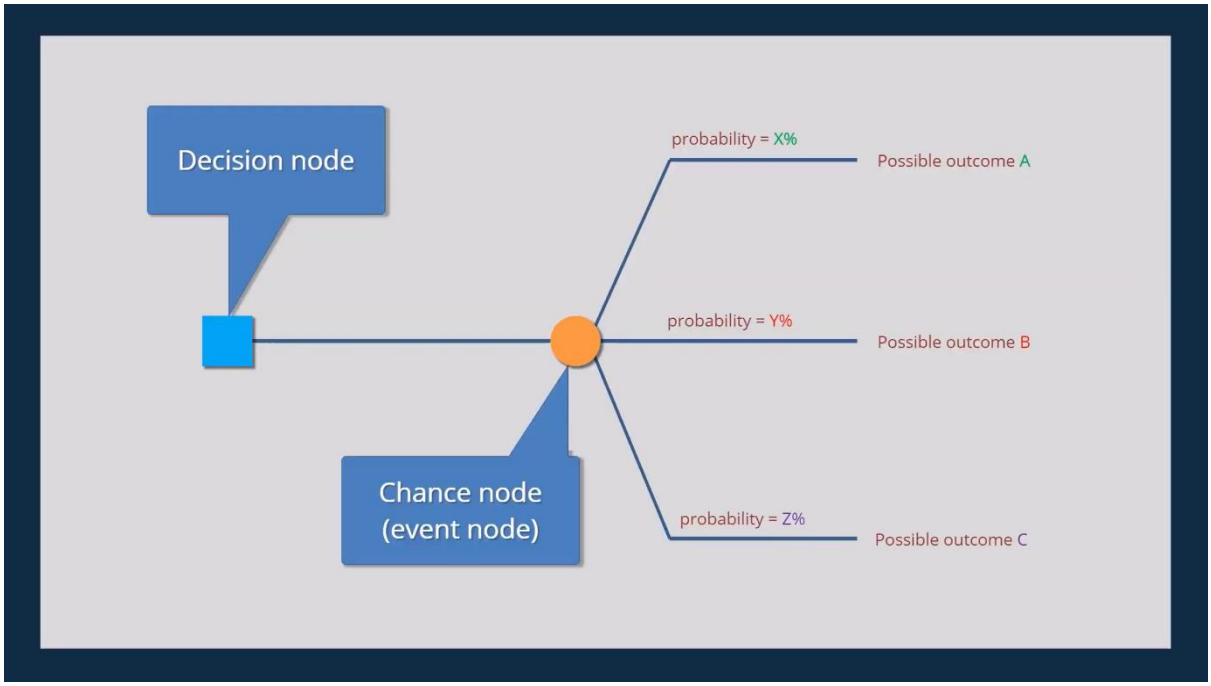
M4L10. Decision Tree Under Uncertainty

Slide #1

In this lecture, we are going to discuss how we use decision trees to solve problems with uncertainty.

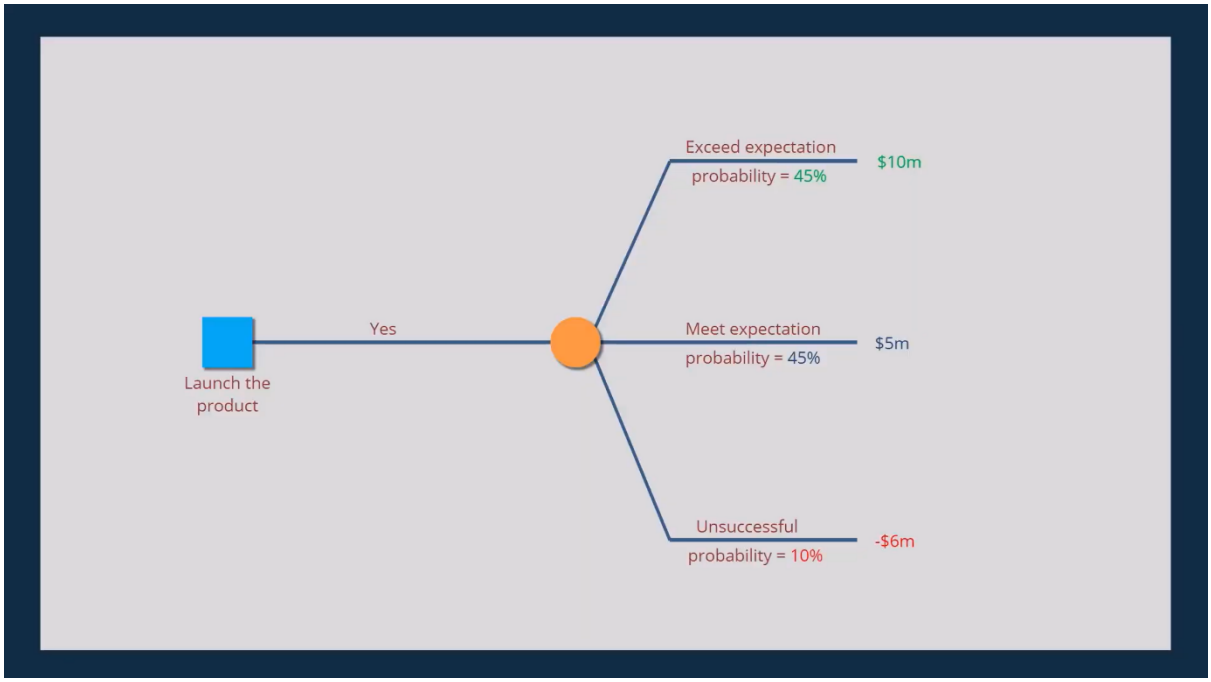
Slide #2



To represent such decision problems, we use a second kind of node, a chance node, a chance node or event node drawn as a circle indicates what following events are uncertain.

Each branch stemming from the chance node shows a possible outcome of the product launch.

Slide #3



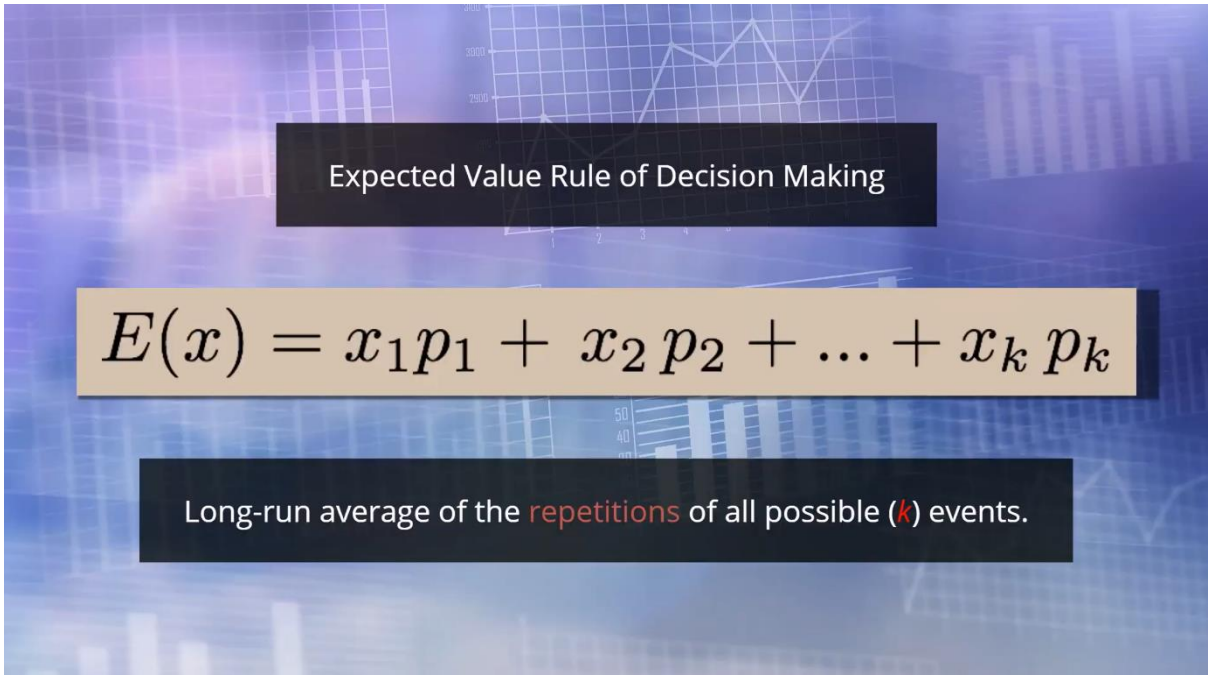
For instance, there are three possible outcomes of the product launch.

First, the performance of the product exceeds expectation. The product launch is very successful and it makes a profit of 10 million dollars. The chance of this best case scenario is 45%.

The second scenario is that the performance of the product meets expectation. The product launch is moderately successful and generates a profit of 5 million dollars. This scenario occurs with a 45% probability.

The third scenario is that the product is not accepted by the market. The product launch is unsuccessful and the company lost 6 million dollars from its investment. The worst case scenario occurs with a 10% probability.

Slide #4

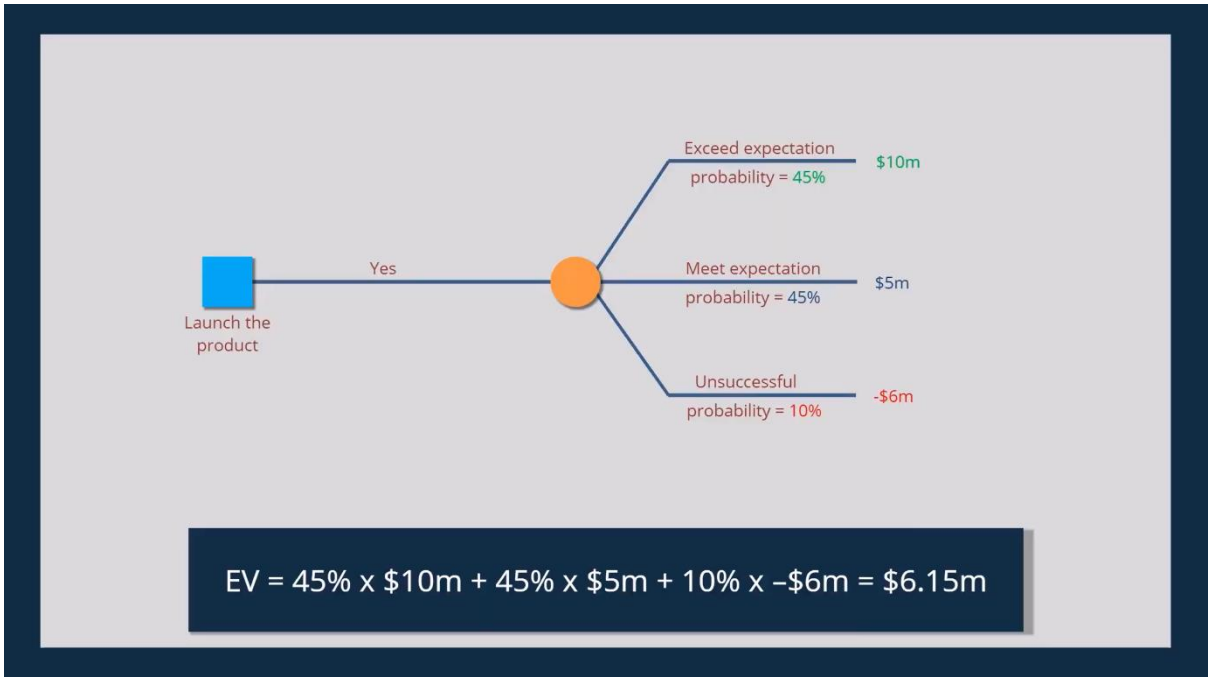


We call this the expected value rule of decision making.

Expected value is calculated by the formula the sum of probability multiplied by the outcome where P is the probability of an outcome and X is the payoff should the event occur.

Note that the expected value represents the long run average value of all possible scenarios.

Slide #5



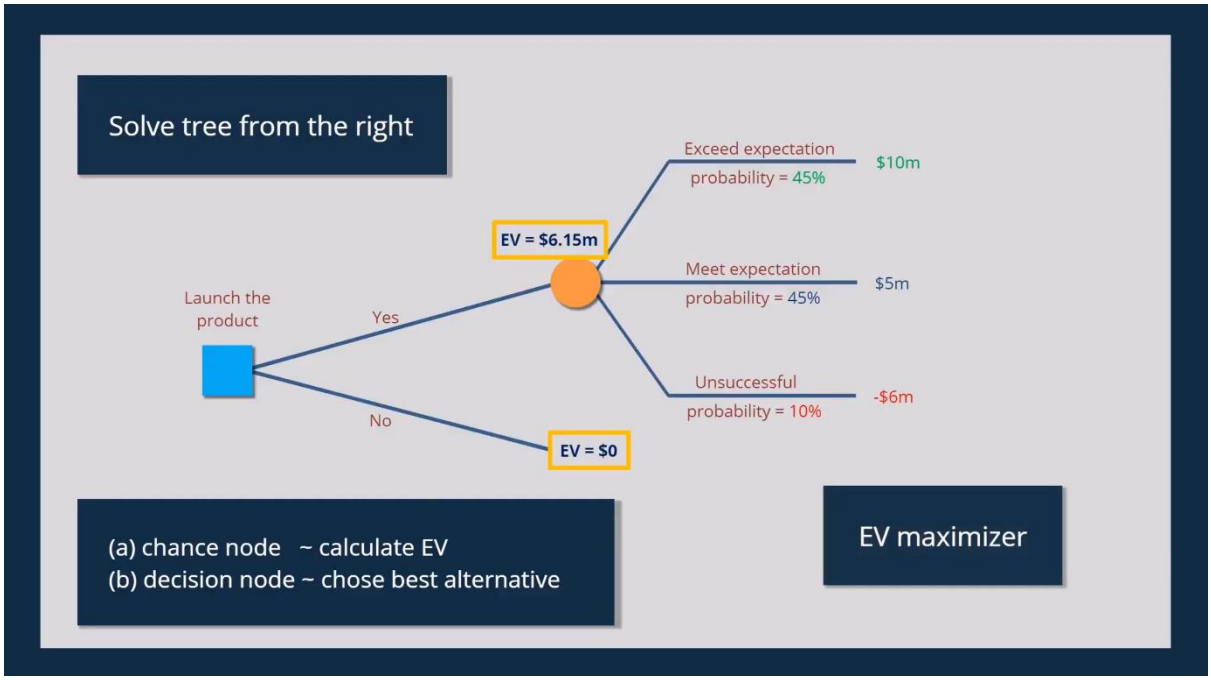
The expected value of the product launch is EV equal to 45% multiplied by 10 million dollars, which represents the best case, plus 45% multiplied by 5 million dollars, which represents the moderately successful scenario, plus 10% multiplied by a loss of 6 million dollars, which represents the worst case scenario.

Adding all the weighted outcomes of the three scenarios together, we get the expected value of $6,150,000.

The justification of the expected value is that we would expect our average winning to be $6,150,000.

Expected value is useful for decision theory because many decision makers are expected value maximizers who choose the action that yields the greatest expected value.

Slide #6



To solve the tree, we start from the right, the same way we solved the previous one.

In fact, we solve all trees by working backwards.

We start at the rightmost node.

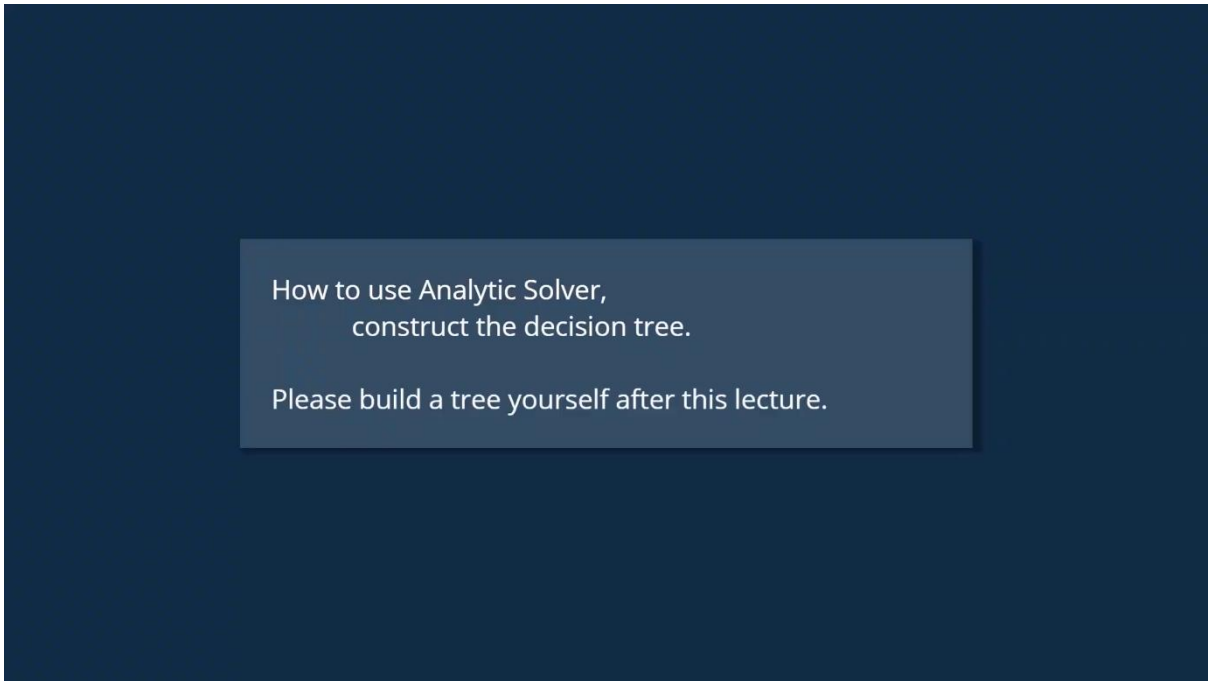
In this case, a chance node.

Calculate the expected value of that node, and then move left to the preceding node, the launch decision node.

Since the expected value of launching the product, $6,150,000, is greater than the $0 return, which is the firm's payoff, if it does not launch the product.

The firm would choose to launch the product, assuming it is an expected value maximizer.

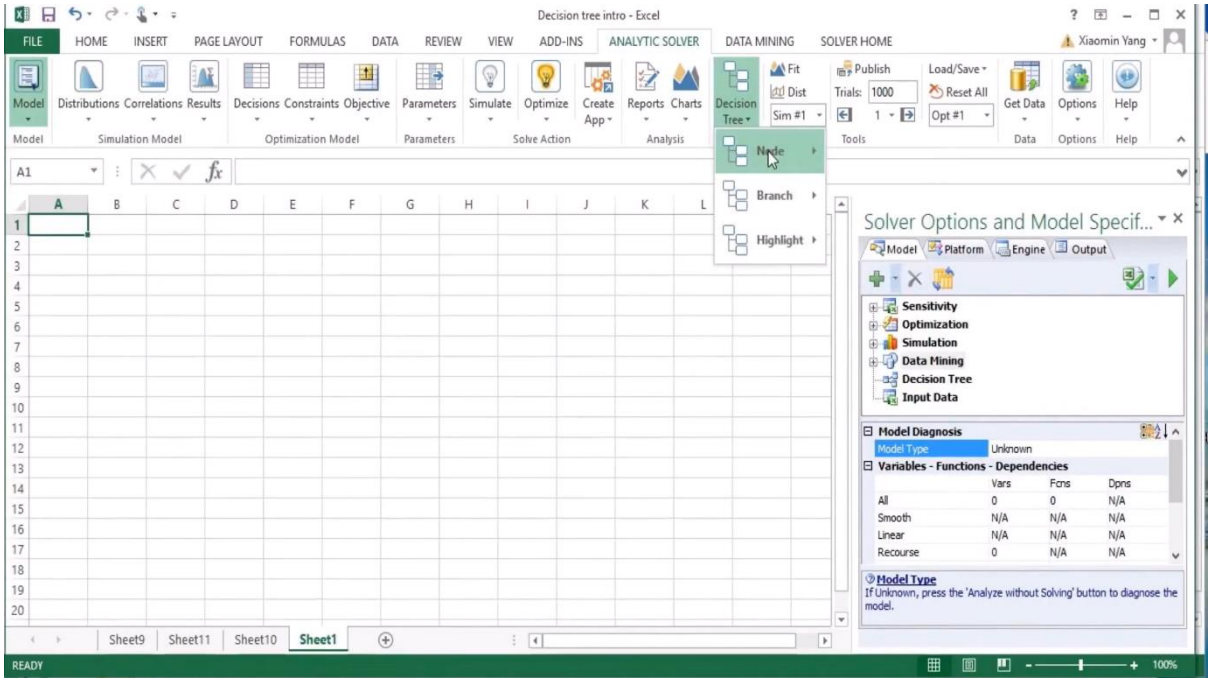
Slide #7



The video illustrates how to use the analytic solver to construct and solve the decision tree.

Please build a tree yourself after this lecture.

Slide #8



To build a decision tree with the analytical solver, click decision tree, add node, give a name to the decision node, launch a product, and then choose decisions launch product.

The second decision is cancel the product.

The value of each decision will be determined by the market response.

Now click the terminal on launch product, add node, and this will be a chance event node.

Input the name of this event, this market response.

There are three possibilities.

First one is the product launch is highly successful. The payoff is 10 million dollars under this best-case scenario, and the probability is 45%.

The second scenario is modestly successful. Input the payoff 5 million in here, and the chance of this scenario is also 45%.

At the, the, the third scenario, the market launch is unsuccessful and the business is going to lose 6 million. The chance is low. It's only 10%.

Click OK.

The chance node is added to the decision tree.

And we can see clearly those three possibilities.

Now highlight the tree.

Highlight the best. I

t shows that launching the product is better than not launching the product.