M4L13. Biodiesel Business Case with Decision Trees

Slide #1

We will build a decision tree for a new biofuels plant problem to visualize the market uncertainty and decisions.

Building a decision tree involves creating a structured model that helps in mapping decisions and evaluating uncertainties.

Slide #2

Decisions and Uncertain Scenarios

Market Condition	Probability	Financial Impact ($ millions)	
		Option 1	Option 2
Exceptional Demand	10%	$40.0	$35.0
High Demand	25%	$30.0	$25.0
Moderate Demand	10%	$20.0	$16.0
Weak Demand	35%	$7.5	$5.0
Market Downturn	20%	($10.0)	$0.0

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The renewable energy firm needs to make decisions regarding its future production strategy.

Specifically, the firm must choose between building a plant, using the technology platform optimized for minimum biodiesel production cost, cost leadership strategy, or building a new plant with an alternative technology solution that provides production, flexibility differentiation strategy. For instance, if the firm opts for the cost leadership technology platform, option one, the potential market conditions and their impacts are as follows.

Exceptional demand, 10% probability, 40 million dollars.

High demand, 25% probability, 30 million dollars.

Moderate demand, 10% probability, 20 million dollars.

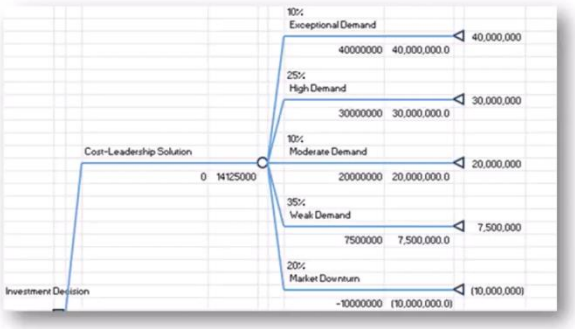
Weak demand, 35% probability, 7. 5 million dollars.

Market downturn, 20% probability, negative 10 million dollars.

Similarly, the potential market conditions and their impacts for option 2 are also listed in the table.

Slide #3

Visualize Uncertain Scenarios with Decision Tree



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The decision tree thus provides a comprehensive visual map of decisions and their associated uncertainties.

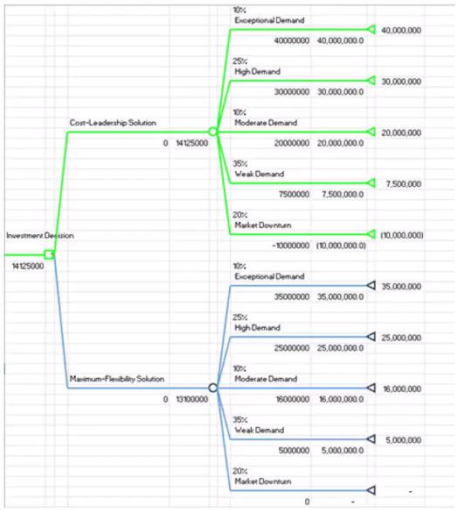
Each investment decision is evaluated under a set of possible market conditions, each with its own financial impact.

Although the market conditions and their probabilities are the same for both investment strategies, the financial impacts differ due to the distinct competitive advantages conferred by each option.

By systematically visualizing both decisions and uncertainties, a decision tree guides firms in considering a complete set of possibilities in complex environments, evaluating the potential outcomes of each decision, and making informed strategic choices.

Slide #4

Decision Tree and Best Option Highlight



- The Decision Tree Tool calculated the expected value of each decision option based on the uncertain scenario data.
- By comparing the expected values of both options, the Tree highlights the decision that leads to the highest EV.

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A decision tree starts with a decision node, which represents a point where a choice must be made.

In the context of an investment example, the decision node signifies the decision.

Uncertain market scenarios in the decision tree are represented by chance nodes, one for each decision option.

A chance node indicates that the outcome is not certain and depends on various possible scenarios.

Each branch from the chance node represents one possible market scenario, complete with a probability and a financial impact value.

Solving a decision tree involves a series of mathematical calculations aimed at determining the expected value of each decision option.

Solver includes a function to highlight the best option, which results in the highest expected value.

By comparing the expected values of both options, decision makers observe that option 1 yields a potential financial return 8% higher than option 2.

This analysis leads to a strategic decision based on the financial performance indicated by objective economic evaluation and the expected value methodology.

By employing this method, decision makers ensure their choices are grounded in a rigorous quantifiable assessment of potential outcomes, thereby enhancing the reliability and effectiveness of their strategic decisions.

Slide #5

Incremental Value of Technology Solution

Increment value of a technology over its best alternative:

EV (Cost Leadership Solution) – EV (Alternative) =$14.1m-$13.1m = $1m

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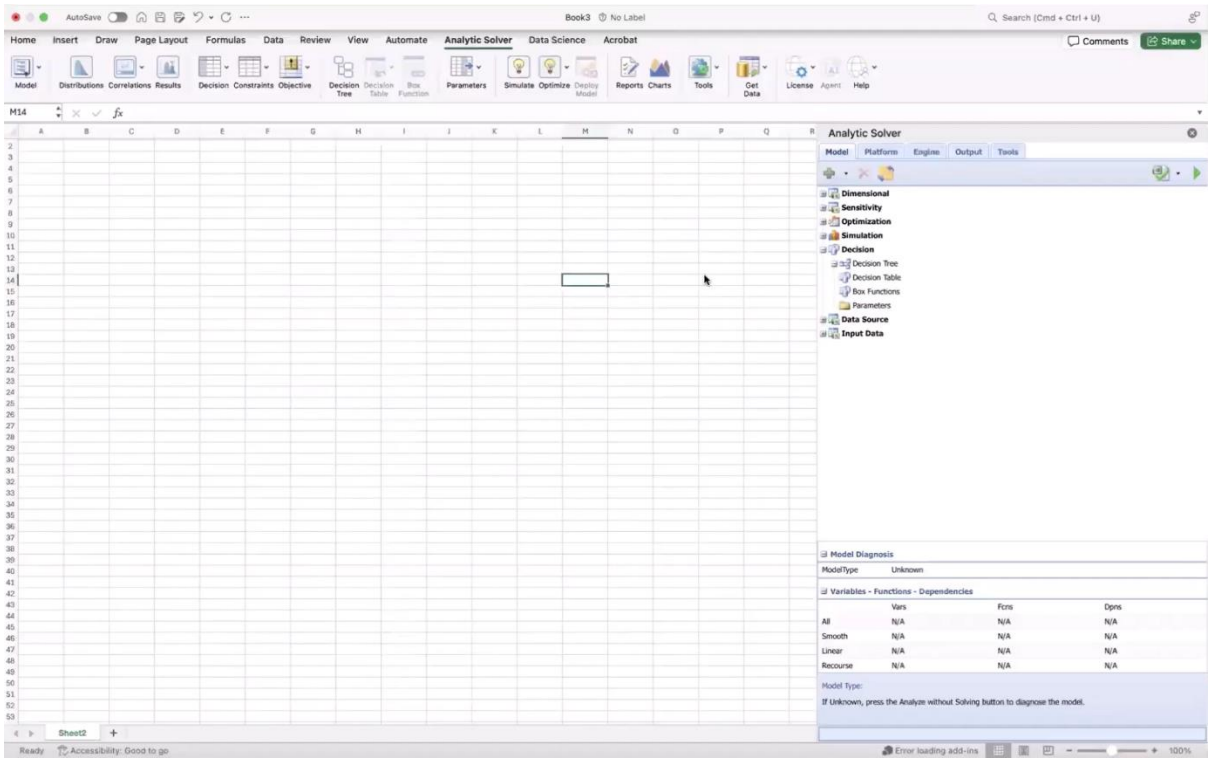
Another type of valuable information can be derived from the decision tree.

The expected value of the cost leadership technology is 14.1 million dollars.

This figure represents the anticipated financial benefit from implementing the technology. The gap between the expected values of the two decisions totaling 1 million dollars highlights the financial advantage provided by the cost leadership approach over alternative options. This monetary difference is attributed to the innovative solution that effectively minimizes production costs, leading to significant savings.

From a business decision making perspective, this difference of 1 million dollars represents the incremental monetary value of adopting the cost leadership technology. It underscores the importance of choosing technologies and strategies that enhance operational efficiency and cost effectiveness. By focusing on such innovations, businesses can achieve substantial financial gains, reinforcing the critical role of strategic decision making in driving economic success and maintaining a competitive edge in the market.

Slide #6



Now we are going to build a decision tree to represent the business model.

Begin by adding the first decision node.

Click add node.

This is a decision node.

Name it Renewable Energy Investment Decision.

We have two decisions or choices, cost leadership solution and maximum flexibility solution.

Input the names of the decisions in the decision tree window and click OK.

Solver will create the investment decision node and two branches.

The terminal node on the cost leadership solution branch. and add a chance node.

Name it demand scenarios.

In the branches section include five scenarios.

The first scenario is exceptional demand.

Input the name.

The cost leadership option will generate a 40 million dollars profit under this scenario with a 10% chance.

The second scenario is high demand.

Input the name.

The cost leadership option will generate a 30 million dollar profit under this scenario with a 25% chance.

The third scenario is moderate demand.

Input the name.

The cost leadership option will generate a 20 million dollar profit under this scenario with a 10% chance.

The fourth scenario is weak demand. Input the name.

The cost leadership option will generate a 7.5 million dollars profit under this scenario with a 35% chance.

The last scenario is market downturn.

Input the name.

The cost leadership option will generate a negative 10 million dollars profit under this scenario with a 20%chance.

After completing the chance node for the first option, we will add the chance node for option two.

Use the copy and paste function of this tool.

Copy the event node, go to the maximum flexibility branch, click the terminal node, and paste the node.

Solver will add the event node of five different market scenarios to the new branch.

Change the payoff numbers of each scenario for option 2.

Now, the decision tree structure is complete.

With one decision node and two chance nodes, one after each decision, all the probabilities and payoff numbers are shown on the tree.

Some of the numbers might not be in the right format.

Adjust the size of the cells to clear up the table.

The advantage of a decision tree is that it is tied to Excel, allowing you to use Excel's format functions to change the information's format on the decision tree.

The numbers are in Excel cells, enabling you to use formulas for additional analysis outside of the decision tree.