Methodology of Teaching the Subject of Inter-Network Equilibrium Model

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ABSTRACT

This paper discusses the method of using the Maple software system when building a model of input-output balance. Using the capabilities of the Maple program to perform many calculations leads to good results. To date, a trained specialist is required to have competencies in the Maple program, which occupies one of the main places.

Keywords: Equilibrium, model, production, gross product, Maple, matrix.

Introduction

It is known that the inter-branch equilibrium model plays an important role in production planning.

n interdependent production branches are given. A part of the production of each network is consumed within the network, and the other part is consumed as a finished product. It should be noted that each sector participates in production as both a producer and a consumer [1-9].

The main part

We will learn to construct equilibrium models in determining this economic dependence. Based on quantitative data, necessary production, and cost calculation is shown with the help of examples [10-22].

Three industries are given, both consumer and producer. Cost matrix (1):

$$A=\begin{pmatrix} 0,2 & 0,6 & 0,1 \\ 0 & 0,2 & 0,4 \\ 0,3 & 0,1 & 0,2 \end{pmatrix} \quad (1)$$

Here are the coefficients of matrix A

$$a_{ij}=\frac{x_{ij}}{x_j}, i=\overline{1,n},\ j=\overline{1,m} \quad (2)$$

x_j - the volume of the gross domestic product of the *j*-network, x_{ij} -j-industry is the amount of product consumed from the *i*-industry product to produce one unit of product.

The size of the finished product $y=\begin{pmatrix} 1000 \\ 500 \\ 800 \end{pmatrix}$ vector is given.

It is required to find the following:

1. Creating an inter-network balance model;
2. To find the gross product volume for the production of the finished product needed by the consumer;
3. We find the income of each network.
4. Complete the cost matrix $(E-A)^{-1}$ and calculate the *E*- matrix.

Solution: we construct an equilibrium model.

$$X_i=\sum_{j=1}^{3} x_{ij}+y_i \quad (3)$$

Here $x_{ij} = a_{ij}x_j$ by replacing $(E-A)X = Y$

We will do this using Maple programming

```
>with(LinearAlgebra):
>A:=matrix([[0.2,0.6,0.1],[0,0.2,0.4],[0.3,0.1,
0.2]]);
```

$$A := \begin{bmatrix} .2 & .6 & .1 \\ 0 & .2 & .4 \\ .3 & .1 & .2 \end{bmatrix}$$

```
>y:=matrix([[100],[500],[800]]);
```

$$y := \begin{bmatrix} 100 \\ 500 \\ 800 \end{bmatrix}$$

```
>E:=Matrix(3,3,shape=identity);
```

$$E := \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

```
>with(linalg):

>x:=multiply(inverse(evalm(EA)),y);
```

$$x := \begin{bmatrix} 1460.937500 \\ 1492.187500 \\ 1734.375001 \end{bmatrix}$$

The flow of inter-industry domestic consumption expenditures x_{ij} we calculate.

```
>M1:=evalm(col(A,1)*X[1,1]);
```

$M1 := [292.1875000, 0., 438.2812500]$

```
>M2:=evalm(col(A,2)*X[2,1]);
```

$M2 := [895.3125000, 298.4375000, 149.2187500]$

```
>M2:=evalm(col(A,3)*X[3,1]);
```

$M2 := [173.4375001, 693.7500004, 346.8750002]$

```
>x:=concat(M1,M2,M2);
```

$$x := \begin{bmatrix} 292.1875000 & 173.4375001 & 173.4375001 \\ 0. & 693.7500004 & 693.7500004 \\ 438.2812500 & 346.8750002 & 346.8750002 \end{bmatrix}$$

We calculate the total income of networks.

```
>X[1,1]-sum(x[i,1],i=1..3);
```

730.4687500

```
>X[2,1]-sum(x[i,2],i=1..3);
```

278.124999

```
>X[3,1]-sum(x[i,3],i=1..3);
```

520.312500

Let's extract the exact cost coefficient matrix

```
>inverse(evalm(EA));
```

$$\begin{bmatrix} 1.562500000 & 1.276041667 & .8333333333 \\ .3125000000 & 1.588541667 & .8333333333 \\ .6250000000 & .6770833333 & 1.666666667 \end{bmatrix}$$

Conclusion

Through these examples, the use of Maple software to construct an inter-industry equilibrium model makes the calculation easier. Improves students' skills in information technologies.

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