Features and Functions

A decision platform can be characterized by the inputs it accepts, the engine that processes the inputs and solves the model, and the various outputs it can deliver. For inputs, it is clearly advantageous to allow information to be specified flexibly, allowing the decision maker to specify whatever information they have in the most comfortable form. The engine needs to maintain good trade-offs between efficiency and accuracy; these should be selectable. The outputs should be varied, allowing nearly any question to be answered. Both inputs and outputs should be transparent, showing the raw inputs and the resulting strategies and valuations in the most natural and visual way.

Inputs

State Variables

A model built with the Provisdom Decision Platform is intended to approximate a small part of the "real world". State variables hold quantities which change as the model evolves, with the combined set of state variable values representing the current state of our model universe. Here is an example definition of model state:

- Product demand
- Manufacturing capacity for each plant
- Advertising campaign
- Variable costs
- Time

State variables change as decisions and uncertainties are resolved. State variables can also remember information that might be useful in calculating payoffs. For instance, to estimate the return on an advertising campaign, we may need to track how long that campaign has been active.

Properties

Model properties are simply the parameters given to the model, such as tax rates, expected project completion time, etc. By varying model properties and re-solving the model, we can understand which parameters have the greatest impact on strategy and shareholder value.

Information Rules

Information Rules specify the logical and dynamical relationships in the model. An Information Rule is specified as an "if-then" statement, for example:

- If we are at the beginning of the 3rd quarter and a new manufacturing technology is available, decide whether to adopt the new technology.
- If our advertising campaign was successful, make expected product demand 20% higher.

Information Rules are used to define *decisions*, *uncertainties*, and *payoffs*. A decision simply provides a set of mutually exclusive choices. The available choices are not necessarily static, but can vary as a

function of the model state. An uncertainty represents limited information about the future, and uncertainty rules specify the conditions under which we learn about the future, as well as the relationship between uncertainties. Payoff rules specify when changes to shareholder value occur, and their value as a function of the current and previous states.

Information Rules provide a high-level compact definition of the model, because they correspond directly to human concepts. You don't have to think about the details of how you're going to encode your knowledge (e.g., write VBA code to drive an Excel spreadsheet) or what constitutes the appropriate model structure (e.g., tree vs. lattice), you just directly specify what you know. Further, you need only specify what you really know, without having to "make up" information to fit the requirements of the system. The Provisdom Decision Platform handles the details.

Outputs

Future Possible States

The nominal output is simply the raw model solution, consisting of the states generated by the model, the transitions between those states, and the NPV (representing shareholder value) of each state. Transitions hold other information, such as the payoffs over the transition, the discount rate applied (when the transition involves change in time), and whether the transition represented an "optimal" decision (one that maximized shareholder value).

Discount Rates

The Provisdom Decision Platform calculates discount rates (potentially millions) using any available information regarding the relationship between the uncertainties in the model and the Market. The information can be supplied in nearly any form (provided it is mathematically consistent) and numerical software can solve for the discount rates. For each passage of time in the model, a different discount rate may be used depending on the resolution of an uncertainty. Consider an uncertainty with a relationship with the Market. When the uncertainty is resolved into a scenario in which the Market tends to rise more than normal, future payoffs are discounted at a rate higher than the risk-free rate for that specific passage of time, thereby decreasing the payoffs' present value. When the Market tends to rise less than normal or even fall, future payoffs are discounted at a rate lower than risk-free rate. With these discount rates, the shareholder value of every choice, now and in the future, is calculated, providing the strategy that maximizes shareholder value.

Queries

However, the "raw" solution can be (and often is) large and complex, containing many details that don't necessarily add to the decision maker's understanding. To get the "big picture", decision makers may *query* the solution, asking a specific question. For instance, you might ask "under what conditions do I decide to deny an insurance claim?" The result of this simple query is a set of states where the optimal decision was to "Deny". These can be viewed directly in a spreadsheet, or charted in various ways. A decision maker might examine this information and realize that a crucial piece had been left out of the model: regulatory constraints which impose monetary penalties if claims are denied under certain conditions.

We may also generate several solutions corresponding to different model parameters. This set of solutions may also be queries, allowing one to answer questions like “at what expected product demand should I hire contractors?”

Engine

The engine does the actual work of solving the model, converting the inputs to the outputs. This includes generating all of the model states from the initial state, based on the information rules, as well as finding the NPV’s of each state. To find the NPV’s, we must take the information specified in the uncertainties and generate probabilities and discount rates for each transition. This is handled by Provisdom’s information solver. The engine also handles optimization of the solution process, for instance only solving the NPV’s for a given state one time, regardless of the path taken to reach that state.