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Choosing the right strategy for manufacturing companies in the provision of energy prices in the electricity market

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ABSTRACT

In the electrical energy market, price is the most important signal to all production units and each unit is to maximize profits makes bid. The independent operator market with network constraints apply is balance. Power plant at the bid price, more coordination between the operation of power plants, Select power plant and the electricity market bidding strategies smarter In addition to implementing the procedures followed for the accumulation of power plants, including ones Executive pay practices that can be turned on and off of power plants Assist in the selection of suitable plants bidding strategy, Therefore, the best strategy and mechanism to promote privatization project in the energy economy is a stock market launch. Regional power companies and power plants as the seller of this product in stock should consider energy Please have the appropriate price. Since these companies can sell their electricity alone at the Energy Exchange Or at the day of the sale by managing the power grid, electricity production to sell, we should take heed When selling stock at a price of alternative energy that are facing the same selling price is to manage the network. System studied in this thesis consists of eight hypothetical power plant with a maximum output is 54,000 MW, In order to assess the best strategy, multi-objective evolutionary algorithm for finding the best strategy is used And the amount of power provided to the stock exchange to the total capacity of the three levels of 20% and 50% and 70% were simulated, Among the strategies outlined in the end, be submitted to the stock exchange to the total capacity of the unit by 50 percent ($\gamma = 50\%$), Proper strategy for manufacturing companies were selected in the provision of energy prices in the electricity market.

Keywords: *electricity market, pricing strategy, production, manufacturing companies.*

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INTRODUCTION

Always a deregulated power systems, seeks to create a competitive environment. With the creation of this trend, Power companies from foreign monopolies and individually divided into parts and each episode will be decentralized to operate. Manufacturing companies can Ability to sell their production to different markets. These markets include Global Energy (active power) and ancillary services markets (eg market reserve and active power) so manufacturing companies have a good bidding strategy in this market, in order to obtain the most profitable choice. Consultants suggest strategies manufacturing companies based on the strategic behavior of other market participants, Forecasts of demand, the power system spinning reserve requirements, as well as past performance and limitations contained in it [1].

In most advanced in the world electricity markets, producers bidding strategy, which is a combination of bid price and the amount of contribution determines the unit on the market. Bidding direct impact on the economic benefit of producers and only includes the strategy adopted by the plant itself is not, It also depends on the behavior of other manufacturers and operating conditions. With the development of competitive markets for electricity in the world, the optimal bidding strategy has been proposed. Electrical retailers in the world's electricity markets are often different options for income coming in every moment and with various technical and non-technical limitations of the face [1].

With the emergence of Iran as well as restructuring in the privatization of some power plants, the optimal strategy for Price ADRs in the electricity market is considered. Unit-based bidding strategy without regard to operating conditions, not only may not be a profit for the seller, But they can also suffer large losses imposed on the seller. Power plant at the bid price, more

coordination between power plant operator and the plants and the electricity market bidding strategies smarter in the follow-up implementation of integration policies Including cases of power plants That executive pay practices shimmer of power plants could be in power plants Help appropriate bidding strategies, Therefore, the best strategy and mechanism to promote privatization project in the energy economy is a stock market launch. Power Exchange, organized place and is regulated after its formation, the possibility of financial transactions and contracts for electricity is produced. In this market, every consumer could enjoy the right to free choice of electricity supplier that Cheaper and provide better service, purchase. Opening of the market can play a key role in advancing privatization and less government intervention and subsidies and prosperity Power and electricity industry's profitability and economic prosperity [6].

As was stated, every supplier, is looking to gain the most benefit from the electricity market, it is clear entry Competitive market strategies of companies in the electricity market will weigh on the stock exchange. Therefore, we can say that the best strategy from the perspective of a supplier, the right strategy is the expected profit Company in the stock market and the expected profit from daily market to be considered simultaneously and by taking the necessary constraints, the two markets have the best bidding [2].

2. Background research

- Lewis and Nark in 2014 shared an article about the price of power generation companies in the electricity market published.
- Meisam Ansari, Mohammad Taghi Ameli in 2014 during a joint study on the optimal pricing strategy The market price of the supply curve probability model, power in the twenty-eighth International Conference in Tehran, presented a paper.
- Hossein Shariat Dehaghan, in 2014, an article about taking security constraints and planned electricity transmission network under market conditions, provided.
- Meisam Ansari and Mojtaba Shivaei and Mohammad Sadegh Ghazi Zadeh eloquently, in 2013, modeling power of competitive markets and Its parameters are evaluated based on the information market players in the Twenty-Fifth International Conference on Electricity, provided.
- Mark and Berg in 2013, an article about the optimal strategy for pricing electricity among power generation companies in terms of spending.
- Thorne and Morris in 2013, during the joint investigation optimal solutions to the price of energy Power generation companies in the electricity market were evaluated.
- Lawrence and Peace in 2012, a discussion about the appropriate strategies for pricing energy in the electricity market were examined.
- Walter and Gameen in 2011, an article entitled routes perfect choice for the price of Assessed by private producers of electricity in the electricity market.
- Fomoul and Roger in 2011, together with solutions for pricing Correct an article published in the electricity market.

3. Research Methodology

3.1 The bid in the electricity market

Market clearing mechanism, however, some local pricing (LMP) is. The sensitivity of profit each player to bid him then calculated the optimal strategy is determined. In electricity markets each unit is responsible for maximizing their profits, In order to achieve its economic objectives defined unit these include short-term and long-term planning is their own. The bid strategy that consists of the set of two producer price, to achieve short-term objectives has been developed [6].

3.2 The bid price of the electricity market

1. Behavioral Analysis; these bid strategies and to discuss the behavior of traders in electricity market Have. In this study, an analysis of how the logic of market power can affect the price of wholesale electricity offer and limitation of this analysis is to forecast future prices.
2. Numerical analysis, the Group fully computer science techniques such as neural networks and genetic algorithms to forecast electricity price changes. The genetic algorithm is useful when there is no escape electricity market [4].
3. Based on the analysis of a firm's perspective, this group is a firm with the ability to learn and adapt systems to develop the bid seeking a dynamic process in the electricity market, taking into account uncontrollable factors [1].

3.3 The bid efficient market price of electricity

Over the years, power companies focused on improving the economic side, the industry output. For decades, attempts to minimize the costs of power generation customers were given a conducted. But since the new electricity markets are not fully competitive, a producer can use market power and profits through strategic price increase proposal. In general, there are three methods for optimal bidding strategies. The first estimates the market equilibrium price (MCP) is the next time period. The second is based on the bidding behavior of competing companies, and the third is based on game theory [3].

3.4 investigate the mechanisms and procedures in the field of research

1. The bid optimization using sensitivity analysis; This method for calculating the optimal strategy recommendation among manufacturing plants in the electricity market with firm views and SA provides, The electric market by offsetting the next day to consider that the producer and a constant demand for T N period. Traders in the market, firms are capable of learning [1].
2. The optimum bid price by using game theory, according to the companies to maximize their profits by competing the competitiveness of these companies to achieve the maximum benefit is a kind of game, which uses the concept of Nash equilibrium is trying to gain the maximum benefit of these companies [1].
3. The bid using linear programming optimization; this bid strategy only to market factors, including market rules, The behavior of other participants and competitors, at least not depend on expected profits etc. But the market-clearing price at any time of day and type of participants who intend to submit proposals depends on the market [1].

3.5 The optimal strategy for participation in the electricity stock market

One of the main goals of each supplier, is maximizing the profit of the electricity market, Clearly participate in the stock market will affect the daily market strategy One can say that the best strategy is a supplier of vision, strategy expected profit company in the stock market and the expected profit from daily market to simultaneously consider And by taking the necessary constraints, have the best bidding on these two markets, that the process is as follows [5].

1. The characteristics of electricity stock market
2. The method of bidding
3. The method
4- UL unit

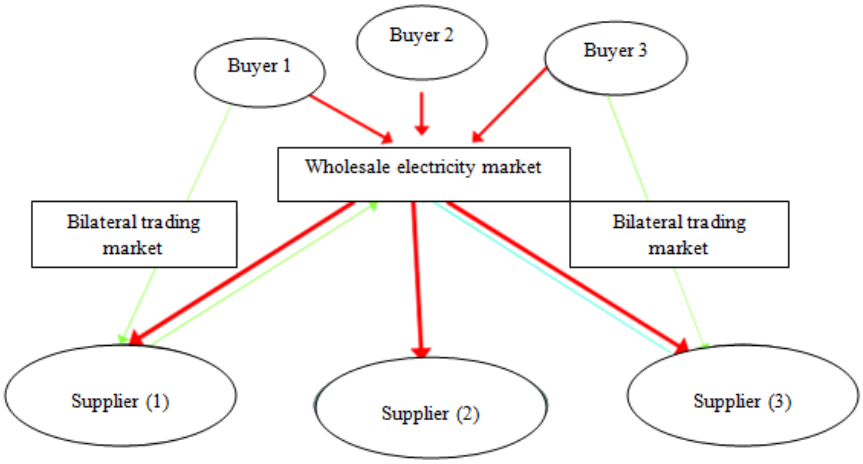


Figure 1. The daily market structure after the formation of a bilateral trading market [5].

4. Debate

4.1 Introduction Test System

The system consisted of eight plant is supposed to determine the best strategy, Multi-objective evolutionary algorithm (MOEA) to find the best strategies we use. Because the mathematical model proposed for multi-objective scheduling problem in cellular manufacturing system is provided And aimed at minimizing the maximum completion time work, the cost of earliness and tardiness costs and maximizing profits to be And due to the complexity of this problem, a multi-objective evolutionary algorithm known as non-recessive genetic algorithm we used arranged. In fact, this algorithm by adding two essential functions typical single-objective genetic algorithms, to a multi-objective algorithm has become Instead of finding the best answer, the answer that category of best known as the Pareto Front, The two are operator; operator that a superior standard (grade) based on sorting non-recessive allocated to members of the and operators who answer a variety of solutions to maintain keeps ranking And their steps are as follows [2].

- Overcome;
- Sorting non-recessive
- Maintaining the diversity of replies (from congestion)

5. Simulation

Simulation for the three levels of 20% and 50% and 70% for the parameter γ (Relative to the total capacity of the power provided to the stock exchange) is done. The number of random samples intended for the stock price and the daily price of 20 100 samples have been taken into account.

In Figure 2 the price offered to exchange randomly generated for 20 samples is shown

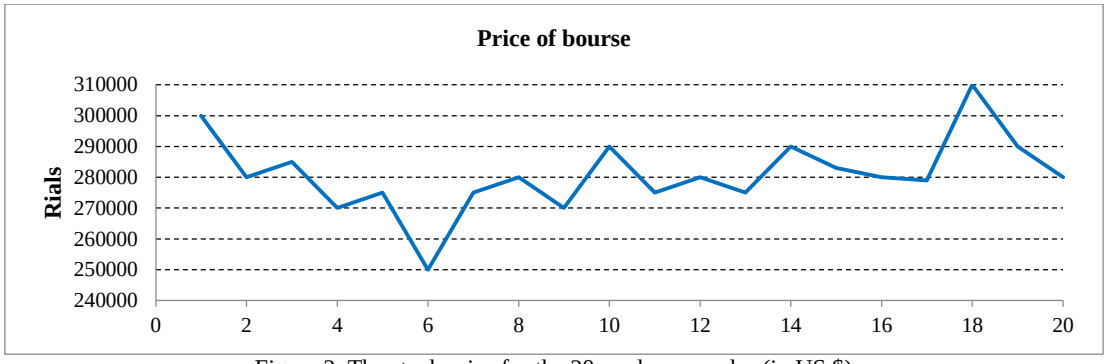
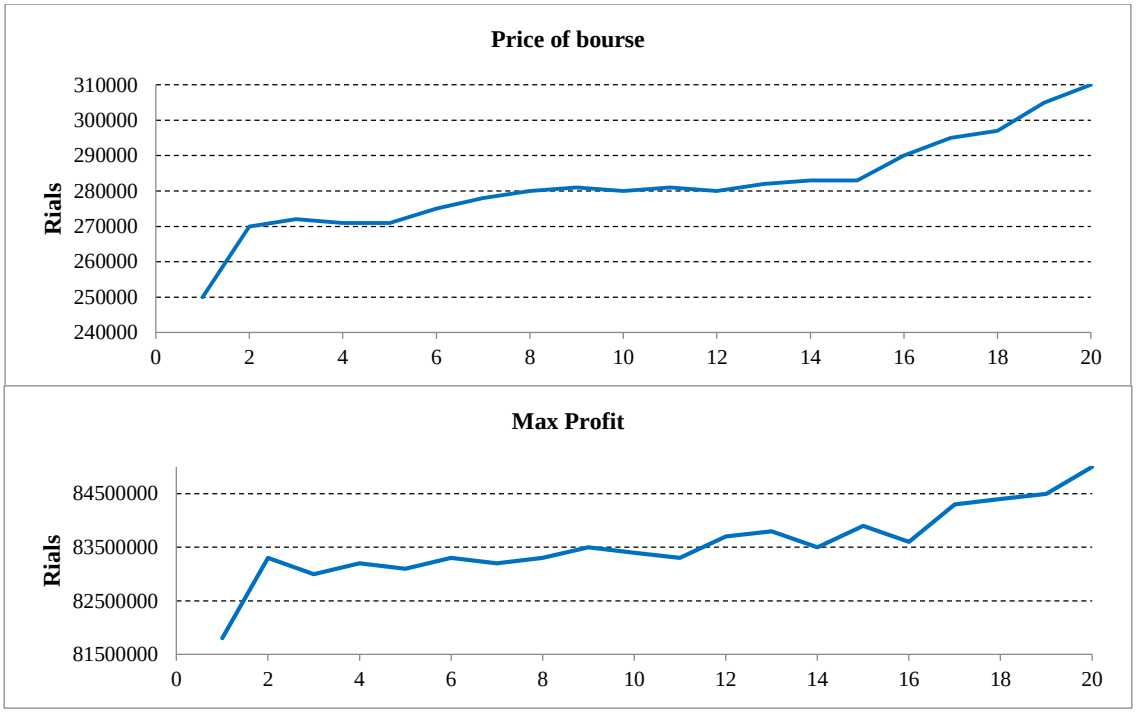


Figure 2. The stock price for the 20 random samples (in US $)

5.1 Per γ = 20%

The mean total profit obtained for each sample and stock prices this benefit show business risk. Risk standard deviation obtained the highest profit per 100 samples taken daily.



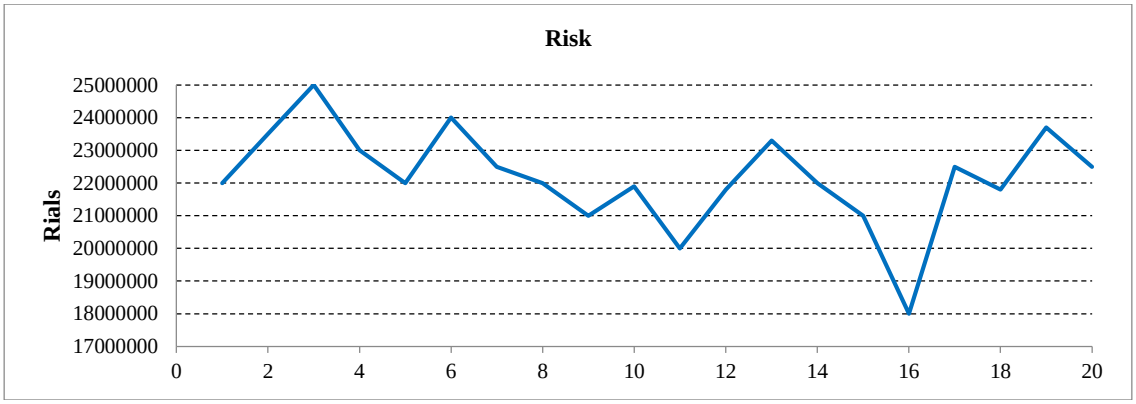
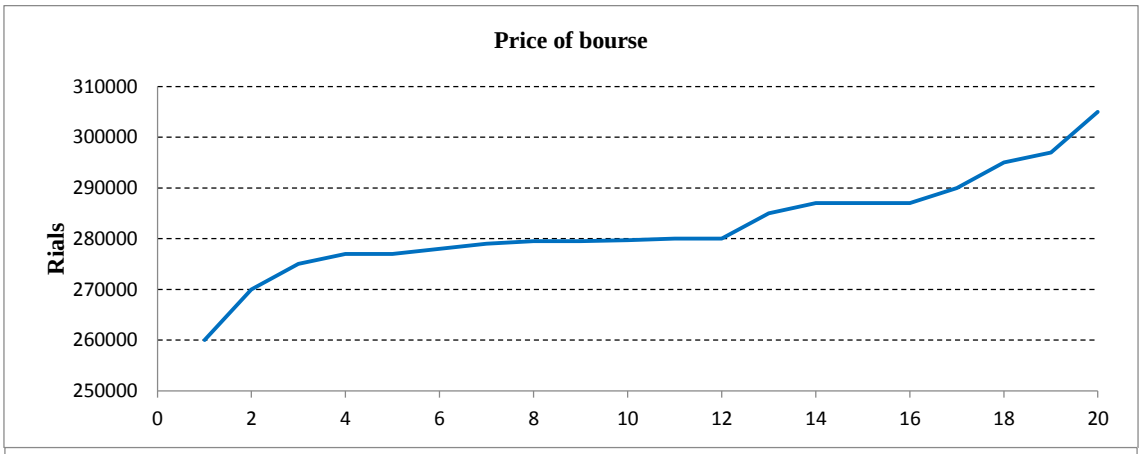
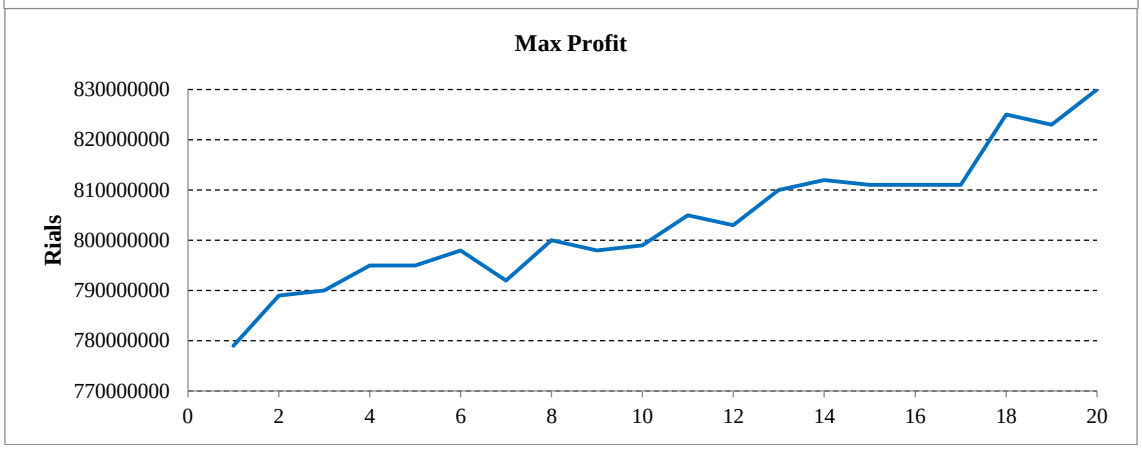


Figure 3. Price, total profit and the risk of 20 random samples Stock Exchange (= 20% γ)

5.2 Per γ = 50%





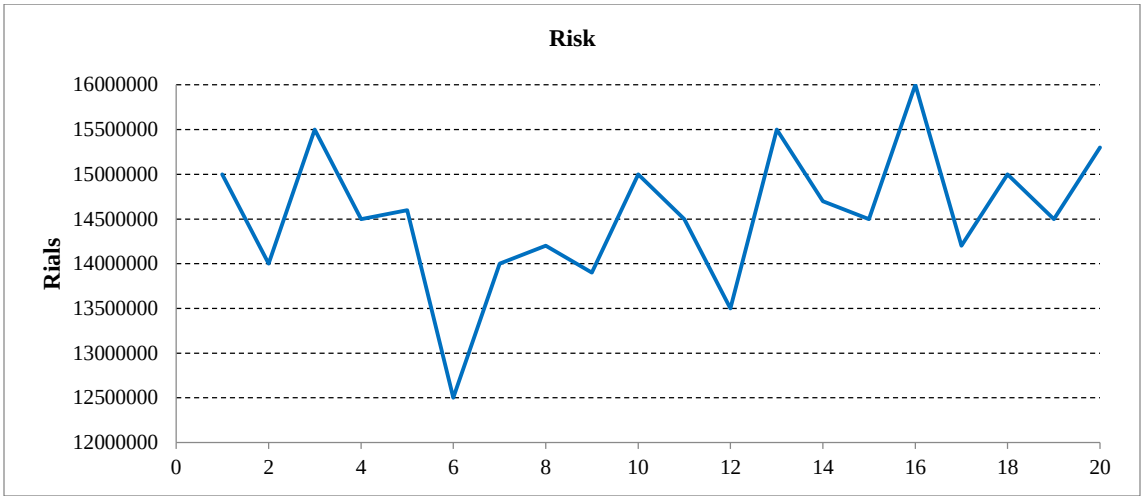
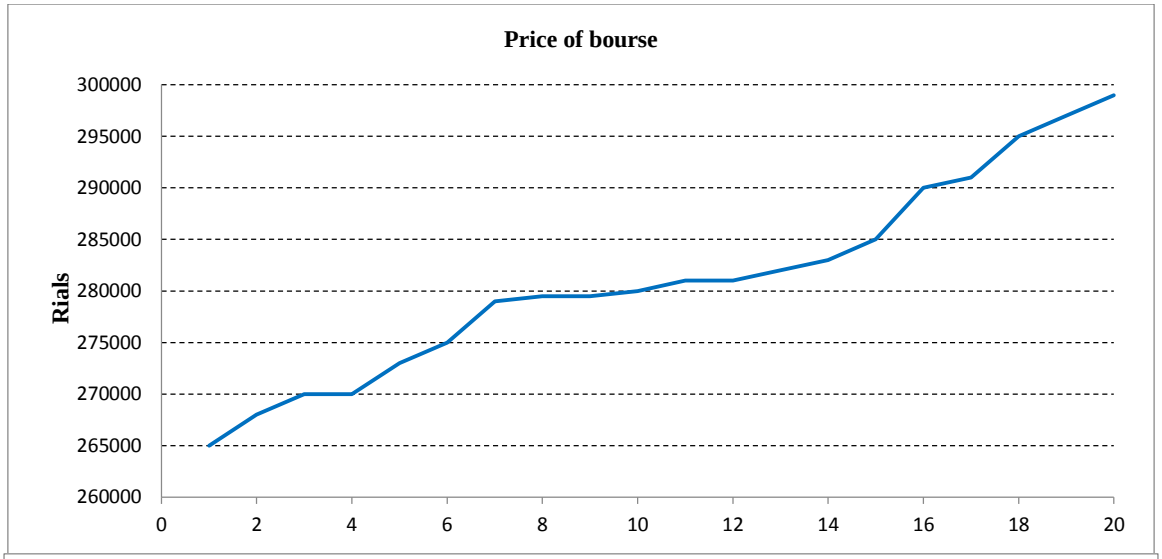
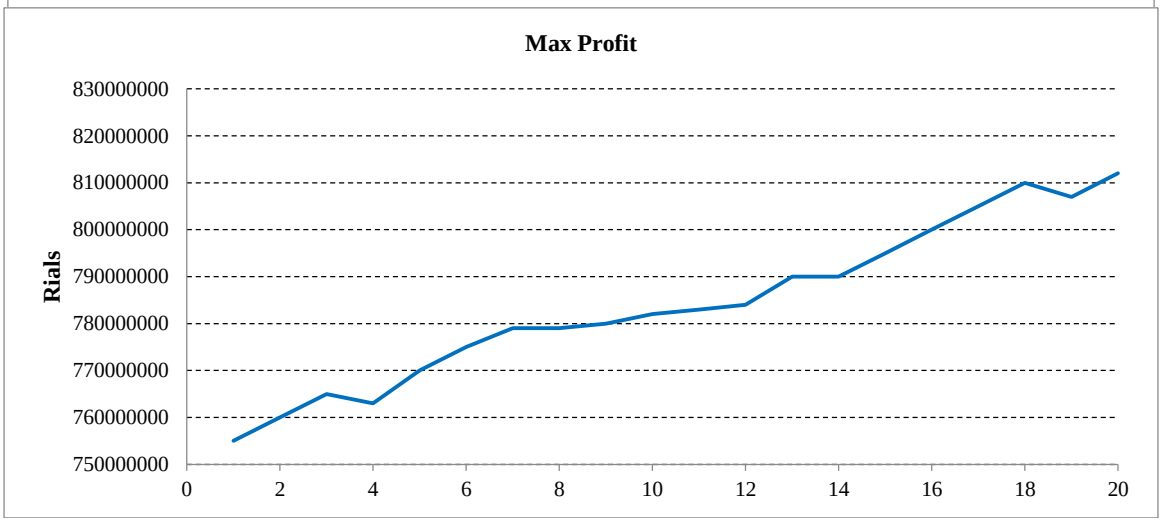


Figure 4. Price, total profit and the risk of 20 random samples Stock Exchange (= 50% γ)

5.3 Per γ = 70%





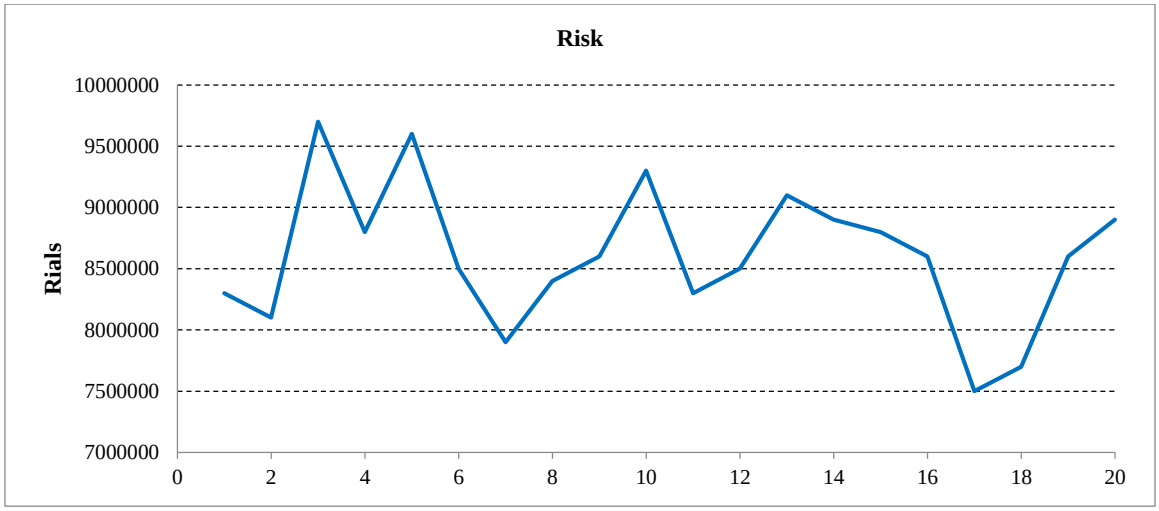
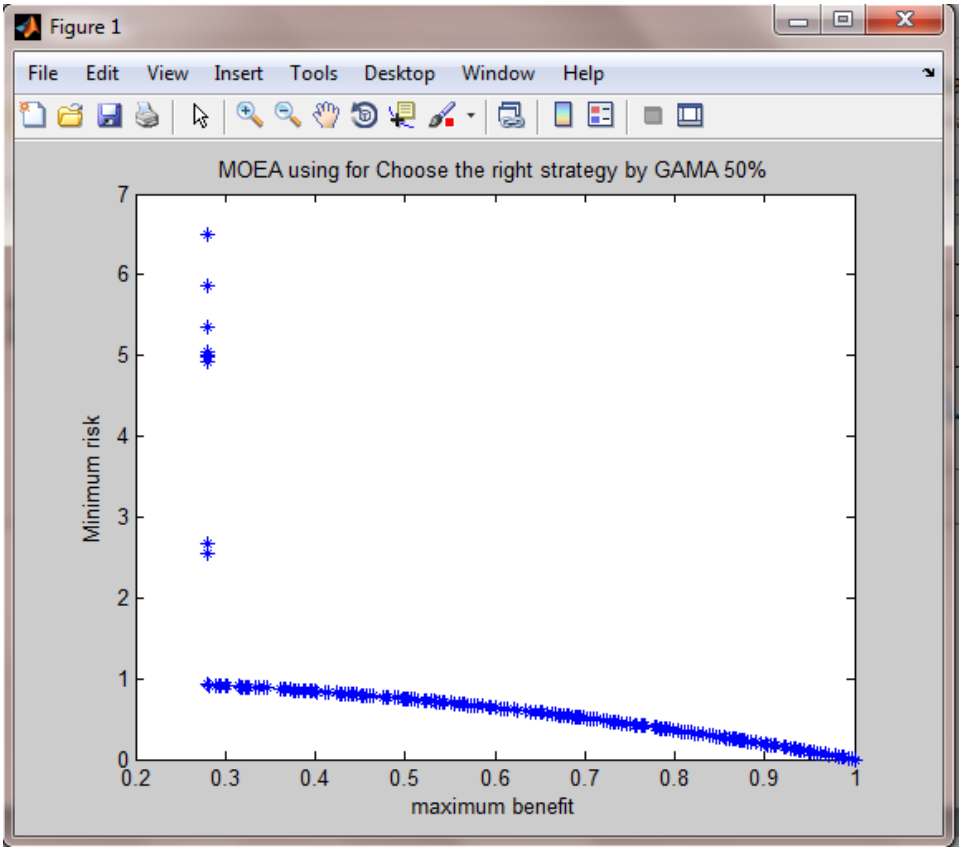


Figure 5. Price, total profit and risk for (γ = 70%)



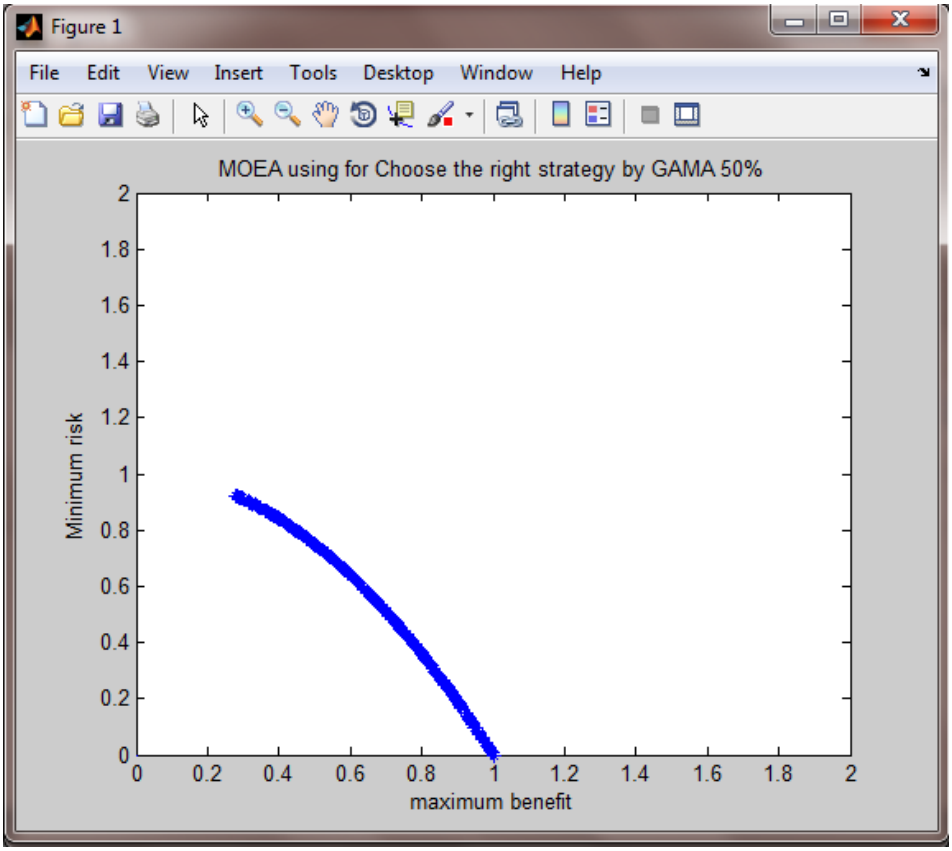


Figure 6: The best pricing strategy using multi-objective evolutionary algorithm strategy

6-Conclusion

According to the ratio of 20% indicates that raising the price offered to exchange the extent to which increases profits and how much risk increases. By selecting the appropriate risk and benefit may be the best strategy adopted bidding in exchange. It is observed by increasing the price offered for the stock, which often increases the profit is reasonable. Also according to the ratio of 20% can be said that the proposed price is the best result in 16 samples. Because although the maximum profit in fourth place but lowest risk in comparison with other samples. But if the goal is only the most profitable, the sample will be selected. Since in this case, only 20 percent of the units will be provided to the stock exchange, Can be seen not only by reducing the price offered in the exchange risk does not decrease, but often increasing as well.

Also as can be seen in the ratio of 50% can be achieved with the lowest risk in the sample 6, but this case brings little profit. The reason could be due to be presented to the increase of the share exchange ratio in this case is to before.

Unlike the two states in the ratio of 70%, with an increase in stock prices, profits increasing trend Because of the high share be offered to exchange the state (70 percent). It can be said with regard to risk factors sample 17 will bring the best results (lowest risk and high profits).

One of the main goals of each supplier, is maximizing the profit of the electricity market. The best strategy is a supplier of vision, strategy and expected profits of companies in the stock market the expected profit from daily market to simultaneously consider and by taking the necessary constraints, the two markets have the best bidding. In this thesis, a method based on repetition to evaluate expected profits Supplier Company in the stock market and the daily market, the benefits of the proposed approach Modeling can be efficient, while UL's unit.

Table 1. The pricing strategy using multi-objective evolutionary algorithm strategy

(Rial)	=20%γ	=50%γ	=70%γ
The highest profit	8.49E+08	8.34E+08	8.15E+08
Price corresponding to the maximum benefit	305492	302272	296424.8
The corresponding maximum benefit risk	21667592	13934849	8463256
lowest risk	18013498	12260252	7468938
Price corresponding to the lowest risk	280842.3	272276	279715.7
Profit corresponding to the lowest risk	8.34E+08	7.95E+08	7.82E+08

According to Table 1 and the best pricing strategy using multi-objective evolutionary algorithm can be stated strategy of increasing the share of the stock, sharply reduced risk Although a lower profit, which ultimately through the strategies outlined, The amount of power provided to the stock exchange to the total capacity unit with a rate of 50 percent, Proper strategy for manufacturing companies were selected in the provision of energy prices in the electricity market. However, the expert operator can be given to any desired objective function (The compromise between maximum profit and minimum risk) have the best bidding strategy.

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