

# **Minicase Report**

Brainy Business

ISOM3900 - Decision Analytics

## Introduction

Decision Tree is often used to make decisions precisely when facing uncertainty, ranging from simple daily life problems to business problems. It first lists out all the possible outcomes, then makes the decision by looking at different options' intrinsic value, which is the expected value. The option with the highest intrinsic value gained will be the best option. However, a decision tree with limited information provided is not enough, with more information being known before making certain decisions, it is often easier to make more beneficial decisions compared to the one with no extra information. Therefore, in the business world, it is common for companies to hire marketing research firms to get more useful information before making an investment decision.

In this case, Charlotte Rothstein is the CEO, major shareholder, and founder of Cerebrosoft. She is now facing a difficult decision regarding her company's newest proposed product, Brainet. Although the product may sell very well, risk is also involved as marketing the product may lead to substantial losses in this competitive market. Therefore, there are two choices in front of her, either to go ahead and launch the product or just abandon it to avoid further potential losses. If decided to launch, what price of the product should she set? Due to the limited information on the level of competition of the market and its impact on unit sales, Charlotte is also considering buying additional marketing research information from a local marketing research company before her final decision.

## Assignment

1) For the initial analysis, ignore the opportunity of hiring the marketing research company. Formulate the decision problem in a decision tree. What is Charlotte's optimal decision if she uses Bayes' decision rule?

Ignoring the opportunity of hiring the marketing research company, Charlotte only has two choices, either launch Brainet and start the marketing campaign, or abandon Brainet. If she decides to launch the product, she has to choose one from the three strategies on the pricing, which are \$30, \$40 and \$50. The lowest price \$30 aims at maximizing market share and the highest price \$50 aims at maximizing revenues, while the price in between of them, \$40, aims at achieving both objectives.

Besides pricing, competition is also a factor relevant to the success of this project. The level of competition is classified into three levels, high, medium and low. According to prior probabilities, the likelihood of each of them is 0.2 for high competition, 0.7 for medium competition and 0.1 for low competition. The probability distribution of unit sales at the 3 prices and 3 levels of competition are developed accordingly from other companies. The 3 possible amounts of sales are expected to be 50,000 units, 30,000 units and 20,000 units.

Other than pricing, competition, and units sales, the last factor we will have to consider is cost. We have already spent \$800,000 for the development costs for Brainet, which is the

fixed cost. This \$800,000 is already spent no matter we launch or abandon the product. If we launch the product, we expect to have an extra variable cost of \$5 per unit for support after sales.

After knowing the above information, we can start to formulate the decision problem in a decision tree, which is as follows.

*Refer to Appendix - Figure 1.*

From the decision tree in *Figure 1*, Charlotte's optimal decision should be launching Brainet and setting the price at \$50, as it creates the highest value of \$563,500.

2) Now consider the possibility of doing the marketing research. Develop the corresponding decision tree. Should Cerebrosoft pay \$10,000 for the marketing research? What is the overall optimal policy?

To know if it is worth it to pay \$10,000 for the marketing research before we make the final decision on launching Brainet or not, we calculated the posterior probabilities, which are probabilities of facing high competition, medium competition and low competition given the prediction of “high”, “medium” and “low” competition respectively. While the prior probabilities are given, we can also calculate the elementary probabilities.

From the excel screenshot below, we can see 4 columns of probabilities. Here we use H, M, L to represent that the competition turns out to be high, medium or low. While "H", "M", "L" represents the predictions by the marketing research company to be high, medium or low.

The 2 columns on the right are given from the case. The 2 columns on the left are what we further need in order to develop a corresponding decision tree. We used Bayesian rule to do the calculation with the help of Excel as follows.

P(H "H")	0.597015	P("H" and H)	0.16	P("H" H)	0.8	prior probabilities	
P(M "H")	0.391791	P("H" and M)	0.105	P("M" H)	0.15	P(H)	0.2
P(L "H")	0.011194	P("H" and L)	0.003	P("L" H)	0.05	P(M)	0.7
	1	P("H")	0.268			P(L)	0.1
				P("H" M)	0.15		
P(H "M")	0.050251	P("M" and H)	0.03	P("M" M)	0.8		
P(M "M")	0.938023	P("M" and M)	0.56	P("L" M)	0.05		
P(L "M")	0.011725	P("M" and L)	0.007				
	1	P("M")	0.597	P("H" L)	0.03		
				P("M" L)	0.07		
P(H "L")	0.074074	P("L" and H)	0.01	P("L" L)	0.9		
P(M "L")	0.259259	P("L" and M)	0.035				
P(L "L")	0.666667	P("L" and L)	0.09				
	1	P("L")	0.135				

These probabilities reflect how likely the results of the marketing research can accurately predict the actual competition level. Then, we can start to develop a corresponding decision tree.

*Refer to Appendix - Figure 2.*

As we can see from the decision tree in *Figure 2*, the expected profit of doing the marketing research is \$563,500, which is just the same as the expected profit of not doing so, as we obtained in Question 1. In other words, the expected value of doing the marketing research would be zero, which is less than the marketing research cost of \$10,000! Therefore, Cerebrosoft should not pay \$10,000 for the marketing research. The overall optimal policy would be not paying for the marketing research, launching Brainet, and setting the unit price at \$50.

## Appendix

Brainy Business Q1

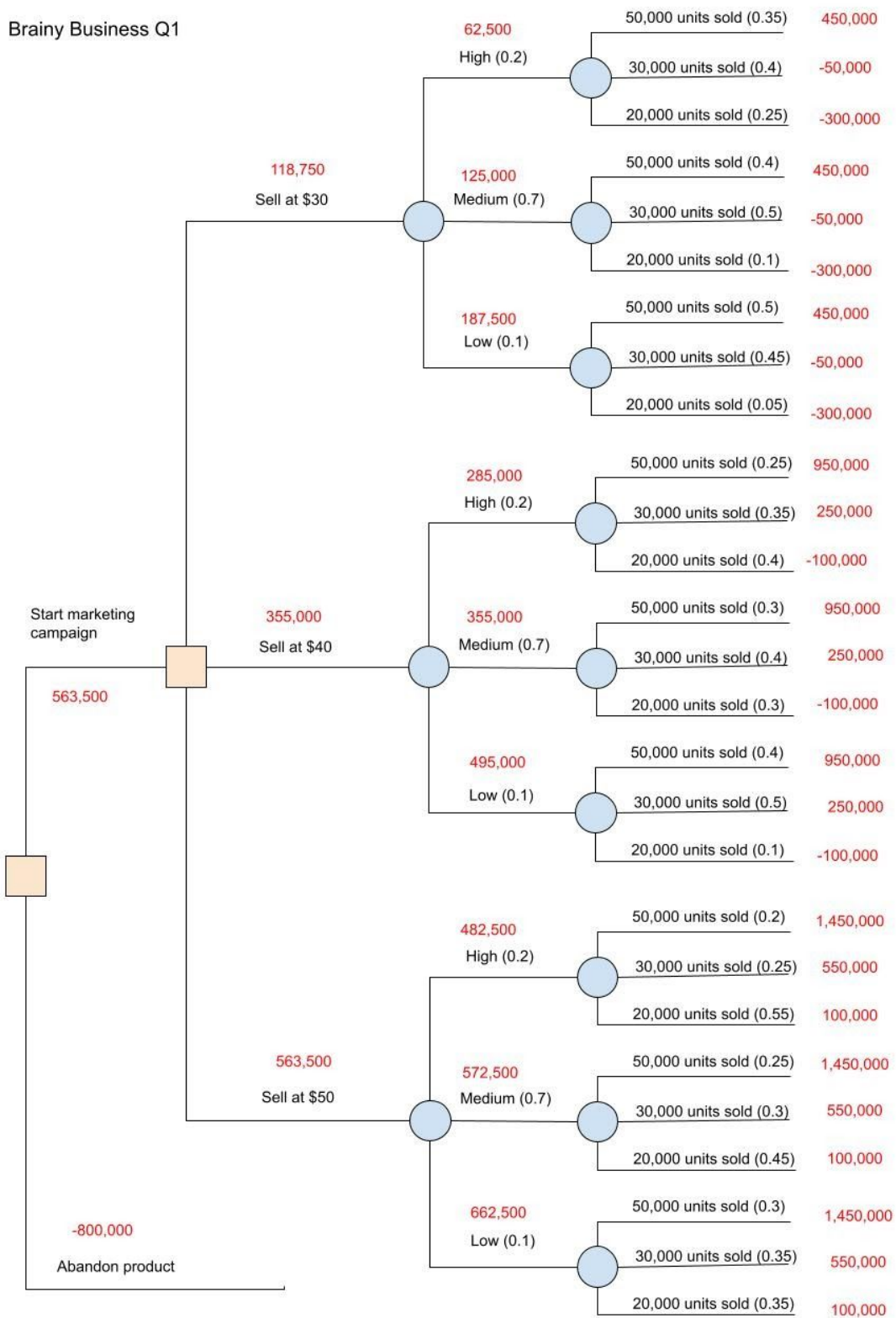


Figure 1 - Decision Tree

**Value of the marketing research**  
**= \$563,000 - \$563,000**  
**= 0**  
**< 10,000 (cost)**

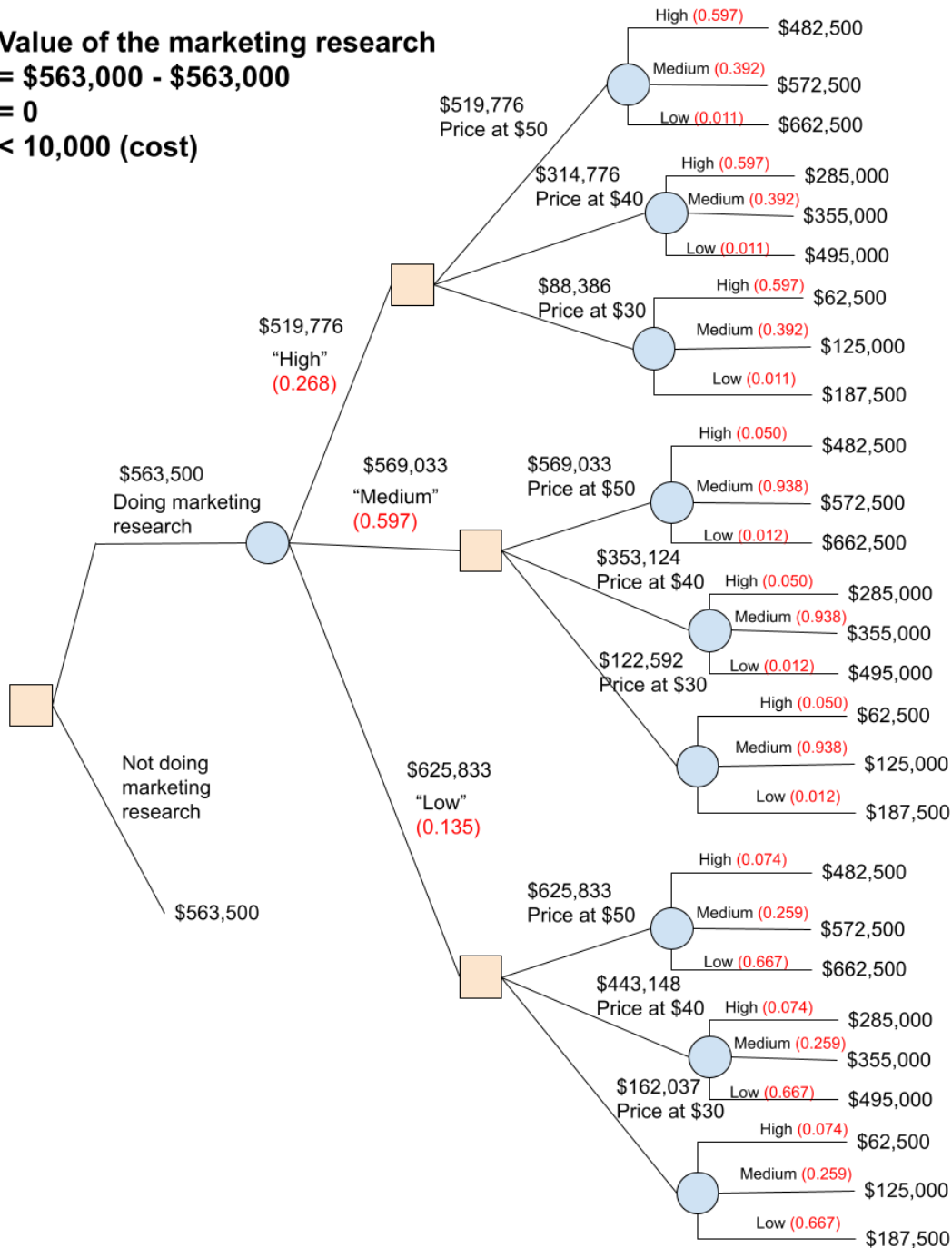


Figure 2 - Decision Tree with Marketing Research