MKT 282: Data Analytics & Dynamic Pricing
(Raghunath Rao: Fall 2021)
Assignment #2

This assignment is due by midnight on 11/03/2021. Please paste your answers within this file and save it as "HW2_DP_SOLN" on Canvas at the appropriate place. If you used M.S. Excel/R (or any other statistical software) to arrive at your answers, please submit the relevant files/annotated code as well (so that you can get partial credits for your work even if your answer is incorrect). The scores from your submissions will be reweighted, and you can earn up to 75 points from this exercise.

Only one submission per team, please- one person from each team should upload the solution. It is the responsibility of each group to get together and finish the assignment. The team information is available under announcements on Canvas.

Late assignments are NOT acceptable.

Write the names of your team members here: Carter Cowman, Chloe Estrin, Nihit Parikh, Demetri Whitsett

Part 1: Using Non-Linear Regression to Understand Prices, Promotions, and Entry

Daniel Mynick been hired as a consultant for a mid-sized local grocery store located in Central Texas. Store management is worried since Wal-Mart has entered the market by opening a "Wal-Mart Super-center" only 3 miles away from the local store. Management is interested in analyzing the impact on store sales of the Wal-Mart entry and whether or not a new strategy is required.

For analysis, management has given Daniel access to one hundred weeks of sales data for the local store covering the period both pre- and post-entry of Wal-Mart.

Look at the data in *"**HW2 Walmart.xls**"* (The file is available on Canvas).

It has the following variables:

WEEK	Week number
Sales	weekly sales
Promotion Index	Index of weekly promotion activity –higher promotion index indicates more products on promotion in the store
Walmart	Walmart dummy = 1 in the weeks after the Walmart opens, and 0 in the weeks before the Walmart opens
Feature Advertising Index	Index of feature advertising activity – higher feature advertising index indicates more feature advertising
Holiday	Holiday Dummy = 1 during major holiday weeks, and 0 for non-holiday weeks

1A. Estimate the following regression model: Create the appropriate variables[1]. (5 points)

$log(sales) = \alpha + \beta_1 \, log(promotion\ index) + \beta_2 \, WalMart$

Paste results here.

Source	Value	Standard error	t	Pr > |t|	Lower bound (95%)	Upper bound (95%)
Intercept	13.477	0.033	410.959	**<0.0001**	13.412	13.542
Log PromotionIndex	0.962	0.231	4.174	**<0.0001**	0.505	1.420
Walmart	-0.303	0.046	-6.524	**<0.0001**	-0.395	-0.211

[1] I use functions Log and Ln interchangeably both referring to natural logarithm.

1B. What is the interpretation of the coefficient on *log(promotion index)?* (5 points)

For every 1% increase in the promotion index variable, there is an expected 0.962% increase in sales if all other variables remain unchanged.

1C. What is the effect of Walmart entry? (5 points)

After Walmart enters, the predicted sales **decreases** by 0.303% compared to before Walmart entered if all other variables remain unchanged.

1D. Which independent variables are significant in explaining the variation in sales? (2 points)

All of the variables are significant in explaining the variation in sales since their p-values are below 0.1.

1E. The local store also engages in feature advertising by mailing ads to households. 'Feature Advertising Index' gives the feature advertising activity in a given week. You add the log of this variable to the regression. In addition to this, you also add a 'Holiday Dummy' equal to one if the corresponding week covers a major holiday. Add these two variables to the regression and re-estimate the model

$$log(sales) = \alpha + \beta_1\, log(promotion\ index) + \beta_2\, WalMart + \beta_3\, log(feature\ index) + \beta_4\, Holiday$$

Paste results here. (5 points)

Model parameters (Log Sales):

Source	Value	Standard error	t	Pr > |t|	Lower bound (95%)	Upper bound (95%)
Intercept	13.457	0.030	441.411	**<0.0001**	13.396	13.517
Log PromotionIndex	0.902	0.211	4.284	**<0.0001**	0.484	1.321
Walmart	-0.307	0.042	-7.264	**<0.0001**	-0.391	-0.223
Log FeatureAdvertisingIndex	0.718	0.206	3.483	**0.001**	0.309	1.128
Holiday	0.261	0.077	3.372	**0.001**	0.107	0.414

1F. Interpret the two newly estimated coefficients. (4 points)

All else equal, when the feature index increases by 1%, sales increase by 0.718%.
All else equal, when it is a major holiday week, sales increase by 0.261%.

1G. Are the two new coefficients significant? (2 points)

Both the independent variables, feature advertising index, and whether or not it is a major holiday week, are both significant as their p-values are less than 0.1.

You add a final variable to the regression: *log(promotion Index) × WalMart*, i.e., the Wal-Mart Dummy multiplied by the log(promotion index) variable. Create this interaction variable. The full regression model is now:

$$log(sales) = \alpha + \beta_1\, log(promotion\ index_t + \beta_2\, WalMart + \beta_3\, log(feature\ index)$$

$$+ \beta_4\, Holiday + \beta_5\, (\log(\text{promotion Index}) \times WalMart_t)$$

1H. What is the interpretation of β_5 ? (5 points)

β_5 is the coefficient of the interaction term of the promotion index when Walmart has entered the market. It describes how the overall percent change in the sales (including main effect and interaction term effect) from a 1% increase in the promotion index changes when Walmart enters the market compared to the effect promotions had on sales before Walmart entered the Market.

1I. Estimate the regression. Paste results here. (5 points)

Source	Value	Standard error	t	Pr > |t|	Lower bound (95%)	Upper bound (95%)
Intercept	13.449	0.030	443.264	**<0.0001**	13.389	13.509
Log PromotionIndex	1.462	0.355	4.122	**<0.0001**	0.758	2.166
Walmart	-0.299	0.042	-7.136	**<0.0001**	-0.382	-0.216
Log FeatureAdvertisingIndex	0.737	0.203	3.621	**0.000**	0.333	1.141
Holiday	0.229	0.078	2.943	**0.004**	0.075	0.384
Log PromotionIndex*WalMart	-0.864	0.444	-1.946	0.055	-1.746	0.018

1J. Is the effect of promotions on store sales higher or lower after Wal-Mart enters? (2 points)

The effect of promotions on store sales after Walmart entered is lower as it changed from a 1.462% increase in sales to a 0.598% increase in sales once Wal-Mart entered.

Effects of promotions on store sales = Beta coefficient of main effect of promotions + Beta coefficient of interaction term of promotions*walmart (entered or not)

= 1.462% + (-0.864%)*1

= 0.598%

1K. What does the estimate for β_5 imply about the possibility of the local store using promotional activity to fight Wal-Mart? What strategy would you recommend to the local store? (5 points)

The beta estimate implies that the local store can use promotions to increase sales prior to Walmart entering the market. However, once Walmart enters the effectiveness drops and therefore higher promotion index doesn't increase sales as much. With this information, the store can still increase sales after Walmart enters using this method, but if the cost of increasing promotion index by 1% is higher than the profit from a 0.598% increase in sales, they should not use this strategy. We would recommend the local store to focus on their advertising strategy. Gathering more data around variables related to advertising and including that information in our regression model would provide great insight and could inform more specific advertising strategies.

Part 2: Understanding the Drivers of Price Competition

Attached data file **"HW2 Pizza data.xls**" shows the prices and quantities sold for six major brands of frozen pizza for 156 weeks in a major Midwestern market.

Using the discussion during Session 2 in the class:

1. Calculate Clout, Vulnerability and Dominance ratio for each brands using an elasticity matrix. (25 points)

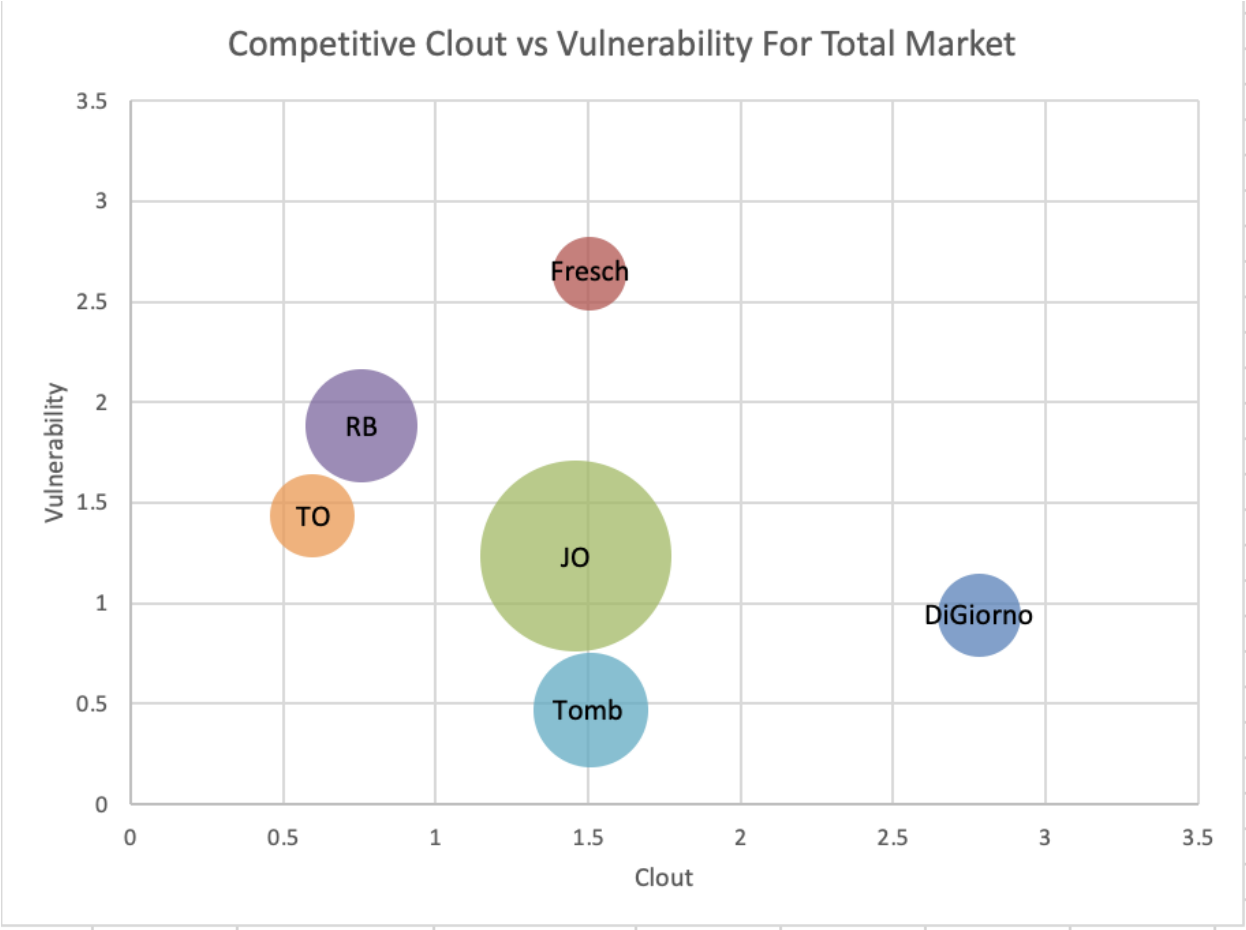
***Note**: For this question, in any regression, an estimate that has a p-value of less than or equal to 0.1 should be considered statistically significant. An elasticity number with p>0.1 should be considered as zero.*

Elasticity Matrix — p=0.10 significance

	DiGiorno	Fresch	JO	RB	Tomb	TO
DiGiorno	**-4.23**	0.94	0	0	0	0
Fresch	2.15	**-3.95**	0	0.48	0	0
JO	0	0	**-4.22**	0.27	0.37	0.60
RB	0.63	0.28	0.47	**-3.76**	0.50	0
Tomb	0	0	0.47	0	**-3.68**	0
TO	0	0.28	0.52	0	0.64	**-4.69**

	Clout	Vulnerability	Dominance Ratio
DiGiorno	2.78	0.94	2.96
Fresch	1.50	2.64	0.57
JO	1.46	1.24	1.18
RB	0.76	1.88	0.40
Tomb	1.51	0.47	3.21
TO	0.60	1.44	0.42

2. Create a graph with x-axis as “clout” and “y-axis” as vulnerability and locate each brand on this map as a circle whose size represents the average market share (in units) during these 156 weeks. (10 points)



Average Market Share over 156 weeks (in units):

DiGiorno: 6906.28

Fresch: 5364.35

JO: 36019.38

RB: 12544.37

Tomb: 12985.13

TO: 6971.99