JUICING THE NUMBERS

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Part 2: Processing Operations

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Pure Fresh Processing

Introduction
Underpinning Pure Fresh's success is their efficiency in processing. Critical to this end is visibility of the operations on the ground. It is the intention of this report to identify operational constraints and recommend solutions to alleviate them.

Methodology
As directed by the Client, the model was developed incrementally. The model was built in 5 stages as follows;
1. Base model, dictated by the constitution of juices, and their cost, in addition to the demand anticipated. Utilising this information, in addition to sale cost we generated a processing cost across the eight quarters to come.
2. The second model incorporated the limitation that fruit concentrate was trucked in, one fruit at a time.
3. The third model restricted juice production to only two gourmet juices each quarter.
4. Subsequently, the client requested the model to ensure that one juice was not out of production for more than one quarter in a row. This was implemented in the fourth model.
5. The final communication from Pure Fresh asked us to optimise their deliveries.

Results

MODEL 1
The profit from Pure Fresh's operations in the Base model is $26, 240, 835.76. The optimal production profile is detailed in Table 1.

Table 1 - Juice in kL

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Orange Juice	880	872	1206	981	781	1055	1420	1236
Orange and MangoJuice	311	347	469	389	329	363	484	568

Breakfast Juice	682	707	838	938	586	788	1141	988
Tropical Juice	492	586	726	739	450	549	645	779
Guava Delight	340	459	593	393	276	424	559	389
Orchard Medley	1151	621	697	909	1133	615	542	865
Strawberry Surprise	625	740	468	409	665	750	411	464

MODEL 2

Following the restriction regarding the trucking in of concentrate, processing operations were remodeled. The effects of that implementation are seen in Table 2. Furthermore, the change in production between the base model and the model with the trucking limitation, is detailed for each juice for each quarter in Table 3. The greatest change in production will be in the first Quarter. Optimal trucking operations are detailed in Table 4.

The total profit for Model 2 is $26, 065, 452.96

Table 2

kL	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	TOTAL
Orange Juice	900	872	1206	981	781	1055	1420	1236	8451
Orange and Mango Juice	289	347	469	389	316	363	484	568	3225
Breakfast Juice	672	707	838	938	586	788	1141	988	6658
Tropical Juice	492	586	720	738	450	549	645	779	4959
Guava Delight	340	452	593	393	276	424	559	389	3426
Orchard Medley	1151	621	697	909	1131	615	542	865	6531
Strawberry Surprise	625	740	464	405	665	747	411	462	4519
TOTAL	4469	4325	4987	4753	4205	4541	5202	5287	

Table 3

Change in Production in kL	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Orange Juice	20	0	0	0	0	0	0	0
Orange and Mango Juice	-22	0	0	0	-13	0	0	0
Breakfast Juice	-10	0	0	0	0	0	0	0
Tropical Juice	0	0	-6	-1	0	0	0	0
Guava Delight	0	-7	0	0	0	0	0	0
Orchard Medley	0	0	0	0	-2	0	0	0
Strawberry Surprise	0	0	-4	-4	0	-3	0	-2

Table 4

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Apple	210	211	217	213	200	211	214	221
Mango	10	8	10	11	10	9	10	12
Pineapple	37	42	51	53	33	43	57	55
Passionfruit	1	1	1	1	1	1	1	1
Guava	5	6	7	5	5	6	7	5
Strawberry	5	6	4	4	6	6	4	4

MODEL 3
Upon the limitation that only two gourmet juices could be produced per quarter, the optimal processing operation was modeled. The output of that model is found in Table 5 and 6. The selection of gourmet juices is found in Table 7. The change in processing cost is detailed in Table 8. This represents the difference in kilo litres of production between Model 2 and Model 3. This change was selected because the comparison between this model and the Base model is largely redundant, considering that trucking is an unavoidable reality of Pure Fresh operations. Naturally, considering the limitation of this model, the greatest reduction in production was seen amongst gourmet juices Guava Delight and Strawberry Surprise.

The profit, upon this limitation was found to be $23, 426, 440.25, representing a 10.73% reduction in profit from Model 2.

Table 5

kL	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	TOTAL
Orange Juice	900.00	872	1206	981	781	1055	1420	1236	8451
Orange and Mango Juice	291	347	469	389	316	363	484	568	3227
Breakfast Juice	682	707	838	938	586	787	1141	986	6665
Tropical Juice	492	586	721	739	450	549	645	779	4961
Guava Delight	0	0	589	393	0	0	559	0	1541
Orchard Medley	1145	621	697	909	1133	615	542	865	6527
Strawberry Surprise	625	740	0	0	665	746	0	464	3240
TOTAL	4135	3873	4520	4349	3931	4115	4791	4898	

Table 6

kL of Concentrate	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Apple	183	175	175	177	178	176	177	190
Mango	10	8	10	11	10	9	10	12
Pineapple	34	38	50	53	30	38	57	51
Passionfruit	1	1	1	1	1	1	1	1
Guava	2	2	6	4	2	2	6	1
Strawberry	5	6	0	0	5	6	0	4

Table 7

Production Y/N	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Guava Delight	N	N	Y	Y	N	N	Y	N
Orchard Medley	Y	Y	Y	Y	Y	Y	Y	Y
Strawberry Surprise	Y	Y	N	N	Y	Y	N	Y

Table 8

Change in kL	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Orange Juice	0	0	0	0	0	0	0	0
Orange and Mango Juice	2	0	0	0	0	0	0	0
Breakfast Juice	10	0	0	0	0	-1	0	-2
Tropical Juice	0	0	1	1	0	0	0	0
Guava Delight	-340	-452	-4	0	-276	-424	0	-389
Orchard Medley	-6	0	0	0	2	0	0	0
Strawberry Surprise	0	0	-464	-405	0	-1	-411	2

MODEL 4

Model 4 involved restricting production of gourmet juice such that any gourmet juice was not out of production for consecutive quarters.

The profit following this restriction, was $23, 206, 547.65.

The detailed optimal production and truck operation plan is detailed in Table 9 and 10. The selection of gourmet juices is indicated in Table 11. The change between these production costs and those in Model 2, is detailed in Table 12. This decision reduces the profit by $219, 892.6 which is obviously quite significant.

Table 9

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Orange Juice	900	872	1206	981	781	1055	1420	1236
Orange and Mango Juice	291	347	469	389	316	342	484	568
Breakfast Juice	682	707	829	938	586	788	1141	986
Tropical Juice	492	586	726	739	450	549	645	779
Guava Delight	0	452	0	393	0	424	559	0
Orchard Medley	1145	0	697	909	1133	0	542	865
Strawberry Surprise	625	740	468	0	665	750	0	464
TOTAL	4135	3704	4395	4349	3931	3908	4791	4898

Table 10

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8

Apple	183	180	170	177	178	181	177	190
Mango	10	5	10	11	10	5	10	12
Pineapple	34	42	44	53	30	43	57	51
Passionfruit	1	1	1	1	1	1	1	1
Guava	2	6	1	4	2	6	6	1
Strawberry	5	6	4	0	6	6	0	4

Table 11

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Guava Delight	N	Y	N	Y	N	Y	Y	N
Orchard Medley	Y	N	Y	Y	Y	N	Y	Y
Strawberry Surprise	Y	Y	Y	N	Y	Y	N	Y

Table 12

Net Change	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Orange Juice	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Orange and Mango Juice	2.00	0.00	0.00	0.00	0.00	-21.00	0.00	0.00
Breakfast Juice	10.00	0.00	-9.00	0.00	0.00	0.00	0.00	-2.00
Tropical Juice	0.00	0.00	6.00	1.00	0.00	0.00	0.00	0.00
Guava Delight	-340.00	0.00	-593.00	0.00	-276.00	0.00	0.00	-389.00
Orchard Medley	-6.00	-621.00	0.00	0.00	2.00	-615.00	0.00	0.00
Strawberry Surprise	0.00	0.00	4.00	-405.00	0.00	3.00	-411.00	2.00

MODEL 5

Pure Fresh were able to optimise their cost of delivery in Model 5. The optimal delivery route is seen in Figure 1 and the cost of that route is $725.

Figure 1
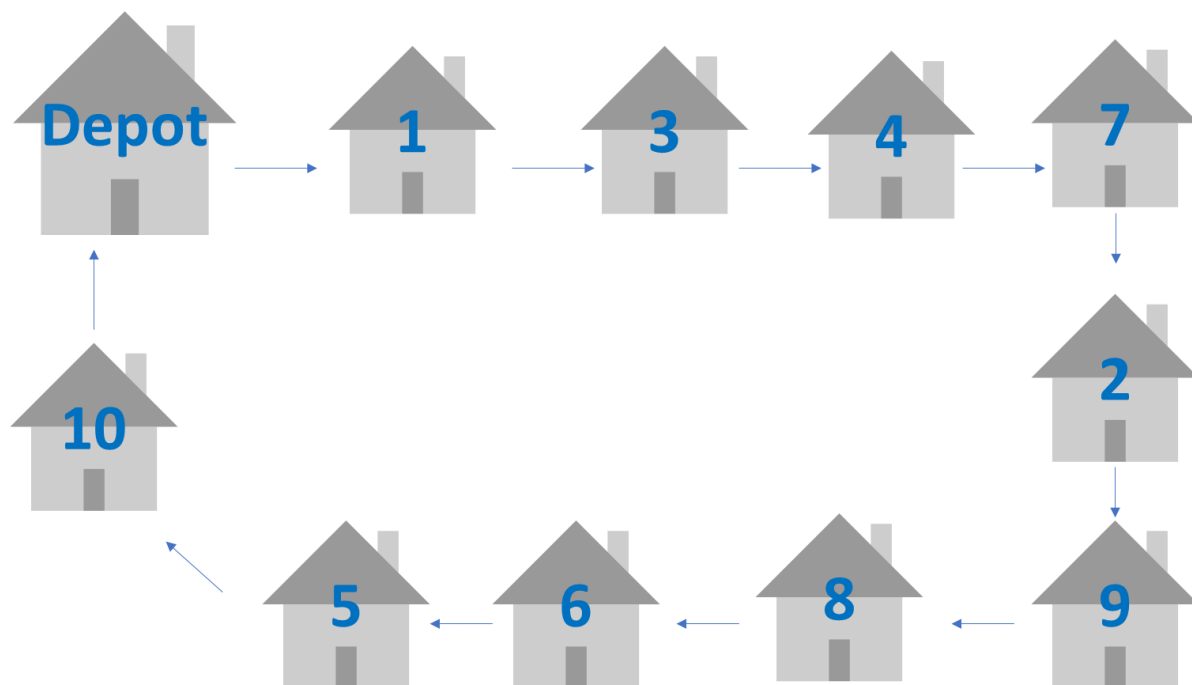
Recommendations and Insights

1. Brisbane Sensitivity Analysis
   As can be seen in Table 13 the supply of orange juice concentrate is a constraint, of significant value, in the first quarter of operations.
   Pure Fresh should consider increasing the initial supply in order to increase profit. Note that this is from the original model, before the trucking is taken into account.

   Table 13

Brisbane supply sensitivity analysis (Pi)								
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Pi	526	0	0	0	0	0	0	0

   The final model is even more constrained by Brisbane supply of orange juice concentrate, as seen in Table 14.
   This is logical, considering that increasing production naturally increases sales. Of particular important to Pure Fresh is the time that this is most important. For example, maximising supply in the second quarter, perhaps at the expense of the first quarter could prove prudent.

Table 14

Brisbane supply sensitivity analysis (Slack)								
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Slack	0	786	404	489	68	446	303	384

2. Pi Analysis

The shadow price of each juice across each quarter is detailed in Table 15. This price represents the value an increase in production would generate for each juice for each quarter, per kilolitre.

Clearly then, Pure Fresh should focus on unlocking Guava Delight and Strawberry Surprise first across all quarters as they represent the most value to be gained from an increase in demand.

Table 15

Demand sensitivity analysis (Pi)								
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Orange Juice	0	526	526	526	526	526	526	526
Orange and Mango Juice	19	493	493	493	493	493	493	493
Breakfast Juice	684	762	762	762	762	762	762	762
Tropical Juice	782	803	803	803	803	803	803	803
Guava Delight	853	853	853	853	853	853	853	853
Orchard Medley	450	686	686	686	686	686	686	686
Strawberry Surprise	818	818	818	818	818	818	818	818

3. Slack Analysis

Table 16 represents the wastage in the optimal solution.

With this understanding on the operations, Pure Fresh should seek to offload the excess product predicted by the model in some way.

Table 17 highlights the waste of each fruit, in kL, each quarter. Because trucks are transported full, with not all of that fruit being used, there is moderately significant waste each quarter. With that information, Pure Fresh should seek to use the fruit in some other capacity, or consider changing the recipe in order to minimise waste.

Table 16

Demand sensitivity analysis (Slack)								
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Orange Juice	72	0	0	0	0	0	0	0
Orange and Mango Juice	20	0	0	0	12	20	0	0
Breakfast Juice	0	0	8	0	0	0	0	1
Tropical Juice	0	0	0	0	0	0	0	0
Guava Delight	340	6	593	0	276	0	0	389
Orchard Medley	5	621	0	0	0	615	0	0
Strawberry Surprise	0	0	0	409	0	0	411	0

Table 17

Truck capacity (10) (Slack)								
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Apple	0	2.65	2.29	4.85	0.2	5.55	5	0.82
Mango	0	1.16	1.66	6.89	0	0	1.68	0.21
Pineapple	1.44	1.04	0	6.36	0.92	2.26	1.12	0
Passionfruit	5.08	4.14	2.74	2.61	5.5	4.51	3.55	2.21
Guava	7.5	0	0.64	0.7	6.7	2.6	4.1	0.72
Strawberry	0	0.8	2.56	0	6.8	0	0	2.88

4. Sensitivity Analysis

For Model Two, we were able to test the model to discover which juices' production could be reduced while maintaining the same amount of profit. As can be seen in Table 18 and 19, this only occurred in Quarter 1 for both supply and demand. This further emphasises just how critical the demand and production is to Pure Fresh's profit.

Table 18

Production sensitivity analysis (SAObjLow) for Model 2								
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Orange Juice	0	0	0	0	0	0	0	0
Orange and Mango Juice	473	0	0	0	0	0	0	0
Breakfast Juice	78	0	0	0	0	0	0	0
Tropical Juice	21	0	0	0	0	0	0	0
Guava Delight	0	0	0	0	0	0	0	0

Orchard Medley	236	0	0	0	0	0	0	0
Strawberry Surprise	0	0	0	0	0	0	0	0

Table 19

Demand supply sensitivity analysis (SARHSLow)								
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Orange Juice	880	0	0	0	0	0	0	0
Orange and Mango Juice	207	0	0	0	0	0	0	0
Breakfast Juice	63	0	0	0	0	0	0	0
Tropical Juice	0	0	0	0	0	0	0	0
Guava Delight	0	0	0	0	0	0	0	0
Orchard Medley	944	0	0	0	0	0	0	0
Strawberry Surprise	0	0	0	0	0	0	0	0