

Assignment 3: Product line pricing

Overview of setting and data

Your marketing-analytic consulting task is to conduct a base pricing analysis for P&G's flagship laundry detergent brand, Tide. The main questions to address are:

1. What is the extent of cannibalization within the Tide product line?
2. Does Tide face a competitive threat from Wisk?
3. How do you evaluate the current pricing tactics? Do you recommend changes?

You have access to scanner data in the laundry detergent category across 86 stores of a retail chain in Chicago. The data are in the file `Detergent.RData` (the file is available on Canvas). The data include weekly sales and price information for three products — Tide 128 oz, Tide 64 oz, Wisk 64 oz — across the 86 stores. The data are available for up to 300 weeks (the exact number of weeks included in the data varies across stores). The variables in the data set are:

store	Store id number
week	Week
acv	ACV (all commodity volume), in \$1,000
promoflag	= 1 if any product in the category was on promotion
q_tide128	Tide 128 oz: unit sales
p_tide128	Tide 128 oz: price (\$)
q_tide64	Tide 64 oz: unit sales
p_tide64	Tide 64 oz: price (\$)
q_wisk64	Wisk 64 oz: unit sales
p_wisk64	Wisk 64 oz: price (\$)

Q1. Data description

- a. Import the data using `load("Detergent.RData")`. Summarize the data using `describe()` function. Discuss any interesting items you see in the summary statistics.
- b. Generate two new variables that capture the price gap (price difference) between (i) Tide 128oz and Tide 64oz, (ii) Tide 64oz and Wisk 64oz. Report the mean, median, and std. dev. of the two price gap variables across store-weeks.
- c. Provide histograms of the price gaps.
- d. What do you learn from the price gap histograms and summary statistics for your analysis above? Is there enough variation in the price gaps across stores and weeks to estimate the cross price elasticities between the two Tide pack sizes and Wisk 64?

Q2. Demand estimation

a. Construct the sales velocity for each of Tide 64 and Tide 128 as:

$$\text{velocity} = \frac{\text{Unit Sales}}{\text{ACV}}.$$

b. What is the purpose of dividing unit sales by ACV to construct the dependent variable?

c. Estimate log-linear demand models for the two Tide products by regressing the log of velocity on all prices (own and competing products).

d. Discuss whether the demand estimates (own and cross price elasticities) make sense. Are the magnitudes and signs of the estimated parameters as you would expect?

Q3. Time trend

a. Re-estimate the log-linear demand models for the two Tide products including a time trend. A time trend is a variable that proxies for the progress of time. Here, you can use the week variable as a time trend.

b. Explain why adding a time trend is important here. Discuss whether the demand estimates now make sense. Is there an improvement over the model specification in question 2?

Q4. Focus on non-promoted weeks

In the data, weeks where at least one product was promoted are flagged by the dummy variable `promoflag`, where a value of 1 indicates a promoted week.

a. In what fraction of store-weeks was at least one of the detergents promoted? (Hint: Look at the summary statistics).

Now create a new data set that only includes store-weeks in which none of the products were promoted. Use the `subset` function that allows you to extract rows of data satisfying a specific condition.

```
detergent_DF_2 = subset(detergent_DF, promoflag != 1)
```

Here, “`!=`” means “not equal to”, in contrast to “`==`” (double equal sign) which means “equal to”.

b. Re-estimate the log-linear demand models with a time-trend for the two Tide products only using data from non-promoted store-weeks. Discuss whether the demand estimates (own and cross price elasticities) now make sense — is there an improvement over the specification in question 3? Provide some intuition for the change in the estimated own-price effects.

Q5. Store fixed effects

a. Re-estimate the log-linear demand models for the two Tide products including a time trend and store fixed effects using the data for the non-promoted store-weeks. (Hint: use the `factor()` function in the linear regression instead of manually creating fixed effects for 86 stores).

b. Do the estimates of own and cross price elasticities reveal an improvement over the model specification in question 4?

c. Compare the estimates to a slightly different regression with the log of unit sales, not log of velocity, as dependent variable. How do the elasticity estimates and the time trend compare across these two regressions? Is the difference (or absence of a difference) as expected?

Q6. Pricing and profitability analysis

Tide's retail margin at Dominick's is 25 percent, and P&G's marginal cost of producing Tide laundry detergent is 2.7 cents **per oz**.

Hint: For the next four questions, you will need to use `mean()` function in R to get the mean of a column.

a. Calculate base (regular) prices, using the data for the non-promoted store-weeks, as follows:

base price of Tide 128 = mean of price of Tide 128 across non-promoted store/weeks.

b. Do a similar calculation for Tide 64.

c. Calculate the base volume as average yearly chain-level volume sales:

base volume of Tide 128 = no. of stores \times 52 \times mean sales of Tide 128

Recall that there are 86 stores in the data set.

d. Do a similar calculation for Tide 64.

e. What is the average yearly base total profit for Tide (sum of profits for Tide 64 and Tide 128)? Don't forget to incorporate retail margin and the marginal cost **per oz** (see beginning of Q6).

f. Calculate the total new expected volume of Tide, i.e. the new volume of the 128 oz and 64 oz products, from the following price changes:

1. A simultaneous 5 percent increase in the prices of Tide 128 and Tide 64
2. A simultaneous 5 percent decrease in the prices of Tide 128 and Tide 64
3. A simultaneous 5 percent increase in the price of Tide 128 and 5 percent decrease in the price of Tide 64
4. A simultaneous 5 percent decrease in the price of Tide 128 and 5 percent increase in the price of Tide 64

g. For each of the four cases from part f, calculate the total new expected profits. Compare the four profits – which one is the highest? Are the prices of Tide approximately optimal, or do you recommend changes to the product-line pricing of Tide?

Q7. Summarize your findings on the main questions

a. What is the extent of cannibalization within the Tide product line?

b. Does Tide face a competitive threat from Wisk?

c. How do you evaluate the current pricing tactics? Do you recommend changes?