MATHEMATICAL MODELLING OF EXCESSIVE DEMAND FOR ESSENTIAL COMMODITIES DYNAMICS AT PERIODIC, PANIC PR-EXCITER

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Summary

The mathematical model of excessive demand dynamics for primary commodities at periodic, panic PR-exciter has been analyzed herein. There is an exact-analytical decision of a homogeneous nonlinear problem. On the basis of software package Mathcad 2001 Pro dynamics of an excessive demand for essential commodities depending on frequency and amplitudes of the exciter.

Keywords. An excessive demand. Essential commodities. Mathematical model.

1. Introduction

The urgency of the given subjects for today is defined by the increased social activity of masses, necessity of development of the formalized, systematized approach for the most exact forecasting and selection methods of management by mass behavior, with the purpose to avoid social explosions and revolutions**.** And also, to avoid an excessive demand of the population for essential commodities or for a foreign currency.

The social psychology totals many theoretical approaches to studying a phenomenon of weights and mass behavior. Works of W. Wundt [1], Lebon [2], R.Harris [3], N.Smelzer [4], M.Weber [5], A.Nazaretyan [6] are most significant. W. Wundt, and then Lebon considered crowd as the uniform organism erasing personal features of the individual, and creating in exchange the uniform scheme of perception-thinking-behavior for all participants of such spontaneous congestion of people.

R.Harris and N.Smelzer considered basically a subject of the social status of crowd-masses as object of a manipulation mass consciousness. A.Nazaretyan offers allocation of conditional kinds of crowd on the basis of change of intensity of the emotional condition dominating over the environment of people masses congestion. Object of our research is drawing up of mathematical model of crowd dynamics to an emotional attribute under the simplified scheme (Fig.1).

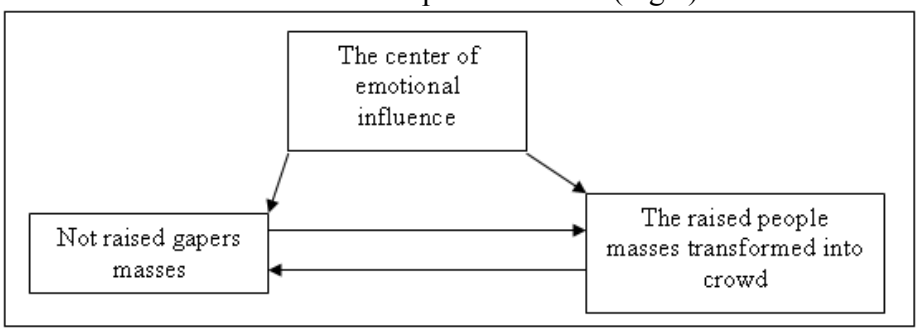

Fig.1. The scheme of emotional influence on peoples masses

Definition: crowd - a congestion of the people who have been not incorporated by a generality of the purposes and uniform organizational-role structure, but connected among themselves the general center of attention and an emotional condition. One of the important properties of crowd (the social unit) is its ability to transformations, i.e., to rather easy and fast transition from one emotional condition in another.

The mechanism of change of behavior of peoples masses - transition from one conditional kind in another, is directly caused by intensity of emotional reaction of crowd depending on force of external PR-influence.

2. Construction of mathematical model

We shall consider the simplified scheme of emotional influence on weight of people with two limiting conditions of behavior: a) not raised weight of people and b) the Raised weight of people transformed into crowd with an excessive demand. The center of emotional influence on weights can serves mass media or emotional performances of orators-provokers before public.

We write down the law of emotional dynamics of weight of people in the form of the equation of dynamics of Newton

$$n \cdot \frac{d^2 P_2}{d\varepsilon^2} = f, \qquad P_1 + P_2 = 1, \tag{1}$$

where n – quantity of people making crowd; P_2 – the probability of that crowd is in the raised condition; f – Size of force of emotional influence on crowd; ε - size of emotional excitation of crowd; P_1 – the probability of that crowd is in not raised condition.

Size of force of emotional influence on crowd (in case of, when a part of the raised weight> = 32 from all weight of crowd - I.Prangishvili's law), It is directly proportional to the double weight (quantity of people) crowds and probabilities of that the crowd is in not raised condition; and also, when the probability of increases that the crowd is in the raised condition, the size of force of emotional influence decreases.

Thus

$$f = -2 \cdot n \cdot \gamma \cdot P_1 \cdot \dot{P}_2, \quad \text{let } \gamma = 1. \tag{2}$$

Considering (1) and (2), we receive mathematical model

$$\ddot{P}_2 = -2 \cdot (1 - P_2) \cdot \dot{P}_2. \tag{3}$$

Let's enter designations

$$P_2(\varepsilon) \equiv X_0; \qquad \dot{P}_2(\varepsilon) \equiv X_1. \tag{4}$$

Then the equation (3) can be copied in the form of system of the equations

$$\begin{cases} \dot{X}_0 = X_1 \\ \dot{X}_1 = -2 \cdot (1 - X_0) \cdot X_1 \end{cases}. \tag{5}$$

Entry conditions look like

$$\begin{cases} X_0(0) = 0 \\ X_1(0) = 1 \end{cases}. \tag{6}$$

Let's try to find the exact decision of a problem (5), (6). Really, neglecting the trivial decision, we shall divide the second equation of system (5) into the first. After reductions we receive the equation with dividing variables

$$\frac{dX_1}{dX_0} = -2(1 - X_0). \tag{7}$$

Integration of this equation in view of conditions (6), gives the analytical decision

$$\begin{cases} X_0 = \dfrac{\varepsilon}{\varepsilon + 1} \\ X_1 = \dfrac{1}{\varepsilon + 1} \end{cases} \tag{8}$$

The decision of a problem (5) - (6) on the basis of package Mathcad 2001 Pro looks like a Fig. 2 – Fig.4.

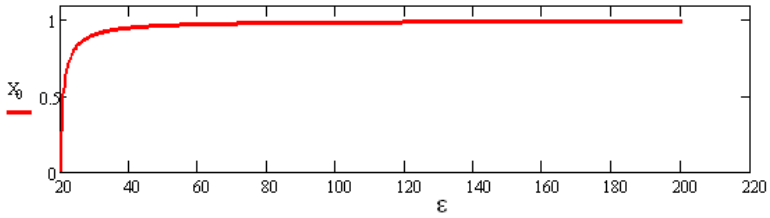

Fig.2. Dynamics of probability excitied crowds depending on increase in emotional influence

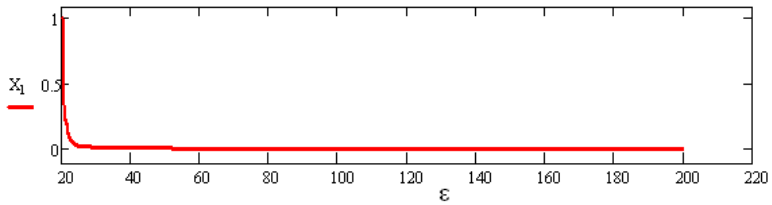

Fig.3. Dynamics of probability of calmness of crowd, depending on increase in emotional influence

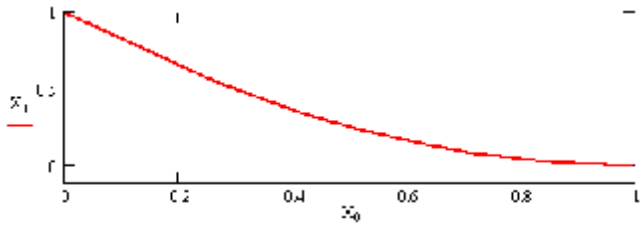

Fig.4. A phase portrait of systems.

3. Mathematical model of the response of system on the periodic activator

Let's consider now mathematical model with the periodic PR-activator at various frequency and amplitude of excitation.

$$n \cdot \frac{d^2 P_2}{d\varepsilon^2} = f + n \cdot A \cdot \sin \omega \cdot \varepsilon \,, \quad f = -2 \cdot n \cdot \gamma \cdot P_1 \cdot \dot{P}_2 \,, \quad \gamma = 1 \,, \quad P_1 + P_2 = 1 \,. \tag{9}$$

Then, we receive mathematical model

$$n \cdot \frac{d^2 P_2}{d\varepsilon^2} = -2nP_1 \dot{P}_2 + n \cdot A \cdot \sin \omega \cdot \varepsilon \,, \tag{10}$$

where $P_1 = 1 - P_2$.

If to enter designations (4) then the equation (10) will copy in the form of system

$$\begin{cases} \dot{X}_0 = X_1 \\ \dot{X}_1 = A \cdot \sin \omega\varepsilon - 2 \cdot (1 - X_0) \cdot X_1 \end{cases}, \tag{11}$$

with corresponding entry conditions (6).

Calculations show, that at small $A \approx 0.01$ amplitude (time) of external, emotional influence, the system passes in the raised condition with increase in frequency of influence. At small frequency of the activator, the system remains in a quiet condition P_1.

When $A = 0.9 \wedge \omega = 3.0$ the system is in a limiting condition. Probability of a quiet condition oscillate about value 0.5. At $A = 0.9 \wedge \omega = 9$ it is received

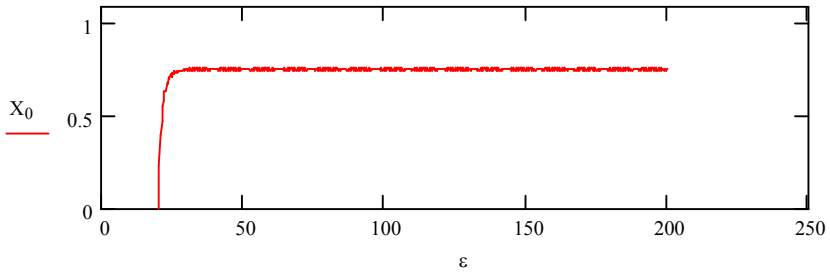

Fig.5. Almost-periodic change weakly excitied conditions at $A = 0.9 \wedge \omega = 9$

Accordingly, probability of calmness of system oscillate under the law

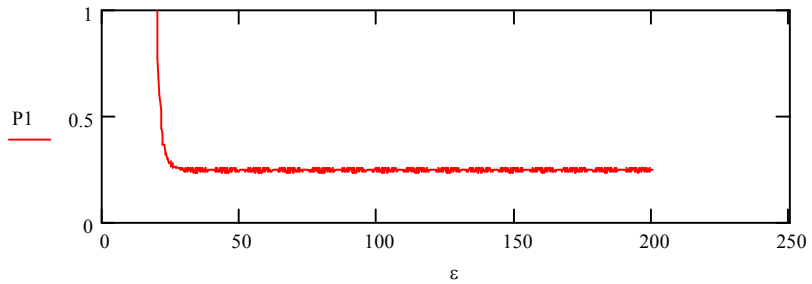

Fig.6. Probability of calmness of system at $A = 0.9 \wedge \omega = 9$

On a phase plane we receive a picture

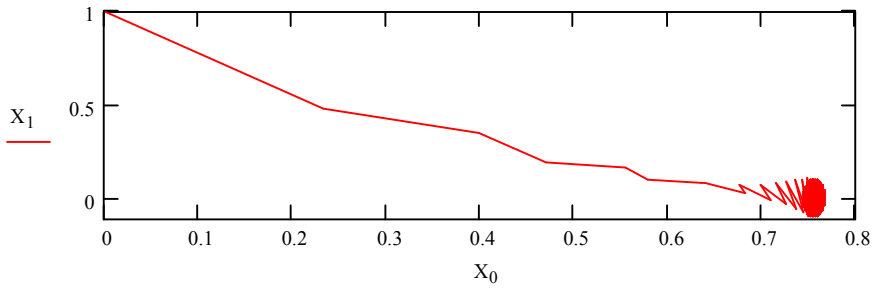

Fig.7. A picture on a phase plane (hank) at $A = 0.9 \wedge \omega = 9$

At increase of frequency of excitation up to $\omega = 29$, we receive

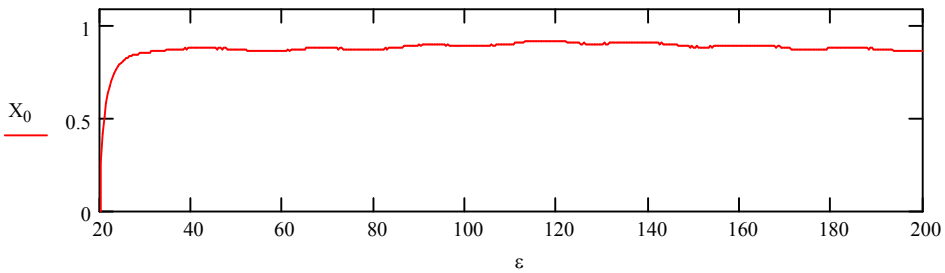

Fig.8. Change excitation at $\omega = 29$ **и** $A = 0.9$

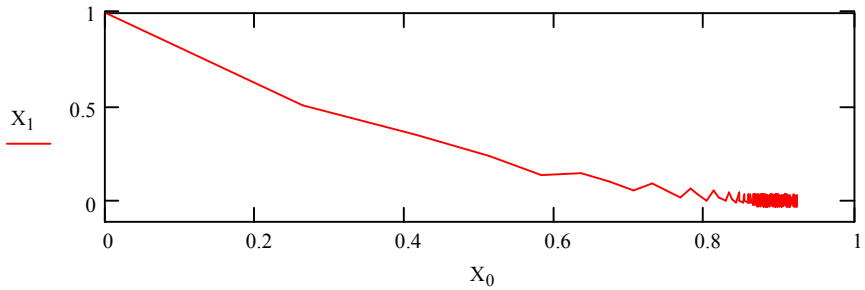

Fig.9. A phase portrait systems (piece) at $\omega = 29$ and $A = 0.9$

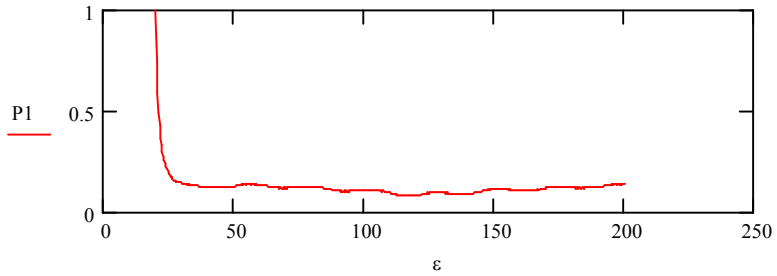

Fig.10. Probability of calmness of system, at $\omega = 29$ and $A = 0.9$

If frequency of influence $\omega = 45$, $A = 0.9$, then it is received

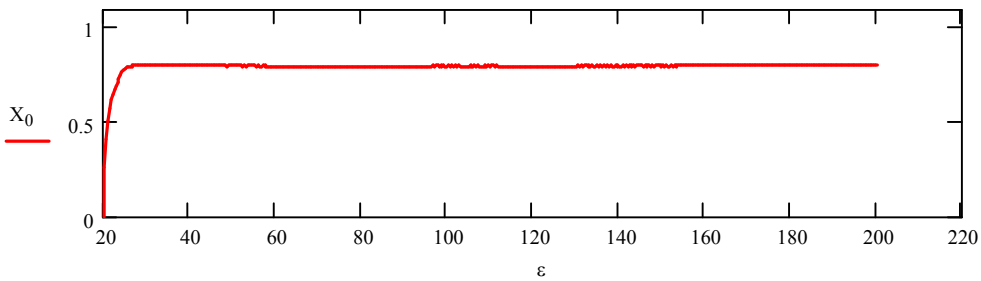

Fig.11. Change excitation at $\omega = 45.09$ and $A = 0.9$

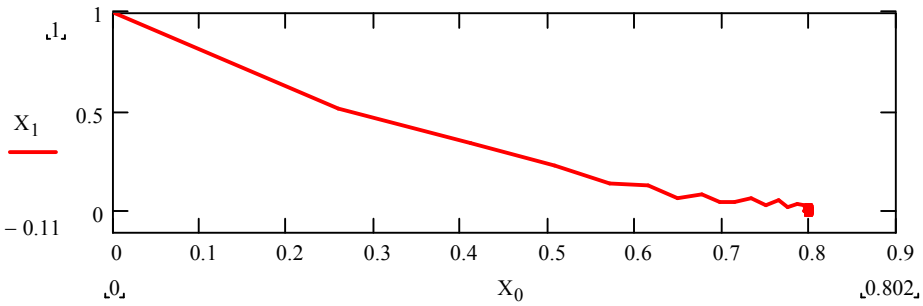

Fig. 12. A picture on phase planes (square) at $\omega = 45.09$ and $A = 0.9$

As appears from calculations, возбужденность systems essentially depends on frequency of influence of the activator.

4. Influence of amplitude of the activator on exciting of systems

We study now, influence of size of amplitude of influence of the activator on the law of change exciting systems. When $\omega = 9 \wedge A = 3$ we receive

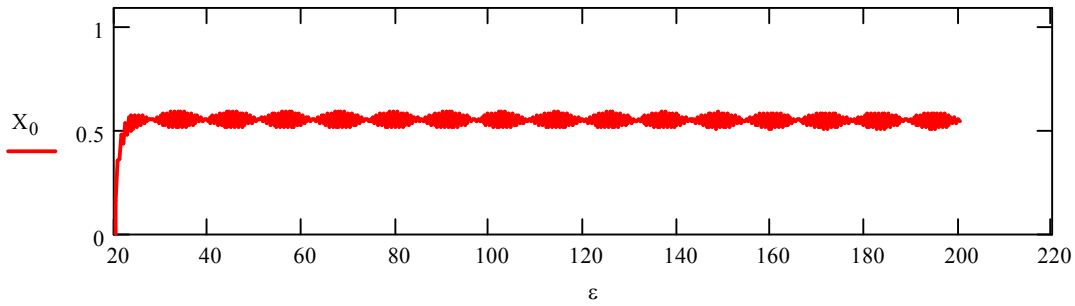

Fig.13. Change exciting at $\omega = 9$ and $A = 3$

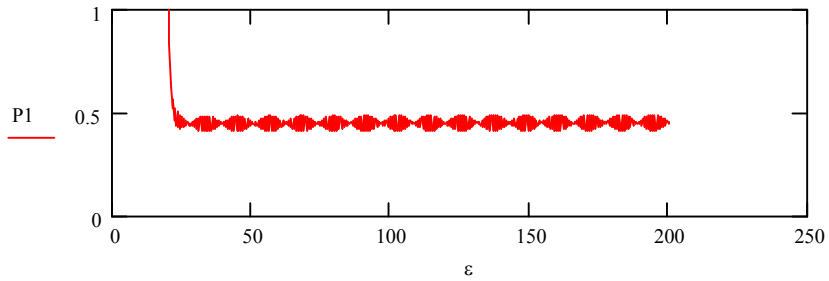

Fig. 14. Probability of calmness of system, at $\omega = 9$ and $A = 3$

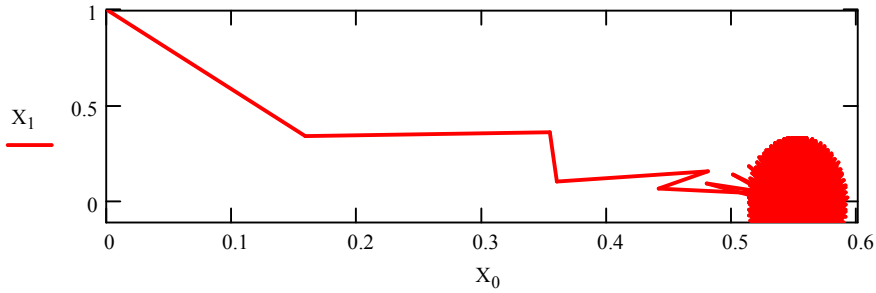

Fig. 15. Picture on phase planes (hedgehog) at $\omega = 9$ and $A = 3$

As we see, on a phase plane there is a hedgehog of palpation. Fluctuations возбужденности occur about an equilibrium condition. At the further increase in amplitude of influence, the system gradually calms down and becomes малозависимой from amplitude of the activator. In particular, at $A = 9 \wedge \omega = 9$ it is received

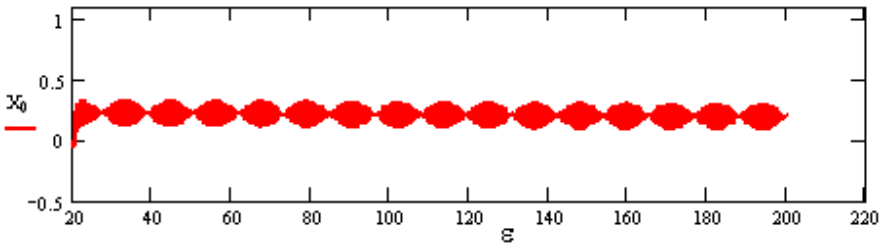

Fig. 16. Change exciting at $\omega = 9$ and $A = 9$

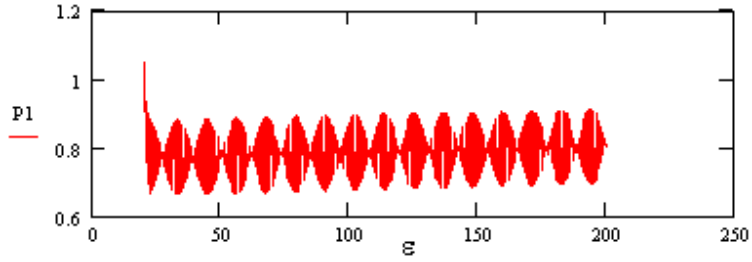

Fig. 17. Probability of calmness of system, at $\omega = 9$ and $A = 9$

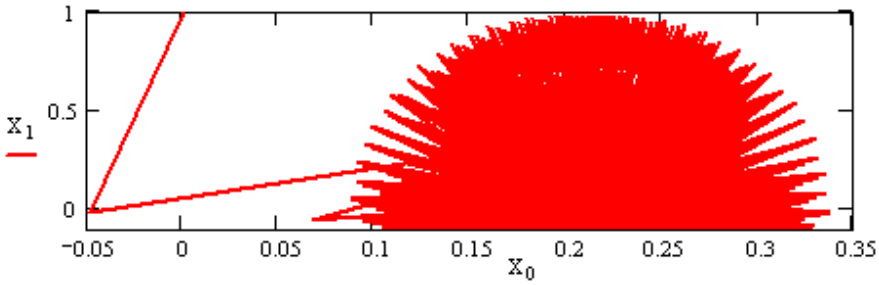

Fig. 18. Picture on phase planes (hedgehog) at $\omega = 9$ and $A = 9$

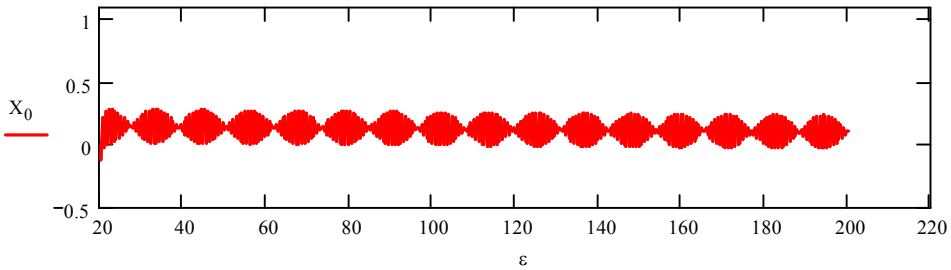

Fig. 19. Change exciting at $\omega = 9$ and $A = 11$

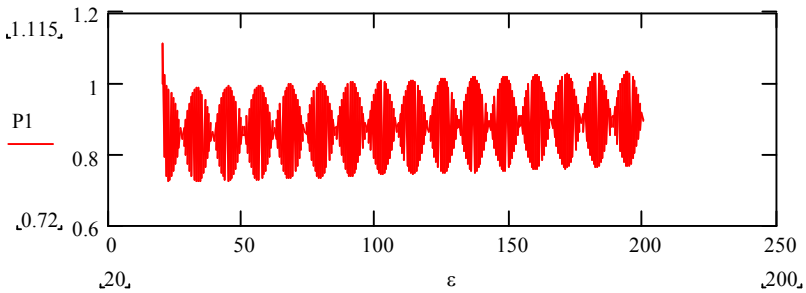

Fig. 20. Probability of calmness of system, at $\omega = 9$ and $A = 11$

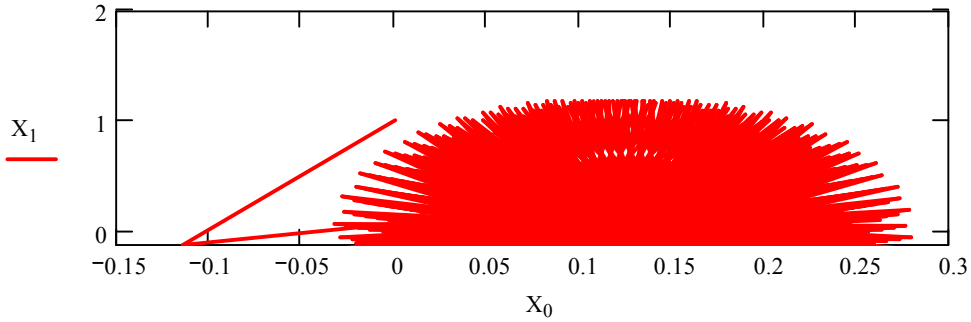

Fig. 21. Picture on phase planes (hedgehog) at $\omega = 9$ and $A = 11$

As we see, at increase in amplitude of the activator, the system passes in a condition of rest of beats conditions

5. The conclusion

Thus, at increase in frequency of emotional influence at crowd, probability of occurrence of an excessive demand increases, and the probability of calmness of system decreases. At increase in amplitude of excitation (time of performance of each provoker), the system calms down beats, and exciting falls; i.e. at not qualified provoker whom to speak one and too long, the trust to it of peoples masses falls and accordingly, the excessive demand gradually goes on recession..

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პირველი საჭიროების საქონელზე აჟიოტაჟური მოთხოვნის დინამიკის მათემატიკური მოდელირება პერიოდული PR - გამაღიზიანებელის მოქმედებისას

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რეზიუმე

ნაშრომში აგებულია, პირველადი საჭიროების საქონელზე, ხალხის მასის აჟიოტაჟური მოთხოვნის დინამიკის მათემატიკური მოდელი, პერიოდული PR-გამაღიზიანებელის მოქმედების პირობებში. მიღებულია ამოცანის ზუსტი-ანალიზური ამონახსნი. პროგრამული პაკეტის Mathcad 2001 Pro–ს ბაზაზე გათვლილია ხალხის მშვიდი მასის, პირველადი მოთხოვნილების საქონელზე დაუკმაყოფილებელ, აჟიოტაჟურ მოთხოვნიან ბრბოში – აგზნებულ მასაში გადასვლის დინამიკა გამაღიზიანებელის სიხშირესა და ამპლიტუდაზე დამოკიდებულებაში.

МАТЕМАТИЧЕСКОЕ МОДЕЛИРОВАНИЕ ДИНАМИКИ АЖИОТАЖНОГО СПРОСА НА ТОВАРЫ ПЕРВОЙ НЕОБХОДИМОСТИ ПРИ ПЕРИОДИЧЕСКОМ, ПАНИЧЕСКОМ PR-ВОЗБУДИТЕЛЕ

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Резюме

Строится математическая модель динамики ажиотажного спроса на товары первой необходимости при периодическом, паническом PR-возбудителе. Находится точное-аналитическое решение однородной нелинейной задачи. На основе программного пакета Mathcad 2001 Pro рассчитывается динамика ажиотажного спроса на товары первой необходимости в зависимости от частоты и амплитуды возбудителя.