



# B.E. International Program

## Faculty of Economics, Thammasat University



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### Course Outline

## MA 332 Linear Algebra

Semester 1/2012 (August 14 – December 1, 2012)

**Number of credits:** 3 credits

**Lecture Time:** Wednesdays and Fridays, 14.00-15.30 hrs

**Lecture Venue:** Room 201, Faculty of Economics

**Instructor:** Dr. Thanet Makjamroen

Office: Room 521, Faculty of Economics

Office hours: by appointment

### General Information:

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 branch of mathematics, not only in Economics but all scientific fields. The aim of this course is to understand the ‘theory’ of linear algebra, not 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.

### Course Description:

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, eigen values, eigen vectors, diagonalization of a matrices, inner product spaces, Gram-Schmidt process, applications of linear algebra.

**Prerequisites:** Second-year status

**Text:** Lecture Notes

**References:**

1. **Carl P. Simon and Lawrence Blume**, *Mathematics for Economics*, Norton, 1994.
2. **John B. Fraleigh and Raymond A. Beauregard**, *Linear Algebra*, 3<sup>rd</sup> edition, Addison-Wesley, 1995.
3. **Nobel and Daniel**, *Applied Linear Algebra*, 2<sup>nd</sup> edition, Prentice-Hall, 1977.
4. **Steven J. Leon**, *Linear Algebra with Applications*, 4<sup>th</sup> 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.

**Teaching Plan:**

**Outline**

1. Introduction  
Techniques of Proof: Deduction, Induction, and Contradiction  
Counterexample
2. System of Linear Equations
3. Solving System of Linear Equations by Gaussian Elimination Method
4. Matrix and System of Linear Equations
5. Rank of Matrix and Row Echelon Form
6. Matrix Algebra  
Scalar Multiplication  
Matrix Addition  
Matrix Multiplication  
Laws of Matrix Algebra  
Transposition of Matrix
7. Special Types of Matrices
8. Elementary Matrices and Elementary Row Operations

## 9. Determinants: Motivation and Definition

Properties of Determinants

Determinant of Product of Matrices

Singular and Nonsingular Matrices

Determinant and Rank

## 10. Inverse of a Matrix

Computation of Inverses

- by Elementary Row Operations

- by Adjoint Matrix

Inverse and Determinant

Cramer's Rule

## 11. Linear Dependence and Independence

Linear Dependence and System of Linear Equations

Linear Dependence and Rank

## 12. Vector Spaces and Subspace

Spanning Sets and Bases of Vector Space

Dimension of Vector Space

Row Space, Column Space and Null Space

Dimension of Row and Column Spaces

Orthogonality of Row and Null Spaces

## 13. Eigenvalues and Eigenvectors

Distinct Eigenvalues and Linear Independence of Eigenvectors

Matrix Diagonalization

Applications of Eigenvalues and Eigenvectors in Dynamic Systems

## 14. Quadratic Form and Its Definiteness

Quadratic Function and Quadratic Form

Definiteness of Quadratic Form

Tests of Definiteness

Definiteness and Convexity of a Function

Necessary and Sufficient Conditions of Optimization Problem

## **Evaluation**

**1. Midterm      45%      (Wednesday, October 3, 2012, 14.00 – 15.30 hrs)**

Almost all questions will ask the student to prove something. No straight forward calculations.

**2. Final            50%      (Monday, December 3, 2012, 9.00 – 12.00 hrs)**

Same as Midterm.

## **Important Dates:**

Class Begins	August 14, 2012
Adding and Dropping Course	August 14-28, 2012
Midterm Exam Period	October 1- 6, 2012 (No Lectures)
Course Withdrawal	October 17-22, 2012
Class Ends	December 1, 2012

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