LGT2106 Midterm Assignment 2020/21 Semester 2

Instructions:

- In this assignment, we adopt Excel's standard format when we refer to a cell. For example, ID!B1 refers to the cell B1 on sheet "ID" of the Excel file "LGT2106_Assignment_Data.xlsx".
- Input your student ID into the cell "ID!B1". Then, a set of parameters and data will be generated for you in the sheets "Forecast" and "Aggregate". You need to answer Questions 1 and 2 using **these data**.
- Include both your name and student ID in the File Name of your submission, e.g., CHAN_TAI_MAN_12345678D_assignment.pdf. Otherwise, marks will be deducted.

Question 1. Forecasting (25 marks)

Bitcoin (BTC) is a cryptocurrency invented in 2008 by an unknown person or group of people using the name Satoshi Nakamoto. Since the digital currency hit the level of US$1 for the first time on 9 February 2011, Bitcoin has leapfrogged to US$54583 on 23 March 2021 in merely one decade. In finance theory, the trading volume and prices are closely related. In this question, let us forecast the **weekly trading volume** of Bitcoin.

Instructions:

- Note that the data of Bitcoin prices and trading volume can be found online via various sources and no source can be comprehensive. To be consistent, we use the data provided by https://data.bitcoinity.org/markets/volume/6m?c=e&t=b which have been downloaded for you and are shown in the sheet "Forecast" of the Excel file.
- In this question, a period corresponds to one week. Suppose that a week starts with Monday. The table in Sheet "Forecast" presents the weekly trading volumes for the past six months. Each week is tagged by the Monday of it in column "A" and assigned a period number in column "B". The trading volume of each week is provided in column "C".
- Keep two decimal places for all numbers in your calculations (including numbers in the middle steps and the final forecast).
- We use date format dd/mm/yyyy in this question. We treat the week of 4/1/2021-10/1/2021 as Period 0. The weeks before this week are labelled by negative period numbers and those after are labelled by positive period numbers.

Questions:

(a) Use Simple Moving Average with *n* equal to the value in cell "Forecast!E4" to forecast the trading volume for Periods 1 to 10 (i.e., 11/1/2021 to 21/3/2021).

(b) Use Exponential Smoothing with alpha value provided in cell "Forecast!F4" to forecast the trading volume for Periods 1 to 10 (i.e., 11/1/2021 to 21/3/2021). The initial F_0 is given in cell "Forecast!F20".

(c) Suppose that you were forecasting at the beginning of Period 1. Use the data of Periods -15 to 0 (i.e., 21/9/2020 to 10/1/2021) to build a linear regression model. Use this model to forecast the weekly trading volumes for Periods 1 to 10.

(d) For the above three forecasting methods, calculate the ME, MAD, and MAPE of Periods 1 to 10. Compare their errors. Which method works better?

(e) Comment on the assumptions and applicable time horizon of these three forecasting methods. For forecasting Bitcoin trading volume, which method do you think is more suitable? (Word limit: 60. Your answer can be based on your knowledge of Bitcoin market and is not limited to the course content.)

(f) Please forecast the weekly Bitcoin trading volume in the week of April 12-18, 2021. You are free to use any methods and any data to do your forecast. Your answer to this sub-question should include a brief description or explanation of your method (limited to 50 words) and your forecast number. You don't need to provide calculation steps. (*Note: The marks you receive depend on how close your forecast is to the actual number to be recorded in April 12-18, 2021.*)

Question 2. Aggregate Production Plan (25 marks)

Use the forecasted demand and other data shown in sheet "Aggregate" to help Helen Industries Inc. to plan its production for one major products group for the next 6 months.

Helen Industries Inc. used to adopt a standard production process in which it moulds and assemblies all parts by itself; the required production time of this standard process is provided in the cell "Aggregate!B2". As the quality of prefabrication parts from suppliers improves, the company now can choose to use a simplified production process in which prefabrication parts are used to shorten the requirement production time. The required production time of the simplified process is provided in the cell "Aggregate!B3". The additional material cost of using prefabrication parts are shown in the cell "Aggregate!B6". [Note that a production time of XX worker·minute per unit means that it takes one worker XX minutes to produce 1 unit of product.]

In order to satisfy the production requirement, the company can vary its capacity by (1) hiring or laying off workers and (2) scheduling workers to use standard production process (not using prefabrication parts) or to use a simplified production process (using the more expensive prefabrication parts). The following assumptions are made.

- Inventory and backorder costs are calculated using ending inventory/backorder of each month.
- Hiring or layoff costs are incurred when the total number of workers changes.
- The number of workers in each month should be an integer. Once scheduled, all workers will produce at their full potential each month.
- The ending inventory requirement of June stated in the cell "Aggregate!B12" must be satisfied.

Consider the following three different strategies.

i. A level strategy **without** the use of prefabrications to meet the overall production requirement. That is, use a constant number of workers for these 6 months; all workers produce without the use of prefabrication parts; demand variations are absorbed by inventory and backorders. Hiring and layoff only happens at the beginning of January.

ii. A chase strategy by varying the number of workers when all workers produce with the use of prefabrication parts. That is, all scheduled workers produce with the use of prefabrication parts; use the minimum number of workers in each month to make the ending inventory of each month non-negative.

iii. Initial workers unchanged and not using prefabrications PLUS variable new workers using prefabrications. That is, schedule all initial workers to produce without prefabrication parts; this number is unchanged over these six months. Except these initial workers, new workers hired in these six months produce with the use of prefabrication parts. Vary the numbers of new workers. [Hint: input the initial number workers to the row "*Number of workers (not using prefabs)*", Aggregate!B18:G18; then, vary the numbers in Aggregate!B19:G19 to make your plan.]

Question:

Develop three plans using the above three strategies, respectively. Your plans should be *cost-effective* among the plans that satisfy the requirements. (For example, using one thousand workers can satisfy some of the above requirements, but it is obviously not cost-effective, i.e., not minimize the cost.)

Period	1	2	3	4	5	6	Total
Demand							
Total number of workers							---
Number of workers (not using prefabs)							---
Number of workers (using prefabs)							---
Beginning Inventory							---
Production quantity (not using prefabs)							
Production quantity (using prefabs)							
Ending Inventory (use negative for backorder)							---
Costs:							
Hiring cost							
Laying off cost							
Labor cost							
Additional material cost (prefabs)							
Inventory holding cost							
Backorder cost							
						Total cost:	

Question 3. Scheduling (25 marks)

ePrinting is a printing company. All jobs it receives must go through Process X and then Process Y in sequence. Each of the processes is operated by a dedicated machine.

Job	Process I (hours)	Process II (hours)
A	7	4
B	1	5
C	6	3
D	8	6
E	3	2
F	5	5

(a) The above 6 jobs have just arrived. Use Johnson's rule to determine the optimal sequence to schedule the jobs. If there is more than one optimal sequence under Johnson's rule, show them all.

(b) Draw a Gantt chart for your schedule. If there is more than one optimal sequence, show them all.

(c) Calculate the mean flow time of the schedules. Which schedule is better? Why?

(d) The company has received 7 special jobs. These jobs have to go through Process X, Process Y and then Process Z in sequence. Each of the processes is operated by a dedicated machine. What is the optimal sequence to schedule the jobs? Show your steps. If there is more than one optimal sequence under the adapted Johnson's rule, show them all. [hint: self-study is required]

Job	Process X (hours)	Process Y (hours)	Process Z (hours)
P	5	2	6
Q	7	1	4
R	8	3	3
S	5	4	4
T	6	4	7
U	8	2	10
V	7	2	2

Question 4. Layout (25 marks)

The activity relationship chart below is obtained from Happy Manufacturing Company. Complete the activity relationship chart. Based on the chart, construct a Dimensionless Block Diagram using the graph-based process. Show both your sequence of placement and the final layout in the space provided.

	Department										Summary						
Dept	1	2	3	4	5	6	7	8	9	10	A	E	I	O	U	X	TCR
1	-	E	E	O	U	U	O	I	E	U							
2	E	-	I	U	O	O	I	E	X	U							
3	E	I	-	U	A	U	O	O	I	U							
4	O	U	U	-	U	E	I	I	A	A							
5	U	O	A	U	-	U	U	U	E	O							
6	U	O	U	E	U	-	E	U	E	U							
7	O	I	O	I	U	E	-	A	O	X							
8	I	E	O	I	U	U	A	-	O	I							
9	E	X	I	A	E	E	O	O	-	I							
10	U	U	U	A	O	U	X	I	I	-							

Sequence:

Final Layout (please draw on this grid chart):

~END~