

# BA 875

## Operations and Supply Chain Analytics

### Homework Assignment 5 (Due 04/27)

**Deliverable:** Please submit your homework assignment as a single Python Notebook and clearly state your answer to each component of a question. Make sure to save Notebook with output shown.

#### Part I: Pricing Analysis

Optimal pricing for weekend vs. weekday

**Dataset:** demand\_data

Think back to the exercise (and corresponding slides) on "Weekend price adjustments", where we examined data on price  $p$ , the corresponding demand  $d(p)$ , and whether the demand is recorded on weekdays/weekends  $w$  ( $w = 1$  if weekend,  $w = 0$  if weekday).

Consider the objective where you would like to know how we should adjust prices between weekday and weekend. That is, given the information on price, demand, and weekend/weekday, the objective is to obtain two optimal prices and the corresponding profit for both cases.

Additional info:

Linear Price-response Curve:  $d(p) = \beta_0 + \beta_1 p + \beta_2 w$

Assume unit cost of eggs is \$3:  $c = 3$

Margin:  $(p - c) = (p - 3)$

- Calculate the optimal weekday price  $p^*$  (when  $w = 0$ ) and its corresponding profit
  - Clearly state your findings, do not simply show output of running code
  - Determine whether the optimal weekday price is within the credible range
- Calculate the optimal weekend price  $p^*$  (when  $w = 1$ ) and its corresponding profit
  - Clearly state your findings, do not simply show output of running code
  - Determine whether the optimal weekend price is within the credible range

## Part II: Pricing Analysis

New vs Refurbished Product

**Dataset:** refurb\_data

Think back to the exercise (and corresponding slides) on "New vs refurbished products", where we examined data on the selling date, the new price for the product, the refurbished price for the same product, and the consumer's choice to purchase the new or refurbished version of the product.

Consider the objective where you would like to know how **we should adjust our refurbished prices depending on the range of new price offerings: 300,350,400 (verify all possible values by looking at the data yourself).** The objective is to set optimal refurbished prices for all ranges of new prices and the corresponding profit for each case.

As a start, you need to get a sense of *demand*  $d(p)$  for the *refurbished price* offerings. This can be achieved by tallying up (counting) all of the instances in the data when the consumer chose the refurbished product, on a day-to-day basis. And this daily demand, representing the cumulative 'refurb' outcomes, could be used as your dependent variable for a  $d(p)$  regression.

### Additional info:

Linear Price-response Curve:  $d(p) = \beta_0 + \beta_1 \text{refurb\_price} + \beta_2 \text{new\_price}$

New prices = [300,350,400]

Assume unit cost of refurbished product is \$150 :  $c = 150$

Margin:  $(p-c) = (\text{refurb\_price} - 150)$

- Calculate the optimal refurbished price and profit when the new price = 300
- Calculate the optimal refurbished price and profit when the new price = 350
- Calculate the optimal refurbished price and profit when the new price = 400

For all cases, clearly state your findings, do not simply show output of running code

### Part III: Pricing Analysis

Two-Segment Pricing

**Dataset:** [none needed]

Think back to the exercise (and corresponding slides) on "Segmentation", where we were provided with a Linear Price-response Curve  $d(p) = 10000 - 800p$ . There is a uniform WTP distribution with 10,000 consumers equally distributed between 0 and 12.5.

Consider the objective where you would like to know how to segment prices to obtain more potential profit. Assume that you are able to charge one price to all customers in segment 1 and another price to all customers in segment 2.

Additional info:

Linear Price-response Curve:  $d(p) = 10000 - 800p$

Cost = \$5

Also assume you will be able to price differently for customers with WTP above and below \$7

- First, find the optimal price\* when only offering one price → i.e., with no segmentation
- Report the optimal prices  $p^*$  for segment 1 and segment 2
- Report the difference in profit between the no segmentation case vs. the combined segment 1 and segment 2 cases and offer your conclusion

For all cases, clearly state your findings, do not simply show output of running code