РОЗРОБКА ПІДПРОГРАМИ ДЛЯ АНАЛІЗУВАННЯ СТРАТЕГІЇ ВИРОБНИЦТВА ПРОДУКЦІЇ В УМОВАХ КОНКУРЕНТНОГО СЕРЕДОВИЩА

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DEVELOPMENT OF A SUBPROGRAM FOR ANALYZING PRODUCTION STRATEGY IN A COMPETITIVE ENVIRONMENT

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Анотація

В данній статті буде розглянуто роботу ринку в умовах конкуренції на прикладі конкуренції трьох, восьми і п`ятнадцяти виробників. Відбудеться порівняння їх стратегії розвитку відносно розподілу ресурсу на рекламу і якість товару. Що можна зробити завдяки прогнозуванню ринку.

Також буде розглянуто стратегію оптимального розподілення ресурсу і наведено приклади коли варто її дотримуватися , а коли краще ризикувати для більшої продуктивності і прибутку на даній лінійці товару.

Abstract

In this article, we will explore market dynamics in competitive conditions, using examples of competitions involving three, eight, and fifteen manufacturers. We will compare their development strategies in terms of resource allocation between advertising and product quality. We will also discuss the benefits of market forecasting.

Additionally, we will delve into the strategy of optimal resource allocation and provide examples of when it is advisable to adhere to it and when taking risks may lead to higher productivity and profit in a particular product line.

Ключові слова: оптимальне агрегування, виробництво, продаж, імітування.

Keywords: Optimal aggregation, production, sales, simulation.

1. INTRODUCTION

“What if?” - This is a question that managers often ask themselves. But why not ask, "what specifically will happen next?" Because "what will happen if" only analyzes certain states of the business environment. Since it is impossible to predict the state of the future at first glance, it may seem that science is helpless here, but this is not the case. Usually, we can only forecast demand, supply, exchange rates, and so on. However, forecasting the economic system is different from forecasting changes in the solar system. Therefore, it is through the influence on the economic system that we can influence its future, and the more our steps are calculated, the greater impact we can have[1].

"What will happen if" serves as active forecasting - our task is to model several scenarios of a better future so that we can then choose it by simple actions in the present and their impact on the economic market.

The goal of this work is to master the technology of developing and using models for decision-making, using the example of developing a model of a system of producers of a certain class of products and conducting research.

2. PROBLEM STATEMENT

The system of producers of meat and dairy products is considered, for example:

Let's create a model that will answer the following questions:

- Changes in the market share of participants.
- The possibility of competition in this market for newcomers.
- Choice of strategies for firms with different capital.
- Are small firms competitive?
- What is the optimal market distribution for the state?
- The presence of equilibrium states and system stability to disturbances.
- Next, we will develop a mathematical model:

Formalize the problem: we have M types of goods and N firms. The firms are independent but connected through the market. The vector of market capacity Vm = , the components of which are the market capacities for individual goods, is given. In the first approximation, we consider them constant.

The firm's activity consists of the following stages: 0) procurement of raw materials and components, 1) production of goods, 2) goods sales in the market, 3) distribution of resources (total income) among productions. These stages cyclically (annually, quarterly, monthly, daily...) repeat. We will break the continuous process into discrete steps (year, quarter, month, day...) and relate all actions to these periods. For example, for a month, we need 121 tons of grain to feed 1332 cattle. If we choose a modeling step of 1 month, how much grain is needed to feed cattle for 1 month?

Note. It is known that for many types of products, production costs are a small part of total costs, with advertising and other marketing costs being the main ones. We will not go into too much detail about organizational, logistical, and marketing expenses.

Let's separate two stages of the "money-goods-money" cycle for now - production and the market - as inseparable links of the process. In the first approximation, we will assume that production is deterministic, while the market is probabilistic. Deterministic industrial production will be described by a known growth model with limitations: production growth is proportional to investments, the achieved level, generalized growth reserves - market underutilization (this coefficient can be negative), the availability of funds, personnel, and raw materials.

Let's go through the components of the production and market model[2-3]:

- Production volume - the total quantity of product production during a specified period.
- Production costs - expenses for product manufacturing, advertising, equipment maintenance, personnel.
- Income - the total amount of money earned from product sales.
- Profit - the amount of income minus production costs.
- Uncertainty and risks - risks associated with events that are difficult to predict, such as disease outbreaks.
- Decision-making logic - the best decision in a given situation.

Further, we will provide an example of the operation of this model for 3 producers and 3 products.

As we can see, the model is functional.

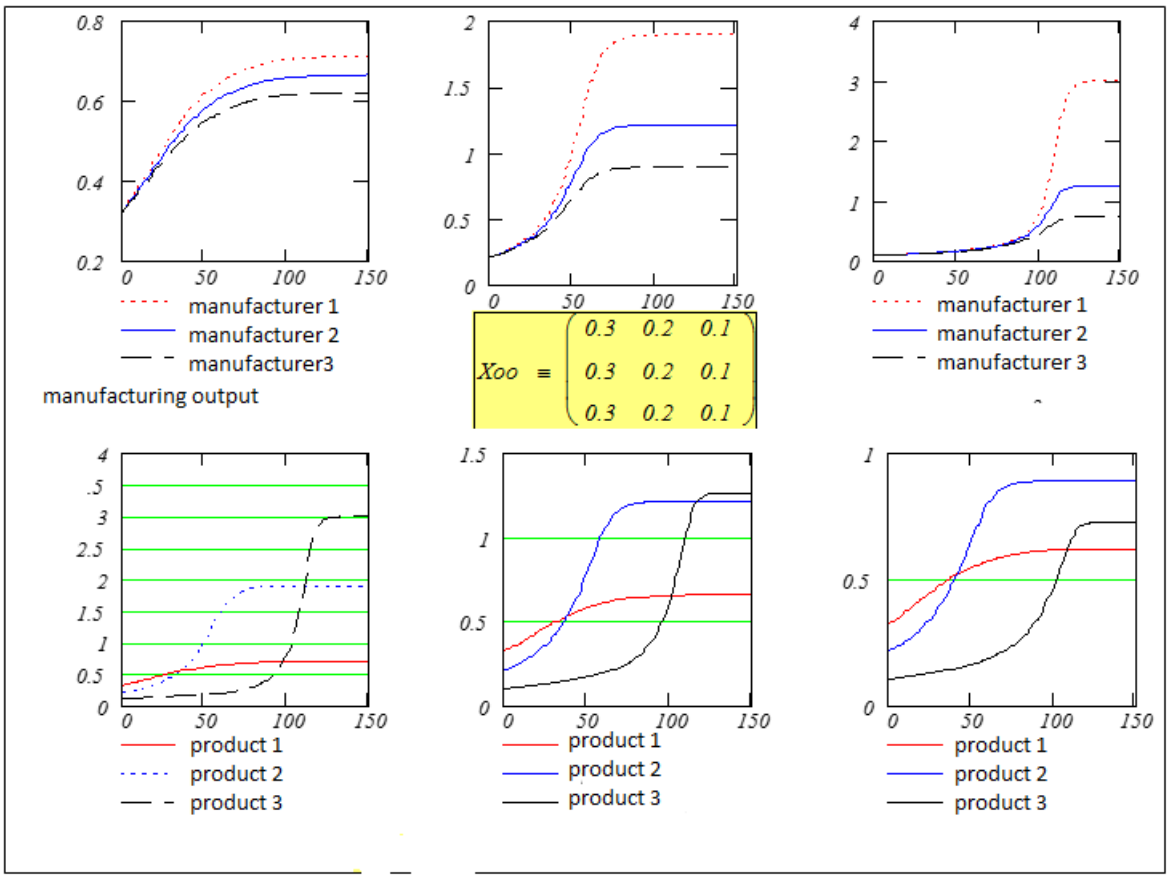

Fig. 1- an example with three manufacturers and three products.

As we can see from the graphs, depending on the strategy, all three producers have recouped their production costs. However, it is also evident that this depends on the timing of sales and the strategy chosen, given that budgets and product parameters are the same.

The first producer followed a strategy of evenly allocating resources to quality and advertising, resulting in a gradual increase in profit.

The second producer adhered to a strategy where 75% of the funds were spent on advertising, while the rest went into product quality and production speed. This resulted in a sharp increase in profit and subsequent stabilization at its peak. However, it's worth noting that such a strategy may not be sustainable and could lose out to a higher-quality product in the long run.

In the third case, 75% of the budget was allocated to product quality and production speed. As we can see, within a low-competition environment, this strategy gradually yielded the best results. However, in a highly competitive market, there is a risk of being overshadowed by more popular products in terms of quantity.

These observations highlight the importance of choosing the right strategy, understanding market dynamics, and adapting to changing conditions to ensure long-term success in business.

3.THE EXPANSION OF THE MODEL FOR ANALYZING THE MICROECONOMIC

CLIMATE NOW INCLUDES 15 PRODUCERS AND 15 PRODUCTS

We set the dimensions of the system to include 15 producers and 15 products, with a specified "recovery after a downturn" point. This situation is similar to opening a new business[4].

For a 15x15 system, a credit distribution step of k=3 is set. Therefore, the initial data for advertising spending is 50%, and with each subsequent step, it will be Adv=50+k. This allows for comparing processes based on advertising expenditure.

It's worth noting that the most stable result often comes from a proportional distribution of resources between advertising and production. However, as you will see from the following graphs, there are situations where an emphasis on advertising spending can lead to either failure or a reasonably positive outcome.

From the graph below, we can observe a trend of decreasing profit as the advertising expenditure coefficient (Adv) increases during multiple tests. In a highly competitive environment, customers typically tend to choose a higher-quality product after initially trying an advertised one, which can lead to a decline in profit and a growing sense of distrust from customers. To prevent this, after the initial investment in advertising, it's better to focus on the quality of your product. This will help solidify the results and maintain the retail of the product at a reasonably high level.

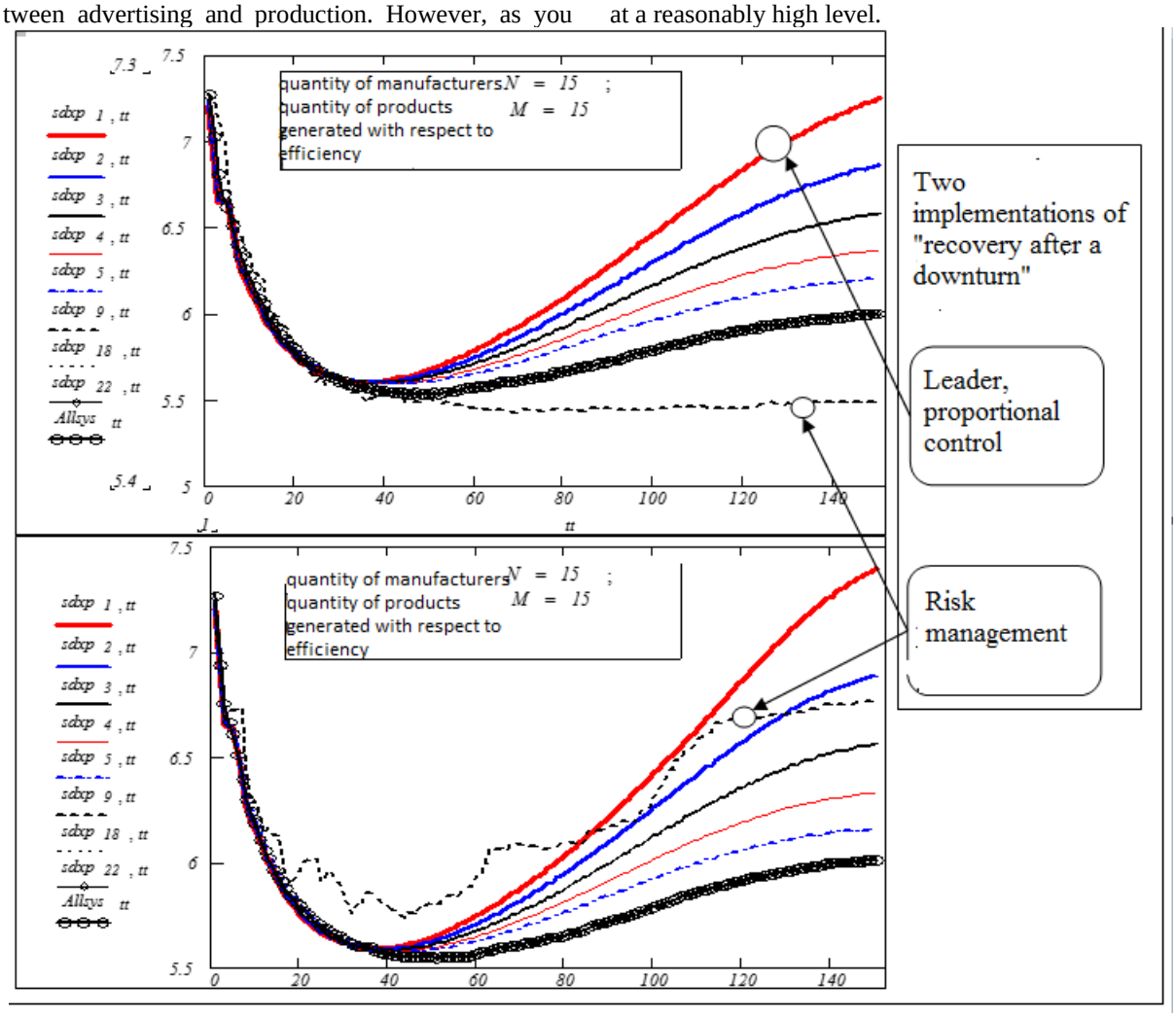

Fig. 2 – Program for 15 manufacturers and 15 products.

In the processes of recovery after a downturn, more often than in equilibrium states, the rankings of producers are disrupted due to bankruptcies of some and effective management of others. Next, we will provide a graph depicting the dynamics of these same producers but from different perspectives.

This will allow for a better understanding of the stages of bankruptcy and effective management of future projects through optimal aggregation of processes. The graphs demonstrate the effectiveness of the best and worst strategies in terms of producing 150 units of a product within a competitive environment saturated with other producers.

As we can see, a stable resource allocation efficiently maintains production in a leadership position, while risky management led to an initial collapse and only subsequent stabilization.

At first glance, it may seem that within this environment, stability is the key to success. However, what will happen if everyone follows the same strategy? This question will be addressed in the next section.

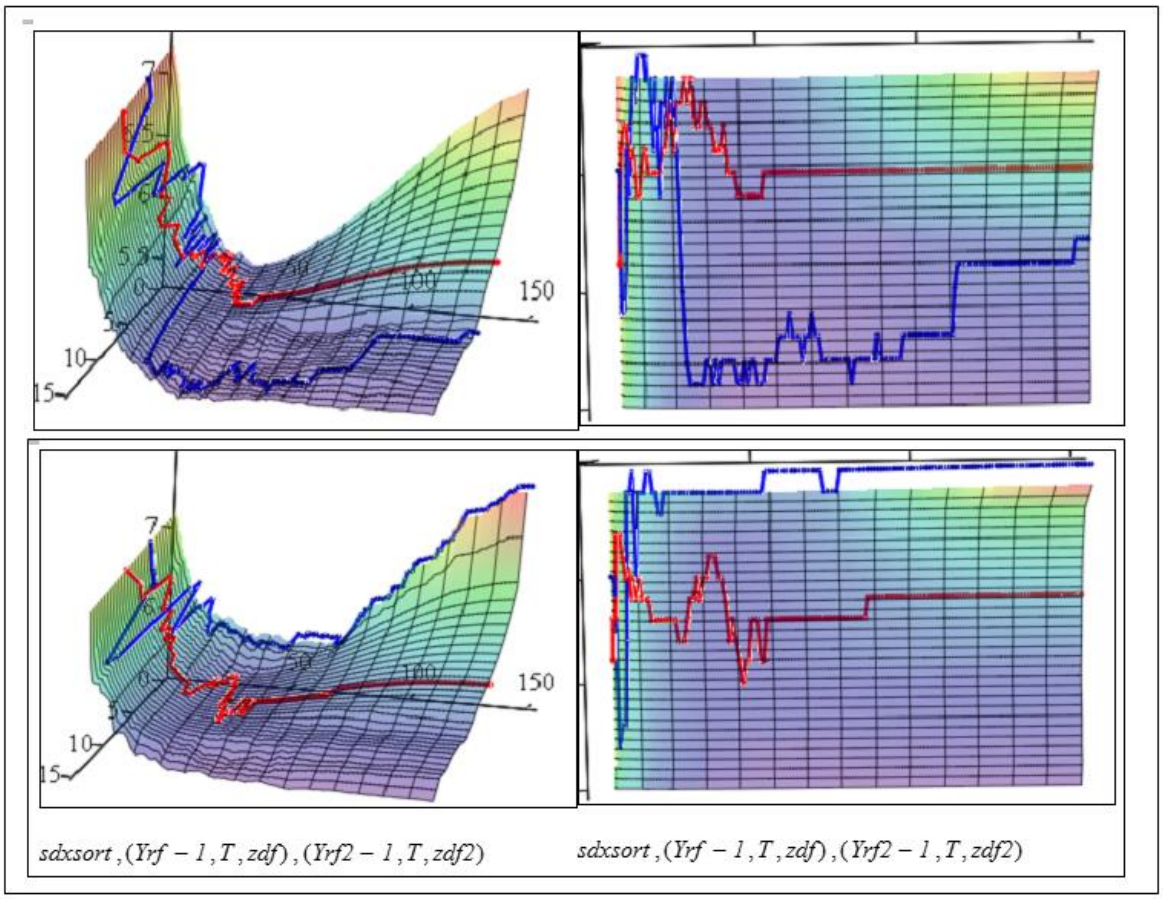

Fig 3 – Testing the RNM program, a system with 15 manufacturers and 15 products. "One against all" processes.

Development and testing of a program for "frequency probability distributions in producer systems" are being carried out. The RNM programs also facilitate histogram construction and analysis. Empirical frequency probability distributions, represented by histograms, allow for the analysis and forecasting of producers in an active environment.

4. THE HISTOGRAMS OF PRODUCT DISTRIBUTION UNDER THE CONDITION OF OPTIMAL PRODUCTION MANAGEMENT BY ALL PRODUCERS ARE SHOWN BELOW.

We can see that the probability distributions are constructed based on samples from 1000 to 2000 runs of the RNM program. The system has a dimension of eight producers, and producers are ranked by productivity. The distributions change not only parametrically but also structurally: unimodal distributions transition into bimodal and others. The distribution shape remains stable, and no significant changes are observed when the sample size exceeds 500-1000[5-6].

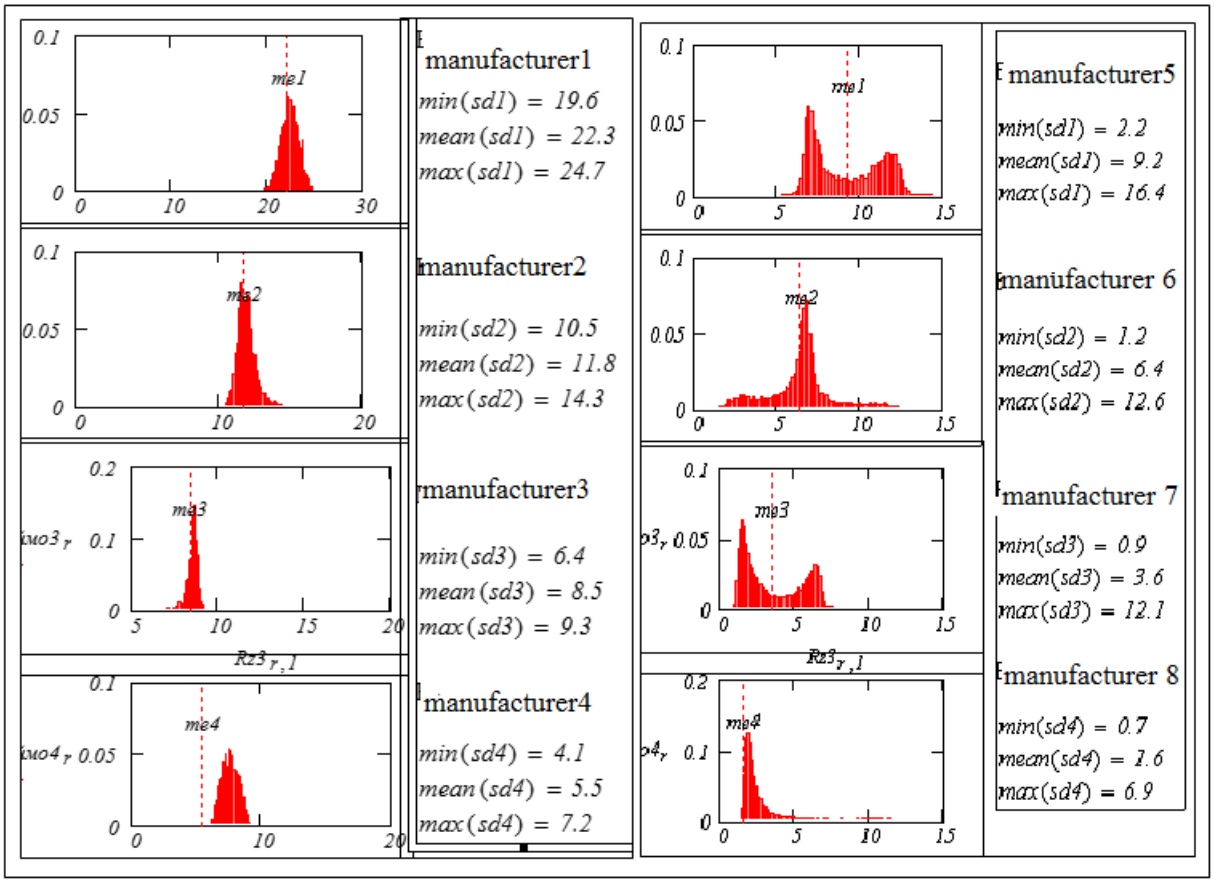

Fig. 4 – Testing the RNM program, a system of small dimensions. The influence of system parameters on the nature of distributions.

Therefore, as we can see, when using the optimal situation, producers can also distribute themselves into different niches, and this will depend on less controllable processes, such as customer preferences or perhaps store placement, assuming we do not influence the interactions between stores and customers.

CONCLUSIONS

Therefore, as we can see, the state and development of the economic system can be predicted, and even more so, it can be controlled, which helps to better understand the development of one's business. Using optimal aggregation modules makes these processes more controllable. In my opinion, if future businesses want to thrive, they should shift their focus towards the methodology of forecasting and controlling the process itself, rather than just dealing with the consequences.

We have also examined processes for 15 product producers who struggled under various conditions depending on advertising and production expenses. As we can see, higher advertising expenses can lead to better results but can also significantly worsen them. However, we have also considered a scenario where everyone acts optimally and noted that in such a situation, not every producer will emerge from the crisis with a profit.

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