Storing and Manipulating
Numeric Data

Binary number representation

- Integers
  - infinite discrete subset of the number line
  - are represented with a limited range
- Decimal numbers (real numbers)
  - infinite and continuous
  - are represented with limited range and limited precision

Binary number representation

- Based on powers of two
  0000011111001111 is 1999
  - 1024 + 512 + 256 + 128 + 64 + 8 + 4 + 2 + 1
- Stored in old PC world as 2 bytes (16 Bits)
  Largest 16 bit integer is 65,535
  Newer and larger systems 32-bits
  - from 0 to 4,294,967,295

Negative Number Representation

- To designate positive and negative integers we use the left most digit
  1 denotes a positive number
  0 denotes a negative number
  1000000000000101 is a +5
  0000000000000101 is a -5
- the remaining 15 digits can then have a range of -32,768 to +32767

Representing negative numbers

- Problems
  - What to do about 0
    10000000 is +0
    00000000 is - 0
- To take care of this problem a method of
  TWOS-COMPLEMENT is used
  We will not discuss this process in this class

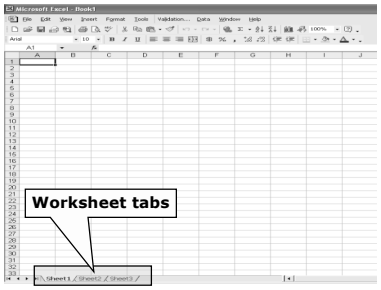
Spreadsheets

- Numeric processing for the rest of us
- Originally written for finance
- Now used by
  - engineers and scientists
  - everyday folk

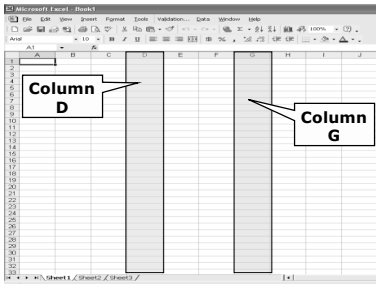
VisiCalc

- First commercial spreadsheet VisiCalc
  - Developed in late 1970's by
    - Dan Bricklin
      - Harvard business school student
    - Bob Frankston
      - programmer
- Killer app for IBM PC compatibles
  - PC's entry point to business
  - Sales of PCs took off

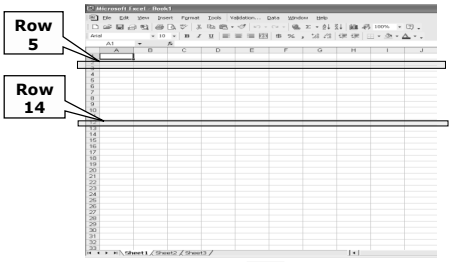
Excel Worksheet



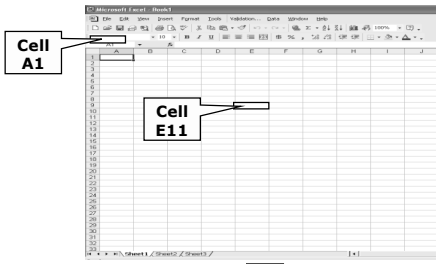
Columns



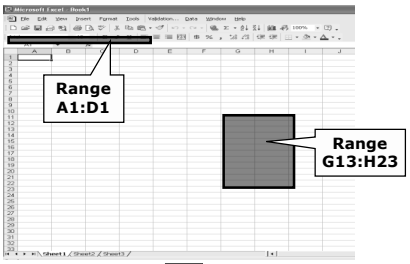
Rows



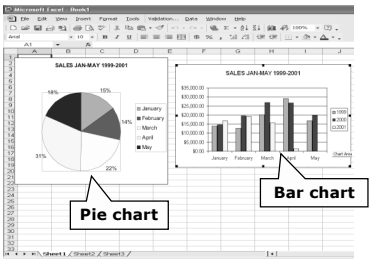
Cells



Range of Cells



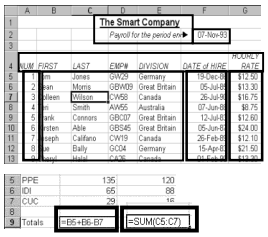
Charts



The Spreadsheet

Spreadsheets are composed of cells in Rows and Columns

- **Values** like numbers,dates
- **Labels**: row/column headings and text entries
- **Formulas** mathematical expressions and commands
- **Functions** automatic calculations using parameters



"What If?"

- Spreadsheets allow you to change numbers and instantly see the effects of those changes.
  - "*What if I enter this value*?"

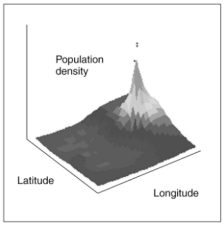
•Example1- Loan

•Example2- Multiple updates

Mathematical packages

- symbolic manipulation
  - Calculus and calculation
  - Mathematica, maple, …
- scientific visualization
  - Display of data
    - in many different format
  - Use to present and understand data
  - Example
  - Example: Demographics

Statistical Software: Beyond Spreadsheets



Statistical and data analysis software collects and analyzes data that tests the strength of data relationships.

Computer Modeling and Simulation

Examples:

- Hurricane Katrina was forecasted by computer models.
- managing a business, city, or nation
- computer models of organisms, objects, and organizations. DNA models
- flight simulators and simulations of science lab activities
- computer games (chess boards, sports arenas, and mythological societies)

Computer Modeling and Simulation

Schools, businesses, and the military use simulations for training because:

- **Safety**: non-threatening environments
- **Economy**: less expensive than real life
- **Projection**: less threatening to systems
- **Visualization**: allows to see and understand
- **Replication**: allows repetition of projects