Mathematics 160: Lecture 1

Introduction

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Course information

- Course information is available at:
  http://dananne.org/doku.php?id=math-160:math-160

What is a vector?

- For physicists, a vector is a quantity with both magnitude and direction.
  - Example: velocity
  - Example: force
- Mathematically, a *vector* is an ordered n-tuple of numbers, a point in n-dimensional space.

How many dimensions are enough?

- Do we need to study more than 3 dimensional space?
- Examples
  - Three dimensions are required to locate a point in space.
  - Four dimensions are needed if we include a time coordinate.
  - Seven dimensions are needed if we include momentum.
  - String theory requires even more dimensions.
  - Economic theory might deal with functions of thousands of variables.

What is a matrix?

- A *matrix* is a rectangular array of numbers.
  - Example: $A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 10 & 0 \\ 4 & 7 & 13 \end{bmatrix}$
- Matrices are useful for encoding information.
  - Coefficients of linear equations
  - Coefficients of a linear function
  - Transition probabilities of a Markov chain
- An $m \times n$ matrix is a matrix with m rows and n columns.
- The number in the ith row and jth column of a matrix is the (i, j)-*entry* of the matrix.

Examples and notation

- Examples:
  - A 2×3 matrix:
    $$\begin{bmatrix} 1 & 2 & 8 \\ -1 & 0 & 3 \end{bmatrix}.$$
  - A 4×2 matrix:
    $$\begin{bmatrix} 2 & -4 \\ 3 & 1 \\ 5 & -6 \\ 3 & -8 \end{bmatrix}.$$
- We may denote a general $m \times n$ matrix A as
$$A = \begin{bmatrix} a_{11} & a_{12} & a_{13} & \cdots & a_{1n} \\ a_{21} & a_{22} & a_{23} & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & a_{m3} & \cdots & a_{mn} \end{bmatrix}$$
- For a more compact notation, we will often write simply $A = [a_{ij}]$.

Octave

- Octave is a free software package for working with matrices.
- You may
  - run Octave on an MS Windows computer directly from the USB flash drive,
  - install Octave on an MS Windows computer using the `exe` file, or on a Mac OS X computer using `dmg` file, both of which are also on the USB flash drive,
  - or download and install Octave from the link on the course web site.
- Homework: Run Octave.

Entering a matrix in Octave

- The command `A = [1 2 3; 4 5 6]` will create the 2×3 matrix
$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$$
in Octave.
- The command `5*A` will multiply each entry of A by 5.
- To exit Octave, type `quit`.
- Note: In Mac OS, you will also want to quit `Terminal` from the menu bar.