ISSN: 2350-0328

International Journal of AdvancedResearch in Science, Engineering and Technology

Vol. 5, Issue 10 , October 2018

The Reform Exploration of Linear Algebra Course

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ABSTRACT : According to the actual situation, we establish relevant mathematical models use Linear Algebra knowledge and MATLAB to solve problems, stimulate students' interests of Linear Algebra, reform the modes of examination improve the ability of innovation and comprehensive applicate knowledge of Linear Algebra to solve practical problems.

KEYWORDS：Linear Algebra, Mathematical Modeling, MATLAB

I .INTRODUCTION

On the road of transformation and development of Local Universities，The talent-cultivation models needs strategic adjustment；applied and technological university is the orientation and goal of many regional colleges and universities；for example, Our university is dedicating to theconstruction of a highly technical university with distinctive features. Under this background，as an important foundation course, we should pay more attention on the application and practice ability during the learning of Linear Algebra. At present, the teaching mode of Linear Algebra is still traditional, it is still focus on the interpretation of definition, the proof and derivation of the theorem and the training of manual calculation, but lack of the application and analysis of knowledge points, and problem solving methods of practice. Students have a good grasp of definitions, theorems and solution methods，but However, when they use their knowledge to analyze and solve practical problems, they looked dazed and bewildered, What's more, many students who have studied Linear Algebra showed that they do not realize its practical value.

In this article, we describe the application of Linear Algebra in Mathematical Modeling, and the basic situation of our school's examination method reform. The concrete example is derived from our actual life, which adapt to the current social hot spot and the actual situation.

II.THR PRACTICAL APPLICATION OF LINEAR ALGEBRA IN MATHEMATICAL MODELING RUNS THROUGH CLASSROOM INSTRUCTION

In this reform, we change the single form of classroom instruction，and combine special lectures, practice with classroom teaching.

A. Input-output model

Input-output analysis is also called input-output technology or input-output method [3]，it was first proposed by American economist w. Leontief in the 1930s，use the theory and method of Linear Algebra, study the intricate relationships among various sectors of the economic system (countries, regions, enterprises, etc.) and establish corresponding mathematical models for economic analysis and economic forecasting, at present, the method has been widely used around the world.

Example 1: Based on the statistics of a certain year，the total output of travel, transportation, and catering is $211 million, $2920 million, $1420 million，it costs $27 million for travel in the course of tourism, $58 million for transportation, $23 million for food and drinks. In the development of the transportation industry, it will cost $1102 million for transportation, $44 million for tourism and $284 million for catering. In the development of the catering industry, the cost of travel is $20 million, the transportation cost is $182 million, and it costs $153 million for catering.

ISSN: 2350-0328

International Journal of AdvancedResearch in Science, Engineering and Technology

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The total output value of the tourism sector, excluding the consumption in the tourism, transportation and catering sectors, is $120 million， The total output value of the tourism sector, excluding the consumption of tourism, transportation and catering sectors, was $1578 million. The total output value of the catering sector, excluding the consumption of tourism, transportation and catering sectors, is $960 million. The new value of tourism, transportation and catering is $103 million, $1406 million and $1065 million respectively. If the balance of tourism, transportation and catering is $135 million, $1680 million and $1120 million in the next year, Please predict the total output, the flow and new value of all departments in the next year.

We present an input-output table，divide the table into four quadrants (omitted in the fourth quadrant). In quadrant I, as a production department, line i represents the quantity consumed because of other departments. Column j represents the consumption of other departments in its production process. In quadrant II, line i denotes the output of department i which is used as final product for accumulation, consumption, etc. In quadrant III, column j represents the new value which is created by department j. The details are as follows：

Table 1：Input-Output table Unit: million

Input Intersector flow Output	Intermediate output			Total	Final demand Y	Total Output X
	Tourism	Transportation	Catering			
Tourism	27	44	20	91	120	211
Transportation	58	1102	182	1342	1578	2920
Catering	23	284	153	460	960	1420
Total	108	1406	355			
New Value Z	103	1514	1065			
Total Input	211	2920	1420			

Since the total output = intermediate output + final demand，then $X = AX + Y$,where $A = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix}$, a_{ij}

represents the direct consumption of product i for producting unit product j， $a_{ij} = \frac{x_{ij}}{x_j}$ ， where x_j denotes the total output of the department j， x_{ij} means the quantity of department i to be consumed in the production process of department j.

It is easy to know the consumption matrix $A = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} = \begin{pmatrix} 0.1280 & 0.0151 & 0.0141 \\ 0.2749 & 0.37740 & 0.1281 \\ 0.1090 & 0.0973 & 0.1077 \end{pmatrix}$,

since $X = AX + Y$,we have $(E - A)X = Y$ ， then $X = (E - A)^{-1}Y$,

ISSN: 2350-0328

International Journal of AdvancedResearch in Science, Engineering and Technology

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Using MATLAB, the follows can be obtained $E-A=\begin{pmatrix} 0.872 & -0.0151 & -0.0141 \\ -0.2749 & 0.6226 & -0.1281 \\ -0.1090 & -0.0973 & 0.8923 \end{pmatrix}$,

$(E-A)^{-1}=\begin{pmatrix} 1.1600 & 0.0320 & 0.0247 \\ 0.5570 & 1.6613 & 0.2661 \\ 0.2178 & 0.1991 & 1.2403 \end{pmatrix}$.

The final demand for the next year is $Y=(135,1680,1120)$, put it into the formula $X=(E-A)^{-1}Y$, we got

$$X=\begin{pmatrix} 238.0 \\ 3164.1 \\ 1753.1 \end{pmatrix}.$$

It can be predicted that the total output of tourism, transportation and catering sectors will be \$238 million, \$3164 million and \$1753 million respectively in the next year. This result can be used to obtain x_{ij} and create value Z. Therefore, the flow between departments and the create value in each department in the next year can be predicted, thereby it can provide a basis for decision-making.

Table 2：Input-Output analysis table for next year's Unit: million

Input Intersector flow Output	Intermediate output			Final demand Y	Total Output X
	Tourism	Transportation	Catering		
Tourism	30.5	47.8	24.7	135	238.0
Transportation	65.4	1194.1	224.6	1680	3164.1
Catering	25.9	307.9	188.8	1120	1753.1
New Value Z	116.2	1614.3	1315		
Total Input X	238	3164.1	1753.1		

According to table 2, we can clearly see the prediction of input and output next year in the three sectors. In this model, matrix inverse, matrix multiplication, equivalence of linear equations and vector equations, and solutions of vector equations are used.

III.REFORM THE EXAMINATION PATTERN

At present, as a public mathematics course closed examination in our school is mainly way about Linear Algebra the usual performance accounts for 30%， paper scores accounts for 70%。But Linear Algebra has wide range different majors have different requirements At the same time, the basic knowledge of each major is different. Considering the difference We have exams for undergraduates in different directions. Energy and automation is engineering major, many students are not interested in Linear Algebra, one of the reasons is they don't know what Linear Algebra does. Many students cope with the exam by going over their lessons temporarily before the exam After the exam they forgot what had learned, also don't know how to use knowledge of Linear Algebra to solve problems about other courses in

ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 5, Issue 10 , October 2018

the future。Therefore, we can reform the examination pattern and let students use the knowledge of Linear Algebra to solve practical problems, which is helpful for improving learning interest and effect.

In this reform, we reformed the traditional grading standards. Take the form of daily grade and paper grade account for 50% each .The main sources of the usual performance are class attendance (15%), homework (15%), and the ability of students to comprehensively use the knowledge of Linear Algebra to solve practical problems (20%). The third is to provide a practical problem in the usual teaching, require students to use what they have learned to solve the problem in the form of paper or program. In this way, we're going to be able to get a full evaluation of what students have to know about their basic knowledge and their ability to synthesize, so that we can do a better job of overall training.

So far, the effect is obvious. First of all, students experience different math classes and have a stronger interest in learning. Second, it improves the passing rate of this course to some extent, reduces the situation that students unable graduate because of they fail the course. Finally, the students' ability to comprehensively use existing knowledge has been improved.

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