

## Fire Damage Decision Tree

A homeowner in Winiger Ridge, Colorado, faces the risk of wildfire damage to her property due to the location of her home. The fires may be small or not happen at all, but there is a 1% chance that a fire will be large and could cause significant damage to her home.

She has several options to confront the risks.

She can take her chances and do nothing at all.

She can purchase insurance at the cost of \$1200 per year. If she does this, and there is a large fire, there is a 90% chance that the fire will cause significant damage, but the cost of repairs will be completely covered by the insurance. (Note: this chance of significant damage is the same whether or not she buys insurance.)

She can install a new fire resistant roof at the cost of \$5000 over 20 years. With the installation of the roof, there is a 50% chance that a large fire will cause no damage, or 50% chance that it will be damaged significantly.

Finally, she could purchase both a new roof and insurance. If she decides to take this route, the cost of her insurance will be reduced by 10% because of the added security provided by the roof.

If her house burns down, she will certainly go through some pain and suffering. We'll put that at a cost of \$50,000. Also, the cost of her \$200,000 house will be lost (unless she has insurance).

In this example, we are doing calculations to determine the possible costs associated with the risk of fire after only one year of having the new roof, insurance, or both (depending on which option we are looking at). Because of this, assume that the value of the roof is only \$250, and insurance is \$1200.

Create a decision tree using the Treeplan Excel plug-in which you can download from the course website.

1. Open Excel with a basic decision tree by following Steps 1-4 in Tutorial 1 (on the course web page).
2. Using the procedures explained in Tutorial 1, change the basic tree that appears when you open the plug-in to have four branches coming out of the decision node. These will represent the homeowner's options: do nothing, buy insurance only, buy fire resistant roofing only, and buy both insurance and roofing.
3. Change each of the four terminal nodes to an event node with two new branches.
4. Change one terminal node from each set of new branches to an event node with two branches. The structure of the tree should now look like Figure 1 below.
5. Add labels to the tree that make sense to you.

6. The branches coming out of the first set of event nodes (Column F) represent the possibility of a large wildfire (1%) or no fire (99%). Change the percentages that automatically appear in Treeplan accordingly.
7. The branches coming out of the second set of event nodes (Column J) represent the possibility of damage or no damage given a large fire. If she has no new roofing, the possibility of damage is 90%, but if she buys the roofing, the possibility drops to 50%. Change the percentages accordingly.
8. Now let's look at the values associated with each option. Starting with the "do nothing" branch, Cells D55, H51, H59, L49, and L54 are the cells that allow for inputting values. Input 200000 in D55 to represent the value of the house. This value will be used in all calculations for all nodes to the right of it. In this example, nothing goes in H51 or H59 because no other values need to be considered at the large fire/no fire split in the tree.
9. In L49, put -250,000. This represents a loss of \$200000 for the house and \$50000 for pain and suffering given a large fire that causes damage with no insurance and no roof.
10. Input appropriate values in the other three branches. In the "insurance only" branch, input 198800 before the first event node (Column D). This represents \$200000 (house value) - \$1200 (insurance). Again, there is no need to put anything in the value cells of row H. In the "home damage" branch you must input -50000 to represent pain and suffering.
11. For the "roofing only" branch, 199750 represents the value of the house minus \$250 ( $\$5000/20$ , the cost of the roof over one year).
12. For the "roofing and insurance" branch, 198670 represents the value of the house, minus the cost of the roof over one year, and the cost of insurance (remember she gets a 10% discount on insurance for having the new roof.)
13. The software performs the "roll back" calculations for each branch and sub branch, displaying them in the cells just to the left of the event nodes. For example on the "roofing and insurance" branch, 173670 is the expected mean value from the "damage/no damage" sub-branch. 198420 is the expected mean value from the entire branch.
14. The "2" that appears in the decision node indicates the branch that has the highest expected mean value from all branches. This is the option that should be chosen by the homeowner.

