Introduction

The product manager at Clean & Brite (C&B) is faced with a pivotal decision regarding the launch of a new product. According to the company's projections, if the new product succeeds in the market, the company stands to gain approximately $1,800,000 in profit; however, if it fails, the company would incur a loss of around $750,000. The product manager estimates the probability of a successful product launch to be 0.35. Additionally, the company has made it clear that if the new product is not launched, there will be minimal change in the company's profits.

Prior decision on whether to launch the new product, the product manager can decide to invest $130,000 in market research. Based on previous research outcomes, it is believed that if the market research predicts a successful launch, the actual probability of the product succeeding in the market is 0.8. Conversely, if the market research predicts failure, the actual probability of the product failing in the market is 0.7.

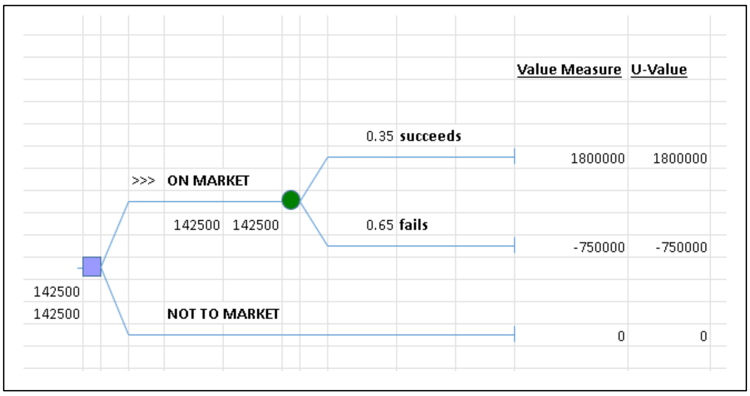
In addressing decision-making under uncertainty, this report employs the construction of a decision tree model to calculate the probabilities of various possible courses of action and predict the potential outcomes, aiming to identify the optimal solutions under different scenarios. Risk assessment is also conducted, along with an examination of the potential impact on outcomes as probabilities vary.

Solution approach

1. Without the market research study.

If no market research is conducted, the company has two options: to directly launch the product or choose not to launch it. If the product is launched, there is a probability of 0.35 of it succeeding, resulting in a profit of $1,800,000 for the company, while the probability of the product failing is (1 - 0.35) = 0.65, leading to a loss of $750,000 for the company. If the decision is made not to launch the product, the company's profit remains unchanged at 0. Therefore, we can simply calculate the expected profit as decision 1 is (1,800,000 * 0.35 + (-750,000) * 0.65) = $142,500. The expected value of decision 2 is 0, indicating no change in the company's profit. According to the principle of maximizing profit, the decision tree suggests that the product should be launched to the market to gain profit. However, it is noteworthy that the probability of failure is significantly higher than the possibility of success.

Decision 1: on market now		
	Probability	Cost incurs
succeeds	0.3500	$1,800,000.00
fails	0.6500	-$750,000.00
EMV of Decision 1	$142,500.00	
Decision 2: not to market		
EMV of Decision 2	$0.00	
Max EMV	$142,500.00	
Best decision	Decision 1	



2. With the market research study

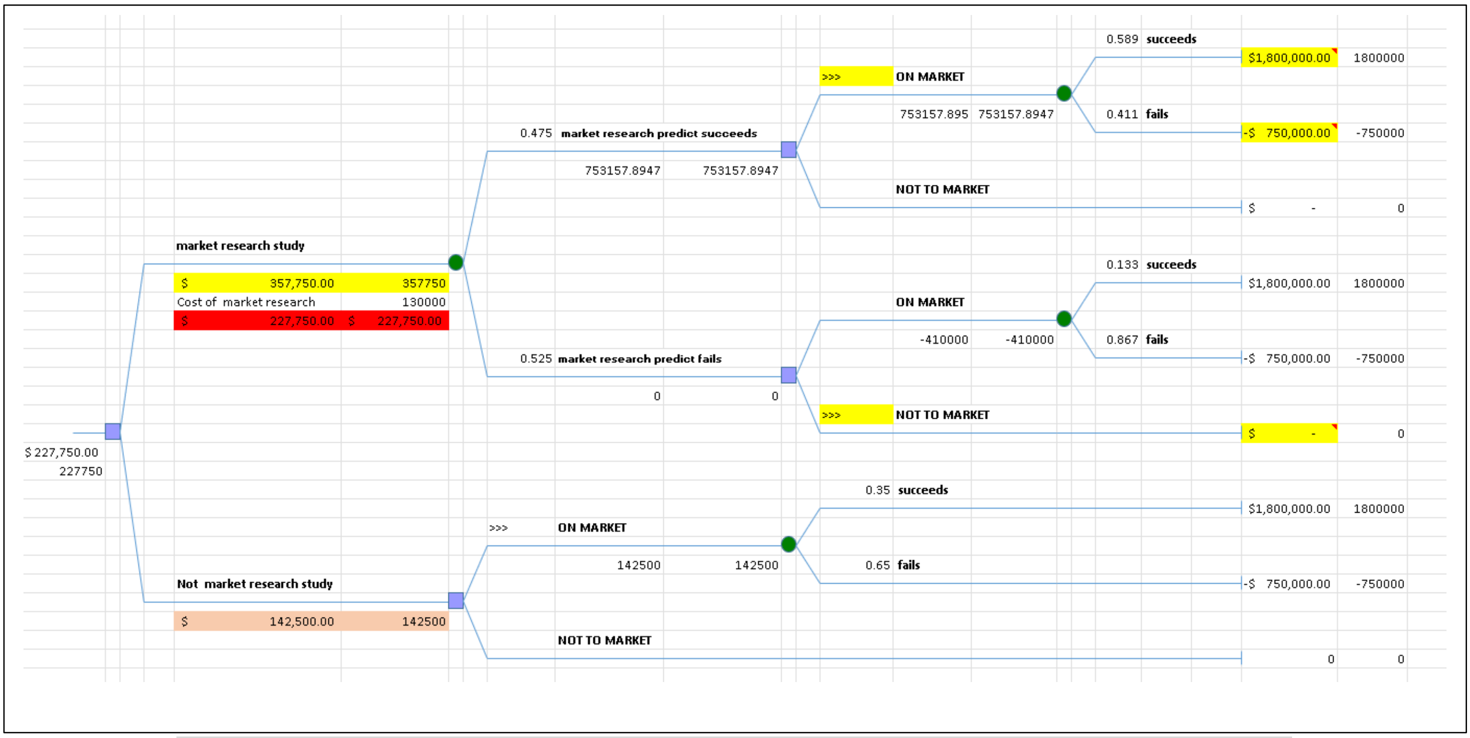
Firstly, if market research is chosen, it will incur a cost of \$130,000. The probability of a successful product launch is defined as P_1= 0.35, and the probability of an unsuccessful launch is (1 - P_1) = 0.65. If the research predicts a successful launch, the probability of the product actually succeeding in the market is denoted as P_2 = 0.8. The probability of the research predicting success but the product failing in the market is (1 – P_2) = 0.2. Similarly, if the research predicts a failed product launch and the product indeed fails in the market, the probability is denoted as P_3 = 0.7. Therefore, the probability of the research predicting failure but the product succeeding in the market is $(1 - P_3)$ = 0.3.

According to the Law of Total Probability, for this product, the probability of market research predicting a successful launch is $P_1 \times P_2 + (1 - P_1) \times (1 - P_3)$ = 0.475. Similarly, the probability of market research predicting an unsuccessful launch for this product is $P_1 * (1 - P_2) + (1 - P_1) * P_3$=0.525.

Finally, applying Bayes' formula, we compute the posterior probabilities given the research study. Assuming the research study concludes that the product will successfully launch, the actual probability of the product succeeding in the market is $P_1 \times P_2 \div 0.475$=0.589 Conversely, the probability of the product actually failing in the market is $(1 - P_1) \times (1 - P_3) \div 0.475$ =0.411.

If the research indicates that the product will fail in the market, then the probability of the product succeeding in the market is 0.133, and the probability of the new product failing in the market is 0.867.

Based on the previously calculated results, a complete decision tree can be constructed.



This decision yields the expected monetary value of $227,750.

3. Risk analysis.

Based on the decision tree and previous calculations, if the optimal solution is to conduct market research and launch the new product, the probability of the company ultimately earning a profit of $1,800,000 in the market is 0.589 * 0.475 = 0.28. The probability of the company ultimately incurring a loss of $750,000 in the market is 0.411 * 0.475 = 0.195. While the probability of the profit remaining unchanged at $0 due to not launching the products is 0.525.

the risk profile (probability distribution of profit) of adopting the strategy in (1)			
	outcome	risk	expected profit
#1-1	1800000	0.28	227750
#1-2	-750000	0.195	227750
#1-3	0	0.525	227750

Hence, it can be inferred that there is a 28% chance for the company to earn a profit of $1,800,000, a 19.5% chance to incur a loss of $750,000, and a 52.5% chance for the profit to remain unaffected. On one hand, the probability of the company experiencing no loss is as high as 80.5%, and once the product successfully launches, the potential profit far exceeds the possible loss. From the perspective of expected value benefits, this significantly outweighs the potential losses.

Based on the previous risk profile calculation method, the following table summarizes the calculations for all possible strategies:

Decision for stage 1		Decision for stage 2		outcome	expected profit	risk	succeeds/ fails
market research	market research predict succeeds	on market	succeeds	1800000	753158	0.28	1.435897436
			fails	-750000		0.195	
		not no market		0	0	0.475	
	market research predict fails	on market	succeeds	1800000	-410000	0.07	0.153846154
			fails	-750000		0.455	
		not no market		0	0	0.525	
no market research	no market research	on market	succeeds	1800000	142500	0.35	0.538461538
			fails	-750000		0.65	
		not no market		0	0	1	

Comparing the three strategies reveals:

For strategy 1, the likelihood of successfully launching the product and earning a profit is 1.435 times higher than the likelihood of a failed launch. In contrast, in Strategies 2 and 3, the probability of a successful launch is significantly lower than that of a failure. It is important to note that the expected profit is merely a weighted average. The company only realizes actual profits if the product is successfully launched; otherwise, it incurs losses. If the product is not launched, the profit remains unchanged at $0.

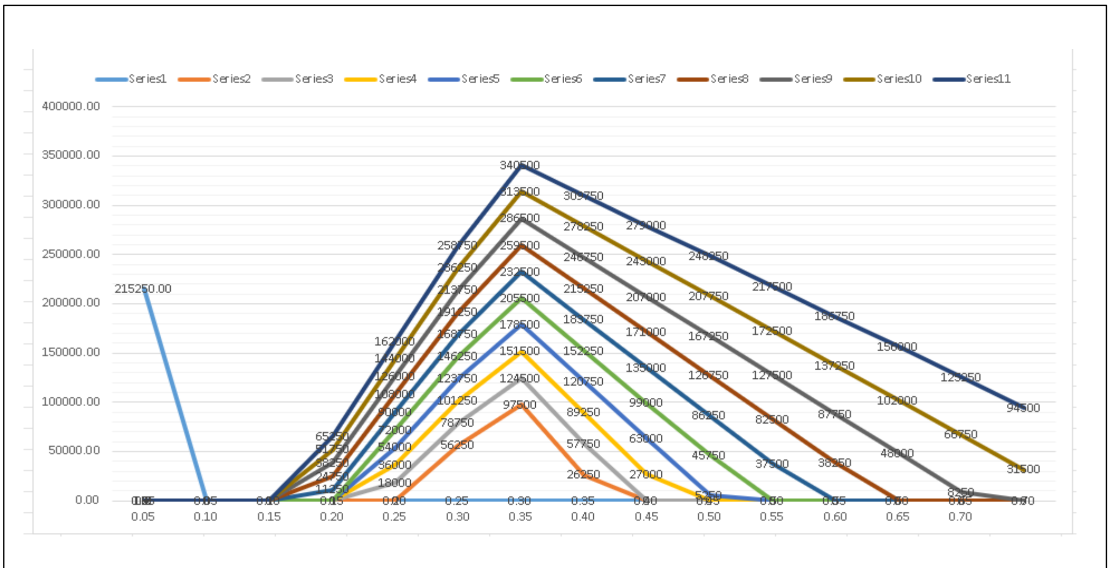
Therefore, if choosing to launch the product, it must be based on market research predicting a successful launch. If market research indicates a likely failure in the launch, refraining from launching to avoid profit losses is crucial. Without market research, the probability of failing upon launch is significantly higher than that of succeeding. Although the expected profit is $142,500, which is higher than the impact of not launching on profit, the risk is too high.

4. Sensitivity analysis for EVSI

EVSI = EMV with free research – EMV without research(Wayne & Christian，2017)
When P1=0.35, P2=0.8, and P3=0.7, the EVSI is $215,250

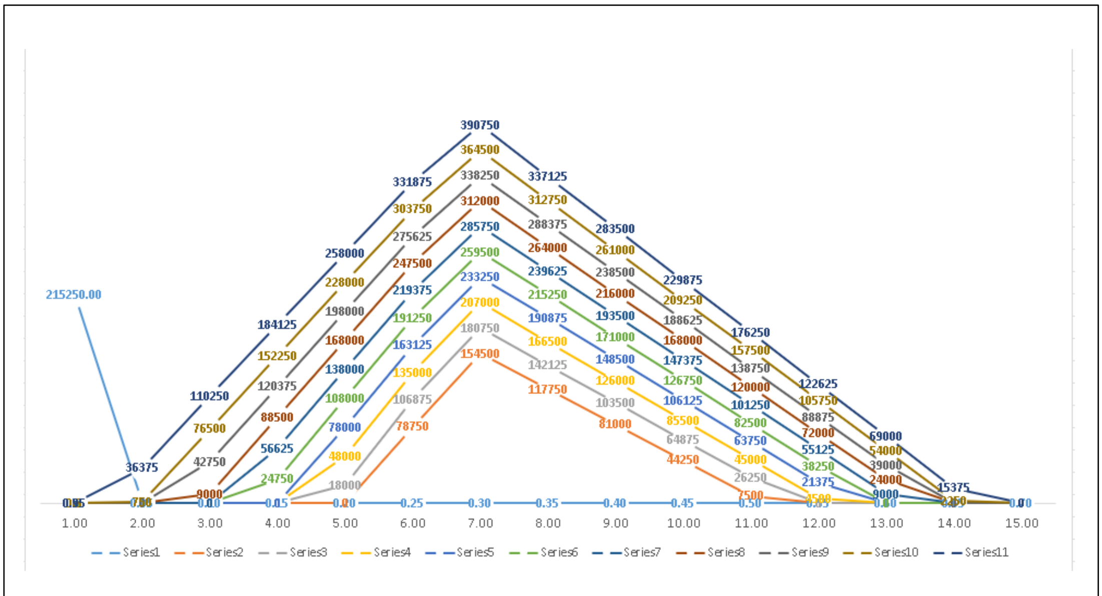
a. EVSI for P_1 from 0.05 to 0.70 and P_2 from 0.5 to 0.95 in increments of 0.05, $P_3$is fixed to 0.7.

P1\P2	215250.00	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9	0.95
	0.05	0	0	0	0	0	0	0	0	0	0
	0.10	0	0	0	0	0	0	0	0	0	0
	0.15	0	0	0	0	0	11250	24750	38250	51750	65250
	0.20	0	18000	36000	54000	72000	90000	108000	126000	144000	162000
	0.25	56250	78750	101250	123750	146250	168750	191250	213750	236250	258750
	0.30	97500	124500	151500	178500	205500	232500	259500	286500	313500	340500
	0.35	26250	57750	89250	120750	152250	183750	215250	246750	278250	309750
	0.40	0	0	27000	63000	99000	135000	171000	207000	243000	279000
	0.45	0	0	0	5250	45750	86250	126750	167250	207750	248250
	0.50	0	0	0	0	0	37500	82500	127500	172500	217500
	0.55	0	0	0	0	0	0	38250	87750	137250	186750
	0.60	0	0	0	0	0	0	0	48000	102000	156000
	0.65	0	0	0	0	0	0	0	8250	66750	125250
	0.70	0	0	0	0	0	0	0	0	31500	94500



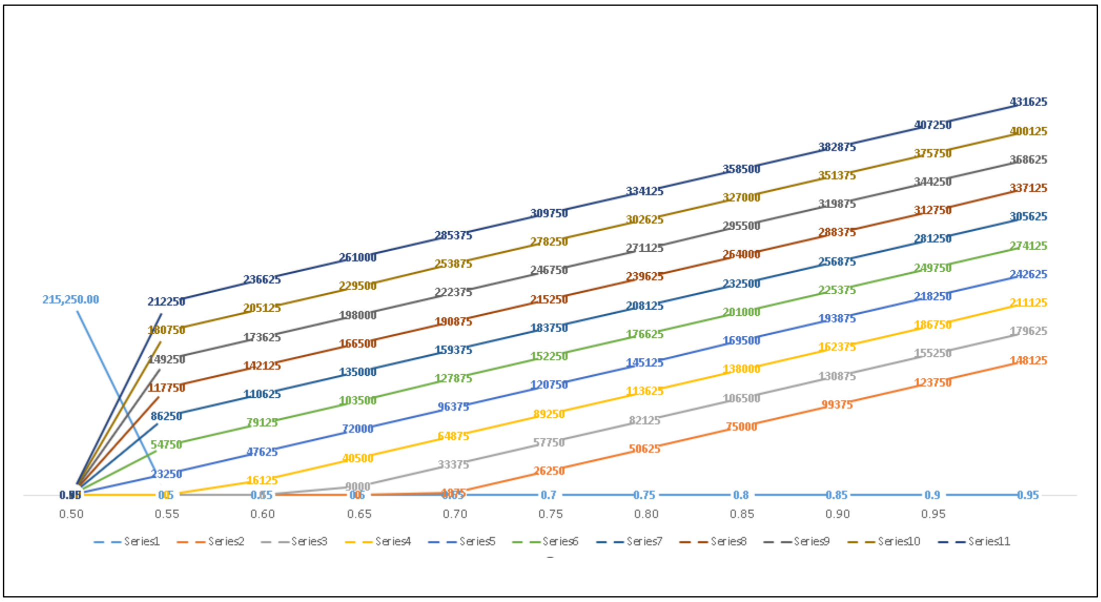
b. P_1 from 0.05 to 0.70 and P_3 from 0.5 to 0.95 in increments of 0.05, P_2 is fixed to 0.8

P1\P3	215250.00	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9	0.95
	0.05	0	0	0	0	0	0	0	0	750	36375
	0.10	0	0	0	0	0	0	9000	42750	76500	110250
	0.15	0	0	0	0	24750	56625	88500	120375	152250	184125
	0.20	0	18000	48000	78000	108000	138000	168000	198000	228000	258000
	0.25	78750	106875	135000	163125	191250	219375	247500	275625	303750	331875
	0.30	154500	180750	207000	233250	259500	285750	312000	338250	364500	390750
	0.35	117750	142125	166500	190875	215250	239625	264000	288375	312750	337125
	0.40	81000	103500	126000	148500	171000	193500	216000	238500	261000	283500
	0.45	44250	64875	85500	106125	126750	147375	168000	188625	209250	229875
	0.50	7500	26250	45000	63750	82500	101250	120000	138750	157500	176250
	0.55	0	0	4500	21375	38250	55125	72000	88875	105750	122625
	0.60	0	0	0	0	0	9000	24000	39000	54000	69000
	0.65	0	0	0	0	0	0	0	0	2250	15375
	0.70	0	0	0	0	0	0	0	0	0	0



c. P_2 from 0.5 to 0.95 and P_3 from 0.5 to 0.95 in increments of 0.05, P_1 is fixed to 0.35

P2\P3	215,250.00	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9	0.95
	0.50	0	0	0	1875	26250	50625	75000	99375	123750	148125
	0.55	0	0	9000	33375	57750	82125	106500	130875	155250	179625
	0.60	0	16125	40500	64875	89250	113625	138000	162375	186750	211125
	0.65	23250	47625	72000	96375	120750	145125	169500	193875	218250	242625
	0.70	54750	79125	103500	127875	152250	176625	201000	225375	249750	274125
	0.75	86250	110625	135000	159375	183750	208125	232500	256875	281250	305625
	0.80	117750	142125	166500	190875	215250	239625	264000	288375	312750	337125
	0.85	149250	173625	198000	222375	246750	271125	295500	319875	344250	368625
	0.90	180750	205125	229500	253875	278250	302625	327000	351375	375750	400125
	0.95	212250	236625	261000	285375	309750	334125	358500	382875	407250	431625



Combining the results of three tests, we can conclude:
The EVSI only consistently increases when the accuracy of external information (P_2, P_3) is simultaneously improved.
As predicted in part c, when the external information is completely correct (P_2 = P_3= 1), the EVSI reaches its peak.
Since P_1 is constant in Part C, the EMV without research is a fixed value. Therefore, the EVSI can also be understood as the maximum potential profit. Hence, if there is a need to enhance potential profits, improving the accuracy of external research information is the most reliable method.

5. EVIP

The Expected Value of Perfect Information (EVPI) is the maximum amount a decision-maker should be willing to pay for perfect information, where perfect information means that predictions are 100% accurate (Wayne & Christian，2017). In this case, it would imply that if market research predicts a successful product launch, the probability of success is 1, and if it predicts a failed launch, the probability of failure is also 1. The formula for EVPI is:

EVPI= EMV with (free) perfect information - EMV without information (Wayne & Christian, 2017)

Therefore, one approach is to directly calculate the EMV with perfect information using the decision tree and subtract the EMV without any information. Alternatively, adjusting the parameters in the decision tree such that P2 equals 1 and P3 equals 1 would also yield the EMPI as $487,500.

Hence, regardless of the accuracy of market research, one should not pay more than $487,500 for market research, as this is the upper limit of the value of perfect information. In practical terms, market research costs should not equal or exceed $487,500, as there is no perfect "God's-eye view" information.

Conclusion and Recommendations

Firstly, in this case, based on previous calculations, to maximize profits, Clean & Brite (C&B) should adopt the strategy of conducting market research predicting a successful product launch followed by the actual product launch. The expected profit is $227,750. However, although the probability of success in this strategy outweighs the probability of failure, a success probability of 0.28 is still not very high.

Secondly, when using the decision tree method, risk analysis should be conducted. In risk analysis, criteria need to be defined and probability assessments of all possible strategies should be conducted to determine the risks of various possibilities and the probabilities of different scenarios.

Additionally, based on the EVSI analysis, the impact of various uncertainties on the results was identified, and the key parameters affecting the results were determined. At the time of the final decision, it helps decision-makers determine what type of information is needed, the impact of different information sources on the results, and the value of information relative to its cost.

Finally, the EVPI calculation quantifies the value of uncertainty by quantifying the value of perfect information. This quantification is used to assess the importance of increasing investment in information. On the other hand, by comparing EVPI with EVSI and the information procurement investment I, it can be decided whether to invest in more perfect information or choose a more economical solution to reduce uncertainty.

Reference List:

Wayne L Winston, & S. Christian Albright (2017) Practical Management Science, South West College ISE;