Minicase Report

Buying a House

ISOM3900 - Decision Analytics

Introduction

Oftentimes when making decisions, noises and uncertainty clouds our judgement. Decisions can range from something as simple as picking what color t-shirt to wear on a day, or something more challenging as choosing which university classes to take, and even something as complicated as buying a new house. There are a multitude of factors to consider when purchasing a house and to achieve the most effective outcome, one must consider all the possible outcomes. Decision Trees are excellent tools to help you choose between several courses of action. They allow you to effectively lay out the options and investigate possible outcomes of choosing those options. They can help form a balanced picture of risks and rewards associated with each course of action. The first step in using a Decision Tree to evaluate a problem is to draw the decision tree.

Assignment

a) Structure Debbie and George's problem as a decision tree.

All Decision Trees start with a decision that you will need to make. It should start with a **square** with **branches** that stem from the square, which represents decisions / events that you are able to choose from. Eventually, there will be uncertain events / outcomes, which is represented by a **circle** with **branches** that stem from it as well. Later, cash value or score is assigned to each possible outcome (they can be viewed as what this decision is worth to you). Meanwhile, uncertainty points (circles) will be assigned a percentage to quantify the probability of these uncertain events (the total percentage should add up to 100%). Percentages can be calculated with historical data on past events. Once all these elements are present, the Decision Tree is completed.

Debbie and George have assigned an "emotional value" of $10,000 to the house, and because the asking price of the house is $400,000, they are willing to pay at most $410,000. If sold at the price of $410,000, this will net them an intrinsic value of $0, ($410,000 - $410,000) and at that point, they are indifferent between purchasing and not purchasing the house. Debbie has also assigned probabilities on the events (e.g. there is 30% that they will be the only bidders of the house, which means that there is a 70% chance that they are not the only bidders of the house). The decision gets more complicated because if there are other bidders, they have the chance to either withdraw the offer, submit the same offer, or increase the offer by $5,000. Each of these following events have their own respective acceptance rate / probabilities (rate which the buyer accepts that bidding price).

The Decision Tree is structured where the red dollar text represents the intrinsic value at the decision point that Debbit and George will gain. For example, at the offer of $390,000 and where they are the only bidders and accepted, the intrinsic value is at $20,000 (calculated from: emotional value - bid value [$410,000 - $390,000 = $20,000]). Also when the offer is declined or withdrawn, the intrinsic value is $0, because they are not successful in purchasing the house. Lastly, the respective probabilities are indicated in the bracketed blue text. For example, there is 30% chance they are the only bidders and 70% chance there are other bidders. The other probabilities are assigned according to the bidding price point as stated in the case.

Refer to Appendix - Figure 1.

b) Solve for Debbie and George's optimal decision strategy.

After all the elements are present in the Decision Tree, the optimal decision strategy can be calculated quantitatively. Circle events represent uncertain outcomes, therefore they are a weighted average of all the possible outcomes. For example, in the event where Debbie and George offers $390,000 and are the only bidders the value is $8,000 (calculated from: $20,000 * 40% + $0 * 60% = $8,000). Square events represent events that can be chosen, therefore it is obvious to pick the event that has the highest value. For example, in the event where Debbie and George offer $390,000 and there are other bidders, they pick to increase the offer because it has the highest value of $4,500 (increase [$4,500], resubmit [$4,000], and withdraw [$0]).

The optimal decision strategy is to **offer $390,000** because it has the highest intrinsic value of $5,550 (compared to $5,300 [offer $400,000] and $3,800 [offer $405,000]). The Expected Profit Without Information is $5,550. If there are other bidders, increase the offer (highest intrinsic value of $4,500).

Refer to Appendix - Figure 2.

c) Find the expected value of perfect information about whether they will be the only bidders on the house.

The expected value of perfect information (EVPI) is the upper bound for the value of any information. Under perfect information, we can foretell the result. In Debbie and George's case, they are able to know exactly which decision will result in the highest intrinsic value and also know for certain the percentage of uncertain events. The 'crystal ball' in this case foretold perfect information about whether they will be the only bidders on the house, which means that the 30% (only bidder) and 70% (other bidder) is certain. Under these conditions, the sequence of decision and events are reversed, meaning the **square** and **circle** events are swapped. The Decision Tree will have to be redrawn to reflect these conditions. Afterwards the EVPI can be calculated from Expected Profit with Perfect Information - Expected Profit Without Information.

Under perfect information, the expected profit with perfect information is $5,900. Then which means the **EVPI is $350** (calculated from: Expected Profit with Perfect Information - Expected Profit Without Information [$5,900 - $5,550]).

Refer to Appendix - Figure 3.

Appendix

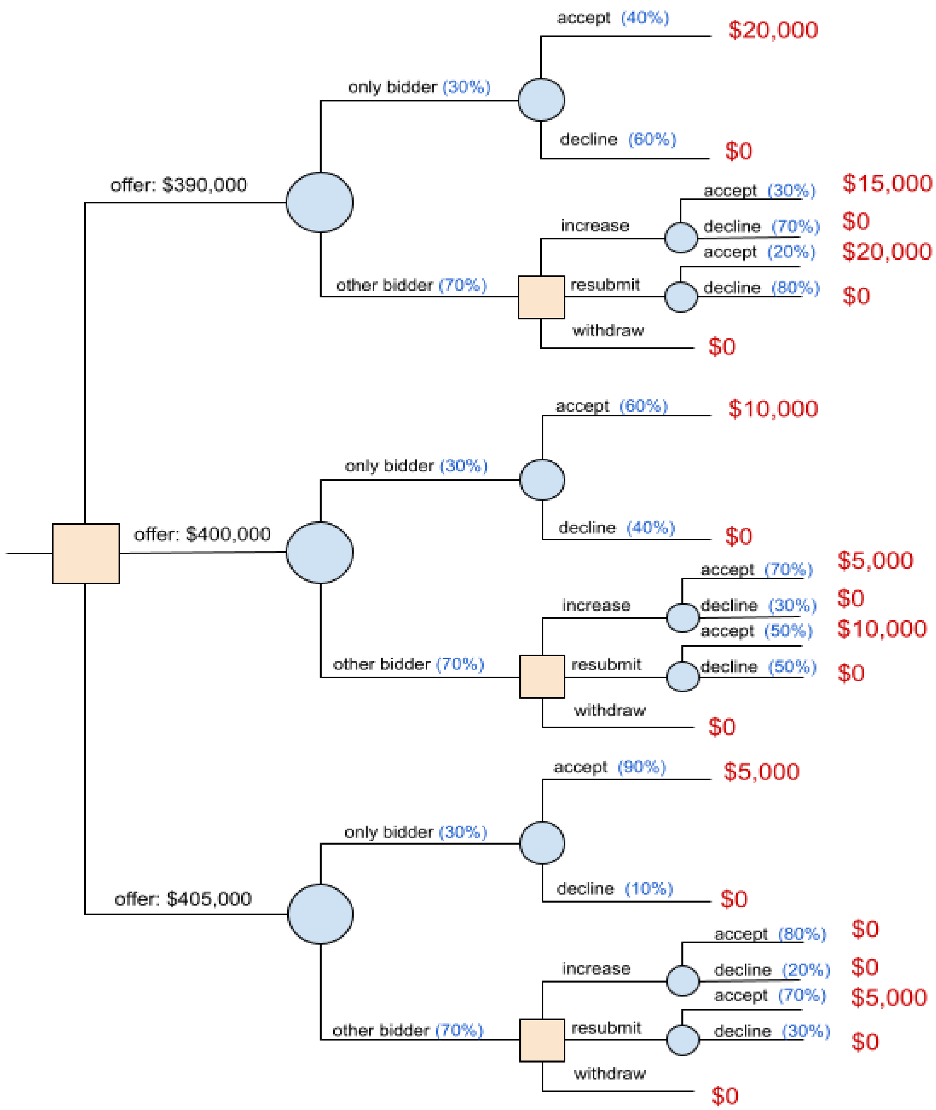

Figure 1 - Decision Tree

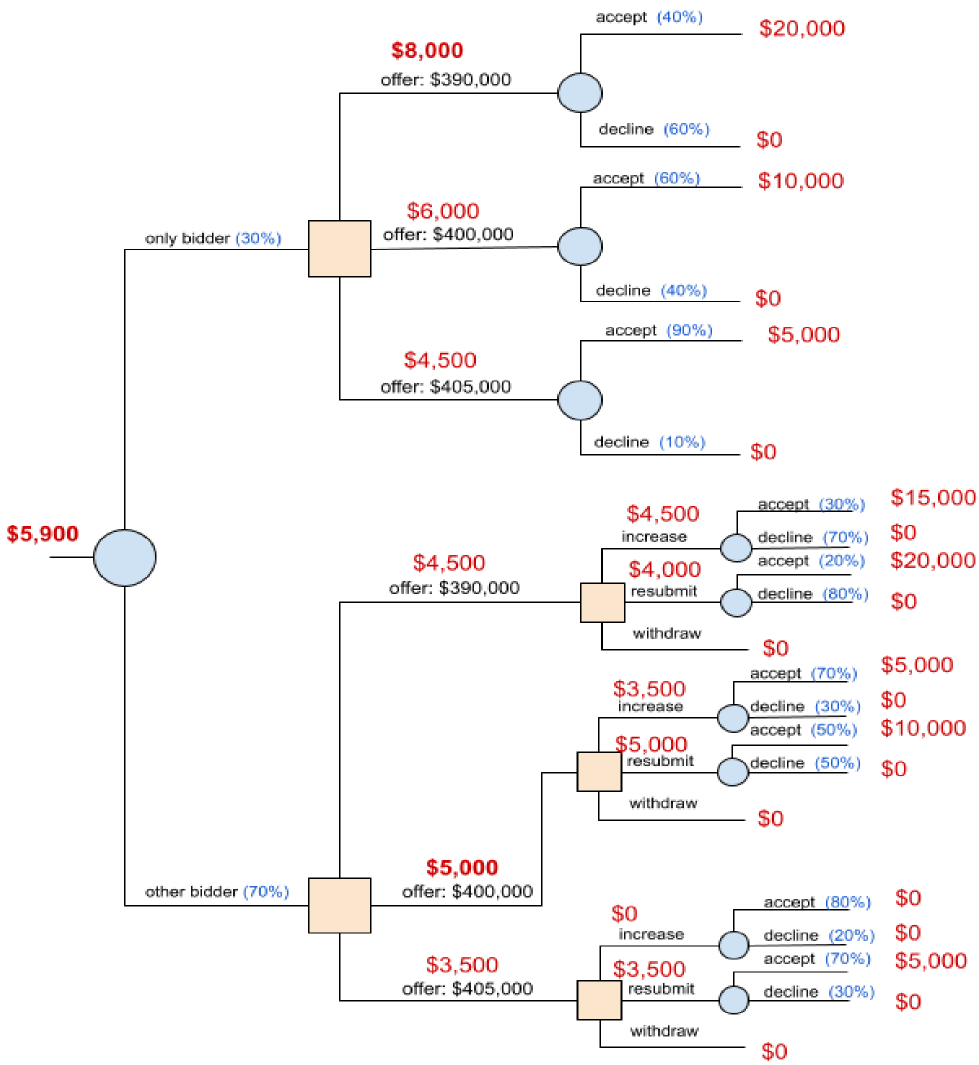

Figure 2 - Optimal Decision Strategy

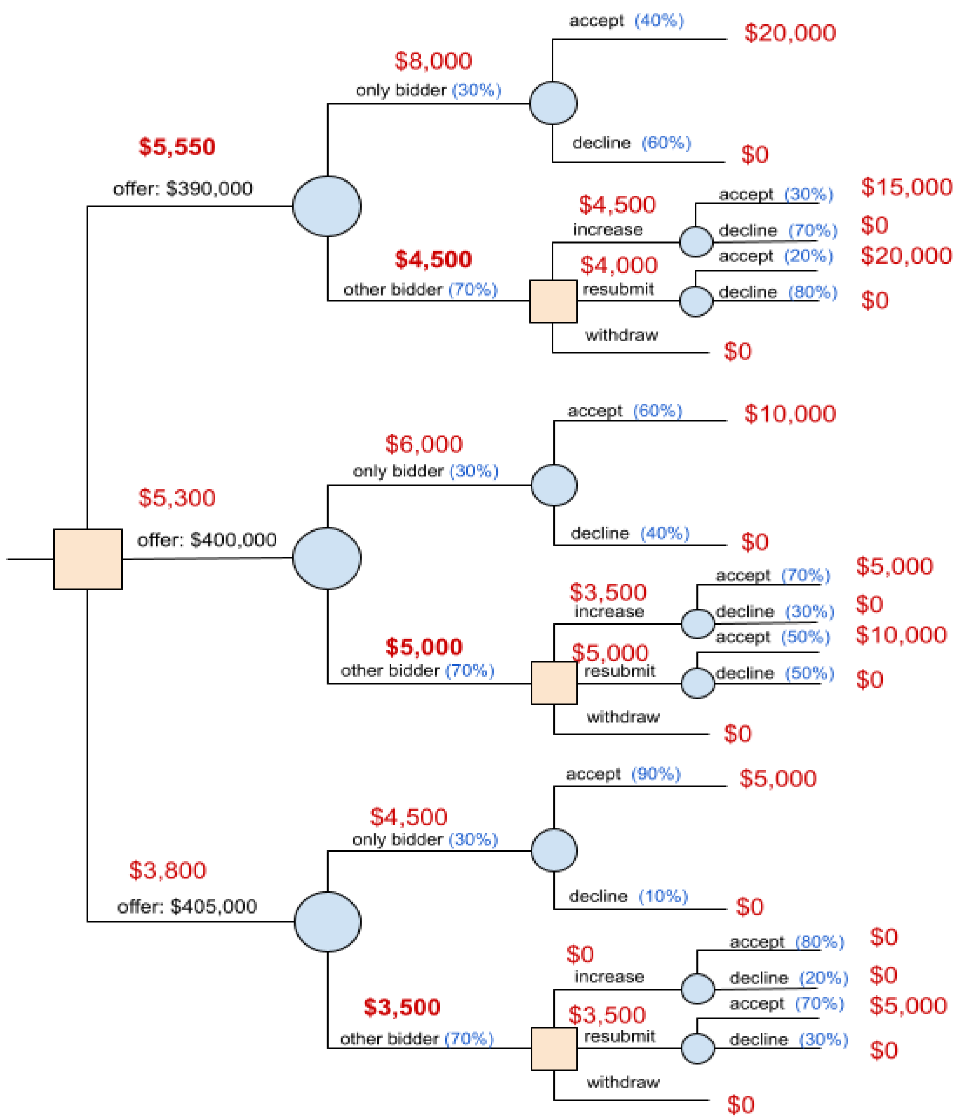

Figure 3 - Expected Value of Perfect Information