



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

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

After reading this chapter,
you should be able to:

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

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

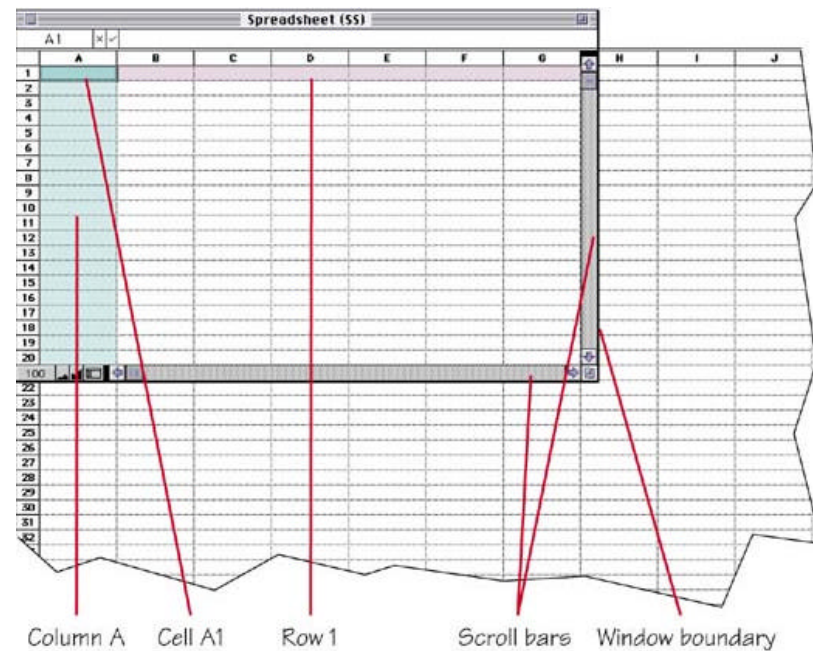
The Spreadsheet

The spreadsheet is a malleable matrix that consists of:

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

The Spreadsheet

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



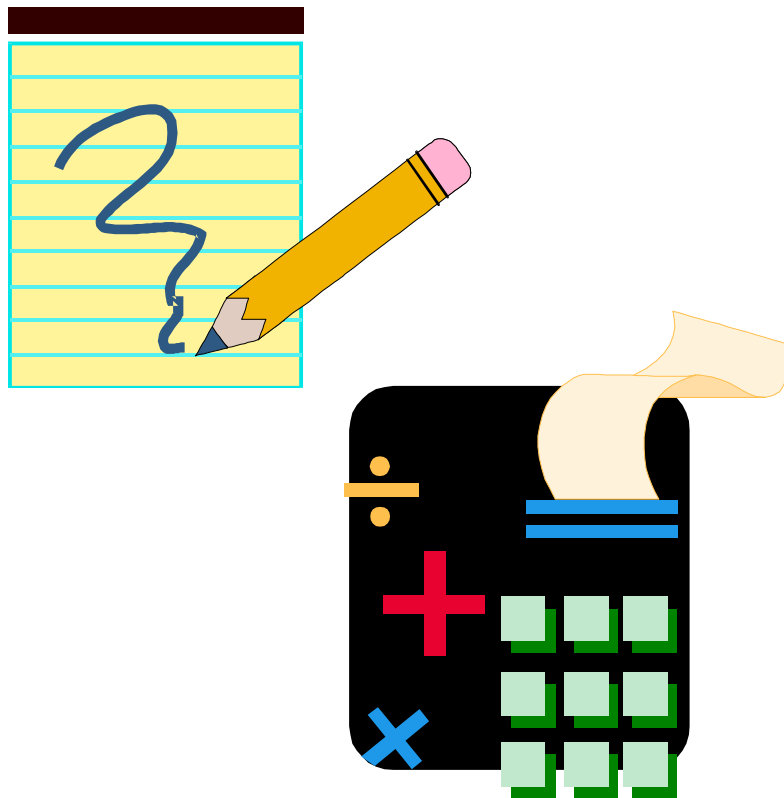
The Worksheet

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

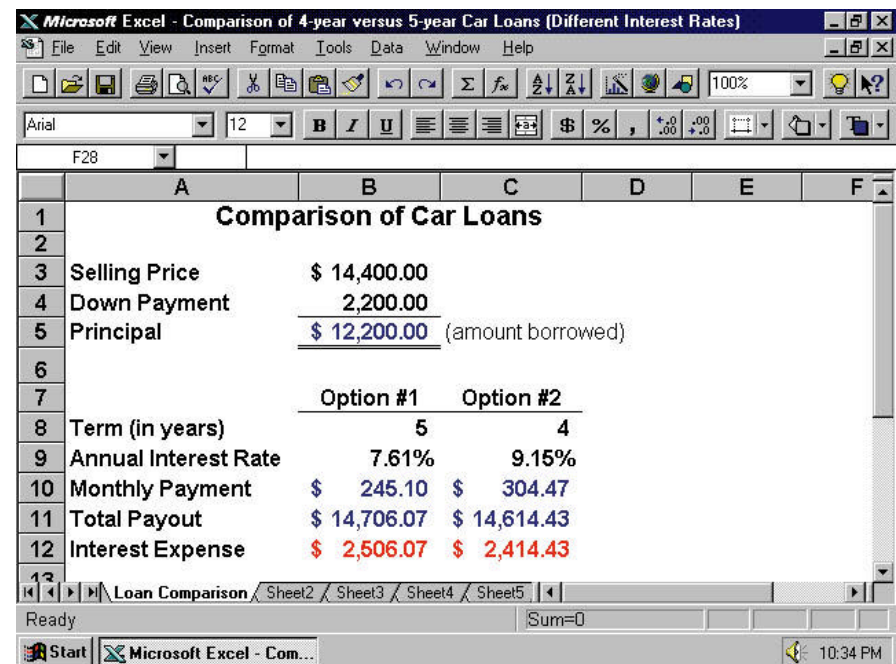
The Worksheet



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

Spreadsheet Features

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

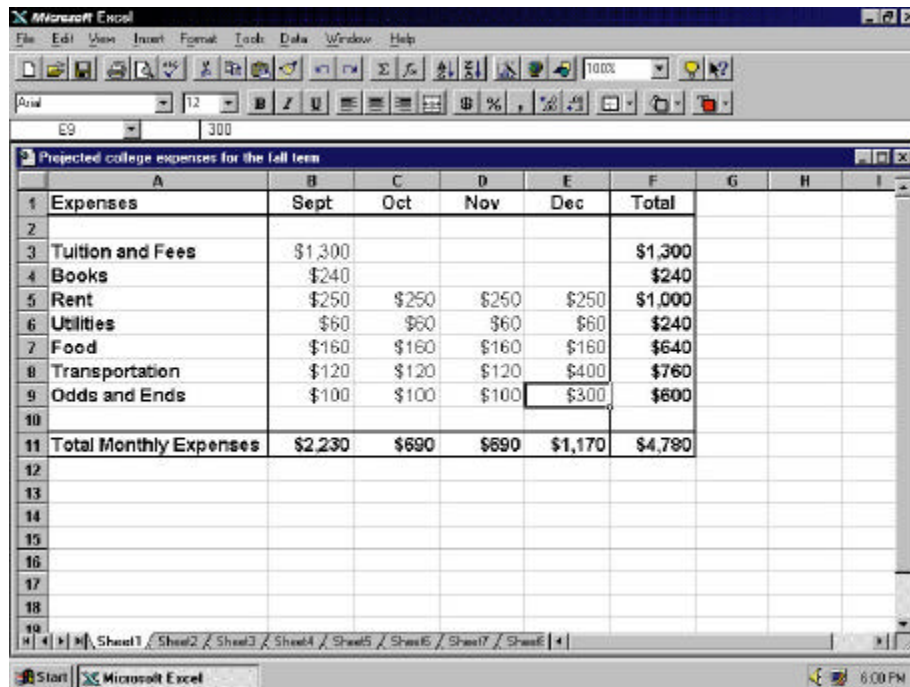


The screenshot shows a Microsoft Excel window titled "Comparison of 4-year versus 5-year Car Loans (Different Interest Rates)". The spreadsheet contains the following data:

	A	B	C	D	E	F
1	Comparison of Car Loans					
2						
3	Selling Price	\$ 14,400.00				
4	Down Payment	2,200.00				
5	Principal	<u>\$ 12,200.00</u>	(amount borrowed)			
6						
7		Option #1	Option #2			
8	Term (in years)	5	4			
9	Annual Interest Rate	7.61%	9.15%			
10	Monthly Payment	\$ 245.10	\$ 304.47			
11	Total Payout	\$ 14,706.07	\$ 14,614.43			
12	Interest Expense	\$ 2,506.07	\$ 2,414.43			

The spreadsheet is displayed in the "Loan Comparison" sheet, with other sheets (Sheet2, Sheet3, Sheet4, Sheet5) visible in the background. The status bar at the bottom shows "Ready" and "Sum=0".

Spreadsheet Features



The screenshot shows a Microsoft Excel window with a spreadsheet titled "Projected college expenses for the fall term". The spreadsheet has columns for months (Sept, Oct, Nov, Dec) and a Total column. The rows list various expenses with their respective amounts.

Expenses	Sept	Oct	Nov	Dec	Total
Tuition and Fees	\$1,300				\$1,300
Books	\$240				\$240
Rent	\$250	\$250	\$250	\$250	\$1,000
Utilities	\$60	\$60	\$60	\$60	\$240
Food	\$160	\$160	\$160	\$160	\$640
Transportation	\$120	\$120	\$120	\$400	\$760
Odds and Ends	\$100	\$100	\$100	\$300	\$600
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).

Spreadsheet Features

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

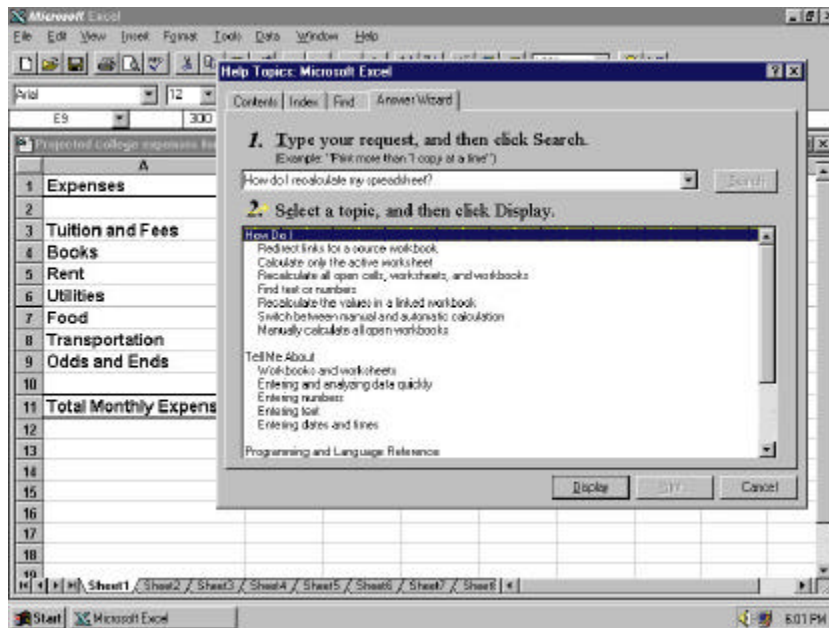
The screenshot displays a Microsoft Excel spreadsheet titled "Checkbook Balancing System". The main worksheet, "Personal Account Summary", is visible, showing a balance sheet with columns for Assets, Liabilities, and Net Worth. The Assets section includes Checking, Savings, and Total Assets. The Liabilities section includes Credit Card and Total Liabilities. The Net Worth is calculated as Total Assets minus Total Liabilities. Below the summary, there are several sub-worksheets or sections: "Credit Card Balancing System", "Savings Account Balancing System", and "Checkbook Balancing System". The "Checkbook Balancing System" section includes a "Register" table with columns for Date, Description, Match, Withdrawal, Deposit, and Balance Forward. The "Savings Account Balancing System" section includes a "Register" table with columns for Date, Description, Match, Withdrawal, Deposit, and Balance Forward. The "Credit Card Balancing System" section includes a "Register" table with columns for Date, Description, Match, Withdrawal, Deposit, and Balance Forward. The spreadsheet is showing the relationship between these different accounts and how they are linked together.

“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.

“What If?” Questions

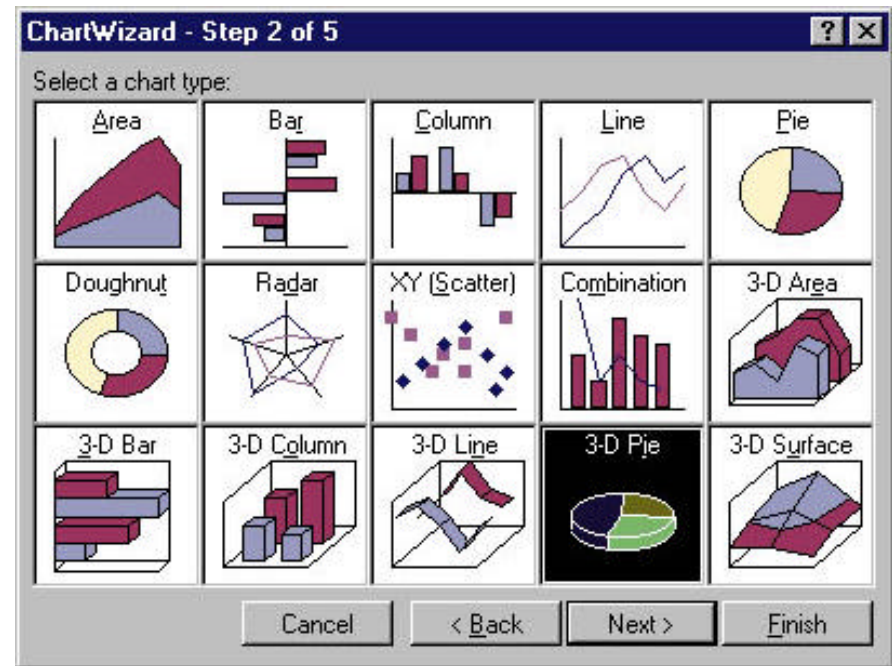
- Validators - the equivalent of spelling and grammar checkers for spreadsheets.



Spreadsheet Graphics: From Digits to Drawings

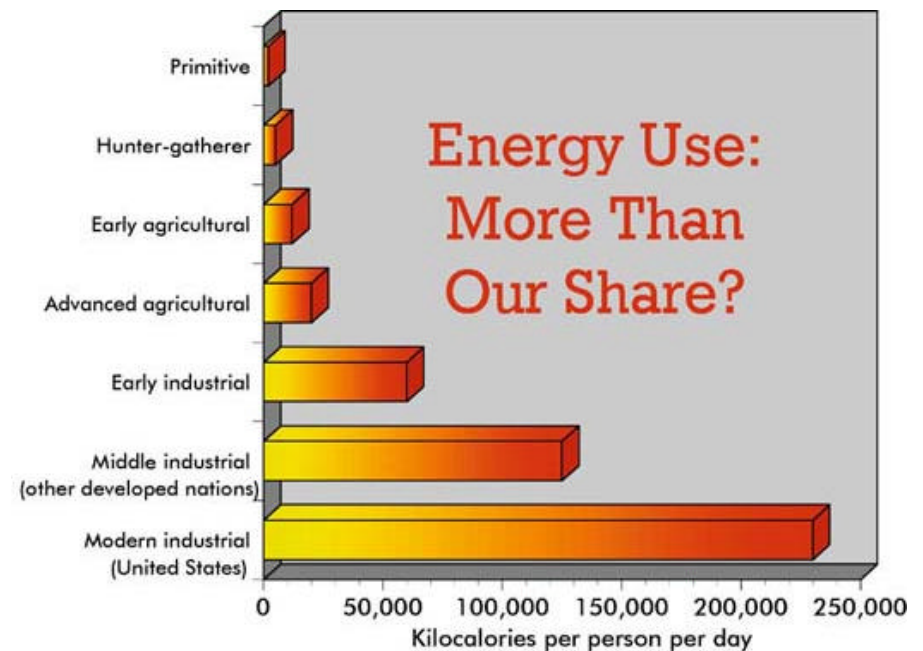
Charts allow you to turn numbers into visual data:

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

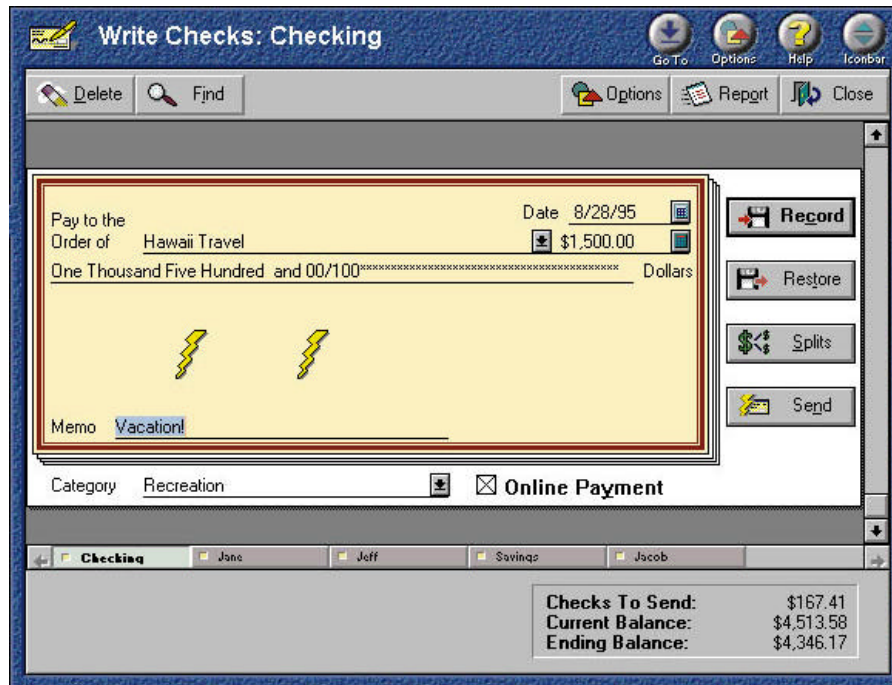


Spreadsheet Graphics: From Digits to Drawings

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



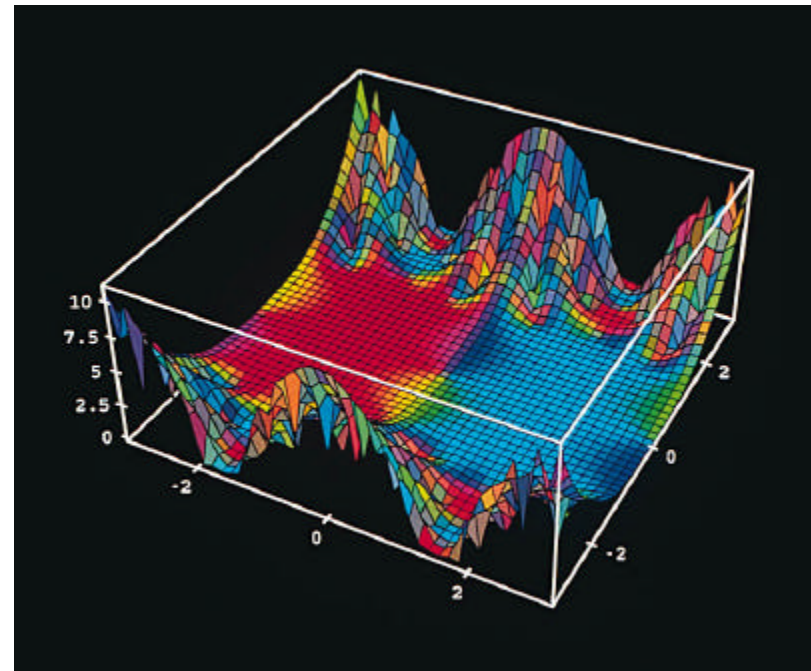
Statistical Software: Beyond Spreadsheets



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

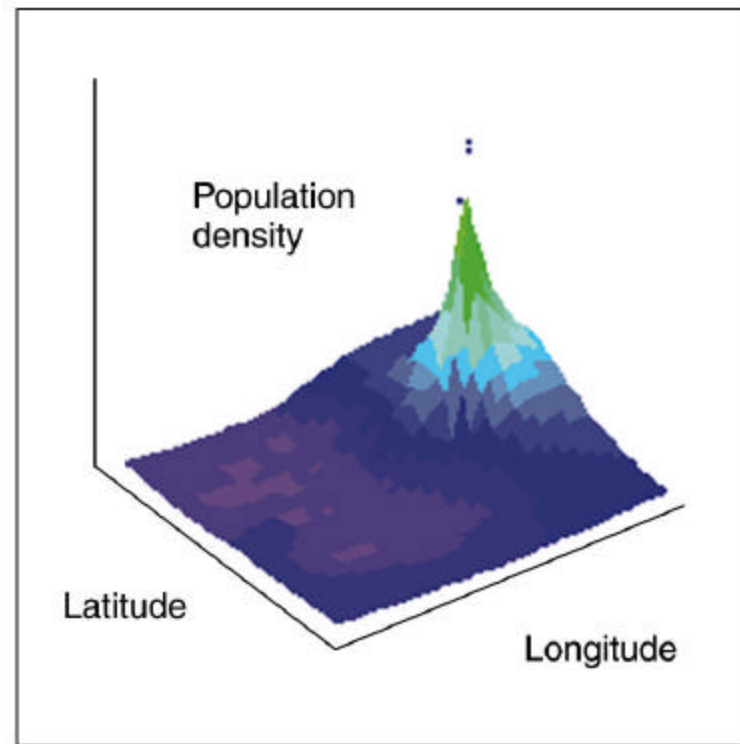
Statistical Software: Beyond Spreadsheets

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

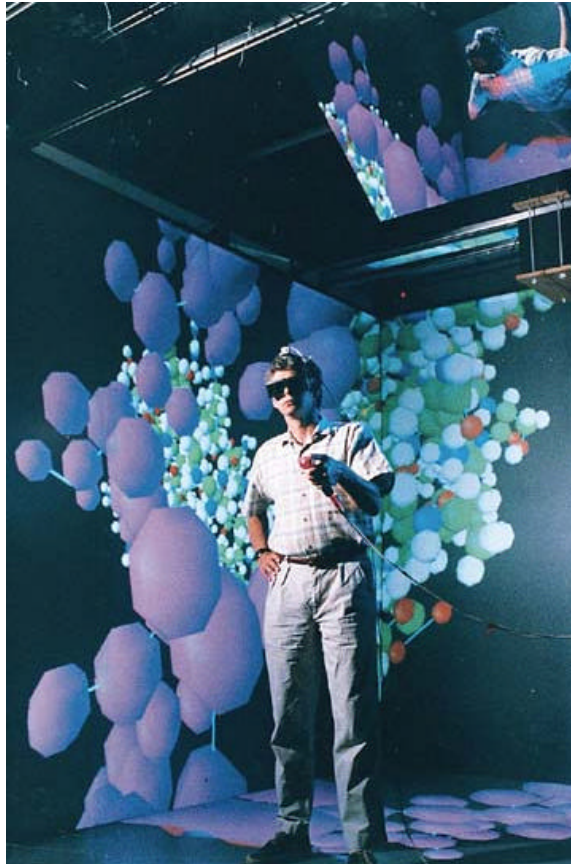


Statistical Software: Beyond Spreadsheets

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



Statistical Software: Beyond Spreadsheets



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

Calculated Risks: Computer Modeling and Simulation

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

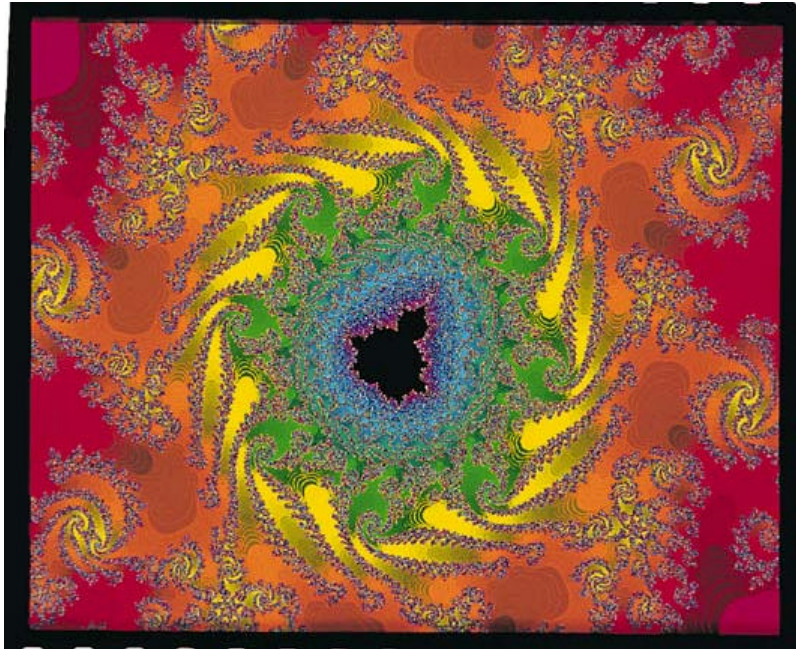


Computer Modeling and Simulation

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

Computer Simulation



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

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

Computer Simulation: The Risks

Risks:

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

