



# A SIMPLE AND IMPROVER ALGORITHM TO SOLVE THE ECONOMIC PRODUCTION QUANTITY MODEL WITH DISCRETE DELIVERY ORDER

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## Abstract

Inventory overhead is one of the costly elements in many organizations. With globalization trends and increase in competition, customers expect to receive their commodities quickly; therefore, inventory management has become a key factor to remain in today's competitive business. Despite extensive researches in this field, there is a significant gap between real-world problems and existing academic researches. Batch production and shipment is one of the main concerns in production systems and inventory control models. This concern stems from real world cases where the system has items manufactured in batches with a known size, for instance production of

bottle caps by cap compression molding machines and so forth. Initial efforts to use mathematical approaches in order to figure out inventory problems, begin as well as producing industries and other engineering fields. Necessity of resolving inventory problems is recognized in some industries that involve combination of producing management problems and inventory problems, in fact they have produced accumulation of items and products and cost of setup machines are quite expensive. In the beginning of the twentieth century, two of the primary mathematical inventory models called the economic order quantity and economic production quantity were presented. In this study, an effective, simple and practical algorithm is represented to solve proposed non-linear integer programming problem. The proposed model formulates an economic production quantity inventory control system consists of a company and a supplier, that receive discrete deliveries orders. In this paper, a previous published work is improved and formulated without constraints. Then, unconstrained model is solved using an improver algorithm involving four simple steps. In this paper, the previously published model is being modified with less constraints and decision variables, in order to find a better solution with less computational time using the proposed heuristic. So, numerical example of previously published paper is solved employing improver algorithm, and the better solution obtained is shown. Finally, the efficiency of this algorithm was shown many comparisons to the previously published algorithm.

**Key Words:** Economic order quantity, multiple deliveries, integer nonlinear programming, effective and improver algorithm.

## Abstract

Determining a unique goal in Goal Programming (GP) method for each objective function due to restriction of information is difficult and inefficient. To overcome this problem, a type of goal programming methods called multiple-choice goal programming has been developed, in which multiple levels introduced for each objective. In this paper, the goals are considered as alternatives, which decision-makers express their agreement or disagreement with them through interval-valued intuitive fuzzy numbers (IVIFNs). In the complex multi-attribute large-group decision making problems where attribute values are interval-valued intuitionistic fuzzy numbers, the number of decision attributes is often large and their correlation degrees are high, which increase the difficulty of decision making and thus influence the accuracy of the result. To integrate multiple opinion with a high degree of correlation and choosing a goal, a principal component analysis algorithm for interval-valued intuitive fuzzy numbers (IVIF-PCA) is applied. IVIF-PCA model represents major information of original attributes, effectively reduces the dimensions of attribute spaces, and synthesizes original attributes into several relatively independent comprehensive variables. The proposed approach has enabled to consider the opinions of decision makers with different interests in large groups and the degree of their Doubt in the model, also it can reduce the computational complexity through selecting a limited number of goals through a scientific and accurate method based on IVIF-PCA Algorithm. To evaluate the performance of the proposed mechanism, a numerical example is presented and solved. Previous approaches, in addition to their inability for considering the decision makers' doubt degree in goal definition, require to identify several variables to take into account the aspirations set by a large group of decision makers, which increase the computational complexity. In contrast, the proposed approach in addition to considering the decision makers' doubt degree in goal definition, reduce the computational complexity through IVIF-PCA Algorithm.

**Key Words:** Multi-choice goal programming, interval-valued intuitionistic fuzzy, principal component analysis, uncertainty, doubt degree.

## PRESENTING A HYBRID APPROACH TO FUZZY HOUSE OF QUALITY, SERVQUAL AND KANO ANALYSIS: PARDIS HOTEL OF RASHT

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## Abstract

The world economy is increasingly characterized as a service economy. This is primarily due to the increasing importance and share of the service sector in the economies of most developed and developing countries. In fact, the growth of the service sector has long been considered as an indicator of a country's economic progress. The hospitality industry is a broad category of fields within the service industry that due to its fundamental influence on national economy is one of the most sensitive fields to the matter of quality. Therefore, application of methods such as House Of Quality (HOQ) can be a big step forward in maximizing the customer satisfaction. Initially we investigated 31 essential customers' expectations from services of Rasht Pardis Hotel and then we prioritized these needs and carried out the Servqual and Kano analysis by sending out corresponding questionnaires to 390 customers. Afterwards, by means of house of quality, the proper acts and corrective actions to meet customers' needs is determined and prioritized. All this survey is done under rectangular fuzzy environment. The results acquired from this research can determine the priority of needs and correction actions, classify customer preferences to meet the customers' expectation at the highest possible. Results demonstrate that most important demands are respectively secure rooms, tidy and clean beds and blankets and well-designed Cafés and restaurants. Furthermore, entertainment facility for kids and 24\*7 exchange centers and medical services have respectively the biggest gap to the desired conditions. Kano analysis show that 31 customers' expectations, 4 are must-be, 22 are attractive and the other 4 are one-dimensional qualities. Also, Activities Hiring well trained staff, hiring skilled technicians, Mechanization of dishwashing, cloths washing and etc., Codification of health and sanitary principles to insure quality and Creating website for online services such as reservation are the activities that have the highest importance level.

**Key Words:** Service industry, hotel industry, quality function deployment, kano, servqual.

was conducted to study the sensitivity of savings on key parameters of the cooperative game. The result of sensitivity analysis indicates that with the increase in per unit cost of the road mode or reduction in per unit cost of the rail mode, the level of cost savings and consequently the desire to cooperation will increase.

**Key Words:** Collaborative logistics, cooperative game theory, multimodal transportation, goal programming.

## MEASURING THE EFFICIENCY OF NETWORK STRUCTURES UNDER INTERMEDIATE VARIABLES CONTROL CONDITION

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### Abstract

The traditional models of data envelopment analysis (DEA) have used only final inputs and outputs for efficiency measuring of decision making units (DMUs) in network structures, and they have considered its all operations as a black box. Hence, they are not able to determine accurately the inefficiency source within structure. The different network models in two separate spectrum, multiplier and envelopment are presented to solve this problem. Multiplier models, also known as relational models, study network efficiency and its parts and as well as relationship between the amounts of their efficiency in a model, while envelopment models, verify

the points projected of non efficient units in addition to study of network efficiency and its parts.

Having envelopment approach, this article develops some production possibility sets (PPS) due to the concept of the link value determination controlling (intermediate variable) by network parts. Some Scenarios presented in each production possibility set with the aspect of kind and control power which determining link value that shown as 1.link control by previous part, 2.Link control by next part, 3.Link control by previous and next part as the same (non-cooperative approach- type 1), 4.Link control by previous and next part as the same (non-cooperative approach- type 2), 5.Link control by none of previous and next part (advanced approach). The results show when parts related to link have no control over its value (scenario 5) or all of them have the same control over the link (scenario 3and 4), the parts efficiency and consequently the whole network efficiency will be more than parts have one-way or unequal control. Furthermore, it can be inferred from the article that there is more efficiency in network structure when a part of network has more control over the link value determination to related part. Therefore, it can be used to design network structure in order to increasing parts and consequently the whole network efficiency.

**Key Words:** Network data envelopment analysis, control of link, intermediate variable.

## DEVELOPMENT OF MULTI-CHOICE GOAL PROGRAMMING BY APPLYING THE INTERVAL-VALUED INTUITIONISTIC FUZZY PRINCIPAL COMPONENT ANALYSIS FOR GOAL SELECTION

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#### Abstract

In today's competitive world, decision making for pricing, inventory control policy and lead time, are important challenging issues in non-exclusive markets. The lead time should be determined in a way that inventory of firms, can provide the market demand and also it should not be too long. This study examines the behavior of firms face to variables demand rate depending on selling price, lead time and the inventory level. The model has been extended for a single product in supply chain. Here is assumed that the shortage is not allowed and market demand is a function of the amount of inventory and price of goods sold. This problem is analyzed and mathematically modeled under two scenarios. In the first scenario the effects of price, lead time and inventory on hand in a single company has been investigated and in the second scenario, the behavior of two competing firms in a non-exclusive market, using the Nash approach is analyzed. Where, both firms, without being informed by each other are competing under a non-cooperative game and each of them is trying to maximize the profit function. Decisions about the appropriate lead time, selling prices and inventory levels as decision variables of the problem are made so that the firm's profit is maximized. In numerical examples section, for each of decision variables and parameters of the model, some comparisons have done and the optimal values are obtained. Moreover, sensitive analysis conducted on various parameters of problem. Finally, from sensitivity analysis, we observed that with setting the price elasticity and inventory elasticity of demand, lead time can be managed and maximum profit is achieved. The results of numerical examples indicate that the maximum profit for the firms in the second scenario is achieved when the share of both firms, in providing the required inventory of market is equal. From the sensitivity analysis if other parameters are remained constant, when lead time is increased, the inventory levels increases and lead to a prolonged response.

**Key Words:** Inventory control, pricing, lead time, game theory.

## MODELING AND ANALYSIS OF COLLABORATIVE MULTI-MODAL TRANSPORTATION BETWEEN RAIL AND ROAD OPERATORS BASED ON COOPERATIVE GAME THEORY

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#### Abstract

Nowadays, due to concerns about economic efficiency and also the energy and environmental issues, multi-modal rail-road transport has attracted a lot of attention among transportation planners. Although multi-modal transportation has economic justification, yet its planning process is complex and challenging. Accordingly, the need for scientific and practical tools for designing efficient and effective systems for multi-modal rail-road transport is necessary. In this study, in order to investigate the collaboration between the rail and road carriers based on cooperative game theory, the mechanisms of cooperation between road and rail operators and fair division of the benefits are provided by employing innovative mathematical programming tools. In the proposed mathematical model, routing decisions, along with rail and road service network design and the rail blocking are most important decisions which are considered simultaneously in the integrated network. To manage interactions between rail and road carriers, a mechanism is devised by employing cooperative game theory concepts and borrowing some ideas of goal programming, which effectively divides the resulted savings of coalition between coalition's members. Accordingly, the participation of members and adherence of each member to collective decisions is led to the optimality of coalition. By taking advantage of proofing some mathematical theorems and lemmas, an efficient method to allocate the resulted savings of coalition to members even in large-scale problems is provided. In order to validate and assess the suggested models and methods, a diverse range of test problems have been designed and solved with CPLEX solver. The results show that the collaboration between rail and road carriers will lead to significant savings. In addition, a factorial design of experiments

system reconfiguration, duplicate machines, lot splitting, workload balance among machines and cells, cell size limits, and material flow between machines. Machine capacity is also considered. Capacity requirement and the number of required machines in each cell are defined as decision variables and for the first time, calculated based on flow shop perspective. The model forms independent cells and determines all related decision variables during each period of the time horizon according to the availability of the machines at the beginning of the first period.

The objective is to minimize the total costs of intra-cell material handling, machine operating, maintenance and setup, cell reconfiguration and forming, inventory holding and backorder, and production. Linearization techniques are used to transform the suggested non-linear programming model into a linearized formulation. Using flow shop perspective to calculate capacity requirement is considered in this paper for the first time and so to verify the performance of the proposed model, a numerical example with randomly generated data is solved by a branch-and-bound (B&B) method under the Lingo 12.0 software.

**Key Words:** Cellular manufacturing system (CMS), production planning, production line balancing.

## ENHANCING ORGANIZATIONAL CAPABILITIES THROUGH SUPPLIER KNOWLEDGE FLOW

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### Abstract

The aim of this paper is to survey the relation of knowledge for supplier with their capabilities and willingness

as the development criteria. There are many context to have knowledge flow.

What are more beneficial contexts? After developing the research hypothesis, a structured questionnaire was adopted to gather primary data from suppliers. The draft questionnaire was sent to five academic and industry experts to comment on the content. Received feedback was utilized to change the layout of the questionnaire. The selected participants were the managers, purchasing managers or equivalent position. Sampling is purposive and defined before the data collection commences. 105 questionnaires were sent back. Six questionnaires were rejected. 99 complete and clean questionnaires were analyzed. The questionnaires received within the first 15 days and questionnaires received later were compared with a subset of 25 non-respondents to test of non-response bias. The non-significance of these tests shows that non-response bias does not matter to the validity of findings. When PLS is applied to reflective constructs, it leads to inconsistency of PLS path coefficient estimates. PLSc provides a correction for this estimate.

The state of the art consistent PLS technique is utilized instead of traditional PLS. With regard to definition, knowledge for supplier has a large effect on supplier capabilities. The Important- Performance Matrix Analysis prioritizes the indicators and suggests to focus on knowledge flow about manufacturing processes, development expertise and marketing expertise. Results showed that supplier willingness for sharing confidential knowledge and longtime relationship depends on development programs. Having a communication mechanism for each of partnership's specific contexts is suggested to maximize the knowledge flow. The main contribution of the paper is to survey the supplier knowledge in depth for maximizing the knowledge flow and study the effect on the segmentation criteria such as capability and willingness. Important-Performance Matrix Analysis is utilized to prioritize the indicators.

**Key Words:** Supplier knowledge, knowledge flow, capability, willingness, consisted partial least square.

## ANALYZING THE BEHAVIOR OF COMPETING FIRMS IN MARKETS WITH PRICE-LEAD TIME-AND INVENTORY LEVEL-SENSITIVE DEMAND

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## ASSESSING THE MATURITY OF SUPPLY CHAIN PROCESSES BY USING COMBINED APPROACHES SCOR AND BPO BASED ON TECHNIQUES FAHP AND GRA

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### Abstract

Supply chain management creates value for companies, customers and stakeholders interacting throughout a supply chain. The strategic dimension of supply chains makes it paramount that their performances are measured. In today's performance evaluation processes, where the supply chain is considered as a vital element in the success of the company, it is important for evaluating the performance of specific. In other hand, companies assess supply chain performance using a variety of models that can be cited maturity models. Maturity models are used as a basis for the evaluation and comparison of improvement, and offer appropriate approach to increase the capability in organizations. The aim of this research is to evaluate the maturity of supply chain processes with the new framework. To achieve this goal, review of the literature related to the supply chain and performance evaluation is provided and concepts related to maturity with models worked in this field are discussed, thereafter by using of Supply Chain Operations Reference (SCOR) model and Business process orientated maturity model (BPO) is provided a comprehensive framework including factors and confirmed indicators. Since up to now not provided a framework that can incorporate both dimension of performance evaluation and maturity in the field of supply chain as well as The technical criteria used in each of its dimensions, The authors of the study have to provide a framework that would assess Iranian organizations supply chain based on Criteria don't handled in other research in the field of maturity. Proposed framework has three dimensions including (1) Identify areas

of the supply chain to assess their maturity, (2) levels of maturity and (3) criteria & indexes. Finally, to assess the maturity of supply chain processes in a number of Iranian companies in the dairy industry and companies have been studied and ranked using techniques Fuzzy Analytic hierarchy process (FAHP) and Additive Ratio Assessment (ARAS), the findings also showed that are the planning process has highest degree importance in maturities processes.

**Key Words:** Supply chain processes, maturity models, BPO model, SCOR Model, FAHP, ARAS.

## CELLULAR MANUFACTURING SYSTEM DESIGN WITH PRODUCTION PLANNING: A FLOW BALANCING PERSPECTIVE

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### Abstract

This paper presents a new mixed integer nonlinear mathematical model to design dynamic cellular manufacturing systems (DCMSs). In the dynamic environment, the entire planning horizon is divided into multiple smaller periods, and each period has different product mix and part demand. In reality, production quantity may not be equal to the demand as it may be satisfied from inventory or backorders. Thus production quantity should be determined through PP decisions in order to determine the number and type of machines to be installed in manufacturing cells. Consequently, the manufactured cells should be reconfigured in each period.

Design and implementation of an effective CMS involves many issues such as cell formation (CF), production planning (PP), layout design, and scheduling. The proposed model is concurrently making the CF and PP decisions and incorporates several design features including multi-period production planning, alternate routings,

sions such as production planning and inventory management and also good performance of the distributor in utilization of its equipment are related to distribution decisions. For example in decentralized manner, if distributor wasn't able to send transportation vehicles to a producer on time as a result of the fact that they have been allocated to other producers, such producers may revise his decision of using some distributor schedule and therefore seeks an alternative distributor in desirable time that by the way doesn't incur the additional cost of holding inventory or delay costs. However if this problem is considered in an integrated way, it results in improvement of overall performance of producers and distributor as the members of a supply chain. Nevertheless as expected, integration doesn't lead to improvement of each member's income than decentralized manner. Therefore a coordination mechanism is needed to ensure that the profitability of all members exceeds by integration. In this article, the integration of a supply chain consisting of multiple producers and a main distributor is studied and a coordination mechanism based on discount on transportation costs is proposed that as shown by results, improves the performance of the producers and distributor by providing sufficient incentive for integrating them. The allocation of the surplus profit as a result of integration is dependent on the bargaining power of the distributor and producers but in this article a mechanism based on marginal contribution of the members in making the surplus is proposed that can be used as guidance to allocation of surplus among the supply chain members.

**Key Words:** Producers-distributor supply chain, supply chain coordination, contract of transportation price discount.

## CLOSED-LOOP SUPPLY CHAIN NETWORK DESIGN MODEL WITH ECONOMIC, SOCIAL, QUALITATIVE OBJECTIVES AND INTERNET SALES

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### Abstract

In this paper, a new multi-objective non-linear mixed-integer mathematical programming model is presented. The goals are to optimize the problem with respect to economic, social, and qualitative viewpoints, simultaneously. In the literature, there is a supply chain management network form as two parts: The forward logistic and the reverse logistic and their combinations are called the closed-loop supply chain and the reverse supply chain includes some parts such as collection center, recycle center, guarantee and disposal center with respect to the objective of minimizing the waste amount of materials and products in the supply chain. In general, the closed-loop supply chain can follow the economic, competitive, environmental and social situation to achieve its goals. In forward direct, we consider suppliers, plants, distributors, and first market; while, in reverse one, guarantee, collection, recycling, disposal, redistribution and second market centers, are applied. Moreover, distributors meet the customer's demand based on traditional and internet sales. Therefore, a stochastic multi-objective multi-product closed-loop supply chain network model is designed. In this manner, the capacity of facilities and location decisions are considered. In economic objective part, the logic of internet sales is relied on customer behavior strategy. Seen from other way round, the employment's profit of employees is considered in both economic and, in turn, social responsibility. In fact, in this proposed model, distributors meet the customer's needs by internet sale or normal sale which this concept is used in supply chain's structure. Furthermore, in reverse logistic there are found environmental and disposal concepts in decreasing defective area, analyzed. With this complexity regard of this model, the multi-objective GRASP heuristic algorithm to solve the model is presented. In order to demonstrate applicability of the proposed model, comparisons are analyzed and compared with one of the most developed multi-objective evolutionary algorithm called non-dominated sorting genetic algorithm (NSGA-II). The results demonstrated that the applicability of multi-objective GRASP algorithm in terms of convergent and spacing of Pareto solutions in comparison with another one to solve closed-loop supply chain problem.

**Key Words:** Closed-loop supply chain network design, recycling, internet sales, multi-objective optimization, GRASP algorithm.



age, and GARCH by using first and second backtesting of Lopez loss function, and Blanco-Ihle backtesting. The results shows that performance of proposed method in normal distribution with confidence levels of 95%, 97.5%, and 99% and also in t-student distribution with confidence levels of 97.5%, 99% is better than others.

**Key Words:** Risk management, robust estimation of value at risk, robust cipra method, GARCH method.

## A GAME THEORETIC APPROACH FOR PRICING OF TWO SUBSTITUTE PRODUCTS WITH SPECIFIED PRICE OF ONE MAIN COMPLEMENTARY PRODUCT

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### Abstract

Today's business has rapidly changed and has become more competitive. In today's world, existing the competitors is an undeniable rule; therefore, for any manufacturer, appropriate decision making requires taking into account the competitors and their policy decisions. In today's competitive market, pricing is one of the important decisions for the success of a company. So, assessing the impacts of pricing strategies on demand and profit is very important. On the other hand, product pricing is one of the most important decisions and a strategic problem for manufacturers that is affected by pricing decisions made by the other producers. In the non-cooperative games, each member is a separate economic entity that makes its operational decisions independently. The Nash game is an equal power game. In this paper, for the first time, the pricing problem for two substitute products in the present of one main complementary product is studied and Nash equilibrium prices have been introduced as well as demand and profit functions. After comparing the equilibrium prices, demand and profits, the effects of some important parameters

on prices, demand and profit are addressed. The results show that the equilibrium prices of the complementary products could be less or greater than the main complementary product price in comparison with each other. The threshold of this change has been provided. The parametric analysis shows that the increasing of the main complementary product price increases the related manufacturer profit with decreasing rate and ultimately reduce the own manufacturer profit. The threshold of this change is, also, calculated. Finally, a numerical example is presented and the results discussed. The numerical example verified the analytical results. This research can be expanded from some aspect such as 1) Considering a supply chain with three manufacturers and retailers. 2) Considering dynamic pricing and using differential game theory for solving and addressing it. 3) Considering other decisions such as inventory and lot sizing to it.

**Key Words:** Pricing, substitute products, nash equilibrium and game theory.

## COORDINATION OF PRODUCTION-DISTRIBUTION IN SUPPLY CHAIN CONSIDERING TRANSPORTATION PRICE DISCOUNT

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### Abstract

Some products such as mineral products need special distribution systems for transportation to the customers. The significant establishment costs of such distribution systems leads manufacturing plants outsource their transportations to a distributor that has the required capabilities. In such distribution network, the plants deci-

# Abstracts of Papers in English

## PRESENTATION OF A NEW APPROACH FOR ROBUST ESTIMATION OF VAR: A COMPARATIVE APPROACH

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### Abstract

Developing of capital markets and decreasing of interest rates in commercial banks has caused to stock investing become as one of the most important opportunities to earn returns for individuals and firms. Since, the nature of capital markets is involved to abrupt shocks and

volatility we have to allow risk. So, It must be predicted and controlled using appropriate models. One of the conventional models to measure and control the risks arising from fluctuations in the capital market is using the concept of Value at Risk (VaR). Which is introduced as a standardized measuring risk tool not only for those financial institutions that are large-scale commercial operations, but also for small banks, insurance companies, investment institutions and non-financial businesses. Since Value at Risk is analogous to the methods, different assets and businesses, in recent years Value at Risk becomes prevalent as a new approach for measuring the risk among the managers and commercial investors. In the current financial world abrupt and unexpected changes, even a little, has strong effective in predicting future fluctuations so it can not be ignored. As a result, robust model should used to predict and control the fluctuations that enhance the power and performance estimation and prediction models. According to the importance of the issue in this paper, the robust Cipra method with an optimal smoothing parameter is used to estimate Value at Risk (VaR) for normal statistical distributions and t-student. The data used daily logarithmic returns of the automobile industry index from Mach 2011 to September in 2015. In order to validate the model, the proposed model has been compared with conventional measuring VaR methods consisting of simple moving average, exponential moving weighted aver-