Using Risk Tolerance with TreePlan

TreePlan provides the option of calculating best decisions based on the decision-maker's risk tolerance. An individual's risk tolerance is measured by the parameter, τ, of the individual's utility function: $u(x) = 1 - e^{-x/\tau}$, where $u(x)$ is the utility of receiving a payoff x (gain or loss), and the constant $\tau > 0$ is the individual's so-called Risk Tolerance coefficient. The use of the risk tolerance coefficient is illustrated here on the decision tree developed in the TreePlan Tutorial. Suppose that a risk preference assessment has revealed that the company's risk tolerance is: τ = 300, in the same monetary units as the payoffs in the decision tree. The steps to incorporate risk tolerance in TreePlan are as follows:

1. Enter the value of the risk tolerance coefficient in a cell *outside* the decision tree area it. Cell O3 is used for this purpose in Figure 1.
2. Assign the name RT to that cell: keeping the cell selected (cell O3 in Fig. 1), go to the Name Box to the left of the Formula Bar, type RT, press [Enter]. The name RT now appears in the Name Box for that cell.
3. Make sure TreePlan is loaded in Excel; if it is not, go to File > Open and browse to TreePlan.xlam.
4. Select any cell *inside* the decision tree diagram and call the TreePlan command. In the dialog box that appears, click the **Options…** button: this opens the 'TreePlan - Options' dialog box shown below.
5. Under **Certain Equivalents**, select **Exponential risk utility function**, and click **OK**.

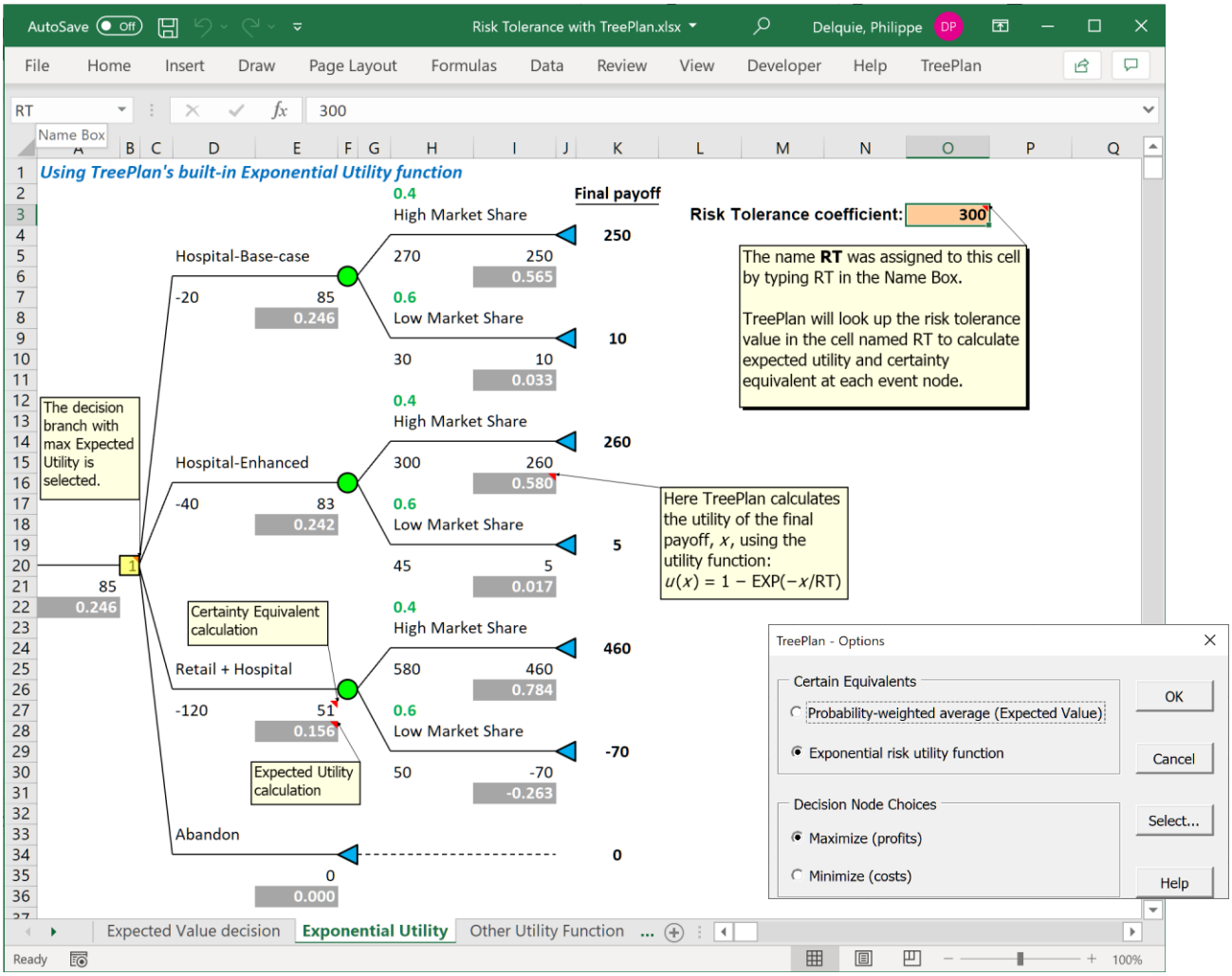

Figure 1. Analysis of the decision tree using exponential utility.

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After Step 5, TreePlan converts the decision tree to calculate expected utilities rather than expected values. The Certainty Equivalent at each node appears in the cell directly below and to the left of the node (previously the location of the Expected Value). The expected utility at each node appears immediately below the certainty equivalent. The cells containing utility values were color-filled to distinguish them from the monetary values. With the current risk tolerance, the alternative branch 1 should be selected because it provides the highest Certainty Equivalent (or Expected Utility) for the company.

We could use a utility function other than exponential, by manually replacing the terminal payoffs in the decision tree with their respective utilities. The TreePlan formulas would then calculate *expected utilities* instead of expected monetary values. An example of how to do this is shown in Figure 2. Suppose the company's utility function can be represented by $u(x) = \text{Log}(300+x)$, for $x > -300$ in the monetary units used in the tree model. In the cells to the right of terminal payoffs, we entered formulas to calculate the utility of the payoff. The utility function formula was entered in cell L4, then copied to the other cells in that column. Next, we redirected the values hanging below the terminal nodes in column I to point to the values in column L, utility values, instead of column K, payoff values. The tree model now computes expected *utilities* and selects alternatives with highest expected utility. With the utility function used here, the best alternative is branch 1. Note that the utility values are in units of utility, not monetary units.

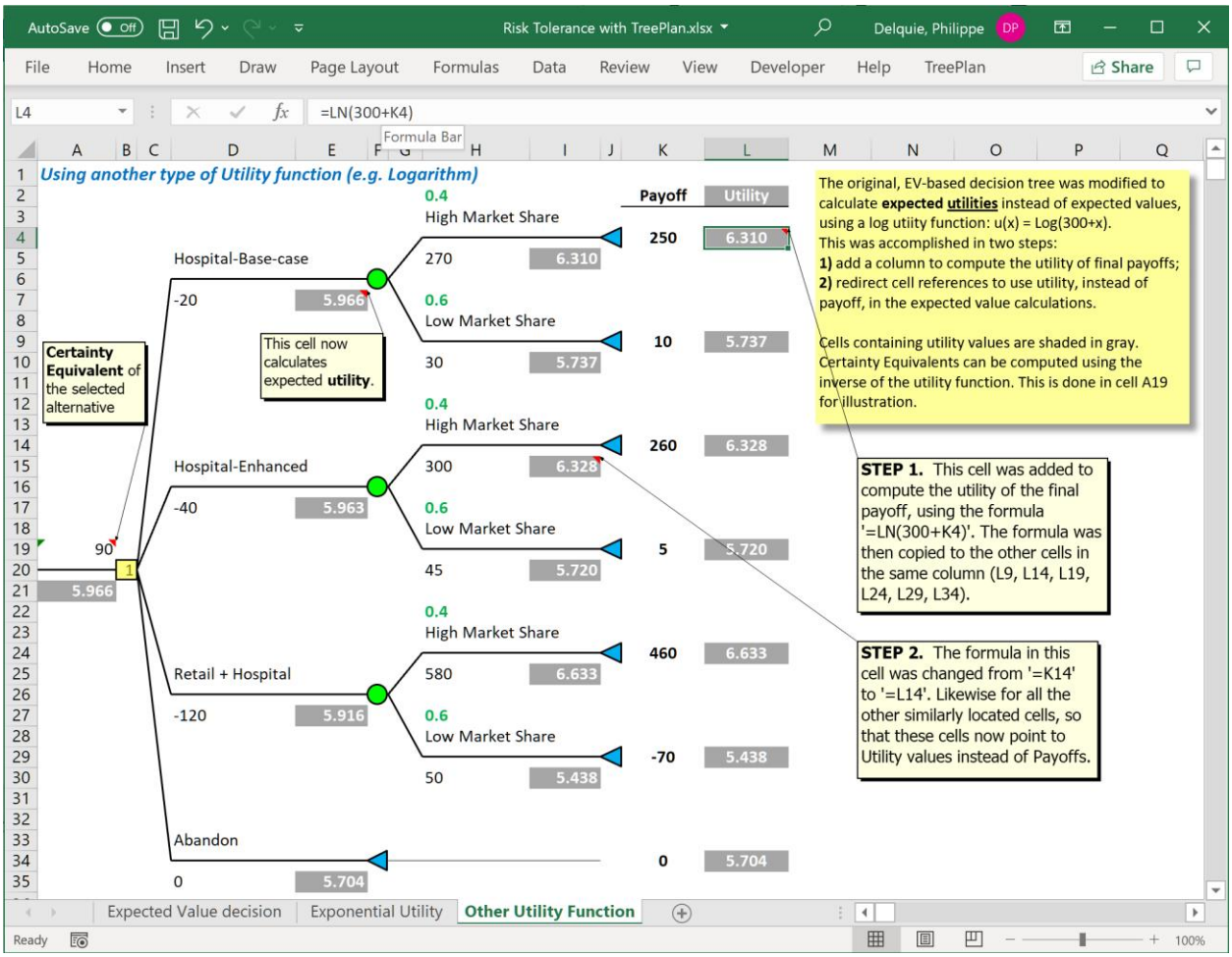

Figure 2. Decision tree modified for expected utility calculations.

In the same fashion, we can manually edit any decision tree model to incorporate other utility function forms. Inspect the accompanying Excel file for further details.