Birla Institute of Technology & Science (BITS), Pilani
2nd SEMESTER 2021-22,
Time Series Analysis and Forecasting MPBA G512
Mid-Semester Examination (Open Book)

Max. Time: 90 Minutes   Date: 13-03-2023   Max. Marks: 40

Question1: Hindustan Copper Ltd was incorporated in 1967 to take over the plants and mines in Rajasthan and Jharkhand from National Development Corporation Limited. Subsequently, it merged with Copper Corporation Limited. The company is engaged in activities ranging from mining, beneficiation, smelting, refining, and production of cathodes, wire bars, and continuous cast rods. The following table provides the income of Hindustan Copper Ltd in different quarters from 20019–2021.

Year/ Quarter	2019 Q1	2019 Q2	2019 Q3	2019 Q4	2020 Q1	2020 Q2	2020 Q3	2020 Q4	2021 Q1	2021 Q2	2021 Q3	2021 Q4
Income (in million rupees)	1400.9	1274.7	1432.2	1282	1145.4	1254.2	1269.6	1361.9	1588.9	1591.5	1280.5	1303.2

  a. Use a classical multiplicative time series model to decompose the data into the four time series components.   [18]
  b. Plot the components obtained from the classical multiplicative time series decomposition model.   [2]

Question2: Case: Nicholas Piramal India Ltd - Success through Innovation

Introduction: An Overview of the Domestic Pharmaceutical Market
The domestic pharmaceutical market has witnessed high growth as a result of rising income levels and increasing penetration of modern medicine. As per the ORG-IMS MAT report for March 2008, the growth for the financial year 2007–2008 was 14.8%. Chronic therapies continue to grow faster than acute. The domestic pharmaceutical industry is centered on branded generics and is intensely competitive. The top 10 companies account for only 36% of the market share. The pharmaceutical industry continues to be highly fragmented with more than 20,000 registered units. The industry expanded drastically in the last two decades. The leading 250 pharmaceutical companies control 70% of the market with the market leader holding nearly 7% of the market share. The demand for drugs and pharmaceuticals is estimated to be Rs 3675 billion by 2024–2025.

Nicholas Piramal India Ltd: India's Second Largest Pharmaceutical Healthcare Company
Nicholas Piramal India Ltd is India's second-largest pharmaceutical healthcare company and is a leader in the cardio-vascular segment. The company came into existence after it acquired Nicholas Laboratories from Sara Lee in 1988. It has a strong presence in the antibiotics and respiratory segment, pain management, neuropsychiatry, and anti-diabetic segments. The company has also

made forays into biotechnology in key therapeutic areas for which it has formed several global alliances. Nicholas Piramal India Ltd is a part of the USD 500 million Piramal Enterprises (PIL), which is one of India's largest diversified business houses.

Great People Create Great Organizations

For Piramal Healthcare Ltd, its employees are vital. The belief that "great people create great organizations" has been at the core of the company's approach to its people. It has created a favorable work environment that encourages innovation and meritocracy. It has introduced a Career Opportunity Programme (COP) to promote internal talent. The learning and development cell of the company is dedicated to developing managerial skills and inspiring them to grow as business leaders. The company has also invested in enhancing the size of its sales. As a result, during the financial year 2021–2022, it increased its sales force from 3154 people to 3789 people.

The following table lists the sales figures of the company from 2004 to 2021:

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sales (in million rupees)	291.4	587.3	836.2	895.1	1243.5	1558.9	1853.7	5035.8	5346.4
Year	2013	2014	2015	2016	2017	2018	2019	2020	2021
Sales (in million rupees)	4417.9	4897.1	5746.3	9608.0	11539.2	14445.1	13096.1	15084.6	17087.9

1. Prepare a time series plot with the help of the data given in the above Table.   [2]
2. Use exponential smoothing method with α = 0.3; and 3 year moving average to forecast sales. Also, discuss the appropriate method out of these two methods to forecast sales for the year 2022-23.   [15]

Question3: Why Does the Time-Series Model Use Multiplication or Addition framework?   [3]