UDC 658.783+339.144+519.86

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ANALYSIS OF MATHEMATICAL METHODS AND MODELS WHICH ARE USED FOR THE PROCESS OF MANAGEMENT OF COMMODITY STOCKS IN RETAIL TRADE

Statement of the problem. The urgency is determined by the necessity of the increase of the efficiency of management of commodity stocks and also the increase of competitiveness – the most important condition of scientific and technical reformation of the economic states in the world. Market system of economic relations generates new queries and promotes the interest to potential possibilities of scientific researches in the field of wholesale and retail trade. It is one of the spheres with which masses of population contact every day.

The urgency of this research consists in the expansion of application of mathematical and instrumental methods and models of the economy through their modification and distribution on a wider range of real economic situations with the aim of overcoming the existent limitations on a number of parameters.

Analysis of basic researches and publications. The problems in relation to forming of commodity were worked out by Z.V. Alfereva, E. M. Anisimova, B. A. Balash, O. S. Balash, O. E. Bashina, U. A. Belyayev, D. Bukan, V. O. Dick, V. O. Dybska, M.E. Zal-manova, S. M. Kolesnikov, V.L.Lenshin, M. R. Linders, A.L.. Margolin, E. A. Mikhailov, U. M. Nerush, V. O. Nikolaichuk, A. R. Radionov, Y.A. Rechkalov, R.V. Savinov, A.A. Spirin, L.A. Fedorov, R.P. Fomin, Zh. P. Shilova. Their works serve as the foundation for further researches in the area of perfection and modification of mathematical and instrumental methods and economic models.

Unsolved constituents of a general issue. However the question of management of commodity stocks remained investigational not enough, as the existent methods allow not estimating it comprehensively.

Formulation of the aim of the article. The aim of the article consists in consideration and analysis of the existent mathematical methods and models which are used for the process of the management of commodity stocks in a retail business.

Stating of basic material of the research. Commodity stocks (CS) are products which are in the sphere of distribution chain (in the warehouses of productive enterprises, trade and sale organizations and retail trade network and in transit) and are intended for realization.

CS is the necessary condition of continuity of the productive process. CS appears at all stages of the motion of commodities in the warehouses of productive enterprises, in transit, in the warehouses of wholesale and retail trade organizations and enterprises.

For managing commodity stocks the following methods are used:

1. Periodic method (the regulating system with the fixed periodicity of order). One of the most popular methods [1].

The essence of this method consists already in its name – it is the system with the fixed periodicity of order or the system of checking of supplies with periodic verification. Graphic interpretation of this method is presented on figure 1:
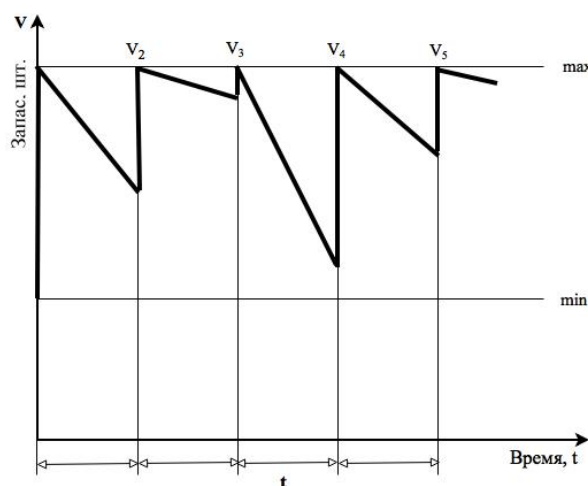
Fig. 1. The change of the level of stock at the periodic method of regulation

Field of application of this system:

1) not very valuable objects;

2) low expenses on storage;

3) insignificant expenses even if stocks are finished;

4) relatively permanent level of inquiry;

5) small expenses on materials and their proportional expense;

6) not high transport-purveying expenses.

Simplicity (regulating only one time during the whole interval - it is not needed to conduct regular account of supplies) is the advantage of this method.

The defects of this method are the danger of exhausting of stocks at their intensive unforeseen consumption. The second defect is the necessity to do an order even on the negligible quantity of materials (it results in additional expenses).

2. Relaxation method (the system of regulating stocks with the fixed quantity of order). It is also one of the most popular methods [1].

The essence of the relaxation method consists in permanent (daily) control after the level of supply and its short-term prognostication. The system of regulating

of stocks with the fixed quantity of order also has a number of different modifications. Graphic interpretation of this method is presented on figure 2:
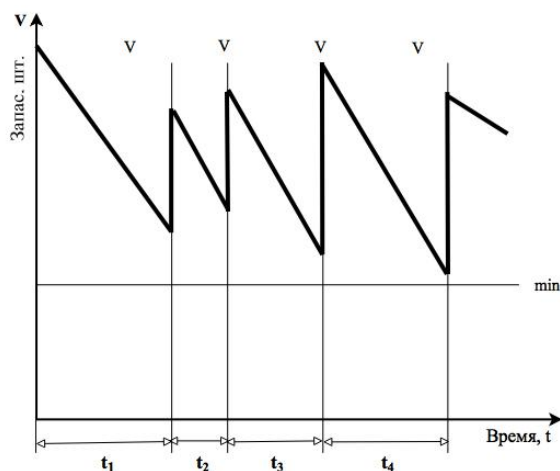
Fig. 2. The change of the level of stock at the relaxation method of regulating
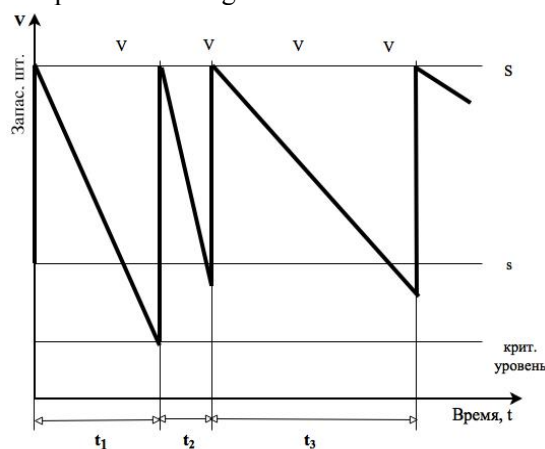
Fields of application :
1) high cost of materials;
2) high expenses of storage;
3) high level of the losses in case of deficit;

The advantage of this system is that the materials come with identical batches which decreases the expenses from delivery and the content of supply.

The defects consist in the fact that it is necessary to take systematic continuous control of stocks which increases expenses related to its regulation.

3. The two-level system of regulating of stocks (the system of maximum-minimum) [3]. It is characterized by the fact that the possible level of stocks is regulated both from upper and from lower: except a maximal (upper) level to which the supply of stock is fulfilled, the lower level is set – the point of order. If the quantity of stock is decreased to this lower level (critical level) before the completion of the set period of order, then out of turn order is done. Graphic interpretation of this method is presented on figure 3.

Fig. 3. The change of the level of stock at the two-level system

Field of application :
1) in situations, where it is necessary to take into account the delay of delivery;
2) oriented to the situation, when expenses on the warehouse and stocks are compared, id est they are considerably lower than possible expenses in case of stopping of the production.

The advantages are the exception of the possibility of shortage of the materials defects to the term of the next delivery; however in this system filling of stocks can be conducted regardless of actual expense of stocks. The second advantage of this method is providing of the support of the system in the non-deficit state.

The main defect is the necessity of conducting the permanent watching of the level of stocks.

Let's consider the existent models which are used for management of commodity stocks:

If the investigated quantity in the model can be presented as an analytical formula or a system of formulas, then the determined models are used. The determined models are classified on static and dynamic.

One of the elementary models, from the point of view of mathematics, are *static models*. It is foreseen that at formulation of static economical-mathematical model, all dependences are set to one moment of time, and the designing system is unchanged in time [5].

Therefore for the economical-mathematical modeling there is a typical situation, when static models are developed at first and then they become complicated by introduction of the factor of time, id est are transformed into dynamic.

Static characteristics can be presented:
• by the mathematical model of the type of $Y = F(X)$;
• by the graphic model.

The examples of static model for management of commodity stocks are one food static model. One food static model assumes a deficit and also a number of products with limits of the capacity of storage facilities [5].

Dynamic models (models of dynamics) are the process of changes of the states of real or designed system. They show the differences between the states, the sequence of changes of the states and the development of events in the course of time.

Mathematical description of dynamic models is conducted as a rule:
• by the systems of differential equations (where time comes forward as a continuous variable);
• by difference equations (where time is a discrete quantity);
• by the systems of ordinary algebraic equations.

The examples of a dynamic model for management of commodity stocks are a model for the absence of expenses on the processing order and a model with expenses on the processing order.

The above mentioned models are applied in the condition of definiteness, but the necessary information is not always described by an analytical formula or sys-

tem of formulas. If there is no one a probabilistic model is used.

A probabilistic model (stochastic model) is such an economical-mathematical model where parameters, conditions of functioning and characteristic of the state are presented by casual quantities and are connected by stochastic (id est casual, irregular) dependences or initial information is also presented by casual quantities [6].

While working out a stochastic model, methods of cross-correlation and regressive analyses and other statistical methods are used [4].

The examples of stochastic models on managing trade stocks is a model with fixed volume of order and

a conception of the level of service, a model with fixed periodicity and a conception of the level of service [7].

Conclusions of this research and prospects of the further research in this direction. Analysis of the existent mathematical methods and models has been done. The table of descriptions of methods which are used for management of commodity stocks has been made up. Advantages and defects have been considered, certain field of application has been defined.

The model of management of stocks is classified by the character of the demand which can be determined or probabilistic. The types of models of management of stocks depend on the character of the demand as shown on figure 4:

Increase of the mathematical complexity of models
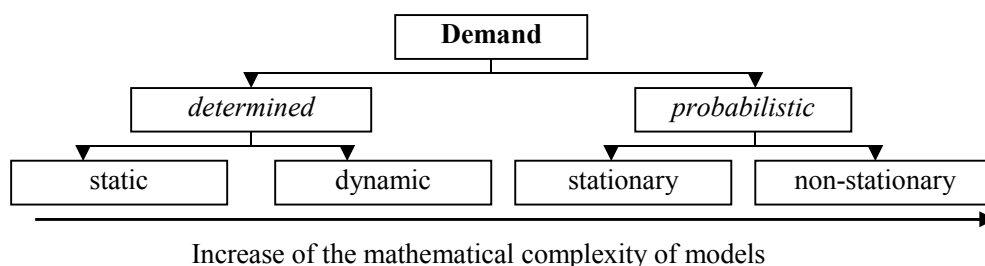
Fig. 4. Types of models of management of stocks depending on the character of the demand

The determined demand depending on the factor of time is divided into static (does not depend on time) and dynamic. Probabilistic demand can be stationary, id est the consistence of probability of the demand does not change in time and is non-stationary when the function of consistence of the distribution of the probability of the demand changes in the course of time.

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Івченкова О. Ю., Лях А. О. Аналіз математичних методів і моделей, які використовуються в процесі управління товарними запасами в роздрібній торгівлі

У статті розглянуто поняття товарних запасів, роль у підприємницької діяльності. Автори зробили порівняльний аналіз існуючих математичних методів з наступним формуванням таблиці. Складена схема класифікації математичних моделей з управління товарних запасів.

Ключові слова: товарні запаси, управління товарними запасами, рівні ньому запасу, періодичний

метод, релаксаційний метод, дворівнева система регулювання запасів.

Ивченкова Е. Ю., Лях А. А. Анализ математических методов и моделей, которые применяются для процесса управления товарными запасами в розничной торговле

В статье рассмотрены понятие товарных запасов, роль в предпринимательской деятельности. Авторы сделали сравнительный анализ существующих математических методов с последующим формированием таблицы. Составлена схема классификации математических моделей по управлению товарных запасов.

Ключевые слова: товарные запасы, управление товарными запасами, уровнем запаса, периодический метод, релаксационный метод, двухуровневая система регулирования запасов.

Ivchenkova H. Y., Lyakh A. O. Analysis of Mathematical Methods and Models which are Used for the Process of Management of Commodity Stocks in Retail Trade

The article discusses the concept of inventory, role in a company's activities. The authors made a comparative analysis of existing mate-automatic methods, followed by the formation of the table. The scheme of classification of mathematical models for the management of inventory.

Keywords: inventories, inventory management, level of inventory, a periodic method, relaxation method, two-level system of regulation of stocks.