SPK : PEMODELAN & ANALISIS

Modeling for MSS
Static and dynamic models
Treating certainty, uncertainty, and risk
Influence diagrams
MSS modeling in spreadsheets
Decision analysis of a few alternatives (decision tables and trees)
Optimization via mathematical programming
Heuristic programming
Simulation

Referensi lihat SAP : [5] Bab 4, [7] Chapter 5, [8] Marakas-14

Modeling for MSS

- Key element in most DSS
- *Necessity* in a model-based DSS
- Can lead to massive cost reduction / revenue increases

Good Examples

- DuPont rail system simulation model (opening vignette)
- Procter & Gamble optimization supply chain restructuring models (case application 5.1)
- Scott Homes AHP select a supplier model (case application 5.2)
- IMERYS optimization clay production model (case application 5.3)

Major Modeling Issues

- Problem identification
- Environmental analysis
- Variable identification
- Forecasting
- Multiple model use
- Model categories or selection (Table 5.1)
- Model management
- Knowledge-based modeling

Static and Dynamic Models

- Static Analysis
  - Single snapshot
- Dynamic Analysis
  - Dynamic models
  - Evaluate scenarios that change over time
  - *Time dependent*
  - *Trends* and patterns over time
  - Extend static models

Treating Certainty, Uncertainty, and Risk

- Certainty Models
- Uncertainty
- Risk

Influence Diagrams

- Graphical representations of a model
- Model of a model
- Visual communication
- Some packages create and solve the mathematical model
- Framework for expressing MSS model relationships

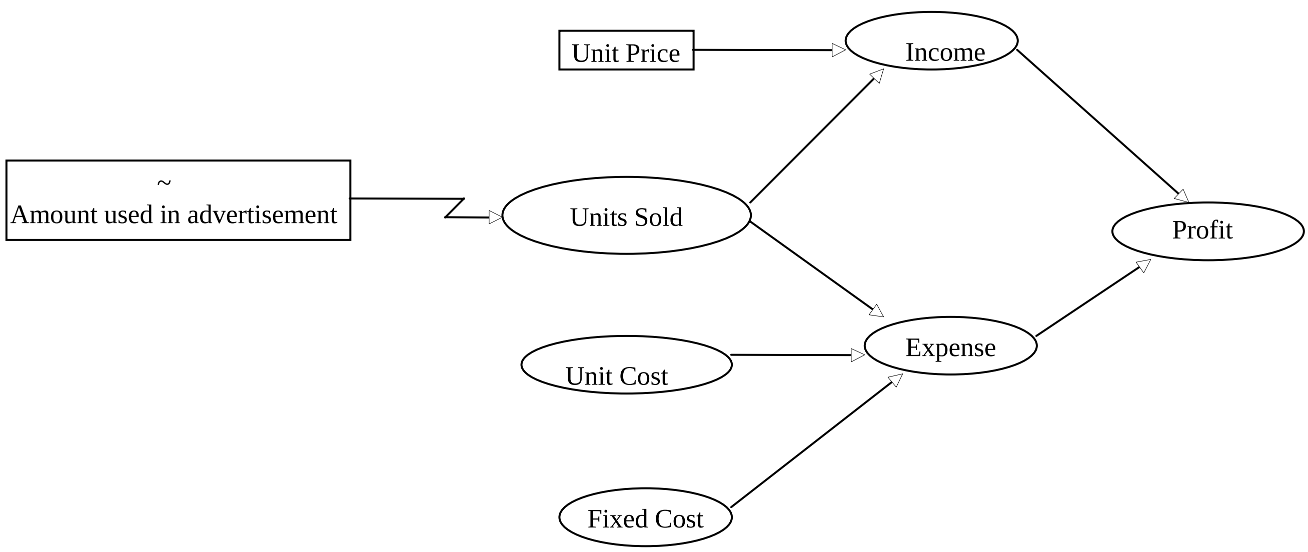
  Rectangle = a decision variable

  Circle = uncontrollable or intermediate variable

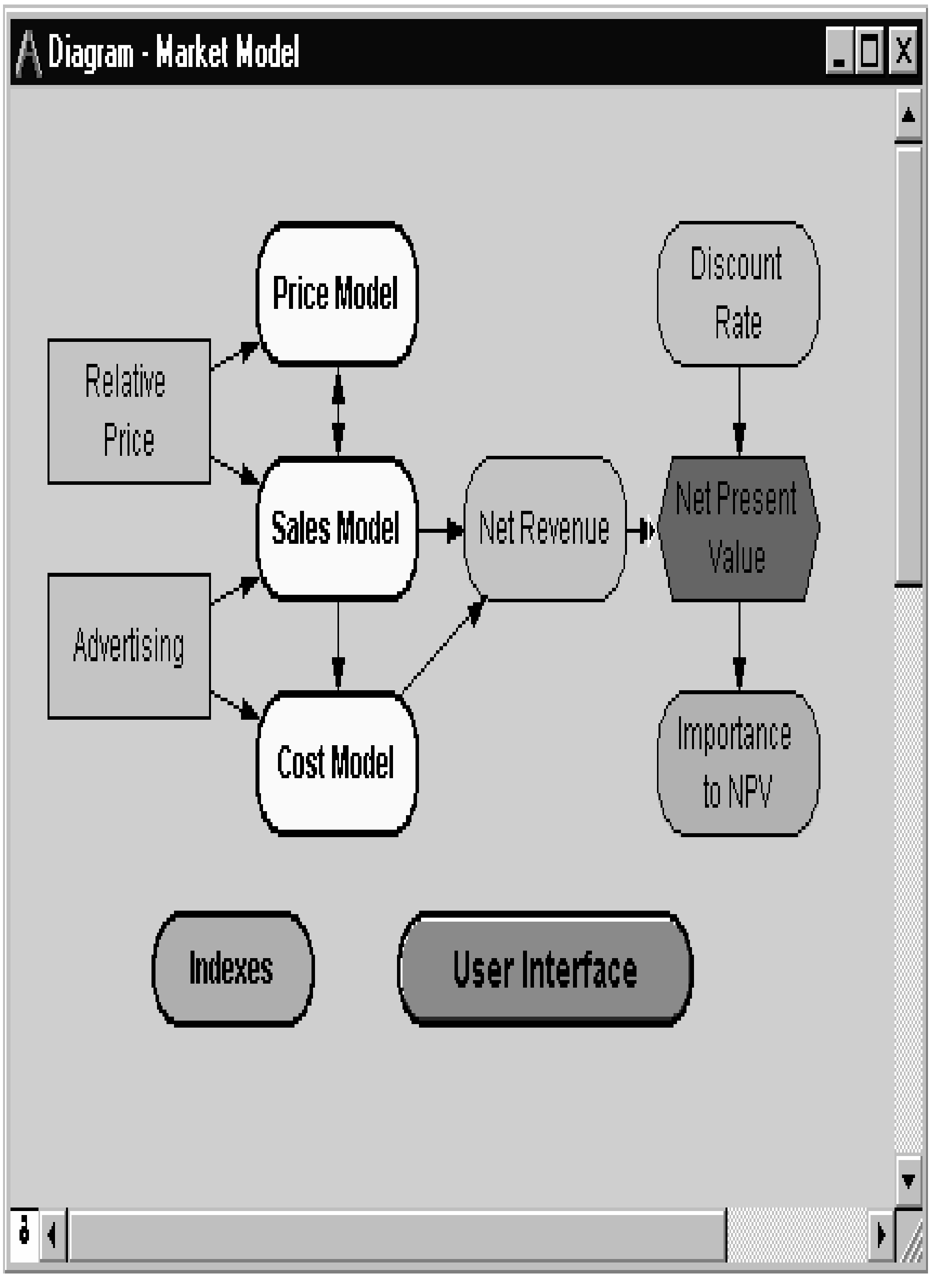
  Oval = result (outcome) variable: intermediate or final

  Variables connected with arrows

  Example (Figure 5.1, Price Model)



Analytical Influence Diagram of a Marketing Problem: The Marketing Model (Figure 5.2a) (Courtesy of Lumina Decision Systems, Los Altos, CA)



MSS Modeling in Spreadsheets

- Spreadsheet: most popular *end-user modeling tool*
- Powerful functions
- Add-in functions and solvers
- Important for analysis, planning, modeling
- Programmability (macros)
- What-if analysis
- Goal seeking
- Simple database management
- Seamless integration
- Microsoft Excel
- Lotus 1-2-3

- Excel spreadsheet static model example of a simple loan calculation of monthly payments (Figure 5.3)

- Excel spreadsheet dynamic model example of a simple loan calculation of monthly payments and effects of prepayment (Figure 5.4)

Decision Analysis of Few Alternatives (Decision Tables and Trees)

Single Goal Situations

- **Decision tables**
- **Decision trees**

Decision Tables

- **Investment example**
- **One goal: maximize the yield after one year**
- **<u>Yield</u> depends on the status of the economy (the *state of nature*)**
  - **Solid growth**
  - **Stagnation**
  - **Inflation**

Possible Situations

1. **If solid growth in the economy, bonds yield 12%; stocks 15%; time deposits 6.5%**
2. **If stagnation, bonds yield 6%; stocks 3%; time deposits 6.5%**
3. **If inflation, bonds yield 3%; stocks lose 2%; time deposits yield 6.5%**

See Table 5.2

Treating Uncertainty

- Optimistic approach
- Pessimistic approach

Treating Risk

- Use known probabilities (Table 5.3)
- Risk analysis: compute *expected values*
- Can be dangerous

Decision Trees

- Other methods of treating risk
  - Simulation
  - Certainty factors
  - Fuzzy logic
- Multiple goals
- Yield, safety, and liquidity (Table 5.4)

Optimization via Mathematical Programming

- Linear programming (LP)
  Used extensively in DSS

- Mathematical Programming
  Family of tools to solve managerial problems in allocating scarce resources among various activities to optimize a measurable goal

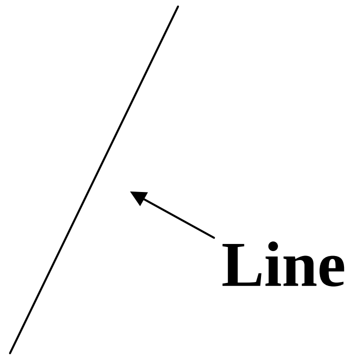
LP Allocation Problem Characteristics

1. Limited quantity of economic resources
2. Resources are used in the production of products or services
3. Two or more ways (solutions, programs) to use the resources
4. Each activity (product or service) yields a return in terms of the goal
5. Allocation is usually restricted by constraints

LP Allocation Model

- Rational economic assumptions
    1. Returns from allocations can be compared in a common unit
    2. Independent returns
    3. Total return is the sum of different activities' returns
    4. All data are known with certainty
    5. The resources are to be used in the most economical manner
- Optimal solution: the best, found algorithmically

- Decision variables
- Objective function
- Objective function coefficients
- Constraints
- Capacities
- Input-output (technology) coefficients



Heuristic Programming

- Cuts the search
- Gets *satisfactory* solutions more quickly and less expensively
- Finds rules to solve complex problems
- Finds good enough feasible solutions to complex problems
- Heuristics can be
  - Quantitative
  - Qualitative (in ES)

When to Use

1. Inexact or limited input data
2. Complex reality
3. Reliable, exact algorithm not available
4. Computation time excessive
5. To improve the efficiency of optimization
6. To solve complex problems
7. For symbolic processing
8. For making quick decisions

Advantages

1. Simple to understand: easier to implement and explain
2. Help train people to be creative
3. Save formulation time
4. Save programming and storage on computers
5. Save computational time
6. Frequently produce multiple acceptable solutions
7. Possible to develop a solution quality measure
8. Can incorporate intelligent search
9. Can solve very complex models

Limitations

1. Cannot guarantee an optimal solution
2. There may be too many exceptions
3. Sequential decisions might not anticipate future consequences
4. Interdependencies of subsystems can influence the whole system

- Heuristics successfully applied to vehicle routing

Heuristic Types

- Construction
- Improvement
- Mathematical programming
- Decomposition
- Partitioning

Modern Heuristic Methods

- Tabu search
- Genetic algorithms
- Simulated annealing

Simulation

- *Technique for conducting experiments with a computer on a model of a management system*

- Frequently used DSS tool

Major Characteristic

- *Imitates* reality and capture its richness

- Technique for *conducting experiments*

- *Descriptive*, not normative tool

- Often to solve very complex, risky problems

Advantages

1. Theory is straightforward
2. *Time compression*
3. Descriptive, not normative
4. MSS builder interfaces with manager to gain intimate knowledge of the problem
5. Model is built from the manager's perspective
6. Manager needs no generalized understanding. Each component represents a real problem component
7. Wide variation in problem types
8. Can experiment with different variables
9. Allows for real-life problem complexities
10. Easy to obtain many performance measures directly
11. Frequently the only DSS modeling tool for nonstructured problems
12. Monte Carlo add-in spreadsheet packages (@Risk)

Limitations

1. Cannot guarantee an optimal solution
2. Slow and costly construction process
3. Cannot transfer solutions and inferences to solve other problems
4. So easy to sell to managers, may miss analytical solutions
5. Software is not so user friendly

Methodology

Model real system and conduct repetitive experiments

1. Define problem
2. Construct simulation model
3. Test and validate model
4. Design experiments
5. Conduct experiments
6. Evaluate results
7. Implement solution

Simulation Types

- Probabilistic Simulation
  - *Discrete distributions*
  - *Continuous distributions*
  - Probabilistic simulation via Monte Carlo technique
  - Time dependent versus time independent simulation
  - Simulation software
  - Visual simulation
  - Object-oriented simulation

Kesimpulan

- Models play a major role in DSS
- Models can be static or dynamic
- Analysis is under assumed certainty, risk, or uncertainty
  - Influence diagrams
  - Spreadsheets
  - Decision tables and decision trees
- Spreadsheet models and results in influence diagrams
- Optimization: mathematical programming
- Linear programming: economic-based
- Heuristic programming
- Simulation - more complex situations