Tuberculosis Incidence Forecasting in Guangxi, China: A Time Series Analysis

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1. Introduction

Tuberculosis (TB) remains a significant public health concern globally, with China being one of the high-burden countries. Understanding TB incidence trends is crucial for effective disease control and resource allocation. This study aims to analyze the historical incidence of TB in Guangxi, China, and develop a forecasting model to predict future trends. The insights from this analysis will assist public health authorities in planning targeted interventions to curb the spread of TB.

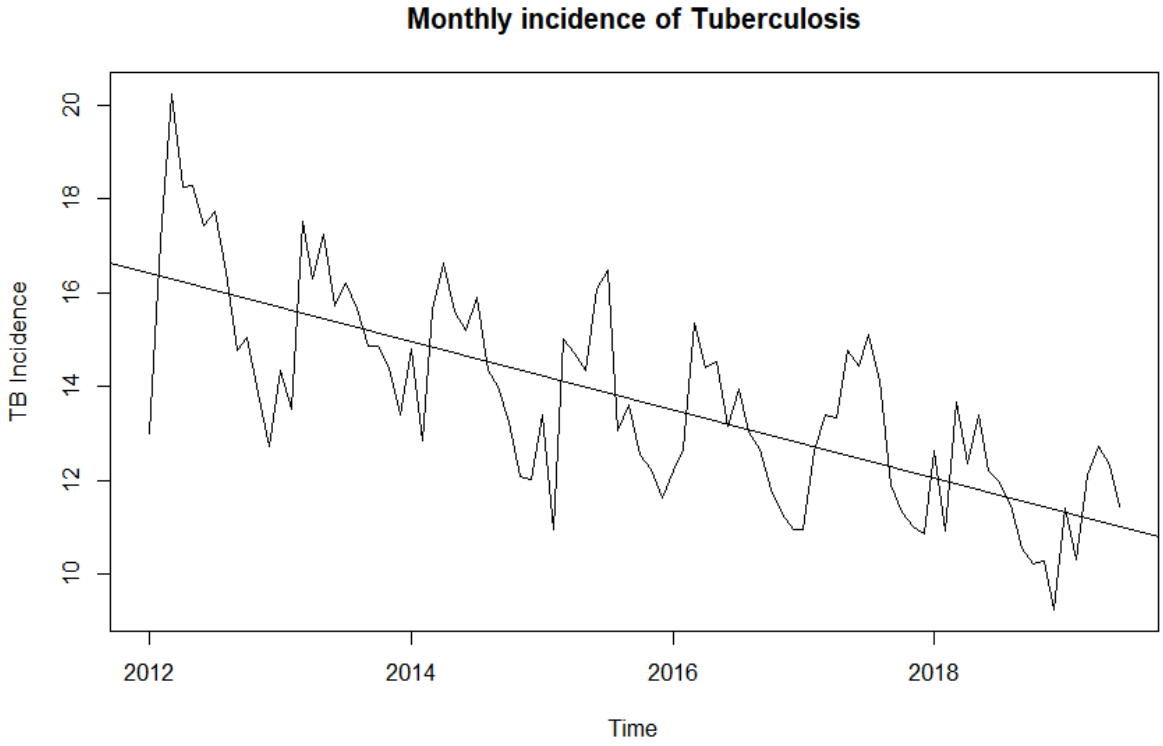
2. Methodology

2.1 Data Collection and Preprocessing

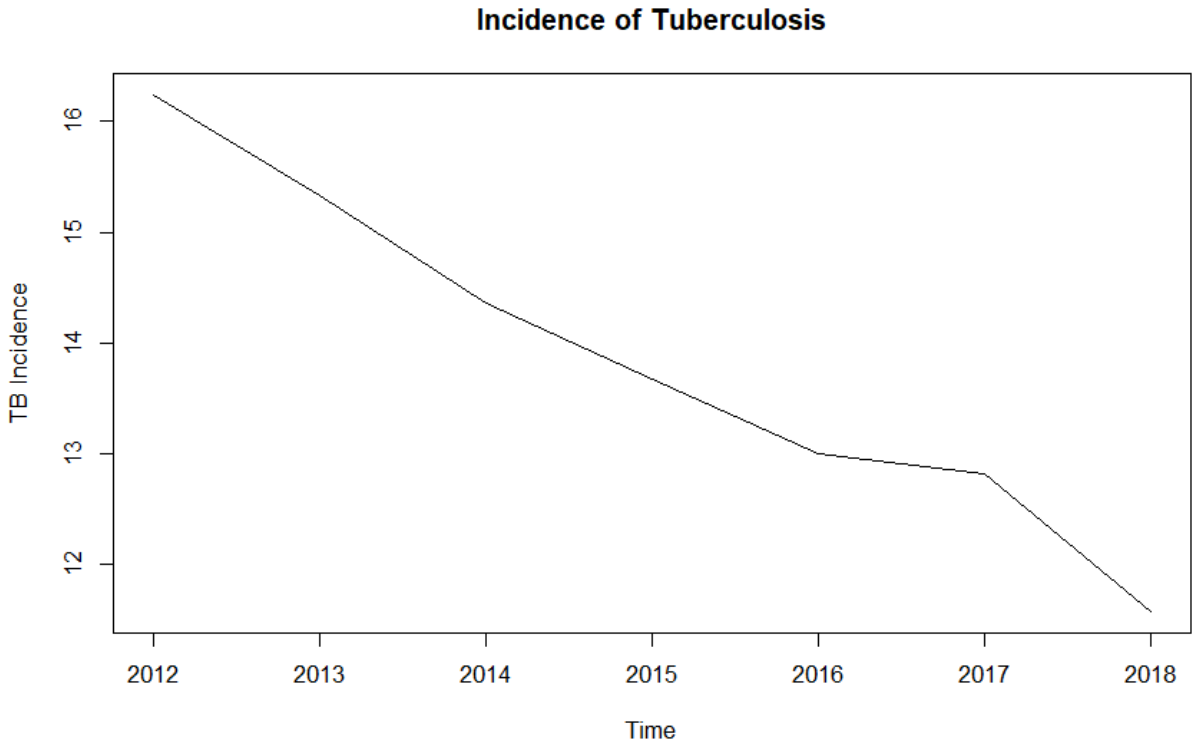
The dataset used in this analysis consists of monthly TB incidence rates (per 100,000 population) recorded from January 2012 to June 2019. The data was obtained from a publicly available source and imported into R for analysis.

2.2 Time Series Analysis

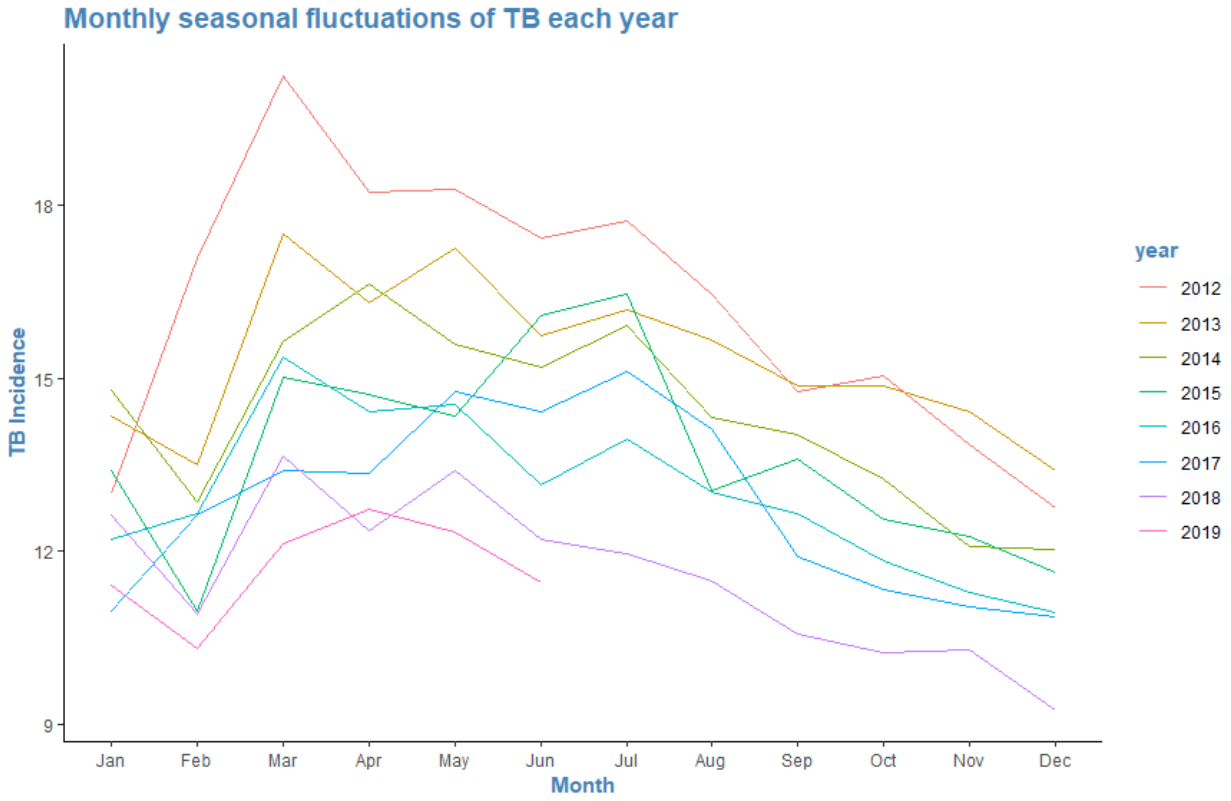
- The data was converted into a time series object to facilitate trend and seasonal analysis.
- A time series plot was created to visualize fluctuations in TB incidence over time.



- Aggregation techniques were used to identify general trends.



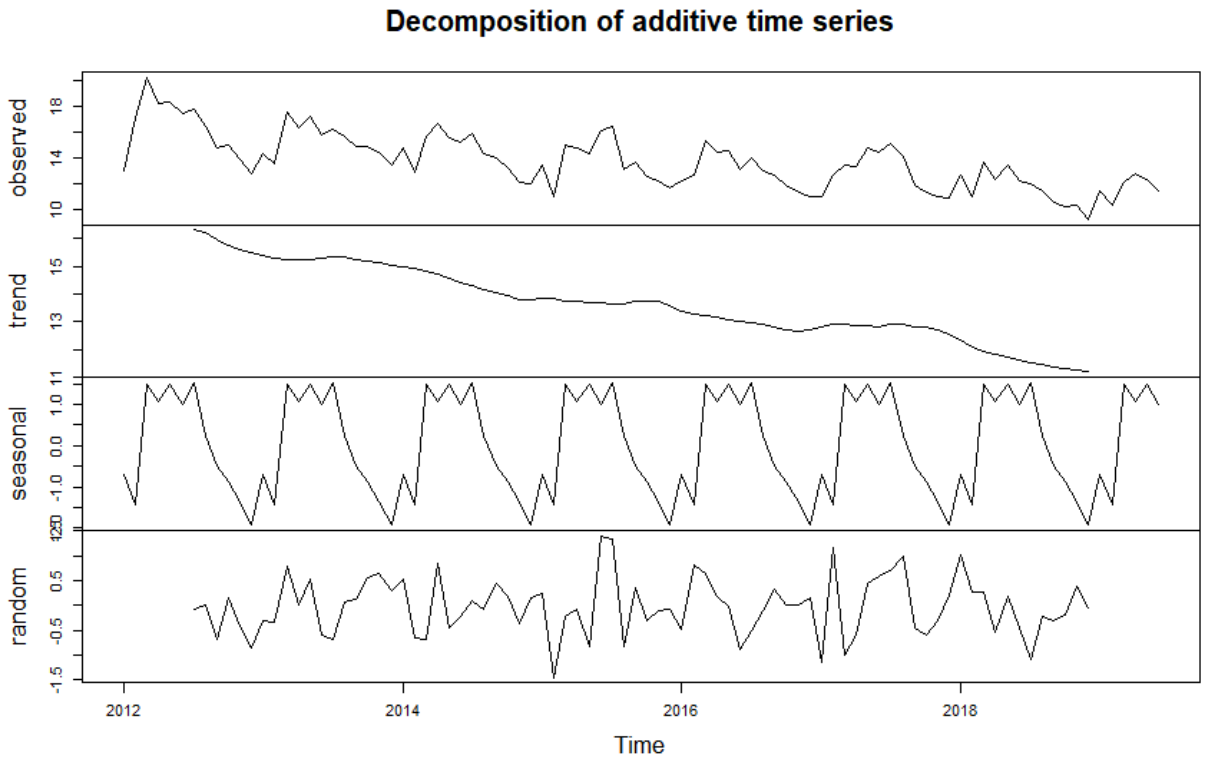
- There is seasonal fluctuations of TB incidence monthly.



2.3 Stationarity Testing

To ensure accurate modeling, stationarity tests were conducted:

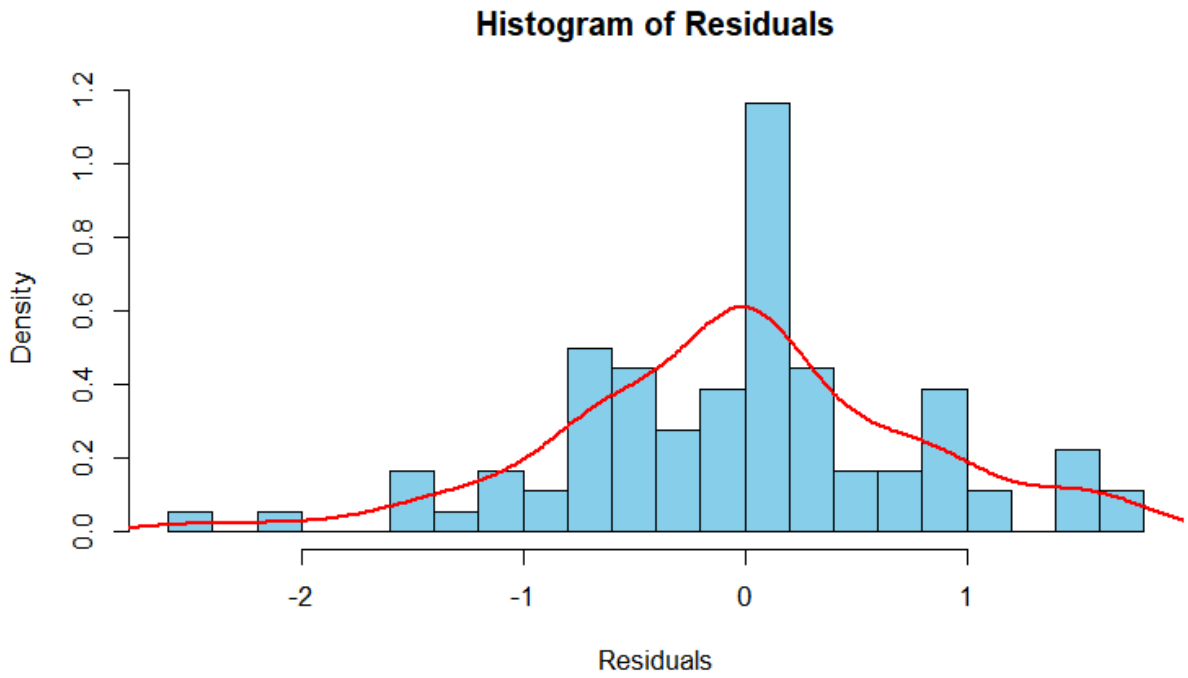
- **Augmented Dickey-Fuller (ADF) test:** The results showed a p-value of 0.333, indicating non-stationarity.
- **KPSS test:** The p-value was 0.01, confirming the data was not stationary.
- Seasonal differencing was applied to make the time series stationary.



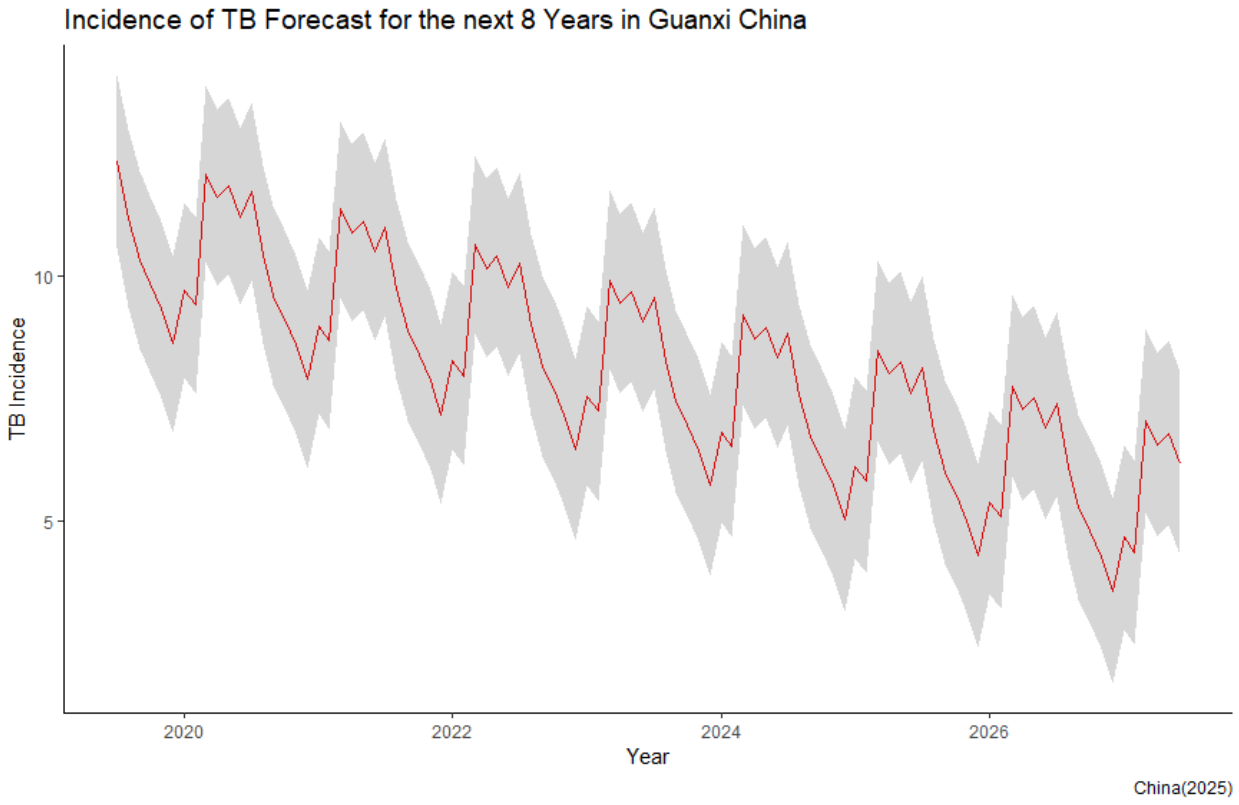
2.4 Model Selection and Forecasting

An **Auto ARIMA** model was used to identify the best-fitting model based on AIC and BIC criteria. The selected model was ARIMA(0,0,1)(0,1,1)[12] with drift, which was validated using residual diagnostic tests.

- **Residual Analysis:** The residuals followed a normal distribution, indicating the model's adequacy.



- **Ljung-Box Test:** The test returned a p-value of 0.9997, confirming the model's goodness-of-fit.
- **Forecasting:** The model was used to predict TB incidence for the next eight years (July 2019 - June 2027).



3. Findings

3.1 Trend and Seasonality

- A decreasing trend in TB incidence was observed from 2012 to 2018.
- Seasonal fluctuations were evident, with TB incidence peaking in specific months each year.

3.2 Forecasted Incidence

- TB incidence is expected to gradually decline over the forecast period.
- The projected values indicate a consistent pattern similar to historical trends.
- Forecast uncertainty increases over time, with a confidence interval widening in later years.

4. Recommendations

Based on the analysis and predictions, the following recommendations are proposed:

Resource Allocation: Public health authorities should allocate resources efficiently based on expected TB incidence patterns.

Targeted Interventions: Seasonal peaks suggest the need for intensified TB control measures during high-risk months.

Continuous Surveillance: Regular data collection and analysis should be conducted to monitor TB trends and refine predictions.

Public Awareness Campaigns: Community education programs should be strengthened to improve TB prevention and early diagnosis.

Enhanced Medical Support: Healthcare infrastructure should be improved in high-risk areas to provide timely diagnosis and treatment.

5. Conclusion

The time series analysis and forecasting of TB incidence in Guangxi, China, indicate a gradual decline in cases with persistent seasonal patterns. The results provide valuable insights for policymakers in optimizing TB prevention strategies and resource distribution. Future research could incorporate additional factors such as socio-economic indicators and healthcare access to enhance predictive accuracy.