

Forecasting Analysis Report

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Business Forecasting (22:544:608)

1. Forecasting Question and Its Importance

Question:

What will the international passenger volumes be over the next 12 months, and how can accurate forecasting optimize decision-making for resource allocation and operational planning?

Importance:

Accurate forecasts of passenger volumes support:

- **Operational Efficiency:** Scheduling flights, allocating resources, and managing staffing.
 - **Financial Planning:** Anticipating revenue fluctuations based on seasonal trends.
 - **Strategic Marketing:** Timing campaigns to align with peak travel periods.
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2. Description of the Data

- **Source:** Monthly international passenger volumes from 2019 to the latest available data.
 - **Structure:**
 - **Columns:** Year, Month, Domestic, International, TOTAL (sum of Domestic and International).
 - **Focus:** The analysis concentrates on the **International** column.
 - **Frequency:** Monthly data, allowing for detailed seasonal trend analysis.
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3. Insights from Exploratory Data Analysis (EDA)

- **Trend:** Passenger volumes show a steady growth over time, reflecting increasing demand for international travel.
- **Seasonality:** Clear seasonal patterns, with peaks aligning with holidays and travel seasons.
- **Summary Statistics:**
 - **Minimum Volume:** 372,915
 - **Median Volume:** 17,194,230
 - **Maximum Volume:** 24,427,292

- **Mean Volume:** 14,577,337
 - **Stationarity:** The series required differencing to become stationary for ARIMA modeling.
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4. Accuracy Measure and Its Importance

Selected Metrics:

- **MAPE (Mean Absolute Percentage Error):** Measures percentage deviation, making it intuitive for stakeholders.
- **RMSE (Root Mean Squared Error):** Penalizes larger forecast errors, useful for sensitive operational decisions.

Importance:

MAPE provides insight into relative accuracy, while RMSE highlights deviations in absolute terms, ensuring the model is suitable for operational and financial planning.

5. Insights from Different Forecasting Methods and Their Residual Analysis

Method 1: ARIMA (1,1,0)(1,0,0)[12]

- **Description:** Accounts for trend, differencing, and seasonality.
- **Residual Analysis:** Residuals exhibit white noise properties (independent and no significant autocorrelation).
- **Accuracy:**
 - **MAPE:** 10.76%
 - **RMSE:** 2,451,180

Method 2: ETS (Exponential Smoothing with Multiplicative Seasonality)

- **Description:** Captures multiplicative seasonal effects and trends.
- **Residual Analysis:** Residuals showed some autocorrelation, indicating room for improvement.
- **Accuracy:**
 - **MAPE:** 17.57%
 - **RMSE:** 4,126,521

6. Prediction and Accuracy Summary

Method	Forecast Horizon	MAPE (%)	RMSE
ARIMA	12 months	10.76	2,451,180
ETS	12 months	17.57	4,126,521

Forecasted Passenger Volumes (Next 12 Months - ARIMA):

Month	Forecasted Passengers
Month 1	~22,009,199
Month 2	~22,009,455
Month 3	~21,975,841
Month 4	~22,071,701
Month 5	~22,036,500
Month 6	~21,938,439
Month 7	~22,121,244
Month 8	~22,123,265
Month 9	~22,171,085
Month 10	~22,270,736
Month 11	~22,345,831
Month 12	~22,284,472

7. Decision Based on the Analysis

Selected Method:

ARIMA (1,1,0)(1,0,0)[12] is the best fit for this dataset due to:

- Lower MAPE and RMSE values.
- Well-behaved residuals, indicating reliable predictions.

Actionable Decisions:

- Use ARIMA forecasts to optimize staffing, flight scheduling, and resource allocation.
 - Plan promotional campaigns around peak months identified in the forecast.
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8. Ideas to Improve Forecasts

1. **Incorporate External Factors:** Include macroeconomic indicators (e.g., GDP, fuel prices) for enhanced accuracy.
2. **Expand Dataset:** Use a longer historical dataset to capture broader trends.
3. **Combine Models:** Use ensemble approaches to leverage the strengths of multiple forecasting methods.
4. **Validate Further:** Employ cross-validation techniques to improve model robustness.