Tropicana

Project #1

Pricing Decisions for Tropicana Orange Juice

Group Number: #4

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Honor Pledge:
We pledge on our honor that we have not given or received any unauthorized assistance on this assignment.

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Executive Summary

ABC Super decided to change its pricing strategy in order to be more competitive in the juice market. This memo explores the aspects of the profit optimization scenario of a single bestseller product, 'Tropicana Orange Juice 64 oz'. In the 'Introduction and Background' section, a brief about the background of the problem is given, followed by the 'Data and Methodology' section. The overview of data and methods to determine the best fitting model are documented. 'Key Findings' consist of the determining optimal price, **$3.19**, and expected profit in Week 105. At the end of this memo, suggestions about advertising placement and inventory are proposed, followed by Appendices.

Introduction and Background

Originating from the Midwest, ABC Super is now one of the biggest grocery chains in the Midwest market, expanding to 15 stores. Tropicana 64 oz accounts for most of the ABC supers' revenue among juice categories and is one of its bestsellers. Historically, the products' price was set indiscriminately by the managers of each store. In this manner, pricing might have either underestimated or overestimated the overall gross profit.

As a higher number of juice companies are now entering ABC Super's juice category, sale of Tropicana is more vulnerable now than ever. Nick, the regional head of the retail, reached out to the research team and hoped to standardize and set an optimal price for their once most profitable product, 'Tropicana 64 oz', to maximize sales and gross profit across all the 15 chain stores.

Data and Methodology

Overview of the dataset: Dataset that included information about five variables (store, price, quantity, deal, and week) among a timeline of 2 years (2009-2010) was used for sales analysis by SAS. Frequency, mean, and correlation tables among different variables were generated. The purchase data consists of 1560 observations from 15 stores within the timeline of 104 weeks (Table 1). Around 70% of the purchases occurred when there were some in-store displays or advertising for the product going on (Table 2). On average, 40914.54 ounces of juice were sold across the stores (Table 3). The lowest amount of juice sales was around 2112 ounces (roughly 33 bottles) & the highest accounts for 11864496 ounces. The price per bottle was, on average, **$3.6** across the stores with a varying range of +/- **$0.35.** The highest price charged for a bottle was **$4.18** & the lowest was **$2.74.** The analysis indicates that **Store#62** had a relatively consistent sales performance with the minimum standard deviation **(19671.72 ounces)** across the duration whereas **Store#17** had too much variation in sales with the maximum standard deviation **(125736.49 ounces),** which indicates an inconsistent sales pattern across the same duration (Table: 4) It was observed that the correlation coefficient of quantity and price is **-0.38**, which indicates that when price increases by $1, sales quantity drops by **38%** (Table: 5) which is statistically significant.

Determining the variables: The research team ran 1 linear regression, 99 semi-log, and 99 log-log models in SAS. Firstly, linear regression is conducted to understand the relationship between sales quantity and price (the independent variable). The '**quantity**' data was converted to **#of bottles** from ounces as the unit of price in the dataset was $/bottle. Even though results indicate that the p-value of price is less than 0.05, the histogram is right-skewed and both tails deviate from the reference line in the Q-Q plot, indicating that data is not normally distributed. Therefore, the research team linearizes the model by applying logarithm to variables. Various versions of semi-log and log-log models were run with different combinations of variables. To detect whether **week** influences **quantity**, **week** is included as a continuous variable in models. To reconfirm the parameter estimates, each week is put as a dummy variable into account as well (Appendix: Robustness Check). Also, weeks are grouped into quarters as **Quarter 1-3** (Quarter 4 as the base) and months as **Month 1-11** (Month 12 as the base) to explore the correlation with **quantity.** There is no inclusion of Quarter 1-3 and Month 1-11 together in one model to avoid collinearity. To analyze how each store influences sales, Store1-14 (Store 15 as the base) as dummies represent 15 stores. **End9** indicates whether the price ended in 9, tempting people to make a purchase. Year1 dummy is also grouped by week to explore the year's influence on quantity.

Key Findings

Based on Adjusted R square and p-values, the semi-log model with variable **Price**, **Deal**, **Store 1-14**, **end9**, **Week**, **Year1** and **Quarter 1-3** was considered as the best-fitting model initially (Adj. R-Square of 0.4865). However, when it came to predicting sales and profit of **Week105**, it was deemed ineffective as the dummy **Year1** cannot help predicting year 3. Later, the semi-log model with variable **Price**, **Deal**, **Store 1-14**, **end9**, **Week**, and **Quarter 1-3** was determined as the best-fitting model with a high adj. R-Square of **0.4740**. The equation of the best-fitting model:

$$\mathbf{ln}=a+b1(P)+b2(Store1)+\ldots+b15(Store14)+b16(Deal)+b17(end9)+b18(Week)+b19(qrt1)+\ldots+b21(qrt3)$$

For Store1-14, P-value<0.05, referring to statistical significance and the parameters, are also negative. It indicates that Store1 to 14 have a less impact on sales quantity than the baseline Store15. Moreover, if the price increased by $1, the sales quantity would drop by 78.5%. The End9 parameter, 0.19, points out that the End9 price-setting causes a 20.62% increase in sales. When Deal is placed, it will increase by 8.4% sales. As time goes by, the sales increase 0.3% more every week. Quarter 1, 2, and 3 influence sales less than Quarter 4 (baseline) (Table: 6).

By using the best-fit model, the optimal price is deduced using: P*=Ct-(1/b) equation. Here, **Ct**(the wholesale price charged by the manufacturer to the retailer)= **$2.57**/bottle. **b(**Price coefficient)= -1.53699. So, the optimal price **P*=**2.57-(1/-1.53699)**= $3.22.** As coefficient **End9** is **0.19** and is statistically significant, it is likely to increase sales. So, the suggestion will be to adjust the optimal price of $3.22 to a price ending in 9, which is likely to be **$3.19** or **$3.29.**

To predict the gross profit in week105, it is assumed that the price elasticity will remain the same. There will be no offer/special promotion by the retailer. From the model, it is deduced that when the price is $3.19, **the #of bottles sold = 17,829.8**, and the overall **profit = $11,054.** When the price is $3.29, **the #of bottles sold = 15,289.6**, and the overall **profit = $11,008**. (Table: 7-9) Based on this analysis, it can be said that **$3.19** is the optimal price for the prediction of future sales.

Conclusions and Recommendations

Increased Promotional Efforts with Focused In-store Advertising For Critical Stores:
From the pricing model, it is evident that the deal factor positively affects the #of bottles sold. E.g., in Week105, it can be seen that if each store displays and has feature advertising, the #of bottles sold increases by 1504, and the gross profit rises by $933, which is 11.2% higher than without promotions. In case of a limited budget for promotions, picking the stores with low sales performance first is recommended. For instance, after promotion in store 1(code=2) and store 10 (code=59), the two least sold stores, the total sales increased by 0.8%, asnd the gross profit increased by 1.1%. (Table: 10). The team noticed that Quarter 4 has the least sales in both years, so a promotional budget should also be allocated for this quarter.

Strategic Inventory Planning:
Inventory plays an essential role in retail sales. If stores do not have enough Products (Tropicana 64 oz) in stock, ABC Super may lose sales revenue. Instead of distributing products evenly to each store, the predicted #**of bottles** sold in week 105 should be considered for a more strategic distribution. (Table: 7-9). E.g., the data indicates that Store 15 (code=137) might have more sales than other stores, and more potential customers can be around it, so more products should be kept in stock for Store 15 (code=137).

Although the team successfully found the optimal price that could maximize the gross profit for Tropicana 64 oz sales, there were some limitations to conduct further research and marketing analysis, planning.

1. Competitors are a critical factor in pricing strategy. As there was no data on competitor brand sales, the analysis falls short in predicting the impact and effect of other brands' sales, pricing & promotions on Tropicana's sales.
2. Additional customer data such as the average number of purchases, advertising method, placement of the juice on the shelf, retailer loyalty program, etc., should also be considered to understand customers' preferences better and try other strategies to boost sales.

Appendices: Tables, Exhibits, Figures

- **Table 1: Frequency Table of Stores**

store	Frequency	Percent	Cumulative Frequency	Cumulative Percent
2	104	6.67	104	6.67
14	104	6.67	208	13.33
32	104	6.67	312	20.00
52	104	6.67	416	26.67
62	104	6.67	520	33.33
68	104	6.67	624	40.00
71	104	6.67	728	46.67
72	104	6.67	832	53.33
93	104	6.67	936	60.00
95	104	6.67	1040	66.67
111	104	6.67	1144	73.33
123	104	6.67	1248	80.00
124	104	6.67	1352	86.67
130	104	6.67	1456	93.33
137	104	6.67	1560	100.00

- **Table 2: Frequency Table of Deal**

The FREQ Procedure

deal	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	475	30.45	475	30.45
1	1085	69.55	1560	100.00

- **Table 3: Mean Table of Quantity and Price**

The MEANS Procedure

Variable	N	Mean	Std Dev	Minimum	Maximum
quant	1560	40914.54	49216.14	2112.00	1186496.00
price	1560	3.6021218	0.3507742	2.7400000	4.1800000

- **Table 4: Mean Table of Quantity and Stores**

The MEANS Procedure

Analysis Variable : quant						
store	N Obs	N	Mean	Std Dev	Minimum	Maximum
2	104	104	27818.79	21659.02	5440.00	161024.00
14	104	104	31783.38	22349.88	2304.00	129152.00
32	104	104	46072.62	37474.19	11264.00	241920.00
52	104	104	38584.09	28021.35	8704.00	153472.00
62	104	104	33152.66	19671.72	10304.00	96192.00
68	104	104	34583.60	29465.33	6080.00	186368.00
71	104	104	54601.24	125736.49	2112.00	1186496.00
72	104	104	37563.69	32008.22	8320.00	199744.00
93	104	104	35760.27	37676.50	7552.00	309696.00
95	104	104	29345.85	31458.89	4608.00	223424.00
111	104	104	51078.77	63980.04	3648.00	371200.00
123	104	104	46139.08	45463.95	6400.00	280448.00
124	104	104	35575.38	33062.36	3648.00	216704.00
130	104	104	46978.69	49490.24	4032.00	290560.00
137	104	104	64680.00	42209.46	13632.00	216256.00

- **Table 5: Table of Pearson Correlation Coefficients**

Pearson Correlation Coefficients, N = 1560 Prob > |r| under H0: Rho=0					
	quant	price	week	deal	store
quant	1.00000	-0.38243 <.0001	0.02307 0.3625	0.10467 <.0001	0.10894 <.0001
price	-0.38243 <.0001	1.00000	0.02946 0.2449	-0.34247 <.0001	-0.03940 0.1198
week	0.02307 0.3625	0.02946 0.2449	1.00000	-0.19639 <.0001	0.00000 1.0000
deal	0.10467 <.0001	-0.34247 <.0001	-0.19639 <.0001	1.00000	-0.01993 0.4315
store	0.10894 <.0001	-0.03940 0.1198	0.00000 1.0000	-0.01993 0.4315	1.00000

- **Robustness Check**

```
model lq = price Week1-Week103;   /* semi-log models week*/
model lq = price Week1-Week103 deal;   /* semi-log models week deal*/
model lq = price store1-store14 Week1-week103 ;          /* semi-log models store week*/
model lq = price store1-store14 Week1-week103 deal;     /* semi-log models store week deal*/
model lq = lp Week1-week103 ;   /* log-log models week*/
model lq = lp deal;   /* log-log models week deal*/
model lq = lp store1-store14 Week1-week103;            /* log-log models store week*/
model lq = lp store1-store14 Week1-week103 deal;     /* log-log models store week deal*/
```

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	15.69151	0.19436	80.73	<.0001
price	1	-1.52556	0.05074	-30.06	<.0001
deal	1	0.05986	0.03867	1.55	0.1218

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	14.14268	0.36041	39.24	<.0001
price	1	-0.92621	0.09887	-9.37	<.0001
deal	1	0.07382	0.05342	1.38	0.1673

- **Table 6: Table of Parameter Estimates**

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	11.76259	0.20390	57.69	<.0001
store1	1	-0.84167	0.08609	-9.78	<.0001
store2	1	-0.60828	0.08626	-7.05	<.0001
store3	1	-0.32561	0.08616	-3.78	0.0002
store4	1	-0.43938	0.08620	-5.10	<.0001
store5	1	-0.54540	0.08615	-6.33	<.0001
store6	1	-0.63595	0.08615	-7.38	<.0001
store7	1	-0.68151	0.08609	-7.92	<.0001
store8	1	-0.55560	0.08616	-6.45	<.0001
store9	1	-0.54498	0.08625	-6.32	<.0001
store10	1	-0.90890	0.08618	-10.55	<.0001
store11	1	-0.61230	0.08620	-7.10	<.0001
store12	1	-0.48004	0.08611	-5.57	<.0001
store13	1	-0.66697	0.08613	-7.74	<.0001
store14	1	-0.62804	0.08611	-7.29	<.0001
price	1	-1.53699	0.04952	-31.04	<.0001
deal	1	0.08074	0.03750	2.15	0.0315
end9	1	0.18746	0.03882	4.83	<.0001
week	1	0.00347	0.00063152	5.50	<.0001
qrt1	1	0.21152	0.05037	4.20	<.0001
qrt2	1	0.17588	0.04756	3.70	0.0002
qrt3	1	0.14630	0.04534	3.23	0.0013

- **Table 7: Expected ln(sales) in Week 105**

Store	at P = 3.22	at P=3.09	at P = 3.19	at P = 3.29
Store 1 (code=2)	6.548	6.748	6.781	6.627
Store 2 (code=14)	6.782	6.982	7.015	6.861
Store 3 (code=32)	7.064	7.264	7.297	7.143
Store 4 (code=52)	6.951	7.151	7.184	7.030
Store 5 (code=62)	6.845	7.045	7.078	6.924
Store 6 (code=68)	6.754	6.954	6.987	6.833
Store 7 (code=71)	6.708	6.908	6.941	6.787

Store 8 (code=72)	**6.834**	**7.034**	**7.067**	**6.913**
Store 9 (code=93)	**6.845**	**7.045**	**7.078**	**6.924**
Store 10 (code=95)	**6.481**	**6.681**	**6.714**	**6.560**
Store 11 (code=111)	**6.778**	**6.978**	**7.011**	**6.857**
Store 12 (code=123)	**6.910**	**7.110**	**7.143**	**6.989**
Store 13 (code=124)	**6.723**	**6.923**	**6.956**	**6.802**
Store 14 (code=130)	**6.762**	**6.962**	**6.995**	**6.841**
Store 15 (code=137)	**7.390**	**6.053**	**7.623**	**7.469**

- **Table 8: Expected sales in Week 105 (in bottles)**

Store	**at P = 3.22**	**at P=3.09**	**at P = 3.19**	**at P = 3.29**
Store 1 (code=2)	697.7	852.0	880.9	755.4
Store 2 (code=14)	881.7	1076.7	1113.1	954.5
Store 3 (code=32)	1168.9	1427.4	1475.7	1265.5
Store 4 (code=52)	1044.0	1274.9	1318.1	1130.3
Store 5 (code=62)	939.0	1146.7	1185.5	1016.6
Store 6 (code=68)	857.3	1046.9	1082.4	928.2
Store 7 (code=71)	818.8	999.9	1033.7	886.4
Store 8 (code=72)	928.7	1134.1	1172.5	1005.5
Store 9 (code=93)	939.0	1146.7	1185.5	1016.6
Store 10 (code=95)	652.5	796.8	823.8	706.4
Store 11 (code=111)	878.1	1072.4	1108.7	950.7
Store 12 (code=123)	1002.0	1223.7	1265.1	1084.9
Store 13 (code=124)	831.1	1015.0	1049.3	899.8
Store 14 (code=130)	864.2	1055.3	1091.1	935.6
Store 15 (code=137)	1619.4	425.2	2044.5	1753.2
Total	**14122.4**	**15693.5**	**17829.8**	**15289.6**

- **Table 9: Expected Gross Profit in Week 105**

Store	at P = 3.22	at P=3.09	at P = 3.19	at P = 3.29
Store 1 (code=2)	453.51	553.81	546.14	543.87
Store 2 (code=14)	573.08	699.82	690.13	687.26
Store 3 (code=32)	759.77	927.81	914.95	911.15
Store 4 (code=52)	678.59	828.67	817.19	813.79
Store 5 (code=62)	610.34	745.33	735.00	731.95
Store 6 (code=68)	557.25	680.50	671.07	668.28
Store 7 (code=71)	532.20	649.91	640.90	638.23
Store 8 (code=72)	603.66	737.18	726.96	723.94
Store 9 (code=93)	610.34	745.33	735.00	731.95
Store 10 (code=95)	424.12	517.92	510.75	508.62
Store 11 (code=111)	570.79	697.03	687.37	684.51
Store 12 (code=123)	651.33	795.39	784.36	781.10
Store 13 (code=124)	540.24	659.73	650.59	647.88
Store 14 (code=130)	561.73	685.97	676.46	673.65
Store 15 (code=137)	1052.60	276.39	1267.59	1262.32
Total	**$9,180**	**$10,201**	**$11,054**	**$11,008**

- **Table 10: Comparison of stores with or without deal in sales and gross profit**

	ln(sales)			sales in bottle			Gross Profit		
Store	**Deal=0**	**Deal=1**	**Store 1 store 10 deal=1**	**Deal=0**	**Deal=1**	**Store 1 store 10 deal=1**	**Deal=0**	**Deal=1**	**Store 1 store 10 deal=1**
Store 1 (code=2)	6.781	6.862	6.862	880.87	955.19	955.19	546.14	592.22	592.22
Store 2 (code=14)	7.015	7.096	7.015	1113.11	1207.02	1113.11	690.13	748.35	690.13
Store 3 (code=32)	7.297	7.378	7.297	1475.73	1600.24	1475.73	914.95	992.15	914.95
Store 4 (code=52)	7.184	7.265	7.184	1318.05	1429.26	1318.05	817.19	886.14	817.19
Store 5 (code=62)	7.078	7.159	7.078	1185.49	1285.51	1185.49	735.00	797.02	735.00
Store 6 (code=68)	6.987	7.068	6.987	1082.37	1173.69	1082.37	671.07	727.69	671.07

Store 7 (code=71)	6.941	7.022	6.941	1033.71	1120.93	1033.71	640.90	694.97	640.90
Store 8 (code=72)	7.067	7.148	7.067	1172.52	1271.45	1172.52	726.96	788.30	726.96
Store 9 (code=93)	7.078	7.159	7.078	1185.49	1285.51	1185.49	735.00	797.02	735.00
Store 10 (code=95)	6.714	6.795	6.795	823.79	893.29	893.29	510.75	553.84	553.84
Store 11 (code=111)	7.011	7.092	7.011	1108.66	1202.20	1108.66	687.37	745.37	687.37
Store 12 (code=123)	7.143	7.224	7.143	1265.10	1371.84	1265.10	784.36	850.54	784.36
Store 13 (code=124)	6.956	7.037	6.956	1049.33	1137.87	1049.33	650.59	705.48	650.59
Store 14 (code=130)	6.995	7.076	6.995	1091.07	1183.12	1091.07	676.46	733.53	676.46
Store 15 (code=137)	7.623	7.704	7.623	2044.50	2217.00	2044.50	1267.59	1374.54	1267.59
			Total	**17,830**	**19,334**	**17,974**	**$11,054**	**$11,987**	**$11,144**