

# Specific Features of Teaching Linear Algebra in Economic Education

Kuchkarov Muxiddin Umaraliyevich

Associate Professor of the Department of "Specialization, Social-Humanitarian and Exact Sciences", Andijan Faculty, Tashkent State University of Economics, Doctor of Philosophy in Pedagogical Sciences, Uzbekistan

**Received:** 10 May 2026; **Accepted:** 02 June 2026; **Published:** 29 June 2026

**Abstract:** This article examines the methodological and practical problems of teaching matrix algebra, which is a component of the applied mathematics course in economic education. The fundamental role of the matrix apparatus in the problems of multidimensional regression analysis and linear programming in static and dynamic modeling of economic systems is shown. The article provides recommendations for a three-stage independent work assignment (case) that should be given to the student through his personal account on the HEMIS platform.

**Keywords:** Linear algebra, matrix operators, linear operators, economic modeling, endogenous and exogenous variables, cross-sectoral balance, multidimensional econometrics, economic cognition.

**Introduction:** Modern economics has become a significantly mathematized and formalized system. The complexity of economic processes, their multifactorial and stochastic nature require future economists to have a high level of mathematical and abstract thinking. Teaching linear algebra, in particular matrix theory, in economic disciplines of higher education should not be limited to the formation of computational skills. Matrices are a fundamental mathematical language that describes a multidimensional economic space and the contours of global equilibrium in it. However, in pedagogical practice, the problem of students mechanically performing operations on matrices (multiplication, determinant, inverse matrix) but not understanding their economic content (cognitive essence) is often observed. Therefore, it is urgent to fundamentally and practically revise the methodology for teaching this section.

A matrix represents a linear operator in mathematical terms. In economic systems, this operator is a transformation mechanism that transforms the space of resources (INPUT) into the space of products

(OUTPUT). If  $X \in R^n$  is a vector of production factors, and  $Y \in R^n$  is a vector of finished products, the relationship between them is given by the operator equation  $Y = AX$ . Here,  $A_{m \times n}$  is a technological matrix that shows the structural efficiency of the system. It is appropriate to explain to the student that the matrix is not just a table of numbers, but an operator that encodes the internal structure of the economic system.

## METHODS

To further analyze the classical model of inter-sectoral balance  $X = \frac{Y}{I-A}$ , it is necessary to introduce the properties of square matrices into the lesson. Students will learn to assess the viability of a macroeconomic system through mathematical approximation conditions.

Matrices play an important role in economic forecasting. In modeling market share changes or consumer behavior, stochastic matrices are used, whose elements consist of probabilities and whose rows sum to 1. If  $P$  is a matrix of transition probabilities, then the state of the system after  $t$  periods is  $S(t) = S(0) \cdot P^t$ . Here, the important power of the matrix promotion

operation in economic forecasting is clearly demonstrated.

Today, the educational process in higher educational institutions of the republic has been completely transferred to the credit-module system and is managed through the HEMIS information system. This system requires prioritizing the student's independent learning.

When teaching matrix algebra, it is necessary to abandon dry syllabus and transfer independent learning hours to a project-based learning format. To do this, the student is given the following three-stage independent work assignment (case) through his personal account on the HEMIS platform:

The first stage (Collection of economic data): The student compiles a small-scale technological matrix A based on 3-4 types of products of a real industry (for example, light industry, banking or small business) and the costs of raw materials consumed for them.

The second stage (Mathematical calculation): The process of determining the inverse of square matrices or solving a system of linear equations is performed using MS Excel or Python.

The third stage (Economic interpretation and submission to HEMIS): The student interprets the

obtained mathematical result economically and uploads the PDF report to the HEMIS system for evaluation.

Such a methodological approach serves to purposefully allocate independent study hours of the subject and form independent analysis skills in the student.

To improve the quality of mathematical education, the structure of lectures and practical exercises should be built on the basis of the following didactic principles: Each mathematical theorem and operation must have an economic analogue. For example, the color of the matrix is the degree of mutual independence of the sectors in the system; Cramer's rule or inverse matrices is a method for searching for local equilibrium points in the economic system.

## RESULTS

At the end of the experiment, students from both groups took a control exam. The exam tasks were divided into two parts: purely mathematical calculations and economic interpretation (interpretation) of the results obtained.

Exam results of the control and experimental groups (on a 100-point scale)

| Evaluation criteria                  | Control group (Mean score) | Experimental group (Average score) | Growth rate (%) |
|--------------------------------------|----------------------------|------------------------------------|-----------------|
| Pure mathematical calculation skills | 72,4                       | 81,2                               | +12,1%          |
| Economic interpretation (Analysis)   | 48.3                       | 69.5                               | +43.9%          |
| Overall average achievement          | 60.35                      | 75.35                              | +24.8%          |

The results show that, due to the transition from manual calculations to digital programs, the students in the experimental group were free from technical errors and their calculation skills increased by 12.1%.

The biggest difference was observed in the analytical part: while the students in the traditional group scored an average of 48.3 points due to their inability to relate the matrix to economic models, the students in the project-based methodology scored 69.5 points, which

is 43.9% higher. The overall mastery index increased by 24.8%.

This methodological approach serves to purposefully distribute hours of independent work on the subject and develop student skills in independent analysis.

To improve the quality of mathematical education, the structure of lectures and practical classes should be based on the following didactic principles:

Every mathematical theorem and operation should

have an economic analog. For example, the color of a matrix reflects the degree of mutual independence of sectors in a system; Cramer's rule or inverse matrices is a method for finding local equilibrium points in an economic system.

Instead of wasting time manually calculating determinants and higher-order matrices, students should be taught to work in digital software systems. In this case, the emphasis is on the economic explanation (interpretation) of the output data. It would be advisable to introduce a system of joint exchanges between economists and mathematics teachers on the topic of input-output balance based on practical examples, such as the industry forecast of the Ministry of Economy and Finance of Uzbekistan.

### **CONCLUSION**

In-depth teaching of matrix algebra in economic education is not just a requirement of the science program, but a methodological foundation that forms the analytical thinking of future economists. Matrix methods allow students to see the economy not as a set of local elements, but as a holistic, structural and dynamic system. Adapting the teaching process to the requirements of the digital economy, both conceptually and practically, is a priority task for higher mathematics departments.

### **REFERENCES**

1. Decree of the President of the Republic of Uzbekistan No. PF-5847 dated October 8, 2019 "On approval of the Concept for the development of the higher education system of the Republic of Uzbekistan until 2030".
2. Kuchkarov M.U. Pedagogical aspects of using applied problems of mathematics in higher education/ Journal of scientific and practical research of scientists of Uzbekistan/ Volume 2, 2023.
3. M. Kuchkarov, S. Khakimov Systematic use of mathematical concepts in professional training of students/ BIO Web of Conferences/ EDP Sciences. Journal of Pharmaceutical Negative Results, 3586–3588.  
<https://doi.org/10.47750/pnr.2023.14.03.445>
4. Ahlimirzayev, A. Rizayev, M. Ibragimov, M. Kuchkarov. Higher mathematics / textbook /

Tashkent "Turon-iqbol", 2015.

5. M. Kuchkarov. The use of applied problems of mathematics in higher education. Newsletter of the Urgench State Pedagogical Institute. Scientific-theoretical, methodological journal // No. 1.2023 // ISSN / 2992-8796 // 99-103 p.
6. M.Kuchkarov. The importance of using applied mathematics In teaching process. Journal of Pedagogical Inventions and Practices //ISSN NO: 2770-2367//USA, Date of Publication: 04-11-2022