Demin S.S.

Territorial interests of the Barents sea countries analysis.

The global warming leads the situation in the Arctic region to important consequences, such as easier process of oil and gas drilling. As a result, it may raise the discussions on disputed shelf zones with fossil fuels' deposits, especially near to Norway-Russia sea border. We construct a model, which highlights potentially disputed territories, analyzes preferences of the countries interested in different types of resources.

Meshcheryakova N.G.

Network Analysis of Food Security

We analyze relations between countries in the context of food trade network. Network models help us deeply understand the organization of these relations. The main goal of this research is to assess the influence and dependence of nodes on each other as well as to detect of the most important connections between them. We apply both classical centrality measures and the indices of long-range connections in order to reveal key elements in this network. We consider individual attributes and the possibility of the group influence which help us more accurately assess the total node-to-node influence in network structures. The results are provided for the total trade as well as for different product categories.

Rezyapova A.N..

Network analysis of international migration

The international migration is analyzed with the help of network model. The international migration is represented as a graph, where the nodes are countries and edges refer to the flows of international migrants between them. The work is based on the data on international migration flows by countries from the international statistical agencies (UN, OECD and Eurostat). The influence of countries in the network is evaluated by the centrality indices. Classic centrality indices are evaluated in line with the novel indices, which account for the indirect influence in the network, group influence and the population of destination countries. The indices of short and long-range interactions suggested new results in terms of countries' influence in international migration, which can be implemented in the migration policy of destination countries.

Shvydun S.V.

Superposition Models in Data Analysis

We consider choice procedures of a special type based on the superposition principle which consists in sequential application of choice functions where the result of the previous choice function is the input for the next choice function. We define which of them satisfy given normative conditions, showing how a final choice is changed due to the changes of preferences or a set of feasible alternatives. A theorem is proved showing which normative conditions are satisfied for two-stage choice procedures based on different scoring rules, rules, using majority relation, value function and tournament matrix. A complexity of two-stage choice procedures as well as its runtime on real data are also evaluated. We propose several superposition models and show their efficiency for various problems related to data analysis from information retrieval problem to the problem of areas allocation in the Arctic region.

Subochev A.N.

Aggregation of journal rankings: an example of application of social choice in scientometrics

We consider a scientometric problem of contradicting evaluations of journals' quality which are based on different bibliometric indicators. Instead of choosing the best indicator, which is controversial, a decision-maker may choose an appropriate aggregation procedure and use all rankings available. The theory of aggregation is a well-developed area, and, consequently, it allows one to make quite definite conclusions regarding the appropriateness of such a choice. To construct an aggregate ranking is to rank on a basis of multiple criteria. Since, there is a formal analogy between the multicriteria decision-making and the social choice, a decision-maker may consider the whole panoply of extensively studied and well-behaved social choice procedures. We propose to use ordinal aggregation methods based on the majority rule. We apply five majority-rule-based ordinal ranking methods to data on economic, management and political science journals in order to produce aggregate journal rankings. First, we calculate aggregates for the set of rankings based on seven popular bibliometric indicators (impact factor, 5-year impact factor, immediacy index, article influence score, h-index, SNIP and SJR). Then, we perform the comparative correlation analysis of the aggregates and the initial rankings. This analysis is framed as a choice of the best representative for the group whose individual opinions are aggregated. To do so, we use two rank measures of correlation, Kendall's tau-b and the share of coinciding pairs r, and apply the majority rule. The

analysis demonstrates that aggregate rankings represent the set of single-indicator-based rankings better than any of the seven rankings themselves.

Tverskoy D.N.

Modeling functional specialization of a cell colony under different fecundity and viability rates and resource constraint

The emergence of functional specialization is a core problem in biology. In this work we focus on the emergence of reproductive (germ) and vegetative viability-enhancing (soma) cell functions (or germ-soma specialization). We consider a group of cells and assume that they contribute to two different evolutionary tasks, fecundity and viability. The potential of cells to contribute to fitness components is traded off. As embodied in current models, the curvature of the trade-off between fecundity and viability is concave in small-sized organisms and convex in large-sized multicellular organisms. We present a general mathematical model that explores how the division of labor in a cell colony depends on the trade-off curvatures, a resource constraint and different fecundity and viability rates. Moreover, we consider the case of different trade-off functions for different cells. We describe the set of all possible solutions of the formulated mathematical programming problem and show some interesting examples of optimal specialization strategies found for our objective fitness function. Our results suggest that the transition to specialized organisms can be achieved in several ways. The evolution of Volvocalean green algae is considered to illustrate the application of our model. The proposed model can be generalized to address a number of important biological issues, including the evolution of specialized enzymes and the emergence of complex organs.