JDEP 384H: Numerical Methods in Business

Instructor: Thomas Shores
Department of Mathematics

Lecture 1, January 9, 2007
110 Kaufmann Center

Outline

Rational File Management

File Management in 384H:

We want to keep perfectly synchronized with all the latest course files. Here's how:

- Create for once and for all a JDEP384hS07 directory somewhere in your own home directory.
- Create subdirectories in which you'll put work, etc., but avoid the names of directories already existing in the course public directory of the above name.
- Before, or at the start of class, grab a copy of ZipDir.zip which will be located in the current Weekx. Save it in your JDEP384hS07 directory and do NOT unzip it.
- Go into the ZipDir.zip and copy all files inside the top directory.
- Move to root of JDEP384hS07 and paste all. Delete ZipDir.zip.

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Course Policy

Let's go to the JDEP 384 Homepage, find and read

- Class Policy Statement
- Course Syllabus
- Questions?

Outline

Text: Numerical Methods in Business and Finance

- Part I: Background
  - Ch. 1: Motivation
  - Ch. 2: Financial problems and related numerical methods.
- Part II: Numerical Methods
  - Ch. 3: Basics of numerical analysis
  - Ch. 4: Numerical integration
  - Ch. 5: Finite difference methods for partial differential equations
  - Ch. 6: Convex optimization
- Part III: Pricing Equity Options
  - Ch. 7: Option pricing by binomial and trinomial lattices
  - Ch. 8: Option pricing by Monte Carlo methods
  - Ch. 9: Option pricing by finite difference methods
- Part IV: Advanced Optimization Models and Methods
  - Ch. 10: Dynamic programming
  - Ch. 11: Linear stochastic programming models with recourse
  - Ch. 12: Non-convex optimization

Pros

- Presents a global view: problem(s), analysis, theoretical solutions, practical (numerical!) solutions.
- Excellent context for learning some basic numerical analysis.
- Excellent incorporation of Matlab tools into body of text.

Cons

- Too much material for a one semester course.
- Stealth requirements of knowledge of linear algebra and statistics.
- No exercises!
- Strictly finance topics, which is only a subset of business.

Workarounds

- Find exercises elsewhere and place them in these notes.
- Approach the book selectively (depending on background and preferences of the class.)
- Relate the tools studied to business topics other than financial engineering.
- Be pragmatic about the depth to which we'll pursue some topics.
- Rely on Matlab to enhance understanding and give answers.

Outline

What We'll Do

Core of the text (must cover this!):

- Part I (Chapter 1-2): Background to financial models.
- Part II, Chapter 3-4: Basics of numerical analysis and Monte Carlo methods.

As time permits cover independent threads (useful MATHEMATICAL tools in other business contexts!):

1. **Binomial Lattices**: Part III, Chapter 7.
2. **Optimization Methods in Business**: Non-text material.
3. **Decision Analysis** Non-text material.

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Outline

Math Examples

A linear equation is one of the form

$$a_1x_1 + a_2x_2 + \cdots + a_nx_n = b,$$

where $x_1, x_2, \ldots, x_n$ are the variables and $a_1, a_2, \ldots, a_n, b$ are known constants.$A\mathbf{x} = \mathbf{b}$.

A linear system of m equations in the n unknowns $x_1, x_2, \ldots, x_n$ is

$$\begin{aligned}
a_{11}x_1 + a_{12}x_2 + \cdots + a_{1j}x_j + \cdots a_{1n}x_n &= b_1 \\
a_{21}x_1 + a_{22}x_2 + \cdots + a_{2j}x_j + \cdots a_{2n}x_n &= b_2 \\
&\vdots \quad \vdots \quad \vdots \\
a_{i1}x_1 + a_{i2}x_2 + \cdots + a_{ij}x_j + \cdots a_{in}x_n &= b_i \\
&\vdots \quad \vdots \quad \vdots \\
a_{m1}x_1 + a_{m2}x_2 + \cdots + a_{mj}x_j + \cdots a_{mn}x_n &= b_m
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The Objects

Linear systems terminology inspires new objects:

Matrix Theory: The $m \times n$ matrix A

is rectangular table of numbers $a_{i,j}$ whose (i,j)th entry, i.e., entry in the ith row and jth column, is denoted by a_{ij}. A is $m \times n$ matrix written

$$A = [a_{ij}]_{m,n}.$$

$\mathbf{b} = [b_i]$ means $\mathbf{b}$ is a column vector (matrix with exactly one column) whose ith entry is denoted by b_i, and "$\mathbf{c} = [c_j]$" means that c is a row vector (matrix with exactly one row) whose jth entry is denoted by c_j.

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The Arithmetic

Go to the more extensive Linear Algebra notes in the file LinearAlgebraLecture-384.pdf at this point.

Outline

Follow this by our Matlab tour, contained in the file MatlabLecture-384H.pdf.