## Other Models: Quantitative Models and Simulation

**List the characteristics of simulation.**

- An imitation of reality rather than a representation of it
- A technique for conducting experiments
- Fewer simplifications than with most other methods
- Descriptive rather than normative; users can use simulation results to search if desired
- Usually used for problems too complex for numerical optimization methods

**List the advantages and disadvantages of simulation.**

**Advantages:**

- The theory is fairly straightforward.
- Time can be compressed a great deal, quickly giving a manager some feel as to the long-term effects of many policies.
- Simulation is descriptive rather than normative. This allows a manager to pose what-if questions. Managers can use trial-and-error quickly, at little expense, accurately, and with low risk.
- A manager can experiment to determine which decision variables and which parts of the environment are really important, and with different alternatives.
- An accurate simulation model requires intimate knowledge of the problem, thus forcing its builder to interact with the manager. This leads to better understanding of the problem and the potential decisions available.
- The model is built from the manager's perspective.
- No generalized understanding is required of the manager; as every component in the model corresponds to part of the real system.
- Simulation can handle a wide variety of problem types, such as inventory and staffing, as well as higher-level managerial functions, such as long-range planning.
- Simulation can include most real complexities of problems; simplifications are not needed. For example, it can use real probability distributions rather than approximate theoretical ones.
- Simulation automatically produces many important performance measures.
- Simulation is often the only DSS modeling method that can readily handle relatively unstructured problems.
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- Simulation is often the only DSS modeling method that can readily handle relatively unstructured problems.
- There are some relatively easy-to-use simulation packages. These include add-in spreadsheet packages, influence diagram software, Java-based (and other Web development) packages, and visual interactive simulation systems.

**Disadvantages:**

- An optimal solution cannot be guaranteed, though relatively good ones are generally found.
- Simulation model construction can be a slow and costly process, although newer modeling systems are easier to use than ever.
- Solutions and inferences from a simulation study are usually not transferable to other problems because the model incorporates

**List some of the major advantages of simulation over optimization and vice versa.**

- Advantages: Simulation can deal with realistic, complex situations (it models risk), simulation theory is straightforward, time is compressed, there is no need for restrictive assumptions, and it fits how managers think (models are built from the manager's perspective).

- Disadvantages: An optimal solution is not guaranteed; construction can be slow; and simulation software is often not user-friendly, requiring programming.

**What is the relationship between environmental analysis and problem identification?**

Environmental analysis is the monitoring, scanning, and interpretation of collected information. Its purpose is to detect problem situations, after which they can be identified more precisely.

**Explain the differences between static and dynamic models. How can one evolve into the other?**

A static model describes relationships among parts of a system at a point in time. A dynamic model describes relationships among parts of a system as it moves through time, with its state at one instant influencing (together with its inputs) its state at the next.

The relationships that hold in a static model at a point in time must also hold in a dynamic model of the same system at every time. To modify a static model into a dynamic model, it is necessary to add relationships between time periods so that the static model in one time period depends, in an appropriate way, on the values of system variables in the prior time period rather than standing on its own. This may increase the model's complexity dramatically and make it harder, if not impossible, to solve

**List and briefly discuss the three major components of linear programming.**

Linear programming is an optimization method used to solve problems in which the objective function and the constraints are all linear. It rests on the assumptions listed in the previous answer. LP problems can be solved by a wide variety of software for all popular computers
The major types :

- Optimization with few alternatives
- Optimization via an algorithm
- Optimization via an analytical formula
- Simulation
- Heuristics ("rules of thumb")
- Predictive models
- Other models

**What is a decision variable?**

A decision variable is a data element controlled by the decision maker, whose possible values describe alternative courses of action.

**List and briefly discuss the three major components of linear programming.**

Of the four components of any decision support mathematical model, linear programming uses result (outcome) variables, decision variables, and uncontrollable variables (parameters). Linear programming models do not use the fourth component, intermediate result variables.

There are other possible answers that do not tie in to the concepts of this section. For example, one could say that the three major components of a linear programming problem are its objective function, its decision variables, and its constraints. You might wish to connect this question to Section 4.8.

**Explain the role of intermediate result variables.**

An intermediate result variable reflects an intermediate result of the mathematical model. It is a result variable, and therefore is influenced by decision and uncontrollable variables in the mathematical model. An intermediate variable also influences other result variables in the mathematical model. For example, in a human resources system, employee salaries (decision variable) affect employee satisfaction (intermediate result variable), which further affects productivity (result variable).

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