
MSiA 410 Homework 7

Chicago Bears' Concession Pricing

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Problem

- ▶ 7 promotional items
 - ▶ BtlWater, HotDog, Nachos, Peanuts, Popcorn, Pretzel, SouvCup
- ▶ Price elasticity
 - ▶ Impact of sales on other items
- ▶ Profitability
 - ▶ Weaknesses

Demand curve

- ▶ Law of demand
 - ▶ For most goods, as the price increases, quantity demanded will decrease
- ▶ Supply
 - ▶ The Bears have a monopoly over concessions at the stadium



Complementary vs Substitute Goods

- ▶ Complementary goods - bought together
 - ▶ Ex: Do you want fries with that?
- ▶ Substitute goods - can be bought to replace one another
 - ▶ Ex: Do you want a hot dog or a hamburger?

Assumptions

- ▶ Price and discounts cause the different quantities sold
 - ▶ Game schedule doesn't matter
 - ▶ Games 1, 7 - Thu 7:20pm
 - ▶ Games 4, 5, 6 - Sun Noon
 - ▶ Games 2, 3 - Sun 3:25pm
 - ▶ Game 8 - Sun 7:20pm
 - ▶ No significant difference between Club and GA Level (other than discount)
- ▶ Sales are only available to season ticket holders (STHs)

Data Cleaning

- ▶ Re-calculated price paid based on price & discount
 - ▶ actual_price seems to have errors or noise
- ▶ Remove free waters for being a designated driver
- ▶ Remove sale items we don't care about

```
# import data  
concessions = data.frame(read_excel(  
  "ConcessionSalesData_ForClass.xlsx"))
```

```
# compute prices  
concessions$price=concessions$PRICES*  
  (1-concessions$Discount.Percentage/100)
```

```
# subset to remove items we don't care about  
concessions = subset(concessions, price>0)  
concessions2 = subset(concessions, special_item=="Yes")
```

Weekly Deals

- ▶ Which discounts are each week?
 - ▶ $2^7 = 128$ combinations, only 8 weeks
 - ▶ Peanuts & Nachos tied together
 - ▶ Games 1 & 4 have identical discounts

#get unique games

```
weekly=concessions2[!duplicated(concessions$game_week),17:23]
```

	HotDog	SouvCup	BtlWater	Peanuts	Nachos	Pretzel	Popcorn
Game 1	Yes	No	Yes	No	No	No	No
Game 2	No	No	No	Yes	Yes	No	No
Game 3	No	Yes	No	No	No	Yes	No
Game 4	Yes	No	Yes	No	No	No	No
Game 5	No	Yes	No	No	No	No	Yes
Game 6	No	No	Yes	No	No	Yes	No
Game 7	Yes	Yes	No	No	No	No	No
Game 8	Yes	Yes	Yes	No	No	No	Yes

Aggregate

- Sum # of sales over variables other than game, menu item, price, discounts

```
ac = aggregate(UseCount ~ game_week + item
               + price + nonSTHrev
               + Discount.Percentage + Discount_HotDog
               + Discount_SouvCup + Discount_BtlWater
               + Discount_Peanuts + Discount_Nachos
               + Discount_Pretzel + Discount_Popcorn,
               concessions2, sum)
```

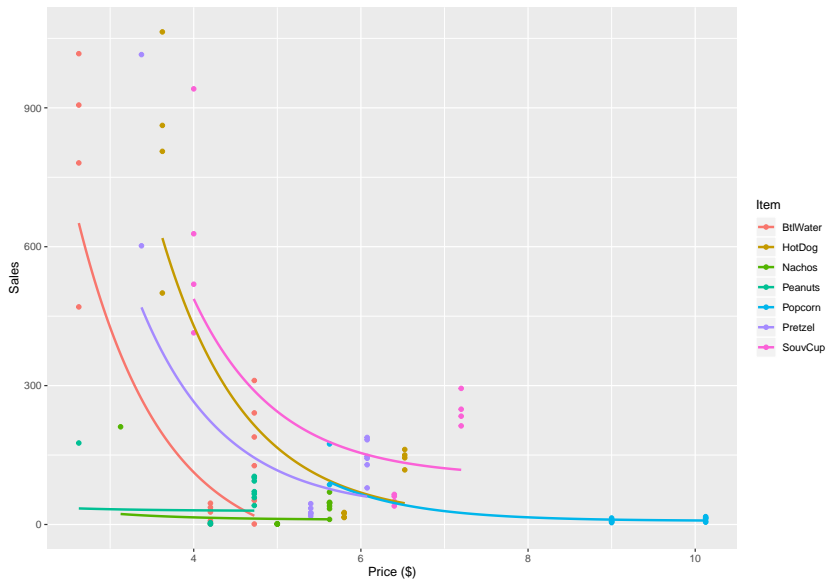

Price Elasticity

- Compute slope and intercept of linear regressions for each item
- Values with p-value < 0.05 **bolded**

```
fits = lmList(log(UseCount) ~ log(price) + log(nonSTHrev)
              | item, data=ac)
```

	Intercept	log(price)	log(nonSTHrev)
BtlWater	38.17	-5.24	-2.59
HotDog	-37.86	-3.61	4.55
Nachos	-31.50	-0.16	3.84
Peanuts	-9.59	0.14	1.36
Popcorn	9.29	-4.15	0.28
Pretzel	-54.27	-0.78	5.78
SouvCup	10.08	-2.54	-0.03

Price Elasticity



How many STHs are at each level?

- ▶ Problem: Club level (getting 20% discount) has fewer STHs than GA getting 10%
- ▶ About 80% GA, 20% Club

```
users = aggregate(Discount.Percentage ~ UserID,  
                  concessions, min)
```

Discount	STHs
10	2684
20	672
50	838

Adjust Sales

- ▶ Adjust sales based on prevalence of club & GA levels
 - ▶ Multiply 10% discounted sales by 5/4
 - ▶ Multiply 20% discounted sales by 5
 - ▶ 50% discounted sales are available to all levels

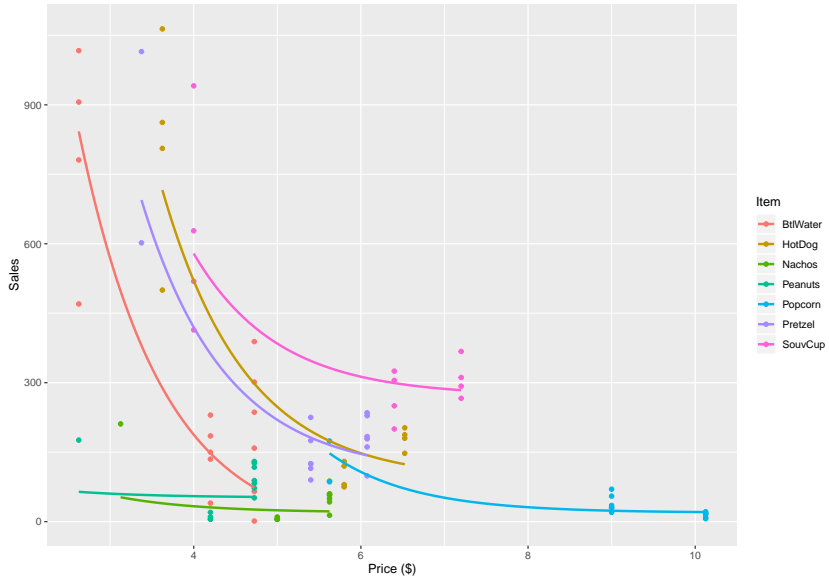
```
ac2=ac; ind=ac$Discount.Percentage==10
ac2[ind,"UseCount"]=5/4*ac[ind,"UseCount"]
ind=ac$Discount.Percentage==20
ac2[ind,"UseCount"]=5*ac[ind,"UseCount"]
```

Adjusted Price Elasticity

```
fits = lmList(log(UseCount) ~ log(price) + log(nonSTHrev)  
              | item, data=ac2)
```

	Intercept	log(price)	log(nonSTHrev)
BtlWater	37.59	-4.14	-2.61
HotDog	-21.36	-2.61	2.91
Nachos	-19.85	-0.72	2.72
Peanuts	-9.31	0.08	1.40
Popcorn	14.42	-3.84	-0.33
Pretzel	-23.55	-1.35	2.99
SouvCup	1.11	-1.42	0.69

Adjusted Price Elasticity



Effect of Hot Dog Discounts

- ▶ Hot dog discounts hurt water sales

```
ac3 = ac2[ac2$item != "HotDog",]  
fits = lmList(log(UseCount) ~ log(price) + log(nonSTHrev)  
              + Discount_HotDog | item, data=ac3)
```

	Intercept	log(price)	log(nonSTHrev)	HD Disc
BtlWater	33.66	-4.79	-2.06	-1.49
Nachos	-19.20	-0.80	2.66	0.05
Peanuts	-14.03	0.79	1.83	-0.63
Popcorn	19.66	-4.15	-0.87	-0.31
Pretzel	-31.07	-1.44	3.71	0.35
SouvCup	0.84	-1.43	0.71	-0.02

Effect of Each Discount

```
for(n in names){  
  ac3 = ac2[ac2$item != n,]  
  f = paste0("log(UseCount)~log(price)+log(nonSTHrev)",  
             "+Discount_",n,"|item")  
  fits = lmList(as.formula(f), data=ac3)  
  cf[rownames(cf)!=n,n] = coef(fits)[,4]  
  pv[rownames(pv)!=n,n] = summary(fits)$coefficients[,4,4]  
}
```


Effect of Each Discount

- ▶ Rows are items, columns discounts
- ▶ Water sales are helped by nacho/peanut discounts
 - ▶ Reminder: nacho & peanut discounts were tied together

	BtlWater	HotDog	Nachos	Peanuts	Popcorn	Pretzel	SouvCup
BtlWater	NA	-1.49	1.94	1.94	-0.83	1.00	0.56
HotDog	0.10	NA	0.02	0.02	0.08	-0.20	0.01
Nachos	0.06	0.05	NA	11.83	0.60	-0.66	-0.24
Peanuts	-0.97	-0.63	11.72	NA	1.03	-0.11	0.87
Popcorn	-0.03	-0.31	-0.43	-0.43	NA	0.63	0.12
Pretzel	0.20	0.35	-0.27	-0.27	-0.47	NA	-0.15
SouvCup	0.22	-0.02	-0.44	-0.44	0.06	0.29	NA

Next Steps

- ▶ Is there enough information/data here to make any decisions?
 - ▶ If so, on what?
 - ▶ If not, how would you collect more data?
- ▶ What additional information may be helpful for future analysis?
 - ▶ More weeks of data
 - ▶ Different discount combinations
 - ▶ More differentiation in price
 - ▶ More users of the concession app
 - ▶ Etc.