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SIMULATION MODEL OF INVENTORY MANAGEMENT CEREALS

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Abstract. The grain market represents the difficult economic system consisting of organised set of managing subjects, being in certain interrelation. At system designing there are the numerous problems demanding an estimation of quantitative and qualitative laws of processes of functioning. The given problem can be solved by means of methods of imitating modelling. In given article the imitating model of storekeeping of the grain is presented, allowing to simulate full-function work of a granary.

Grain market is a complex economic system, consisting of an organized set of economic agents in a specific relationship. When designing the system, there are numerous tasks that require evaluation of quantitative and qualitative patterns of functioning processes. This problem can be solved using simulation techniques. This paper presents a simulation model of inventory control of the grain market, allowing simulating a fully functional operation of the elevator.

Topicality

Grain production is a major industry in agriculture and it plays an important role in the economy of the Republic of Kazakhstan, so the study of the functioning and development trends of grain are current issues of economic importance. To improve the efficiency of grain production, the stability of its market strategy is necessary to improve the grain market, the mechanisms of its regulation.

Lack of effective mechanisms for self-regulation in relation to grain market due to its characteristics and, above all, its dependence on soil and climatic conditions, fluctuations in grain yields in production of marketable products. In addition, the transition state of the economy the relationship between supply and demand is very unbalanced, and the deviation reaches a considerable value. Eliminate them at the expense of market mechanisms in the short term, so even without the negative social and economic consequences, it is not possible, so there is increased regulatory role of the state. The difference between supply and demand leads to a mismatch and onset of action of regulatory mechanisms, as well as the mechanisms of market self-regulation, which together eliminate this mismatch. Supply and demand are characterized by constant fluctuations in volume, sales prices, depending on the yield of grain crops, weather conditions and a number of other external factors. By virtue of this regulatory mechanism and self-regulatory mechanisms must be continuous.

1. The model of inventory management in the elevator

Inventory model - view of the model, which is used to determine the time of placing orders for resources and their number and weight of finished products in warehouses [1].

The purpose of the model of inventory management - to minimize the adverse effects of the accumulation of reserves, resulting in certain costs.

In the development of a simulation model of inventory control grain used classical inventory model [2], which is one of the simplest and most obvious examples of application of the mathematical apparatus for decision-making in the economic field. This model is practically useful for decision-making in the management of inventory and brings significant economic effect. Also, the optimum size of the order, considered in this model is widely used in various stages of production and distribution.

Consider the model of a granary with the following conditions:
- Demand is a discrete random variable with a given distribution law - μ;
- Delivery time - a continuous random variable with a normal distribution - ti;
- The volume of grain supplies for a certain period of time - Qpos;
- Payment for the storage of grain for the unit of time - s;
- Payment for the delivery of a shipment of grain - g;
- The cost of shipping grain - k;
- Payment for the lack of unit price per unit of time - h;
- Planning horizon - T.

As an indicator of the effectiveness will take average costs:

$$f(y,T) = f(y(t), 0 \le t \prec T) \to \min$$

Let y (t) - value of stocks of grain in stock at time t, t> 0. Demand for grain random value with a given distribution and the intensity of demand μ, t. E. The time interval Δt is removed from the warehouse and into consumers of the grain size of the stock μΔt. At ti replenished supply of grain in stock - come Qpos delivery quantity. Thus, the time variation values of grain stocks y (t) is represented stock toothed broken line (Figure 1) consisting of an inclined or vertical units, wherein the inclined parallel segments.

Thus, at the time ti ($i = \overline{1,n}$) value of grain stocks in the warehouse y (t) increases abruptly at Qpos. Consequently, the function y (t) has discontinuities at points t1, t2, ..., tn. For definiteness, we assume that this function is continuous on the right.

Let s - payment for grain storage for a unit of time. Since it can be assumed that the quantity of grain stocks y (t) does not change during the time interval (t; t + dt), where dt - differential t. E. Infinitesimal, the fee for the storage of the entire stock during this time interval is equal to sy (t) dt. Consequently, the costs for storage during time interval [0; T), where T - planning interval, proportional (proportionality coefficient s) area under the graph (Figure 1) at the level of reserve stock grain y (t) are equal and

$$L_{xp} = s\int_{0}^{T} y(t)dt. \tag{1}$$

Let g - postage one batch of grain. We assume that the board is independent of the size of the shipment.

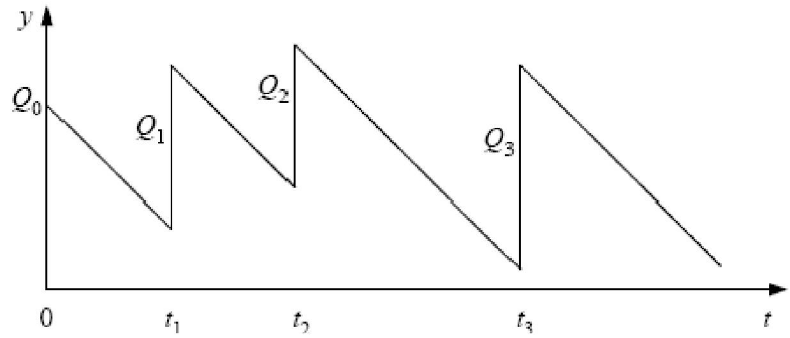


Figure 1 – Changes in the value of the stock of grain in stock

Let n (T) – the amount of grain supply that came in the interval [0; T). Then the total cost of shipping grain equal

$$L_{пос} = gn(T). \tag{2}$$

Let k - the cost of shipping grain, not depending on the volume. then

$$L_{отг} = k*\mu. \tag{3}$$

We assume that if there is no grain to the elevator, which owns the warehouse organization pays a fine - every day in proportion to the shortage. Upon arrival the next grain supplies all the accumulated demands are met immediately. Pent-up demand will be considered as a negative margin. Schedule change of the grain reserve stock is depicted in Figure 2.

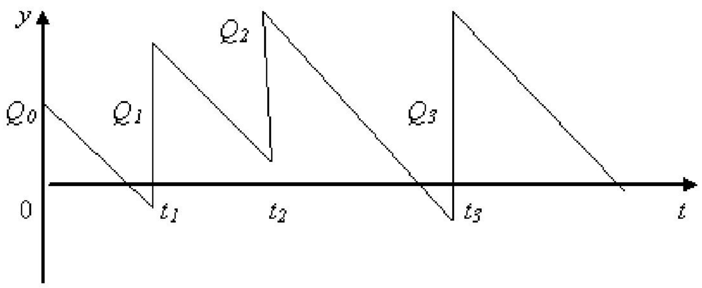


Figure 2 – Diagram of the value of the stock of grain in stock if possible deficit

Let h - charge for lack of unit price per unit of time (eg, daily). Then the penalties for deficiencies will be equal

$$L_{деф} = h \int_0^T |y(t)| \chi(y(t) < 0) dt . \quad (4)$$

where where χ (A) - an indicator of the set A, ie χ (y (t)> 0) = 1 for y (t)> 0, and χ (y (t)> 0) = 0 for y (t) <0, whereas χ (y (t) <0) = 1 for y (t) <0, and χ (y (t) <0) = 0 for y (t)> 0.

Consequently, the overall costs (costs) for the time T equal to

$$F(T; y) = F(y(t), 0 \le t \prec T) = gn(T) + k\mu + s\int_0^T y(t)(y(t) \ge 0)dt + h\int_0^T |y(t)| \chi(y(t) < 0)dt. \quad (5)$$

Record means that the total costs depend on the values of the function y = y (t) for all 0 <t <T. Symbol y represents a function as a whole. That is the domain of the F (T; y) for fixed T - not a lot of numbers, and a variety of functions.

Total costs obviously increase with the growth of the planning horizon T. Therefore, often use the average cost per unit of time.

Then the average cost in time T defined by the formula

$$f(T; y) = f(y(t), 0 \le t \prec T) = \frac{1}{T}\left\{ s\int_0^T y(t)\chi(y(t) \ge 0)dt + h\int_0^T |y(t)| \chi(y(t) < 0)dt + gn(T) + k\mu \right\}. \quad (6)$$

Thus, the area of the graph under the stock level lying above the abscissa is taken with factor s, and the area between the abscissa of the graph and y (t), corresponding to negative values of the margin is taken with markedly greater in magnitude by a factor h.

Optimal plan is as follows [3]. First fix moments grain supplies and find in this condition the optimal size of supplies. In fact, it comes to choosing the level of reserve Y at the time of arrival the next delivery.

Increasing or decreasing the Y, you can increase or decrease the area of the triangle above the x-axis (to take into account a factor of s) and, accordingly, reduce or increase the area of the triangle under the x-axis (to take into account a factor of h), seeking to minimize the weighted sum of these areas. All elements of the right-angled triangles in Figure 2 are expressed through the Y, the set interval of time between the supply and the model parameters. Minimizing the corresponding quadratic polynomial gives the optimal value

$$Y = \frac{h}{s+h}\mu\Delta. \quad (7)$$

The minimum amount of storage costs and expenses caused by the deficit is

$$\frac{\Delta^2\mu}{2}\frac{sh}{s+h}. \quad (8)$$

In the second step of finding the optimal plan fixed number of grain supply, and by varying the size of the intervals between deliveries minimizes the objective functional. Since the sum of the squares of a number of variables for a given amount of them reaches a minimum when all these variables are equal, the best plan is a plan in which all the teeth are the same, ie, inventory level at the time of the arrival of the next delivery - always the same. Thus all shipments, except for the initial (zero) are equal

$$Q = Q_1 = Q_2 = Q_3 = ..., Q_0 = \frac{h}{s+h}Q \qquad (9)$$

In the third stage of this one-parameter among a discrete set of plans are the best. As a guideline used to the size of the delivery plan, determined by the formula (10), square root,

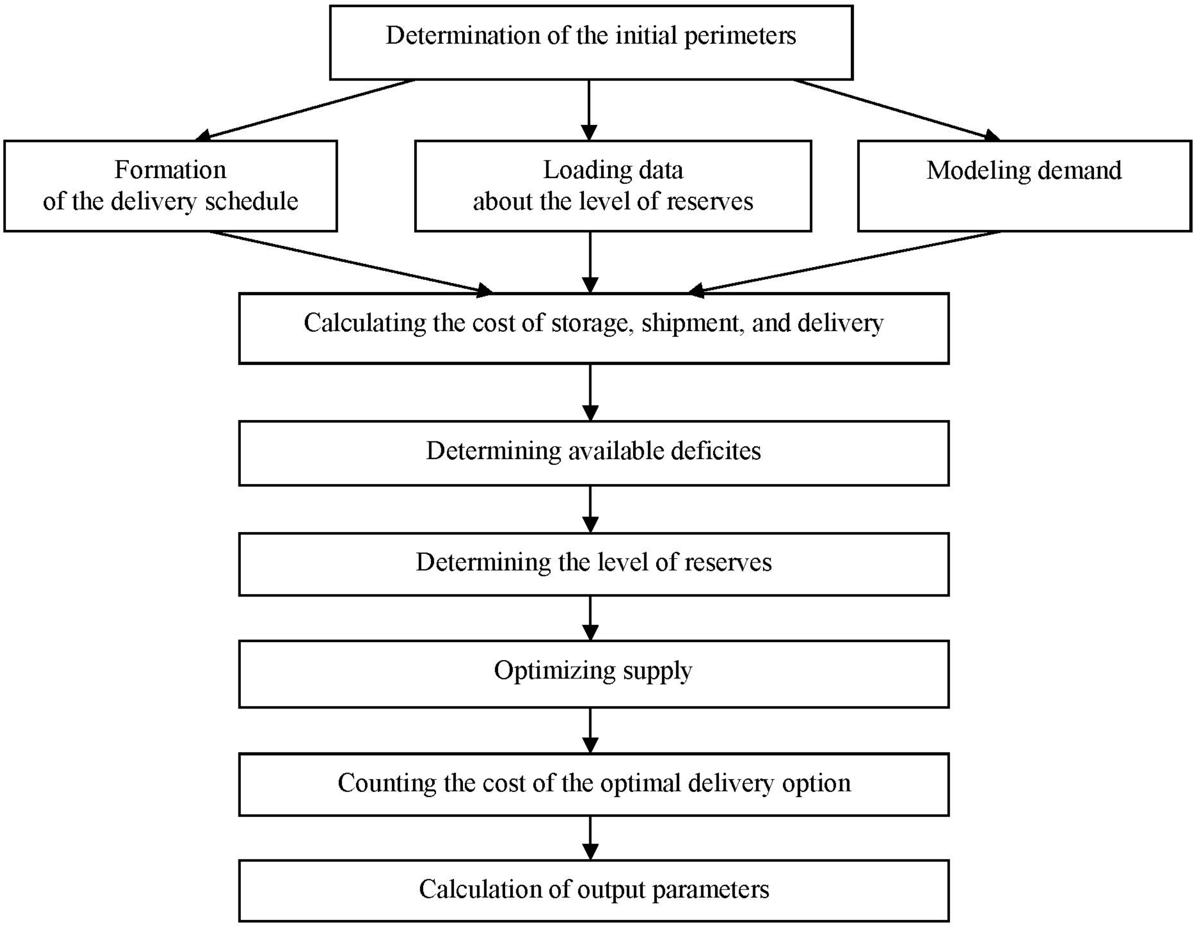
$$Q_0(\mu, g, s, h) = \sqrt{\frac{2\mu g(s+h)}{sh}}. \qquad (10)$$

For T planning horizons, multiple / μ, is optimal plan type (9) with $Q = Q_0(\mu, g, s, h)$. For all other planning horizons, as in the case of the model without the deficit is necessary to find a non-negative integer n such that $Q_q = \frac{\mu T}{n+1} < Q_0(\mu, g, s, h) < \frac{\mu T}{n} = Q_2$.

Then, comparing the costs for Q = Q1 and Q = Q2, declare that the best of these two values, for which costs less.

2. Simulation algorithm inventory management

In modeling and solving the problem of inventory management grain initially setting initial values (Figure 3). After the initial data is entered, select the method of modeling and simulation produced the volume of demand, supply and construction of the graph preserving the simulation results in the database. Analyzing the presence of deficits. Calculated the cost of storing, shipping, and delivery volumes of fines for deficits, then summed and output the final cost of these measures for a month. Calculated the total cost



Picture 3 – Chart of algorithm of case frame by the supplies of grain per month by reference plan. We analyze the stock level. Then formed the scope of delivery. At the end of the calculation are given recommendations to adjust the delivery schedule. Formed corrected table delivery schedules, and then formed the optimal schedule of delivery and payment of expenses for storage, shipment and delivery on the optimal schedule. It also calculates the total cost per month by the optimal plan.

Findings

In conclusion, it should be noted that the state of development of the grain market depend date, extent and effectiveness of the implementation of grain production, the rate of return on investment in production facilities, as well as providing consumers with the grain and its products. A simulation model of inventory control allows the grain to reveal regularities of the process, significant from the point of view of automatic control, flow control information to identify and select the optimal control algoritm

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АСТЫҚ ТҮРІ ҚОРЫНЫҢ БАСҚАРУДАҒЫ ИМИТАЦИЯЛЫҚ МОДЕЛІ

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Тірек сөздер: астық, қалып, имитация, элеватор, алгоритм, оңтайландыру, нәтиже, басқармалар.

Аннотация. Мақалада астық нарығы белгілі байланыста болатын шаруашылық субъекттерінің ұйымдасқан жиынтығынан тұратын күрделі экономикалық жүйе болып табылады. Жүйені жобалау кезінде жұмыс істеу процесстерінің сандық және сапалық заңдылықтарын бағалауды талап ететін көптеген мәселелер туындайды. Бұл проблеманы имитациялық модельдеу әдістерінің көмегімен шешуге болады. Бұл мақалада астық қоймасының толық жұмыс істеуін имитациялауға мүмкіндік беретін, астық қорын басқарудың имитациялық моделі көрсетілген.

ИМИТАЦИОННАЯ МОДЕЛЬ УПРАВЛЕНИЯ ЗАПАСАМИ ЗЕРНОВЫХ КУЛЬТУР

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Ключевые слова: зерна, модель, имитация, элеватор, алгоритм, оптимизация, эффект, управления.

Аннотация. В этой статье зерновой рынок является субъектом объединяющим хозяйства как сложная экономическая система. В процессе работы во время проэтирования системы численности и закономерности качественного состава возникли много вопросов. Эти проблемы можно решить имитационной моделью управления и показать ресурсы зерна.

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