Example: A Simple News Vendor Problem

To illustrate stochastic implosion, consider the following very simple example of the classic "news vendor problem": A news vendor purchases a quantity of newspapers in the morning and then sells them throughout the day. There are 500 papers available to be purchased in the morning. The cost to buy the papers is $0.60 per paper and the revenue for selling them is $1.00 per paper. The vendor will generally sell as many papers as possible: no more than were purchased at the beginning of the day and no more than the demand over the course of the day. The difficulty is that when the vendor buys the papers, the demand is not known deterministically. For the simplicity of this example, we assume that the set of all possible demand volumes can be reduced to the following three representative cases:

- Low Demand: 200 papers, with probability = 25%
- Medium Demand: 300 papers, with probability = 50%
- High Demand: 400 papers, with probability = 25%

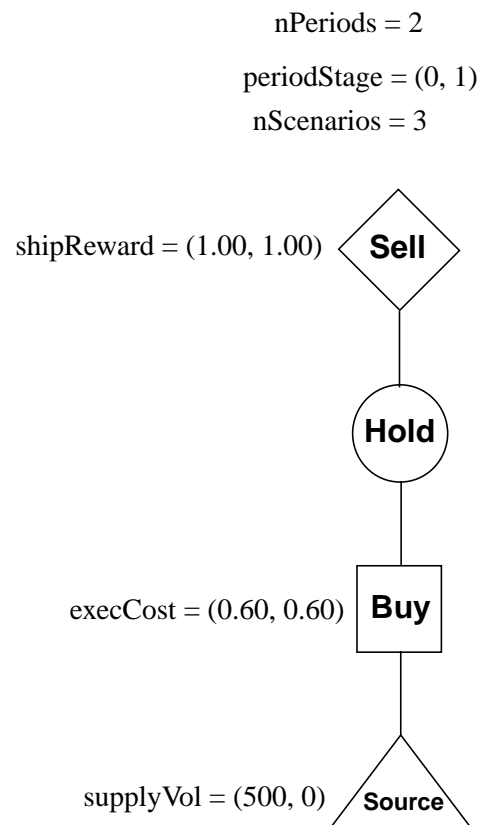The problem is to construct the following contingency plan:

- How many papers to buy at the beginning of the day.
- How many papers to sell over the course of the day, given the demand.

The objective is to maximize the expected profit.

A stochastic implosion model of this new vendor problem is shown in the following WIT diagram:

FIGURE 1   A Simple News Vendor Problem

nPeriods = 2

periodStage = (0, 1)

nScenarios = 3

shipReward = (1.00, 1.00)   **Sell**

Hold

execCost = (0.60, 0.60)   **Buy**

supplyVol = (500, 0)   **Source**

The scenario-specific data for this problem is given in the following table:

TABLE 1   **Scenario-Specific Data for the News Vendor Example**

Scenario	Probability	DemandVol for Sell
0	0.25	(0, 200)
1	0.50	(0, 300)
2	0.25	(0, 400)

Invoking stochastic implosion on this problem results in the following solution:

- Buy.execVol = (300, 0)
- Scenario 0: Sell.shipVol = (0, 200)
- Scenario 1: Sell.shipVol = (0, 300)
- Scenario 2: Sell.shipVol = (0, 300)
- objValue = 95

So the contingency plan is to buy 300 papers, then if the demand is for 200 papers, sell 200 papers; if the demand is for 300 or 400 papers, sell 300 papers. The expected profit is $95.