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Pastries, Microbreweries, Diamonds and More

Small Businesses Can Profit with SAS

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Small Businesses Can Profit with SAS

Cameron Jagoe, Taylor K. Larkin, Denise J. McManus

The University of Alabama

ABSTRACT

Today, there are 28 million small businesses which account for 54% of all sales in the United States. The challenge is that small businesses struggle every day to accurately forecast future sales. These forecasts not only drive investment decisions in the business, but also are used in setting daily par, determining labor hours, and scheduling operating hours. In general, owners use their "gut instinct." Using SAS provides the opportunity to develop accurate and robust models that can unlock costs for small business owners in a short amount of time. This research examines over 9,800 records from the first year of daily sales data for a start-up small business, while comparing the four basic forecasting models within SAS Enterprise Guide. The objective of this model comparison is to demonstrate how quick and easy it is to forecast small business sales using SAS Enterprise Guide. What does that mean for small businesses? More Profit. SAS provides cost effective models for small businesses to better forecast sales, resulting in better business decisions.

INTRODUCTION

The trends and cycles of daily sales have a direct impact on the success of small businesses. One small business experiencing these challenges is presented here as a case study. Like most businesses, the point-of-sale terminal collects hourly sales data that are compiled and imported into a single database, resulting in 9,800 records of business activity. After cleaning and organizing the dataset, the cycles of the business are identified with a clear trend of actual revenue growth.

The dataset clearly represents the seasonality of the business; thus, it is imperative to be able to quickly make accurate forecasts of sales. While forecasting is possible in a other software packages, SAS Enterprise Guide allows us to quickly and easily partition the data to make forecasts using multiple models. Once the model is completed, the user interface of Enterprise Guide makes comparing and analyzing the models a straightforward task, even for a novice user.

While the forecasting models used are basic, the ability to use all of them across multiple date ranges, and then visually compare the results, is a competitive advantage over other, perhaps more common, data software.

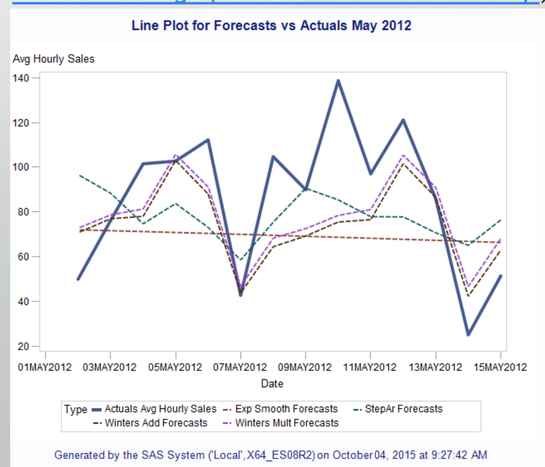
METHODS

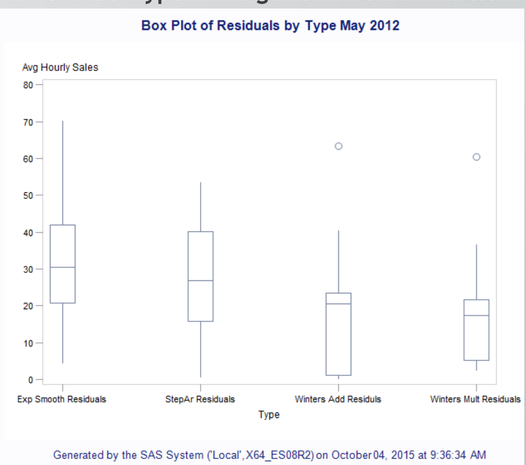
The dataset is partitioned into six subsets by date. The first subset consists of the first fiscal year for the small business. Each subsequent subset added months to the original dataset. From these six subsets, we forecast two week periods from their ending dates. This gives us six validation sets to compare the four basic forecasting models in SAS Enterprise Guide: Step-wise Autoregressive, Winters Multiplicative, Winters Additive, and Exponential Smoothing. Using the forecasted values from each model, we plot them against the actuals in that data range and construct boxplots of their absolute residuals.

The line plots provide a visual reference for comparing the individual forecasting models with the actual values. The box plots represents a side-by-side comparison of the residual values for each model. Together, these two plots represent how well each model performed against the given data set. While one could look at only one of the plots to get a sense of the comparison, both are necessary for a more in-depth analysis.

RESULTS

First Date Range (05/02/2012 to 05/15/2012):, *Figure 1* & 2 ← Blue Hyperlinks go to full size charts.





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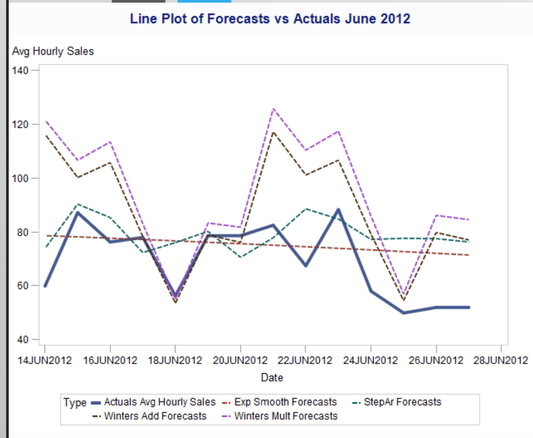
RESULTS

Second Date Range (06/14/2012 to 06/27/2012):, *Figure 3 & 4*



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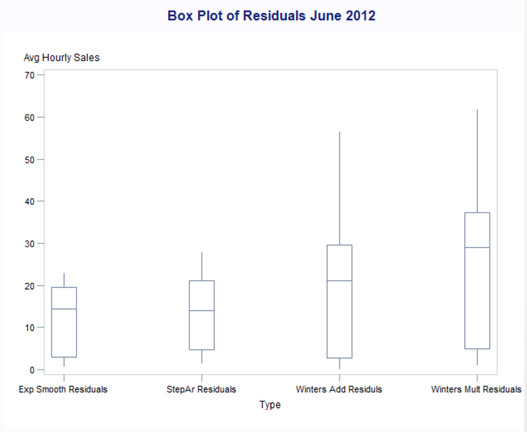

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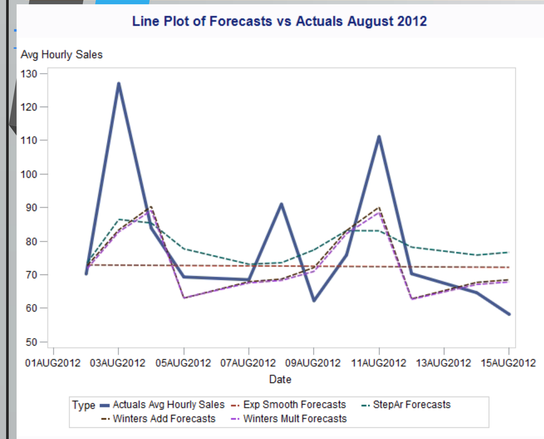
Third Date Range (08/02/2012 to 08/15/2012):, *Figure 5 & 6*



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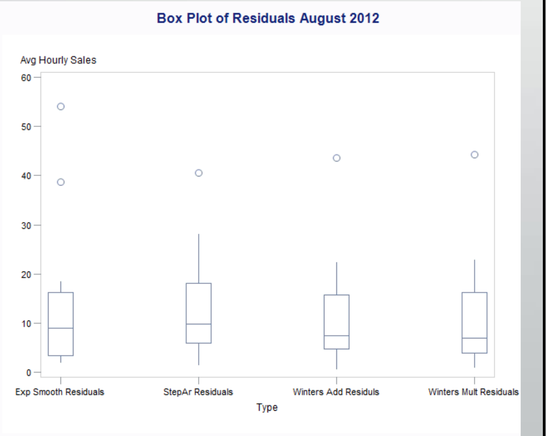

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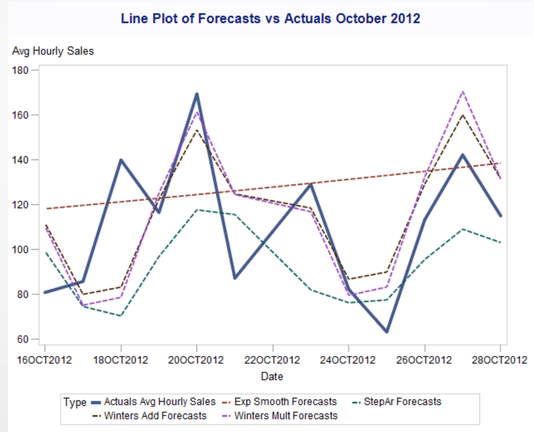
RESULTS

Fourth Date Range (10/16/2012 to 10/29/2012):, *Figure 7 & 8*



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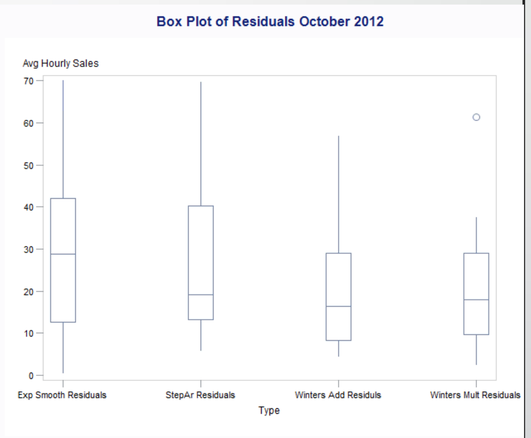

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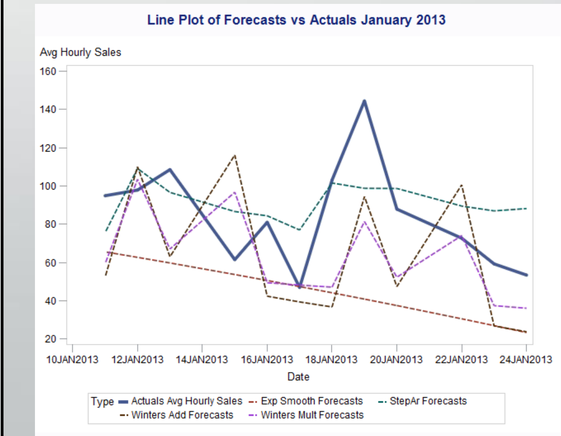
Fifth Date Range (01/11/2013 to 01/24/2013):, *Figure 9 & 10*



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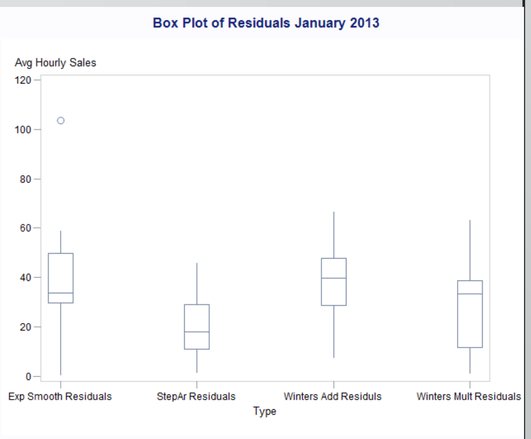

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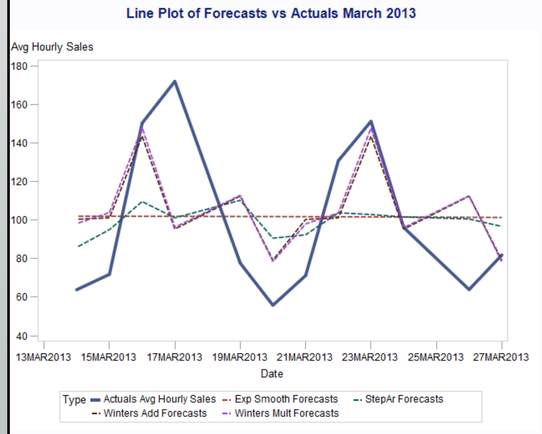
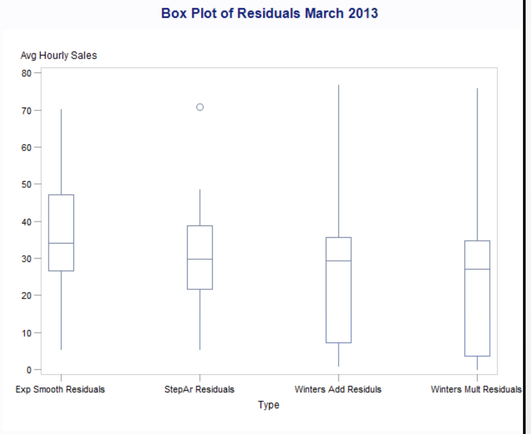
RESULTS CONTINUED

Sixth Date Range (03/14/2013 to 03/27/2013):, *Figure 11 & 12*





Summary Statistics for Residuals Across All Date Ranges, *Table 1 and Figure 13*

Summary Statistics

Results

The MEANS Procedure

Variable	Mean	Std Dev	Minimum	Maximum	N
StepAr Residuals	22.1532276	15.7635446	0.6499650	70.8454180	76
Exp Smooth Residuals	26.6356771	20.2996542	0.4800573	103.7426203	76
Winters Mult Residuals	21.8963031	18.0462168	0.0502866	75.7214037	76
Winters Add Residuls	22.3189221	18.1210188	0.2628987	76.6387565	76

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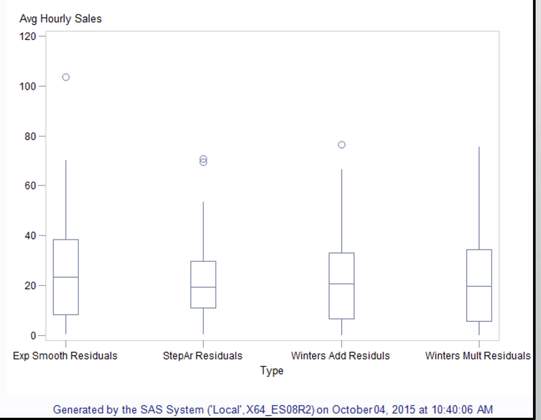


CONCLUSIONS

Considering only the summary statistics and box plot from the residuals across all date ranges, the four models look to be relatively close (see Table 1 and Figure 13). Both Winters models and the Stepwise Auto-Regressive models are within less than one average hourly sale for their means. The Stepwise Auto-Regressive, stands out from the others with the tightest standard deviation, but overall, it can be concluded that choosing between the Stepwise, Winters Additive and Winters Multiplicative models is a matter of preference.

However, if we look at the individual line plots for each date range, we can see that the Winters models mimic the daily seasonality closer than any of the other models (see Figure 1 and Figure 7). The Stepwise autoregressive model performs better when there is a deviation from seasonality (see Figure 9 and Figure 10). In addition, as we add more data to the training set, the Stepwise model starts to better reflect seasonality.

SAS Enterprise Guide is very effective in representing the evolution in the models. Imagine a scenario where we only used the four models on the first date range, and then discarded all but the Winters Additive based upon those results. But when forecasting can be accomplished quickly in SAS Enterprise Guide, the incentive to cull the models is removed, and instead we are incentivized to continue to experiment with all of the models. This change in behavior will result in paying strong dividends as the business changes, and we are better equipped to react to those changes.

REFERENCES

Cody, Ron. 2007. *Learning SAS by Example: A Programmer's Guide*. Cary, NC: SAS Institute Inc.

First Date Range (05/02/2012-05/15/2012)

Figure 1

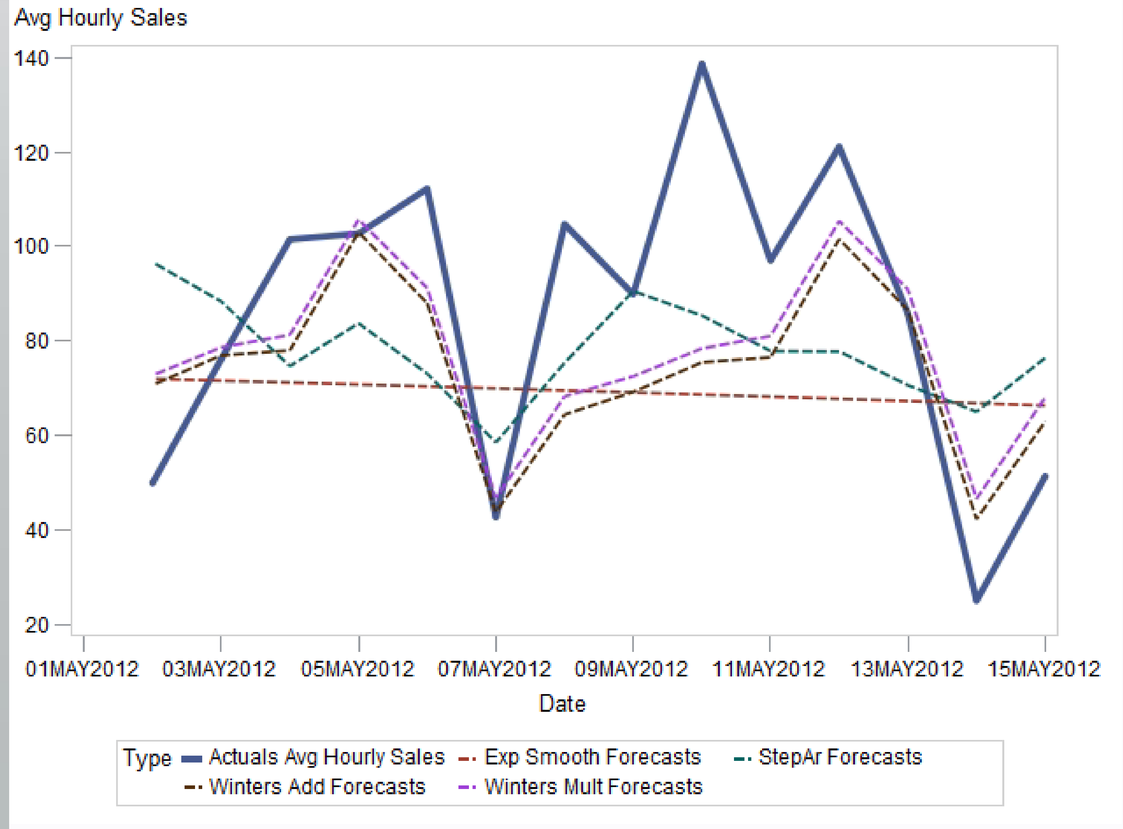
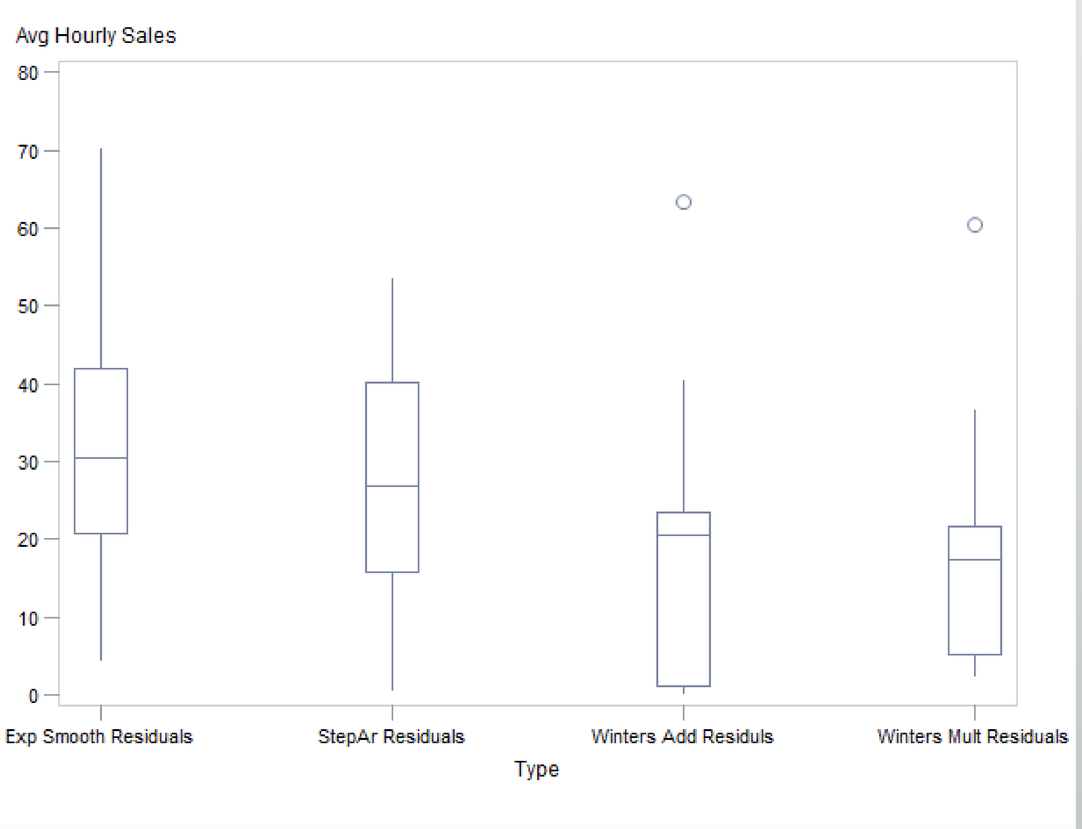


Figure 2



Second Date Range (06/14/2012-06/27/2012)

Figure 3

Line Plot of Forecasts vs Actuals June 2012

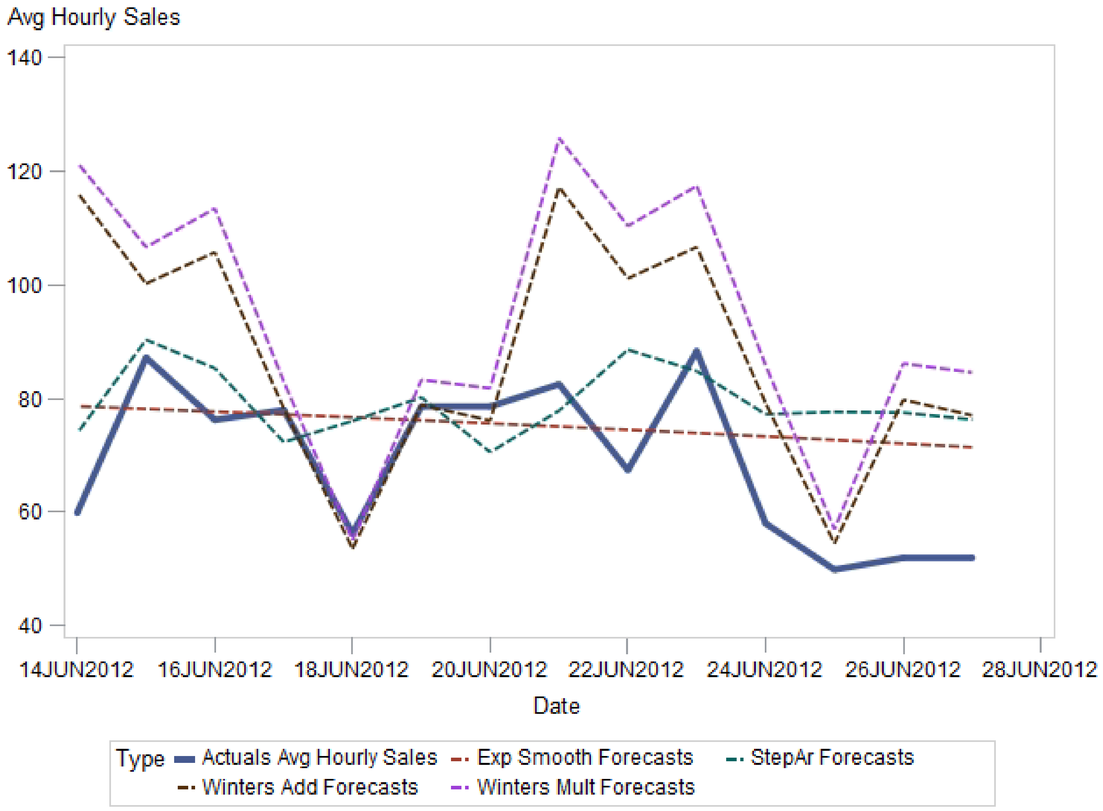


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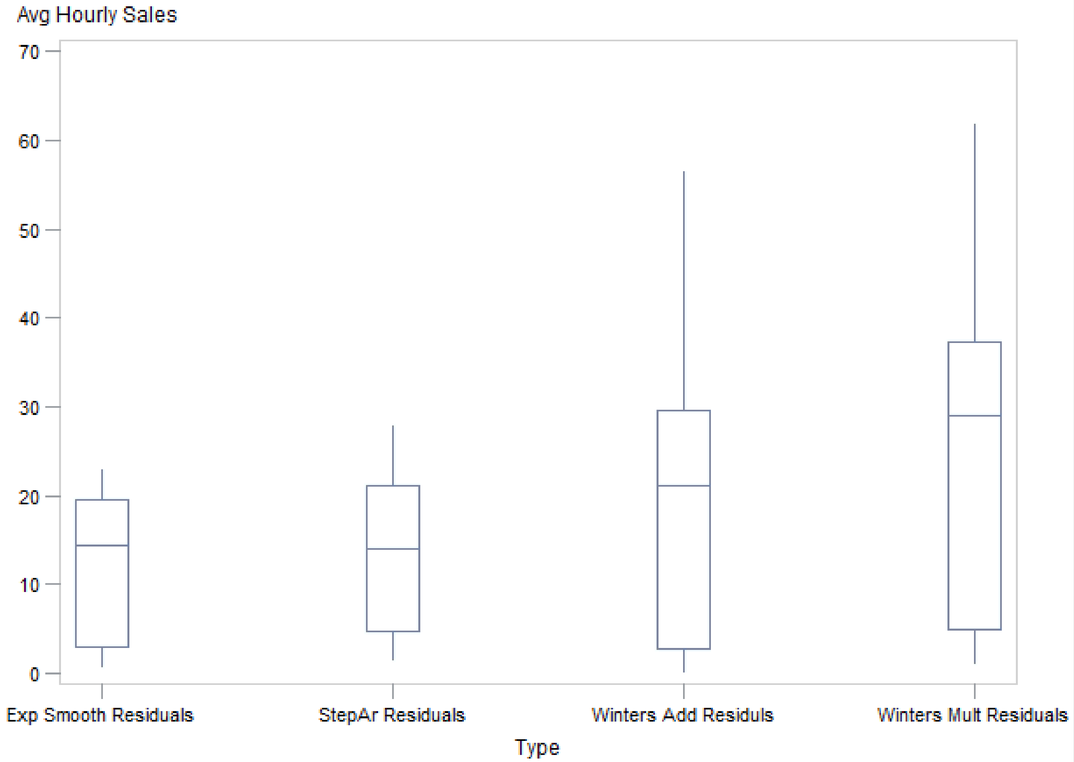
Figure 4

Box Plot of Residuals June 2012



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Third Date Range (08/02/2012-08/15/2012)

Figure 5

Line Plot of Forecasts vs Actuals August 2012

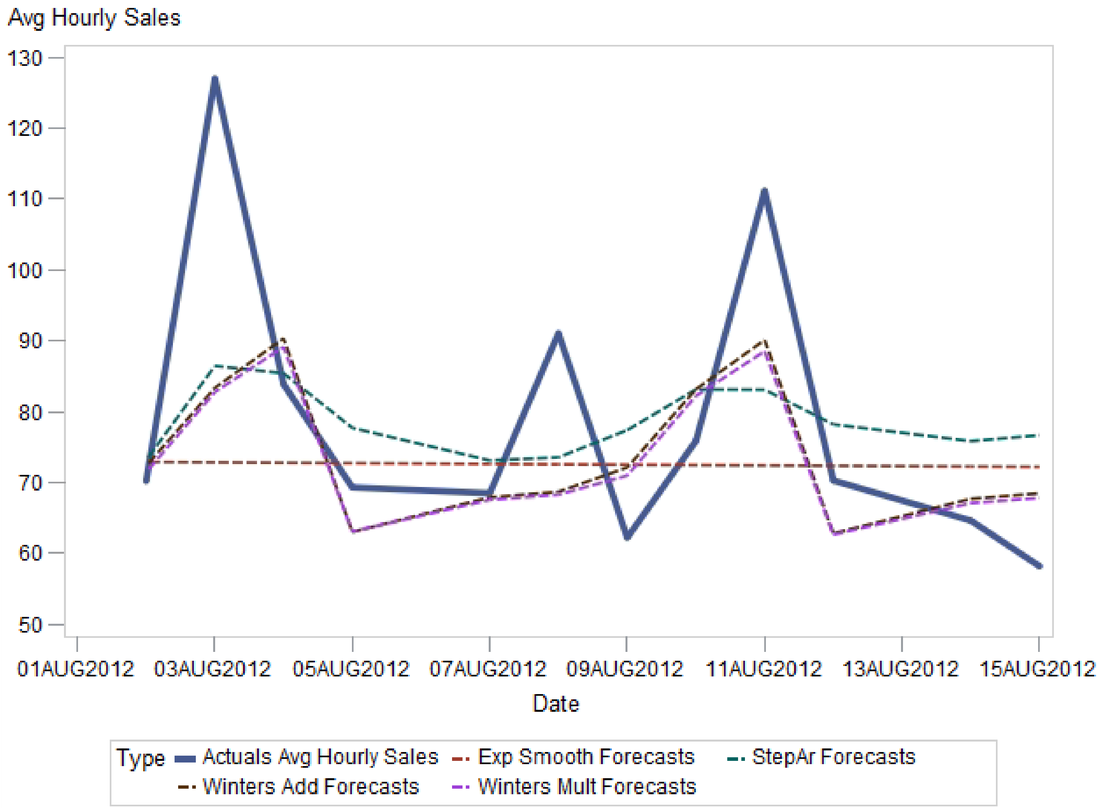

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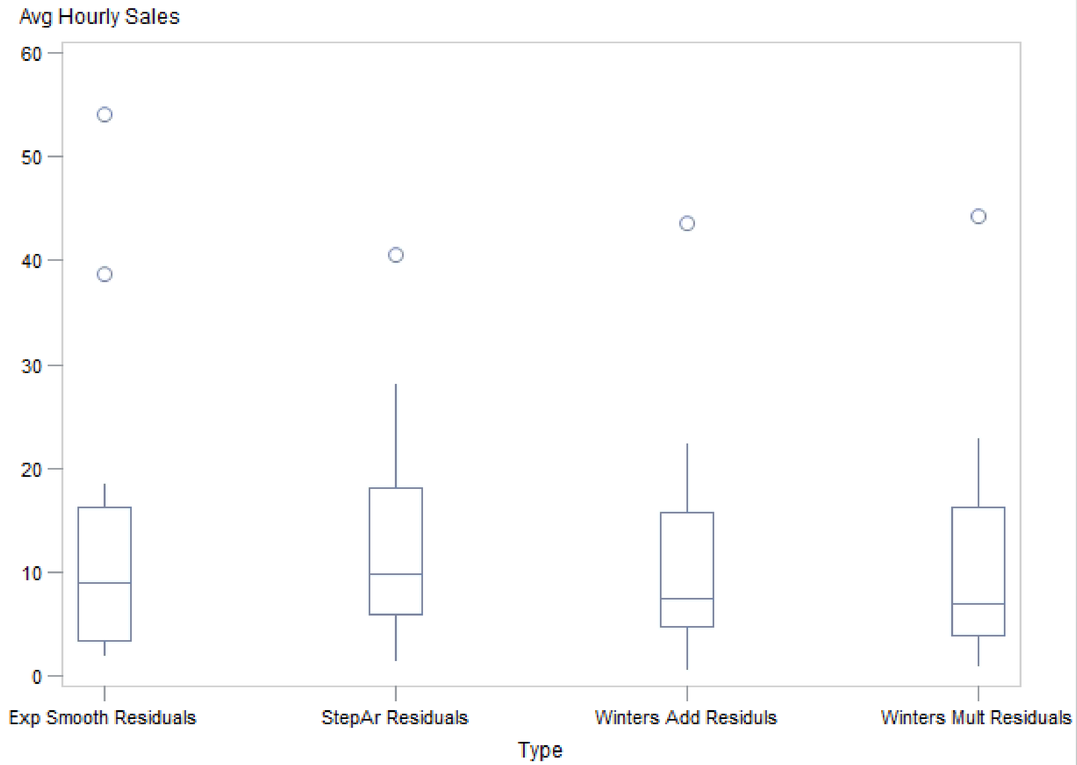
Figure 6

Box Plot of Residuals August 2012



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Fourth Date Range (10/16/2012-10/29/2012)

Figure 7

Line Plot of Forecasts vs Actuals October 2012

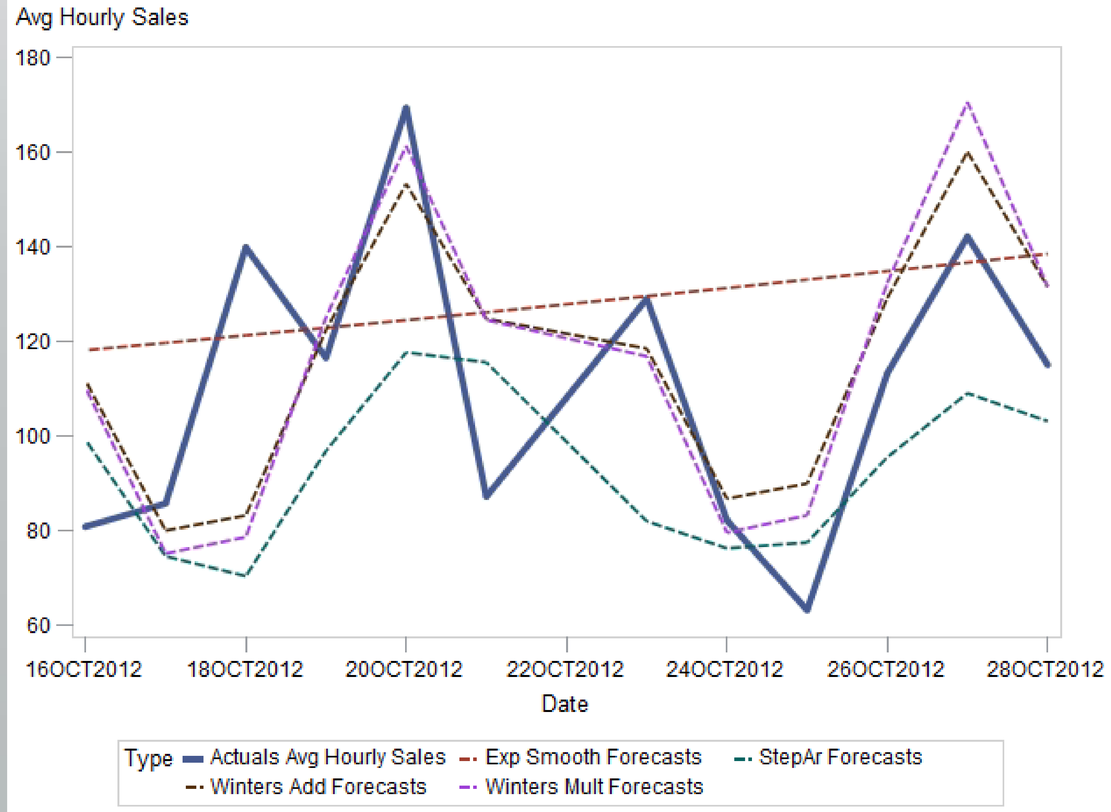

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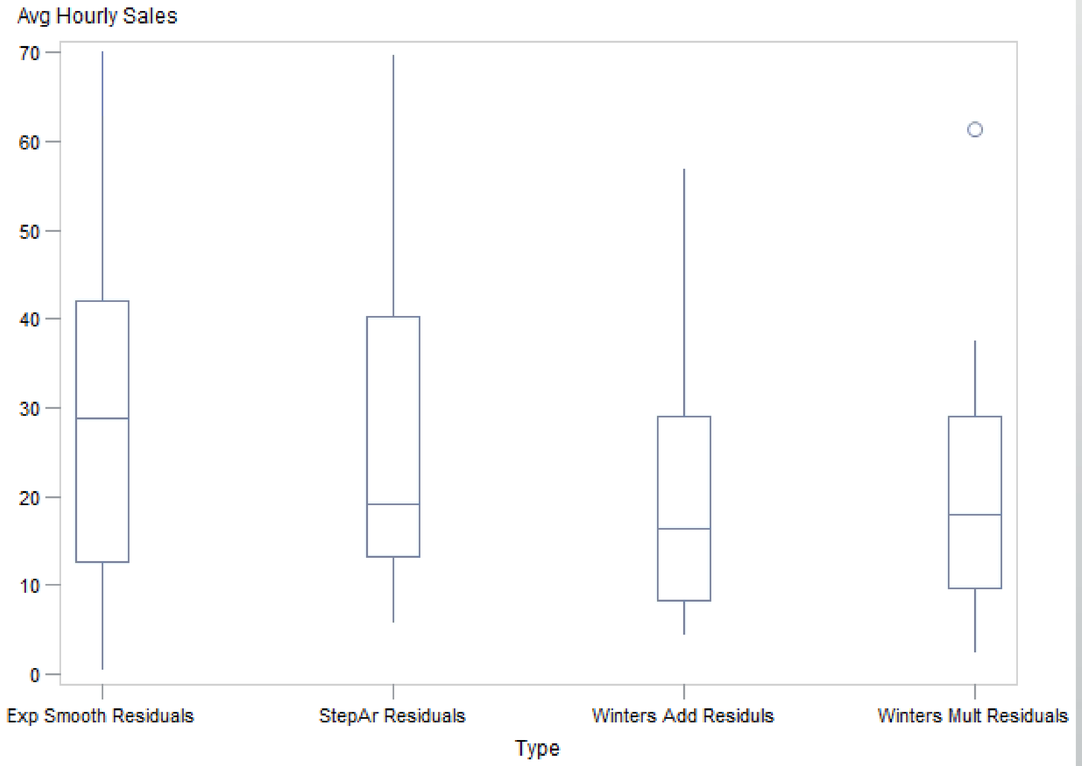
Figure 8

Box Plot of Residuals October 2012



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Fifth Date Range (01/11/2013-01/24/2013)

Figure 9

Line Plot of Forecasts vs Actuals January 2013

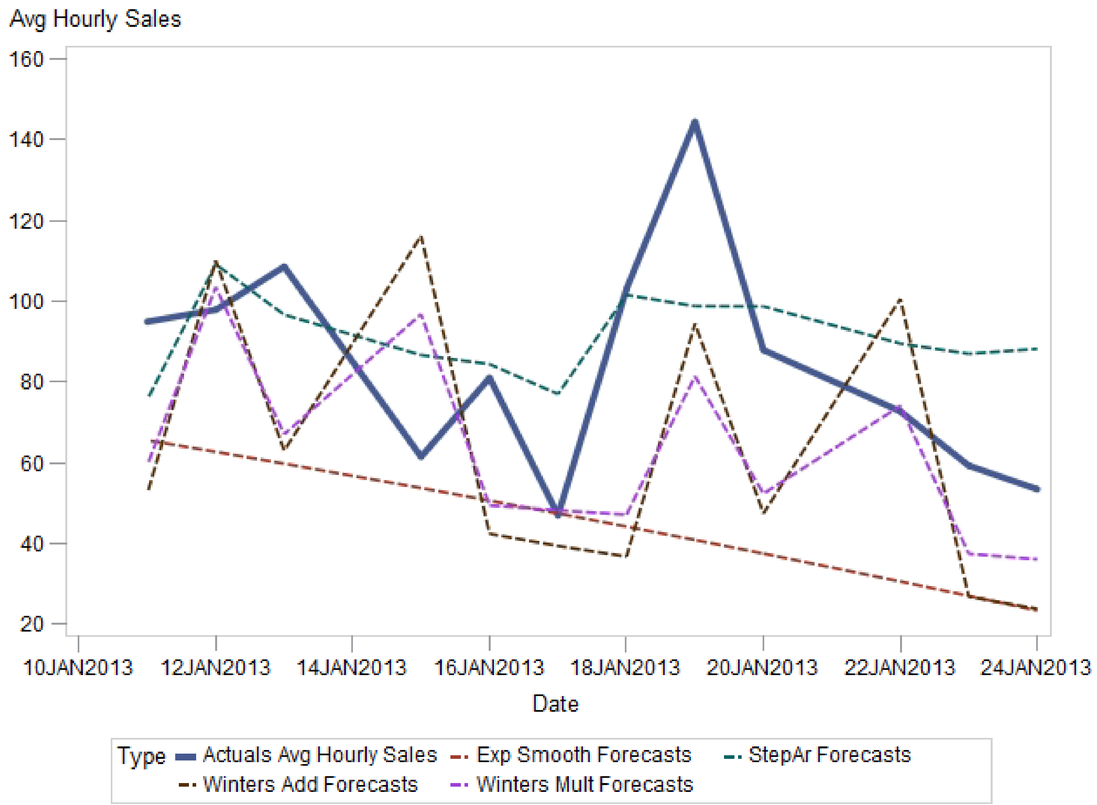

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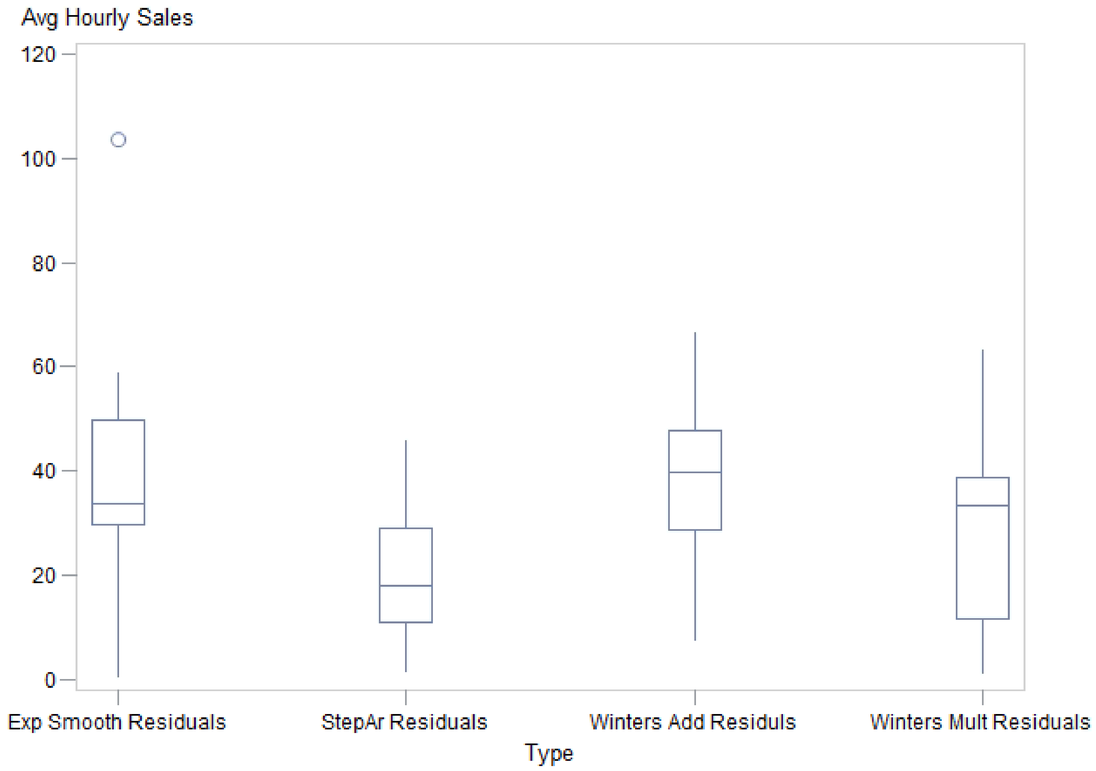
Figure 10

Box Plot of Residuals January 2013



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Sixth Date Range (03/14/2013-03/27/2013)

Figure 11

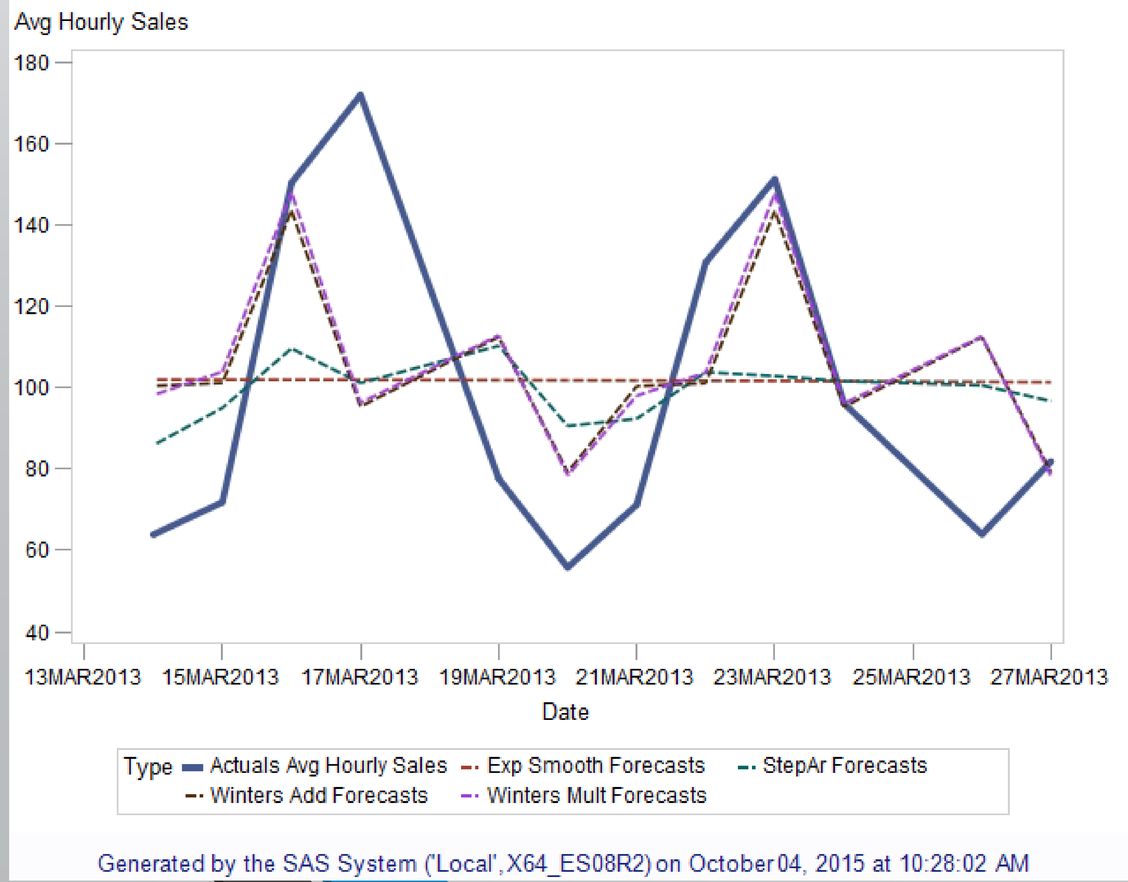
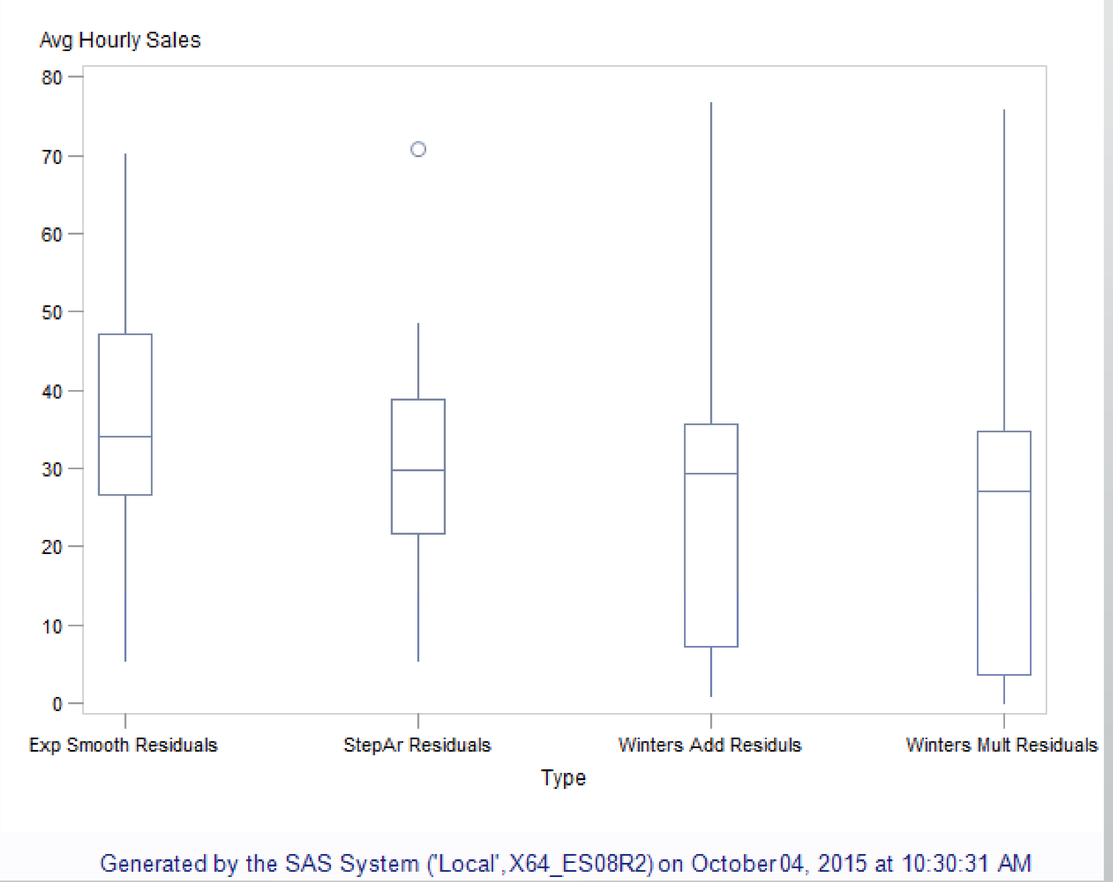


Figure 12



Summary Statistics for Residuals Across All Date Ranges

Table 1

Summary Statistics

Results

The MEANS Procedure

Variable	Mean	Std Dev	Minimum	Maximum	N
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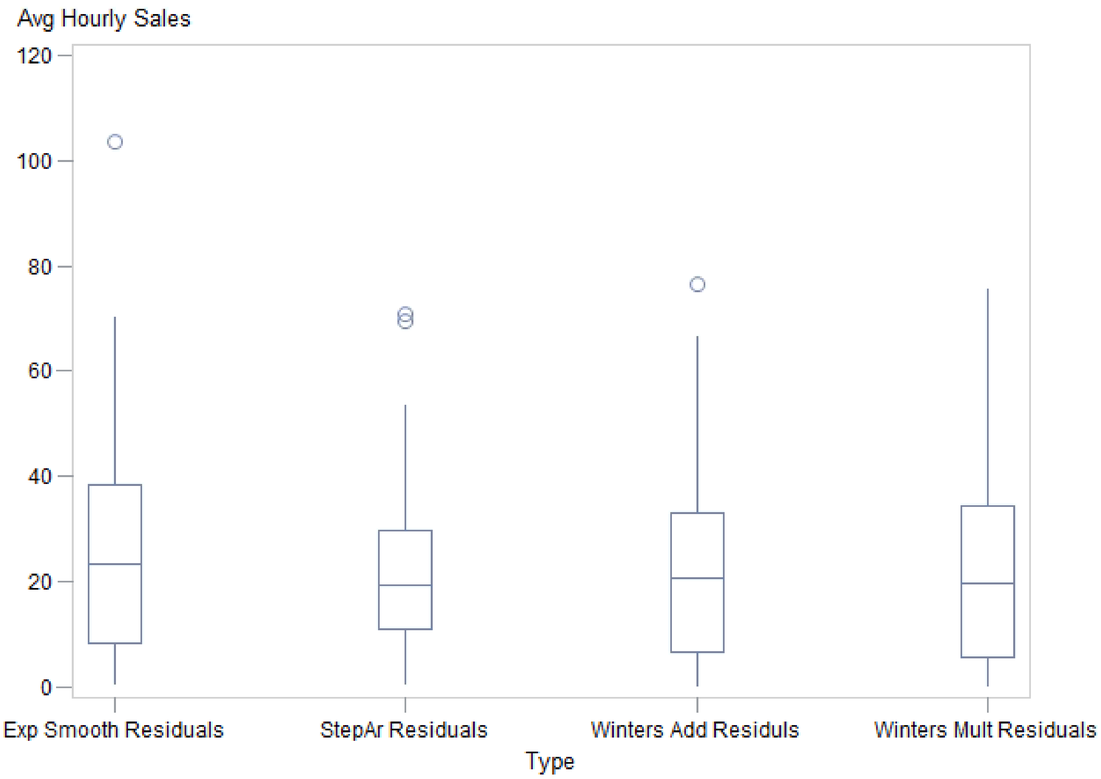
Figure 13

Box Plot of Residuals All Dates



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