



Modeling and Optimization

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TEAM ASSIGNMENT

Spring 2018

Instructions

This team assignment consists on the formulation and solution of a real life case study. It will be divided in two parts (delivered separately):

First Part: due by the 30th of March:

- Interpret and clearly explain the problem in its context and what is your aim;
- Define and formulate a model in linear programming – identify the objective function, decision variables, parameters and constraints;
- Use the Excel *Solver Add-in* to find the optimal solution(s), if they exist;
- Write a draft of the main results and of the report you would write for the client.

Second Part: due by the 15th May:

- Use sensitivity and/or what-if analysis as you see fit to postulate beyond the problem (make realistic assumptions and analyze what changes on the problem and solution you presented);
- Discuss the solutions that you have found and produce conclusions in the context of the problem;
- Write an ***Executive Summary*** (maximum 2 pages) intended for the client to understand the steps to take, and a ***Technical Report*** (maximum 10 pages) intended to show the work you did on the problem;
- Prepare an oral presentation of your completed work.

Approach the case as if you had been hired to manage the described situation and present solutions to be applied in the company. In the ***Executive Summary***, you should employ a business language, simple, straightforward and clear. Carefully consider the problem, present a solution and make some recommendations you think pertinent.

Regarding the delivery:

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- You should submit the First Part on *moodle* by the due date (30th of March, 11pm), uploading a digital copy of the draft report and the Excel file;
 - You should deliver a paper copy of the draft report in the first practical class immediately after the first due date (6th of April);
 - You should submit the finalized assignment on *moodle* by the due date (15th May, 1pm), uploading a digital copy of the Final Report (including the Executive Summary, the Technical Report and possible annexes) in .pdf format, and the Excel file;
 - You should deliver the finalized assignment at Prof. Bárcia's correspondence drawer - no.51 - in the 3rd floor 15th May (by 1pm) – two printed copies of the Final Report;
 - You should submit the Slides for your oral presentation in .ppt or .pdf formats on *moodle* by the day of the presentations (to be confirmed);
 - **Late submissions will not be accepted.**

Oral presentations will be scheduled to the last week of classes of the spring semester (the week of 15th May). Each group will present their work for no longer than 10 minutes, with resource to a PowerPoint presentation (or similar), and all the elements of the group must actively participate.

Case Study

Can & Will Canning Company

On Monday, August 26, 1990, Mr. Al E. Gater, Vice-President of Operations, asked the Controller, the Sales Manager and the Production Manager to meet with him to discuss the **amount of tomato products to pack that season**. The tomato crop, which had been purchased at planting, was beginning to arrive at the cannery, and packing operations would have to be started by the following Monday. Can & Will Canning was a medium-sized company that canned and distributed a variety of fruit and vegetable products under private brands in the western states of the USA.

Mr. Arty Fischel, the Controller, and Miss Dinah Myte, the Sales Manager, were the first to arrive at Mr. Gater's office. Justin Thyme, the Production Manager, came in a few minutes later and said that he had picked up Produce Inspection's latest estimate of the quality of the incoming tomatoes. **According to their report, about 20% of the crop was Grade "A" quality and the remaining portion of the 3 000 000-pound crop was Grade "B" quality.**

Gater asked Myte about the demand for tomato products for the coming year. Myte replied that they could sell all of the whole canned tomatoes they could produce. The expected demand for tomato juice and tomato paste, on the other hand, was limited. The Sales Manager then passed around the latest demand forecast, which is shown in the following table.

Demand Forecasts

Product	Selling Price per Case	Demand Forecast (Cases)
24 2 ¹ / ₂ whole tomatoes	\$4.00	800 000
24 2 ¹ / ₂ choice peach halves	5.40	10 000
24 2 ¹ / ₂ peach nectar	4.60	5 000
24 2 ¹ / ₂ tomato juice	4.50	50 000
24 2 ¹ / ₂ cooking apples	4.90	15 000
24 2 ¹ / ₂ tomato paste	3.80	80 000

She reminded the group that selling prices had been set in light of the long-term marketing strategy of the company, and potential sales had been forecasted at these prices.

Arty Fischel, after looking at Myte's estimates of demand, said that it looked like the company "should do quite well (on the tomato crop) this year". With the new accounting system that had been set up, he had been able to compute the contribution of each product, and according to his analysis the incremental profit on the whole tomatoes was greater than for any of the other tomato products. In May, after Can & Will had signed contracts agreeing to purchase the grower's production at an average delivered price of 6 cents per pound, Fischel had computed the tomato products' contributions as follows.

Product Item Profitability

Product	24 2 ¹ / ₂ Whole Tomatoes	24 2 ¹ / ₂ Choice Peach Halves	24 2 ¹ / ₂ Peach Nectar	24 2 ¹ / ₂ Tomato Juice	24 2 ¹ / ₂ Cooking Apples	24 2 ¹ / ₂ Tomato Paste
Selling Price	\$4.00	\$5.40	\$4.60	\$4.50	\$4.90	\$3.80
Variable Costs:						
Direct Labour	1.18	1.40	1.27	1.32	0.70	0.54
Variable OHD	0.24	0.32	0.23	0.36	0.22	0.26
Variable Selling	0.40	0.30	0.40	0.85	0.28	0.38
Packaging Mat'l	0.70	0.56	0.60	0.65	0.70	0.77
Fruit ^a	<u>1.08</u>	<u>1.80</u>	<u>1.70</u>	<u>1.20</u>	<u>0.90</u>	<u>1.50</u>
Total Variable Costs	<u>\$3.60</u>	<u>\$4.38</u>	<u>\$4.20</u>	<u>\$4.38</u>	<u>\$2.80</u>	<u>\$3.45</u>
Contribution	0.40	1.02	0.40	0.12	1.10	0.35
Less Allocated OHD	<u>0.28</u>	<u>0.70</u>	<u>0.52</u>	<u>0.21</u>	<u>0.75</u>	<u>0.23</u>
Net Profit	\$0.12	\$0.32	(\$0.12)	(\$0.09)	\$0.35	\$0.12

^aProduct usage is given as follows:

Product	Pounds per case
Whole Tomatoes	18
Choice Peach Halves	18
Peach Nectar	17
Tomato Juice	20
Cooking Apples	27
Tomato Paste	25

Justin Thyme brought to Fischel's attention that, although there was ample production capacity, it was impossible to produce all whole tomatoes as too small a portion of the tomato crop was "A" quality. Can & Will used a numerical scale to record the the quality of both raw produce and prepared products. This scale ran from zero to ten, the higher number representing better quality. Rating tomatoes according to this scale, "A" tomatoes averaged nine points per pound and "B" tomatoes averaged five points per pound. Thyme noted that the minimum average input quality for canned whole tomatoes was eight and for juice it was six points per pound. Paste could be made entirely from "B" grade tomatoes. This meant that whole tomato production was limited to 800 000 pounds.



Gater stated that this was not a real limitation. He has been recently solicited to purchase 80 000 pounds of Grade "A" tomatoes at 8½ cents per pound and at that time turned down the offer. He felt, however, that the tomatoes were still available.

Myte, who had been doing some calculations, said that although she agreed that the company "should do quite well this year", it would not be by canning whole tomatoes. It seemed to her that the tomato cost should be allocated on the basis of quality and quantity rather than by quantity only as Fischel had done. Therefore, she had recomputed the marginal profit on this basis, and from her results, Can & Will should use 2 000 000 pounds of the "B" tomatoes for paste, and the remaining 400 000 pounds of "B" tomatoes and all of the "A" tomatoes for juice. If the demand expectations were realized, a contribution of \$48 000 would be made on this year's tomato crop.

Marginal Analysis of Tomato Products

Z=Cost per pound of A tomatoes in cents			
Y=Cost per pound of B tomatoes in cents			
1. $(600\ 000\ \text{lb} * Z) + (2\ 400\ 000\ \text{lb} * Y) = (3\ 000\ 000\ \text{lb} * 6)$			
2. $\frac{Z}{9} = \frac{Y}{5}$			
Z=9.32 cents per pound			
Y=5.18 cents per pound			
Product	Canned Whole Tomatoes	Tomato Juice	Tomato Paste
Selling Price	\$4.00	\$4.50	\$3.80
Variable Cost:			
(excl. tomato costs)	<u>2.52</u>	<u>3.18</u>	<u>1.95</u>
	\$1.48	\$1.32	\$1.85
Tomato Cost	<u>1.49</u>	<u>1.24</u>	<u>1.30</u>
Marginal Profit	(\$0.01)	\$0.08	\$0.55