

**Advanced Business Analytics**

**BU.520.620. Section:\_\_\_\_\_**

**Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ID:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

# **In Class Assignments (NLP 2)**

1. ***Please submit your Excel file to Blackboard, and***
2. ***A pdf containing your final answers, i.e., a screenshot of your spreadsheet with your formulas.***
3. ***One submission per group is sufficient.***

**Case Study Hayat Clothing Brand**

Hayat, a good quality clothing brand, prepares for a 4-week period of discount pricing at the end of each season.

Hayat holds an increasing discount policy where the discount percentage is increasing every week. This means that the discount percentage in a week is less than the discount in the subsequent week, e.g., discount percentage in week 2 ≤ discount percentage in week 3[[1]](#footnote-1).

Hayat starts the discount period in week 1 with an inventory of 2476. The inventory at the end of week 1 can be calculated as inventory in the beginning of week 1 minus the sales of week 1[[2]](#footnote-2). The sales functions are given below. Furthermore, the sales amount in each period cannot exceed the inventory in that period.

Any products that are left over at the end of the discount period, i.e. the inventory at the end of week 4, is then liquidated at a loss of 60%, i.e., 40% of its’ initial price.

Sales amounts during the discount period depend on the discount amounts in the current and previous week and the sales of the previous week. Let , and represent the percentage discount in weeks 1 through 4, respectively. The sales amount in week 1,, is a function of the discount percentage and is expressed as follows:

|  |  |  |
| --- | --- | --- |
|  |  | () |

We can calculate the expression for the sales in week 1 as .

The sales amounts for the following weeks are a recursive formula that is based on the sales from the previous week and the discount percentages. The sales for the 2nd week can be expressed as:

|  |  |  |
| --- | --- | --- |
|  |  |  |

Similarly, we can write the equation for the sales in week 3 and 4 as:

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |

The firm has a limit on the minimum and maximum amount of discount in weeks 1 through 4. The minimum discount amount is 10% and the maximum discount amount is 60%[[3]](#footnote-3). If the price of the product during the regular season is $606, what are the discount percentages for weeks 1 through 4 that maximizes the revenue? Solve this problem using Excel solver. (Note the values in red are the Sales Intercept in the NLP\_2\_ICE\_Shell file.)

**Short Answer Questions**

1. Suppose the customers of a manufacturer are located as shown in figure below. Determine where the store should be located to minimize the weighted sum of squared distances that the customers will have to travel to the store.

The number of customers in each location is given as:

|  |  |
| --- | --- |
| **Location** | **Number of Customers** |
| 3 | 1000 |
| 4 | 1500 |
| 5 | 3000 |
| 6 | 2000 |
| 17 | 7000 |

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1. A small printing shop has 15 machines that are being assigned 4 groups. The color and B&W print capacity in number of prints per day for each machine is given on the table below. Each machine must be assigned entirely to a group. Each group must have a total, i.e., color plus B&W, capacity of between 150 to 600 prints. As there is a large fixed cost associated with new cartridges, especially with color cartridges, the printing shop would like maximize the number of B&W dominant groups. A group is B&W dominant if total B&W capacity (prints per day) exceed the total color capacity (prints per day). You may use if function for this question.)

|  |  |  |
| --- | --- | --- |
| **Machine** | **Color Capacity (#/day)** | **B&W (#/day)** |
| **1** | 80 | 34 |
| **2** | 43 | 61 |
| **3** | 40 | 44 |
| **4** | 20 | 24 |
| **5** | 40 | 114 |
| **6** | 40 | 64 |
| **7** | 70 | 34 |
| **8** | 50 | 44 |
| **9** | 70 | 54 |
| **10** | 70 | 64 |
| **11** | 80 | 45 |
| **12** | 40 | 50 |
| **13** | 50 | 60 |
| **14** | 60 | 65 |
| **15** | 50 | 70 |

1. A gas truck contains five compartments with the capacities listed on the spreadsheet Loading. Three products must be shipped on the truck, and there can be only one product per compartment. The demand for each product, the shortage cost per gallon, and the maximum allowable shortage for each product are listed on the spreadsheet Loading. How should the truck be loaded to minimize the shortage costs? (You may use if functions for this question.)
2. Lin’Oreal sells 4 different types of lipstick: Infallible, endless, color riche, and never fail. Lin’Oreal has the capacity to produce a total of 10,000 lipsticks per month. For the last 16 months, Lin’Oreal kept track of price and sales of each product. Experts believe that infallible and endless are substitutes of each other, and color riche and never fail are substitutes of each other. This means the demand for Infallible is . Similarly, the demand for Endless is . Similarly, the demands for color riche and never fail are and . In those equations, a represents the intercept, b and c are the slope in the direction of the respective prices.
   1. Find the values of the intercept and the slopes for the demand functions of each of the lipsticks using the data given in the Excel file. (Remember regression?)
   2. The variable cost for each product is: infallible, $2.0, endless, $2.20, color riche, $2.30, and never fail, $2.40. Determine the price of each lipstick that will maximize profits using the demand functions found in step a.
   3. Let’s say Lin’Oreal can increase the capacity for $20,000 for each thousand units added. What is the optimal capacity level?

1. Example of a constraint [↑](#footnote-ref-1)
2. Inventory definition. Remember inventory represents units and cannot be negative. [↑](#footnote-ref-2)
3. Minimum and maximum constraints [↑](#footnote-ref-3)