What-if Analysis at a Food Service Operation

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Abstract

In this research work, a problem related to the most expensive cut that is purchase (Tenderloin) by food service operations company has been analyzed. The monthly relevant data such related to fixed and variable costs was collected. The monthly demand and average selling price of Tenderloin observed. The breakeven point, Sensitive analysis and Monte Carlo simulation were done. The risk associated with the loss (22%) has been observed and recommendations were given to enhance the price.

Keywords
What if analysis, food supply chain, Breakeven analysis, Sensitivity analysis and Monte Carlo simulation.

1. Introduction
The aim of this project is to conduct several what-if analyses, Most empirical studies indicate that farmers are risk neutral to slightly risk averse. It is doubtful whether decision makers could be classified according to their risk preferences. Proposed topics for agricultural risk research include the need for a strategic change and the effectiveness of decision support for different decision problems (Gul & Pesendorfer, 2008) in order to help a food service operation company in Saudi Arabia to plan for their procurement (Sen, 1998). By understanding the different possible scenarios and what could happen as a result for each of them, the management of the company could make a well-thought and sound decision, the integration of life-cycle assessment methods with a new input-output model of the world economy to analyze the environmental and economic implications of alternative future diets. It reviews findings by industrial ecologists about the energy and land required for the production and consumption of alternative foods and diets. (Duchin, 2005). The decision directly impacts the bottom-line of the company, as it will increase the revenues obtained (Liu & Lu, 2015). Three different analyses were conducted:

- Breakeven analysis
- Sensitivity analysis
- Monte Carlo Simulation

1.1. Objectives
The objective of this work is to help the management of the company determine whether or not to order a certain cut from a supplier to satisfy the monthly demand of the customers.

2. Methodology
To begin, we needed to understand the business side of the problem. We sat down with the Operations manager, and the Supply Chain Executive to understand how the process of purchasing work. We then agreed to tackle a single problem which is related to the most expensive cut they purchase (Tenderloin). Furthermore, we obtained all the relevant data such as all cost items whether it was Fixed Costs or Variable Costs. After that, we looked into the monthly

demand requested by the customers, and the average selling price for Tenderloin. Moreover, we figured out the Breakeven Point BEP, at which the total cost equals the total revenue (i.e., the profit is 0). Followed by the impact of changing the Quantity and Selling Price on the Profit. (Sensitivity Analysis). Finally, to ensure that overall, the order is profitable, we assumed a normal distribution for: Revenues, Fixed Costs and Variable Costs and conducted a Monte Carlo Simulation of 500 trials and gathered the basic information based on these trials.

3. Results and Discussion

Below are the inputs of our model, it's clear that if the company orders only 10 tons of Tenderloin a month, its net profit is expected to be 7000 SR. This is for one beef cut; however, the company does order several other products. Also, the selling price has to be set to 130 SR per Kg in average (Table 1).

Table 1. Tenderloin monthly forecast using What if analysis

Tenderloin – Monthly forecast	
What if analysis	
Selling price	1300
Quantity	10,000
Total Revenue	13,00,000
Transportation Cost	1,30,000
Item Cost	100
Total item cost	10,00,000
Warehouse	13,000
Rent	20,000
Salaries	1,20,000
General Overhead Cost	10,000
Total Cost	12,93,000
Profit	7,000

For breakeven, we have obtained the breakeven point for 2 different scenarios.

The first case is by changing the selling price. As we can see, if we sell at 129 SR per Kg the company will breakeven. Therefore, if the company knows in advance that the customers won't pay this much, or if there are competitors offering cheaper prices, then the decision is not to make this order (Figure 1).

Tenderlion - Monthly forecast	
What if analysis	
SellingPrice	129
Qty	10,000
Total Revenue	1,292,135
Transportation Cost	129,213
Item Cost	100
Total Item Cost	1,000,000
Warehouse	12,921
Rent	20,000
Salaries	120,000
General Overhead Cost	10,000
Total Cost	1,292,135
Profit	-

Figure 1. Breakeven point for first scenario

However, keeping the selling price fixed at 130 SR, we see that the company needs to sell 9,554 Kgs of Tenderloin monthly. Therefore, if the demand at a certain month will not be higher than this number, the company shouldn't make the order (figure 2).

Tenderlion - Monthly forecast	
What if analysis	
SellingPrice	130
Qty	9,554
Total Revenue	1,242,038
Transportation Cost	124,204
Item Cost	100
Total Item Cost	955,414
Warehouse	12,420
Rent	20,000
Salaries	120,000
General Overhead Cost	10,000
Total Cost	1,242,038
Profit	-

Figure 2. Breakeven point for second scenario

Conducting Sensitivity Analysis, the management can see the big picture and an overview of multiple scenarios at once. The red zone is the zone where the company can't be profitable, thus it should avoid these combinations of quantity and selling price. The green zone is the zone it should concertante on, and it should know how much each step affects the profit at the end. One step of increasing the selling price is more important than one step of increasing the quantity. Therefore, if the possibility of increasing only one is available to the company. Whether it is the price or increasing the quantity, then it should increase the price (if it will not affect demand negatively) (Figure 3).

		Selling Price						
	7000	120	122	124	126	128	130	132
Qty	8,000	(95,600)	(81,360)	(67,120)	(52,880)	(38,640)	(24,400)	(10,160)
	9,000	(88,800)	(72,780)	(56,760)	(40,740)	(24,720)	(8,700)	7,320
	10,000	(82,000)	(64,200)	(46,400)	(28,600)	(10,800)	7,000	24,800
	11,000	(75,200)	(55,620)	(36,040)	(16,460)	3,120	22,700	42,280
	12,000	(68,400)	(47,040)	(25,680)	(4,320)	17,040	38,400	59,760
	13,000	(61,600)	(38,460)	(15,320)	7,820	30,960	54,100	77,240
	14,000	(54,800)	(29,880)	(4,960)	19,960	44,880	69,800	94,720
	15,000	(48,000)	(21,300)	5,400	32,100	58,800	85,500	112,200
	16,000	(41,200)	(12,720)	15,760	44,240	72,720	101,200	129,680
	17,000	(34,400)	(4,140)	26,120	56,380	86,640	116,900	147,160

Figure 3. Chart showing Conductive Sensitivity Analysis

The final analysis was done using Monte Carlo Simulation, the expected revenues, FC and VC were forecasted based on the historical monthly data available. The standard deviation was also calculated, and then as it shows on the First Simulation, the profits were calculated (Figure 3).

	Revenue	FC	VC	
Expected	1,300,000	150,000	1,143,000	
Standard deviation	7,000	5,000	7,000	
				Profits
First Simulation	1,297,917	145,992	1,143,182	8,743

Figure 4. Expected Standard deviation and First Simulation

Then we ran the model for 500 other simulations, and figure 5 are the results for just the first 20 of them. Finally, we calculated basic statistics to help aid the decision making, in which we found out that 22% of the times ordering will not be profitable for the company (will yield loss instead of profit).

Trial	Profits
1	8,743
2	(9,173)
3	22,810
4	1,006
5	17,276
6	(14,798)
7	(3,872)
8	12,651
9	(5,436)
10	14,880
11	28,149
12	21,654
13	4,197
14	27,329
15	22,275
16	11,278
17	(4,252)
18	(12,302)
19	5,859
20	16,422

Mean	7,415
SD	10610.23
Min	(27,365)
Max	36,249
Risk of loss	22%

Figure 5. Basic statistics to help aid the decision making

4. Conclusions and Future Research

As per the above analysis, we recommend that the company make the order, as it will yield profit from it. However, it should try to increase the price if possible, and if not then increasing the demand will also increase their net profit. The risk associated with loss in this is only 22% which is moderate, but this is a decision for the managers to make. One way to improve and carry on this work is to conduct the same analysis for the full range of products (portfolio of products). The analyses conducted throughout this work has been very insightful to the directors at the food service operation company. Their decision before to order was not informed by data and powerful statistical insights, therefore in the past they have been barely profitable. Such analysis is expected to enhance their profitability in the near future. Alternative way is recommending to the company to change the way they do business by utilizing sea freight shipping for bigger quantities instead of air freight. Also, negotiations with the suppliers for better prices, as well as reducing the storage and delivery costs of their operations in Saudi Arabia.

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Biography

Dr. Sobhi Mejjaouli

possess several years of progressive experience in the Industrial and Systems Engineering fields and their applications. He is serving now as an Industrial Engineering Assistant Professor at Alfaisal University. Sobhi earned a Bachelor and Master Degree in Industrial Engineering from Ecole Nationale d'Ingenieurs de Tunis before joining the Systems Engineering Department at University of Arkansas at Little Rock, USA where he got his Phd. Sobhi qualifications and research are related to the fields of Engineering Economics, Operations Research and Optimization (Linear and non-linear programming, network and Dynamic Programming, heuristics..etc), C/C++ Programming, supply chain Management, and software like CPLEX, LINGO, ARENA and MATLAB.

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