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Cubic Stochastic Operators

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ABSTRACT

The theory of cubic stochastic operators is one of the central branches of the rapid development of operator theory, which is important in the study of biomathematical problems at the same time as modern science and technology are developing.

By using mathematics as a tool to explore the physical world, we can gain much more valuable experience. On the one hand, knowledge of physical (biological) processes shows us new theorems and their solutions.

On the other hand, mathematical analysis gives a new meaning and structure to the external world. Knowledge of this structure and logic constitutes the "nature of bodies. "Many problems are solved by the theory of dynamical systems.

Let $E=\{1,2,...,n\}$ be, then

$$S^{n-1}=\left\{x=(x_1,x_2,...,x_n)\in R^n : x_i\geq 0, i\in E \sum_{i=1}^{n} x_i=1\right\}$$

the set is called an $(n-1)$-dimensional simplex.

Each element is a probability world in $x\in S^{n-1}$ and can be considered a biological (physical, social, etc.) system consisting of n elements. One of the main tasks for this system is to study the evolution of the system. Usually this is determined by several laws. Quadratic operators are used to solve problems in mathematical genetics. Nowadays, there is a lot of scientific research on quadratic operators, and these theories are very advanced. Let's look at an example of genetic reproduction in a biological system. Here, system E consists of n identical $1,2,...,n$ elements. Determines l probabilities i, j, k for different parents (Elements are treated as descendants on

average, i.e. new l types are formed from different types of i, j, k triples).We denote this probability by $P_{ijk,l}$.Then

$$P_{ijk,l} \geq 0, \sum_{i,j,k=1}^{n} P_{ijk,l} = 1$$

reasonable and $P_{ijk,l}$ does not change despite the change of i, j, k .

In a constant population, $x = (x_1, x_2, ..., x_n)$ determines the single-valued probability. So, $x \in S^{n-1}$ is the following probability

$$x_l^{'} = \sum_{i,j,k=1}^{n} P_{ijk,l} x_i x_j x_k, \; l = \{1, 2, ..., n,\}$$

will be the full probability for the generation.

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