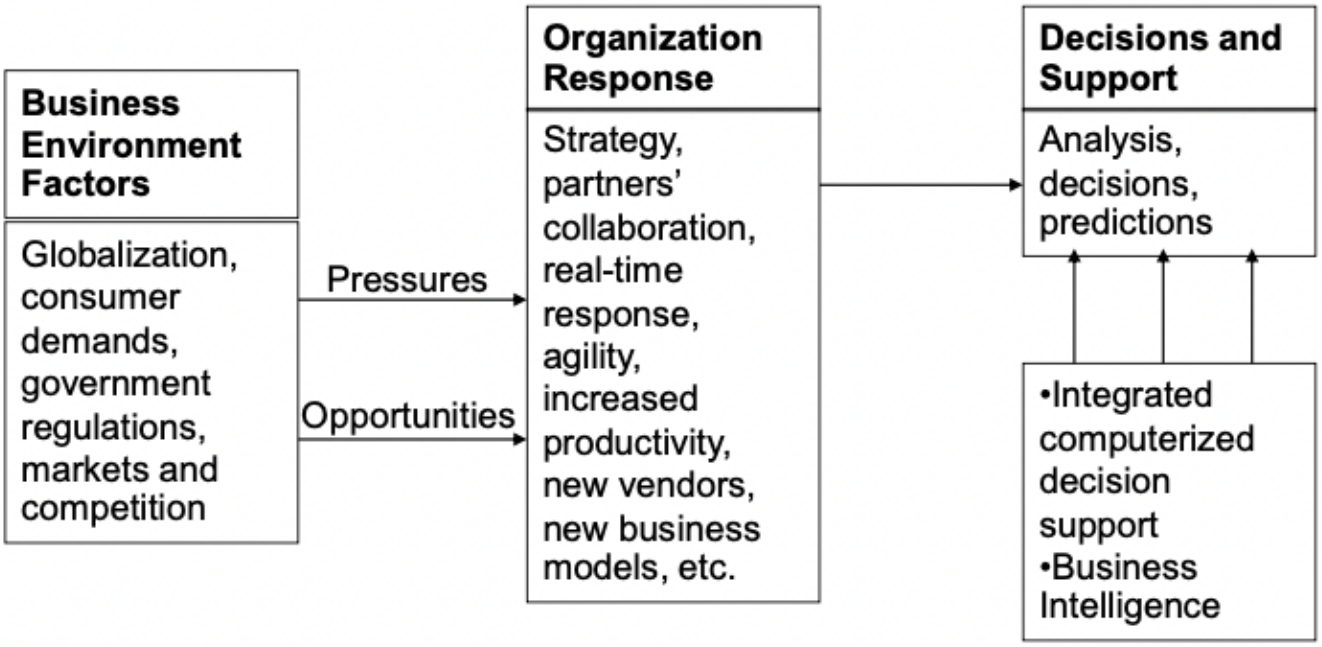
Lecture 6.1: Introduction to Decision Support Systems

Decision Making

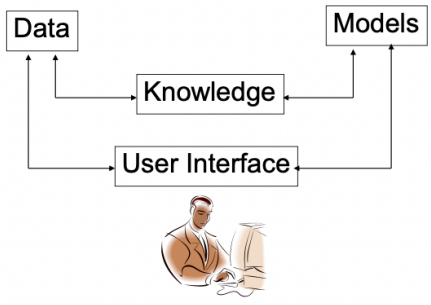
- Business Environment Factors.
  - Markets: strong competition, global markets, market on Internet.
  - Consumer demands: customization, quality, diversity, delivery.
  - Technology: more innovations, more obsolescence rate, more information overload.
  - Societal: more regulation and deregulation, more diversified workforce, more social responsibility.
- Business Pressure-Response-Support Model



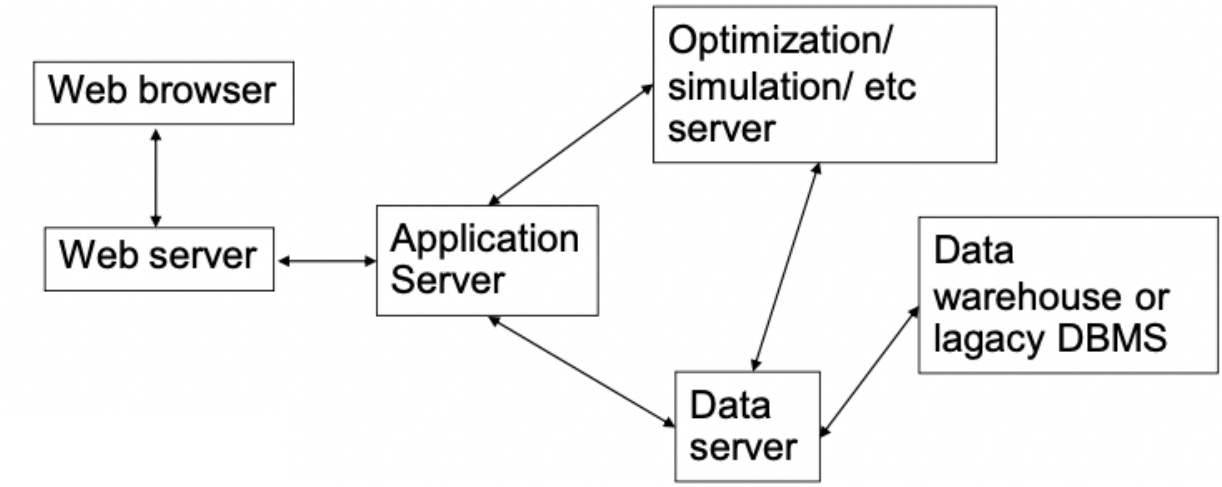
- Process of Decision Making:
  - Define the problem (i.e., a decision situation that may deal with some difficulty or with an opportunity).
  - Construct a model that describes the real-world problem.
  - Identify possible solutions to the modeled problem and evaluate the solutions.

Decision Support Systems

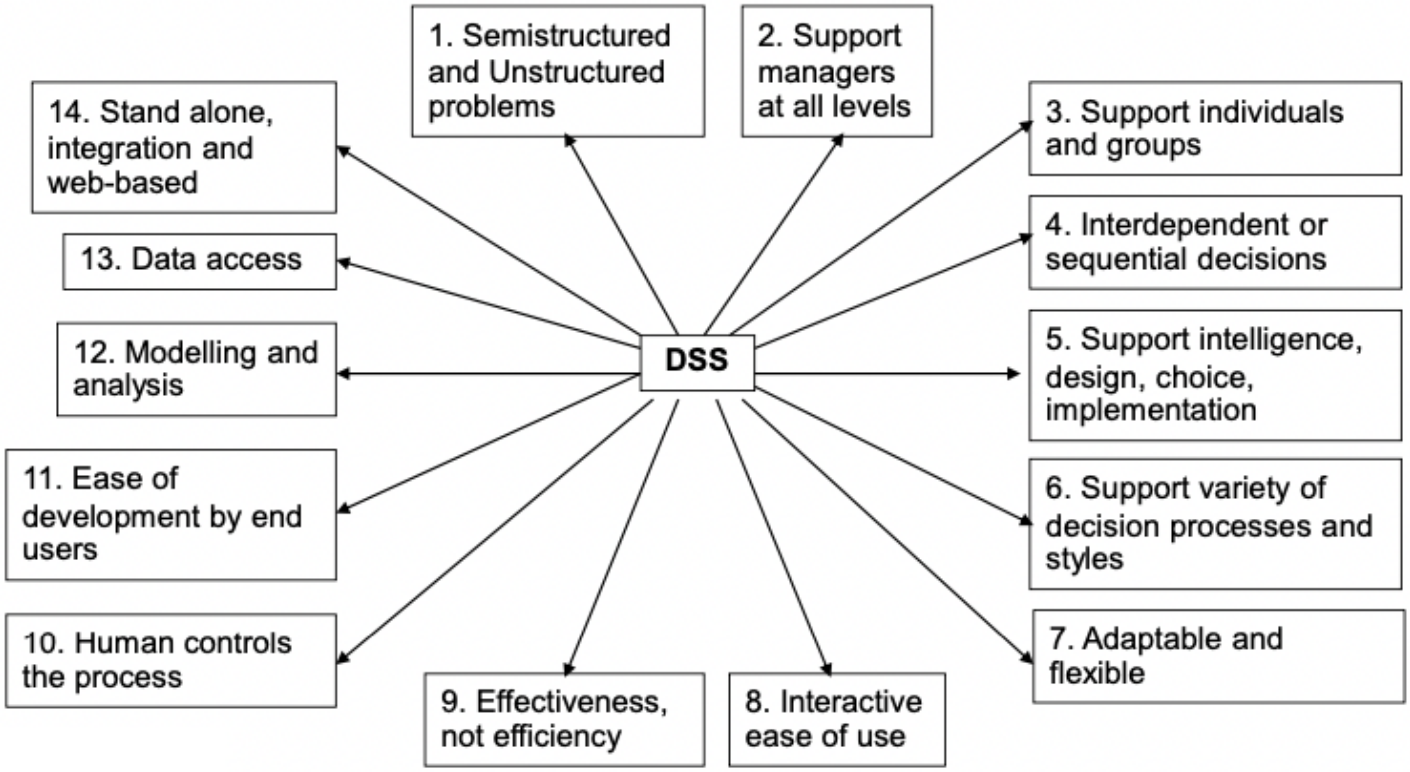
- Definition I (Keen and Scott-Morton):
  - Decision Support Systems couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions.
  - It is a computer-based support system for management decision makers who deal with semi-structured problems.
- High-level Architecture of DSS:



- Multitiered architecture for incorporating optimization, simulation, and other models into web based DSS:

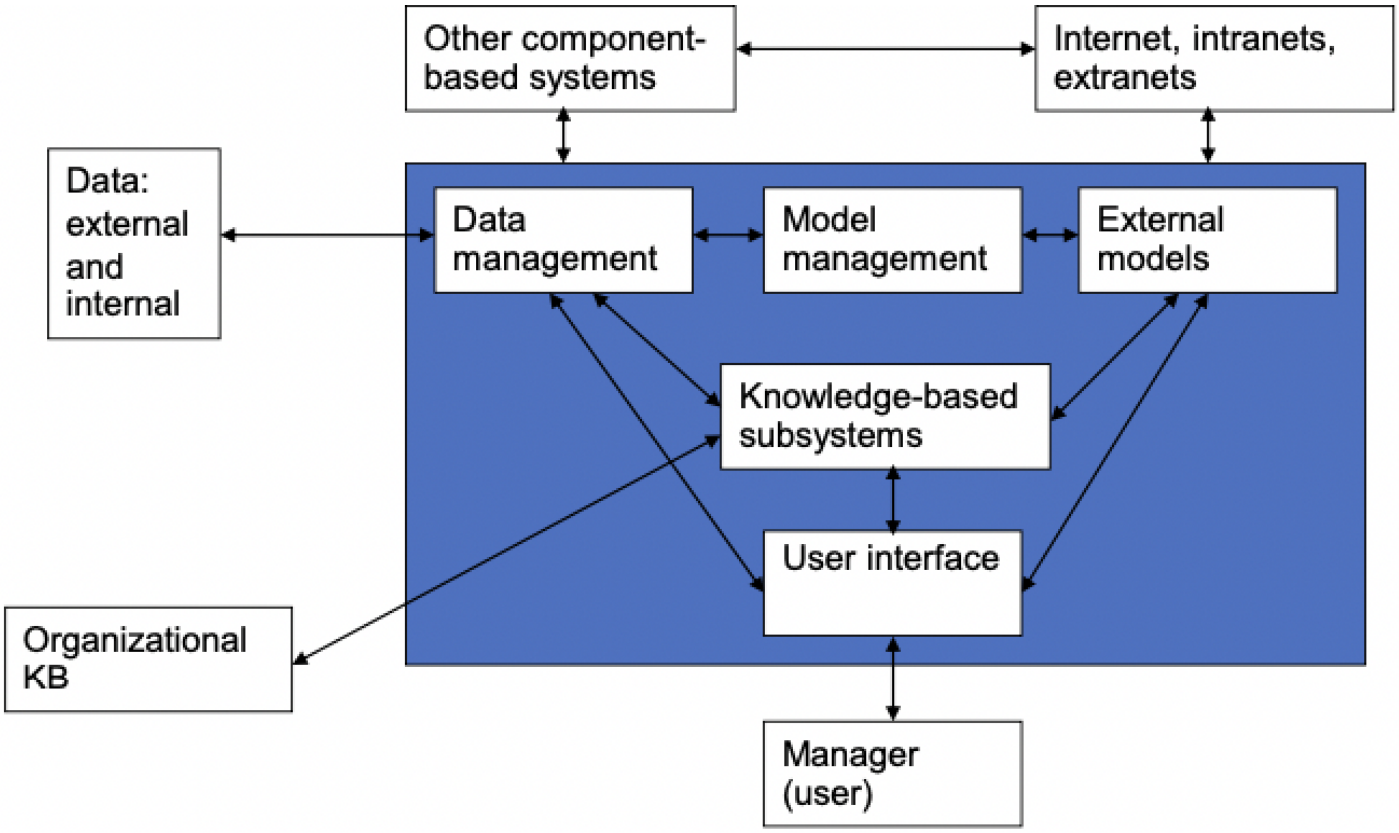


- Key characteristics and capabilities of DSS:

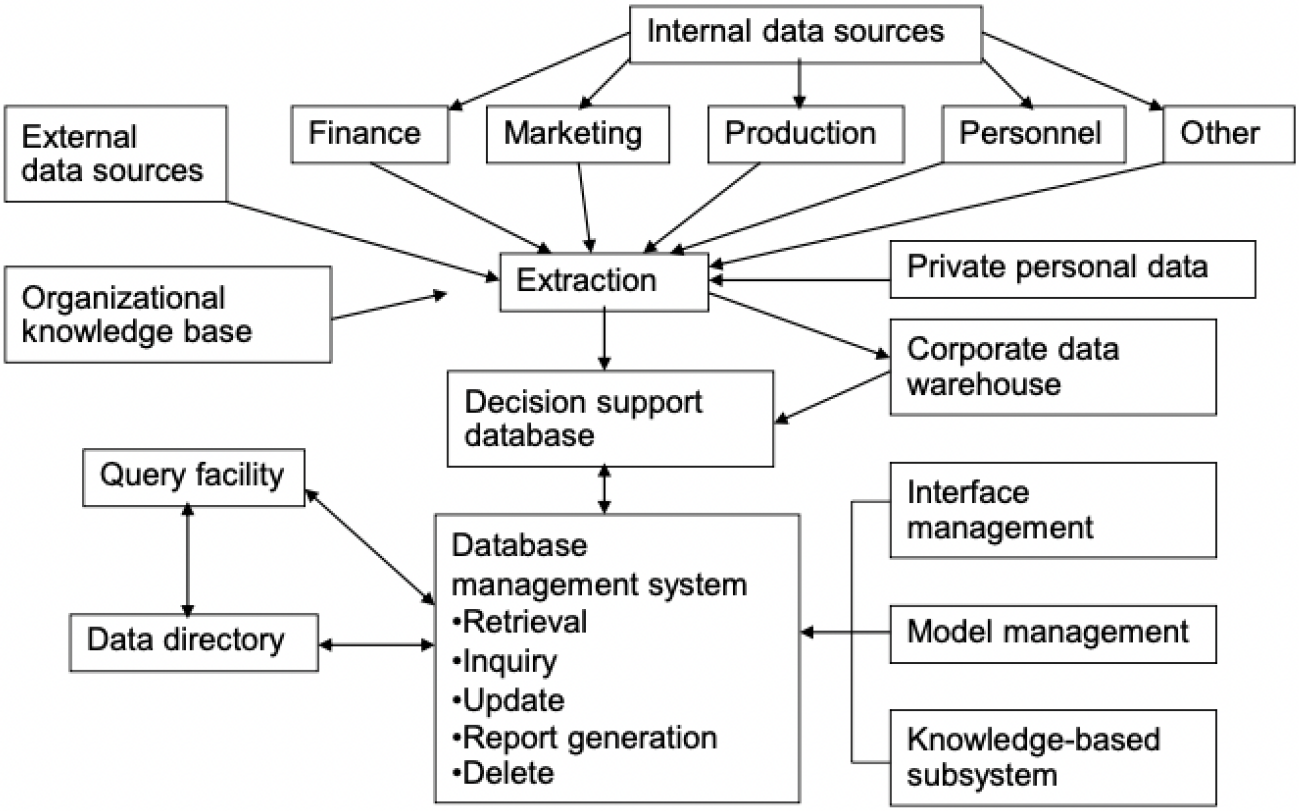


- Components of DSS:
  - Data Management Subsystems: include Database Management System (DBMS) and data warehouse.
  - Model Management Subsystems: include financial, statistical, management science, or other quantitative models that provide the analytical capabilities (also called model base management system MDMS).
  - User Interface Subsystems: include graphical user interface (GUI) that allows users to communicate with the system.

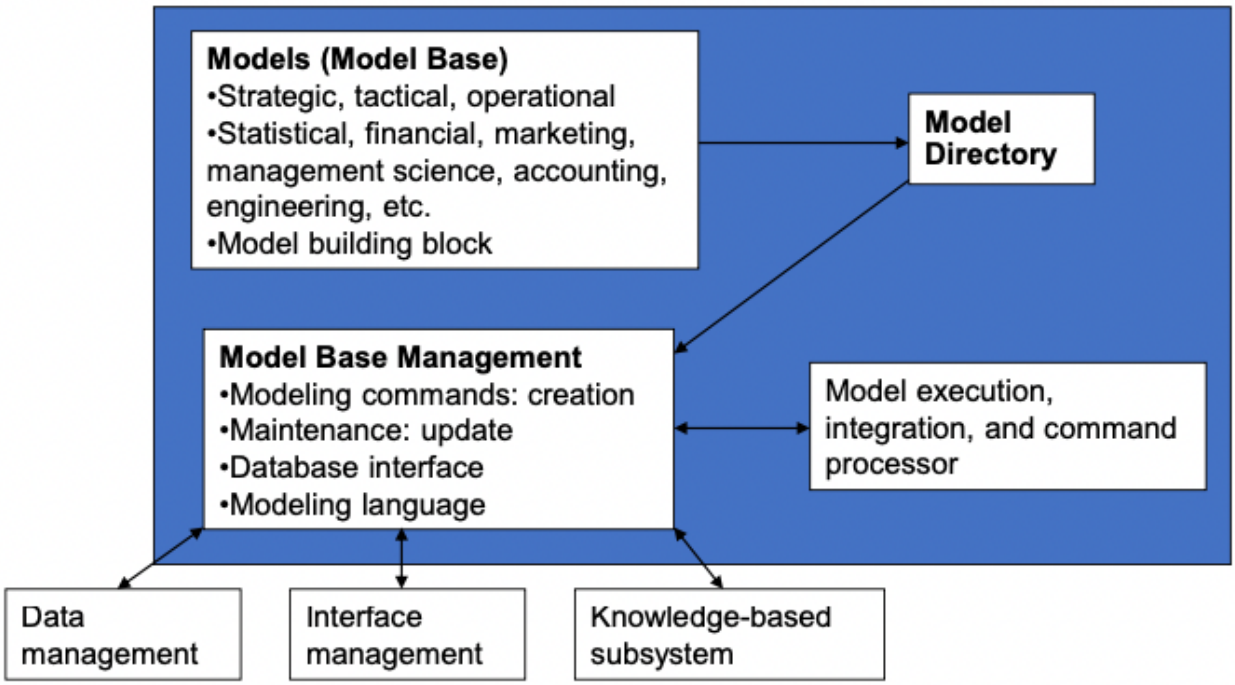
- Schematic View of DSS:



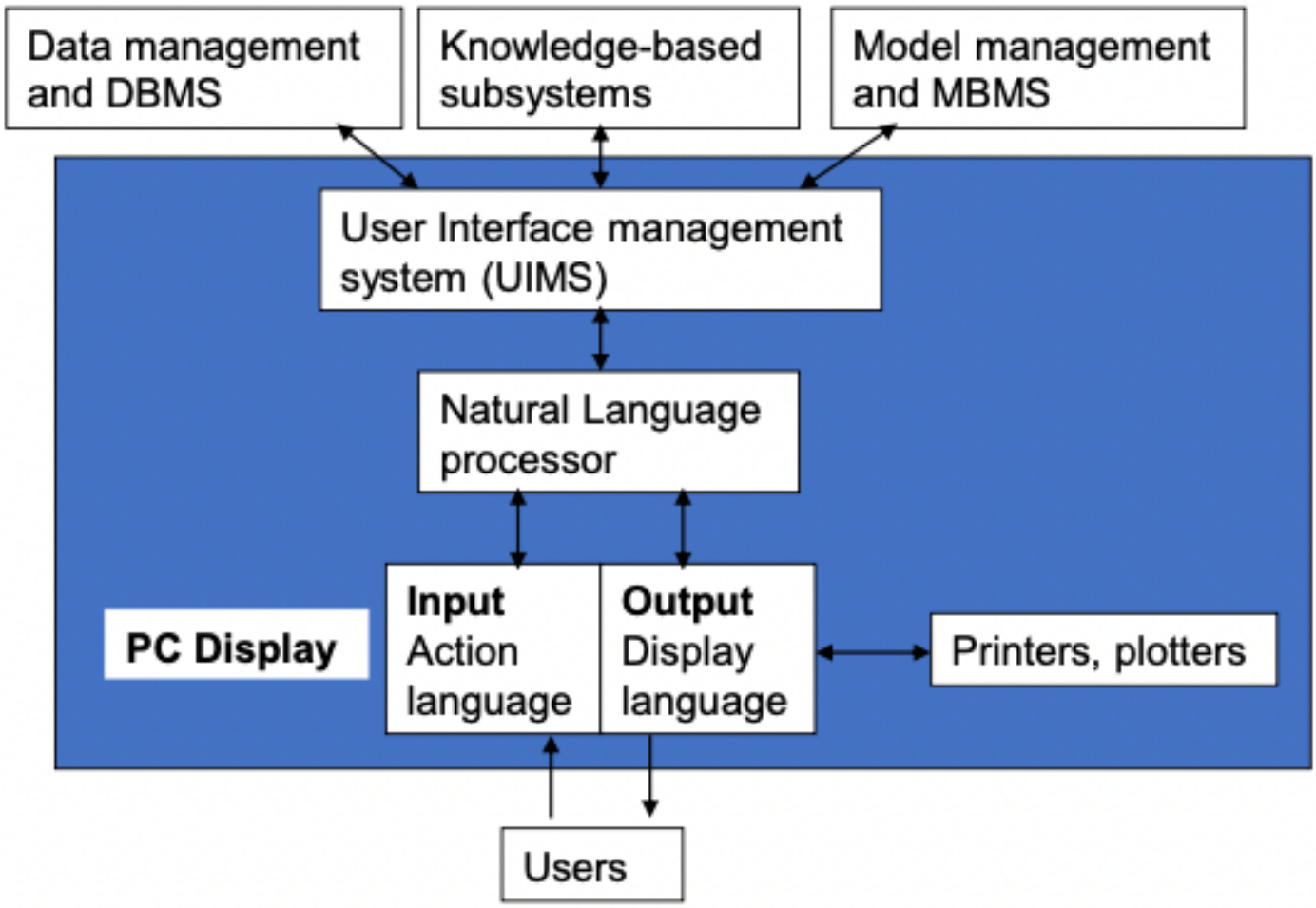
- The Structure of the DMS:



- The Structure of MMS:



- Schematic View of the User Interface Systems:



Modeling

- Static and Dynamic Models
- Certainty, Uncertainty, and Risk
- Modeling with Spreadsheets
- Decision Tables and Decision Trees
- The Structure of Mathematical Models
- Mathematical Programming Optimization
- Multiple Goals, Sensitivity, What-if and Goal Seeking
- Problem Solving Search Methods

Static and Dynamic Models

- A static model takes a single snapshot of the system. The decision is made on that snapshot.
- A decision where to buy a product, a quarterly or annual income statement, the decision to invest are static.
- A dynamic model is time dependent.
- Determining how many checkout points should be open in a supermarket – this needs to consider the time of day because different numbers of customers arrive during each hour.

Certainty, Uncertainty, and Risk

- In decision making under certainty, it is assumed that complete knowledge is available so that the decision maker knows exactly what the outcome of each course of action will be.
- Certainty models are relatively easy to develop and solve, and they can yield optimal solutions.
- In decision making under uncertainty, the decision maker consider situations in which several outcomes are possible for each course of action.
- The decision maker does not know, or cannot estimate, the probability of occurrence of the possible outcomes.
- It is more difficult than making decision under certainty because there is insufficient information.
- A decision made under risk (also known as a probabilistic, or stochastic) is one in which the decision maker must consider several possible outcomes for each alternative, each with a given probability of occurrence.
- Risk analysis is a decision-making method that analyzes the risk (based on assumed known probabilities) associated with different alternatives.

Modeling with Spreadsheets

- Spreadsheet packages were quickly recognized as easy-to-use implementation software for the development of a wide range of applications in business, engineering, mathematics, and science.
- Spreadsheets include extensive statistical, forecasting, and other modeling and database management capabilities, functions, and routines.
- These DSS-related spreadsheets include solver (solver.com), What's best (lindo.com), Braincel (promland.com), NeuralTools, Evolver, @RISK (palisade.com), and GRG-2 (MS Excel).

Decision Tables and Trees

- Decision tables conventionally organize information and knowledge in a systematic tabular manner to prepare for its analysis.
- Decision under certainty:

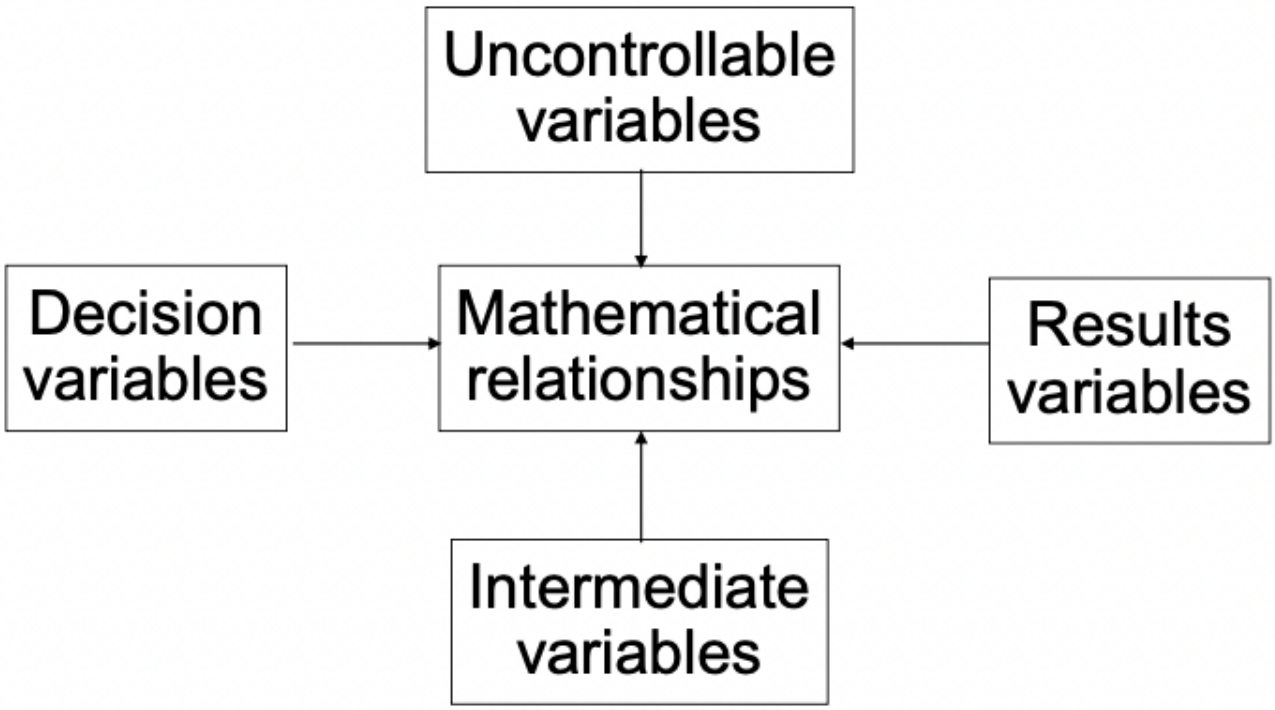
	State of Nature (Uncontrollable Variables)		
Alternative	Solid Growth(%)	Stagnation(%)	Inflation(%)
Bonds	12	6	3
Stocks	15	3	-2
CDs	6.5	6.5	6.5

- Decision under risk:

	Solid Growth	Stagnation	Inflation	Expected Value
Alternative	.5 (%)	.3 (%)	.2 (%)	(%)
Bonds	12	6	3	8.4
Stocks	15	3	-2	8.0
CDs	6.5	6.5	6.5	6.5

- A decision tree shows the relationships of the problem graphically and can handle complex situation in a compact form.
- TreeAge Pro (treeage.com), PrecisionTree (palisade.com), psychwww.com/mtsite/dectree.html and Mind Tools (mindtools.com).

Structure of Mathematical Model



Example of the Components of Models

Area	Decision variables	Result variables	Uncontrollable variables and parameters
Financial investment	Investment alternatives and amounts	Total profit, risk Rate of return on investment (ROI) Earning per share Liquidity level	Inflation rate Prime rate Competition
Marketing	Advertising budget Where to advertise	Market share Customer satisfaction	Customer's income Competitor's action
Manufacturing	What and how much to produce Inventory levels Compensation programs	Total cost Quantity level Employee satisfaction	Machine capacity Technology Material prices
Accounting	Use of computers Audit schedule	Data processing cost Error rate	Computer technology Tax rates Legal requirements
Transportation	Shipments schedule Use of smart cards	Total transport cost Payment float time	Delivery distance Regulations
Services	Staffing levels	Customer satisfaction	Demand for services

Mathematical Programming Optimization

- Linear Programming.
  - Product Mix.
  - Transportation Problem.
- Non-Linear Programming.
  - Travelling salesman.
  - Vehicle routing problem.

Multiple Goals

- Managers want to attain simultaneous goals, some of which may conflict.
- In addition to earning money, the company wants to grow, develop its products and employees, provide job security to its workers.
- Managers want to satisfy the shareholders and at the same time enjoy high salaries and expense accounts, and employees want to increase their take-home pay and benefits.
- To solve this kind of problems, common methods are:
  - Utility theory.
  - Goal programming.
  - Expression of goals and constraints, using LP.
  - A point system.

Sensitivity Analysis

- Sensitivity analysis attempts to assess the impact of a change in the input data or parameters on the proposed solution.
- Sensitivity allows flexibility and adaptation to changing conditions and to the requirements of different decision-making situations.
- Sensitivity analysis tests relationships such as the following:
    - The impact of changes in external (uncontrollable) variables and parameters on the outcome variables.
    - The impact of changes in decision variables on the outcome variables.
    - The effect of uncertainty in estimating external variables.
    - The effects of different dependent interactions among variables.
    - The robustness of decisions under changing condition.

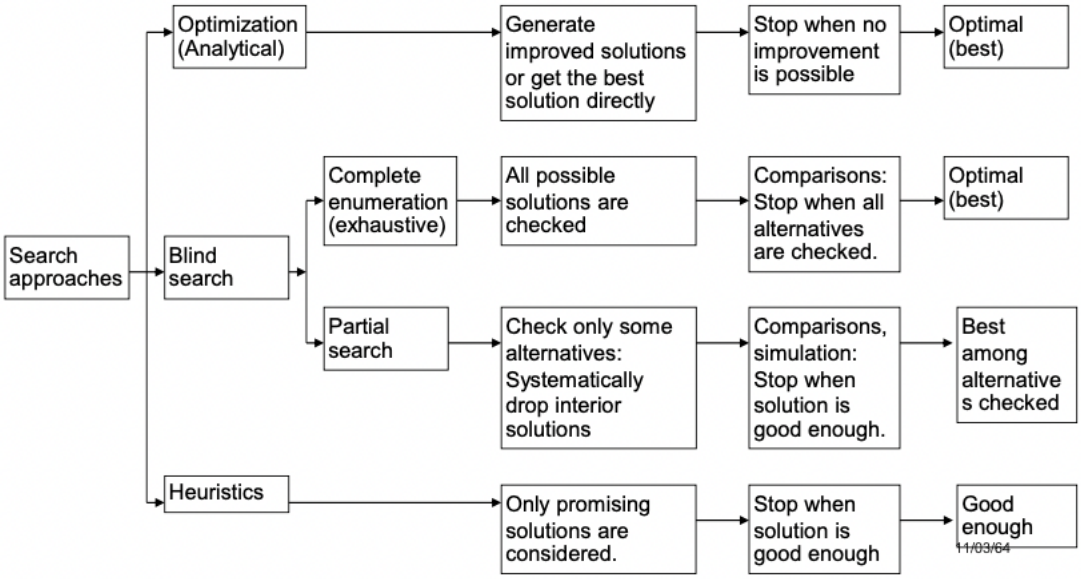
What-if Analysis

- What-if analysis is structured as What will happen to the solution if an input variable, an assumption, or a parameter value is changed.
- For example, what will happen to the total inventory cost if the cost of the carrying inventories increases by 10 percent?
- A spreadsheet tool is a good example. A manager can analyze a cash flow problem by changing parameter's values and see the differences without any involvement computer programmers.

Goal Seeking

- Goal seeking calculates the values of the inputs necessary to achieve a desired level of an output (goal). It represents a backward solution approach.
- For example, what annual R&D budget is needed for an annual growth rate of 15 percent by 2012?

Problem Solving Search Method



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