Claim Count Forecasting

Commercial Property

Mrudula Devarakonda

Agenda

- Executive Summary - **3 Minutes**
- Insurance 101 - **2 Minutes**
- Data Exploration - **4 Minutes**
- Modeling Approach & Results - **5 Minutes**
  - Hail Model
  - Weather Model (Non-CAT & Non-Hail)
  - xWeather Model (Non-CAT & Non-Hail)
- Next Steps - **1 Minutes**

Executive Summary

Business Challenge: Forecast 12 months of claim frequency for commercial property risks

Intro

- Company in question is a major market share player in the USA
- Commercial property focused analysis
- Forecasting claim volumes assists in the reserving process
- Claims are difficult to predict due to behavior and non-behavior forces
- Property reserves are critical to managing the business

Data Analysis

- 10 years of claim data
- For frequency modeling, weather vs non-weather is the most important bifurcation of the data
- Non-Hail catastrophic (CAT) activity is all noise
- “All other” activity is all noise
- Seasonality is important
- Underwriting appetite has remained consistent

Modeling Approach & Results

- Break data into 3 independent datasets and build 3 separate models
- Hail Model: ESM Additive
- Non-CAT Weather: Winters Multiplicative
- Non-CAT xWeather: Winters Multiplicative
- Combine the results of the 3 models for guidance

Next Steps

- Work with loss analytics on seasonal pattern of non-weather water claims
- Peer review models with actuarial and R&D
- Recommend that Non-Hail CAT activity use industry standard models like RMS or AIR for hurricane, earthquake, terrorism & wildfire
- Recommend a simple 5 year average claim volume for “All Other” activity

Insurance 101

Slides 5-7

Why Are Reserves Important?

Property and Casualty Insurance Companies Differ Most Traditional Companies

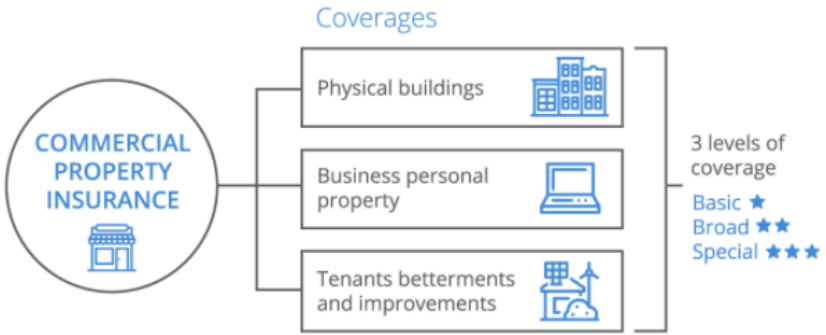
	Insurance	Ducati
Product		
Cost of Goods Sold	UNKNOWN!!	KNOWN
Distribution Costs	KNOWN	KNOWN
Administrative Exp.	KNOWN	KNOWN
Financial Costs	KNOWN	KNOWN

Insurance companies do not truly understand their future liabilities (cost of product) thus reserves are needed

Understanding Commercial Property

Typical Commercial Property Coverage

Oversimplification !Caution!



Everything In-between

Small

Large

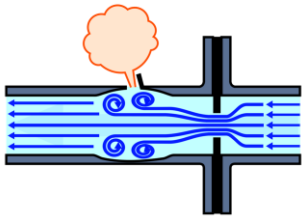
Property insurance is designed, generally speaking, to indemnify against direct physical loss of Real property

Understanding Commercial Property Losses

The Event That Causes The Loss Is Called A Peril

Illustration Of Peril Types (There Are More)




Losses Are Caused By Perils

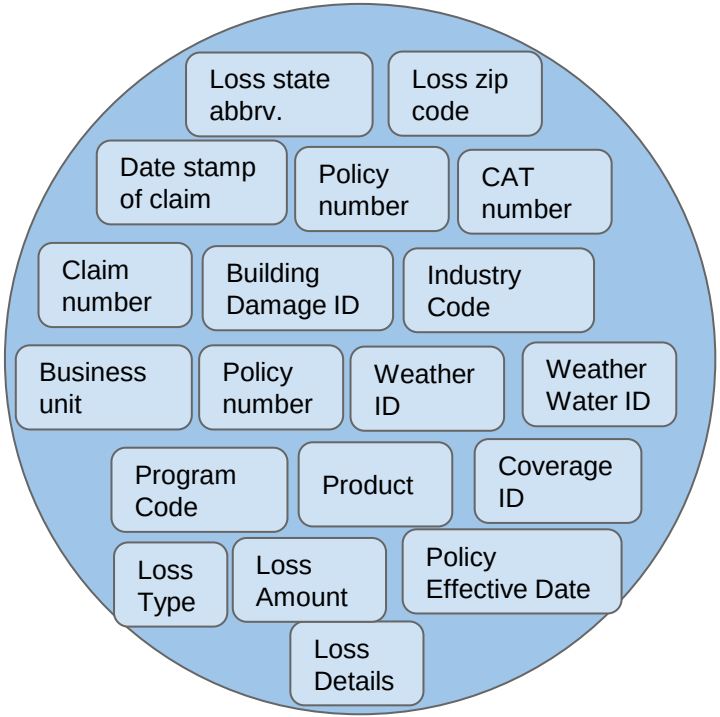
Perils are another word for event and a policy can choose to include or exclude perils, so read the contract!!

Data Exploration

Slides 9-13

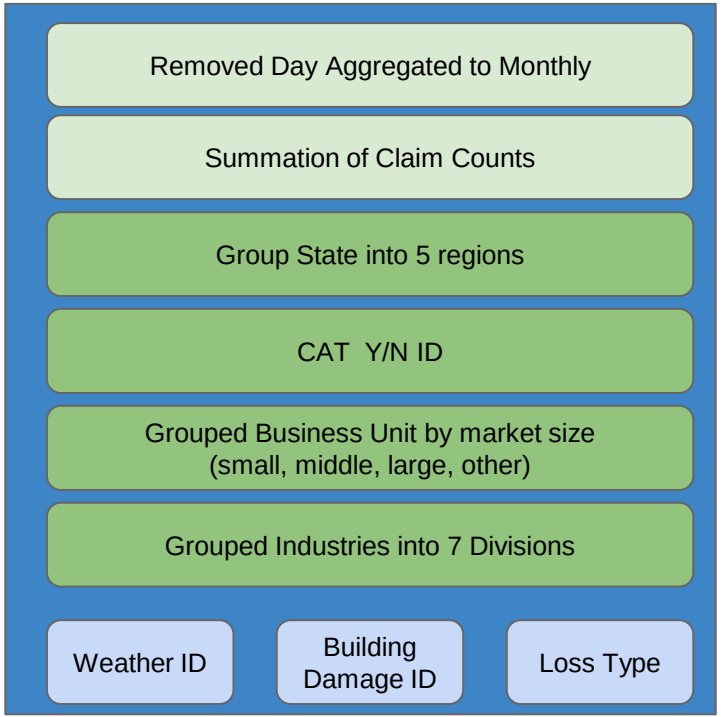
Making Sense out of Transactional Data

Transactional Data



Transform & Accumulate

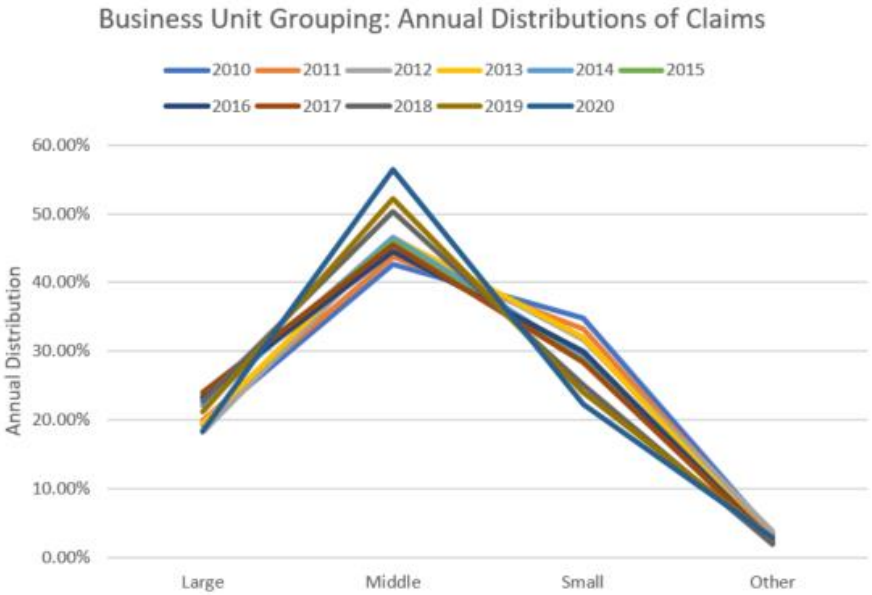
Accumulated Time Series Data

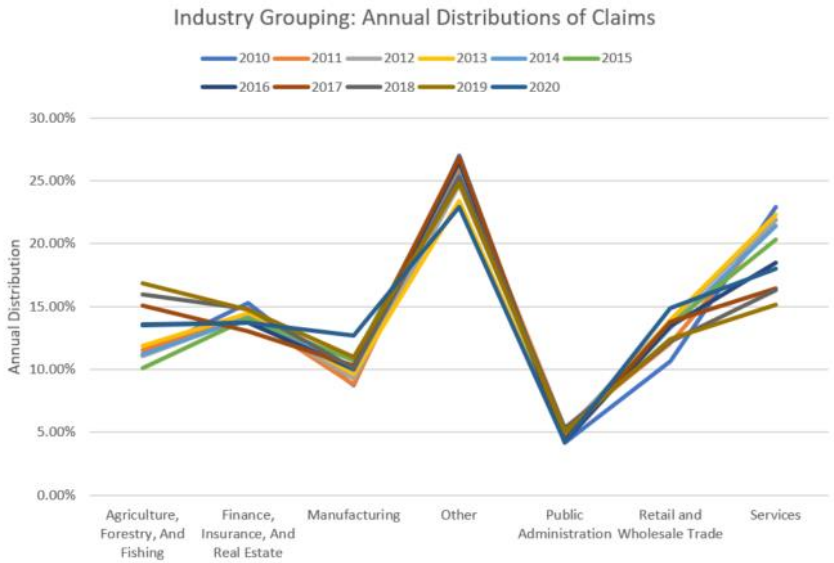


Domain knowledge, analysis, and intuition guided in the transformation and accumulation process

Data Exploration Part 1

Analyzing Key Differentiators In the Data

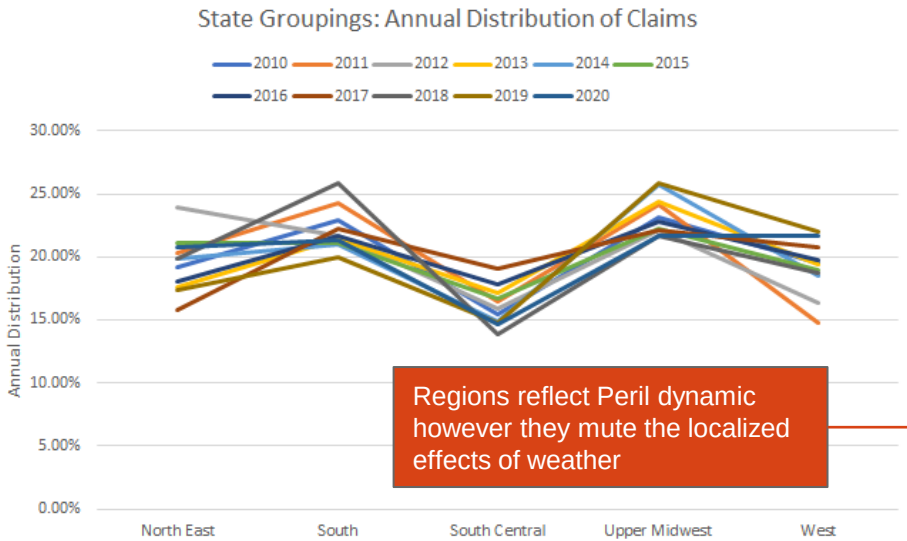


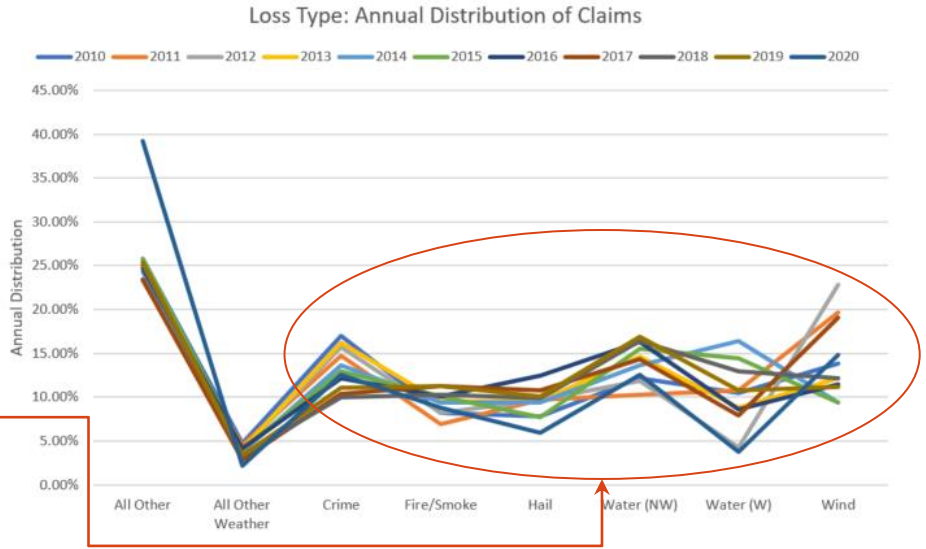


Due to underwriting appetite annual claim distributions are consistent across business units and industries

Data Exploration Part 2

Uncovering The Key Drivers



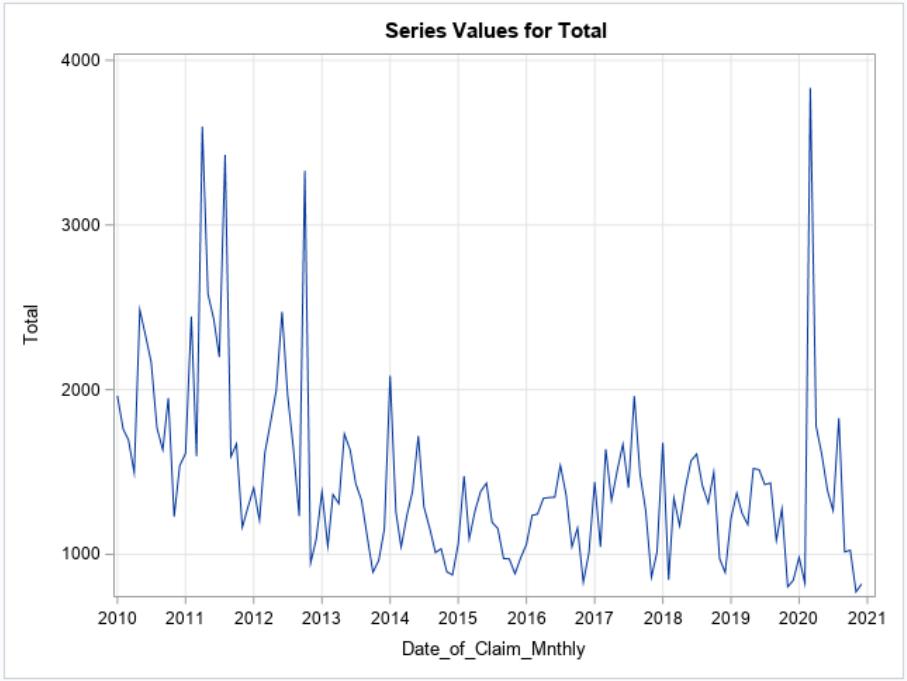


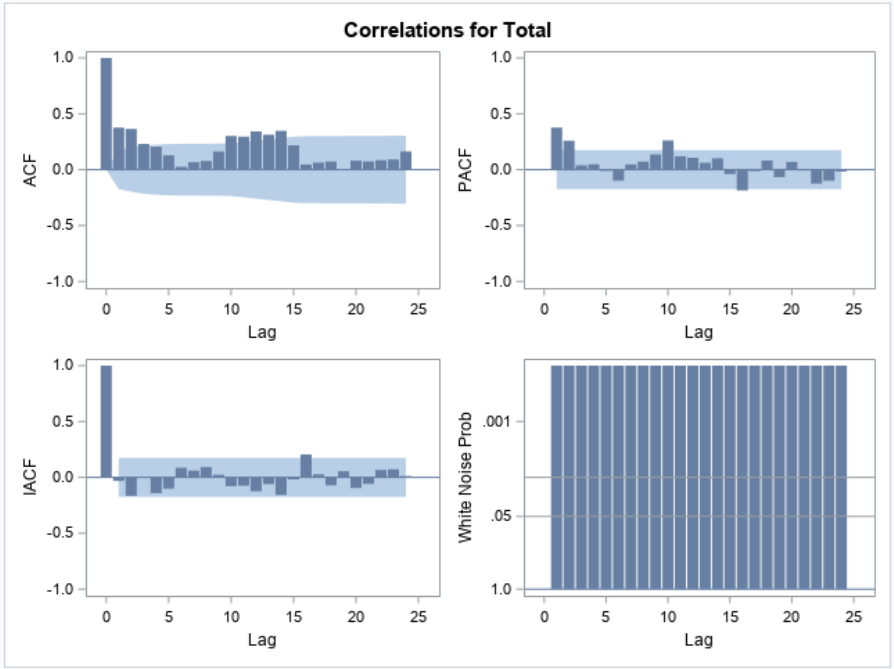
Regions reflect Peril dynamic however they mute the localized effects of weather

Loss type has most variation within the annual claim distributions which will serve as the key variable to focus on

Exploring The Time Series and Correlation

What Can Be Modeled?



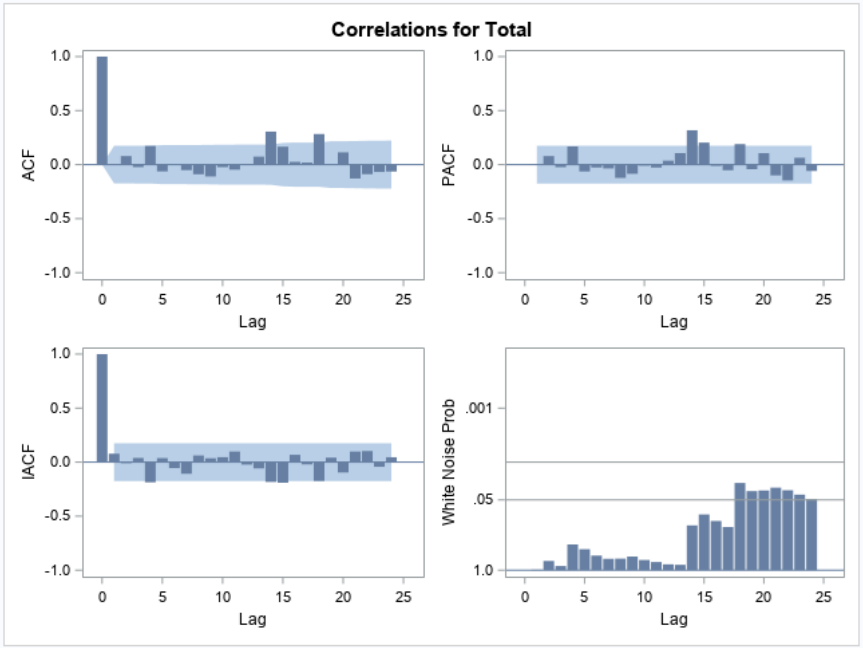


We can do better! Data shows seasonal patterns, outliers, autocorrelation, and plenty of signal to work with!

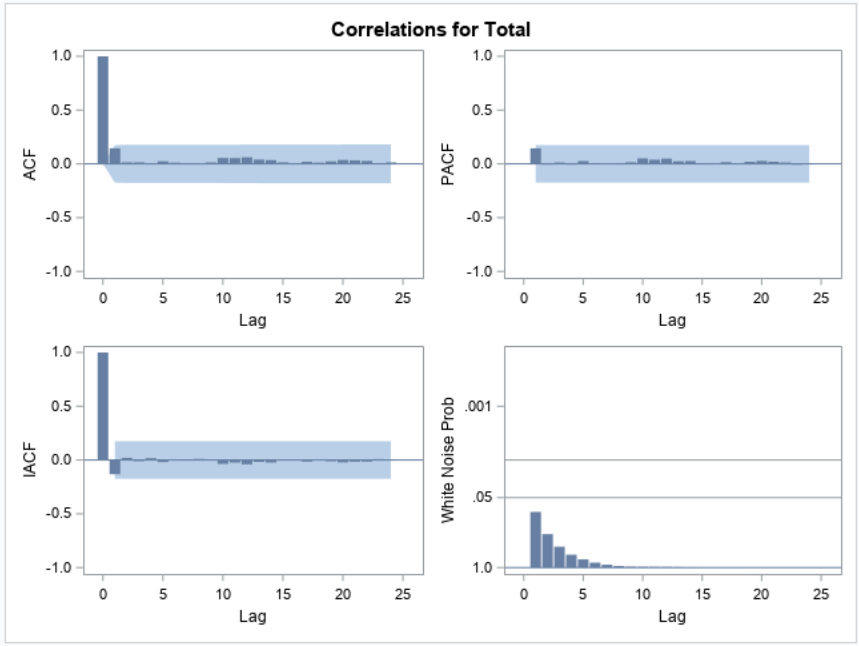
What Cannot Be Modeled?

Catastrophic Activity Like Hurricanes or Vehicles Striking A Building Are Too Random

Catastrophic Activity Excluding Hail



All Other Loss Activity



CAT excluding hail and All Other are too random to use in our modeling exercise

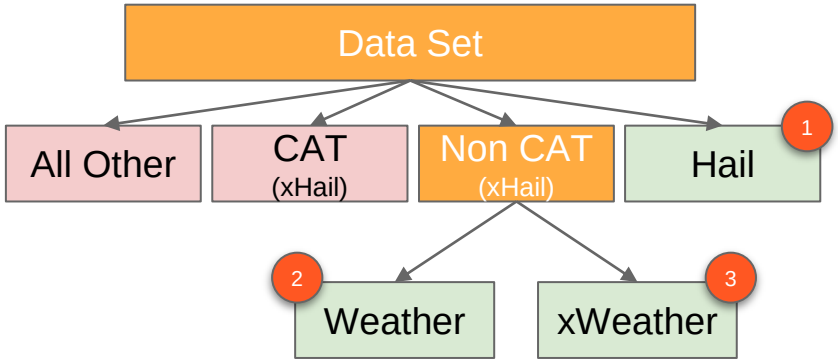
Modeling Approach & Results

Slides 15-21

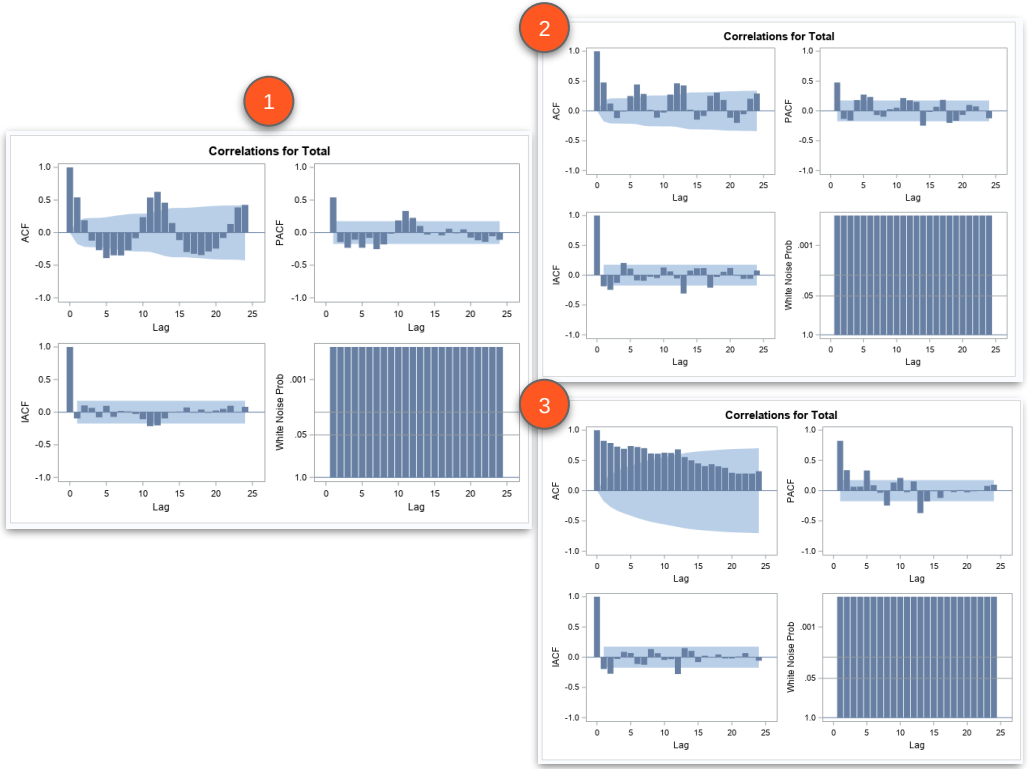
Modeling Approach

Approach = Create 3 Models

Decision Tree



Correlation Plots



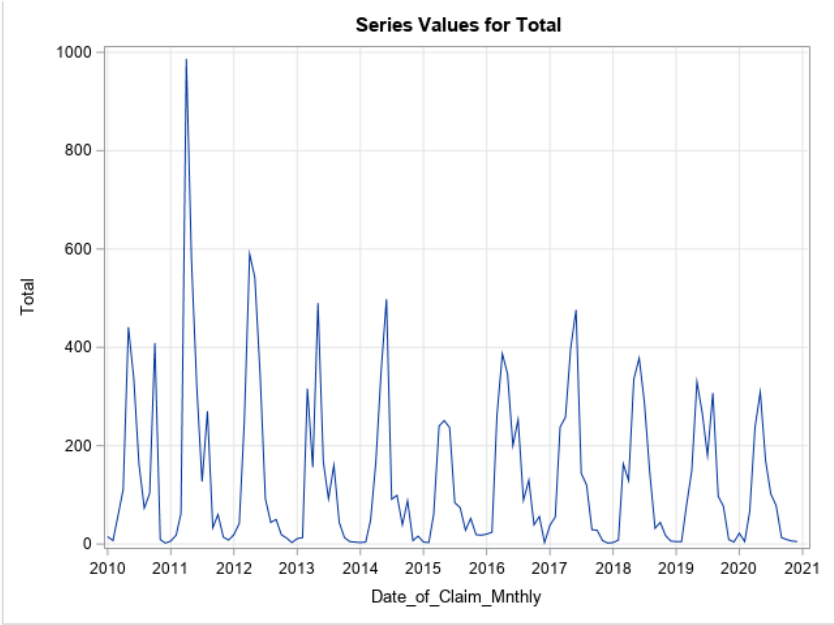
Separate the data into 3 different independent time series datasets then fit the best models and aggregate the results

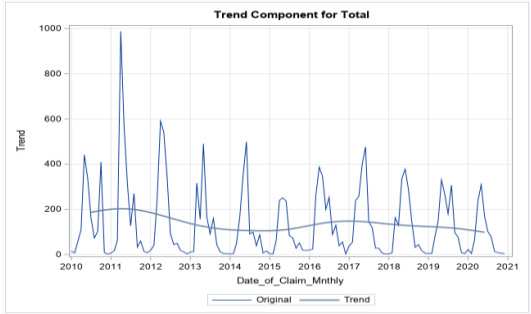
Model 1: Hail Model

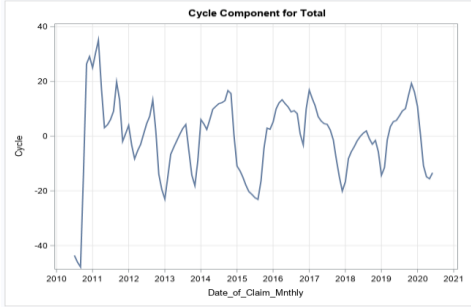
Exploring The Signals

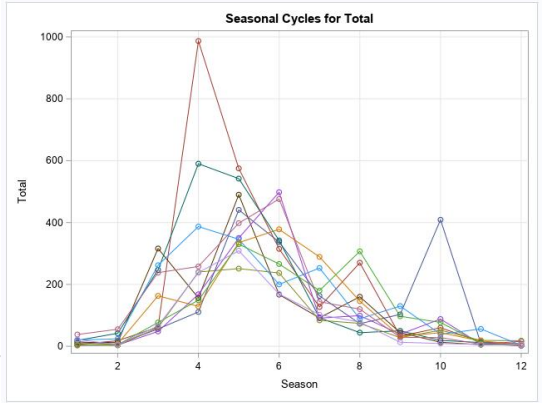
Signal Components

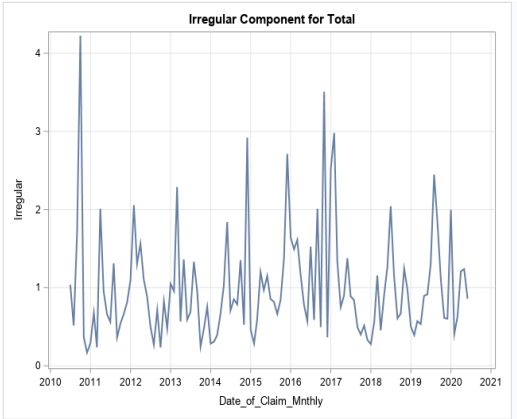
Trend	Seasonality	Cycle	Irregular
✗	✓	✗	✗









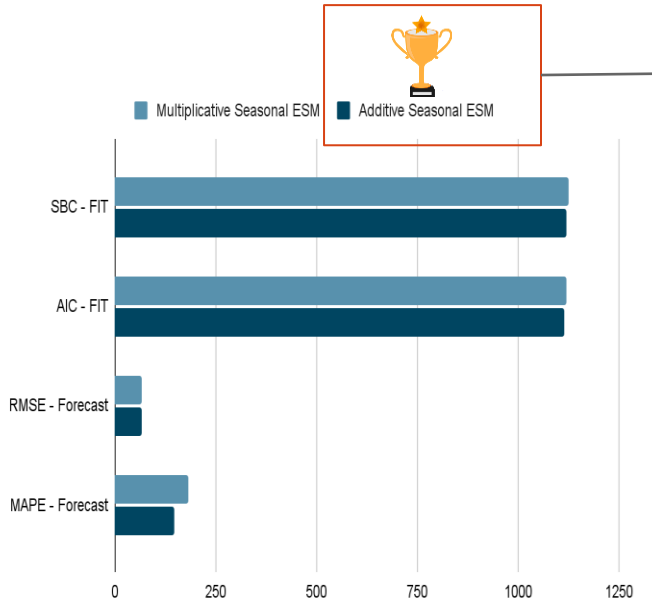


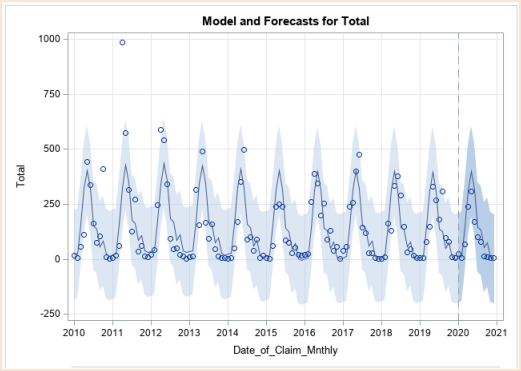
Hail has a defined season and the business has managed their exposure to this peril

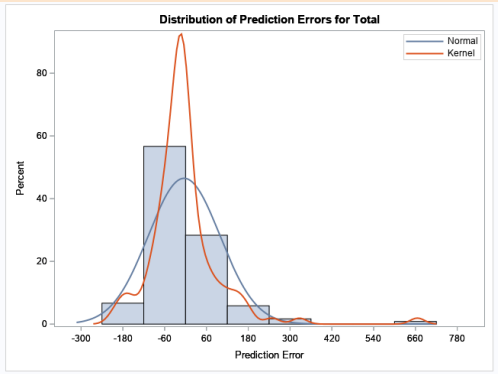
Model 1: Hail Model Selection

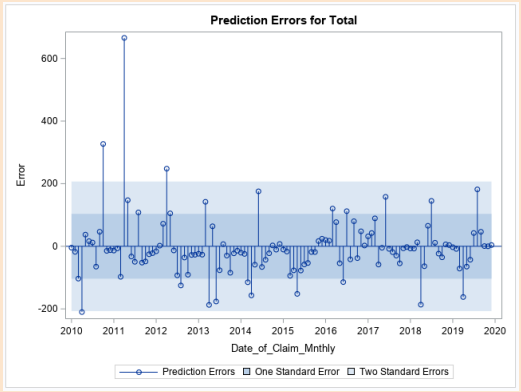
ARIMA Was Not Used Because 1 Seasonal Difference Left The Data Set = White Noise

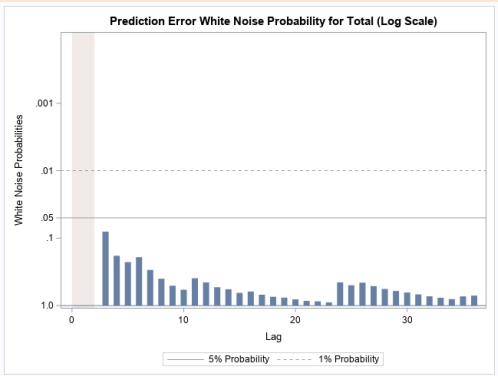
Model Comparison











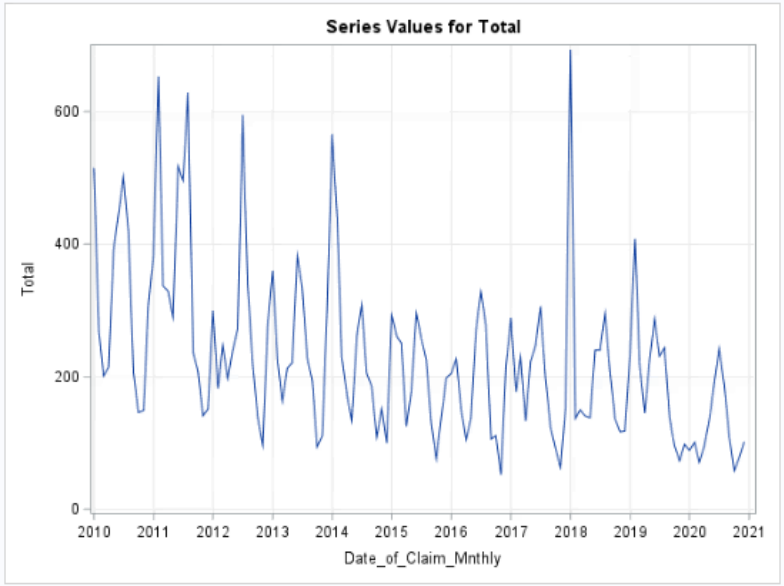
Additive Seasonal ESM outperformed the multiplicative ESM and the residuals are white noise and distributed normally

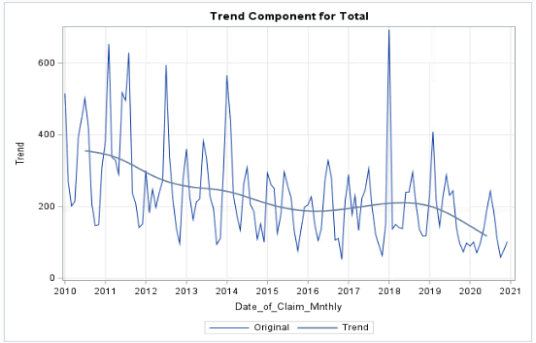
Model 2: Weather Model xCAT & xHail

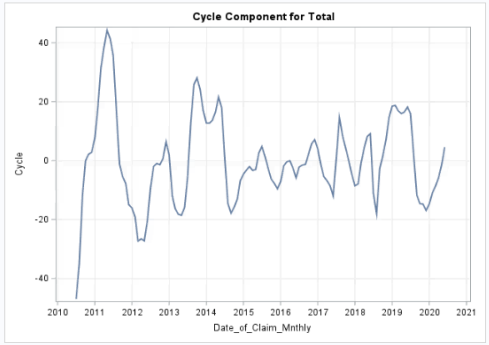
Exploring The Signals

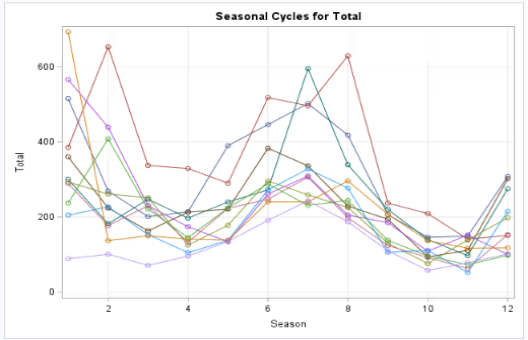
Signal Components

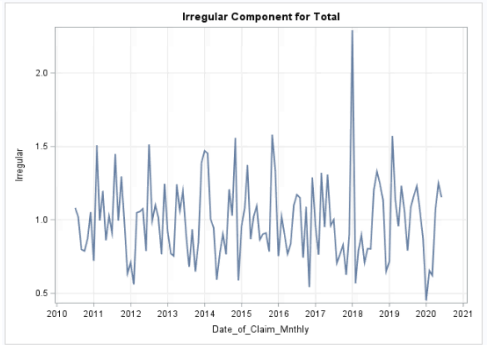
Trend	Seasonality	Cycle	Irregular
✓	✓	✗	✗







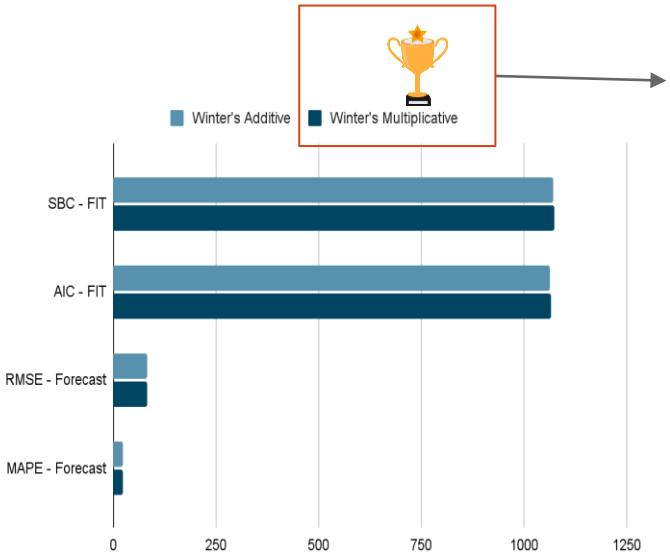


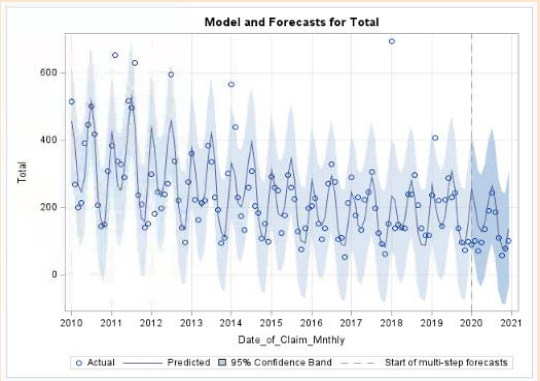


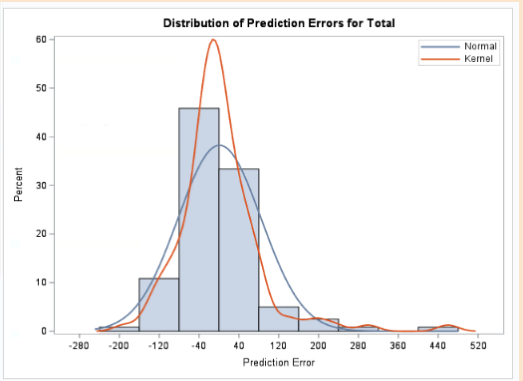
Water during the winter and Wind during summer are driving the seasonal pattern and the business has managed their exposure to these perils which resulted in a downward trend

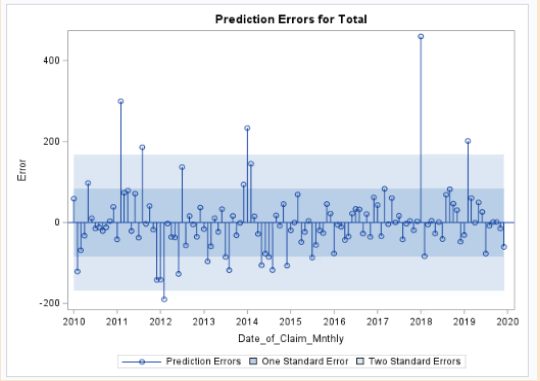
Model 2: Weather Model Selection

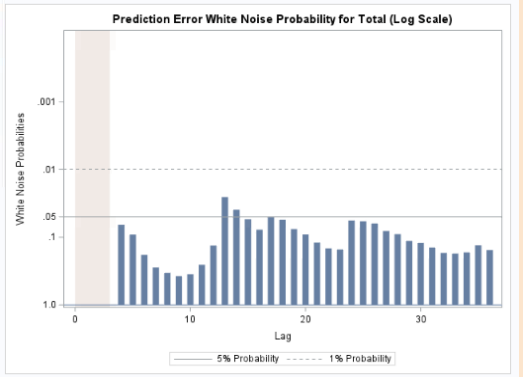
Model Comparison









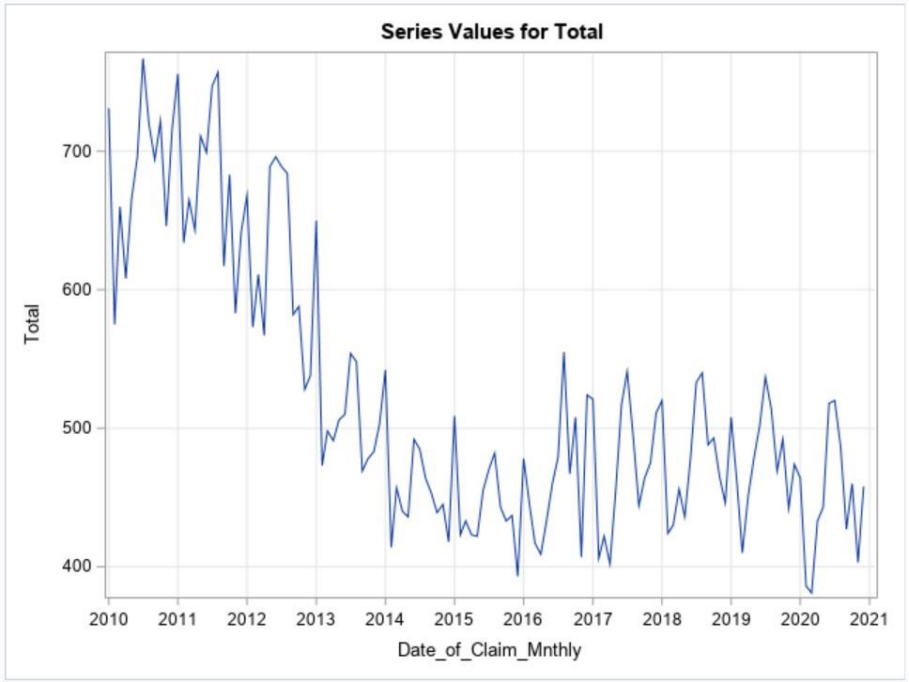


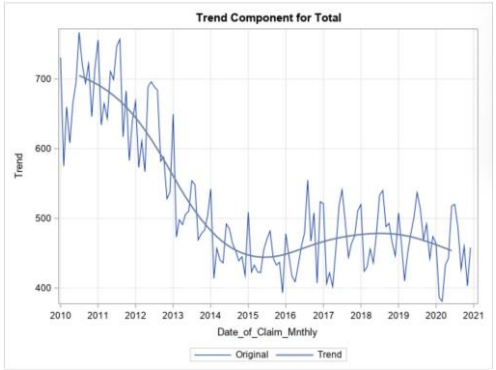
Winters Multiplicative Model outperformed the Winters Additive Model; The residuals are white noise and distributed normally

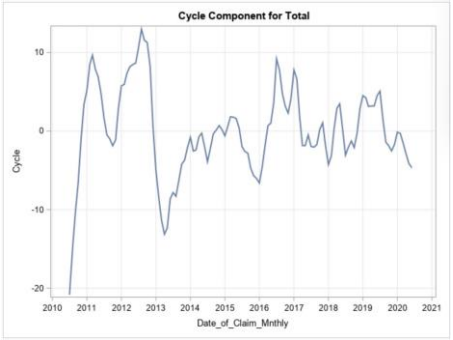
Model 3: xWeather Model xAll Other

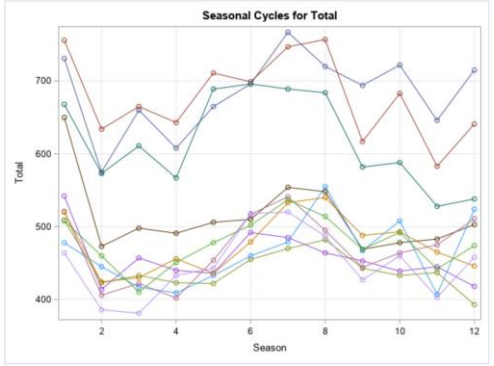
Exploring The Signals

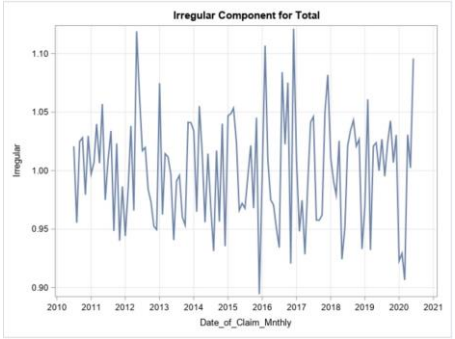
Signal Components | Trend ✓ | Seasonality ✓ | Cycle ✗ | Irregular ✗







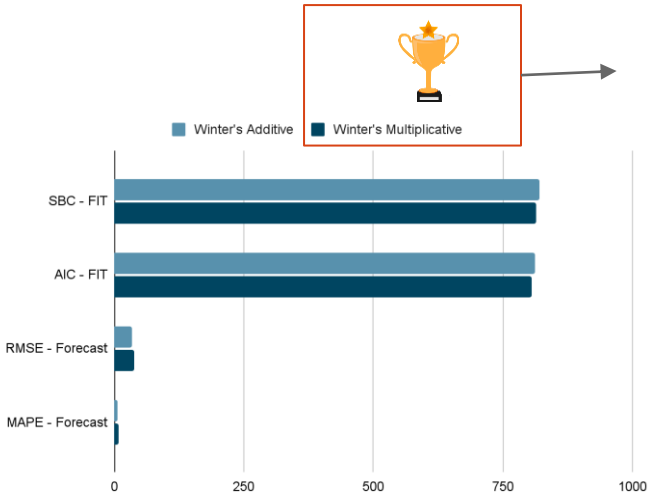


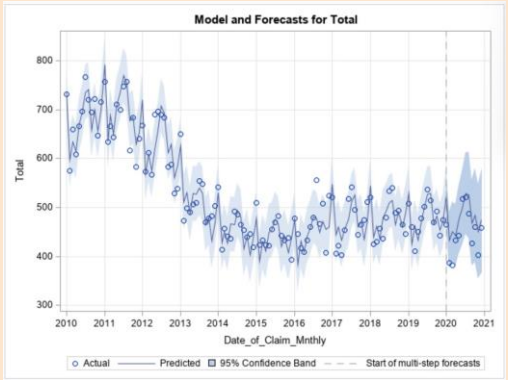


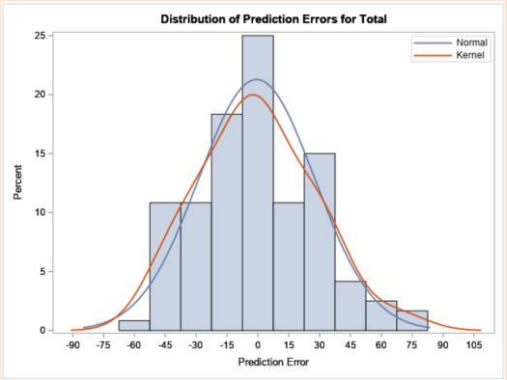
Non-weather water is driving the seasonal pattern

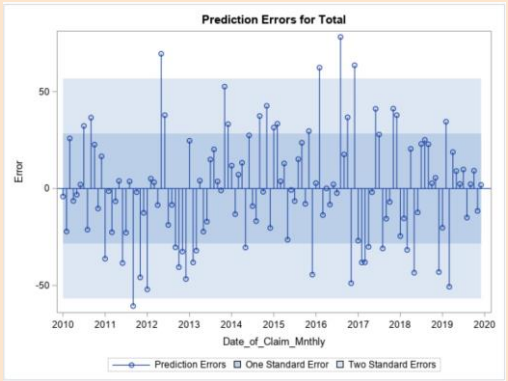
Model 3: xWeather Model

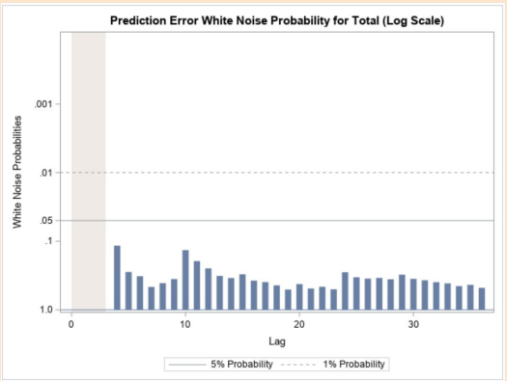
Model Comparison











Winter's multiplicative gave slightly better SBC & AIC with residuals which were white noise

Next Steps

Explore seasonality within the Non Weather data set

Peer review models with actuarial and R&D

Recommend that Non-Hail CAT activity use industry standard models like RMS or AIR for hurricane, earthquake, terrorism & wildfire

Recommend a simple 5 year average claim volume for “All Other” activity

Appendix

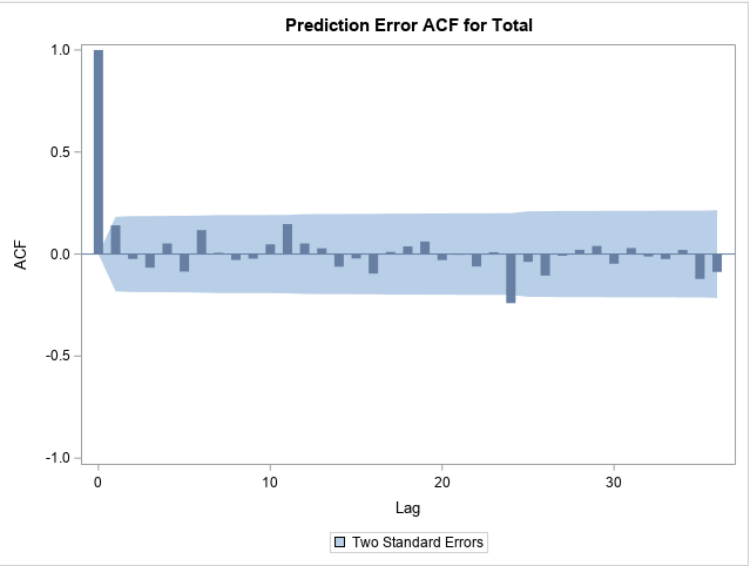
Slides 24-33

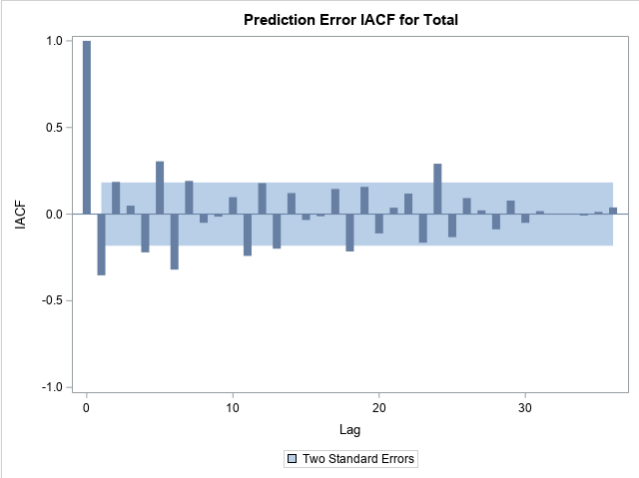
Model 1: Hail Model Alternative Modeling **Slides 24-27**

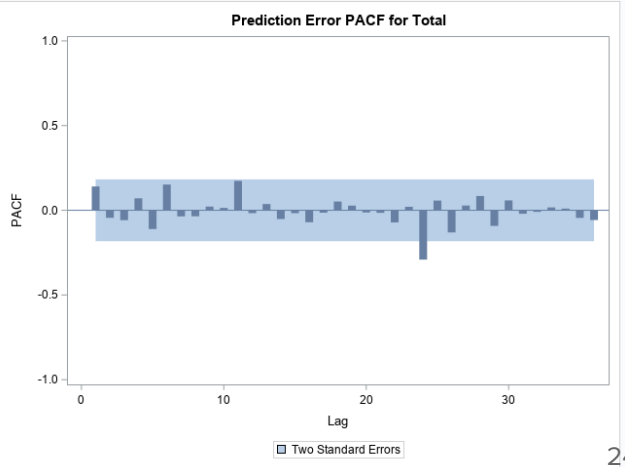
Model 2: Weather Model Alternative Modeling **Slides 28-30**

Model 3: xWeather Model Alternative Modeling **Slides 31-33**

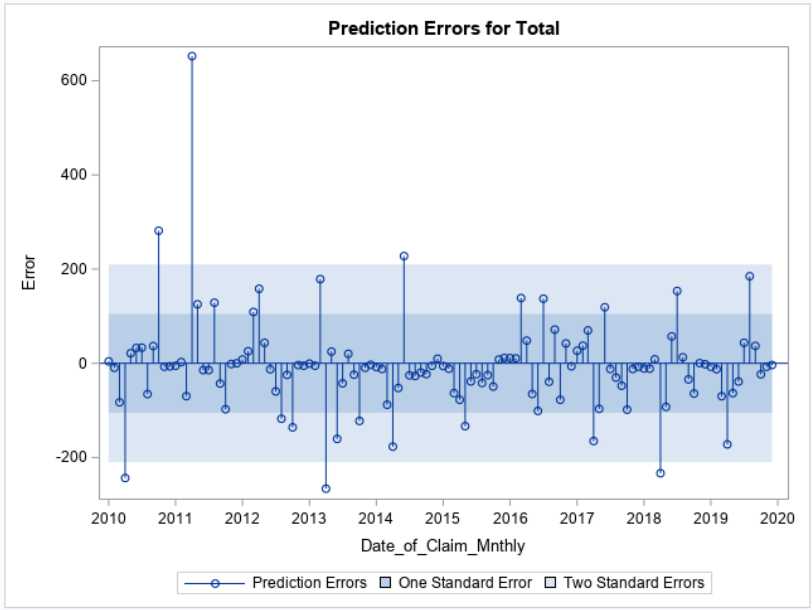
Model 1: Hail Model - ESM Additive

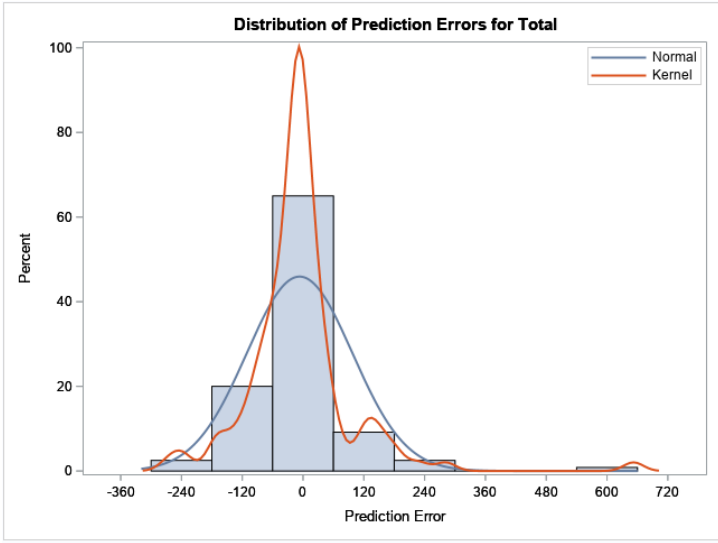


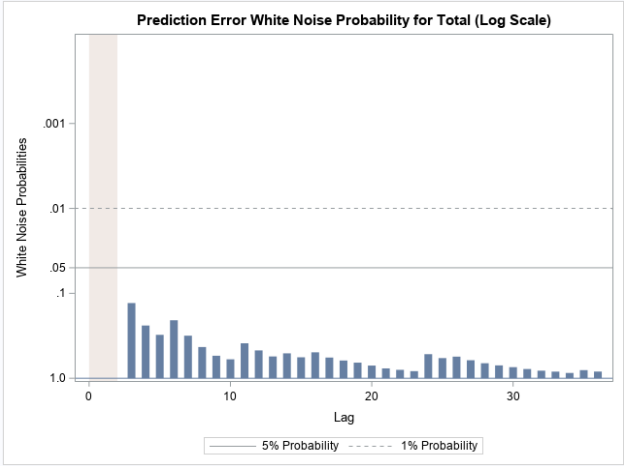




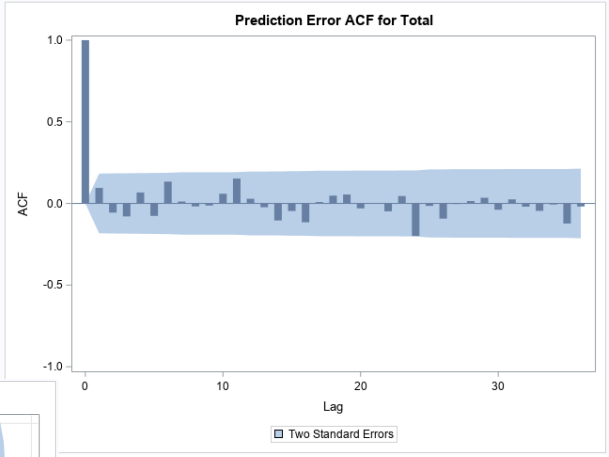
Model 1: Hail Model - ESM Multiplicative

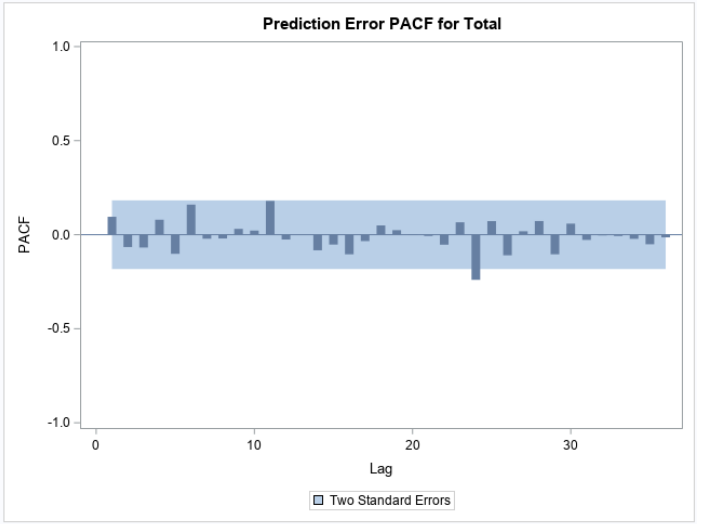


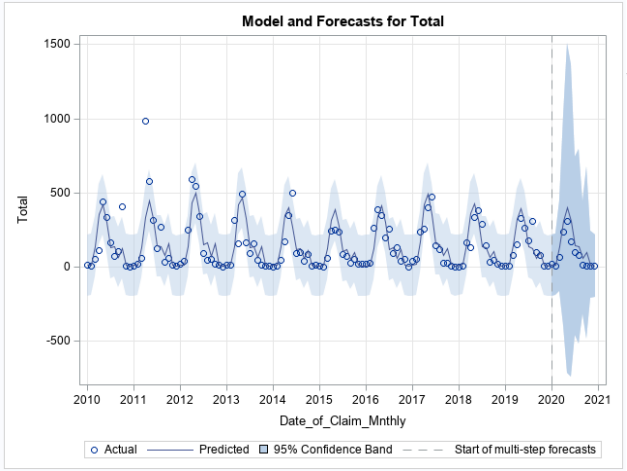


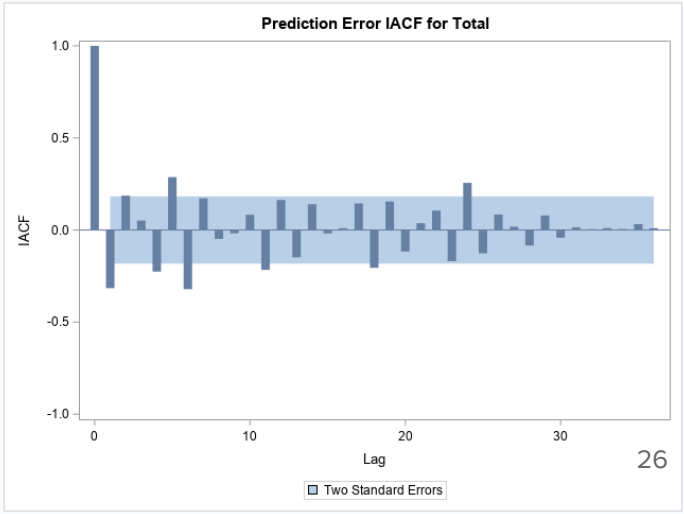


Model 1: Hail Model - ESM Multiplicative

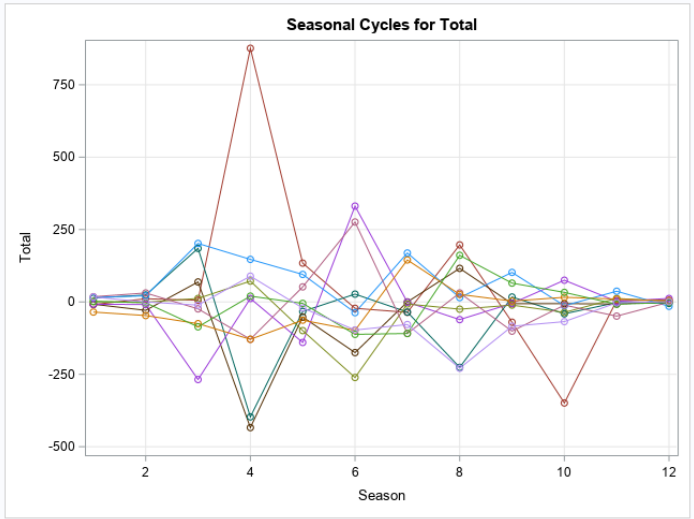


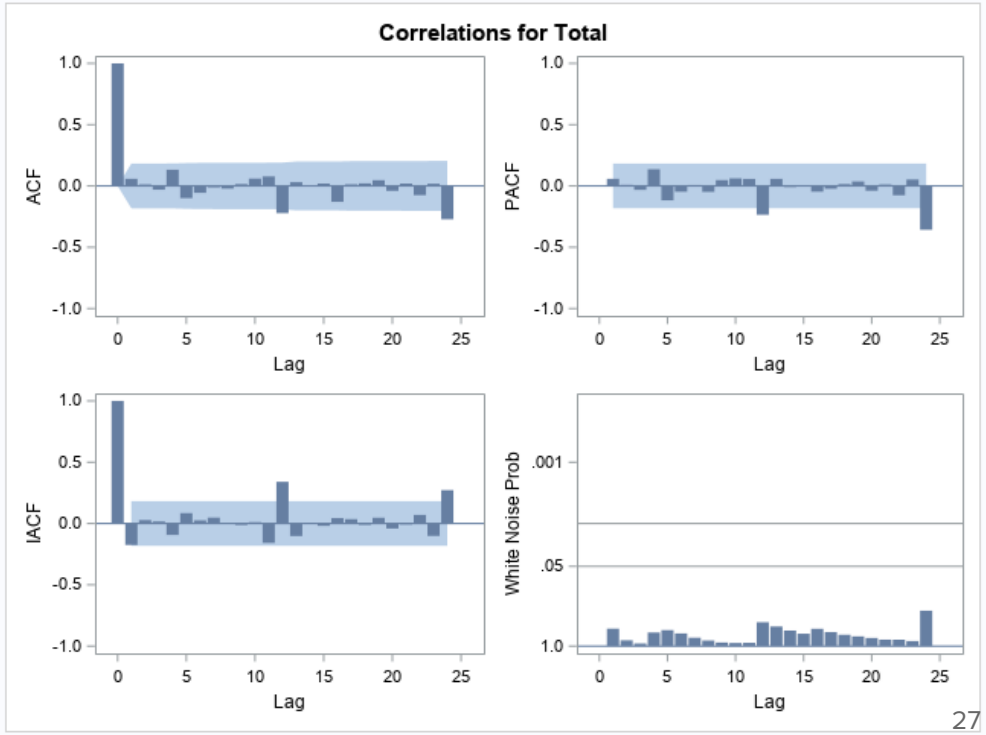




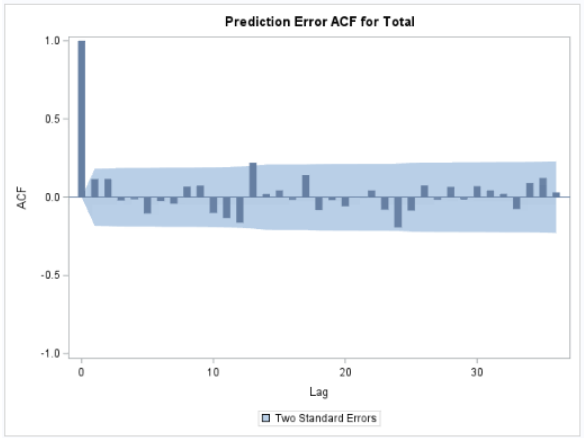


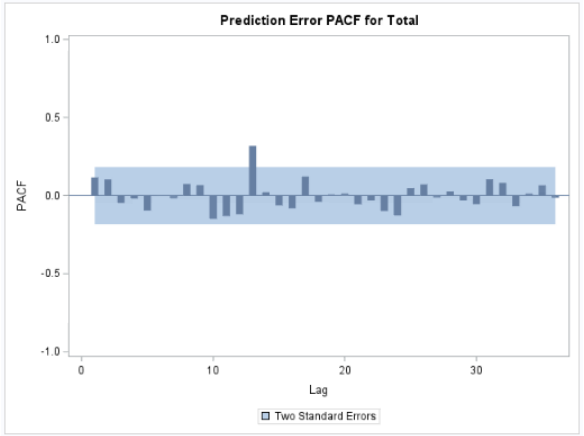
Model 1: Hail Model - Data Set After 1 Seasonal Differencing

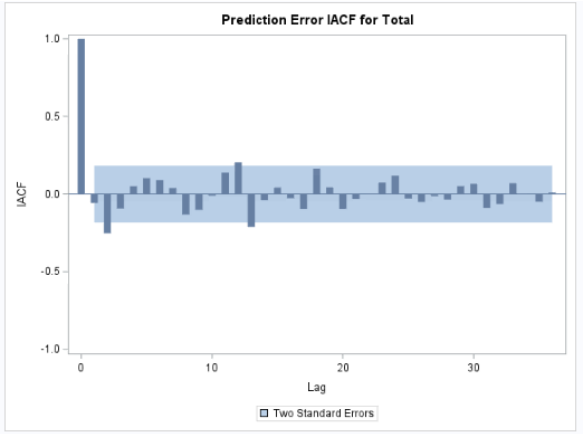




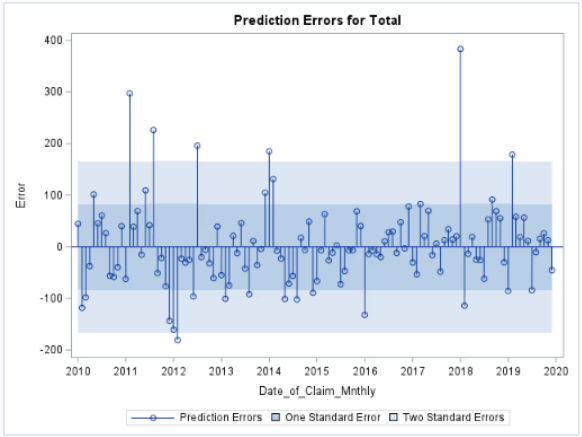
Model 2: Weather Model - Winters Multiplicative

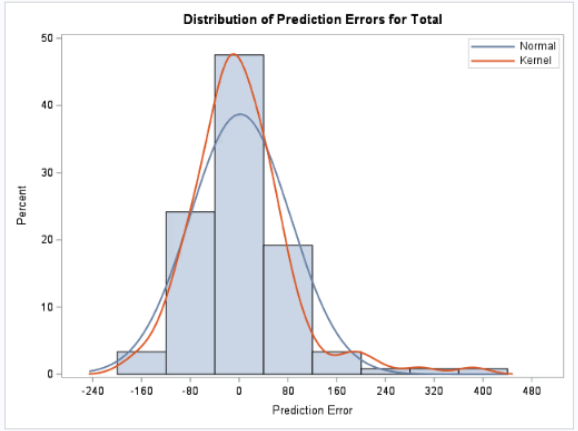


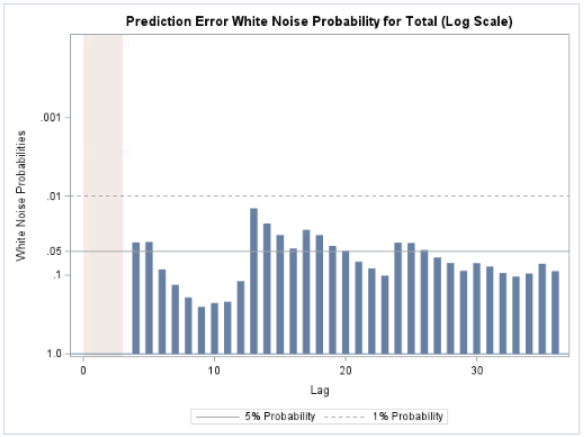




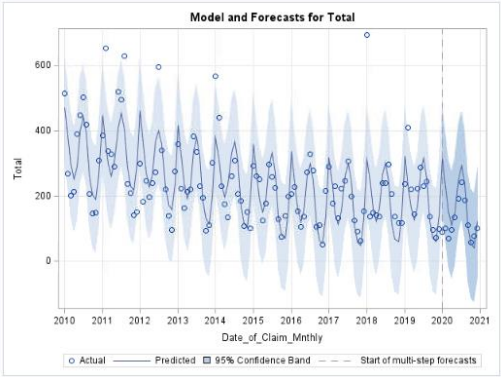
Model 2: Weather Model - Winters Additive

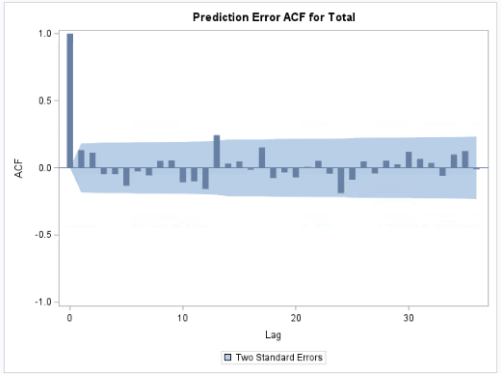


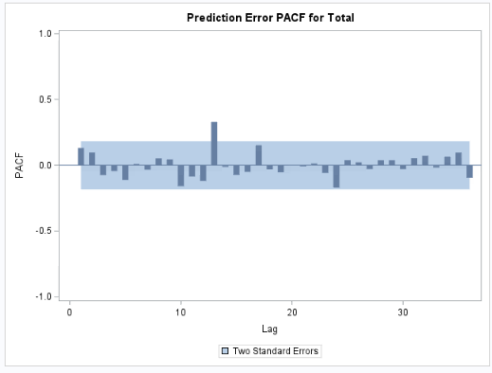


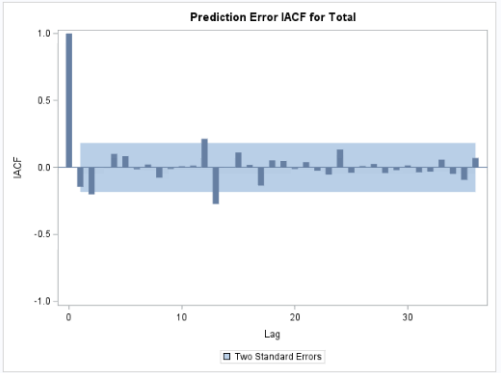


Model 2: Weather Model - Winters Additive

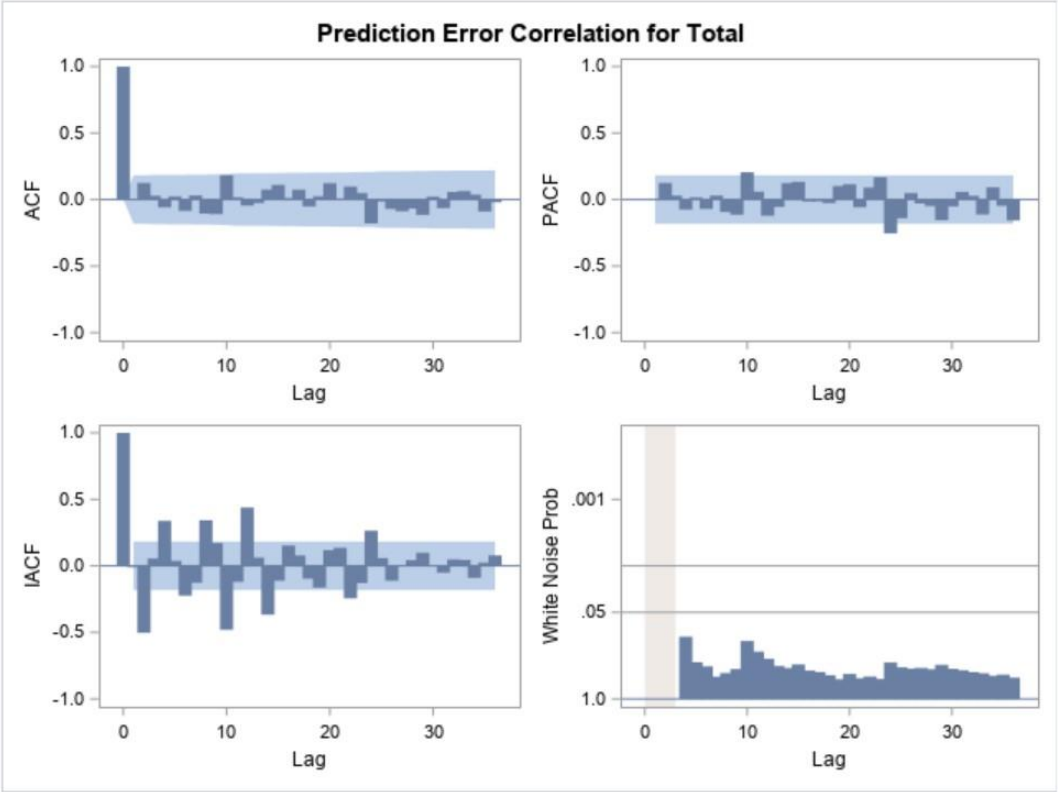




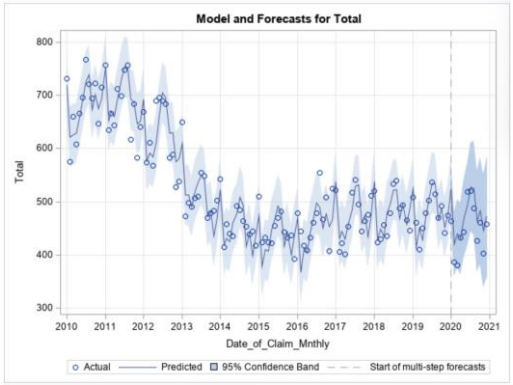


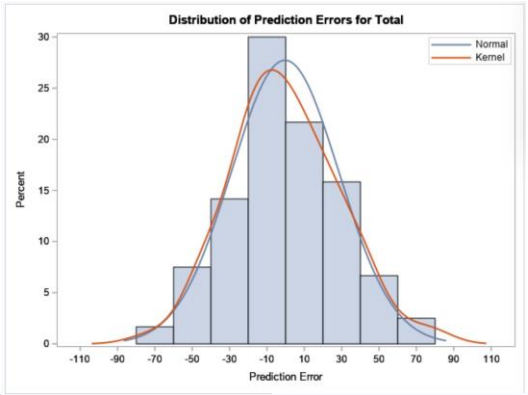


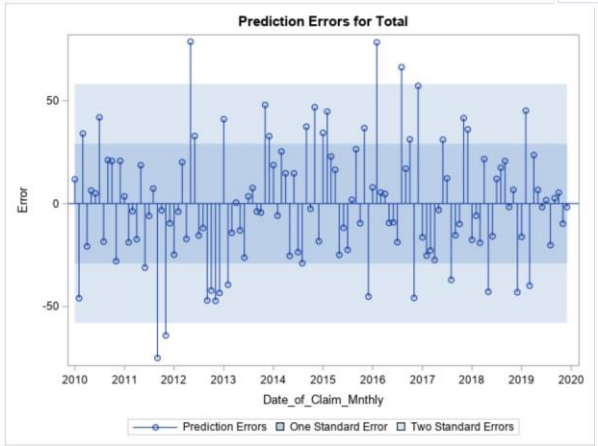
Model 3: xWeather Model - Winters Multiplicative

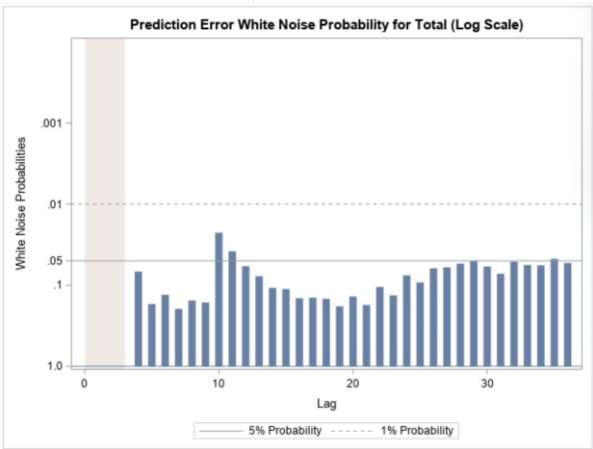


Model 3: xWeather Model - Winters Additive

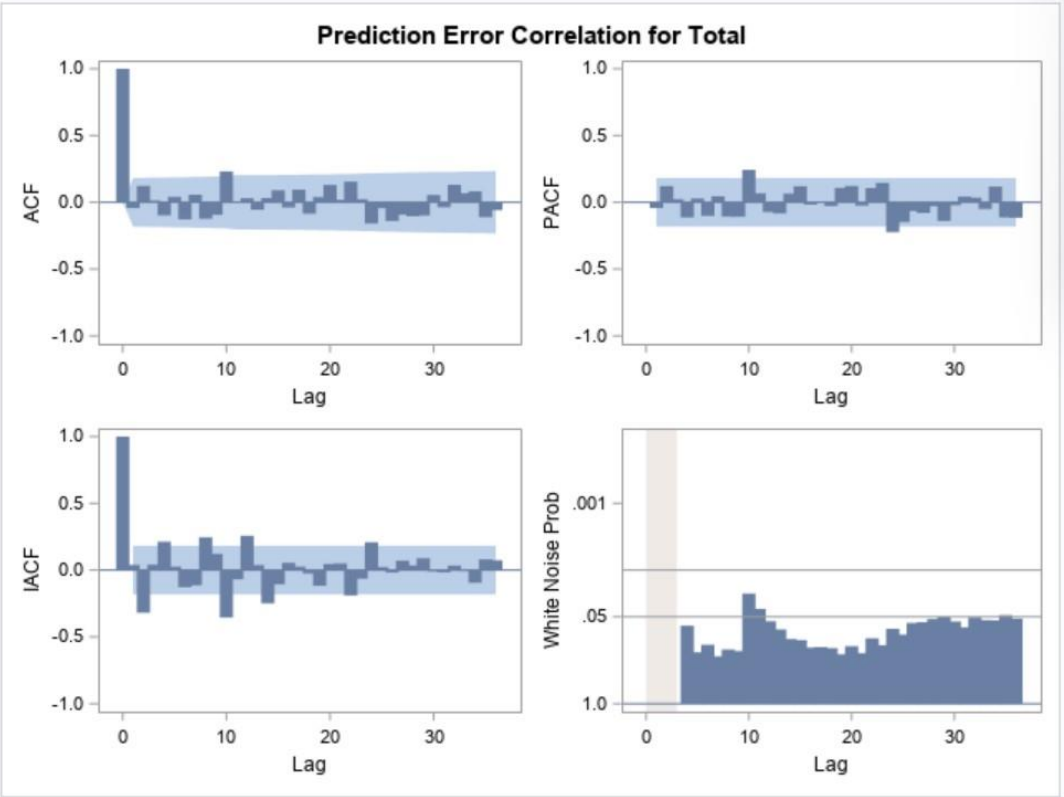








Model 3: xWeather Model - Winters Additive



References

George Fernandez, Marc Huber, Jay Laramore, Danny Modlin, and Chip Wells, ISBN 978-1-64295-144-8, Time Series Modeling Essentials Course Notes