Chapter Six

Calculation, Visualization, and Simulation

After reading this chapter, you should be able to:

- Describe the basic functions and applications of spreadsheet programs on personal computers
- Explain how computers can be used to answer “What If?” questions
- Show how spreadsheet graphics can be used and misused as communication tools

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After reading this chapter, you should be able to:

- Describe other software tools for processing numbers and symbols on personal computers, workstations, and mainframes
- Explain how computers are used as tools for simulating mechanical, biological, and social systems

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After reading this chapter, you should be able to:

- Discuss the advantages and disadvantages of computer simulations as a tool for research and education

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Chapter Outline

- The Spreadsheet: Software for Simulation and Speculation
- Spreadsheet Graphics: From Digits to Drawings
- Statistical Software: Beyond Spreadsheets
- Calculated Risks: Computer Modeling and Simulation

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The Spreadsheet

The spreadsheet is a malleable matrix that consists of:

- **Worksheet** (a spreadsheet document)
- **Columns** (alphabetical horizontal divisions)
- **Rows** (numbered vertical divisions)

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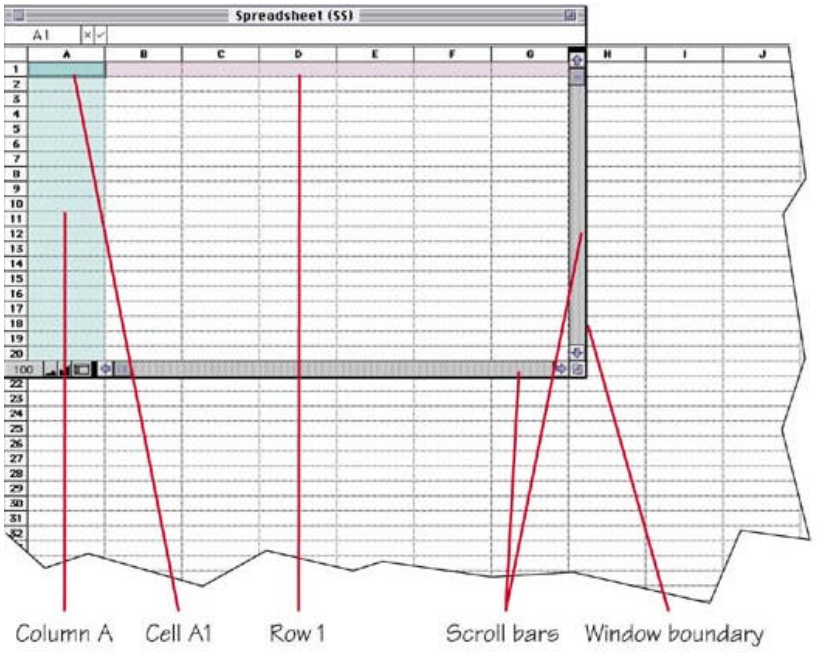
The Spreadsheet

- **Cells** (the intersection of a row and column)
- **Addresses** (column letter and row number, e.g., C12)



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The Worksheet

The worksheet is a grid formed by columns and rows and can contain:

- **Values** (or numbers such as 4, -76, $120.00).
- **Labels** (words that explain what the numbers mean such as Food).

	A	B
1	Expenses	Amount
2	Rent	$400
3	Food	$250
4	Utilities	$120
5	Total	$760

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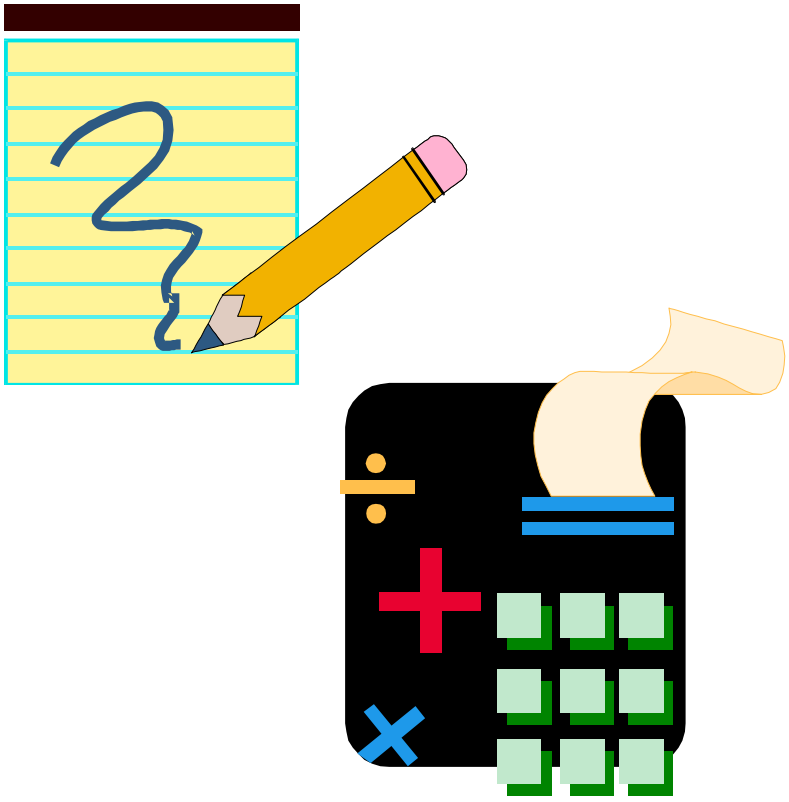
The Worksheet



- **Formulas** (a step-by-step procedure for calculating a number, e.g. =Sum(B2:B4).

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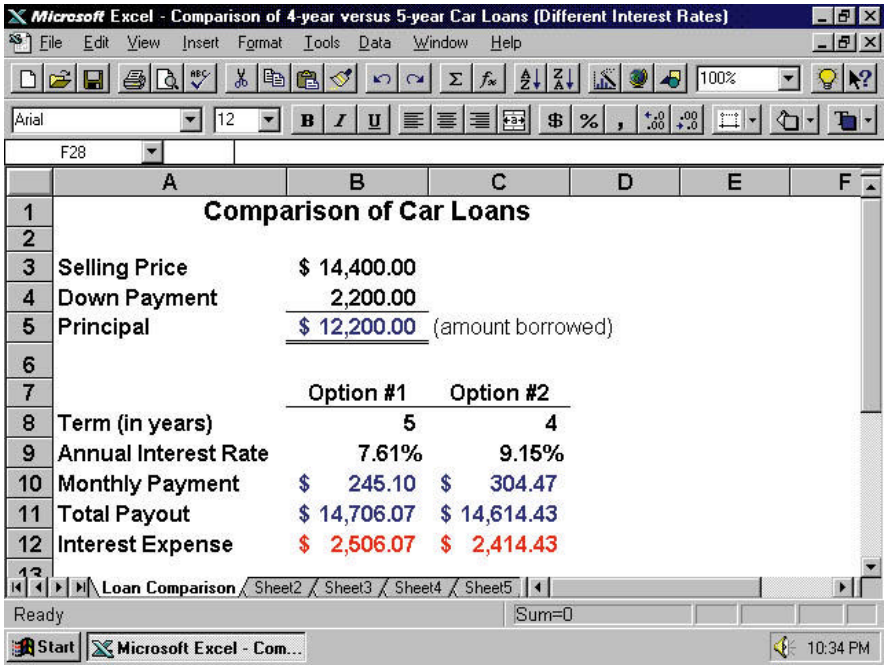
Spreadsheet Features

- Automatic replication of values, labels, and formulas (relative versus absolute references)
- Automatic recalculation



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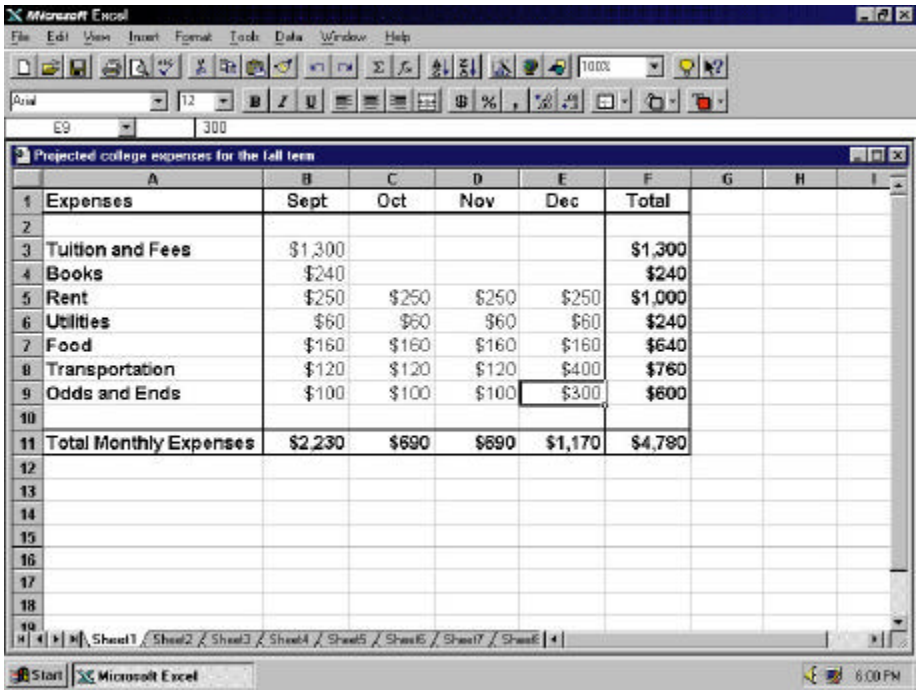
Spreadsheet Features



	A	B	C	D	E	F
1	Expenses	Sept	Oct	Nov	Dec	Total
2						
3	Tuition and Fees	$1,300				$1,300
4	Books	$240				$240
5	Rent	$250	$250	$250	$250	$1,000
6	Utilities	$60	$60	$60	$60	$240
7	Food	$160	$160	$160	$160	$640
8	Transportation	$120	$120	$120	$400	$760
9	Odds and Ends	$100	$100	$100	$300	$600
10						
11	Total Monthly Expenses	$2,230	$690	$690	$1,170	$4,780

- Predefined functions (e.g., SUM, AVG, SQRT).
- Macros (custom design your own feature)
- Templates (ready-to-use worksheets).

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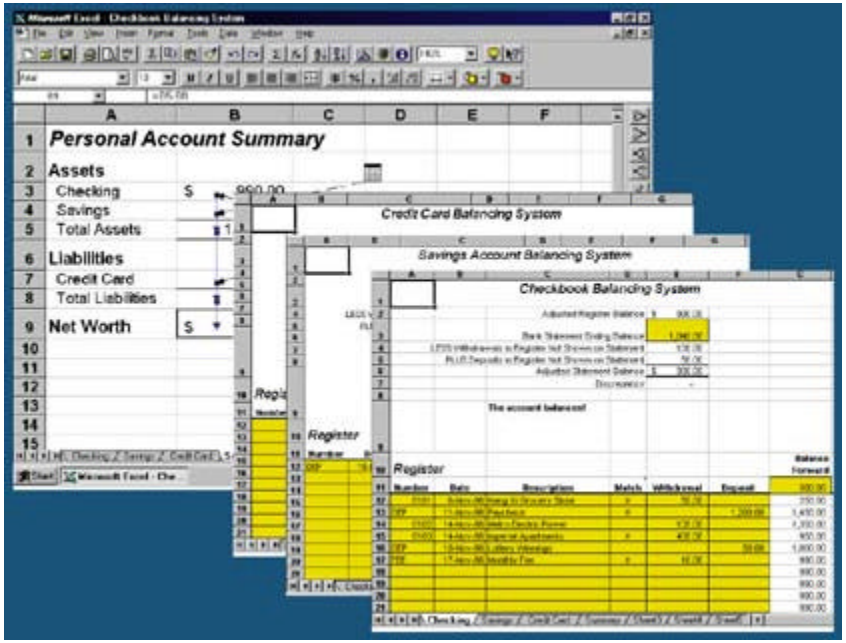
Spreadsheet Features

- Linking (reflect changes in related worksheets).
- Database capabilities.



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“What If?” Questions

- Spreadsheets allow you to change numbers and instantly see the effects of those changes.
  - “What if I enter this value?”
- Equation solvers
  - Some spreadsheets generate data needed to fit a given equation and target value.

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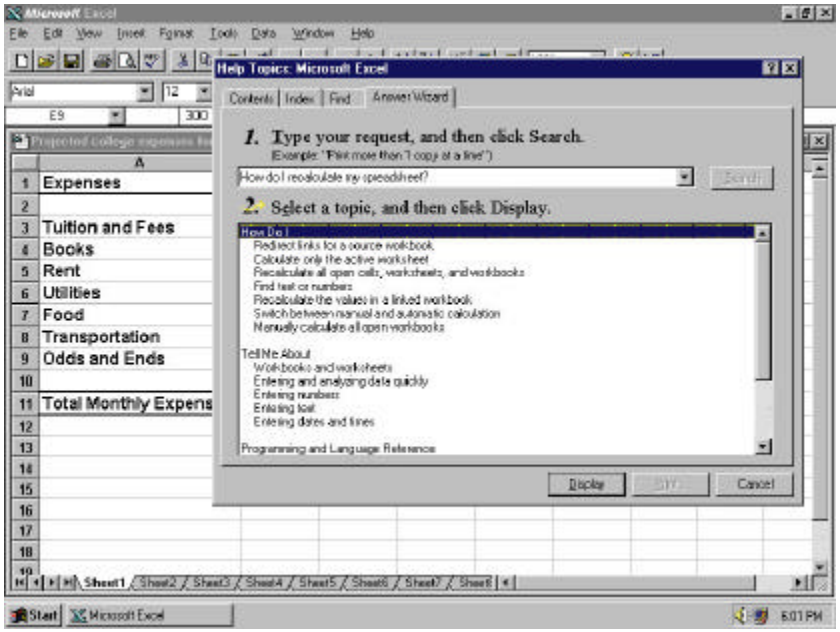
“What If?” Questions



- Validators - the equivalent of spelling and grammar checkers for spreadsheets.

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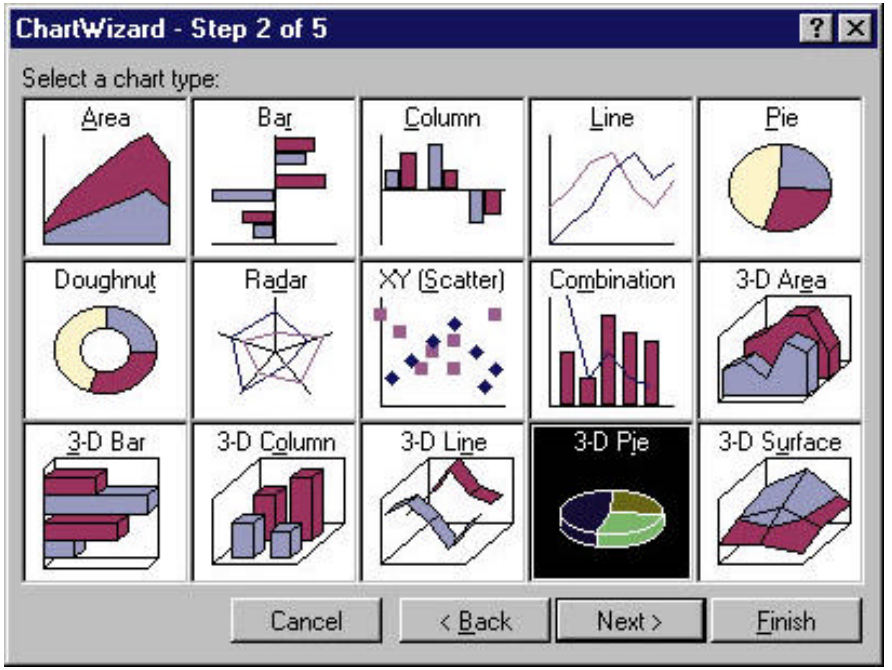
Spreadsheet Graphics: From Digits to Drawings

Charts allow you to turn numbers into visual data:

- **Pie charts** (show relative proportions to the whole)
- **Line charts** (show trends or relationships over time)



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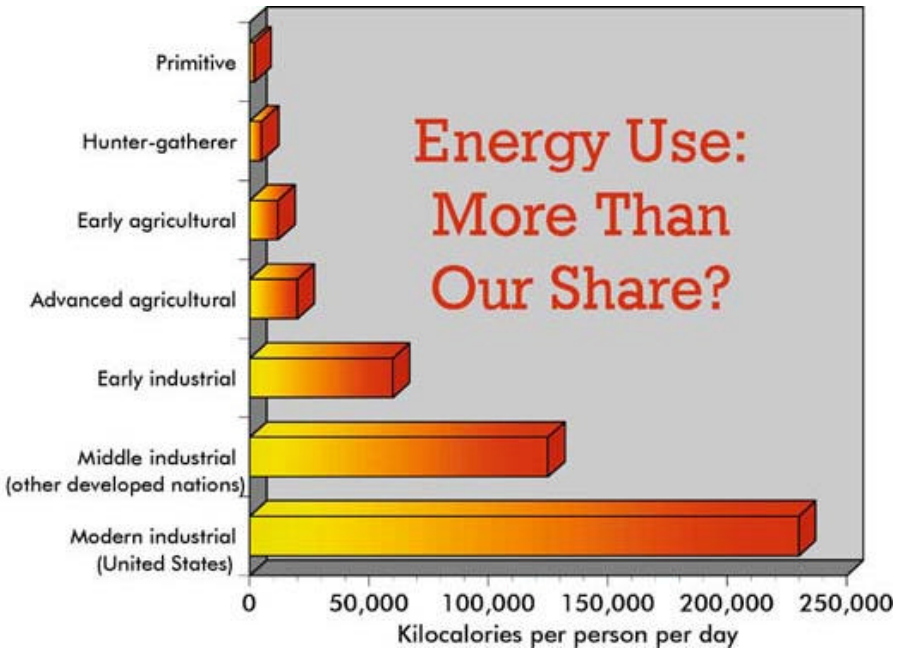
Spreadsheet Graphics: From Digits to Drawings

- **Bar charts** (use if data falls into a few categories)
- **Scatter charts** (use to discover, rather than to display, a relationship between two variables)



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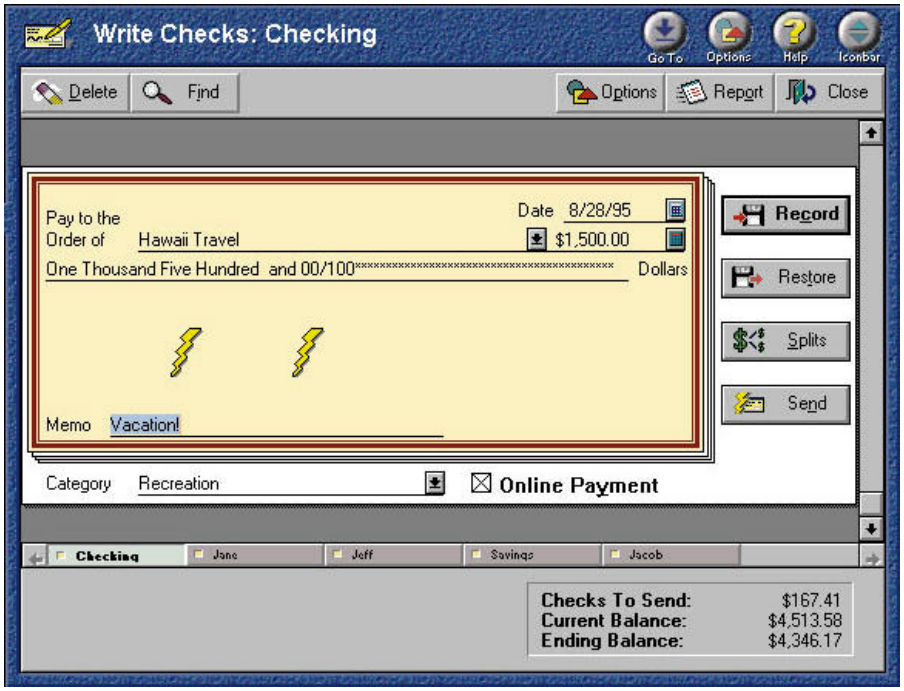
Statistical Software: Beyond Spreadsheets



- **Money Managers** - accounting and financial management software make the accounting process easier.

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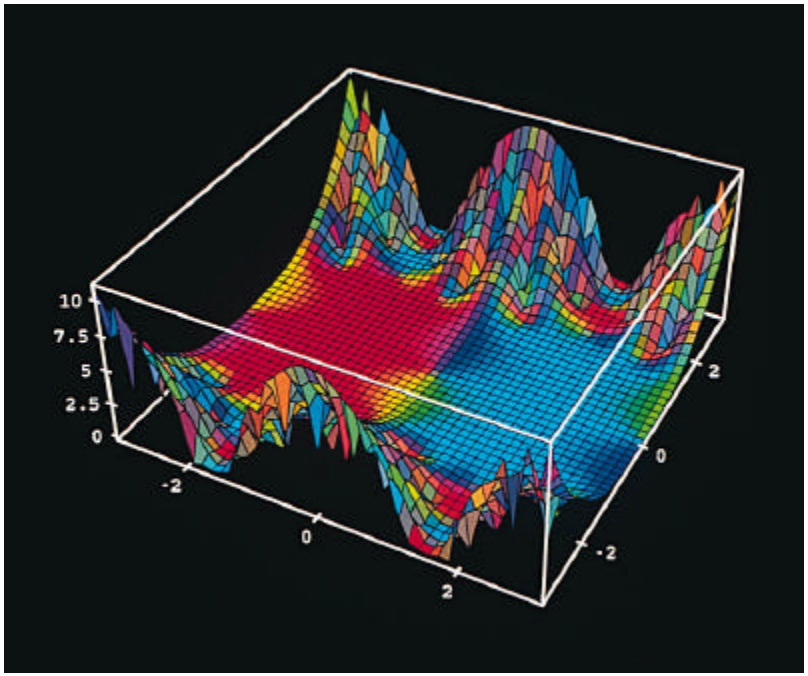
Statistical Software: Beyond Spreadsheets

- **Automatic Mathematics** - Mathematics processor software turns abstract mathematical relationships into visual objects.



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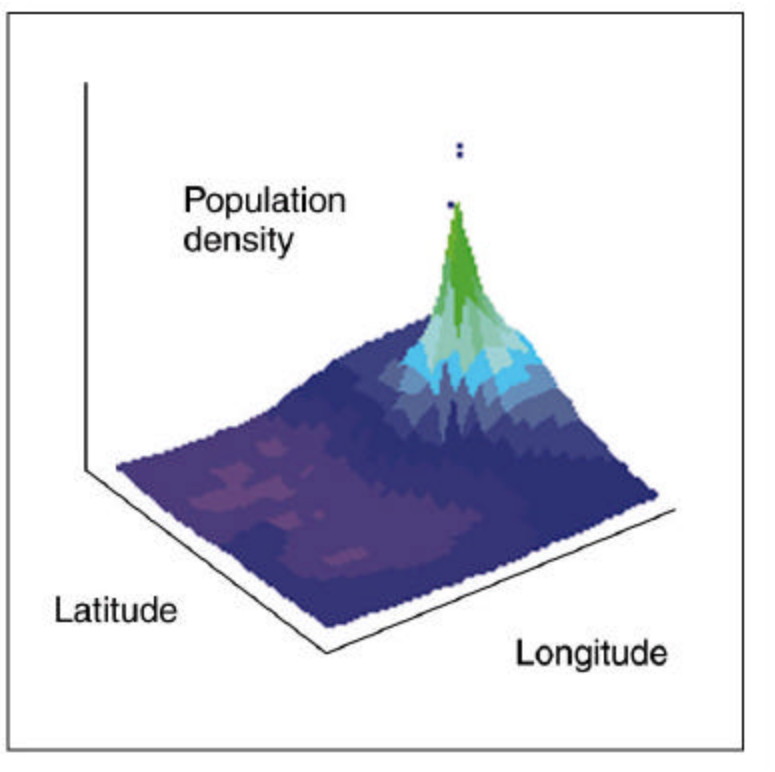
Statistical Software: Beyond Spreadsheets

- **Statistical and data analysis software -** collecting and analyzing data that tests the strength of data relationships.



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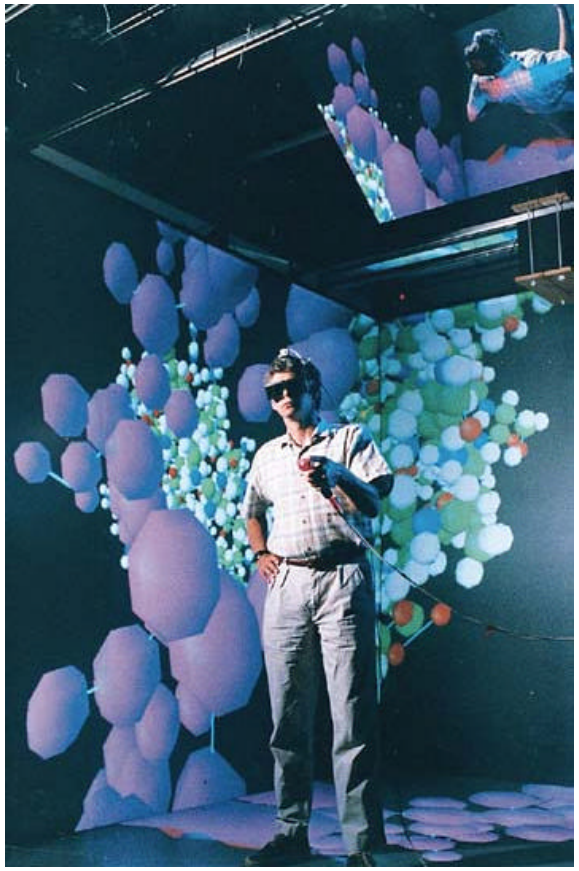
Statistical Software: Beyond Spreadsheets



- **Scientific visualization software** - uses shape, location in space, color, brightness, and motion to help us visualize data.

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Calculated Risks: Computer Modeling and Simulation

Computer modeling - the use of computers to create abstract models of objects, organisms, organizations, and processes

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Computer Modeling and Simulation

Examples:

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

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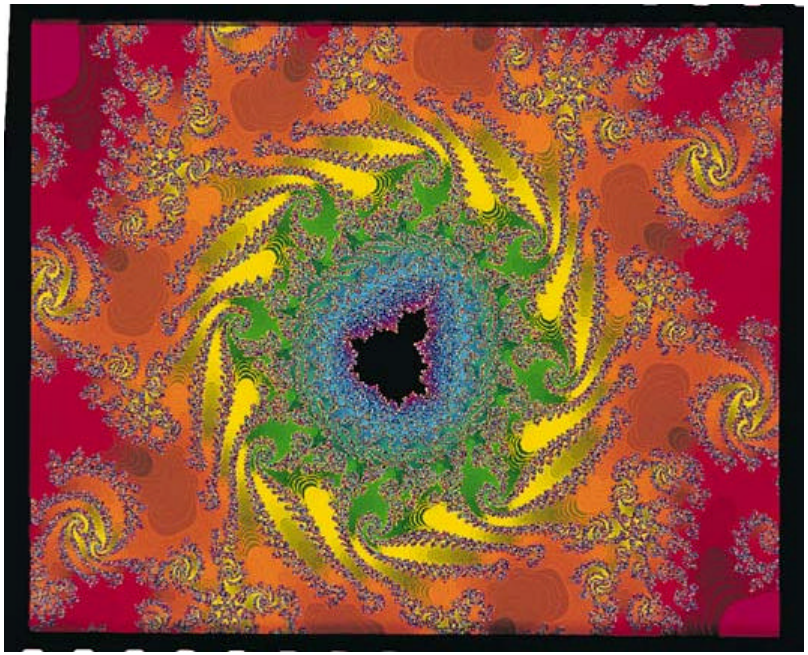
Computer Simulation



Computer Simulations - are widely used for research in the physical, biological, and social sciences, and in engineering.

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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

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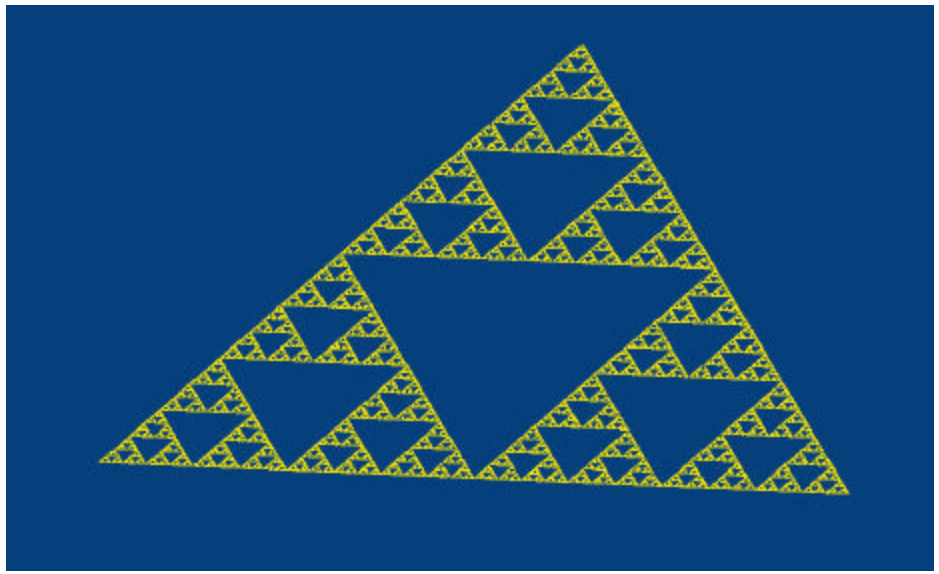
Computer Simulation: The Risks

Risks:

- Simulation isn't reality.
- Not all factors can be entered into the model or simulation.



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