

Application of MATLAB in College Students Mathematical Modeling Competition

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ABSTRACT

In the process of college students mathematical modeling competition, it is necessary to improve the data processing and calculation ability. This research mainly starts from the modeling competition, and analyzes and discusses the application points of MATLAB in the process of college students mathematical modeling competition. In the research, it is necessary to use MATLAB software to complete the determination and analysis of fitting function. According to actual examples, we can use MATLAB software to obtain cubic polynomial fitting function and complete the solution of fitting function. In addition, when analyzing the planning problems, it is necessary to transform the planning problems into the maximum problems on the basis of determining the constraint conditions. In order to ensure the uniformity of numerical values in MATLAB software, the maximum problems can be transformed into the minimum problems by using functions, thus improving the calculation efficiency. Through the example analysis of college students mathematical modeling competition, we can get the following conclusions: the application of MATLAB software in mathematical modeling can not only improve the efficiency of mathematical modeling, but also carry out the work of graphics and data processing, which also plays an active role in ensuring the data calculation and analysis effect.

Keywords: *Mathematical modeling competition; MATLAB; Application points*

1. INTRODUCTION

Under the background of rapid development of science and technology, different fields of natural science need to use mathematical models to complete problem calculation to effectively solve practical problems. In the process of mathematical modeling, it is necessary to abstract and simplify practical problems based on reasonable assumptions, so as to use mathematical problems to solve practical problems, and at the same time, to accept the test of practice. In the process of solving specific problems, it is necessary to use computer calculation to improve the efficiency of data processing. At present, as a widely used scientific computing software, MATLAB has strong data processing and data analysis capabilities, besides, it also has the functions of image visualization. In the process of national college students mathematical modeling competition, the application of MATLAB is quite common. Therefore, it is necessary to strengthen the application research of MATLAB in college students mathematical modeling competition, so as to provide some reference for further promoting the development

and innovation of MATLAB software, and at the same time, it can also enhance college students' enthusiasm for learning mathematics.

2. OVERVIEW OF COLLEGE STUDENTS MATHEMATICAL MODELING COMPETITION

The concrete steps of mathematical modeling include the following contents: (1) Complete the model preparation. In this step, it is necessary to understand the actual problems, clarify the main purpose of modeling, and collect the characteristic information of the modeling object to form a relatively clear modeling goal. (2) Model assumption. In this process, it is necessary to rationalize and simplify assumptions based on the characteristics of the problem and the purpose of modeling. At the same time, it is necessary to analyze and calculate the data to obtain the parameters that play a major role. After the refinement and simplification work is completed, the hypothesis that is consistent with the objective reality is put forward. (3) Establish a model. In this process, we need to use mathematical

language and mathematical symbols to describe practical problems, and we can use relatively simple and appropriate mathematical formulas to express the relationship between variables, so as to construct corresponding mathematical expressions. (4) Complete the model solution. In the process of solving the model, it is necessary to apply different mathematical methods, mathematical software and computer technology to obtain the optimal solution of the model. If it is difficult to obtain the final solution in the analysis process, it is necessary to use a computer to calculate the numerical value. (5) Complete the model analysis. This step is mainly to use mathematical theory or computer technology to analyze the error of the final calculation result, and at the same time, to comprehensively analyze the stability of the data model to ensure the accuracy and rationality of the final solution. (6) Complete the model test and inspection. This step is mainly to compare the model, actual phenomena and related data to determine the rationality and applicability of the model [3].

3. OVERVIEW OF MATLAB

MATLAB software itself has relatively strong numerical calculation ability, and can complete many functions such as numerical analysis, visualization, matrix calculation and programming. Students must have an understanding of the basic functions of the MATLAB software, and each team member needs to learn and master the MATLAB software data processing, 2D and 3D drawing, MATLAB programming, and different toolbox two months in advance. At the same time, it is necessary to develop MATLAB programming for commonly used mathematical models, so as to skillfully apply MATLAB software in the process of college students mathematical modeling competition. In the process of applying MATLAB software, it is necessary to know its main role in mathematical modeling, which can be generally studied from the following angles:

3.1. Data fitting process of MATLAB software

Data processing is one of the basic links in mathematical modeling. After determining the topic or collecting data, it is necessary to complete data processing and analysis, and transform it into mathematical expression, so as to complete the process of establishing mathematical model [4]. Generally, it is necessary to use data interpolation and fitting. Given a batch of data points, if the required surface must pass through all data points, it is an interpolation problem. If the surface is not required to pass through all data points, it needs to reflect the changing trend of the object for data fitting. MATLAB software can realize interpolation function and fitting function, so as to obtain the corresponding mathematical model [5]. For

example, in a curve fitting solution and modeling process, the known observation point data are shown in Table 1.

Table 1. The known observation data points

x	0	0.1 0.2	0.3 0.4	0.5 0.6 0.7 0.8 0.9	1
y	2.1	2.27 2.51	3.5 4.28	5 6.35 7.16 8.49 10.65	12.34

The image is compared with the image of the original observation data in a picture. When solving this problem, it can be identified as a typical curve fitting problem. The main purpose of curve fitting is to use the least square method to approximate relatively complex or unknown functions by using relatively simple functions. MATLAB curve fitting can be fully applied to polynomial fitting, specified function fitting and so on. When solving this problem, cubic polynomial fitting is mainly used. The cubic polynomial fitting function can be obtained by using MATLAB software, and its specific statements are as follows:

```
x = 0:0.1:1; y = [2.1,2.27,2.51,3.5,4.28,5,6.35,7.16,8.49,10.65,12.34];
p3 = polyfit(x,y,3);
t = 0:0.1:1.2;
s = polyval(p3,t);
hold on; plot(x,y,'k.','marker size',25);
axis([0 1.2 0 16]);
plot(t,s,'r-','linewidth',2)
```

After running with MATLAB software, it can be determined that the function of cubic polynomial fitting is:

$$f(x) = 2.3699x^3 + 5.0105x^2 + 2.9767x + 1.9836$$

The obtained cubic polynomial fitting function image is shown in Figure 1. By comparing it with the original point, it can be determined that using MATLAB software to complete known data fitting has a prominent role. Therefore, the software has a wide range of application value in the process of college students modeling competition and practical problem solving.

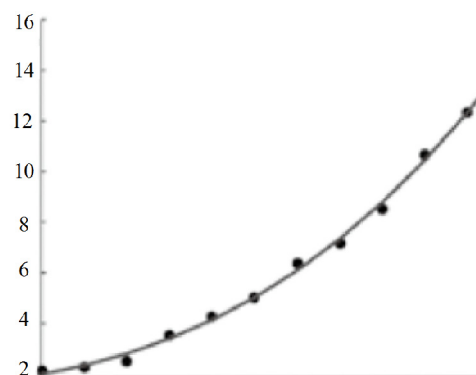


Figure 1. Cubic polynomial fitting function

3.2. Linear programming of MATLAB software

As a common problem in the process of mathematical modeling, planning problems can also be solved by using MATLAB software, which can provide powerful planning model solving commands and quickly calculate the required results in a short time. In the application process of MATLAB programming model, it mainly includes linear programming, integer programming and nonlinear programming. The basic function of linear programming in MATLAB is linprog, and the function command of nonlinear programming is fmincon [6]. In the concrete practice process, it is necessary to apply the existing resources to obtain the maximum economic benefits. This linear programming problem mainly analyzes the decision variables based on practical problems. When constructing the objective function, it is necessary to determine the constraint conditions, and finally complete the solution to clarify the objective function of linear programming. Generally, the maximum value is required, mainly including the maximum value and the minimum value, and the inequality of the constraint condition can be $>$ or $<$. In the process of solving planning problems, in order to ensure the uniform format, the objective function of linear programming is defined in the application process of MATLAB software to seek the minimum value, and the constraint condition is \leq . Therefore, when solving the maximum value problem, we can use relatively simple mathematical calculation to transform it into the problem of finding the minimum value.

4. PROBLEMS OF MATLAB IN COLLEGE STUDENTS MATHEMATICAL MODELING TRAINING

In the process of mathematical modeling training for college students, there are some problems in the application of MATLAB software, which are mainly manifested in the following aspects: First, the knowledge of related theories is not deep. In the process of MATLAB software training, programming can test students' mastery of theory. Only by ensuring that the program can be written smoothly can students be sure that they understand the knowledge. If students' understanding of knowledge is only superficial, there will be great problems in the specific programming application process. For example, the entrance prediction model can be fitted by Logistic curve, but students usually only use the basic form of Logistic curve model and the command of curve fitting function to complete the fitting. There are some problems when using MATLAB software to carry out regression analysis and calculation. Second, when some students apply MATLAB software, they only use the software to do some simple programming. After acquiring the initial programming ability, students need to have a comprehensive grasp of the logical structures such as

linked list, stack, queue, generalized table and binary tree in the data structure, and at the same time, they should have a comprehensive grasp of these algorithms that act on specific data structures, such as dynamic programming, backtracking algorithm, divide-and-conquer algorithm and string matching algorithm [7].

5. APPLICATION EXAMPLE OF MATLAB IN COLLEGE STUDENTS MATHEMATICAL MODELING CONTEST

5.1. Application points in the mathematical modeling competition

In the process of college students mathematical modeling competition, it is generally necessary to complete relatively complex calculations in a relatively short time. If students only use manual calculations, the calculation efficiency will be directly affected. Therefore, in the process of college students mathematical modeling competition, it is necessary to fully apply computer technology to improve the calculation efficiency and quality. In the traditional mathematical modeling competition, Mathematica software is mainly used to process data. This software has relatively low learning difficulty, excellent symbolic calculation ability and numerical calculation ability, and relatively convenient drawing process. Compared with C language or basic language programs, it is simpler to write programs with Mathematica, and it has special symbolic operation function, which has outstanding advantages in application process [8]. However, in the process of college students mathematical modeling competition, the amount of data calculation is relatively large. Although the numerical calculation function of Mathematica is relatively good, it cannot be compared with that of MATLAB. In addition, MATLAB software itself has more software toolkits, which can obtain more prominent application effects in more professional fields. MATLAB software can solve many practical problems in the process of mathematical modeling more quickly and efficiently. Therefore, in the process of college students mathematical modeling competition, the application of MATLAB software is quite common.

At present, the national college students mathematical competition has set up the MATLAB innovation award, which shows that it occupies a vital position in mathematical modeling. In addition, the introduction of MATLAB software is relatively simple, but it is impossible to master all functions of MATLAB software. Therefore, when learning MATLAB software, it is necessary to selectively learn some theoretical knowledge and operation points according to your own actual situation, so as to improve students' application ability of MATLAB software. With the continuous development of college students mathematical modeling

competition, the students' ability to solve problems creatively is getting higher and higher. Therefore, participants need to have the comprehensive ability to develop their own programs in order to get good competition results. In this case, learners should not only learn the relevant theoretical knowledge of MATLAB software, but also master more complicated programming methods and skills, such as simulated annealing algorithm, neural network, dynamic simulation, numerical simulation[9].

5.2. Application example in mathematical modeling competition

Take a certain topic in the mathematical modeling contest of college students as the main research object and analyze its specific application methods. The title is to investigate the geological environment of the city, and then complete the data quality evaluation work to analyze the specific impact on the geological environment in the process of production activities. Because different geological environments are affected by production activities to some extent, after investigating the geological environment of a city, we can complete mathematical modeling and have a comprehensive grasp of the spatial distribution of heavy metal elements in the region. Heavy metal pollution exists in different parts of the region, and the factors of heavy metal pollution should be pointed out [10].

From this topic, it can be determined that in order to solve practical problems, it is necessary to effectively process a large amount of data and draw graphs. In the process of modeling, it is necessary to comprehensively sort out and count the data of heavy metals in this area, draw the distribution map of this area effectively by using MATLAB software, and then use interpolation to complete the drawing of metal distribution. MATLAB software is also used to calculate the load of different heavy metals (as shown in Table 2).

Table 2. Different heavy metal loads

Heavy metal	The first principal component load	The second principal component load	The third principal component load
Arsenic	0.43	-0.28	-0.28
Chrome	0.74	-0.44	0.30
Cadmium	0.71	0.28	-0.28
Cuprum	0.76	0.12	0.37
Hydrargyrum	0.41	0.67	0.30
Nickel	0.72	-0.51	0.19
Lead	0.76	0.31	-0.24
Zinc	0.70	-0.04	-0.12

After obtaining relevant data, it is necessary to draw the normal distribution map of the specific situation of

pollution diffusion based on MATLAB software. Based on the MATLAB model, the relevant simulation skills of pollutants using Gaussian diffusion are simulated. In the drawing, the spatial distribution of water elements in the center of the region, the heavy metal pollution in different areas of the region and the specific causes of heavy metal pollution can be visually observed. Therefore, in the process of mathematical modeling, MATLAB software has strong advantages, especially in numerical calculation and data graphics processing, which can fully play a role in the process of mathematical modeling and help to improve the overall efficiency of modeling.

6. CONCLUSION

In a word, the function of MATLAB software is relatively powerful, and it plays an increasingly prominent role in the process of mathematical modeling competition. In the daily teaching process, it is necessary to introduce MATLAB software. In mathematics classroom teaching, teachers can use relatively simple explanations to improve students' knowledge and understanding of MATLAB software. In addition, students should learn to use MATLAB software to complete program design and simulation, and master the basic functions of MATLAB software. MATLAB software is beneficial to stimulate students' enthusiasm in mathematics learning, and it is helpful to cultivate students' autonomous learning ability and improve students' ability to solve practical problems by using mathematics knowledge.

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