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Research Article

Game Theory And Its Optimum Application For Solving Economic Problems

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Abstract: This article discusses the application of game theory in economics. Game theory is a branch of mathematical economics. She develops recommendations on the rational action of the participants in the process when their interests do not coincide. Game theory helps enterprises make the best decision in a conflict situation. The focus of the article is game theory a section of mathematical methods for modeling and forecasting the economy related to the implementation of a formal study of social, political, and economic situations in conflict and cooperation. The use of game-theoretic models is able to describe the interaction of several agents participating in game interaction. These agents are traditionally people, groups of people, companies, ministries, or any combination thereof. The introduction of methods and models of game theory into the mathematical training of bachelors and masters of economics is intended to equip future economists with a special language that allows them to efficiently formulate, structure, analyze and simulate strategic scenarios, and make optimal scientifically based decisions in the face of incomplete information and risk

Keywords: game theory, visualization, strategy, matrix, modeling, model, price game.

1. Introduction

In practice, it often becomes necessary to coordinate the actions of firms, associations, ministries and other project participants in cases where their interests do not coincide. In such situations, game theory allows you to find the best solution for the behavior of participants who are required to coordinate actions in a conflict of interest [1, 2, 3]. Game theory is increasingly penetrating into the practice of economic decisions and research. It can be considered as a tool to help increase the effectiveness of planned and managerial decisions [4, 5, 6]. This is of great importance in solving problems in industry, agriculture, transport, and trade, especially when concluding agreements with foreign partners at any level. So, it is possible to determine scientifically substantiated levels of lowering retail prices and the optimal level of inventories, solve the problems of excursion services and the selection of new lines of urban transport, the task of planning the procedure for organizing the exploitation of mineral deposits in the country, etc. The task of choosing plots of land for agricultural crops has become classic. The game theory method can be used for random surveys of finite populations, and for testing statistical hypotheses.

2. Literature Review

Applied research aimed at improving game theory in economics has been carried out: Lahoz-Beltra, R., Ochoa, G., & Aickelin, U. (2009); Zhang, S., & Zhang, Y. (2003); Leonard, R. (2016); Durmanov, A. at. el. (2019); Hilorme, T. at. el. (2019); Tkachenko S. at. el. (2019); Umarov, S. R. (2019). The questions of theory of games and economic behavior, introduction to game theory, game theory: analysis of conflict, economic game theory for mutualism and cooperation are reflected in the works of the following scientists: Kalai, E. (1991); Neumann, J., & Morgenstern, O. (2007); Archetti, M., Scheuring, I., Hoffman, M., Frederickson, M. E., Pierce, N. E., & Yu, D. W. (2011). The aim of the study is the introduction of methods and models of game theory in the mathematical preparation of bachelors, masters of economics, designed to equip future economists with a special language that can effectively formulate, structure, analyze and simulate strategic scenarios, make optimal scientifically based decisions in the face of incomplete information and risk [16,17].

3. Findings And Discussions

The current stage of economic activity of domestic companies is characterized by market relations.

Today, along with commercial structures, in market conditions, state (municipal) institutions, which in accordance with Federal Law of May 8, 2010 No. 83-ФЗ may be of three types, are forced to solve their tasks: state, budget and autonomous.

For almost all domestic commercial and state (municipal) organizations (institutions, companies, corporations, etc.) [7, 8, 9] in economic decisions it is necessary to take into account Vat uncertainty (risk) factors and competitive confrontation, often in conditions of partial or complete lack of information about competitors. To improve the quality and effectiveness of decisions made in the conditions of market relations and uncertainty, game theory methods can be successfully applied.

Game theory is a mathematical theory of conflict situations, i.e. such situations in which conflicting interests of two or more parties that pursue different goals.

From the definition of the game theory shows that it was considering the problem, typical of market Noah's economy - making decisions in the face of fierce competition.

A game is a conflict situation regulated by certain rules, in which should be indicated:

- the order of alternating actions of participants (moves);
- rules for the execution of each move;
- quantitative result of the game (win, loss), which this set of moves leads to.

A party is a possible implementation of these rules.

A player's strategy is a set of recommendations for playing the game from start to finish.

The scheme of tasks considered in game theory is shown in Table 1. It does not pretend to be complete and complete, but represents only those features that one has to face in the study of operations when applying game theory when making economic decisions [10, 11, 12].

Table 1. Game theory problem classification

Rules of the game	Game theory problems
The nature of the phenomena being evaluated	Strategy games
	Games with a purely random result
Completeness of information	Games with full information
	Games with incomplete information
Alternating moves	One way
	Multi-way
Number of strategies	Final number of strategies
	Infinite number of strategies
The quantitative result of the game	With zero amount
	With a non-zero sum
Number of game participants	Two sides
	Many parties
Nature of the interaction	Non-cooperative
	Coalition (cooperative)
Type of win features	Matrix
	Bimatrix
	Continuous
	Convex
	Type of duels, etc.

Distinguish strategic game where the outcome depends on the chosen strategy, and games with purely random result, the solution of which is beyond the scope of consideration given to Noah article questions and requires the use of problem-solving techniques with stochastic ne belt [13].

Games can be with full information (for example, chess, checkers), or with incomplete. Economic decision-making officials face it with incomplete information, which necessitates making decisions under conditions of indeterminacy laziness and therefore some degree of risk. The latter are the main ones in the study of operations of an economic nature and represent the purpose of the issues considered in the article [14].

As can be seen from table 1, in the study of operations, one has to deal with one-way and multi-way games, and the number of strategies can be either finite or infinite.

In the economic sphere the most in demand so-called matrix, or straight carbon, the game for which the Account Fees matrix (Table 2) can be derived.

Table 2. Payment matrix of the game

Payment matrix game				
B \ A	B 1	B 2	...	Bn
A1	...	...	...	...
A2	...	...	...	...
...	...	...	...	...
Am	...	...	...	...

A payment matrix is a matrix showing the payment of one side to the other side, provided that the first side has chosen the strategy Ai, and the second - Bi. If side A has m strategies, and side B has n strategies, then this game is called m ^{x} n.

Games with zero sum are those games in which what one side loses wins the other. It is with such games, as a rule, that one has to deal with studies of operations of an economic nature.

Solving a game means finding the optimal strategies on both sides and determining the price of the game: the expected win of side A or the loss of side B.

The optimal strategy is called a strategy that repeats with multiple game player rhenium Liu fight deviation reduces the gain from the optimal strategy.

When considering a payment matrix, duplicate and dominant strategies should be immediately discarded.

Duplicates are those policies for which the payments are fully coincides give to each other.

The dominant is called obviously disadvantageous strategies, i.e. those with all payments higher than any other strategy.

Play solution can be found either in pure strategies, where the player must follow Dowa single strategy or a mixed strategy, where the player has to a certain frequency to apply two or more pure strategies. The latter in this case are called active.

It is proved that any finite game has a solution in pure or mixed governmental strategies, the number of active strategies in the second case no more than m and n.

When choosing the optimal strategy shall be based on the assumption that the compete rent is reasonable and does everything possible to prevent us (considered side) to beat its target. Where does the basic principle of game theory follow: choose your behavior so that it is designed for the worst way for us to respond to a competitor [15].

The principle of choice of each party to the most cautious («reinsurance") stratum ology called "minimax principle".

The lower price of the game, and - this is the maximum gain that can be guaranteed in the game against a reasonable competitor by choosing one of their strategies.

The top price of the game β is the minimum loss that a competitor can count on by choosing one of his strategies for himself based on our worst-case behavior.

If, as = beta, the solution of the game is in the field of pure strategies, otherwise SLU tea - multimodal.

Choosing the minimum from each row, we find the lower price of the game: a = max ai, and choosing the maximum from each column, we find the upper price of the game: β = min β j.

If they match, then the intersection of the appropriate row and column gives the opti -formal strategy (this is the case of pure strategies). The price of the game in this case: v = a = β.

If they do not match, then the price of the game is between, and β, and there is a case of mixed strategies.

There is an analytical solution for a 2 ^ 2 game. Frequency of use side A Stragies are:

P1 = (a22 - a 21) / [a1 1 + a22 - (a12 + o21)]; P2 = 1 - P1. (1)

The price of the game in this case: v = a11 x P1 + a21 x P2, (2)

Optimal frequencies of application by a competitor in the strategy are:

q1 = (v - a12) / (a11 - a12); q2 = 1 - q1. (3)

Consider the solution of the problem of choosing the optimal combination of different kinds of realizations being operated products in a competitive market methods of game theory [18].

Let our company in the market of a certain region is realized two kinds about induction: A1 and A2. In the market under consideration, the company has a competitor who also sells the same two types of products: B1 and B2.

Efficiency calculations for all four possible combinations of options strategies allowed us to construct a matrix, which shows the probability of a class competitor seg for each product market ment

Table 3. Payment matrix of the 2x2 game

B / A	IN 1	AT 2	Min columns
A1	0.5	0.4	A1 = 0.4
A2	0.3	0.6	A2 = 0.3
max columns	β 1 = 0.5	β 1 = 0.6	0.4 / 0.5

It is required to find the optimal strategies of the parties and the price of the game.

In accordance with equations (1), we obtain:

P1 = (a22 - o21) / [a1 1 + a22 - (a12 + o21)] = (0.6 - 0.3) / [0.5 + 0.6 - (0.4 + 0.3)] =

= 0.3 / (1.1 - 0.7) = 0.3 / 0.4 = 0.75;

P2 = 1 - P1 = 1 - 0.75 = 0.25.

In this case, according to equation (2), the price of the game will be:

v = a1 1 x P1 + i21 x P2 = 0.5 x 0.75 + 0.3 x 0.25 = 0.375 + 0.075 = 0.45; and the optimal frequency of use of its competitor B1 and B2, the strategies according to the equation niyamas (3) respectively will be:

q 1 = (v - a 12) / (a 11 - a12) = (0.45 - 0.4) / (0.5 - 0.4) = 0.05 / 0.1 = 0.5;

q 2 = 1 - q 1 = 1 - 0.5 = 0.5.

Consequently, in accordance with the obtained results, the company's regarded Vai competitive market, it is advisable to production of the first type to give 75% of the estimated market segment, and the production of the second kind - only 25% of the market segment. Competitor also in these conditions it is advisable its market segment divided equally between do productions of first and second types.

However, this result is valid only when competing Store, us are not aware of the actions of the other side, which is unlikely.

In the case of the game m x n, where: m> 2 and n> 2, the solution turns out to be more complicated (if the upper, lower prices of the game do not match).

The problem of game theory in this case can be described by the following system of equations:

$$\begin{cases} a11 \times x1 + a21 \times x2 + \ldots + am1 \times xm \geq 1; \\ \ldots\ldots\ldots\ldots\ldots\ldots \\ a1n \times x1 + a2n \times x2 + \ldots + amn \times xm \geq 1. \end{cases} \quad (4)$$

x1 = P1 / v; £ xi = 1 / v and it is required to find a minimum of a linear form

M=x1+x2+...+xn.

$$v(F,G)=\int\int M(x,y)\,dF(x)\,dG(y) \quad (5)$$

Such games through the normalization process are reduced to equivalent rectangular games (Figure 1). The normalization procedure consists in building a game tree, calculating the payment for each branch of the game, and compiling a payment matrix.

Figure 1. Tree Game 8 x 4

Let side A have two strategies at the first move (for example, focusing on the markets of one region A'11 or at the markets of another region A'12) and at the second move also have two strategies (for example, sell products of the first kind A'21 or second A'22). Competitors in the first time during the two strategies (for example, focus on about induction of the first type B '1 or the product of the second type B' 2). A payment is known for any variant of moves (for example, loss of a market segment by side B).

Consider all the possible strategies of side A:

A1 - A'11 and A'21 are selected, regardless of the behavior of side B;

A2 - A'11 is chosen, and the second move according to the rule: if B'1, then A'21; if B'2, then A'22;

A 3 is the same, but the second move is made inverse in comparison with the previous order;

A4 - A'11 and A'22 are selected, regardless of the behavior of side B;

A5 - A'12 and A'21 are selected, regardless of the behavior of side B;

A6 - A'12 is chosen, and the second move according to the rule: if B'1, then A'21; if B'2, then A'22;

A7 - the same, but the second move is made inverse in comparison with the previous order;

A8 - A'12 and A'22 are selected, regardless of the behavior of side B.

Side B has four possible strategies:

B1 - choose B'1 regardless of the behavior of side A;

B2 - if A'11, then B'1, and if A'12, then B'2;

B3 - the same, but vice versa;

B4 - choose B'2, regardless of the behavior of side A.

Now it is possible to compose a payment matrix using Figure 1 and the introduced notation for the strategies of the parties (table 4).

Instead of the 2x4 matrix, which took place in a one-way game, a bulkier 8x4 matrix was obtained.

The game can be played if there is complete information, if there is information about the first move and if there is no information.

If the information is complete, then all of the strategies of parties A and B above are possible.

If side A does not have information before the second move, then strategies A2, A 3, A6 and A7 disappear, since side A makes a move depending on the first move of side B and a 4x2 game takes place.

Table 4. Payment matrix of the game 8x4 (general view)

B / A	B1	B 2	B 3	B 4	min lines
A1	a1	a1	a3	a3	a1

A2	a1	a1	a4	a4	a2
A3	a2	a2	a3	a3	a3
A4	a2	a2	a4	a4	a4
A5	a5	a7	a5	a7	a5
A6	a6	a8	a6	a8	a6
A7	a2	a7	a2	a7	a7
A8	a6	a8	a6	a8	a8
max the columns	β 1	β 2	β 3	β 4	

If side B does not have information, then only two strategies B1 and B4 remain for it and an 8x2 game takes place.

Finally, in the complete absence of information, a 4x2 game takes place.

For the situation described above, consider the example where the mathematical expectation given Denmark losses side B (thousand. UZB.):

A1 = 8; a2 = 9; a3 = 5; a4 = 10; a5 = 6; a6 = 4; a7 = 12; a8 = 3.

Table 5. Payment matrix of the game 8x4

B \ A	B 1	B 2	B 3	B 4	min lines
A1	8	8	5	5	a1 = 5
A2	8	8	10	10	a 2 = 8
A3	9	9	5	5	a 3 = 5
A4	9	9	10	10	a 4 = 9
A5	6	12	6	12	a 5 = 6
A6	4	3	4	3	a 6 = 3
A7	9	12	9	12	a 7 = 9
A8	4	3	4	3	a 8 = 3
max the columns	β 1 = 9	β 2 = 12	β 3 = 10	β 4 = 12	9 \ 9

Determine the price of the game v in cases:

1) complete information (both sides are aware of each other's progress);

2) side A does not have information before the second move (she does not know how side B acted);

3) party B has no information before the first move (she does not know how the party acted and);

4) a complete lack of information from the parties.

According to the first option, when both sides have complete information about the actions of the competitor, it is easy to see from table 5 that the payment matrix has a saddle point corresponding to the price of the game v = 9, since:

M ax (min ai) = 9 (strategies A4 and A7);

Min (max Pj) = 9 (strategy B1).

Thus, if we have complete information about the actions of a competitor, our company can alternately apply the A4 and A7 strategies, while ensuring a guaranteed win of 9 thousand UZB ., And it is advisable for a competitor to apply the B1 strategy, ensuring a loss of no more than 9 thousand. UZB.

According to the second option, when our company (party A) does not have information about the actions of the competitor, strategies A2, A 3, A6 and A7 should be excluded, since they require the second step after the known first step of the competitor, so we get a payment matrix (table - 6)

Table 6. Payment matrix of the game 4 x 4

B / A	B 1	B 2	B 3	B 4	min lines
A1	8	8	5	5	a1 = 5
A4	9	9	10	10	a 4 = 9
A5	6	12	6	12	a 5 = 6
A8	4	3	4	3	a 8 = 3
max the columns	β 1 = 9	β 2 = 12	β 3 = 10	β 4 = 12	9 / 9

From table 6 it can be seen that under the conditions considered, the payment matrix also has a saddle point corresponding to the price of the game v = 9, since: max (min ai) = 9 (strategy A4); min (max Pj) = 9 (strategy B1).

Thus, in the absence of the information we have about the expedient competitor actions applied differently A4 strategy, while ensuring yourself a guaranteed win in the 9 th. UZB., And the competitor is advisable to apply B1 strategy, providing itself losing no more than 9 thousand. UZB

According to the third embodiment, when a competitor (side B) No information about our business activities, B1 and B4 competitor strategies are excluded, as they caused no necessity of the second step after the famous first step of our company, so that we get of the payment matrix (Table 7):

From table 7 it can be seen that in the considered conditions the payment matrix does not have a saddle point, and the price of the game is in the range from 9 to 10, since: max (min ai) = 9 (strategies A4 and A7); min (max Pj) = 10 (strategy B3).

Table 7. Payment matrix of the game 8 x 2

B / A	B 2	B 3	min lines
A1	8	5	A1 = 5
A2	8	10	A 2 = 8
A3	9	5	A 3 = 5
A4	9	10	A 4 = 9
A5	12	6	A 5 = 6
A6	3	4	A 6 = 3

A7	12	9	A 7 = 9
A8	3	4	A 8 = 3
max the columns	β 2 = 12	β 3 = 10	9 10

Thus, in the absence of competitor information about our company activities is expedient alternately use A4 and A7 strategy, while ensuring yourself Garan ted gains 9 ths. UZB., And the competitor is advisable to apply B3 strategy, providing itself losing no more than 10 thous. UZB.

If in these conditions our company will alternately apply the strategies A4 and A7, then the price of the game will be:

v = a43 x P3 + a73 x P7 = 10 x 0.5 + 9 x 0.5 = 9.5.

Thus, when alternately applying strategies A4 and A7 our company floor chaet ability to increase gain to 0.5 (th. UZB.) Or 5%.

According to the fourth embodiment, when the sides there is no information about the action ditions competitor (at our company (side A) no information on the actions of competitors - are excluded A2 strategy, A 3, A6 and A7; competitor (side B) there is no information about the action ditions our company - are excluded B1 and B4 strategy), to thereby obtain payment hydrochloric matrix (table 8):

Table 8. The payment matrix of the game 4 x 2

B A	AT 2	AT 3	min lines
A1	8	5	α 1 = 5
A4	9	10	α 4 = 9
A5	12	6	α 5 = 6
A8	3	4	α8 = 3
max the columns	β 2 = 12	β 3 = 10	9 10

From table 8 it can be seen that in the conditions under consideration the payment matrix also does not have a saddle point, and the solution (price of the game) is in the range from 9 to 10, since: max (min ai) = 9 (strategy A4); min (max Pj) = 10 (strategy B3).

Thus, in the absence of information from the parties on the actions of our company competitor is advisable to use the A4 strategy, while ensuring yourself Garan ted gains 9 ths. UZB., And the competitor is advisable to apply B3 strategy, providing itself losing no more than 10 thous. UZB.

If, under these conditions, party B will alternately apply strategies B2 and B3, then the price of the game will be:

v = a42 x P2 + a43 x P3 = 9 x 0.5 + 10 x 0.5 = 9.5.

Thus, if a competitor takes the initiative and makes an attempt to reduce losses in the conditions under consideration, then he has the opportunity to do this - by 0.5 (thousand UZB.) Or 5%

If there are several competitors, the game can have an infinite number of strategies, and for such a game it will not be possible to compose a payment matrix. It is replaced by the payment function M (x, y), where: x and y are the parameters that characterize the strategies of the parties.

Strategies in the general case are the distribution functions F (x) and G (y), and the price of the game.

$$v(F,G)=\int \int M(x,y)\cdot dF(x)\cdot dG(y)$$

In a number of practically encountered cases, games with an infinite number of strategies can be reduced to a finite one by dividing the continuous value into a number of discrete ones, which reduces the accuracy of solving the problem and leads to a cumbersome payment matrix.

An exact solution to games with an infinite number of strategies and with a lack of information can only be obtained in individual cases.

3. Conclusion

Thus, in a market economy, game theory can be a reliable tool for ensuring managerial activity and decision-making in conditions of uncertainty, including the complete or partial absence of information about competitors' actions.

References

1. Kaplinski, O., & Tamošaitiene, J. (2010). Game theory applications in construction engineering and management. Technological and Economic Development of Economy, 16(2), 348–363. https://doi.org/10.3846/tede.2010.22
2. Lahoz-Beltra, R., Ochoa, G., & Aickelin, U. (2009). Cheating for problem solving: A genetic algorithm with social interactions. In Proceedings of the 11th Annual Genetic and Evolutionary Computation Conference, GECCO-2009 (pp. 811–817). https://doi.org/10.1145/1569901.1570013
3. von Neumann, J., & Morgenstern, O. (2007). Theory of games and economic behavior. Theory of Games and Economic Behavior. Princeton University Press. https://doi.org/10.2307/2019327
4. Zhang, S., & Zhang, Y. (2003). Introduction to game theory. Chinese Science Bulletin. https://doi.org/10.1360/99ws0111
5. Leonard, R. (2016). Game theory. In Handbook on the History of Economic Analysis (Vol. 3, pp. 222–235). Edward Elgar Publishing Ltd. https://doi.org/10.4018/jaci.2011070106
6. Kalai, E. (1991). Game theory: Analysis of conflict. Games and Economic Behavior, 3(3), 387–391. https://doi.org/10.1016/0899-8256(91)90037-f
7. Archetti, M., Scheuring, I., Hoffman, M., Frederickson, M. E., Pierce, N. E., & Yu, D. W. (2011, December). Economic game theory for mutualism and cooperation. Ecology Letters. https://doi.org/10.1111/j.1461-0248.2011.01697.x
8. Durmanov, A., Tulaboev, A., Li, M., Maksumkhanova, A., Saidmurodzoda, M., & Khafizov, O. (2019). Game theory and its (greenhouse complexes). In International Conference on Information Science and Communications Technologies: Applications, Trends and Opportunities, ICISCT 2019. Institute of Electrical and Electronics Engineers Inc. https://doi.org/10.1109/ICISCT47635.2019.9011995
9. Durmanov, A.S., Sangirova, U.R., Abdurazakova, N.M., Abraev N.K. and Xoliyorov U.E. (November, 2019). Implementation of innovative technologies as a mean of resource saving in greenhouses (through the example of the Republic of Uzbekistan). Proceedings of the 34th International Business Information Management Association Conference - Vision 2020: Sustainable Economic Development and Application of Innovation Management from Regional expansion to Global Growth, (Madrid, Spain. In Press.) pg. 15. https://ibima.org/accepted-paper/implementation-of-innovative-technologies-as-a-mean-of-resource-saving-in-greenhouses-through-the-example-of-the-republic-of-uzbekistan/
10. Hilorme, T., Tkach, K., Dorenskyi, O., Katerna, O., & Durmanov, A. (2019). Decision making model of introducing energy-saving technologies based on the analytic hierarchy process. Journal of Management Information and Decision Sciences, 22(4), 489-494.
11. Tkachenko S., Berezovska L., Protas O., Parashchenko L. and Durmanov A. (2019). Social Partnership of Services Sector Professionals in the Entrepreneurship Education, Journal of Entrepreneurship Education, 22(4), 6.
12. Umarov, S. R., Durmanov, A. S., Kilicheva, F.B., Murodov S.M. and Sattorov O.B. (2019). Greenhouse Vegetable Market Development Based on the Supply Chain Strategy in the Republic of Uzbekistan, International Journal of Supply Chain Management (IJSCM), 8(5).
13. Durmanov, A. S., Tillaev, A. X., Ismayilova, S.S., Djamalova X. S. & Murodov, S. M. ogli., "Economic-mathematical modeling of optimal level costs in the greenhouse vegetables in Uzbekistan". Espacios. Vol 40, No 10, pp. 20, 2019.

14. Durmanov, A., Bartosova, V., Drobyazko, S., Melnyk, O., & Fillipov, V. (2019). Mechanism to ensure sustainable development of enterprises in the information space. Entrepreneurship and Sustainability Issues, 7(2), 1377-1386.
15. Durmanov, A., Li, M., Khafizov, O., Maksumkhanova, A., Kilicheva, F., & Jahongir, R. (2019). Simulation modeling, analysis and performance assessment. In International Conference on Information Science and Communications Technologies: Applications, Trends and Opportunities, ICISCT 2019. Institute of Electrical and Electronics Engineers Inc. https://doi.org/10.1109/ICISCT47635.2019.9011977
16. Durmanov, A., Kalinin, N., Drobyazko, S., Yanishevska, K., Shapovalova, I. (2019). Strategic support of innovative activity of modern enterprises. 34th IBIMA Conference: 13-14 November 2019, Spain
17. Atakhanova N., Almuradova D., Khakimov G., Usmonova S., & Durmanov A. (2020). Values of a mathematical model for predicting the survival of patients with triple negative breast cancer depending on androgen receptors. International Journal of Pharmaceutical Research, 12(3), 695-704. https://doi.org/10.31838/ijpr/2020.12.03.104
18. Durmanov, A., Kalinin N., Stoyka, A., Yanishevska, K., & Shapovalova, I. (2020). Features of application of innovative development strategies in international enterprise. International Journal of Entrepreneurship Issues, 1(24), 1-9.
19. Umarov, S., Babadjanov A., Tabaev A., Yahyaev M., Durmanov A. (2020). Formation and use human capital of agriculture. Solid State Technology, 63 (4), pp. 646-655
20. Umarov, S., Muqimov, Z., Kilicheva, F., Mirkurbanova, R., Durmanov, A. (2020). New technologies in the construction of greenhouse complexes republic of Uzbekistan. Solid State Technology, 63 (4), pp. 444-452
21. Kodirov, D., Muratov Kh., Tursunov O., Ugwu E.I., Durmanov A. The use of renewable energy sources in integrated energy supply systems for agriculture. International Conference on Energetics, Civil and Agricultural Engineering 2020