# Prescriptive vs Descriptive Modeling Solvers

## Supply Chain and Marketing Definitions

### SUPPLY CHAIN

Paul Bender: There are, broadly speaking, only three classes of model solvers: descriptive (enumeration), heuristic (rules-based) and prescriptive (mathematical programming). Further, prescriptive solvers are the only ones capable of mathematically-demonstrably optimizing complex models.

Jeremy Shapiro: Paraphrasing from *Modeling the Supply Chain*, there are two types of mathematical models for integrated supply chain planning: descriptive and normative.

Descriptive models include forecasting models, simulation models and cost relationship models which describe how direct and indirect costs vary as functions of cost drivers.

Normative models are the second type of model. Normative refers to processes for identifying norms that the company should strive to achieve. Shapiro's view is that normative models and optimization models are synonymous. Further, he views optimization models as synonymous with mathematical programming models, a venerable class of mathematical models that has been studied by researchers and practitioners in the field of operations research for 50 years.

### MARKETING

Gary Lilien at al: Paraphrasing from *Marketing Engineering*, the authors' basic premise is that the model-building process improves decisions. They distinguish between two main types of models: those that are descriptive or predictive and those that are normative.

Descriptive models answer questions like "what will happen if we do X?" Examples include exploring a set of alternate assumptions or scenarios, finding explanations for a phenomenon by identifying the specific variables and relationships that form causal links (e.g., poor new product sales) and predicting possible outcome(s) when model inputs are extended to parameter regions other than those used for developing the model (e.g., what will sales be next month?).

Normative models address the question "what is our best course of action in a given situation?" For example, determine the best location of a new store or the best level of advertising for a particular product. The managerial question can be modeled as a constrained optimization problem where the objective function

measures the value to the firm of a particular decision option and the constraints limit the range of allowed variation in the decision options. When the manager has only a few options, case studies or simulations using descriptive models may be adequate. When he or she is faced with many options to choose from, formal mathematical procedures are needed to identify good options (see Appendix to Chapter 2).

Normative models are often referred to as prescriptive models because such models can prescribe effective courses of action from among numerous options available without being driven by an explicit optimization of an objective function (see, the ADCAD model in Chapter 8. ADCAD is a rules-based expert system.).