A Decision Analysis on the Entry and Exit of A New Market Product

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Abstract. This study is a retrospective study to arrive at the optimal decision on the quantity of "Harp lime larger beer" that should have been produced by Guinness Nigeria Plc in a given month in a year – say (June 2012). The following parameters were estimated – the possible market demand of harp lime, the cost of production, the company's selling price per create and possible market demand in the month of June 2012. Using a number of criteria for making decision under uncertainty, **-** maximax criterion, maximim criterion, minimax regret criterion, Laplace criterion, Hurivicz criterion, several decision where arrived at and prepositions made on what would have sustained the product in the market.
Keywords; act, state of nature, payoff table, opportunity loss table or regret table, optimal decision.

1 INTRODUCTION

Harp lime was an extended brand of harp larger beer, a product of Guinness Nigeria Plc. This premium larger was made of water, sorghum, barley malt, sucrose, hops, stabilizer E40S and lime flavour. It had an alcohol content of 5.15% vol, and came in 33 centiliters (cl) bottle with these nutritional content; energy (171kg), protein (0.2g), carbohydrate (3g), fat (0g).

Brand analysts collectively saw the introduction of harp-lime into the market as an ill–informed experiment based on the premise that the mother brand, harp larger is fighting a tough battle to adequately position itself in the market against other rivals.

For harp lime not to be like other extended brands such as gulder max, diet coke, Indomine peppersoup, maggi crayfish, e.t.c which has fizzled out of the market or only exists as living dead brands. One of the measures to carry out is that decisions on production must be made such that harp lime is produced to satisfy existing market demand, thereby preventing loss of potential gains, and excess production is avoided to prevent losses due to expiration.

Background

Decision making is an everyday activity. It can be regarded as the mental process resulting in the selection of a course of action amongst several alternatives. It is also seen as the process of sufficiently reducing uncertainty about alternatives, to allow a reasonable choice to be made from among them. Every decision making process produces a final choice. A layman would see decision making as the process of choosing what to do by considering the possible consequences of different choices. It is even more interesting to know that if one is faced with a decision ,a decision not to act until more information is available is still a decision. Only an understanding of what decision making involves together with a few effective techniques, will help produce a better decision. This is of great importance because almost everybody wants to make an optimal decision Logical decision making is an important part of all science based research, where professionals apply their knowledge in a given area to make informed decision. For example, statistical decision making may involve testing an assertion (statistical hypothesis testing) using one of the statistical tools and then making decision to either accept or reject such assertion. A major part of decision making involves analysis of a finite set of alternatives described in terms of some evaluative criteria. These criteria may be benefits or cost in nature. It is irrational to make decisions without analyzing the problem, therefore a discussion on decision making is not complete without involving the concept of problem analysis. Problem analysis must be done first, and then the information gathered from such process may be used in decision making.

Considering the case of a producer who is interested in producing an item that would be sold in the market, due to waste, he would not produce too many, and due to loss of potential profit he would not produce too few. Since the exact market demand for this item cannot be predicted to enable him produce exactly the number of item and optimize his profit, he needs to predict the possible demand. The list of all the possible demand is called the state of nature.

Let the demand be = S_1, S_2 ----------S_n

And the courses of action (alternatives) = a_1, a_2 --------a_m

Having in mind that the objective is to minimize loss due to unutilized capacity and optimize profit. The first step is to prepare a payoff table for the producer's decision

Table 1.1 Payoff Table For The Producer

Alternatives	S_1	S_2	S_3	---S_n
a_1	$V(a_1S_1)$	$V(a_1S_2)$	$V(a_1S_3)$	---$V(a_1S_n)$
a_2	$V(a_2S_1)$	$V(a_2S_2)$	$V(a_2S_3)$	--- $V(a_2S_n)$
a_3	$V(a_3S_1)$	$V(a_3S_2)$	$V(a_3S_3)$	--- $V(a_3S_n)$
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
a_m	$V(a_{m1}S_1)$	$V(a_mS_2)$	$V(a_mS_3)$	--- $V(a_mS_n)$

where $V(a_iS_j)$, i=1, 2 ------m and j = 1, 2------n are the conditional profit or payoffs. Therefore table 1.1 above is termed a conditional profit table. Since his decision is under condition of uncertainty, a number of criteria are available for making decision, they include;

i. The maximax criterion
ii. The maximim criterion
iii. The minimax regret criterion (savage criterion)
iv. The Laplace criterion
v. The Hurivicz criterion.

2 MATERIALS AND METHODS

For the case of production of harp lime we had that the cost price for producing a create was N1,400 while the selling price was N2,300. Possible demand in (creates) throughout the month of June (2012) = N180,000, 195,000, 201,000, 225,000, 240,000.

To set up the payoff table,

For a_1 and s_1 we have (180000 x 2300) – (180000 x 1440) = 154,800,000

For the combination of a_1 and s_2, there is no capacity to produce more than 180,000 therefore; the payoff is same for a_1 with s_2, s_3, s_4 and s_5.

For the combination a_2 and s_1 we have (180,000 x 2,300) – (195,000 x 1,440) = 133,200,000 for a_2 and S_2 we have;

(195,000 x 2,300) – (195,000 x 1440) = 167,700,000 for combination of a_2 with s_3, s_4, s_5 there is no capacity to produce more than 195,000, with this algorithm the payoff table as follows;

TABLE 1.2 PAYOFF FOR THE PRODUCTION OF HARP LIME (₦000,000)

	State of nature demand				
Alternatives	**S_1**	**S_2**	**S_3**	**S_4**	**S_5**
(act)	180,000	195,000	210,000	225,000	240,000
180,000	154.8	154.8	154.8	154.8	154.8
195,000	133.2	167.7	167.7	167.7	167.7
210,000	111.6	146.1	180.6	180.6	180.6
225,000	90.0	124.5	159.0	193.5	193.5
240,000	68.4	102.9	137.4	171.9	206.4

Hence, the decisions are made based on any of the aforementioned criteria.

3 DATA ANALYSIS

In maximax criterion, for each act we first locate the maximum possible payoff over different state of nature, thus, for the jth act Aj, we find the maximum of the payoffs X_{ij}, X_{2j} ---X_{nj}, Let
$\underset{1\leq i\leq m}{\text{Max}} (X_{ij}) = P_j$; j = 1, 2, -----n
.

Maximum payoff for the jth act Aj over different state of nature, we then find the maximum of these maxima for different act say p_1, P_2 -----------p_n, then the act (decision) corresponding to the Max (p_1, p_2 ------p_n) is taken as the optimal act.
Therefore,
Max [154.8, 154.8, 154.8, 154.8, 154.8] = 154.8
Max [133.2, 167.7, 167.7, 167.7, 167.7] = 167.7
Max [111.6, 146.1, 180.6, 180.6, 180.6] = 180.6
Max [90.0, 124.5, 159.0, 193.5, 193.5] = 193.5
Max [68.4 102.9, 137.4, 171.9, 206.8] = 206.8
Hence, the matrix (table of this criterion) is given below.

TABLE 1.3 MAXIMAX CRITERION FOR HARP LIME PRODUCTION

	State of nature (demand)					
Alternatives	**S_1**	**S_2**	**S_3**	**S_4**	**S_5**	**Max**
(act)	180,000	195,000	210,000	225,000	240,000	
a_1 = 180,000	154.8	154.8	154.8	154.8	154.8	154.8
a_2 = 195,000	133.2	167.7	167.7	167.7	167.7	167.7
a_3 = 210,000	111.6	146.1	180.6	180.6	180.6	180.6
a_4 = 225,000	90.0	124.5	159.0	193.5	193.5	193.5
a_5 = 240,000	68.4	102.9	137.4	171.9	206.4	206.4*

Therefore, the decision using the minimax criterion is producing 240,000 crates of harp lime which corresponds to
Max (154.8, 167.7, 180.6, 193.5, 206.4) = 206.4.

USING THE MAXIMIM CRITERION

Under this criterion, we first note the minimum payoff over different state of nature, thus, for jth act, we find minimum of the payoffs (X_{1j}, X_{2j} -------X_{mj}).
Let, $\underset{1\leq i\leq m}{\text{Min}} (X_{ij}) = P'j$, (j = 1, 2, ----------------n)

Next, we find maximum of these minimum payoffs i.e we find
Max (P'_1, P'_2 -----------p'_n) or $\underset{1\leq j\leq n}{\text{Max}}$ ($P'j$)

Therefore, the act (strategy) corresponding to this maximum of the minimum payoffs is taken as the optimal decision.

The table for the maximim criterion is shown as follows.

TABLE 1.4 MAXIMIN CRITERION FOR HARP LIME PRODUCTION

	State of nature (demand)					
Alternatives	**S_1**	**S_2**	**S_3**	**S_4**	**S_5**	**MIN**
(acts)	180,000	195,000	210,000	225,000	240,000	
a_1 = 180,000	154.8	154.8	154.8	154.8	154.8	154.8*
a_2 = 195,000	133.2	167.7	167.7	167.7	167.7	132.8
a_3 = 210,000	111.6	146.1	180.6	180.6	180.6	111.6
a_4 = 225,000	90.0	124.5	159.0	193.5	193.5	90.0
a_5 = 240,000	68.4	102.9	137.4	171.9	206.4	68.4

Since Max (154.8, 132.8, 111.6, 90.0, 68.4) = 154.8.
Hence, the decision using the maximum criterion is producing 180,000 crates of harp lime which corresponds to 154.8.

DECISION USING THE MINIMAX REGRET CRITERION

The minimax criterion is based on the regret or opportunity losses, costs or damages instead of profit or gain. Each payoff is subtracted from the highest payoff in the column. It appears;

For column S_1 = 180,000, the highest payoff is 154.8, we have 154.8– 154.8 = 0, 154.8 – 133.2 = 216 etc. Therefore the regret table is given below,

TABLE 1.5 MINIMAX REGRET CRITERION FOR HARP LIME PRODUCTION

	State of nature (demand)					
Alternatives	**S_1**	**S_2**	**S_3**	**S_4**	**S_5**	**Max**
(act)	180,000	195,000	210,000	225,000	240,000	
a_1 = 180,000	0	12.9	25.8	38.7	51.6	51.6
a_2 = 195,000	21.6	0	12.9	25.8	38.7	38.7*
a_3 = 210,000	43.2	21.6	0	7.4	25.8	43.2
a_4 = 225,000	64.8	43.2	21.6	0	12.9	64.8
a_5 = 240,000	86.6	64.8	43.2	21.6	0	86

Hence Min [51.6, 38.7, 43.2, 64.8, 86.4] = 38.7 which corresponds to the decision of producing 195,000 crates of harp lime for the month.

DECISION USING THE LAPLACE CRITERION

Under Laplace decision criterion of equal likelihood, for each act Aj, we compute the expected (average) payoff over different state of nature. Since each of the m states of nature (S_i; i = 1, 2 -------m) is assigned equal probability we have pi =p(S_i) = 1/m; i = 1, 2, ------m.

Average payoff (A_i) $= \sum_{i=1}^{m} P_i X_{ij} = 1/m \sum_{i=1}^{m} X_{ij}$

Laplace criterion for the production of harp lime

TABLE 1.6 LAPLACE CRITERION FOR HARP LIME PRODUCTION

	State of nature (demand)					
Alternatives	**S_1**	**S_2**	**S_3**	**S_4**	**S_5**	$\sum(a_i)$
(acts)	180,000	195,000	210,000	225,000	240,000	
a_1 = 180,000	154.8	154.8	154.8	154.8	154.8	154.8
	133.2	167.7	167.7	167.7	167.7	160.8*
a_3 = 210,000	111.6	146.1	180.6	180.6	180.6	159.9
a_4 = 225,000	90.0	124.5	159.0	193.5	193.5	152.1
a_5 = 240,000	68.4	102.9	137.4	171.9	206.4	137.4

Hence, Max [154.8, 160.8, 159.9, 152.1, 137.4] = 160.8
This corresponds to the decision of producing 195,000 crates of harp lime.

DECISION USING THE HURWICZ CRITERION

This decision rule is a compromise between the optimistic (maximax) and the pessimistic (maximim) decision with an index of optimism α and an index of pessimism ($1 - \alpha$). Where α is a real number lying between 0 and 1,i.e $0< \alpha <1$

For any act Aj (j = 1, 2, ---------n); Let:

$\underset{1\le i\le m}{\text{Max}} (X_{ij}) = \text{Max} (x_{1j}, x_{2j} \text{--------} X_{mj}) = p_j$

and $\underset{1\le i\le m}{\text{Min}} (X_{ij}) = \text{Min} (X_{1j}, X_{2j} \text{--------} X_{mj}) = p'_j$

Then Hurwicz rule consists in finding the expected value for the act A_j by $E(A_j) = \alpha p_j + (1 - \alpha) P'_j$; (j = 1, 2 --------n)

TABLE 1.7 HURWICZ CRITERION FOR HARP LIME PRODUCTION

Alternatives	P_j	P_j	$E(a_j)$
a_1	154.8	154.8	154.8
a_2	133.2	167.7	150.5
a_3	111.6	180.6	16.1
a_4	90.0	193.5	141.8
a_5	68.4	206.4	137.4

Under this criterion, where $\alpha = 0.5$, the decision is producing 180,000 crates of harp lime, this corresponds to
Max [154.8, 150.5, 146.1, 141.8, 137.4] = 154.8

4 SUMMARY AND CONCLUSION

For an extended brand of Harp larger (Harp Lime), a product of Guinness Nigeria Plc, data on the cost of production and selling price of a crates was collected. A decision analysis on the number of crates to be produced by the company in order to maximize profit was carried out using the data collected, where possible market demands is the "state of nature" and the company can produce any of the possible demands(alternatives). The payoffs were obtained under a number of criteria. Using the maximax criterion which involves selecting the alternative that corresponds to the maximum of the maximum payoff for each alternative row in the payoff table, a decision of producing 240,000 crates of Harp lime was arrived at. A decision of producing 180,000 crates which corresponds to the maximum of the minimum payoff was reached using the maximin criterion. Under the minimax regret criterion, a decision of producing 195,000 crates which corresponds to the minimum of the maximum regrets associated with producing an alternative instead of another was arrived at. The Laplace criterion helped arrive at a decision of producing 195,000 crates which corresponds to max $[E(a_i)]$. While the Hurwicz criterion demands that the producer produces 180,000 crates.

In conclusion, the maximax criterion demands that the producer should produce 240,000 crates, maximin criterion as well as the Hurwicz criterion demands the production of 180,000 crates, minimax regret and the Laplace criterion also demand the production of 195,000 crates of Harp lime. Based on the work carried, it is recommended that the producers should have used the Hurwicz criterion in reaching a decision on the quantity to be produced since it considers the most optimistic and pessimistic conditions for decision making.

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