МИНОБРНАУКИ РОССИИ

федеральное государственное бюджетное образовательное учреждение высшего образования

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Mathematical models for predicting material damage from fires

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- **The article examines mathematical models for analyzing and predicting material damage from fires. Using linear and non-linear dependencies, the dependence of material damage on such factors as gross domestic product, population, the cost of fixed assets and the exponential time trend was estimated. The results obtained in the study can be used for short-term forecasting of damage caused by fires**

Introduction

In the world practice, the problem of fire protection is one of the most urgent problems that require careful analysis and forecasting of damage from them. It is possible to study the material damage caused by fires using statistical methods and nonlinear methods such as Cobb-Douglas, which allow us to identify the relationship between the material damage caused by fires in the country and macroeconomic indicators. It is necessary to anticipate the degree of damage from fires

Introduction

- **The relevance of scientific research consists in the development of new multi-factor nonlinear models to identify the interdependence between macroeconomic factors and the choice of those parameters that make a great contribution to the assessment of the damage caused by the number of fires. Since fires in most cases are a kind of product of society, it is better to use the following parameters for their assessment: the population, the volume of fixed assets and gross domestic product (GDP). The constructed dependencies make it possible to solve the following problems of scientific research: the ability to anticipate; predict the state of the process when changing macroeconomic parameters.**

A mathematical model

$$Y_t = AX_1^{\alpha} X_2^{\beta} X_3^{\gamma} e^{\lambda t}$$

Next, multivariate nonlinear Cobb-Douglas dependencies were constructed using an exponential trend. Significant models and their main indicators are presented in table.

The statistical characteristics of the models

Model	R^2	F	SD
$FD = 0,05833 \ GDP^{1,1888} VF^{0,3988} e^{-0,1258 t}$	0,91	65,912	0,149
$FD = GDP^{1,35711} CHN^{-0,3913} e^{-0,09553 t}$	0,997	1048,438	0,154 $_{SD}$
$FD = GDP^{1,174} CHN^{-0,54} VF^{0,363} e^{-0,1185 t}$	0,997	1491.413	0,149
$FD = 0,1348 \ GDP^{1,38} e^{-0,0991 t}$	0,912	41,37	0,154

Conclusion

The nonlinear models presented in the article, taking into account the identification of significant macroeconomic parameters that make the greatest contribution to the indicator of material damage from the number of fires, have shown efficiency sufficient for their practical application. Multivariate linear dependences of the Cobb-Douglas type are proposed and investigated, which demonstrate a high dependence of the presented factors on the assessment of material damage on the