



B.E. International Program

Faculty of Economics, Thammasat University



Course Syllabus

MA332 Linear Algebra

Semester 1/2021 (August 9 – November 27, 2021)



Number of credits: 3 credits (3-0-6)

Lecture Time: Tuesdays and Thursdays, 11.00 – 12.30 hours

Lecture Venue: Zoom, invitation sent to Line Group 'MA 332 Linear Algebra'

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Course Descriptions

This course is an introduction to concepts, algorithms, theory, and applications of linear algebra. The topics will be delivered in this course are matrices, algebra of matrices, elementary operations and elementary matrices, rank of a matrix, determinants, inverse of matrices, system of linear equations and solutions, Cramer's rule, vector spaces, bases and dimension of vector space, linear transformation, eigenvalues, eigenvectors, diagonalization of a matrices, inner product spaces, Gram-Schmidt process, applications of linear algebra.

Prerequisites:

Course Objectives

After successful completion of this course, students should be able to demonstrate competence with the basic ideas of linear algebra including concepts of linear systems, independence, theory of matrices, linear transformations, bases and dimension, eigenvalues, eigenvectors and diagonalization.

There are at least two reasons why Economics students should study linear algebra. The first is that linear algebra is one of the most widely used branches of mathematics, not only in Economics but all scientific fields. The aim of this course is to understand the 'theory' of linear algebra, not just to learn how it is applied and get numerical answers. That is, how each mathematical object is defined? What are its properties, and how each is related to others?

The other reason is that the theory is surprisingly so rich that the mathematical ideas that the students will encounter in linear algebra will be good representatives of ideas used in other branches of mathematics. This serves as a good introduction to the rigor of mathematical reasoning that is crucial in the advanced Economics study.

Teaching Materials and Resources

Textbook: Lecture Notes to be uploaded to uploaded on BE Moodle

Recommend readings

1. **Carl P. Simon and Lawrence Blume**, *Mathematics for Economics*, Norton, 1994.
2. **John B. Fraleigh and Raymond A. Beauregard**, *Linear Algebra*, 3rd edition, Addison-Wesley, 1995.
3. **Nobel and Daniel**, *Applied Linear Algebra*, 2nd edition, Prentice-Hall, 1977.
4. **Steven J. Leon**, *Linear Algebra with Applications*, 4th edition, Prentice Hall, 1994.
5. **Seymour Lipschutz**, *Schaum's Outline of Theory and Problems of Linear Algebra*, McGraw-Hill, 1968. (QA273 L52)
6. **David G. Luenberger**, *Introduction to Dynamic Systems: Theory, Models, and Applications*, John Wiley & Sons 1979.
7. **David Gale**, *The Theory of Linear Economic Models*, McGraw-Hill, 1960.

Outline:

Chapter 1 System of Linear Equations

1. System of Linear Equations
2. Solving System of Linear Equations by Gaussian Elimination Method

Chapter 2 Matrices

1. Matrices
2. Matrices and System of Linear Equations
 1. Row Echelon Form and Reduced Row Echelon Form
3. Rank of a Matrix
4. Rank and Solutions of System of Linear Equations

Chapter 3 Matrix Algebra

1. Matrix Operations
2. Matrix Representation of System of Linear Equations
3. Laws of Matrix Operations
4. Transposition of a Matrix
5. Special Types of Matrices
6. Elementary Matrices and Elementary Row Operations

Chapter 4 Determinants

1. Motivations for the Definition of Determinants
2. Properties of Determinants
3. Determinant and Elementary Matrices
4. Determinant and Rank of a Square Matrix
5. Determinant of Product of Matrices

Chapter 5 Inverses

1. Properties of Inverse
2. Computation of Inverse
 1. Computing Inverse by Elementary Row Operations
 2. Computing Inverses by Adjoint Matrix

3. Inverse and Determinants
4. Cramer's Rule

Chapter 6 Linear Dependence of a Set of Vectors

1. Linear Dependence and Independence
2. Linear Independence and system of Linear Equations
3. Alternative Definition of Linear Dependence
4. Linear Dependence and Rank
5. Graphical Illustration of Linear Dependence

Appendix: Graphical Representation of Scalar Multiplication and Addition of Vectors

Chapter 7 Vector Spaces

1. Vector Spaces and Subspaces
2. Spanning Sets and Basis of Vector Space
3. Dimension of Vector Space
4. Row, Column and Null Spaces
5. Dimension of Row Space and Rank
6. Dimension of Row and Column Spaces
7. Linearly Independent Rows and Row Space
8. Fundamental Theorem of Linear Algebra
9. Orthogonality between Row and Null Spaces

Chapter 8 Eigenvalues and Eigenvectors

1. Characteristic Polynomial and Characteristic Roots
2. Cayley-Hamilton Theorem
3. Distinct Eigenvalues and Linear Independence of Eigenvectors
4. Matrix Diagonalization and Decomposition
5. Applications of Eigenvalues and Eigenvectors in Dynamic Systems
 - Application 1: Homogeneous System of Linear Difference Equations
 - Application 2: Nonhomogeneous System of Linear Difference Equations
 - Application 3: Dynamics of Left and Right Eigenvectors
6. Eigenvalues and Eigenvectors of Symmetric Matrix

Evaluation

The final grade will be based on the following

- Midterm examination: 45% (October 7, 2021, 13:00-15:00)
- Final examination: 55% (December 13, 2021, 9:00-11:30)

ACADEMIC CALENDAR & HOLIDAY SEMESTER 1/2021

Semester 1/2021 (August 9 - November 27, 2021)	
Classes Begin	August 9, 2021
Add-drop period	August 6 - 15, 2021
Tuition Fee Installment Plan For ID.61-63 only <i>(9 AM - 10.30 PM)</i>	#Round 1 (July 16 – 18, 2021) #Round 2 (August 30 – September 3, 2021) #Round 3 (September 20 – 22, 2021)
<i>H.M. Queen Sirikit The Queen Mother's Birthday*</i>	<i>August 12, 2021</i>
<i>Prince Mahidol Day*</i>	<i>September 24, 2021</i>
Mid-term Examination Period	September 27 - October 3, 2021
Withdrawal period with "W" on record	October 11 - November 15, 2021
<i>H.M. King Bhumibol Adulyadej The Great Memorial Day*</i>	<i>October 13, 2021</i>
<i>Substitution for King Chulalongkorn's Day*</i>	<i>October 22, 2021</i>
<i>King Chulalongkorn's Day*</i>	<i>October 23, 2021</i>
Last day of class for Semester 1/2021	November 27, 2021
Final exam period	November 29-30, December 1-3, 7-9, 11-17, 2021
<i>H.M. King Bhumibol Adulyadej The Great's Birthday*</i>	<i>December 5, 2021</i>
<i>Substitution for H.M. King Bhumibol Adulyadej The Great's Birthday*</i>	<i>December 6, 2021</i>
<i>Constitution Day*</i>	<i>December 10, 2021</i>

Remark * Holiday, No classes during this period