

Exercise CN-211

Calculating the value of information

The Economic Skills Project

1 Problem

Problem

Ted is thinking of buying a \$40,000 electric vehicle but is worried it won't have enough range for his needs. There's a 40% chance the range would be good (G), in which case he'd get \$42,000 of gross benefits from the car. However, if the range is bad (B), the car wouldn't work for him and he'd need to sell it for \$25,000.

Ted could also lease a similar car for a month, which would reveal whether it would work for him or not.

If Ted is risk-neutral and cares only about expected value, how much would he be willing to pay for a month lease (that is, how valuable is the information about the range)?

2 Answer

Answer

- He'd pay up to \$800.

3 Method

Solution method

Here's one approach:

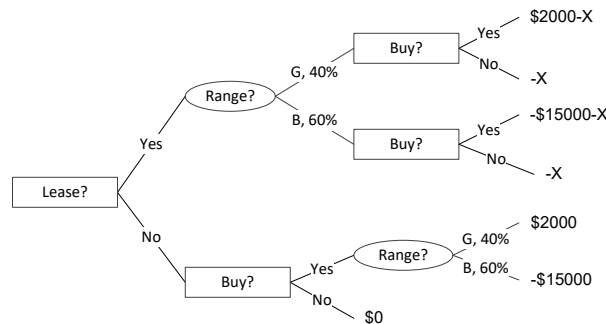
1. Draw the decision tree putting in X for the cost of the lease.
2. Repeatedly evaluate the nodes from right to left.
3. Solve for the value of X that makes him indifferent to leasing.

4 Solution

4.1 Step 1

Draw the decision tree

Here's his decision tree; the payoffs are explained on the next page.



Decision tree payoffs

All of the payoffs in the tree are Ted's net outcomes at the end points. For example, the top endpoint occurs when he pays X for the lease, finds out the range is good, buys the car for \$40,000, and ends up with \$42,000 of gross benefits. That gives him a net payoff of:

$$-X - \$40,000 + \$42,000 = \$2,000 - X$$

Similarly, if he decides not to lease, buys the car anyway, and ends up finding the range is good, he'll be at the fifth endpoint from the top and his payoff will be:

$$-\$40,000 + \$42,000 = \$2,000$$

If he doesn't lease or buy the car, his net payoff is zero because his situation is unchanged by the decision.

4.2 Step 2

Evaluating the nodes from right to left

There are three nodes at the far right side of the diagram: the two *choice* nodes on the branch where he chooses the lease, and the *chance* node where he buys the car without the lease.

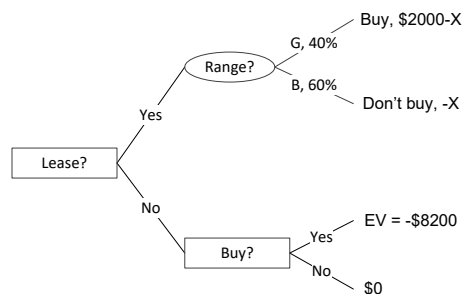
The two choice nodes are evaluated by picking the action with the best payoff. For the top node, where the car is good, he'd buy it and have a payoff of $\$2,000 - X$. For the next node, where the car is bad, he'd walk away from the deal with a payoff of $-X$.

Finally, the chance node at the bottom is evaluated by computing its expected value:

$$0.4(\$2,000) + 0.6(-\$15,000) = -\$8,200$$

Evaluating the nodes from right to left, continued

After the first group of nodes is evaluated the tree can be simplified to:



Evaluating the nodes from right to left, continued

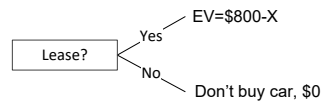
There are now two nodes at the far right. The top is a chance node with an expected value of:

$$0.4(\$2,000 - X) + 0.6(-X) = \$800 - X$$

The lower node is a choice and the highest payoff is not to buy the car, with a value of $\$0$.

Evaluating the nodes from right to left, continued

Simplifying the tree one more time gives:



4.3 Step 3

Solve for the value of X that makes him indifferent

He's just indifferent about the lease when the EV in the top branch is equal to the payoff in the bottom branch:

$$\$800 - X = \$0$$

Solving for X gives the maximum he'd be willing to pay for the lease: \$800.

Done!