

# A Study on The Application of Artificial Intelligence in Mathematical Modeling

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**Abstract:** This paper discusses the application of artificial intelligence in the field of mathematical modeling. It analyzes the unique advantages of AI techniques, such as machine learning and deep learning, in improving the efficiency of mathematical modeling and solving complex problems. The specific application scenarios of AI in mathematical modeling in various fields, including natural science, engineering technology, social economy and so on, are introduced in detail. At the same time, we analyze the challenges of data quality and model interpretability in the application process, and look forward to the future trend of the integration of AI and mathematical modeling. The aim is to reveal the changes brought by AI to mathematical modeling, to provide reference for research and practice in related fields, and to promote new breakthroughs in mathematical modeling under multidisciplinary cross-fertilization.[1].

**Keywords:** Artificial Intelligence; Mathematical Modeling; Machine Learning; Applied Research that.

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## 1. Introduction

Mathematical modeling, as an effective means of solving practical problems by mathematical methods, plays a key role in many disciplines and fields. From the simulation of physical phenomena in natural sciences, to the optimal design of systems in engineering and technology, to the prediction of market trends in socio-economic fields, mathematical modeling provides a clear logical framework and quantitative analysis for the solution of complex problems. However, with the increasing complexity of practical problems, traditional mathematical modeling methods face many challenges in dealing with large-scale data, highly nonlinear relationships and dynamic processes. The rapid development of artificial intelligence technology has injected new vitality into mathematical modeling.

## 2. The Technological Basis of Artificial Intelligence and Its Advantages in Mathematical Modeling

### 2.1. The technological basis of artificial intelligence

Machine learning, as one of the core fields of artificial intelligence, covers various paradigms such as supervised learning, unsupervised learning and semi-supervised learning. Supervised learning learns from labeled data and constructs predictive models for classification or regression prediction of new data, and common algorithms include decision trees, support vector machines, neural networks, etc. Unsupervised learning seeks to discover the intrinsic structure and patterns of data from unlabeled data, such as clustering. Unsupervised learning is dedicated to discovering the intrinsic structure and pattern of data from unlabeled data, such as clustering algorithms, principal component analysis, etc. Deep learning, as a branch of machine learning, is based on deep neural networks, which automatically learns complex feature representations from a large amount of data by constructing neural network models containing multiple hidden layers, and

has achieved great success in the fields of image recognition and speech recognition.

### 2.2. Advantages in mathematical modeling

Artificial intelligence shows significant advantages in mathematical modeling. First of all, its powerful data processing ability can quickly process massive data, mine valuable information from the data, and provide rich data support for the construction of mathematical models. Compared with traditional manual data processing, it greatly improves the efficiency and accuracy of data processing. Secondly, the self-learning ability of artificial intelligence makes the model able to adjust and optimize its own parameters according to new data, adapt to the dynamic changes of the problem, and improve the generalization ability of the model. For example, in time series prediction modeling, machine learning models can continuously learn new data patterns over time to improve the accuracy of prediction. Moreover, for complex nonlinear problems, artificial intelligence models such as neural networks can effectively solve highly nonlinear problems that are difficult to be handled by traditional mathematical models by constructing complex nonlinear mapping relationships, providing a more powerful tool for mathematical modeling.

## 3. Application Scenarios of Artificial Intelligence in Mathematical Modeling

### 3.1. In the field of natural sciences

In physics, mathematical modeling using artificial intelligence can be used to simulate complex physical systems. For example, when modeling the many-body problem in quantum mechanics through deep learning models, traditional mathematical methods are difficult to solve accurately due to high computational complexity, while deep learning models can predict the quantum state and physical properties of the many-body system by learning from a large amount of simulation data. In astronomy, AI-assisted mathematical modeling is used for galaxy evolution simulation and celestial

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