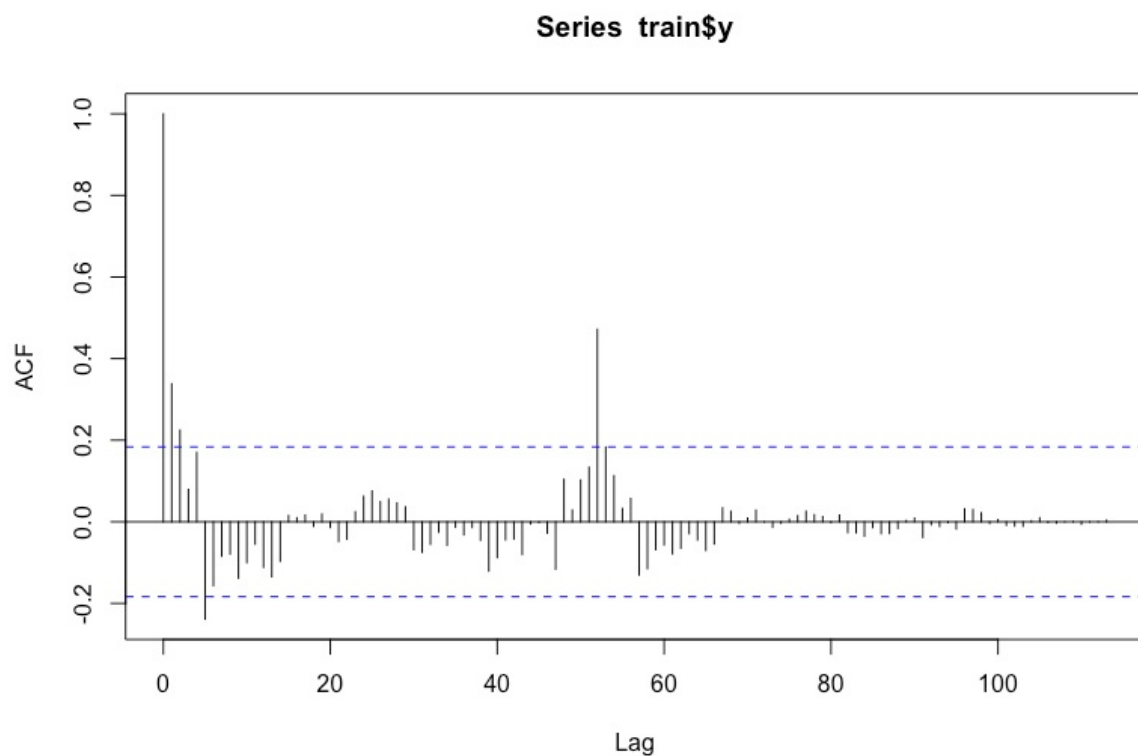


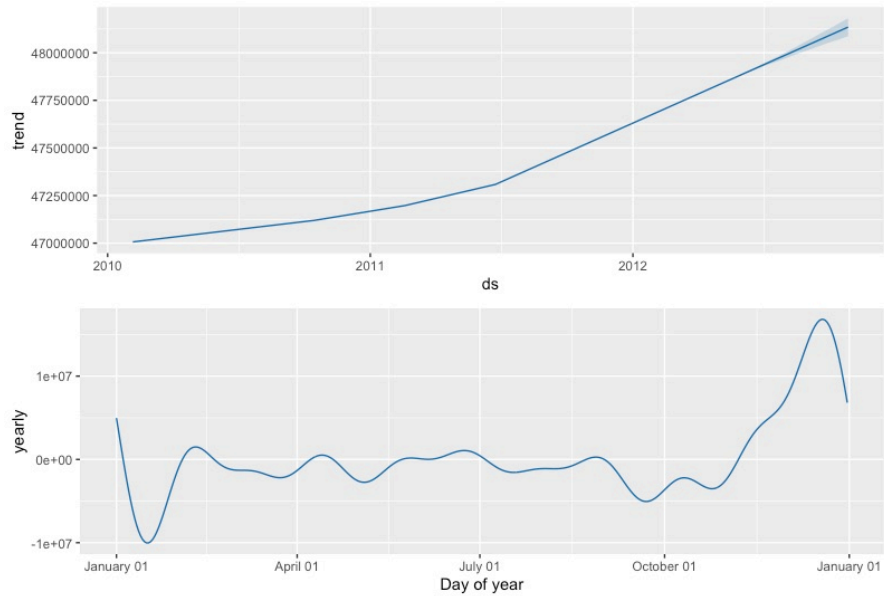
Part 4: Prophet Model and Sales Forecasting

The last model was used with Walmart Sales Data is the Prophet model. There are several reasons for using this model. First, the Prophet model is suitable for data with solid seasonality, and the Sales data has extreme seasonality based on the analysis from the previous part. Second, the Prophet model helps identify and state change points in the time series. These changepoints can either be manually configured or automatically detected. The experiment found that manually defining the number of changing points helped increase the model's accuracy. Otherwise, the model might be overfitting.

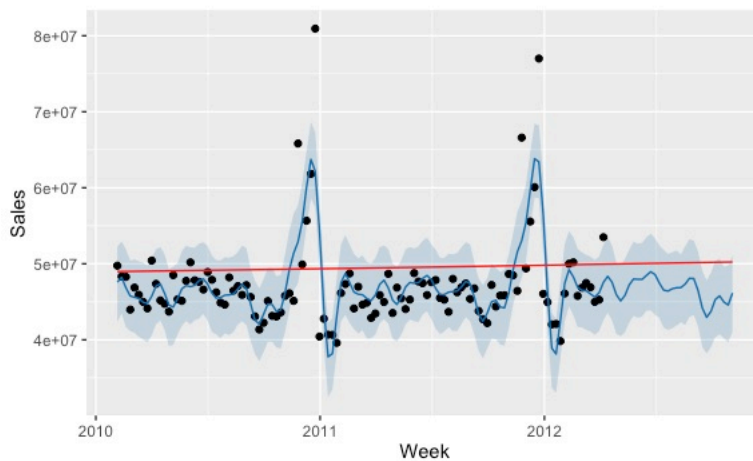
Determine the original Prophet Model:



From the ACF plot, there are five significant changepoints that should be included in the Prophet model.



The above image shows the components of the Prophet model when the prediction is applied. A clear linear trend could be seen from the data. The yearly residual trends also show no definite pattern, which confirms the linearity of the time series.

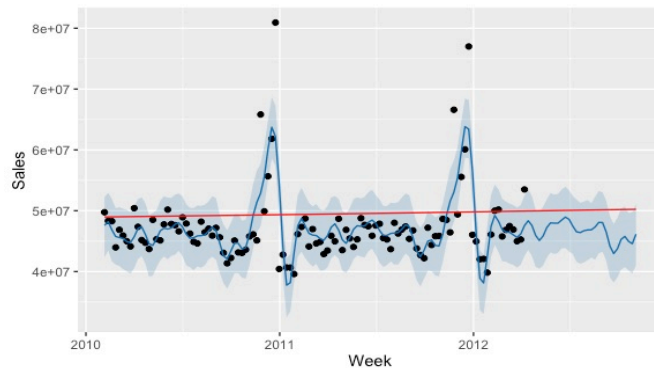


As shown by the plot above, the sales predictions for the last 30 weeks are within the confidence bands. The trend is also consistent with the trend implied in the training data. The MSPE for the Prophet model is 2.357449%. This result is impressive for fitting and predicting a model.

Prophet Model with different parameters:

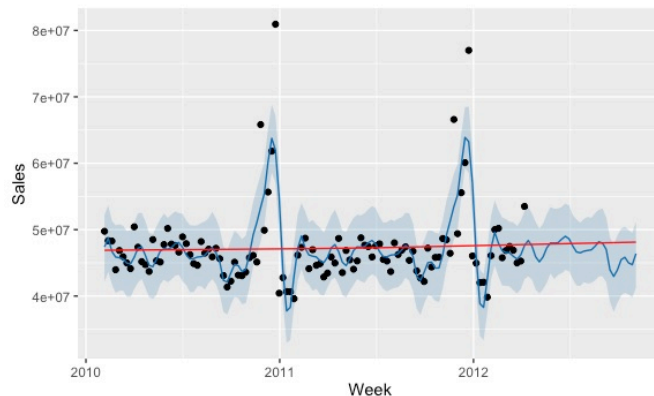
Moreover, many different parameters were experienced to illustrate the influences of those parameters to the Prophet model, determined by the change in MSPE.

Prophet model with weekly seasonality



- Introduced weekly seasonality from the original model
- Experience the change in MSPE. For example, the model MSPE is 2.383013%, which slightly increased from the original model.
- The increasing of MSPE result in rejecting the weekly seasonality as a parameter for Prophet model.

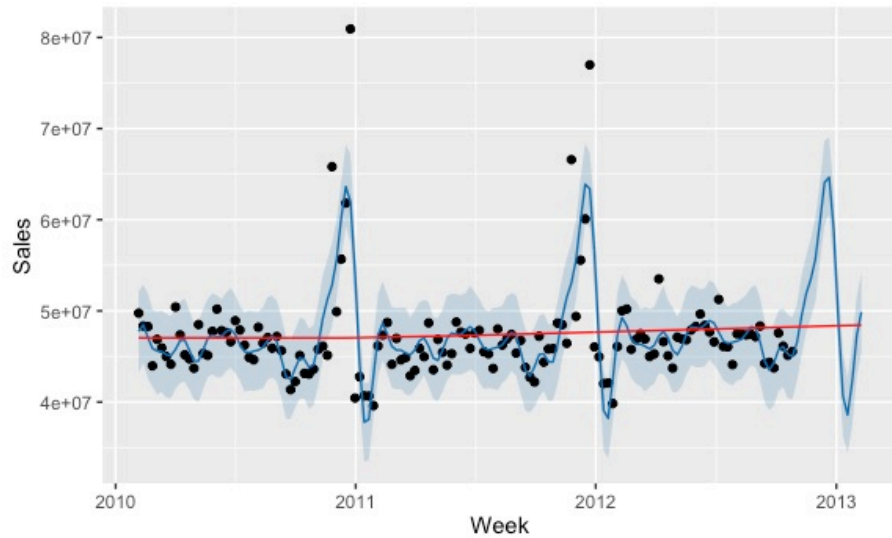
Prophet Model with Holiday



- Introduced holiday for the training model.
- This model MSPE is 2.357862%, which increased from the original model.
- The increasing of MSPE suggested that the Prophet model should not include holiday as a parameter.

Forecasting with Prophet Model:

Prophet model was also used to forecast the additional 14 weeks from the original data.



In conclusion, the Prophet model did a great job fitting and forecasting Walmart's Weekly Sales. The MSPEs are low for all experienced models, and the model potentially can capture the trend and seasonality of the data.