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Mathematical Model of Ethnic Communities Of Kazakhstan

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Abstract
In this paper, based on the sociological theory of T. Parsons and the methodology for balancing of Nash equilibria, we constructed a mathematical model of the dynamics of ethnic processes that describes the development of four subsystems of ethnic communities: political, economic, ethnic, and community of Institute of the Assembly of the People of Kazakhstan (APK). The aim of our research was to find and identify ways of constructive resolution of social conflicts, establish a balanced way of taking into account the interests of various subsystems of society. The subsystems mentioned above were identified in the framework of the Parsons theory because this theory offers a way of constructive resolution of social conflicts. The level of social tension is the control parameter. For example, when political differentiation and degree of adaptation are constantly written relations characterizing the number of equilibrium states, their type, the number of special points at infinity. The result of this work was to solve the problems of constructing a mathematical model and computer analysis of the model of ethnic groups of the Republic of Kazakhstan and the role of the Assembly of the people of Kazakhstan in stabilizing society. When studying ethnosocial processes using such a model, we can predict and predict the future of ethnic groups in modern society.
Key words: *ethnic communities, ethnos, mathematical modeling, social tension.*

Introduction

With the development of digital technology in the humanities, tools and approaches of the natural sciences have become increasingly used. Today, mathematical methods are widely used in sociology, economics, medicine, politics, etc. Currently, there are two main areas of application of the mathematical methods: the processing of large amounts of data and mathematical modeling.

The use of tools and methods of the natural sciences in the process of conducting scientific research in the humanities allows the researcher to clearly formulate his ideas about the studied object, receive meaningful and reliable conclusions. It is difficult to do without the use of the mathematical apparatus in solving practically any sociological problem.

Mathematical models have long been successfully used in the study of many social processes. In the first works, models of socio-demographic processes were built, problems of the influence of ecology on the development of society were examined. Laptev in his work he noted the model of world dynamics by Forrester, in which the main characteristics were selected: population, investment (funds), natural resources and environmental pollution (Laptev, 2002). The main modeling tool in this area are differential equations. In this issue, the following works are distinguished: (Kruse et al., 2018).

Scientific and technological progress in the computer technology area has played a huge role in the creation of new techniques at the intersection of mathematical modeling and social sciences. Among the researchers who made a visible contribution to the development of advanced modeling of social and ethnic processes, we can distinguish: (Laptev, 1999; Guts et al., 2000, 2003).

Modeling of ethnic processes is a fairly new area and not sufficiently studied field. Scientists of Omsk State University under the guidance of Professor Guts et al. (2000, 2003) published several textbooks and computer programs for the simulation of ethnic processes. These works

described all sorts of nuances of the development of ethnic systems (Guts, 1997).
A lot of researchers note the connection between the processes of globalization, culture and the intensification of interethnic contradictions. In this regard, the question of the sufficiency appears, which we use to model the theory of Parsons society (Parsons, 2005) in fact - Parsons theory is very old and has a large number of critics, among the weaknesses they call in particular the exclusion from the consideration of conflicts, in connection with this there will be a reasonable question - how can to model a society without social conflicts? This view does not fully reflect the legacy of Parsons, Parsons rejects conflict as a way of developing society, but does not exclude conflict as such, considering the latter as a violation of the balance between the systems that make up society. Since our goal is precisely to achieve harmony between social forces, we are considering a resolution of the conflict that can be called constructive, i.e. output of the results into a winning strategy, and not into a zero amount. Nevertheless, we use the Nash equilibrium theory as a model of social change, as a good description of the dynamics of social transformations, we think that the combination of the Nash and Parsons approaches is a good approximation for describing social dynamics on the way from local stable but not optimal states to a state satisfying all social subsystems.
The ethnicity globalization is studied as a new phenomenon. Multiple estimates in this area foreshadowed the gradual disintegration of national identities in a certain global cosmopolitan culture, the fall of nation-states and the formation of a supranational government and showed us the obvious actualization of the problem of ethnicity. The growth of old and the emergence of new conflicts in the field of interethnic relations, allowed the well-known British researcher - E. Smith to draw a conclusion about the "global ethnic revival" (Smith, 2004).
On the basis of the foregoing, for the development of the state among the most important conditions that make possible some kind of social transformation, one of the central places is inter-ethnic harmony. Therefore, in a multi-ethnic Kazakhstan, where live representatives of 130 nationalities, it acts as the cornerstone of the foundation of social stability and civil peace, which are the basic components of the country's successful development (Sagindykov et al., 2019).
According to the results of many surveys, the overwhelming majority of respondents in Kazakhstan believe that interethnic relations in Kazakhstan are relatively calm and prosperous, but we should not deny that some unsightly cases have been recorded recently:
In February 2015, bashing of the local Tajik population took place in the village of Bostandyk in South Kazakhstan region.
Interethnic clashes between Kazakhs and Turks. In February 2016, in village of Buryl, Zhambyl region, a 17-year-old teenager of Turkish nationality intrude into a house to rob, he killed a 5-year-old boy of Kazakh nationality, inflicting 11 stab wounds. The houses of the Turks in the village were stoned. Troops were introduced to maintain order (GordonUA, 2016).
From December 31, 2018 to January 1, 2019, in Karaganda, in restaurant "Ancient Rome" there was a fight between visitors to the restaurant and employees of the restaurant. As a result, in the courtyard of the restaurant, a fight broke out between the two conflicting sides, during which one person died and several more were injured. The fight, in which, according to various sources, from 14 people to 30 people participated on both sides, was not interethnic, as the group of Kazakhs who left the restaurant were opposed by Armenians, Azerbaijanis and Kazakhs themselves. However, in view of the fact that the Kazakh turned out to be the dead, and the owners of the restaurant were Armenians, anti-Armenian sentiments erupted in the city, resulting in a crowded rally. Spontaneous protests in Karaganda followed, calls for reprisal against Armenians began to sound in social networks. Several Armenian families, fearing reprisal, left the city (Armeniasputnik, 2019).
The conflict in Masanchi. On February 7, 2020, a conflict occurred in the village of Masanchi, Kordaysky district, Zhambyl region, in which participated Kazakhs, Dungans and police. 8

people were killed, 40 injured, 30 houses and 23 cars burned (Mamashuly, 2020). This is an exhaustive list of interethnic conflicts in Kazakhstan.

In all these cases, the context of interethnic conflict is secondary, and cannot be considered the root cause. As a rule, small-criminal or hooligan incidents take place, which only then, in the escalation phase, acquire an interethnic character. Although interethnic conflicts themselves do not become the primary cause of tension in society, the fact that the population uses ethnocentric rhetoric during the conflict is alarming and forces us to look for ways to resolve these conflicts. Therefore, the consolidation of interethnic accord as the leading priority of state policy and the fundamental value of Kazakhstani society seems quite logical.

In modern mathematic, the problem of analyzing interethnic processes in Kazakhstan has not yet received the proper coverage and understanding. Therefore, this study was carried out, based on the experience of foreign researchers and scientists not only in mathematical science, but also in related disciplines: ethnology, political science, sociology, economics (Wilk, 2018).

The aim of the paper is to build a mathematical model of ethnic groups based on T. Parsons sociological theory in the form of a system of ordinary differential equations, which allows studying the dynamics of subsystems of an ethnic system and its stability.

Symbolic model of ethnic communities

For mathematical description of ethnic communities in Kazakhstan, Talcott and Parson's systematic approach (Parsons, 2005) will be used, and the transition from non-optimal local states using the Nash approach (Ye & Hu, 2017). Based on this approach, we will compose differential equations describing the dynamics of the phase variables of the system under consideration. A system consists of constituent elements that are present in interconnections and interdependencies. Elements have integral properties and they maintain the integrity of the system. Any change in the position of one part inevitably leads to a change in other parts. In any system, a structure is distinguished that has a stable connection of elements in the system, the relationship between the system and its parts, as well as the function - the role that the element performs, bringing a specific activity to the general activity.

In each Parsons system, there are four main functions adaptation, goal setting, integration, preservation of the existing order. Thus, the system must adapt to the environment, achieve the goal, possess internal unity and be able to protect this state, reproduce the structure and relieve tension in the system. Thanks to the definition of these four functions, it was possible to analyze systems of any level in terms of functional subsystems: a subsystem of societal community, a subsystem for maintaining institutional ethnic patterns, a political subsystem, and the economic subsystem. Taking into account the importance of understanding the paper, we briefly consider each of them.

The subsystem of societal community ensures the maintenance of an established lifestyle, the transfer of norms, rules and values, which become important factors in motivating a person's behavior (the function of stability and self-preservation). The core of society is a structured regulatory order through which the collective life of people is organized.

Note that a team consisting of an ethnic group is united at the subconscious level (friend or foe). A collective forms a societal community when people (members of, possibly more than one ethnic group or even a super-ethnic group) are united together on the basis of a consciously accepted norm.

The main function of the subsystem of societal community is the integration of different people, their statuses and roles into a single whole. It involves the organization of sustainability.

The subsystem for the maintenance of institutional ethnic patterns provides internal control over the life of people in accordance with the norms and values accepted in society and integrates society, establishes and maintains solidarity ties between its elements. The function of this subsystem is performed by culture. It creates complexes of the meanings of certain social

actions, thereby limiting the possibility of their arbitrariness.

The Parsons political subsystem provides common goals. It consists of any team in which relations arise regarding power and management. The function of the political subsystem is to determine collective interests and goals, attracting resources to achieve them. The political system also provides external control over events taking place in the territory in which society resides.

Burlatsky proposed to single out the following subsystems of the political system: a political organization that embraces stable political institutions of a given society; political norms; political consciousness. When exploring the domestic political system, it is important to remember two things. A huge influence on its functioning is exerted by the political culture and consciousness of the population, which are the root cause of all the characteristics of the political system. The changes taking place in our country encompass both the political and the economic systems, giving rise to the "dilemma of synchronicity" since both transformations are interdependent.

Economic subsystem - a component of the regulatory order is associated with the practical field. The most obvious areas of its application are economics and technology, and its guiding principle is efficient resource management. According to Parsons, economic action (behavior) cannot be regarded as an autonomous phenomenon, from which all other components of the economy are derived. It is, although important, but a derivative of the determination of many components of the social system (society) as a whole (Laptev, 1999).

Thus, each subsystem specializes in the performance of some function. Moreover, each subsystem depends on other subsystems, they exchange the results of their activities.

The stable state of society (social equilibrium) may differ from the optimal (social optimum). Such suboptimal, but stable states are called Nash equilibrium in sociology.

In view of the abovementioned, at the Parsons system level, we distinguish four subsystems of ethnic systems of Kazakhstan, each of which performs one of four main functions: economic, designed to ensure the adaptation of the system to the environment, political, the purpose of which is to achieve the goal, ethnic groups (a single team that obeys a certain accepted regulatory order), which ensures internal unity, and the governing institute of ethnic systems of Kazakhstan (Assembly of the Peoples of Kazakhstan), which is responsible for the legitimization of norms of activity order and preservation of the unity of the state.

To the political system we confront a variable - political differentiation {L}. Political differentiation is an assessment of the depth of socio-political changes, the extent of complication or simplification of the political system. The unit of measurement of political differentiation is the number of political institutions (political organizations, parties, etc.) in Kazakhstan.

The development of the economic system is considered through a change in the degree of adaptation of society to the environment {E}. We measure the degree of adaptation in arbitrary units - units of funds. In the framework of the model, we believe that any object of economic relations or action can be evaluated in these units.

The development of ethnic groups {T}, within the framework of the proposed model, is measured in the number of ethnic groups of Kazakhstan, through which society is integrated.

The dynamics of the APK institute {H} is measured by the principles of APK activity, which is closely interconnected with the dynamics of the three subsystems - political (L), economic (E), ethnic (T), so we can say that they are functionally dependent, i.e. a change in some is accompanied by a change in other quantities and is expressed as follows (Guts et al., 2000, 2003):

$$H = f(L, E, T) \quad (1)$$

Time t is considered continuous and measured in years.

As a control parameter, we take an assessment of the nature of the influence of the natural factor - *social tension P* (characteristic of the ethnic group), because the social system within our model has an ethnic basis.

We describe the dynamics of changes in these levels by a system of differential equations, based on mathematical models of a societal society (Parsons, 2005; Swartz, 2017; Ye & Hu, 2017). The equation describing the political system will look like this:

$$\frac{dL}{dt} = L(L) + L(E) + L(T), \quad (2)$$

where L (L) = k_LL (e ^ (δP-δ_1) -1) · L - describes the process of self-organization of the political system, which ensure the maintenance and development of states, and this process includes actions by the authorities that impede the change of the existing political system; L (E) = k_LE e ^ (- μE + μ_1) · E - people's efforts to strengthen the political system at the expense of the economy, the degree of effort is determined by living conditions, i.e. level of development of the economy; L (T) = k_LT (P-P_1) (T + H) · L –support of the political system by ethnic groups, legitimization of power (with a sufficient level of social tension, i.e. P> P_1).

We describe the dynamics of the economy by the equation:

$$\frac{dE}{dt} = E(E) - E(L) - E(T), \quad (3)$$

where $E(E) = k_{EE}(e^{\delta P - \delta_1} - 1) \cdot E$ – are the efforts of people aimed at increasing the degree of adaptation. This is the process of reproduction of economic resources (the greater the social tension P, the more effective these measures are, and at the initial stage these measures have a negative effect, since $e^{\delta P - \delta_1} - 1 < 0$, nd then positively $e^{\delta P - \delta_1} - 1 > 0$); $E(L) = k_{EL}\, e^{-\gamma E + \gamma_1} \cdot L$ – limitation on the economy imposed by politics (the more developed the political system, the less restrictions, because the political system is already less in need of economic recharge); $E(T) = k_{ET}(P - P_2)(T + H) \cdot E$ describes the limiting factors associated with ethnical and cultural traditions and the normative order (for P> $P_{\_2}$), and some impetus (support) at the beginning of development (for P < $P_{\_2}$).

The development of ethnic groups is described by the following differential equation:

$$\frac{dT}{dt} = T(L) - T(T) - T(H), \quad (4)$$

где $T(L) = k_{TL}(L^2 + E^2)$ – control over compliance with the regulatory order, the state's struggle against crimes against order, restorative sanctions (the stronger the state and the more adaptation to the environment (economy), the stronger the control); $T(T) = k_1 \cdot T$ – describes the losses in actions aimed at supporting the authority of the established regulatory order associated with their legitimation (at a sufficiently high level of K, the costs are negligible), where $k_1 = k_{TT}\, e^{-\eta E + \eta_1} \cdot P$; $K_D = k_{TH} \cdot H^2$ – describes the resistance of traditional (obsolete, ancient) foundations of society to new civilized norms and order; fundamentalism.

The dynamics of the ANC Institute will be described by the equation:

$$\frac{dH}{dt} = H(L) - H(H) - H(T), \quad (5)$$

where $H(L) = k_{HL} \cdot L^2$- describes municipal assistance of ethnocultural patterns of behavior, through the implementation of their institutionalization; $H(H) = k_2 \cdot H$ – describes the costs of actions aimed at establishing ethnocultural morality, to protect the ordinary way of life. Gradually, the "departure" from the organizational principle inherent in any ethnic system is classical morality, the law of the ancestors gives way to the normative order, a civilized law, where $k_2 = k_{HH}\, e^{-\theta E + \theta_1} \cdot P$; $H(T) = k_{HT} \cdot T^2$- correlation with the normative order

Ethnic communities do not appear without reason, therefore, as the initial data, we will take the corresponding values of the previous values of the corresponding subsystems: $L|_{t=0} = L_0$, $E|_{t=0} = E_0$, $T|_{t=0} = T_0$, $H|_{t=0} = H_0$.

Thus, the model of ethnic groups in Kazakhstan is a system of four differential equations:

$$\begin{cases} \frac{dL}{dt} = k_{LL}(e^{\delta P-\delta_1} - 1)\cdot L + k_{LE}\, e^{-\mu E+\mu_1}\cdot E + k_{LT}(P-P_1)(T+H)\cdot L \\ \frac{dE}{dt} = k_{EE}(e^{\delta P-\delta_1} - 1)\cdot E - k_{EL}\, e^{-\gamma E+\gamma_1}\cdot L - k_{ET}(P-P_2)(T+H)\cdot E \\ \frac{dT}{dt} = k_{TL}(L^2+E^2) - k_1 \cdot T - k_{TH}\cdot H^2 \\ \frac{dH}{dt} = k_{HL}\cdot L^2 - k_2\cdot H - k_{HT}\cdot T^2 \\ L|_{t=0} = L_0,\ E|_{t=0} = E_0,\ T|_{t=0} = T_0,\ H|_{t=0} = H_0 \end{cases} \quad (6)$$

The number of equilibrium states and their types

Consider the case when L-political differentiation and E is the degree of adaptation constantly, i.e. fixed at some level and do not change in time. Then, in this case, we can assume that these variables are equal to some constants.

$$\begin{cases} \frac{dT}{dt} = k_{TL}(L^2+E^2) - k_1 \cdot T - k_{TH}\cdot H^2 \\ \frac{dH}{dt} = k_{HL}\cdot L^2 - k_2 \cdot H - k_{HT}\cdot T^2 \\ T|_{t=0} = T_0, H|_{t=0} = H_0 \end{cases} \quad (7)$$

To simplify the study, suppose that the following coefficients are equal:

- coefficients characterizing the share of political systems influencing the change in ethnic groups and the institution of the Assembly of the People of Kazakhstan (APK), т.е. $k_{TL} = k_{HL}$;
- the intensity of losses of ethnic groups and the Institute of the Assembly of the People of Kazakhstan (APK), $k_1 = k_2$;
- coefficients of mutual influence of ethnic groups and the Institute of the Assembly of the People of Kazakhstan (ANC) $k_{TH} = k_{HT}$.

We introduce new notation: $s_1 = k_{TL}(L^2+E^2)$, $s_2 = k_{HL}\cdot L^2$, $k = k_1 = k_2$, $l = k_{KD} = k_{DK}$ and assume thats_1, s_2, k, l positive coefficients and k linearly depend on the positive parameter P. We note that $s_1 \geq s_2$. We also denote the variables T and H by x and y, respectively, and we do not impose any restrictions on the initial data T_0, H_0.

Then we get the system of equations:

$$\begin{cases} \frac{dx}{dt} = s_1 - k \cdot x - l\cdot y^2, \\ \frac{dy}{dt} = s_2 - k \cdot x - l\cdot y^2, \\ x|_{t=0} = x_0, y|_{t=0} = y_0, \end{cases} \quad (8)$$

Follow the change in the qualitative picture of the solution of system (8) depending on the parameter P. To do this, we study the possible equilibrium states and the directions along which the trajectories can tend to them. We find the number of equilibrium states. To do this, we find the singular points equating the right-hand sides of the system of equations (8) to zero. These are the intersection points of two parabolas:

$$x = \frac{s_1}{k} - \frac{l}{k}y^2,\ y = \frac{s_2}{k} - \frac{l}{k}x^2 \quad (9)$$

The points of intersection with the coordinate axes for the first parabola: $A_1\left(\frac{s_1}{k}, 0\right)$, (10)

$$A_2\left(0, -\sqrt{\frac{s_1}{l}}\right) \quad (11)$$

$$A_3\left(0, \sqrt{\frac{s_1}{l}}\right); \quad (12)$$

and for the second

$$B_1\left(0, \frac{s_2}{k}\right), \quad (13)$$

$$B_2\left(-\sqrt{\frac{s_2}{l}},0\right) \tag{14}$$

$$B_3\left(\sqrt{\frac{s_2}{l}},0\right). \tag{15}$$

When

$$\frac{s_1}{k} > \sqrt{\frac{s_2}{l}}, \tag{16}$$

$$\frac{s_2}{k} > \sqrt{\frac{s_1}{l}} \tag{17}$$

the intersection of two parabolas consists of four points (Fig. 1a), in other cases, two points (Fig. 1b, 2a, 2b).

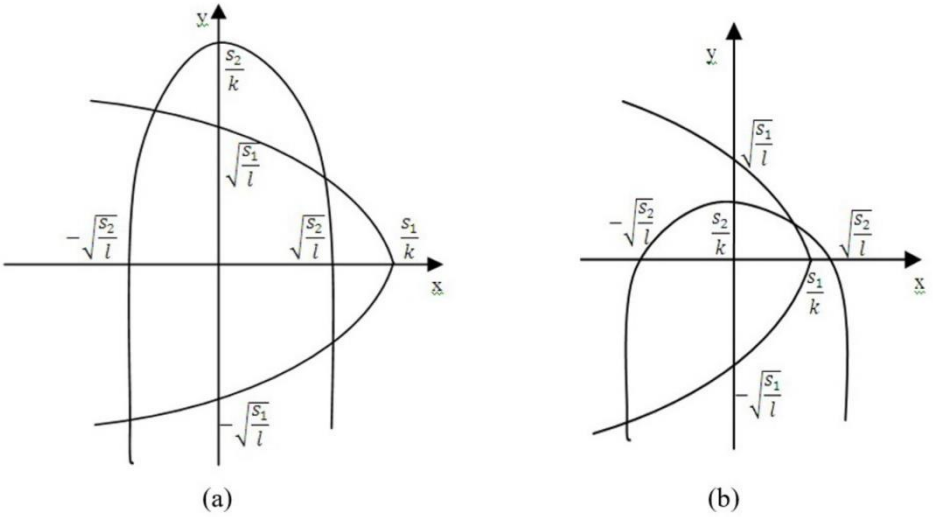

Figure 1. The possible equilibrium states and the intersection of two parabolas consists: a) four points, b) two points

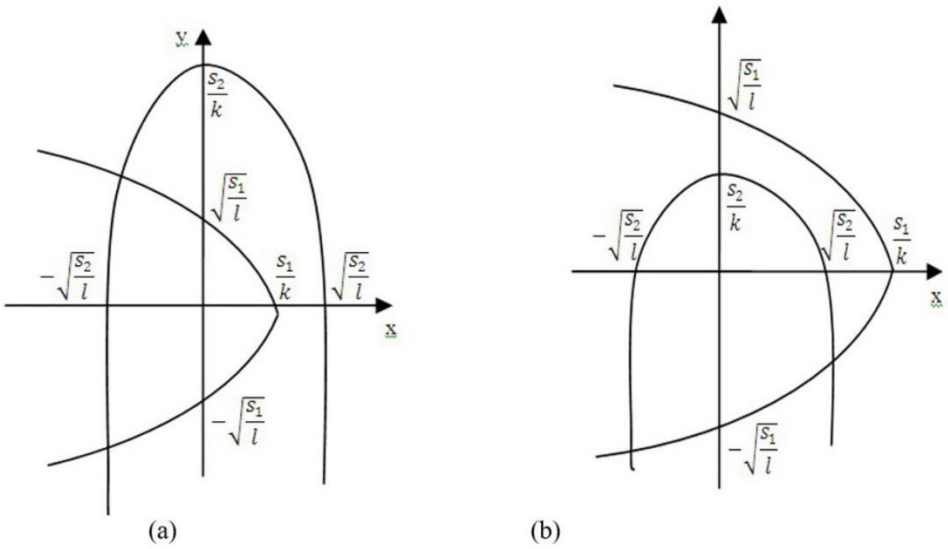

Figure 2. The number of intersections of curves: a) four points, b) two points

To study the equilibrium state, we consider the right-hand sides of the system of equations (8):

$$R(x_0,y_0) = s_1 - k\ \cdot x_0 - l\cdot y_0^2, \tag{18}$$

$$S(x_0,y_0) = s_2 - k\ \cdot y_0 - l\cdot x_0^2. \tag{19}$$

(x_0,y_0) - the nature of the equilibrium is determined by the sign of the following three

quantities:

$$\Delta = \Delta(x_0, y_0) = \begin{vmatrix} R'_x(x_0, y_0) & R'_y(x_0, y_0) \\ S'_x(x_0, y_0) & S'_y(x_0, y_0) \end{vmatrix} = k^2 - 4l^2 x_0 y_0, \quad (20)$$

$$\sigma = \sigma(x_0, y_0) = R'_x(x_0, y_0) + S'_y(x_0, y_0) = -2k, \quad (21)$$

$$\sigma^2 - 4\Delta = 16l^2 x_0 y_0. \quad (22)$$

For functions Δ:

- in I and III quarters, the sign of the functions Δ is positive, for $k^2 - 4l^2 > 0$, i.e. $k < -2l$ and $k > 2l$; otherwise, i.e. for $2l < k < -2l$ the sign of the functions Δ is negative

In the II and IV quarters, the sign of the functions Δ is positive, for any value of k and l
And the signs of the functions $\sigma^2 - 4\Delta$ (for any value of k and l):

- in the I and III quarters is positive;
- and in the second and fourth quarters is negative.

Thus, we obtain the following types of equilibrium:

1. In case of $2l < k < -2l$, in I and III quarters there is a saddle, because $\Delta < 0$
2. In case of $k < -2l$ and $k > 2l$, in I and III quarters there is a knot, because $\Delta > 0$, $\sigma^2 - 4\Delta > 0$
3. In II and IV quarters there is a focus $\Delta > 0$, $\sigma^2 - 4\Delta < 0$.

Computer study of the model

Follow the phase portraits of the system (3), depending on the parameter P. The parameter P is present as a factor in the coefficients $k_1 = k_{TT}\, e^{-\eta E + \eta_1} \cdot P$ and $k_2 = k_{HH}\, e^{-\theta E + \theta_1} \cdot P$, but it is clearly not among the coefficients of system (3). Therefore, we use other new notation for the coefficients: $k_3 = k_{TT}\, e^{-\eta E + \eta_1}$, $k_4 = k_{HH}\, e^{-\theta E + \theta_1}$ and get the system of equations:

$$\begin{cases} \frac{dx}{dt} = s_1 - k_3 \cdot P \cdot x - l \cdot y^2, \\ \frac{dy}{dt} = s_2 - k_4 \cdot P \cdot y - l \cdot x^2, \\ x|_{t=0} = x_0, y|_{t=0} = y_0, \end{cases} \quad (23)$$

With the help of a computer study, the dynamics of the relative position of two parabolas, as well as the curves, which allow to determine the type of equilibrium:

$$\Delta(x, y) = 0, \quad (24)$$

$$\sigma^2(x, y) - 4\Delta(x, y) = 0, \quad (25)$$

where

$$\Delta(x, y) = k_3 \cdot k_4 \cdot P^2 - 4l^2 xy \quad (26)$$

$$\sigma(x, y) = -k_3 \cdot P - k_4 \cdot P, \quad (27)$$

$$\sigma^2(x, y) - 4\Delta(x, y) = P^2(k_3 - k_4)^2 + 4l^2 xy. \quad (28)$$

Here it is worth making a remark that this model is simplified, but simplification is not excessive roughening. The linear boundary conditions that we adopted as applied to real problems should be replaced by a solution to the logistic equation — a curve of the form

$$P(t) = \frac{KP_0 e^{rt}}{K + P_0(e^{rt} - 1)}; \quad (29)$$

which obviously differs somewhat from the linear boundary conditions adopted in our analysis, however, as a first approximation and for the purpose of illustrating the solution, we consider the linear initial conditions to be an acceptable option, in fact, in this approximation the problem allows an analytical solution, which would be impossible if nonlinear initial conditions.
In the case of using as initial conditions a curve of the form

$$P(t) = \frac{KP_0 e^{rt}}{K + P_0(e^{rt} - 1)} \quad (30)$$

The task becomes much more complicated, but nevertheless, the main conclusions of our study

remain practically the same; as an illustration, we calculate the number of singular points for nonlinear initial conditions, see Fig. 3. Differentiation of the solution curve of the logistic equation instead of a parabola will give a Gaussian, which is shown in Fig. 3. From Figure 3 it can be seen that in the vicinity of the origin, the number of singular points has not changed, for comparison see Figure 1 (a and b).

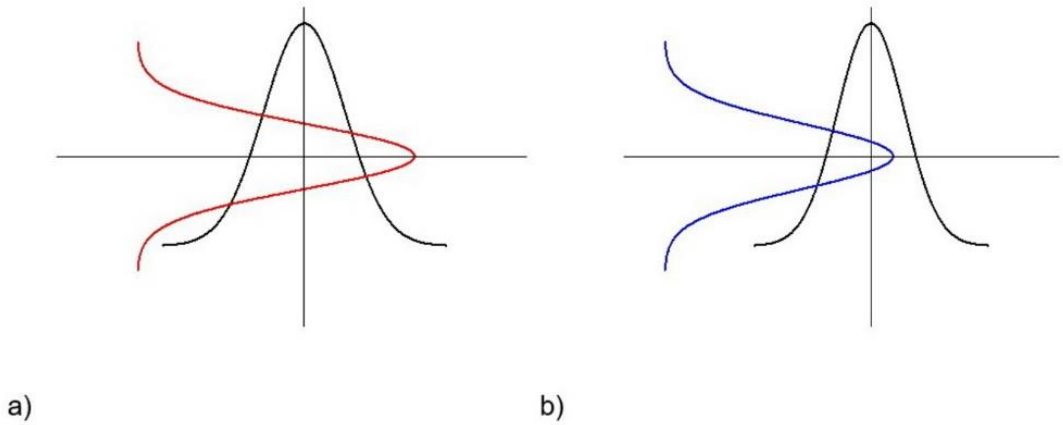

Figure 3. The number of intersections of curves in the vicinity of the origin.

The computer study made it possible to effectively consider the change in the solution pattern with changes in the parameter P of values from a certain numerical segment and confirm the results of determining the types of equilibrium states obtained analytically.
Of course, the model we present here paints a simplified picture of the relationship between ethnic diversity and rule making at the community level. A more dynamic version may model processes of interethnic interaction as a function of population share or weaken the assumption of random interaction probabilities. For example, indigenous people living in different areas can more easily mix between ethnic groups and show less discrimination than indigenous people from a small number of minorities (Schaeffer, 2012; Winter & Zhang, 2018).

Conclusion

Nowadays the use of tools and methods of the natural sciences in the process of conducting scientific research in ethnosocial processes is gaining increasing recognition both among specialists in natural sciences and among sociologists.
The use of mathematical modeling methods to describe ethnosocial phenomena allows us to overcome many of the shortcomings of the verbal description. It provides an opportunity to conduct research more fully and better, as well as to predict the dynamics of the studied processes and phenomena.
To construct a mathematical model of ethnic groups of Kazakhstan, Talcott Parson's systematic approach was used in the work. The system consists of four differential equations describing the development of functions: political, economic, ethnic, and the institute of APC.
The result of this work is to solve the problems of constructing a mathematical model and computer analysis of the model of ethnic groups of the Republic of Kazakhstan and the role of the Assembly of the people of Kazakhstan in stabilizing society.
When studying ethnosocial processes using such a model, we can predict and predict the future of ethnic groups in modern society.

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