Mathematical Time Series Forecasting of Aviation Passenger and Aircraft Traffic Using LSTM and SARIMAX Models

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Abstract

Forecasting future aviation traffic is both a practical need and a mathematical challenge. Air passenger numbers and aircraft movements show seasonal patterns and are influenced by many factors, making them suitable for time series modeling. Forecasts help the Airports Authority of India and Airlines to improve flight scheduling, optimize airport capacity, and support long-term infrastructure planning. In this paper, we develop two mathematical approaches to forecasting. The first is the Long Short-Term Memory (LSTM) network model, a deep learning method that learns complex patterns directly from source data (in our case Belagavi Airport data). The second is the Seasonal Auto Regressive Integrated Moving Average with Exogenous Regressors (SARIMAX), a statistical model that explains seasonal changes and includes external variables such as aircraft movements. Using Belagavi Airport monthly records, SARIMAX is applied to both passenger and aircraft traffic, while LSTM is used for passenger forecasting. Results show that SARIMAX provides interpretable mathematical equations useful for understanding seasonal behavior, while LSTM is effective at capturing nonlinear passenger trends. Together, these approaches demonstrate how mathematical models and modern machine learning can complement each other in improving aviation forecasting and supporting sustainable growth for VIKASIT BHARAT 2047.

Keywords

Mathematical Time Series Forecasting, Deep learning in Aviation, LSTM Model, SARIMAX Model, Statistical Modeling, Aviation Analytics, Air Passenger Forecasting, Aircraft Traffic Prediction, Infrastructure planning, Vikasit Bharat 2047.