УДК 004.042:007.51

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METHOD FOR PREDICTING THE NUMBER OF SMALL GROUPS IN WAR CONDITIONS

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Анотація

Метою роботи є розробка методу прогнозування чисельності малих груп у воєнний час. Розроблено методику застосування запропонованої моделі, описано можливі варіанти проведення експериментів, необхідних для вимірювання параметрів моделі. Описано метод управління громадською думкою, який полягає в управлінні кількісними значеннями параметрів моделі. Модель удосконалено у випадку, коли обидві складові є нелінійними (що описують зростання кількості прихильників і обмеження з боку суспільства).

Ключові слова: *метод, прогнозування, ефективність, громадська думка.*

Abstract

The aim of the paper is to develop a method for predicting the number of small groups in wartime. The method of application of the offered model is developed, the possible variants of carrying out the experiments necessary for measurement of parameters of model are described. The method of public opinion management is described, which consists in managing the quantitative values of the model parameters. The model has been improved in the case where both components are nonlinear (which describe the growth in the number of supporters and restrictions on the part of society).

Keywords: method, forecasting, efficiency, public opinion.

Introduction

During the war, the formation of small groups intensified considerably. The enemy seeks to create among the population sympathetic and tolerant people. While public policy is aimed at developing patriotism. Simply countering by denying hostile efforts is not effective. To optimize the system of counteracting hostile attempts to form the necessary communities of collaborators, you can use the results [1]. They are based on the study of equations

$$\frac{dN}{dt} = aN - bN^2, a > 0, b > 0, N(t = 0) = N_0. \quad (1)$$

In dimensionless form, this task can be written as follows:

$$\frac{dn}{d\tau} = n(1 - n), n(\tau = 0) = n_0 \quad (2)$$

The following quantitative characteristics of quantities that characterize the dynamic processes of change of public opinion can be measured in experimental studies:

1) the average value of a stable number of N_{av} people who share the new public opinion;

2) the characteristic time of change of negative public opinion (ie the time during which the number of its supporters will be the required share of β from stable N_{av});

3) the initial number of people N_0 who support the new public opinion.

It should be noted that we are simultaneously considering two diametrically opposed directions of the new public opinion: both favorable for us and the one that the enemies are trying to impose on our people.

Under the model, the quantitative values of parameters *a* and *b* in the model are determined by different social processes.

The parameter of model a is set by the current processes of information dissemination in society and the tendency of people to join the new public opinion (for different public opinions, the quantitative value of this parameter will be different). This circumstance allows us to use the values of the parameter *a*, which are calculated from the quantitative values of the characteristics of the distribution of one public opinion (or several of them), to predict the dynamic characteristics of another (other) social opinion.

The parameter of model *b* serves as a kind of "counteraction" to the growth of new social thought. He characterizes society as a whole, determining its reaction. For example, the enemy's attempt to impose his opinion will be accompanied by much greater values of this parameter than the spread of new patriotic thought.

Research results

Method of managing public opinion.

Stage 1. The goals and subject area of social thoughts in which management will be carried out are set.

The subject area should include the social thought that will need to be managed. In addition, the given subject area should include several already active public opinion (this will be necessary to determine the parameters of the model and to check its compliance).

Stage 2. The dynamic characteristics of other social thoughts that are already functioning in a given subject area are studied. Such characteristics are the characteristic time t_c. It can be chosen as the time that corresponds to the characteristic change in the dynamics of a certain (unexplored) social thought. For example, this may be the time during which the number of supporters of this particular social opinion increases from the initial n_0 or N_0 (which occurs at the beginning of the measurement) to the value of N_{exp} (to which it grew during the observation t_c). For example, you can select a value as the value of N_{exp}

$$N_{exp} = N_0 + \frac{1}{2}(N_s - N_0) = \frac{1}{2}(N_s + N_0). \quad (3)$$

For the value of N_s you can choose N_{av}. Quantitative value of N_{av} is measured as the average time value of supporters of this particular social opinion after its rapid growth (or rapid decline in the case when n_0>1). Thus, for social opinion, which will be used to calculate the parameters of model *a* and *b*, it is necessary to use those social thoughts from a given subject area, which have already gone through the entire dynamic cycle from the beginning of implementation to stabilizing the number of supporters.

In the practical implementation of management, this means that the relevant state and public expert structures should monitor the dynamics of change and functioning of public opinion. To do this, it is most appropriate to use higher education institutions, where teachers will involve students in relevant research.

Step 3. Using the quantitative values of the corresponding characteristics obtained at the previous stage, we calculate the quantitative value of the model parameter *a*.

$$\boldsymbol{a = \frac{1}{t_c} ln \left[\frac{\beta(1-n_0)}{n_0(1-\beta\_}\right] = \frac{1}{t_c}\left[\frac{N_{exp}(N_{av}-N_0)}{N_0(N_{av}-N_{exp})}\right]} \quad (4)$$

Step 4. Using the indicators of steps 2 and 3, we find the quantitative value of the parameter of model *b* by the following formula.

$$b = \frac{a}{N_{av}} \quad (5)$$

Step 5. We use the calculated values of the parameters of model *a* and *b* to forecast and manage a given public opinion in accordance with a given goal.

Management of public opinion includes, according to the considered model, management of parameters *a* and *b*. Parameter a is determined by the ability of supporters of the studied public opinion to "recruit" new supporters. Parameter *b* characterizes the "resistance" from supporters of other existing public opinion.

The use of electronic means of communication by society is growing almost every year. Therefore, the influence of supporters of some public opinion on others is also growing. Electronic means of communication allow to present a large number of arguments of both objective, logical, and subjective, emotional direction. This is the first time in human history that anyone can turn to virtually all of humanity. As a result, the range of public opinion is naturally expanding.

The number *Ns* of supporters of the new public opinion (or its real average value of *Nav*), as can be seen from the above formulas, increases with increasing parameter of model a and decreases with increasing

parameter of model b. To reduce the number of N_s public opinion holders, the parameters of models a and b must be changed in the opposite way (however, it is also possible to limit the change of only one of these parameters). Thus, this number can be managed by creating conditions in society to change these parameters.

For example, to increase the number of supporters of the desired public opinion, it is necessary to create conditions set by the following procession:

$$\boldsymbol{R} = \{\boldsymbol{A}, \boldsymbol{B}, \boldsymbol{E}, \boldsymbol{I}\} \tag{6}$$

Here A is a set of conditions necessary to control the quantitative value of a. B is a set of conditions for managing the quantitative value of the indicator b. E is a set of conditions for communication between society and government, which are focused on the necessary management of the parameters of model a and b (usually today it is mainly electronic means of communication: Internet, social networks, e-books, e-television, e-media). I is a set of political, social and economic institutions that make possible both the task of managing public opinion and its implementation.

The general task of optimizing the number of supporters of public opinion can be written as follows:

$$K = \begin{cases} argmax\{a(K)\}, or \\ argmin(b(K), or \\ \begin{cases} argmax\{a(K)\} \\ argmin\{b(K)\} \end{cases} \end{cases} \tag{7}$$

$$K = \begin{cases} argmin\{a(K)\}, or \\ argmax\{b(K)\}, or \\ \begin{cases} argmin\{a(K)\} \\ argmax\{b(K)\} \end{cases} \end{cases} \tag{8}$$

The problem of optimization (7) corresponds to the situation of the need to increase, and the problem of optimization (8) - to reduce the number of supporters of this public opinion.

In conclusion, we note that, in general, equation (1) can be written in a more general case:

$$\frac{dN}{dt} = aN^c - bN^d, N(t=0) = N_0, N_s = \left(\frac{a}{b}\right)^{1/(d-c)} \tag{9}$$

The condition for the presence of a restriction on the growth of $N(t)$ is $c<d$.

The main features of the dynamics of the number of people who share the studied public opinion, as well as the main conclusions of the article remain valid. However, the study of real cases requires a simulation experiment using a differential equation (9).

The parameters of model (9) a, b, c and d can be found experimentally as follows. The first term in differential equation (9) describes the intensity of the increase in the number of supporters (intensity of aggregation of supporters) of this public opinion, and the second - the decrease in the number of supporters (intensity of disintegration of the community of like-minded people).

Therefore, at the stage of formation of public opinion in society, when the second member of (9) is small and it can be rejected in the first approximation, the increase in the number of supporters can be described by the following formula:

$$N \approx \frac{N_0}{\left[1 - N_0^{1-c}\right]^{1/(1-a)}} \approx N_0(1 + N_0^{1-c}at), if: N \ll N_s \tag{10}$$

From (10) it is seen that in order to meet the requirement of increasing the number of supporters, it is necessary that the requirement $0<c<1$ is met. The last approximation is valid under the condition $N^{1-c}(1-c)at<<1$, ie at small values of the observation time.

Quantitative values of a and c can be quantified from experimental data using, for example, the least squares method. Of course, the conditions specified in (10) must be met.

For the case a=1, which corresponds to the conditions of model (2), instead of relation (10) you need to use the following relation:

$$N \approx N_0 e^{ct} \approx N_0(1+ct), if: N \ll N_s \quad (11)$$

Experimental data should be processed in semi-logarithmic coordinates. Note that relation (11) is valid for the time when ct<<1.

Quantitative values of the characteristics of the term in (9), which are responsible for the decay of the number of like-minded people (which occurs under the condition N>N_S), can be found from the following relationship:

$$N \approx \frac{N_0}{\left[1+N_0^{d-1}(d-1)bt\right]} \approx N_0\left(1-N_0^{d-1}bt\right), if: N_0 \geq N \gg N_s. \quad (12)$$

From (12) it is seen that to meet the requirement to reduce the number of supporters, it is necessary that the ratio d>1. The last approximation is valid under the condition $N_0^{d-1}(d-1)bt$<<1, ie at small values of the observation time.

Relationships (10) - (12) can be used at the beginning of a change in public opinion, revealing the quantitative values of parameters that are specific to it. That is, those that affect its growth. While the characteristics of "resistance" to the studied public opinion, as a rule, characterize society as a whole.

Thus, the problem of managing new public opinion (optimization problem (7) or (8); for the general case of model (9) it can be easily reformulated) can begin almost at the very beginning of this process.

Conclusion

The aim of the article is to develop a model for predicting the number of small groups in wartime. It is proposed to describe the dynamics of the number of small groups by a nonlinear differential equation. It includes a linear member by the number of supporters, which corresponds to the growth of the number of supporters. The limiting member is quadratic in the number of supporters and describes society's resistance to public opinion. It is shown that electronic means of communication of society are a powerful factor influencing the formation and dynamics of public opinion. The method of application of the offered model is developed, the possible variants of carrying out the experiments necessary for measurement of parameters of model are described. The method of public opinion management is described, which consists in managing the quantitative values of the model parameters. The model has been improved in the case where both components are nonlinear (which describe the growth in the number of supporters and restrictions on the part of society).

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