**MEF UNIVERSITY**

**BDA 541**

**FINAL EXAM**

**INSTRUCTIONS**

* The R will contain two parts, for Problems 1 and 3. (Add comments to mark the beginning of each part). The R file should have comments to increase readability.
* The Excel file (and Google Sheets link) will contain two parts, for Problems 2 and 3. The Excel file should be easy to read, properly color-coded as in the examples solved in videos.
* The Word file will be this file, renamed and edited to show your answer for Problem 4.
* You can use any resource on- and off-line but under no circumstances should you collaborate while working on this exam. **If you do collaborate, you will receive a 0 from this final exam.**

GOOD LUCK!

1. **LINEAR PROGRAMMING (CHOOSE ONE OF TWO) *(30)***

**A:**  *Fancy* *Skateboard Manufacturing* produces two popular skateboards: the Red and the Blue. In the coming week, the manufacturer wants to produce at least 600 skateboards and wants to ensure the number of Reds produced does not exceed the number of Blues by more than 300. Each Red produced and sold results in a profit of $80 while each Blue results in a profit of $30. Both skateboards use the same mechanical equipment; however, they require different amount of wood for the appearance. Each Red’s trim requires 2 pounds of wood and 3 hours of production time while each Blue requires 1 pound of wood and 4 hours of production time. *Fancy* has limited amount of wood and labor hours that they can use each week as follows: at most 1200 pounds of wood and 2,800 labor hours. What is the best production schedule?

**B:** *Zara*, a leading producer of fashion clothes, is planning their manufacturing operations for Products A, B, and C. All products are manufactured in four different departments: cutting, sewing, insulating and packaging. For the upcoming season, they have some demands that they will try to satisfy for all products. According to their contracts with retailers, they need to pay a penalty for each undelivered item. All information related to products (demand, profit and penalty) and operations (time requirements and the capacities) are given in the following table. Devise an optimal production plan for the company.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Time per units (hr) | | | |
| Department | Product A | Product B | Product C | Capacity (hr) |
| Cutting | .30 | .30 | .25 | 900 |
| Sewing | .25 | .35 | .30 | 900 |
| Insulating | .45 | .50 | .40 | 900 |
| Packaging | .15 | .15 | .10 | 900 |
| Demand | 800 | 750 | 600 |  |
| Unit profit | $30 | $40 | $20 |  |
| Unit penalty | $15 | $20 | $10 |  |

**2. INTEGER/BINARY PROGRAMMING (CHOOSE ONE OF TWO) *(30)***

**A:** A company named *Uretici* can produce an *item* on six different machines. The following table summarizes the manufacturing costs associated with producing the *items* on each machine along with the available capacity on each machine. If the company has received an order for 1,800 items, which machines should be used to minimize cost?

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Machine** | **1** | **2** | **3** | **4** | **5** | **6** |
| **Var Cost** | **21** | **23** | **27** | **24** | **19** | **28** |
| **Fixed Cost** | **1000** | **950** | **875** | **850** | **800** | **700** |
| **Max Prod** | **500** | **600** | **850** | **400** | **600** | **900** |

**B:** A clock manufacturer is planning to produce 2000 clocks on three different machines. The minimum lot size on any machine is 600 units, i.e., if you decide to use a machine, you have to produce at least 600 clocks. The following table gives the related data. Find the optimal production plan for this company.

|  |  |  |  |
| --- | --- | --- | --- |
| Machine | Setup Cost ($) | Production cost/unit ($) | Capacity (units) |
| 1 | 300 | 2 | 650 |
| 2 | 100 | 10 | 850 |
| 3 | 200 | 5 | 1250 |

**3. SIMULATION (CHOOSE ONE) *(30)***

**A:** A publisher has 1500 copies of a popular book on hand and would like to decide whether to do another printing within the next year. The publisher estimates that demand for the book during the upcoming year will be minimum 1250, maximum 5000 and most likely 2500 copies. A production run incurs a fixed cost of $72,000; plus there will be a variable cost of $10 per book printed. Books are sold for $30 per book. Any demand that cannot be met incurs a penalty cost of $2 per book, due to loss of goodwill. Leftover books can be sold to Barnes&Noble for $3 per book. If the publisher decides to print 1000 copies, what is the expected profit?

**B:** A shoe store, which sells a single type of shoes called *Unique*, must keep enough shoes on hand to satisfy customers’ demands. Suppose the weekly demand for shoes at this store follows a lognormal distribution with means and standard deviation summarized as follows:

M T W Th F Sat Sun

Mean 180 120 90 60 120 140 65

Std Dev 30 18 13 9 18 25 9

A medium-sized truck delivers shoes to this store once a month. The manager of the store can order any amount of shoes she desires for this delivery. Of course, running out of shoes in any month is very undesirable. If the manager starts each month with a balance of 805,000 shoes, what is the probability that the store will run out of shoes at some point during the month? (Assume that there are 4 weeks per month.)

**4. BIG DATA *(10)***

Of all the cases we read this semester, which case have you found to have the most possible potential for machine learning applications? Please explain your answer thoroughly in one or two paragraphs.

**Answer 4:**

**I think Carlson *Rezidor Hotel Group Maximizes Revenue Through Improved Demand Management and Price Optimization* paper is the most possible potential for machine learning applications. As a first reason, in this case; Rezidor Hotel Group has massive historical data and these data can be used on training model. These data can be used clustering based on Rezidor Hotel Group’s distinct brands, after that, demand forecast according to generated clusters. Output of demand forecast model and the other factors may be features for a machine learning model which generates price simultaneously. Secondly, this optimization model needs an output -price- in real time which can be easily provided by a machine learning model after model deployment.**

**Notes: Excel File includes the answers of problem 1-A and 2-A.**

**Gsheet includes the answer of problem 3-A.**

**R-File includes the answers of problem 1-A and 3-A.**

**Gsheet Link:**

[**https://docs.google.com/spreadsheets/d/1LaAc8aAK0Tokm1X\_vQOjCL\_KPJEte2lJkpmMwi93A4c/edit?usp=sharing**](https://docs.google.com/spreadsheets/d/1LaAc8aAK0Tokm1X_vQOjCL_KPJEte2lJkpmMwi93A4c/edit?usp=sharing)