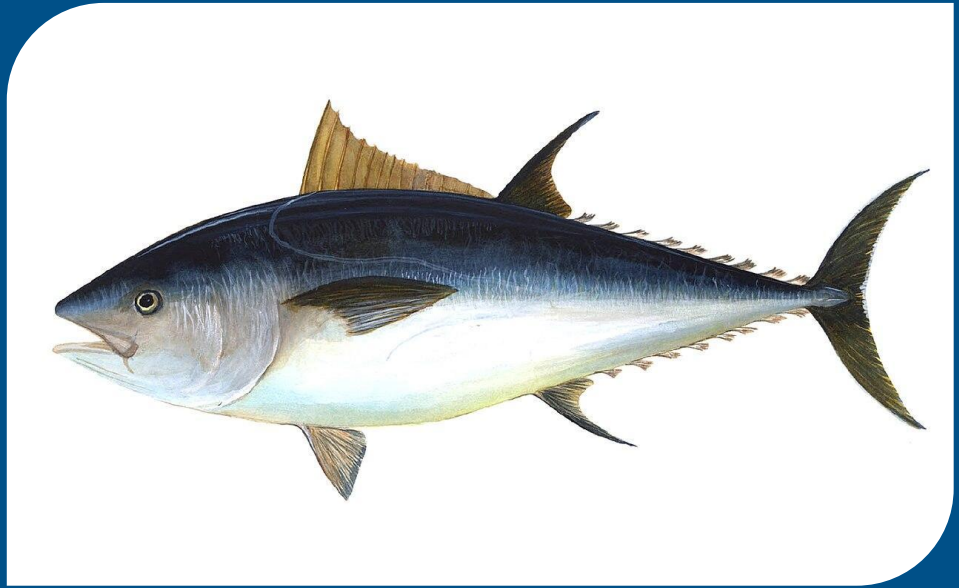
Tokyo's Bluefin Tuna Trends

Data Source: Tsukiji Tuna Prices

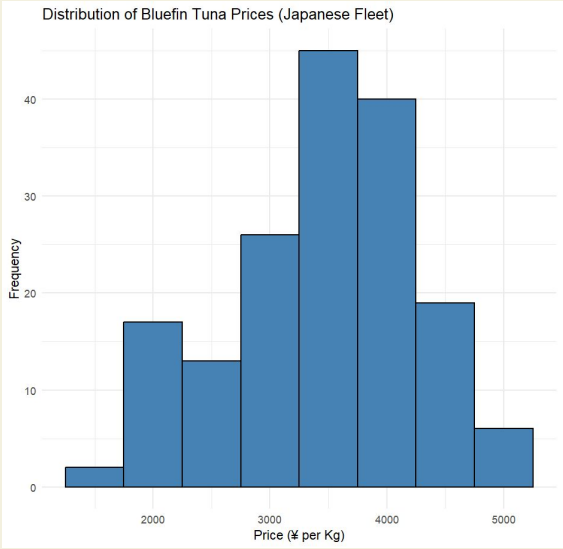
Laurynn Coleman, Justin Elwell, Thomas Cerreto, Romontae Thornhill, and Tammie Beckett



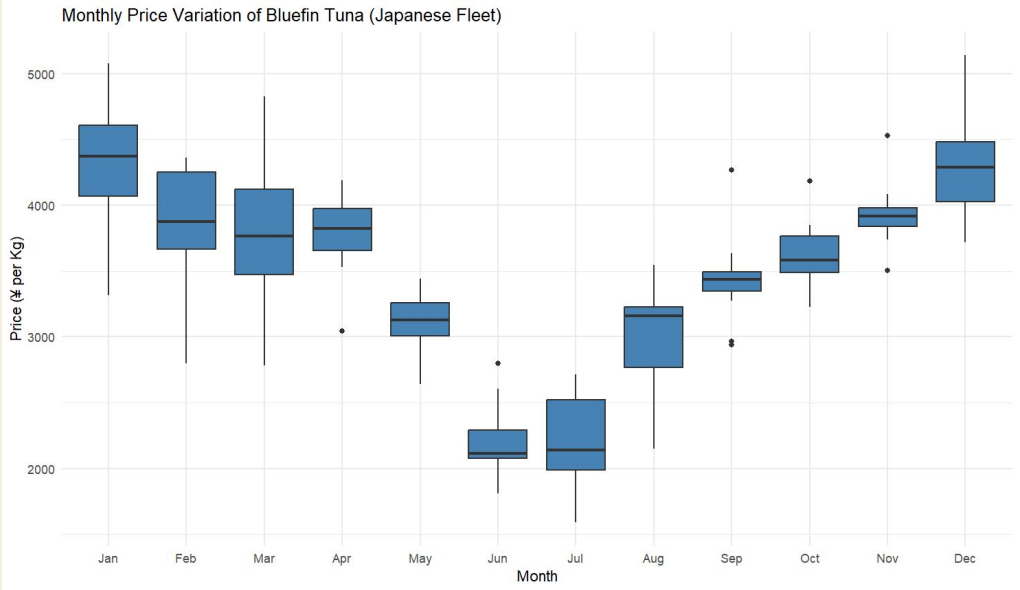
Overview of Data

- **Data in Focus:** A dataset on the wholesale prices of Bluefin Tuna in Tokyo's Tsukiji markets.
- **Timeframe and Granularity:** Monthly records spanning 2003-2016, capturing the ebbs and flows of market dynamics.
- **Forecasting Aim:** To apply time series forecasting methods to predict 2017 market trends for Bluefin Tuna.
- **Stakeholder Value:** The forecast will assist market players in making informed decisions regarding procurement, sales, and sustainability efforts.

Introduction to the Data



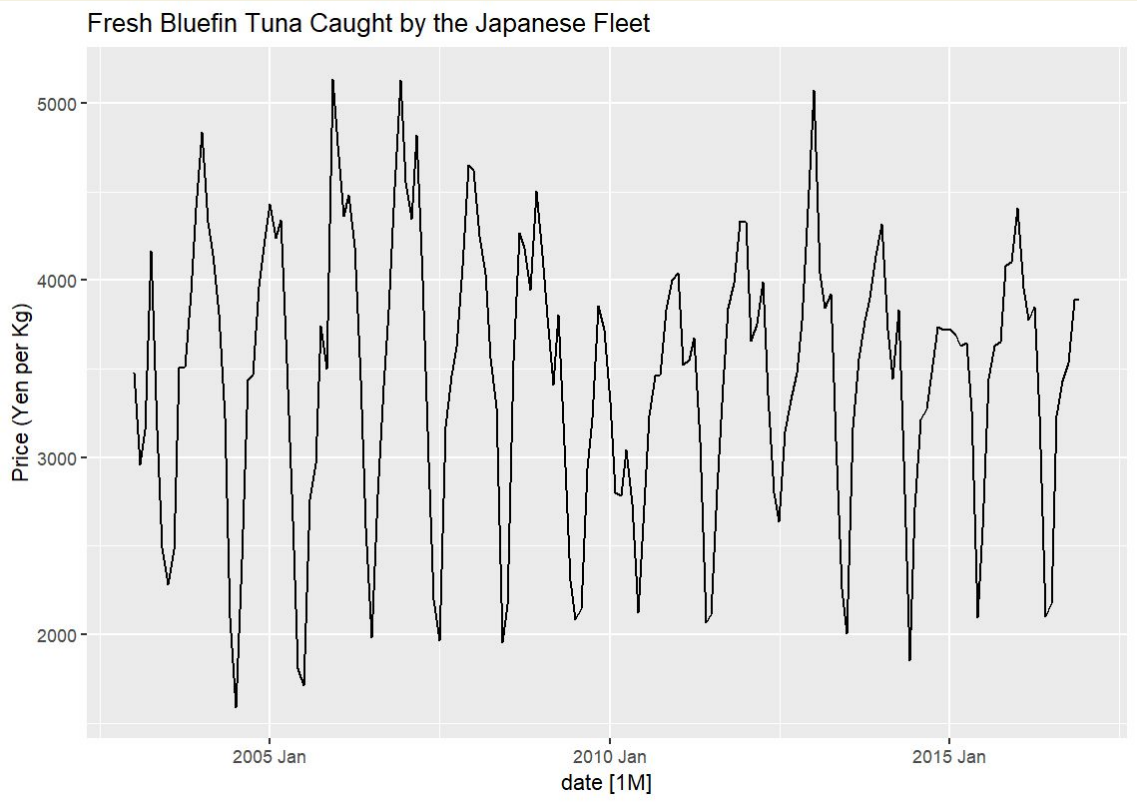
Histogram of Bluefin Prices: indicates a left skewed distribution with a peak ~3,500 yen per kg. This suggests that while prices can range widely, a majority of transactions occur within this price bracket.



Boxplot of Monthly Price Variation: Prices tend to be higher and more volatile during the winter months (December & January to March), which could indicate increased demand or limited supply during this period.

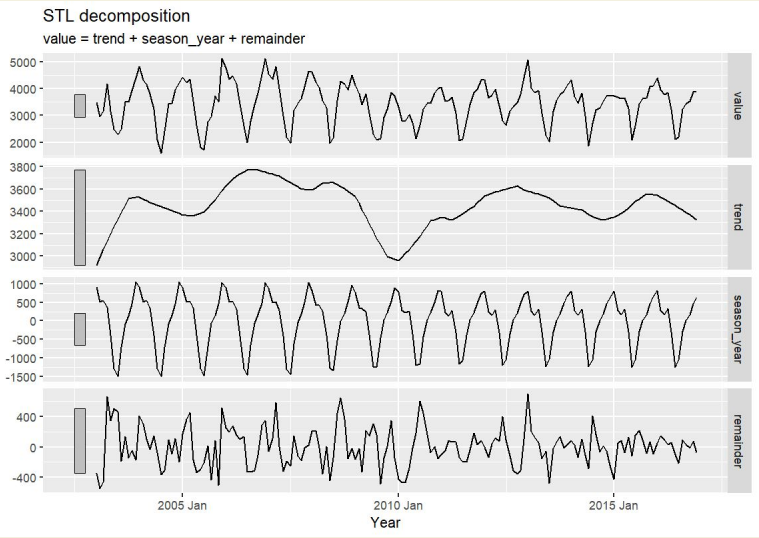
Lower and more stable prices in the summer months (May to August) could suggest a seasonal increase in supply or possibly a lower demand.

Bluefin Tuna Trends

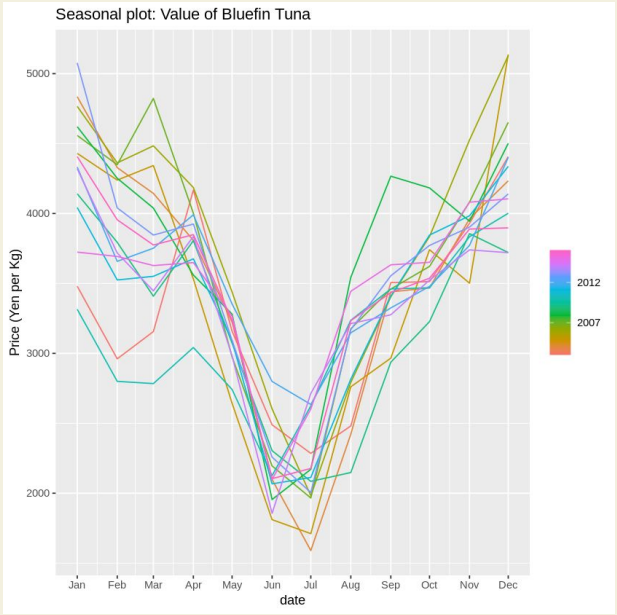


There seems to be a pattern of seasonality with the peaks and valleys, but let's look into it further.

Bluefin Tuna Trends



The trend line in the decomposition does not show a trend. There is one very large price decrease in 2009. The seasonal pattern (season_year) suggests multiplicative seasonality.



This shows a consistent seasonal pattern that may change in depth over the years. Overall, there is seasonality, which will affect what model we use.

Model Selection

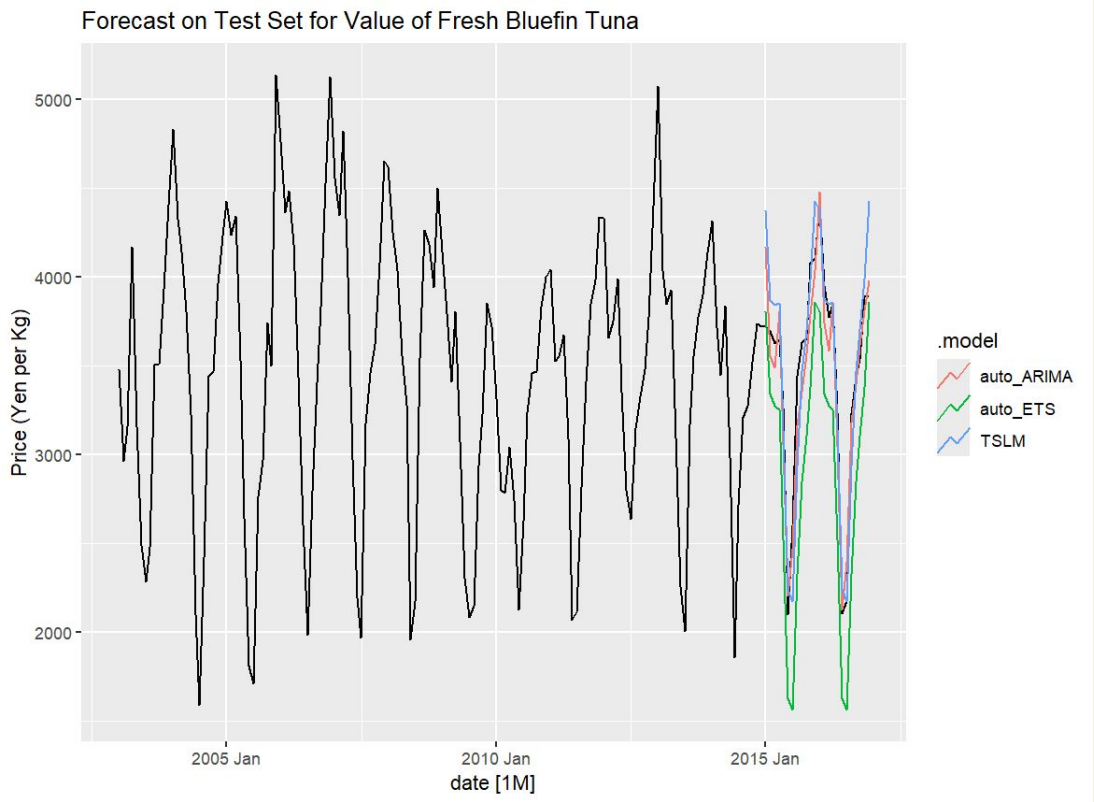
Training Data Isolation: Segregated all but the last two years of data (24 months) to form the training set for model building.

Data has monthly multiplicative seasonality, therefore is non-stationary.

- auto_ARIMA
- auto_ETS
- Log transformed TSLM

Dip in 2009 (shown in STL decomposition), therefore a recession indicator variable added.

Forecast Output



Accuracy Measures

	Models	RMSE	MAE	MAPE
#1	auto_ARIMA $(1,0,0)(2,1,0)_{12}$	181.	149.	4.41
#2	TSLM	260.	194	5.73
	auto_ETS (ANA)	615	560	17.2

Based on the lowest RMSE, MAE, and MAPE, models Auto-ARIMA and TSLM performed the best.

Cross Validation: Auto_ARIMA vs TSLM

	Models	RMSE	MAE	MAPE
#1	auto_ARIMA	278.	216.	6.98
	TSLM	430.	302.	9.53

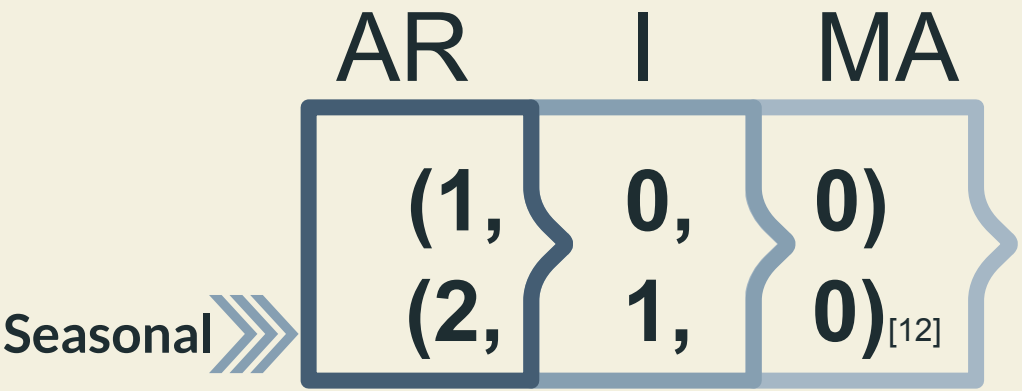
Cross validation: the data set was split sequentially to train and test the models multiple times for stability.

Parameters: There are 168 available observations. We used 80 observations in the training period, stepping forward 3 observations at a time resulting in 30 different training periods.

The formula to calculate the number of training periods is:

$$Training\ Periods = \frac{Total\ Observations - Initial\ Training\ Set\ Size}{Step\ Size} + 1$$

Model Overview: Auto-ARIMA



AR (Autoregressive)

- Models current values based on previous values.
- Uses a linear combination of past values (p terms).

I (Integrated)

- Differencing raw observations to remove trends and seasonality.
- Denoted by d, represents the change from one observation to the next.

MA (Moving Average)

- Models current values as a function of past forecast errors.
- Number of terms (q) shows how past errors influence predictions.

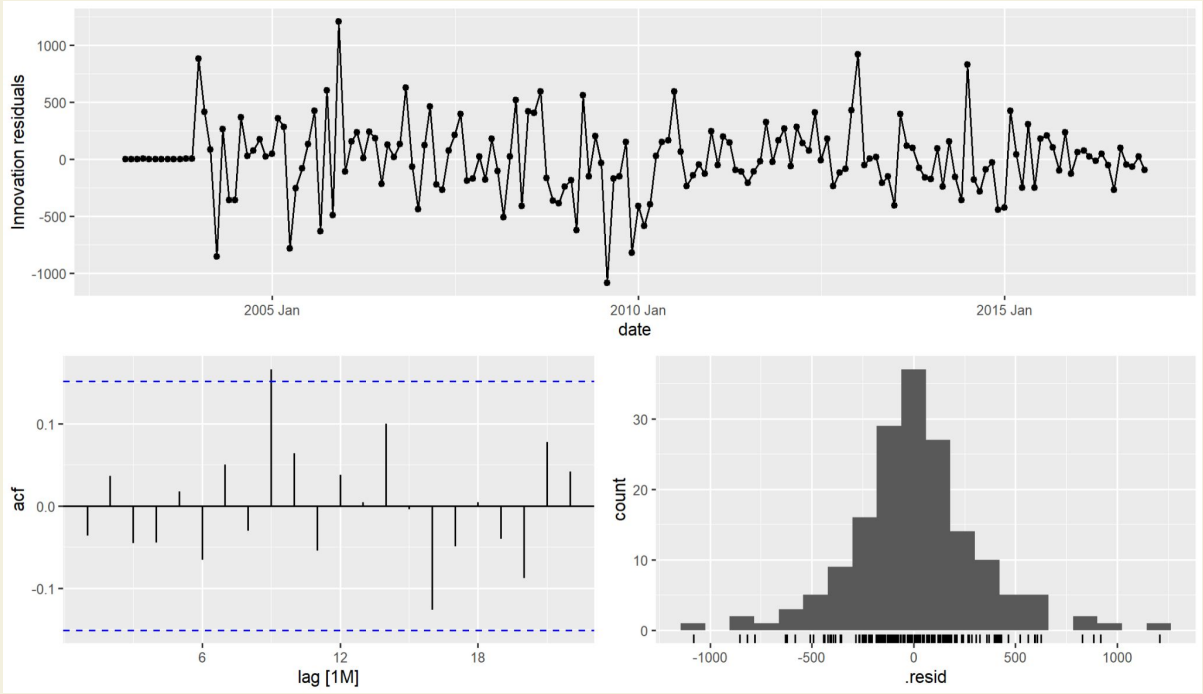
Residual Analysis

Term	Est.	P-Value
AR1	0.651	6.47e-19
SAR1	-0.558	2.96e-10
SAR2	-0.323	2.66e- 4

AR1 suggests that a higher price in the previous period is associated with a higher price in the current period.

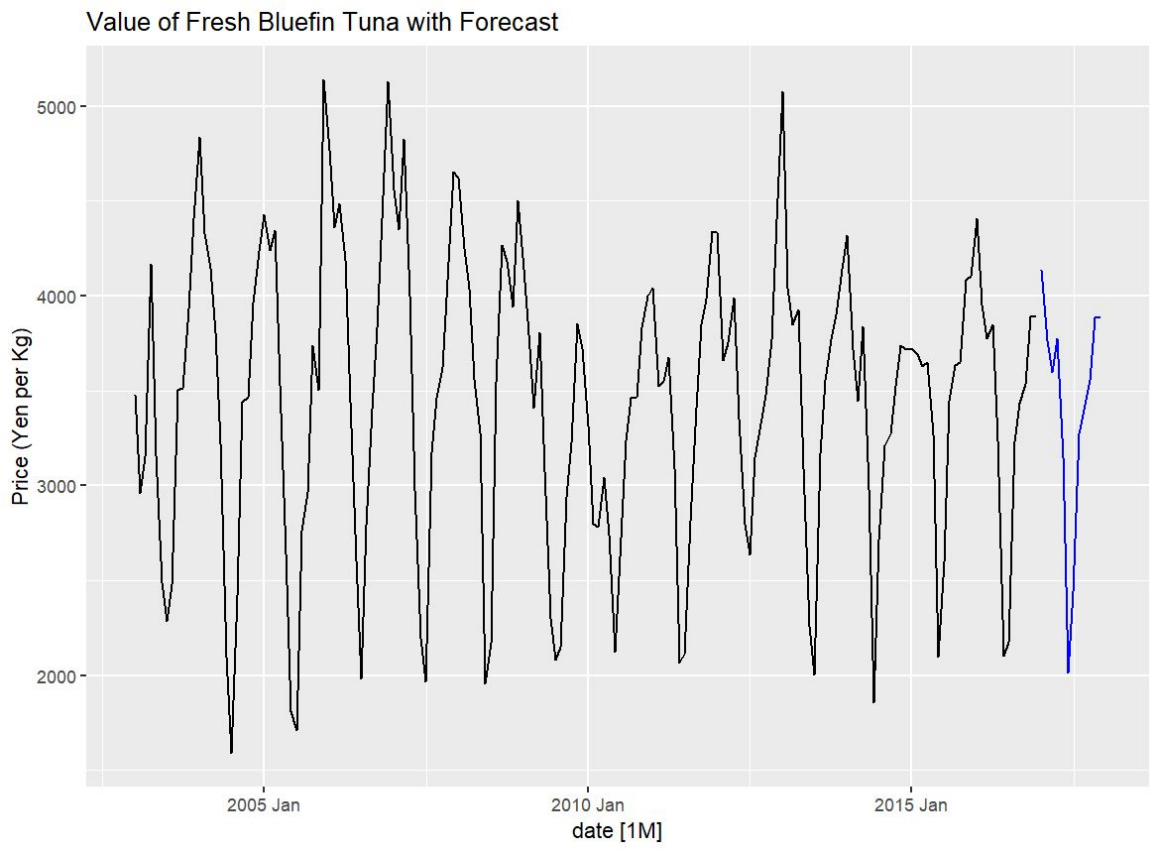
SAR1 suggests that there is a negative relationship between the current value and the value from one season ago

SAR1 suggests that the value from two seasons ago has a negative relationship with the current value.

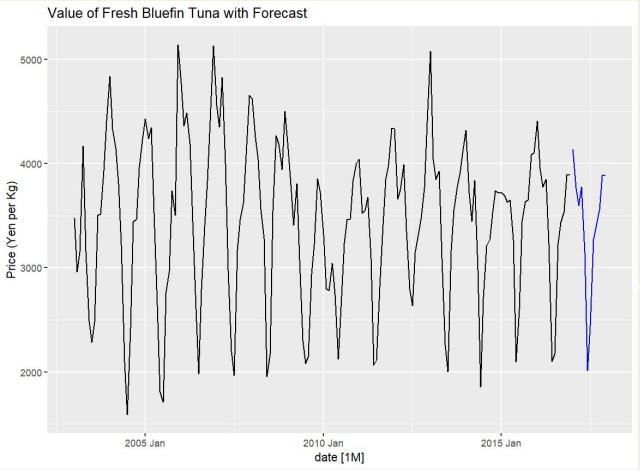


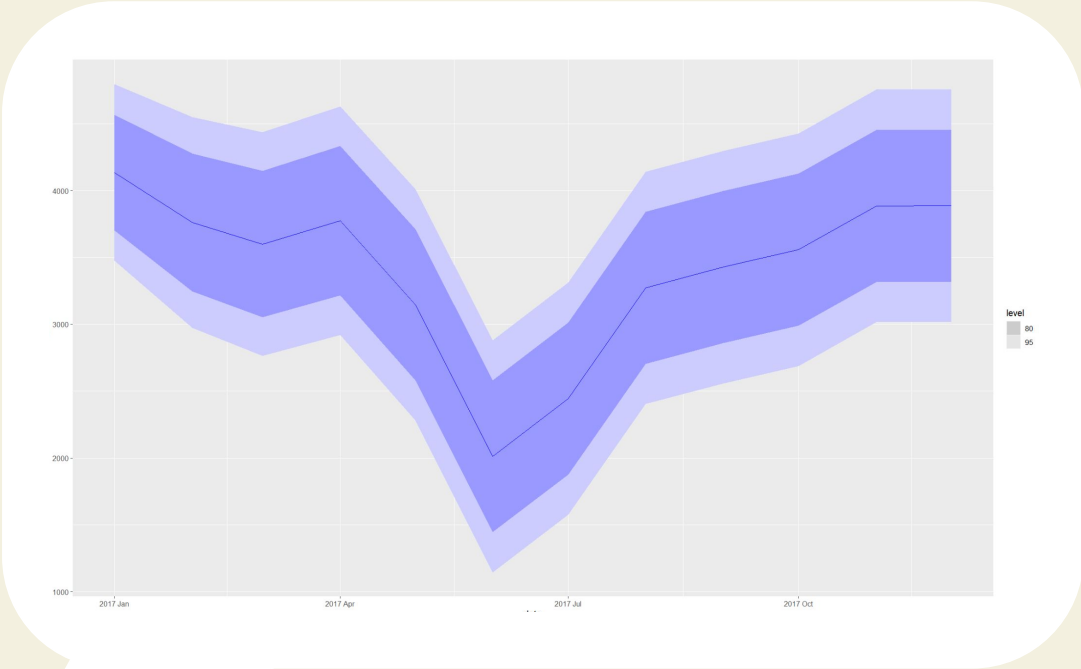
Residuals appear to be homoscedastic and normally distributed. There is one significant autocorrelation at lag 9, but it is not large enough to be a major concern and not in lags 1 or 2.

The Final Forecast



The Final Forecast





Thank You!