with a performance-sharing mechanism is provided. In this system, the surplus performance of each subsystem is shared with adjacent subsystems through multi-state transmission lines. Due to transmission loss, the lines lose some of their performance during transmission. The mathematical model is presented for the proposed system and the universal generating function method is used to evaluate it. To solve the proposed model using a genetic algorithm, a numerical example is defined. In this example, two issues are examined.1) The effect of the performance-sharing mechanism on system reliability 2) The effect of transmission loss on system reliability. The results show an increase in reliability in the proposed system.

Key Words: Series- parallel system, performance sharing mechanism, multi-state transmission lines, transmission loss, universal generating function.

INVESTIGATING THE EFFECT OF FINANCIAL RISK ON THE PROFITABILITY AND RESILIENCE OF IRANIAN BANKS

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Abstract

One of the most important issues in the banking industry is risk issues and risk management. At the top of the financial system of any economy is the banking industry, which in developing countries has the largest role in financial intermediation, therefore one of the biggest tasks of the bank is to create a balance in correct assessment and risk management so as to create sustainable profits and value for shareholders. The purpose of this study was to investigate the effect of credit risk, liquidity risk, and capital adequacy ratio on the profitability and resilience of Iranian banks using the panel data method during the period 2016 to 2021. The statistical population of this study includes 27 banks in the country that are operating with the permission of the Central Bank. In the present study, the variables of credit risk, liquidity risk, and capital adequacy ratio are considered as independent variables while profitability and resilience are considered dependent variables, and data related to these variables are extracted from the website of the Central Bank and Iran Banking Higher Education Institute. At first, the significance of the data was investigated and the result showed that the data are significant. Also, based on the Chow and Hausman tests, the appropriate model for the problem was selected. A data normality test was also performed and the results show that all data are normal. Then, by performing the tests of error independence, heterogeneity of variance, and alignment of independent variables, the final model of the research was fitted. The results showed that credit risk did not have a significant effect on profitability but had a negative and significant effect on resilience and also liquidity risk had a significant negative effect on both profitability and resilience. Among these, the capital adequacy ratio has a positive and significant effect on profitability and a negative and significant effect on liquidity.

Key Words: Financial risk management, credit risk, liquidity risk, capital adequacy ratio, profitability, resilience.

PORT INVESTMENT MODELING BY SYSTEM DYNAMICS APPROACH (CASE STUDY: CONTAINER TERMINAL OF SHAHID RAJAEI PORT)

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Abstract

Due to the large volume of exports and imports of goods, developing the country's ports as the country's communication gateways is a need. A comparative economic study of different countries shows that sustainable development in these countries is always been accompanied by investment. This fantastic economic phenomenon has reached significant proportions in the world today. This paper aims to present a model for investing in the container terminal of ports with a system dynamics approach and examine various management policies. The proposed model considered these subsystems: growth and investment, capacity, berth, and access channels.
According to the proposed model variables, investment data in the container terminal of Shahid Rajaei port for ten years from 1388 to 1397 is entered into the model, and simulation results are presented. The variables that are evaluated are investment per unit of container, entry tariff of ships to port, container storage tariff, the tariff of transport operators in the container terminal, and depth of berth and access channel.
In order to confirm the proposed model, first, the model is approved by the software, and then some important validation tests are used, and the validity of the proposed model is confirmed. Also, to examine the sensitivity of performance variables to changes in policy parameters, policies adopted in the three areas of service quality, revenue, and the capacity of incoming ships to the port, which are: increase of investment per container unit, reduction of port service tariff and increase of berth depth, were implemented on the model in the period of 1397-1406. Finally, the selected policies in each area are implemented simultaneously. The results of the simultaneous implementation of the proposed policies are satisfactory. There is a 24% increase in the operating capacity of the container terminal, a 31% increase in equipment capacity, a 30% increase in revenue, and a 96% increase in the capacity of incoming ships. As a result, by adopting the proposed policy of this research, the performance of the container terminal of Shahid Rajaei port can improve.

Key Words: System dynamics, operating capacity, container terminal, investment, Shahid Rajaei Port.

PROGRESSIVE MEAN CONTROL CHARTS FOR PHASE II MONITORING OF MULTIVARIATE SIMPLE LINEAR PROFILES

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Abstract

In some statistical quality control applications, the process outcome is better expressed by a functional relationship among several correlated response variables and one independent variable called multivariate simple linear profile. Monitoring such profiles without taking the correlation structure among the response variables into account leads to misleading interpretations. Specifically, monitoring each profile by a separate chart increases the

probability of Type I error. With increasing customer expectations, detecting small and moderate changes has become important in today's competitive markets. In this regard, some monitoring schemes including memory-type charts, adaptive charts, and progressive mean (PM) charts have been proposed to enhance the chart sensitivity in reacting to small and moderate disturbances. In this paper, three PM based monitoring schemes including MPM_a, MPM_e and MPM_{ae} charts are developed for Phase II monitoring of multivariate simple linear profiles. Extensive simulations in terms of average run length (ARL) metric are carried out to probe the capability of the proposed charts in detecting separate and simultaneous changes in regression model parameters (intercept, slope and standard deviation). Moreover, the sensitivity of the proposed PM based charts is compared with competing ones in the literature including MEWMA, MEWMA/x^2 and MEWMA-3 schemes. The results confirm that under different correlation coefficient values, when the intercept parameter of one profile changes from its nominal value, the proposed charts work better than the competing ones. Under the mentioned shift structure, the sensitivity of all charts improves by increasing the value of correlation coefficient. Concerning the sustained shifts in slope parameter, it is observed that by increasing the correlation coefficient and shift magnitude, the MPM_a and MPM_{ae} charts perform better than the other ones. Besides, under standard deviation disturbances, the proposed charts have almost the same sensitivity to react to small and moderate changes. The results indicate that under simultaneous shifts in model parameters of both profiles, the proposed PM based schemes have better detectability than their competing ones. Finally, the applicability of the best proposed chart is illustrated using a real life example from automotive industry.

Key Words: Phase II, average run length, progressive mean, multivariate simple linear profile.

EVALUATE AND DEVELOP PUBLIC TRANSPORTATION SERVICES BASED ON FUZZY QUALITY FUNCTION DEPLOYMENT APPROACH

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Abstract

Designing appropriate services is critical to customer satisfaction and meeting the needs of stakeholders. However, in the field of public transport, despite its importance, this goal does not seem to have been achieved. Evaluating the services provided and determining customer expectations can be helpful in achieving this goal. Improving the quality of public transportation services and increasing customer satisfaction by identifying their needs and providing an appropriate solution to meet the needs of this study. Nowadays, performance appraisal is inevitable and all organizations evaluate performance to gain awareness of progress, identify challenges in the organization, and identify their weaknesses, and without it, performance improvement will not be possible. The key to achieving performance improvement is understand the customer needs and wants and using them in product / service design and delivery processes. Quality Performance Deployment (QFD) is a concept that seeks to capture the true voice of customers in the design and delivery of products / services. The present study intends to use QFD and multi-criteria decision-making process to provide a framework for better understanding of public transport system planners' customer requirements, identifying program strengths and weaknesses, and developing appropriate programs. In this research, the three-stage QFD model is used to evaluate the performance and identify the requirements of public transportation. Its stages are divided into three stages: extracting the relative importance of strategies, extracting the relative importance of criteria, and evaluating the performance of public transportation programs. In the first and second stages, using the BWM method, the cumulative relative importance of each organization strategy and the cumulative relative importance of each criterion are determined, respectively, and in the third stage, development plans to improve public transportation are ranked. The results show that the field of public transport facilities has the most weight. Also, the ranking of programs shows that investing in intercity rail transportation can greatly increase public transportation service.

Key Words: Transportation, quality function deployment, best-worst method, fuzzy system.

COORDINATING THE SUPPLY AND DISTRIBUTION OF HUMANITARIAN LOGISTICS RELIEF ITEMS UNDER THE QUANTITY AND OUTSOURCING FLEXIBILITY CONTRACT: A STOCHASTIC PROGRAMMING APPROACH

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Abstract
Growing natural disasters such as floods, earthquakes, war, and terrorist attacks have encouraged the government to plan for crisis response situations. As an important crisis management activity, the humanitarian supply chain can play a key role in saving lives, transporting victims to emergency centers, evacuating the homeless from the affected area, and meeting the needs of those in crisis. Also, considering coordination between the members of the supply chain and using suitable contracts can increase the efficiency of helping injured people. In previous research, the quantity flexibility contract (QFC) is rarely used in crisis situations. Therefore, this contract is investigated in this study. In the present study, a QFC is concluded between the internal supplier (manufacturer) and the relief organization. Quantity flexibility contract provides a kind of coordination for inventory management by determining the number of orders between the relief organization and the internal manufacturer. In this study, the purpose of signing a quantity flexibility contract between the relief organization and the supplier is not only to satisfy more demand points in the event of a disaster but also to reduce the unused items of relief items after the disaster attacks, and to create fewer shortages in the affected areas. The components of the supply chain of several products presented in this research include an internal supplier (manufacturer) and a foreign supplier, the relief organization, and the points of demand (affected areas). Due to the crisis, the demand for the affected areas has been considered inde finitely. The objectives of the model minimize total costs and time. To solve the proposed model, the augmented ε-constraint method is used. The results of the studies show that the model is more sensitive to changes in demand, which makes it more necessary for planners in this field to be more careful about the demand parameter.

Key Words: Humanitarian logistics, coordination, quantity flexibility contract, outsourcing.

A GAME-THEORETIC APPROACH FOR PRICING AND DETERMINING VIRTUAL REALITY INVESTMENT IN A DUAL-CHANNEL SUPPLY CHAIN IN THE PRESENCE OF WEBROOMING AND RETURN POLICY

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Abstract
Today online retailers all over the world are looking to offer virtual reality service through their online channels in order to attract customers to purchase product online and increase sales by creating a sense of customer confidence. Virtual reality service provides information about how a product fits a customer and closes the gap between online and offline retailers. However, such services also facilitate consumer webrooming behavior, which may reduce online demand and intensify competition between traditional and online retailers. Webrooming behavior means customers use virtual reality service in the online channel and view the specifications of the product, but they buy the product in the offline channel. On the other hand, providing virtual reality through the online channel due to the conditions of the testing products before the purchase can have a positive impact on the rate of returned products. This study aims to investigate the optimal amount of investment in virtual reality service and its impact on the rate of return, as well as the impact of webrooming behavior on pricing and competition between the two channels. To address this issue, we develop a dual-channel supply chain including an online and a traditional retailer under two

different scenarios. In the first scenario, the online retailer offers a partial refund in his channel to attract customers, but he does not provide virtual reality service. In the second scenario, the online retailer provides virtual reality service in the online channel to compete with the traditional retailer. The results show that providing virtual reality will have a positive effect on the demand of both channels and will increase retail prices on both online and offline channels. Also, providing virtual reality in the online channel causes the customers to view and test the product before buying. Therefore, the number of returned products was reduced.

Key Words: Virtual reality, webrooming, return policy, pricing, artificial intelligence, game theory.

DESIGNING FACILITIES LOCATION AND DISTRIBUTION FLOWS FOR PHARMACEUTICAL DISTRIBUTION COMPANIES: A LEGAL VIEW

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Abstract

In this paper, a mathematical model has been developed with the aim of locating branch warehouses of a pharmaceutical distribution company, taking into account the existing legal requirements regarding drug distribution. In this model, in addition to the structure of the distribution network, the optimal flow of contracted drugs at the level of the company's branches throughout the country is also determined. Due to the high complexity and high dimensions of the model in real conditions, a combined solution approach based on meta-heuristic methods has been proposed. To solve the model, at the beginning, the structure of the model was decomposed into a main problem and several sub-problems and then it was solved using a two-stage genetic algorithm. In the first stage, it solves the main problem and in the second stage, it solves sub-problems. In order to apply the balance constraints related to the connection between stages in the supply chain (input or output flow of or from each stage to others), priority-based encoding was utilized in the second level. Since in solving the model with real dimensions, due to the high dimensions of the problem in addition to its complexity, solution time is very high, the p-medoid clustering method was incorporated to aggregate supply chain customers. Finally, the tuning of algorithms was used with the popular Taguchi method. In order to validate the model, a case study using real data from Elite Daru Distribution Company has been considered. Results of the case study indicate a 23% reduction in distribution costs in optimal design as compared to existing design. Studies have also shown that we face a 7% cost in the case of restrictions imposed by law compared to the case without it. Sensitivity analysis on the number of cluster centers showed that data integration would lead to an average cost change of less than 1%.

Key Words: Facilities location, optimal distribution plan, legal enforcement, pharmaceutical distribution companies.

A NOVEL MATHEMATICAL MODEL FOR VACCINE ALLOCATION CONSIDERING GOVERNMENTAL HEALTH POLICIES AND SEIR EPIDEMIC MODEL

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Abstract

Spread of infectious disease forces the nations to cope with the effects of disease using different protocols. Vaccination is an effective tool to immunize the individuals against the epidemic. In the case of limited resources of vaccine doses, there should be an appropriate plan to allocate the vaccine properly. During the Covid-19 epidemic, the vaccination was based on age groups while the other protocols like the lockdown policy was implemented which resulted in shop closures. It should

be considered that implementing lockdown policies and consequently shop closing result in different economic and psychological impacts. Therefore, a new strategy should be designed to cope with such impacts in the similar cases. In this paper, we propose a new strategy, i.e. parallel vaccination, to minimize the social cost of infected individuals as well as economic impact of lockdown policy using SEIR epidemic model. To do so, we consider retailers and shopkeepers as a priority group in addition to the age group. We develop a bi-objective mathematical model to minimize the social cost of infected individuals and economic impact of implementing the lockdown policy. Also, differential equations of SEIR epidemic model are considered as the constraints of the model to reflect on the dynamicity of the infectious disease. Finally, we determine the required doses of vaccine that should be allocated to each priority group in order to control the epidemic using optimal control theory. An illustrative example inspired by a real case is presented to evaluate the model's performance, and its numerical result is discussed. The results show that applying the new strategy for vaccine allocation leads to reduction in the social cost of infected people and economic impact of lockdown policy simultaneously. Therefore, the policymakers should consider such strategies to control the outbreak of epidemic diseases as well as their side effects like economic and psychological effects.

Key Words: Infectious disease, SEIR epidemic model, parallel vaccination, optimal control, lockdown policy.