**1. Data Visualization:**

**Time Plot of Mean Temperature:**

The provided time plot shows mean temperature data over several years. The plot reveals distinct cyclic patterns, likely indicating seasonal variations. The peaks and troughs might correspond to the summer and winter months, respectively, in a specific geographical location.

A graph showing the temperature of a person

Description automatically generated

**2. Decomposition of Time Series:**

The decomposition provides a breakdown of the original series into three components: trend, seasonality, and residuals.

**Trend**: The trend component exhibits a gentle undulation, but there doesn't seem to be a consistent upward or downward progression over the years. This indicates that while there might be short-term fluctuations in temperature, over the years, there hasn't been a dramatic rise or drop.

**Seasonality**: The clear repeating pattern in the seasonality component suggests annual cyclic variations, likely corresponding to seasonal changes in temperature. This is consistent with our observation from the time plot.

**Residuals**: Ideally, residuals should be random. In this decomposition, the residuals display minor fluctuations around the zero line, suggesting that the trend and seasonality components have captured the main patterns effectively.

A graph of a graph of a graph

Description automatically generated with medium confidence

**3. Forecasting using ARIM and ETS:**

**ARIMA Model Analysis:**

**a.** **Forecasting**:

The ARIMA model used for forecasting plot shows fluctuations in the data with a clear seasonality pattern.

A graph with black lines

Description automatically generated

**b. Residual Analysis:**

The residuals of a model give insight into the model's fit. For a good model, residuals should resemble white noise, meaning they should be randomly distributed around zero without any pattern.

A graph of a sound wave

Description automatically generated

**ARIMA Residuals Plot:** The plot shows residuals over time. Ideally, the residuals should hover around the zero line without any discernible pattern.

**ETS Model Analysis:**

**Forecast:**

The ETS forecast reveals continuations of the observed patterns. The cyclical behavior continues, implying a recurrence of the seasonal patterns.

A graph with black lines

Description automatically generated

**ETS Residuals:**

The ETS residuals appear to hover around the zero line, indicating the model has done a reasonably good job in capturing the underlying patterns. There's no clear trend in the residuals, suggesting the randomness we would expect from a well-fitting model.

A black and white graph

Description automatically generated

**Discussion:**

**ARIMA Model**: The chosen ARIMAmodel seems to capture the time series data well, as observed from the forecast plot. The residuals also seem to be randomly distributed around zero, suggesting a decent fit. However, the ACF of the residuals suggests some minor correlations at certain lags, indicating potential room for improvement.

**ETS Model:** The residuals from the ETS model, as visualized by the ACF plot, also suggest some minor correlations. This indicates that while the ETS model captures a significant portion of the time series patterns, there might be some aspects that it's missing.