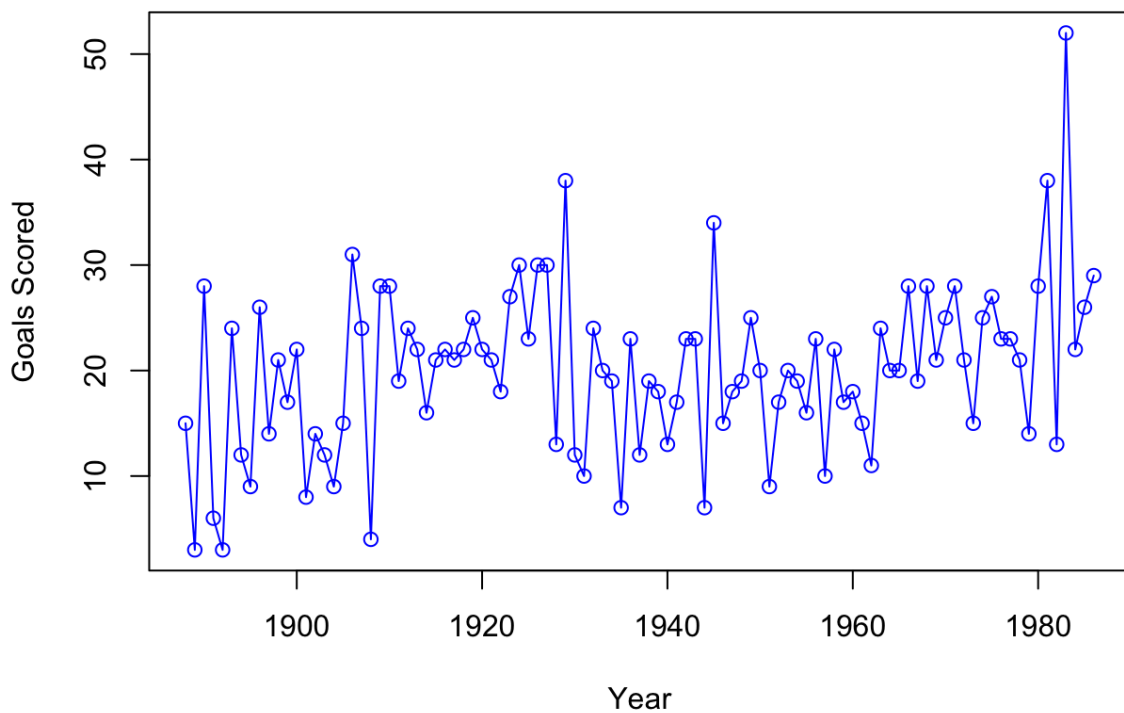# Results Interpretation

1. Time Series Analysis of Goals Scored

- **Time Series Plot**: The plot illustrates how **England's goal-scoring performance** fluctuated from year to year. Significant fluctuations suggest a **lack of consistency** or a presence of periodic variations.
- **Interpretation**: The plot reveals some significant fluctuations in goals scored over the years, suggesting a level of inconsistency or variability in England's goal-scoring performance. The series shows some periods of relatively higher scores, followed by quieter periods.

Goals Scored by England

- **Differenced Time Series Plot**: After differencing, the time series becomes more stable around zero, indicating that the data was initially non-stationary and required transformation to meet ARIMA's assumptions.
- **Interpretation**: The differenced plot helps to stabilize the mean and remove any apparent trends, confirming that the data was non-stationary before differencing. The result is a series that fluctuates around zero, which is characteristic of a stationary time series.

Differenced Goals Scored
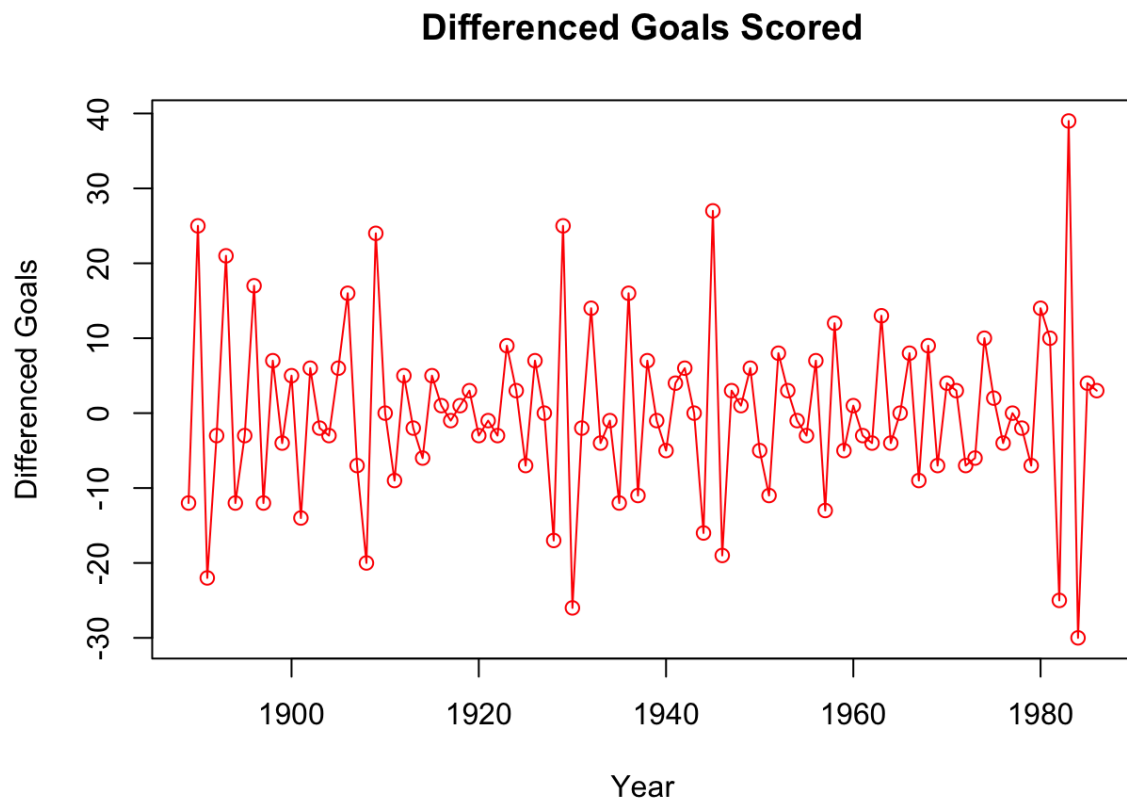
2. Stationarity Test

- **ADF Test p-value**: The ADF test on the original series returned a **p-value of 0.1517**, which is above the threshold of 0.05, indicating that the series is **non-stationary**. Therefore, we applied differencing to the time series.
- After differencing, the ADF test on the differenced series returned a **p-value of 0.01**, which is less than 0.05, confirming that the series is now **stationary**. This is an important step in time series modeling, as ARIMA models require stationary data.
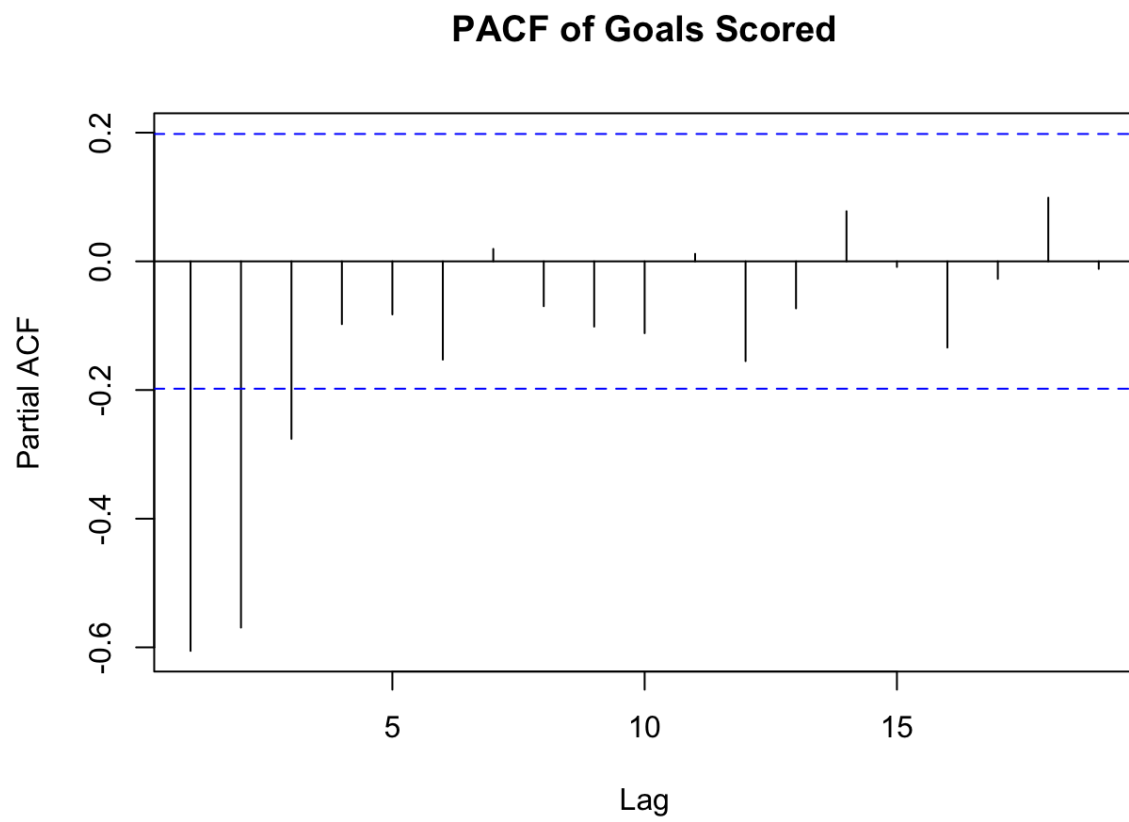
3. Autocorrelation and Partial Autocorrelation (ACF & PACF)

- **ACF Plot**: The autocorrelations suggest that the time series is somewhat autocorrelated, with some lags showing correlation.
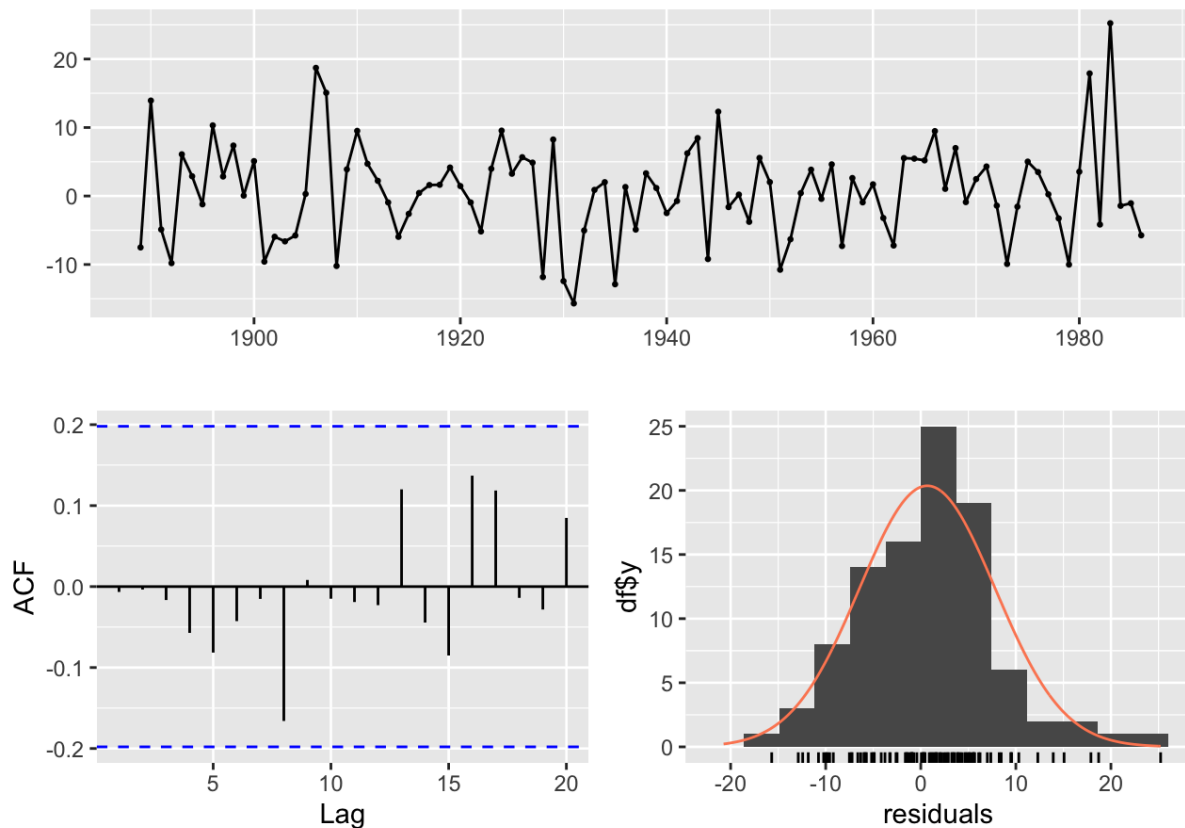
ACF of Goals Scored
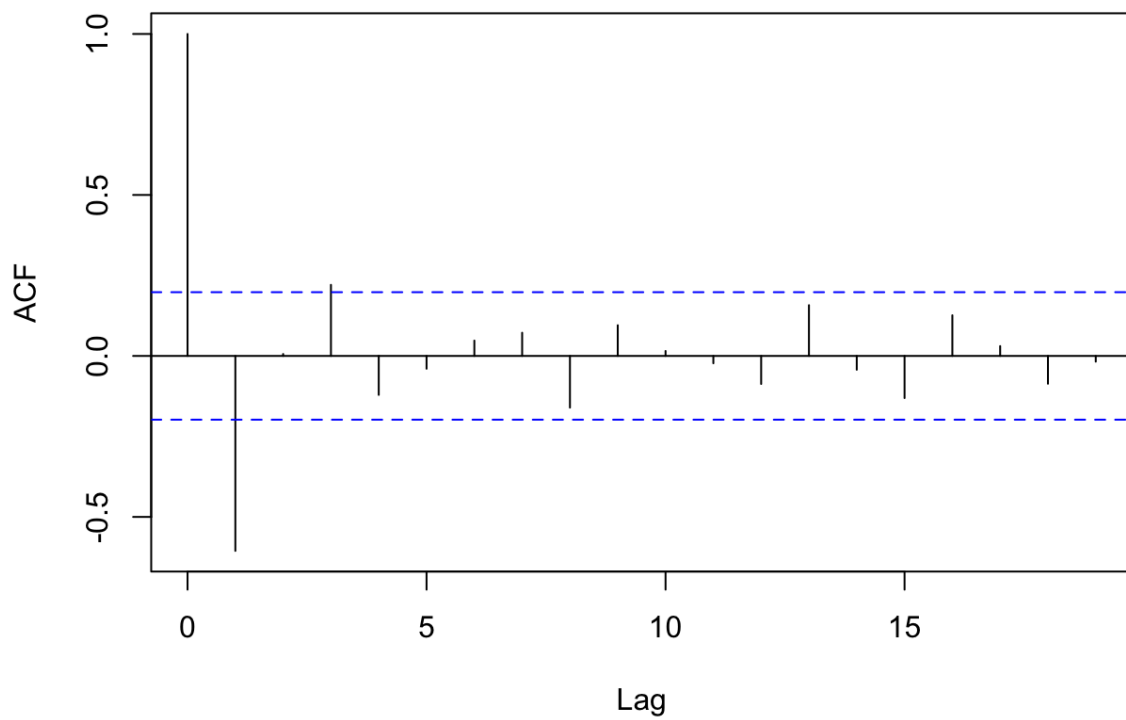
- **PACF Plot**: Significant spikes at **lags 1 and 2** indicate the use of **AR(2)** terms in the ARIMA model.

PACF of Goals Scored

4. ARIMA Model (AR(2), I(0), MA(1))

Residuals from ARIMA(2,0,1) with zero mean

- **Model Fit**: The ARIMA model selected was **ARIMA(2,0,1)**, meaning it uses two autoregressive (AR) terms, no differencing (I=0), and one moving average (MA) term.
  - **AR(1)** = -0.5993, **AR(2)** = -0.3516: These values suggest a moderate relationship between the current and two previous observations.
  - **MA(1)** = -0.5545: This indicates the model accounts for the previous forecast error.
- **Model Performance**:
  - **AIC**: The AIC (Akaike Information Criterion) value of **672.91** suggests that the model fits the data reasonably well.
  - **RMSE**: The RMSE (Root Mean Squared Error) of **7.14** and **MAE** (Mean Absolute Error) of **5.45** show that the model has a reasonable fit, though there's still some room for improvement.

5. Forecasting and Prediction Results

- **Forecast Values**: The forecasted goals for the years **1987–1991** are close to zero, with wide confidence intervals:
  - **1987**: -0.02
  - **1988**: -1.04
  - **1989**: 0.63
  - **1990**: -0.01
  - **1991**: -0.21
  - **Confidence Intervals**: The wide confidence intervals (ranging from -22 to 22) reflect the uncertainty in the forecast due to variability in past data and a lack of clear trends.

Forecast of Goals Scored by England
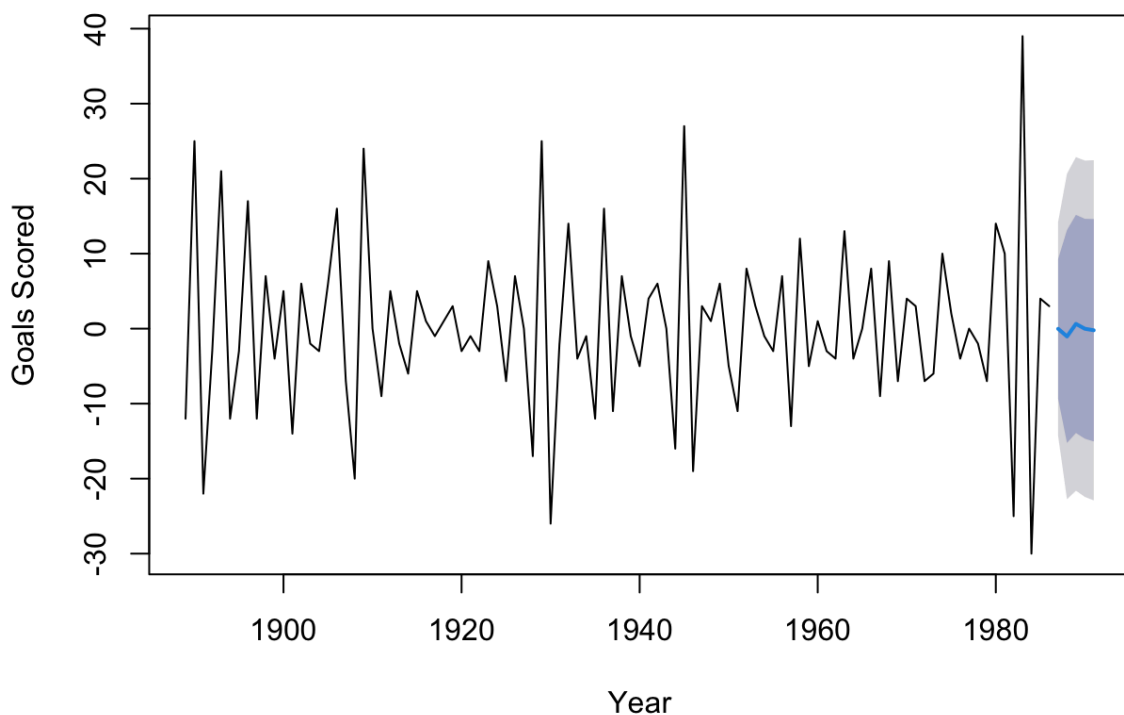
- **Interpretation**: The forecast suggests that England's goal-scoring performance in the coming years will likely remain stable with minimal variation. However, the wide confidence intervals highlight significant uncertainty in the forecast. The lack of strong trends or seasonality in the historical data makes it difficult to predict future performance with high confidence.

6. Residual Diagnostics

- **Residuals Plot**: The plot of the residuals shows that they fluctuate around zero, with no significant patterns, suggesting that the model has adequately captured the underlying structure of the data.

Residuals of the ARIMA Model
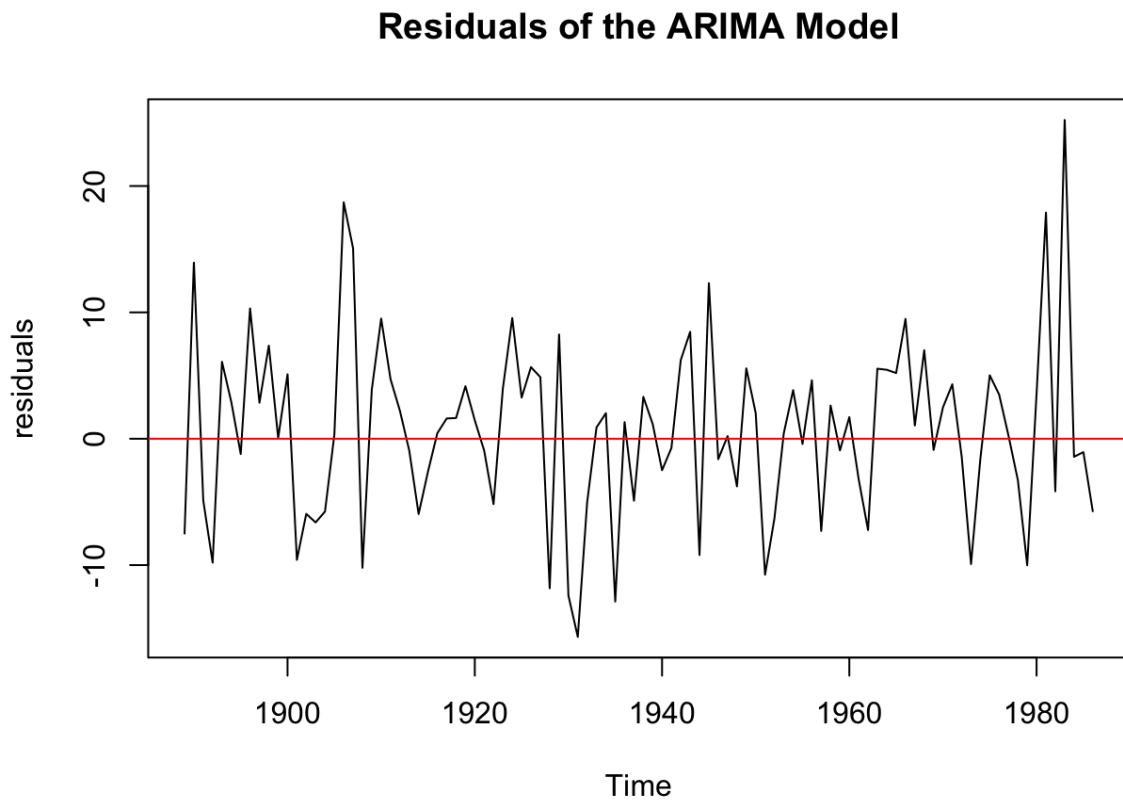
- **Ljung-Box Test**: The p-value of **0.7416** for the Ljung-Box test indicates no significant autocorrelation in the residuals, confirming that the model fits well.

- **Histogram of Residuals**: The residuals histogram appears roughly normal, which is another good indicator that the model is appropriate for the data.

Residuals Histogram
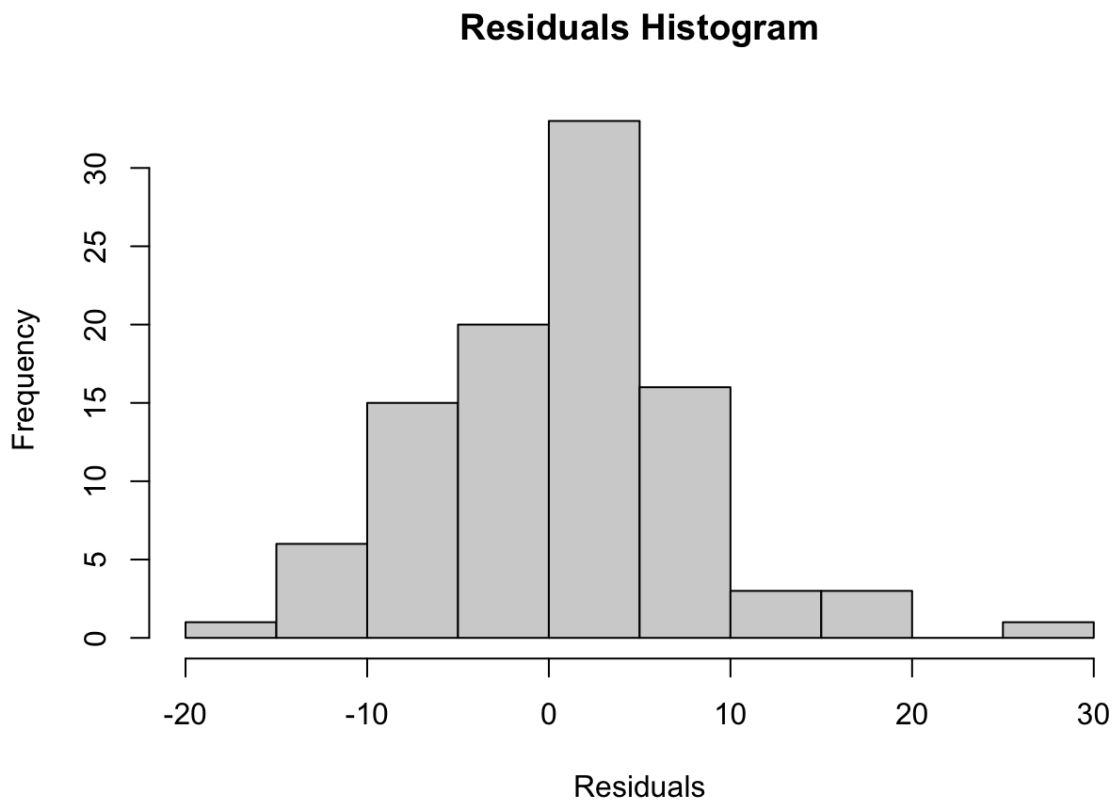
7. Key Insights and Visualizations

- **Time Series Plot**: The first graph effectively illustrates how England's goal-scoring performance has fluctuated over time, showing both high and low points.
- **Forecast Plot**: The forecast plot shows the predicted goals for the next five years, with wide confidence intervals indicating uncertainty about future performance.
- **Residual Plots**: The residual analysis, including the residuals plot and histogram, confirms that the ARIMA model has fit the data well, with no significant patterns or large deviations from the expected normal distribution.

8. Conclusion and Recommendations

- **Model Reliability**: The ARIMA model performs reasonably well, but the wide confidence intervals suggest that the predictions are uncertain. The lack of strong seasonality or trends in the data makes it difficult to predict future goals accurately.
- **Forecast Interpretation**: While the forecast suggests stable performance in terms of goals scored, the variability and wide confidence intervals should be considered when making any strategic decisions based on this forecast.
- **Next Steps**:
    - Further model refinement might involve exploring SARIMA (Seasonal ARIMA) models if seasonality is suspected or additional features are incorporated (e.g., player performance, injuries).
    - Expanding the model to include external factors or data from multiple teams could provide richer insights.

This analysis concludes that while the ARIMA model provides a reasonable forecast of England's future goal-scoring performance, the uncertainty in the predictions means that external factors should be considered for more accurate forecasting.