# TIME SERIES FORECASTING USING ARIMA .AND ITS APPLICATION IN FREIGHT TRANSPORTATION IN INDIA

UNDERSTANDING ARIMA AND ITS IMPACT ON THE LOGISTICS SECTOR:

# TABLE OF CONTENT

This presentation begins with an introduction to time series forecasting, followed by a deep dive into the ARIMA model for predictive analysis. We then explore its application in optimizing and managing freight transportation for improved efficiency and decision-making.

# BASICS OF THE ARIMA MODEL

- **ARIMA** : A statistical model for time series forecasting.
- **AutoRegressive (AR)**: Uses past values.
- **Integrated (I)**: Differencing for stationarity.
- **Moving Average (MA)**: Uses past errors.
- **ARIMA(p, d, q)**: p = lag, d = differencing, q = forecast errors.

# WHY ARIMA FOR FREIGHT FORECASTING?

**01** **First Vision**
Demand forecasting for roads, railways, ports.

**02** **Second Vision**
Supply chain optimization and route planning.

**03** **Third Vision**
Cost management for logistics.

**04** **Fourth Vision**
Policy decisions for infrastructure development

# STEPS TO APPLY ARIMA FOR FREIGHT FORECASTING

1. Data Collection: Freight volume, transport costs.

2. Exploratory Data Analysis: Check seasonality, trends.

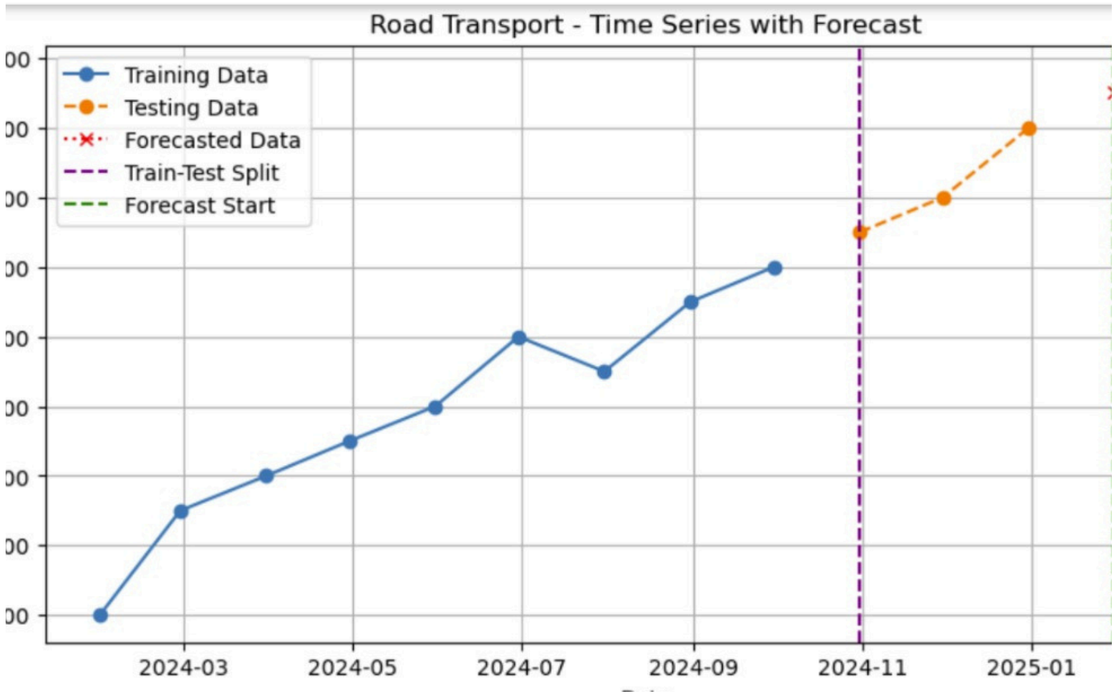
3. Make Time Series Stationary: Differencing, log transformation.

4. Identify AR (p) and MA (q) values: ACF & PACF plots.

5. Build ARIMA Model: Use Python (statsmodels) or R.

6. Model Evaluation: Check residual errors, MAE, MSE.

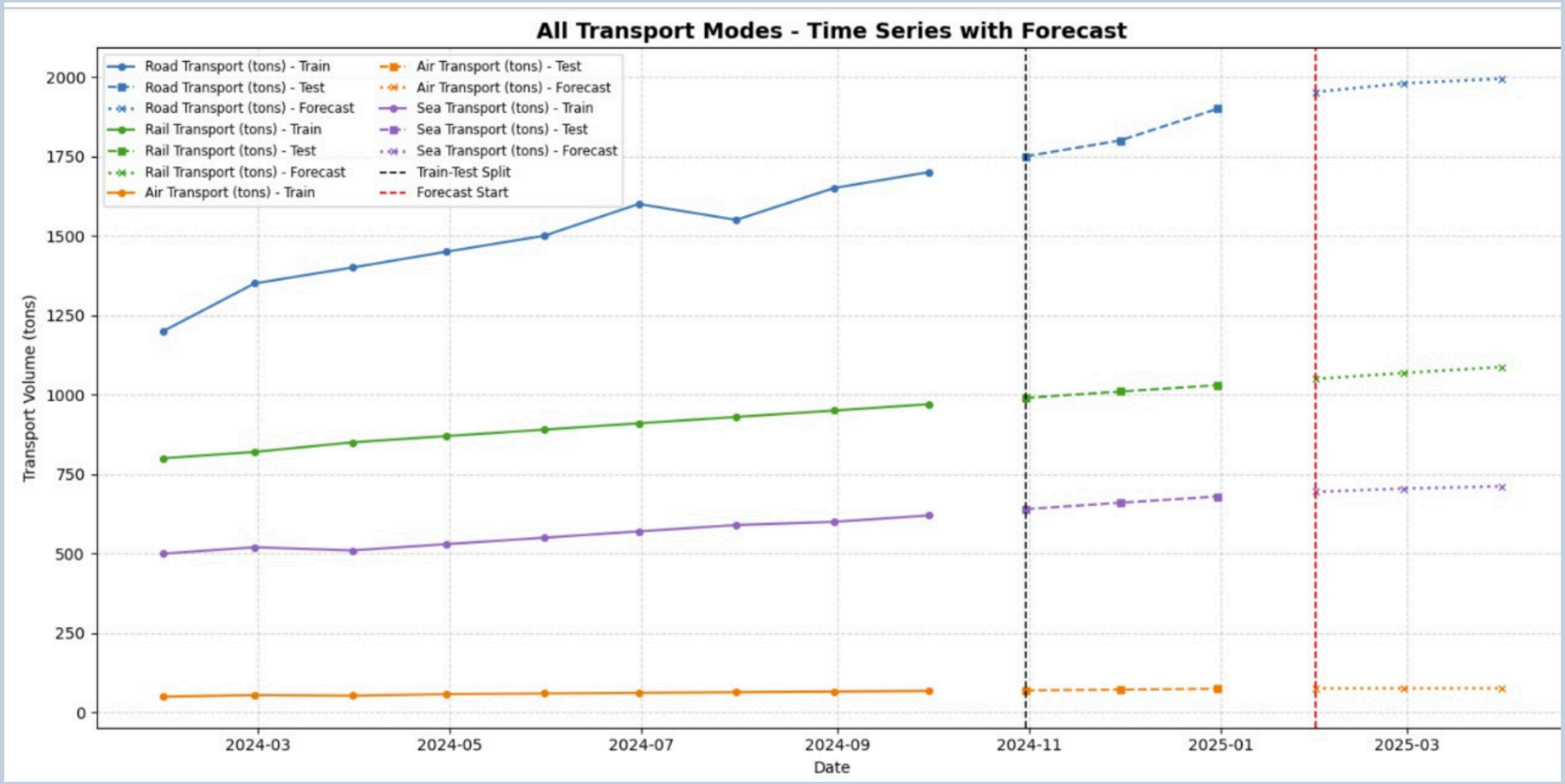
7. Forecasting: Generate demand predictions.

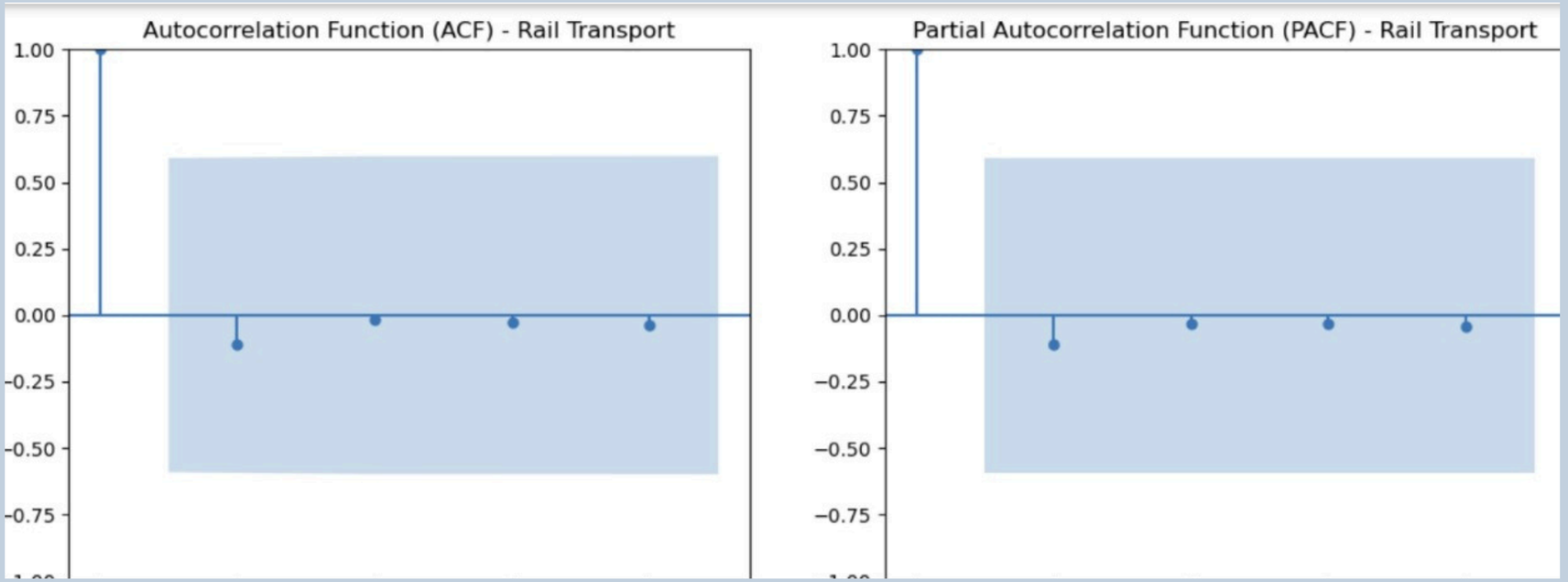



# ARIMA MODEL IMPLEMENTATION

- Tools: Python, R, Excel, analytics software.
- Data: Freight volume, fuel prices, transport costs.
- Sample Python Code.
- from statsmodels.tsa.arima.model Import ARIMA.
- model = ARIMA(data, order=(p, d, q)).
- model_fit = model.fit(
- forecast = model_fit.forecast(steps=12)
- print(forecast)

# IMPORTANCE OF FREIGHT TRANSPORTATION IN INDIA

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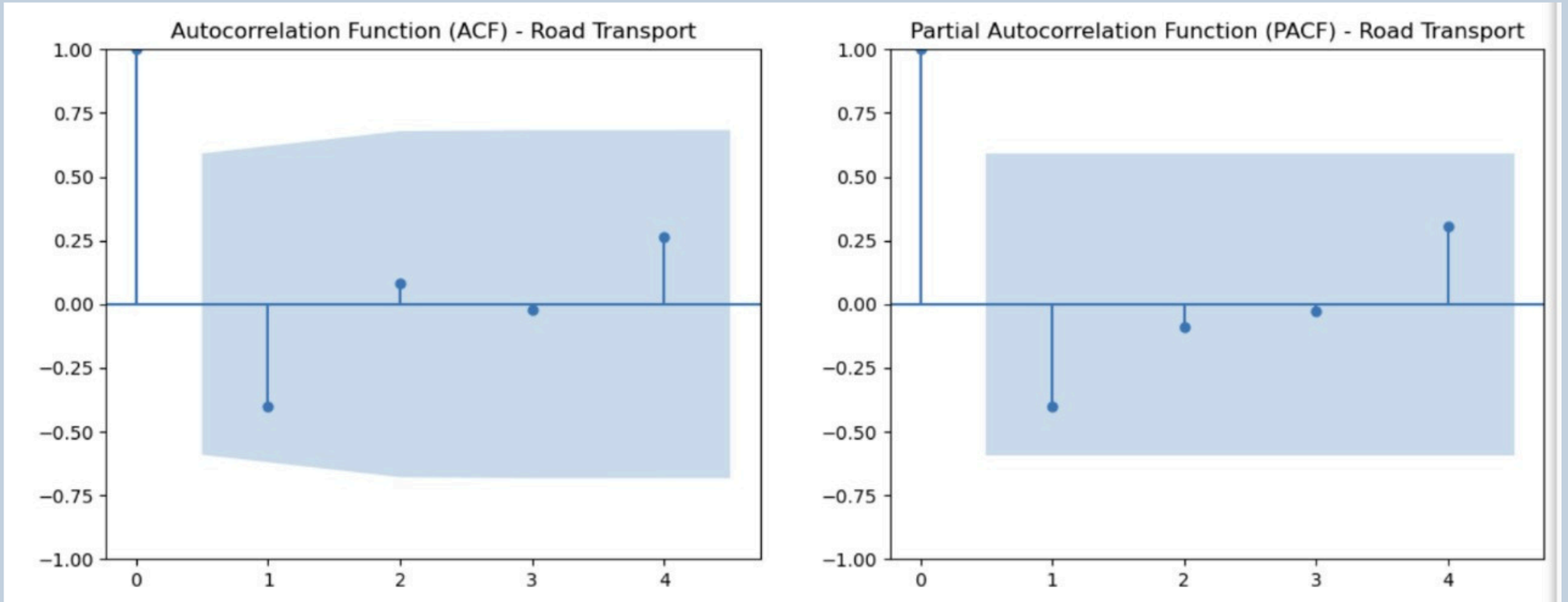
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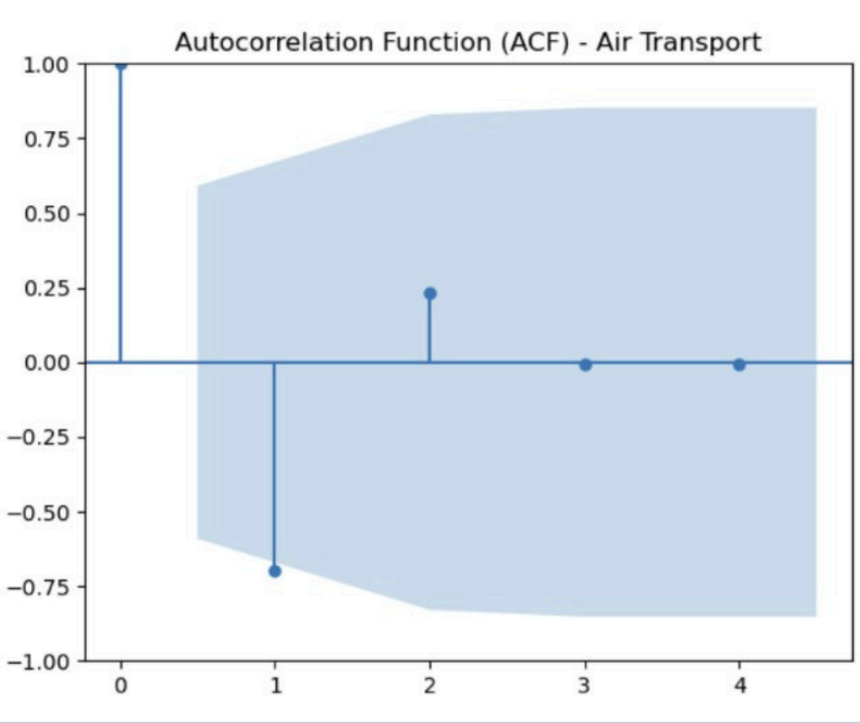
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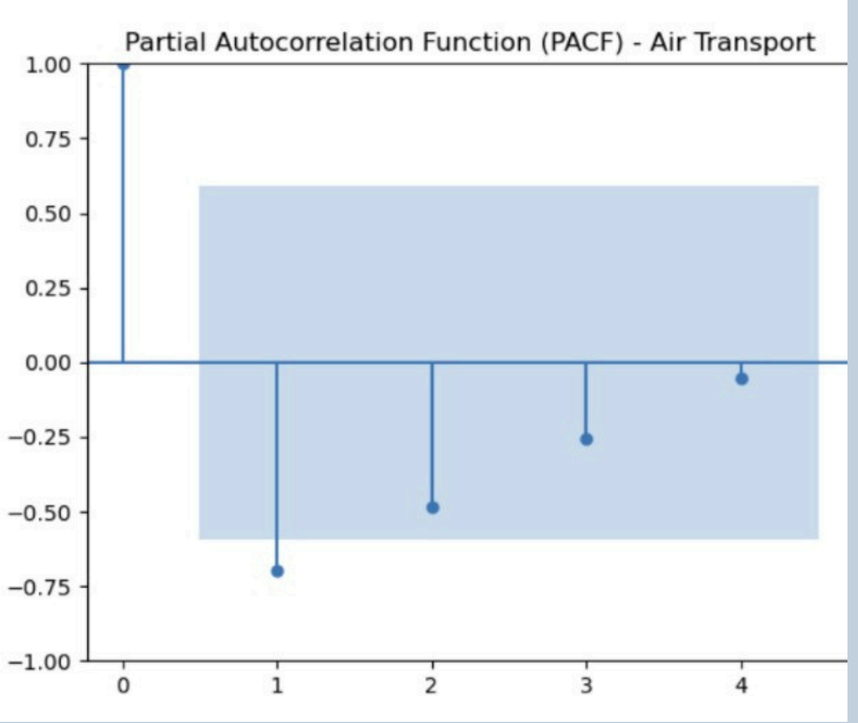
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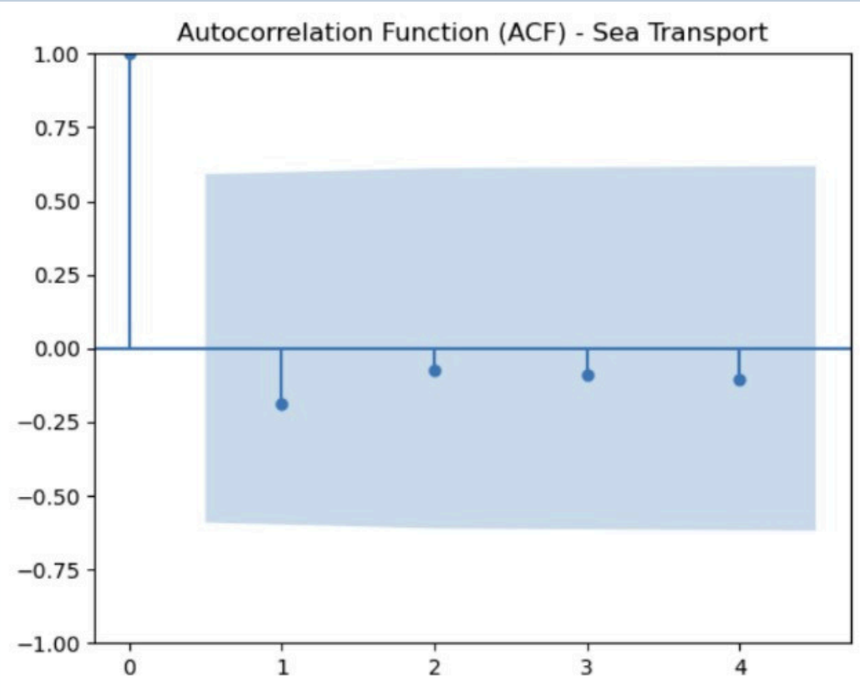
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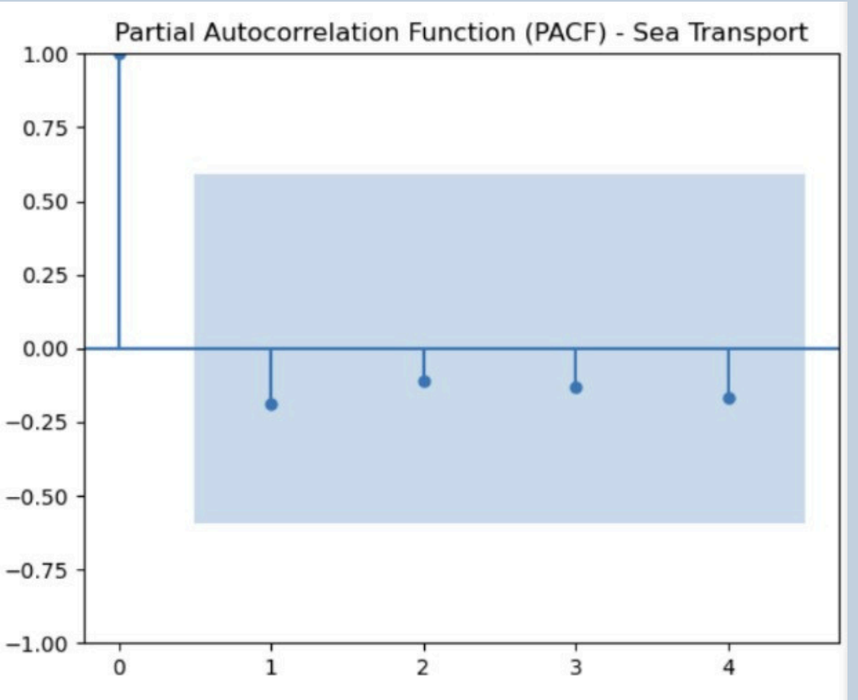
Partial Autocorrelation Function (PACF) - Sea Transport
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# CHALLENGES & LIMITATIONS OF ARIMA

⋆~Data quality issues: Missing or Inconsistent data.

⋆~External factors: Fuel prices, economic policies, disasters.

⋆~Short-term limitation: Not ideal forlong-term predictions.

⋆~Solution: Hybrid models (SARIMA, LSTMs).

# IMPORTANCE OF FREIGHT TRANSPORTATION IN INDIA

⋆~Contributes 5% to India's GDP.

⋆~Supports trade & industrial growth.

⋆~Generates revenue from fuel, tolls, duties.

# GOVERNMENT INITIATIVES IN FREIGHT TRANSPORTATION

» Bharatmala Project: Expanding highways.

» Golden Quadrilateral: Connecting major cities.

» Dedicated Freight Corridors (DFC): Rail freight efficiency.

» Green Transport Policies: Promoting electric freight vehicles.

# ENVIRONMENTAL & COST BENEFITS OF FREIGHT OPTIMIZATION



» Rail & waterways consume less Energy.

» Optimized freight networks reduce cost.

» Green transport policies lower emissions.

» Freight transport is key for economic growth & trade.

» Government investment in freight infrastructure enhances efficiency

# Problem statement

## Forecasting Freight Transportation Demand for Strategic Decision-Making:

Freight transportation plays a critical role in India's economic infrastructure, contributing approximately 5% to the national GDP. It supports trade, fuels industrial growth, and generates significant government revenue through fuel taxes, tolls, and import/export duties. However, the current system lacks a robust, data-driven mechanism for accurately forecasting freight transportation demand, especially in the face of rapid economic shifts, urbanization, and infrastructure development.

This absence of reliable forecasting limits the government's ability to make informed strategic decisions regarding infrastructure investment, logistics policy, environmental sustainability, and national supply chain resilience. Without accurate demand forecasts, resources may be misallocated, congestion may rise, and carbon emissions may go unchecked, ultimately impacting economic efficiency and environmental goals.

The proposed solution aims to develop an advanced freight transportation demand forecasting model tailored for strategic government planning. By integrating historical data, economic indicators, and real-time logistics inputs, this model will enable more precise planning of transportation corridors, logistics hubs, and multimodal networks. This, in turn, will enhance revenue generation, reduce logistical bottlenecks, support sustainable development, and strengthen India’s global trade competitiveness.

# Analysis and Forecast of China Railway Freight Volume based on ARIMA Model

## Analysis Process :

- **The railway freight volume data of China from 1949 to 2008 was analyzed.**
- **The data from 1999 to 2008 was used as a test set.**
- **The predicted values from the model were compared with the actual values.**

The problem of forecasting China's railway freight volume was resolved using the ARIMA (AutoRegressive Integrated Moving Average) model. The researchers tested different variations of the model and found that the ARIMA model with a drift term provided the most accurate predictions.

For example, they used historical railway freight data from 1999 to 2008 to test their model. The results showed that the ARIMA model with a drift term closely followed the actual trend, while the model without a drift term had higher errors. This demonstrated that including a drift term made the forecast more reliable and aligned with real-world data.

By applying this optimized ARIMA model, policymakers and railway operators can now make informed decisions about future freight transport trends, infrastructure investments, and operational planning.

**Reference :** https://www.clausiuspress.com/assets/default/article/2021/07/21/article_1626852410.pdf