

Decision Trees and Robustness Analysis

While decision trees can be used to develop a plan of action, or a strategy, in the face of uncertainty, a crucial question is the robustness of the selected strategy, given that elements of the decision tree are based upon assumptions which may not be valid. One particular issue is the robustness of the strategy in the face of possible errors in the specification of the probability of the outcomes.

For this exercise, you should explore the implications of different probabilities in Problem 16.12 (P. O'Toole) given in *Applied Systems Analysis* (de Neufville). For simplicity's sake, we will assume that $P(1000)$ is definitely fixed at 20%. Using spreadsheet analysis (and, in particular, Data Tables), please answer the following questions:

- (a) Assuming the probabilities given in the problem are correct, what is the best strategy to follow?
- (b) Assuming that only $\text{Pr}(1000)$ is correct (i.e., $\text{Pr}(1000) = 20\%$), how wrong do the other probabilities have to be before the optimal strategy changes from that given in part (a)?
- (c) In light of the answer you gave in part (b), is your part (a) answer robust; i.e., is it the best strategy to take in the face of possible mis-specification of the given probabilities?

16.12 *P. O'Toole*

Paddy O'Toole makes outdoor furniture that sells in the summer (the Paddy O. Furniture line). Production starts in January, however, right after the holidays. That is when Paddy must decide on whether to hire 1, 2, or 3 assistants at \$14,000 each for the season. He could then produce Low (1200 units), Medium (1800 units), or High (2400 units). His product sells for \$30/unit on average in June. Units not sold in June must be sold at half price. Based on experience, he estimates $P(N)$, the probability that the demand for his furniture next June will be N , as:

N	1,000	1,500	2,000	2,500
P(N)	20%	30%	40%	10%

How many assistants should Paddy hire to maximize expected profit?

(from *Applied Systems Analysis: Engineering Planning and Technology Management*; Richard de Neufville; McGraw-Hill, Inc.; New York; 1990; p. 328)