BA 875
Operations and Supply Chain Analytics
Homework Assignment 5 (Due 05/01)

Deliverable: Submit your homework assignment as a single Python Notebook only and clearly state your answer to each component of a question. Ensure to save Notebook with output shown. The delivery requirement has been stated here and in the HW submission portal. *You shall receive a 10 point reduction in grade if you do not submit in the format specified, no exceptions*.

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 to ***Maximize Profit***. That is, given the information below on demand d(p) and cost below, as well as the data 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 \$4: c = 4
Unknown decision variable to optimize: p

- Estimate the demand d(p) by regressing on price and weekend. Interpret the regression results. Provide an interpretation in your own words!
- 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 and provide response in your own words!
- 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 and provide response in your own words!

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) = $\beta_0 + \beta_1 refurb\_price + \beta_2 new\_price$
New prices = [300,350,400]
Assume unit cost of refurbished product is $150 : c = 150
Margin: (p-c) = (*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

- Comment on the differences in the optimal refurbished price when offering the three different new prices. Next, comment on the differences in the optimal profit when offering the three different new prices.

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. Ultimately, you want to determine whether the (i) strategy of segmenting to offer two distinct prices (*segmentation*) outperforms the (ii) default strategy of offering a singular price (*no segmentation*).

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 of the two strategies (i) and (ii)

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