5080 UNIT 1212

Lesson Guide

Upon completion of this unit, students should be able to:
Explain the criteria for making decisions under organizational uncertainty.

Illustrate the various methods of decision-making under risk.

Types of Decision-Making Environments

As you may recall from the previous unit, the Thompson Lumber example of proposed sales expansion (seen on pages 68–69 of the textbook) was explored with a condition of uncertainty. Thompson knew the payoffs/profits for each alternative under each of two outcomes (favorable market or unfavorable market), but he did not know the outcome of the market for his decision. This uncertainty was one of *three classifications of decision-making environments* shown in Section 3.3 of the textbook.
Decision-making under certainty has an attractive charm of being simple in most ways: the decision maker knows what is being offered in each of several choices, as in choices of bonds yielding a certain interest rate over a given time. Thompson was making a *decision under uncertainty*—more than one outcome had to be considered possible for each alternative, but he did not know the probability of each outcome, and he has to risk losing something held at value (his investment) to find out the outcome (recall that in the case, "outcome" was either a favorable or unfavorable market). For the third decision-making environment, as gamblers and card players know, there is *decision-making under risk*. Once again, there are several outcomes possible for each alternative. The probabilities of the outcomes are known (six sides to a die, 52 cards in a normal deck, 13 cards of each suit in a normal deck), and the player has to risk losing something held at value to find out the outcome. This unit focuses, in turn, on tools you can use when facing organizational uncertainty and risk.

Decision-Making Under Uncertainty

Analysts and scholars have established the following list of decision-making criteria to choose from to best fit the situation:
Optimistic: Of the alternatives in each outcome, the best/maximum payoff for each is figured, and the alternative with the maximum of these "maximums" is selected. This can also be termed the *maximax* method, which is indeed optimistic! This method of analysis can work, but who has experienced a completely optimistic situation? A leader has to be sure about the calculations before using this method to choose, but it is available. As indicated in the textbook, if the problem is really one of minimizing the payoff the most, then the minimums are figured, and the smallest minimum payoff is selected.
Pessimistic: This criterion considers the lowest (minimum) payoff for each alternative of each outcome, and the alternative with the best (maximum) of the minimum payoffs is the one to choose. It is like considering, "this alternative will hurt the least," and this method is also termed the *maximin* way. Note that unlike what many people believe, doing nothing is always an alternative, which here may be a payoff of zero. Sometimes, especially under uncertainty, it is apparently the best choice—at least until leaders and their supporting analysts know a bit more.

Criterion of Realism (Hurwicz Criterion): This is a method philosophically between the optimistic and pessimistic methods, as for this one, analysts obtain a coefficient of realism (α), and then calculate a weighted average to find the degree of optimism between 0 and 1. So when:
Weighted average = α (best payoff) + $(1 - \alpha)$ (worst payoff),
and α can be agreed on, then the expected payoff is "steered toward realism" with this equation. As was the case with the optimistic criterion, if the problem instead was that of minimizing the payoff, then the best payoff is the lowest of them, and the worst payoff would be the highest of the choices.

Equally Likely (Laplace Criterion): This makes use of all the alternative payoffs where before, only the "best" and "worst" payoffs were considered, or there were no more in the tables except high and low payoffs. This approach regards all possible outcomes as equally likely, and so that the average payoffs of the alternatives are the ones to choose from. The best choice would be either the highest value average payoff, or the lowest if minimizing the payoff is the goal.

Minimax Regret: In this criterion, regret is synonymous with opportunity cost (or loss). For any outcome, the regret is the difference between the payoff realized after the alternative was chosen for that outcome and the payoff actually realized after a choice of alternative was made for that outcome. As shown on page 71 and Table 3.8 of the textbook, minimax regret is a useful method for making reasonably sure that the regret will not be more than a certain payoff amount for the alternative selected. ***<u>See ATTACHMENT</u>***

Decision-Making Under Risk

As noted earlier, in decision analysis, *uncertainty* means the probabilities are not known, and *risk* means the probabilities are known, but in each classification, a decision has to be made in conditions other than certain. Under risk (the probabilities are known but the value to be gained is unknown) until chosen, there have been two approaches developed—where you can use calculations and tables to figure an *expected monetary value (EMV)* or an *expected opportunity loss (EOL)*. These expected values are really the mean values. You set them as approximately the same thing, in the following equation:
EMV(of the alternative) = $\Sigma X_i P(X_i)$

This equation of the EMV determines it as the sum of each alternative's probability multiplied by the payoff for a condition's outcome, with all of these added together (Σ) to produce the EMV for the alternative. When this sum is calculated, the analyst then proceeds to solve this equation for the next alternative and all its outcomes. For an EMV, when looking for the most value, the alternative with the highest EMV is the best choice; for minimizing the payoff, the lowest EMV is the best choice.
A decision based on expected opportunity loss, or EOL, is very close to minimizing an EMV payoff. The equation is the same, with new terms:
EOL(of the alternative) = $\Sigma X_i P(X_i)$
As shown on page 74 of the textbook, an alternative's probabilities and payoffs are multiplied for each outcome, and then these terms are summed to determine that alternative's EOL; then usually the best (lowest) EOL is chosen as the decision.

Decision Trees

A decision tree is a useful tool, not only in quantitative analysis but in engineering as well, and in both fields lead to a "good" decisions when all relevant factors are considered. In this course and textbook, you explore decision trees with nodes (locations where the tree will "branch out" to another or more than one path) that either show an outcome (e.g., favorable market or unfavorable market) or two or more alternatives. These analysis decision trees start at the left and flow toward the right, as shown in the textbook's Section 3.8 starting on page 79. Note that the nodes have been standardized so that square-shaped nodes signify decision points of two or more possible alternatives, and circle-shaped nodes signify state-of-nature nodes showing one or more possible outcome.

Decision trees have their own analysis steps,

1. Define the problem. This is still critical here, or analysts will be working with a faulty input.
2. Draw the decision tree. This step entails making sure the right types of nodes are located in the right positions, in the order that they occur from left to right. All alternatives have to be determined and represented in the tree.
3. Assign probabilities to the states of nature/outcomes. These have to be known or researched.
4. Assign payoffs for each alternative and outcome.
5. Solve the problem by calculating the EMVs for each state of nature/outcome. Because comparisons of the end results are what decision-makers use to decide, these calculations are started at the end, on the far right of the tree (at the "branches' ends) and calculate back to the decision points. In the example of the decision tree for Thompson Lumber as shown in Figure 3.3 on pages 80–81, note that the EMV calculations, calculating with payoffs and outcome probabilities steers Thompson to the prudent, but still positive, choice of building a small plant. The calculations' results based on the probabilities skew the expectations away from both a bold but risky choice of building a large plant and also away from passing up the marketing opportunity.