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Predictive Modeling of US Winter Apparel Sales Using Time Series Forecasting Method

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ABSTRACT

Fashion and apparel sales have always been an interesting aspect of study due to the immense number of controllable and uncontrollable variables that contributes to the total sales. In order to develop a sound predictive model for forecasting apparel sales a lot of factors can be incorporated to enhance the results and minimize the forecast error. This paper will present a Time Series Forecasting model of US Apparel and accessories sales for the winter season. This model is generated to shed the light on the unexpected loss incurred by retailers for the winter season of 2015 by incorporating weather variation as an influencer on the sales. This paper is also going to discuss some important managerial approaches which empower firms to deal better with unforeseen variabilities.

Keywords: Time series forecasting, US apparel sales, fast fashion

I. Introduction:

US Apparel industry sales is one of the main revenue generating sectors in the US retail trade, indeed in 2014 it accounted for 19% of the total retail trade sales[1]. There are a number of complex factors that affect the sales of the apparel industry; some of these variables include weather, consumer preferences and behavior (style and fashion), personal income, economic factors, prices, political climate and seasonality. Forecasting sales for the fashion and apparel domain becomes quite challenging given the fact that sales are generated by volatile demand patterns that are influenced by so many factors some of which are mentioned above.

II. Literature Review:

The traditional apparel supply chains are usually quite diverse, globally dispersed and multi-tiered which indicates longer lead times, lower flexibility and higher vulnerability when dealing with uncertainty. Apparel supply chains commonly deploy the historical sales data gathered from downstream to generate an updated forecast according to which all the activities upstream are planned for and managed (i.e. procurement of raw materials, manufacturing

capability and scheduling, transportation, inventory and warehouse management). Thus, there is a significant emphasis on the accuracy of forecasts as it governs the overall revenue generated for all partners within the supply chain from downstream to upstream stages.

Consequently we ought to highlight some of the key contributing factors affecting US retail apparel sales forecasts and its accuracy:

1. Seasonality: refers to the variation governed by weather or holidays which is one of the key elements affecting the total retail sales of clothing and clothing accessories in the US, it is reported that the holiday season sales contributes to 20% of the total retail annual sales and for some retailers like specialty stores it escalate up to 30% of the total [2].

It was estimated by experts that the percentage of retail sales affected by weather accounts for 2% - 8%, however for highly seasonal items like the sales of winter apparel the percentage will escalate to 40% [3].

By analyzing the data from year 2005-2014, it can be visually evident that the US demand for apparel peaks significantly during the winter/holiday season, more specifically in December [Figure 1 and Figure 2]. It could be inferred from the data that retailers rely on the holiday season to generate most of their annual revenue.

2. Economic conditions: the economic conditions are closely related to the level of spending and the sales volumes generated and factors as pricing, national and personal income, inflation/deflation rates ought to be integrated into the sales forecast. The US economic-recession of 2008 is a clear indicator of how economic conditions could heavily impact the sales of apparel and other domains as well, as observed there is a huge decline in the apparel sales throughout year 2008 (Figure 1,2 and 3). Year 2008 marked the lowest sales total within the US market and the following year witnessed a cautious increasing trend for the total sales.

3. Fashion Trends: the clothing sector is dominated by having an ever changing fashion trends/styles in addition to a great portion of variety with so many SKUs (Stock Keeping Units) to meet different tastes, preferences and sizes. To incorporate all of these elements into the forecast becomes a daunting task**.**

4. Consumer Behavior: this is by far the most difficult aspect to assess and quantify, despite all of the research efforts exerted in this area, however it remains quite misleading to generalize and standardized the obtained results.

This paper is going to examine the effect of only one of these factors on the apparel and apparel accessories sales, which is the seasonality driven by weather variation. More specifically this paper will be addressing the variation of US winter apparel sales and developing a predictive model for forecasting the winter season sales 2015-2018 while integrating the historical weather data for the winter season.

III. The Need for This Study

During the winter/holiday season of 2015, it was reported that there was a significant loss of sales due to the unexpected warm weather. Retail consultancy Planalytics stated that their estimates for the loss of apparel sales were around $572 million due to the unusual high temperature in November and December [3]. Additionally, it was reported by the National Retail Federation (NRF) on their monthly economic review of December 2015 that despite of the weather and the pricing challenges the holiday sales are still heading towards an overall modest growth [4]. NRF also reported that "unseasonably warm weather has dampened consumers' appetite for winter apparel, and the shift in spending toward services continues to be a challenge for retailers." [4]. Despite the unprecedented loss that was incurred by some apparel retailers during the winter/holiday season, due to the unseasonably warm weather, however it was mentioned by the NRF report that the retail

holiday sales of 2015 growth rate was less than the expectations but it still marked a better overall growth rate when compared to both the 2012 and 2013 holiday seasons.

The data gathered clearly reflected that some of the apparel retailers suffered tremendously during the winter/holiday season of 2015 blaming the losses on the weather variation, also there was an increase towards online shopping with 0.3% [5] and the consumer spending is generally shifting more and more towards services.

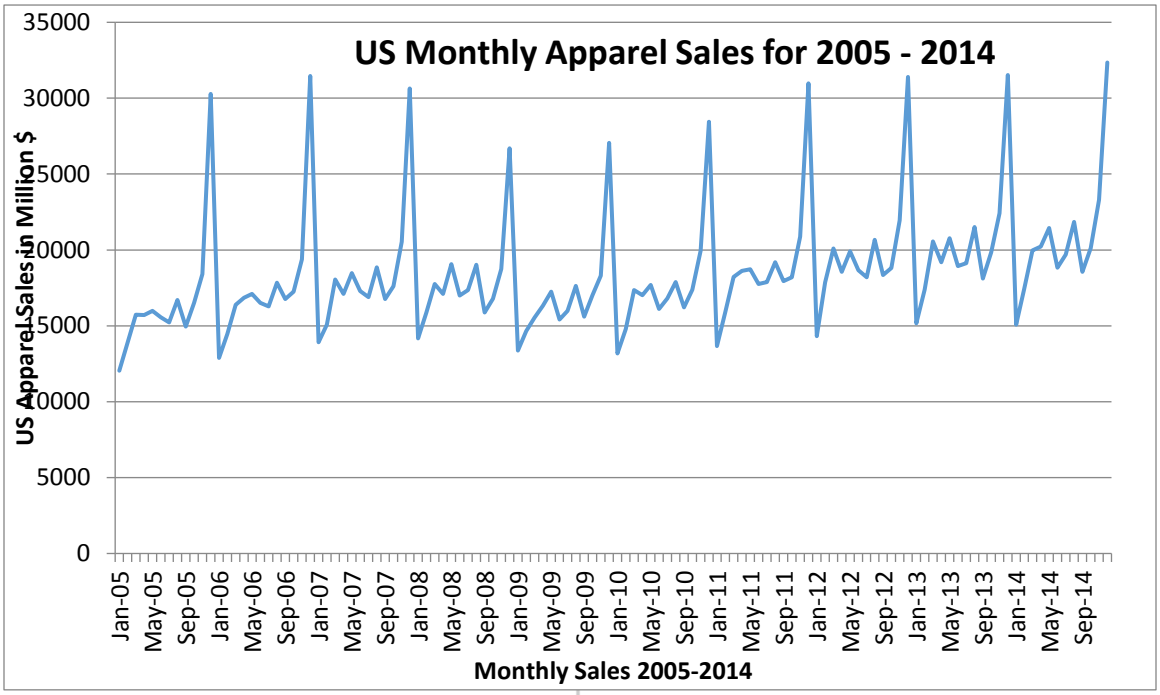

Figure 1: US Monthly Apparel and Apparel accessories sales for years 2005-2014. Source: Sales Data used for plotting the diagram was retrieved from http://www.economagic.com/em-cgi/data.exe/cenret/nrt448nsa

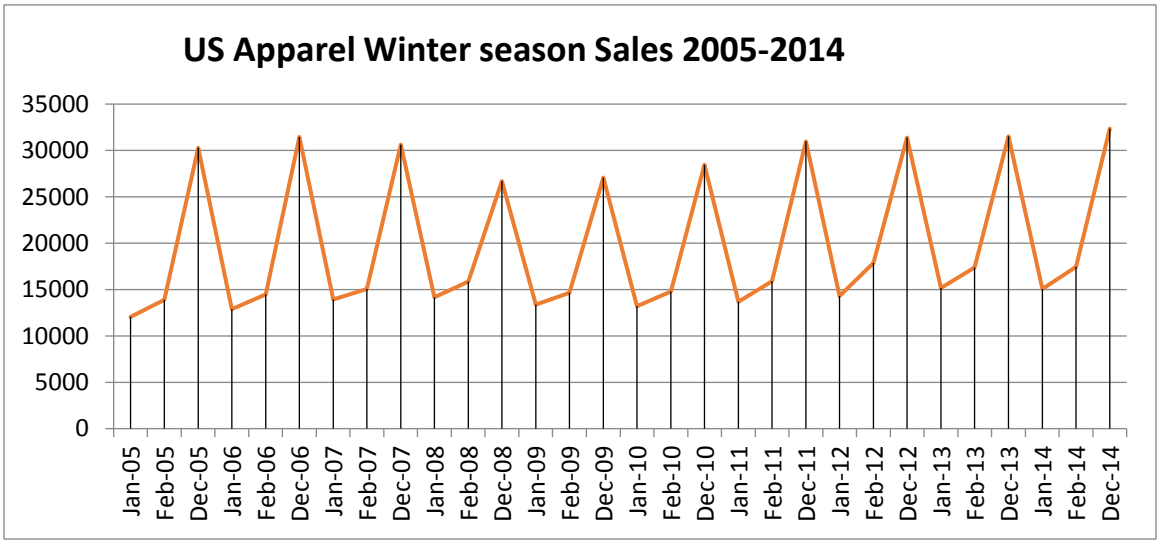

Figure 2. US Apparel and Apparel Accessories Sales of the Winter Season (Dec through Feb) for years 2005-2014. Source: Sales Data used for Plotting the Diagram was retrieved from http://www.economagic.com/em-cgi/data.exe/cenret/nrt448nsa

IV. The Methodology/Approach

The objective of this paper is to investigate and test if there is a significant correlation between the weather variation during the winter/holiday season and the volume of apparel sales in the US. The second objective is to develop a predictive model using time series forecasting and regression models. "Time series forecasting methods are probably the most used techniques for prediction of sales data." [10].

The time series forecast will integrate the weather data to enhance the results of the forecast if the hypothesis was true.

To test the hypothesis, the average temperature in Fahrenheit degrees, during the winter season (from December through February) for years 2005-2014 was collected from historical records [6]. The US clothing and clothing accessories sales data from year 2005-2014 during the winter season (from December through February) was collected [1]. Both of the data sets were plotted into JMP software and analyzed. The results showed that there is a significant statistical correlation between the weather variation and the apparel sales volume. A regression model was used to forecast for the apparel sales while integrating the weather data set as an X factor and a new updated weather-driven sales predictions were generated.

A time series forecasting technique was used to predict the US apparel sales during the winter season until December 2018 [Figure 3]. It is also evident that the forecasted data matches the actual sales values to a very high extent which indicates that the model is sound. Also after generating the model and comparing the values to one of the recently documented sales estimates by the US Census Bureau, the results were fairly close to the estimates.

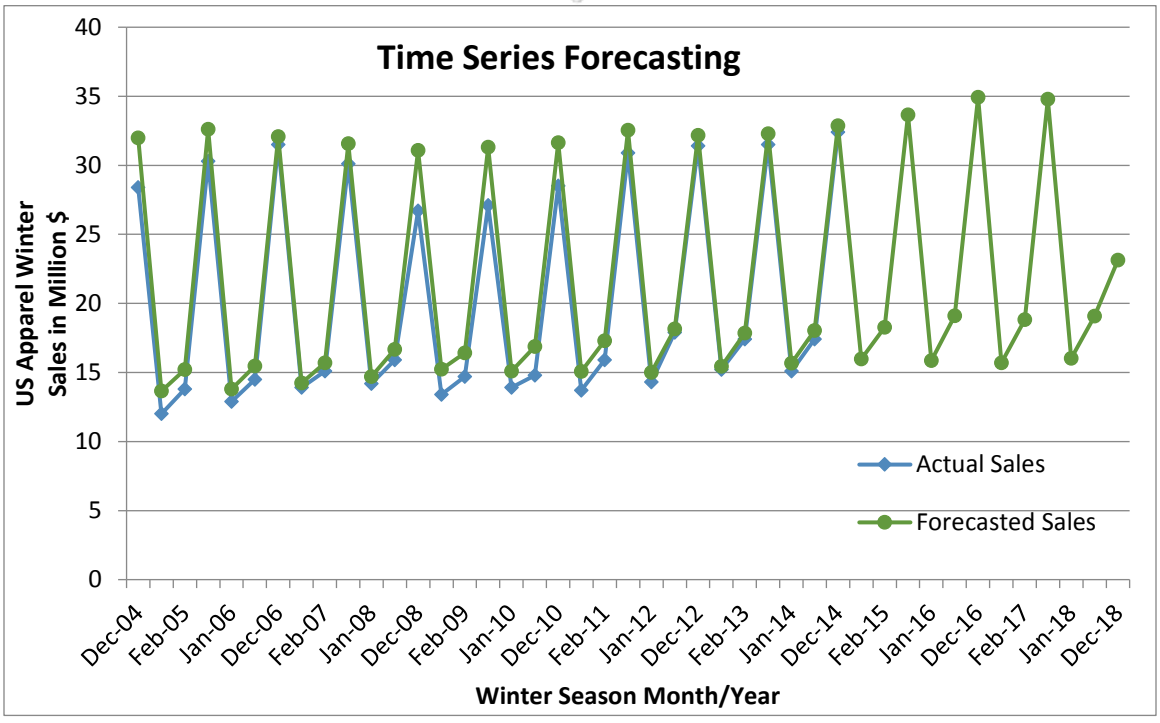

Figure 3. Predictive model of US Apparel (and Apparel accessories) Sales of the Winter Season (Dec through Feb) up to Year 2018 using Time Series Forecast Technique.

V. Conclusion and Recommendations

The sales values generated by the predictive model showed a relatively high conformity with the actual values. The predictive model used the weather data set that was proven to have high correlation with the sales volume in order to enhance the forecasting method and lower the forecast error. It is worth denoting that some of the deviation reflected by the model is due to integrating only one factor into the historical sales data set, while by deploying more of the significant factors into the forecast model the more accurate the prediction will be.

The apparel sales for winter 2015 were lower than the expectations; however not all the retailers faced the same portion of loss in revenues. Some of the retailers have successfully managed to run their businesses with more flexibility to encounter unforeseen variabilities. One of the remarkable managerial approaches that‘s implemented by fast fashion retailers like Zara and H&M is Quick response. Quick response refers to the ability to react to demand variability in a timely responsive manner. It was mentioned that Zara was more capable of dealing with the warm weather wave of winter 2015 when compared to traditional retailers [7], moreover Zara managed to increase its worldwide sales with 18% in 2015 [8].

The forecasting model represents a steady increase in the sales followed by a drastic drop in the sales which requires further analysis, this drop in sales could be interpreted by different causes, as it was mentioned earlier that one possible cause would be the evident change in the consumer’s spending habits as it is shifting more and more towards services, people are inclined more and more towards online shopping thus retailers ought to plan to create an interesting online shopping experience for customers to attract more customers to buy apparel online.

According to a recent report that analyzed the projected US population growth from year 2015-2060, the US census bureau declared that based on the data and the analysis, the projected growth of the US population for the future decades is estimated to follow a slower increasing trend compared to the rate in the recent past. This indicates that the population growth will not be considered as a significant influencer on any change observed in the patterns of sales [9].

The limitation of this model is that it only considered one out of so many factors that affects the sales volume, more factors ought to be quantified in order to improve the model.

Forecasts usually relies on historical data to predict the possible outcomes however in today’s Volatile, Uncertain, Complex and Ambiguous (VUCA) environment, firms are required to run more flexible and resilient business models to cope with all the unforeseen situations that forecasts may not account for , in order to remain successfully competitive and sustain today’s business environment.

VI. References

1. "US Retail Sales: Clothing And Clothing Access. Stores: NAICS 448: NSA: Millions Of Dollars". *Economagic.com*. N.p., 2016. Web. 28 Apr. 2016. Retrieved from: http://www.economagic.com/em-cgi/data.exe/cenret/nrt448nsa
2. Va, V. I. (n.d.). Holiday Trends and Expectations. Retrieved from: https://nrf.com/sites/default/files/Images/Media Center/2015 NRF HSK_Final_Small.pdf
3. Kottasova, Ivana. "Fashion Retailers Pay Heavy Price For Warm Winter". *CNN Money US*. N.p., 2016. Web. 22 Apr. 2016. Retrieved from: http://money.cnn.com/2016/01/06/news/companies/warm-weather-business/
4. Kleinhenz, J., & Ph, D. (2015). Dec 2015, 3–5. Retrieved from https://nrf.com/sites/default/files/Documents/retail library/December-2015_Monthly-Economic-Review.pdf
5. Reuters,. "Why Retail Sales Ended 2015 Poorly". *Fortune*. N.p., 2016. Web. 24 Apr. 2016. . Retrieved from:

http://beta.fortune.com/2016/01/15/why-u-s-retail-sales-ended-2015-poorly/
6. "Weather Forecast & Reports - Long Range & Local | Wunderground | Weather Underground". *Wunderground.com*. Web. 20 Apr. 2016. Retrieved from: https://www.wunderground.com/
7. Tabuchi, Hiroko. "Retailers Feel The Heat Of Lost Winter Clothing Sales". *Nytimes.com*. N.p., 2015. Web. 24 Apr. 2016. http://www.nytimes.com/2015/12/16/business/retailers-feel-the-heat-of-lost-winter-clothing-sales.html
8. Garc, Ana. "Inditex Net Profit Up 15% In 2015 On Zara Sales". *MarketWatch*. N.p., 2016. Web. 25 Apr. 2016. . Retrieved from: http://www.marketwatch.com/story/inditex-net-profit-up-15-in-2015-on-zara-sales-2016-03-09
9. Colby, Sandra L. and Jennifer M. Ortman, Projections of the Size and Composition of the U.S. Population: 2014 to 2060, Current Population Reports, P25-1143, U.S. Census Bureau, Washington, DC, 2014. Available online: https://www.census.gov/content/dam/Census/library/publications/2015/demo/p25-1143.pdf.
10. T.-M. Choi et al. (eds.), Intelligent Fashion Forecasting Systems: Models and Applications, DOI 10.1007/978-3-642-39869-8__2, © Springer-Verlag Berlin Heidelberg 2014, Available online: http://link.springer.com/chapter/10.1007%2F978-3-642-39869-8_2