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QUALITATIVE ANALYSIS OF THE ANTINEOPLASTIC IMMUNITY SYSTEM ON THE BASIS OF A DECISION TREE

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Abstract. *Analysis of antineoplastic immunity on the basis of a multivariative method is proposed. As a result, a decision tree for predicting the form of a pathological process is obtained. The method is implemented as a package of Java-classes.*

Keywords: *qualitative analysis, antineoplastic immunity, differential equation with delay, decision tree.*

INTRODUCTION

Qualitative theory arose as a part of the general theory of differential equations for solving problems in mechanics and astronomy [1] at the end of the XIXth century.

The application of the qualitative theory of differential equations to dynamic systems of two- and three-dimensional vector fields for determining topology and structural stability is imperative. These questions were first reflected in Poincaré's works and then in works of G. D. Birkhoff, A. A. Lyapunov, A. A. Andronov, V. I. Arnold, and others.

The use of differential equations for mathematical modeling does not mean at all that an analytical formula should be obtained to solve (or approximate) them. More importantly, such formulas are absent in the majority of cases. A formula for an explicit or approximate analytical solution is often so complicated that it does not reveal the nature of a solution until a diagram is constructed [1, 2]. Therefore, in system medical investigations, decision diagrams (at least, their general forms) are mainly generated, and analytical solutions are absent in this case [2, 3–6].

To obtain numerical solutions to basic initial problems represented by systems of ordinary differential equations, there is a wide class of software support packages. This class is considerably narrowed when functional and differential equations are considered.

The following natural question arises: since computer programs easily generate quantitatively exact solutions to differential equations, why is the qualitative theory of differential equations used? The answer is as follows: the majority of models in system medical investigations contain a number of parameters each of which can assume a wide range of values. For each definite range of parameter values of a system of ordinary differential equations (ODEs), there will be infinitely many solutions, and the majority of them are redundant. Initial conditions or other constraints select one (or several) of these solutions as relevant. Thus, in order to numerically characterize the behavior of an ODE based model, a definite sequence of sets of parameters and initial conditions (values) should be specified and numerical solutions, namely, one solution for each set of parameters and initial values should be generated. A direct "blind" numerical investigation of the dependence of solutions on parameters in the case of only two–three parameters can lead to an unacceptable increase in the amount of computations or data for perception and analysis.

The objective of this publication is the development of a multivariative method (that is reduced to a decision tree and takes into account both rate constants and initial conditions) for qualitative analysis of a system of functional and differential equations and the implementation of this method as applied to a model of antitumoral immunity.

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