JAIPURIA INSTITUTE OF MANAGEMENT
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JAIPURIA INSTITUTE OF MANAGEMENT, NOIDA
PGDM / PGDM (M) / PGDM (SM)
FIFTH TRIMESTER (Batch 2024-26)
END TERM EXAMINATIONS, JANUARY 2026

SET-1

Course Name	Business Forecasting	Course Code	**XO831**
Max. Time	**2 hours**	Max. Marks	**40 MM**

INSTRUCTIONS:

1. All questions are compulsory to attempt.
2. Standard statistical tables and calculator use are permitted.

Q1. GlobalExpress, a logistics partner for major Indian e-commerce firms, has observed significant fluctuations in daily package volumes over the last three years. Preliminary data visualization reveals a consistent upward trajectory in year-on-year shipments. Additionally, there are sharp spikes in volume every October and November, coinciding with festive sales, followed by a predictable dip in February. The operations team has noted that sudden "shocks," such as localized transport strikes or unexpected weather events, impact delivery times, but the effect of these errors tends to dissipate within a few days.

The management wants to move from "gut-feeling" scheduling to a robust mathematical framework. You are provided with historical shipment data and asked to build a SARIMAX model to forecast next month's requirements. **(1+6+5=12 Marks)**

Questions:

a) Identify the four main components of the time series described in the GlobalExpress scenario.

b) Critically evaluate the necessity of making this data **stationary** before applying an ARIMA-based model. Discuss the specific roles of the **Integrated (d)** and **Seasonal Differencing (D)** components in stabilizing this specific dataset.

c) Explain how the **Moving Average (q)** component of the model would specifically handle the "shocks" (like weather events) mentioned in the case. How does the model ensure these past forecast errors do not permanently skew future predictions?

Q2. The GlobalExpress analytics team ran a SARIMAX (1, 1, 1) x (0, 1, 1,12) model on monthly shipment data. The following diagnostic results were obtained:

Metric	**Value**
Log Likelihood	245.1
AIC	-480.3
Prob (Ljung-Box)	0.91
Prob (Jarque-Bera)	0.18
Prob (Heteroskedasticity)	0.11

Questions (4x3 = 12 Marks):

a) Analyse the Prob (Ljung-Box) and Prob (Jarque-Bera) values. What do these specific outputs tell you about the "White Noise" characteristics of the residuals and the validity of the resulting forecast confidence intervals?

b) The team also tested a simpler ARIMA (1, 1, 1) model (Model B) which yielded an AIC of -450.1. Mathematically justify which model is superior for forecasting GlobalExpress shipments.

c) Design a "Sanity Check" for this model: If the model passes the JB test but the ACF plot of residuals still shows a sharp spike at Lag 12, evaluate the business risk of using this forecast for December inventory planning.

Q3. You are interviewing for the position of Senior Forecast Analyst. The panel asks you to demonstrate conceptual depth through the following **(4x4 = 16 Marks):**

1. Explain the ARIMA philosophy that "History Repeats Itself." Discuss why this approach might fail to capture complex non-linear relationships in highly volatile retail markets.
2. A Python adfuller output for a new revenue stream shows a p-value of 0.65. State the Null Hypothesis (H_0) of this test and explain the exact steps you would take to prepare this data for modeling.
3. Distinguish between the theoretical impact of an Autoregressive (p) component versus a Moving Average (q) component. Specifically, how does the use of PACF vs. ACF plots help you identify the correct orders for these parameters?
4. The management suggests adding "Competitor Discount Percentage" as an exogenous (X) variable to the model. Explain what the "X" in SARIMAX represents and justify how the inclusion of such external data improves forecasting accuracy compared to a standard univariate ARIMA model.