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Forecasting Monthly Export of Readymade Garments by Removing Seasonal Impact

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Abstract

Various Bangladeshi authorities release time series data that takes seasonal effects into account. However, no adjusted series is offered. The developed world has completely different conditions since they broadcast seasonally adjusted series. Many seasonal adjustment techniques, such as classical and X-based techniques, are available; however they cannot be used in practice in accordance with Bangladesh's seasonal time series. So here we have executed X-11 and X-12-ARIMA which are known as *X-based* seasonal adjustment methods and some classical methods like SARIMA and MA to seasonal time series data collected from secondary source as economic trend revealed by Bangladesh Bank. We will use export of readymade garments which are monthly data and have seasonal impacts. The entire data collection must first be divided into training and test data. Next, the data was de-seasonalized, and future values were predicted using training and test data sets, respectively, to compute various forecasting errors such as MAPE, PMAD, MAD, and RMSE. We utilize several X-based approaches and traditional methods to compare the errors. We conclude that the seasonal adjustment strategy performs better and has fewer forecasting mistakes. In conclusion, we suggest the optimal seasonal adjustment technique for ready-to-wear exports and project certain future values based on that technique.

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Introduction

Economic distribution in Bangladesh is based on ancient practices, such as inheritance and crude calculations. During the time when East Pakistan was known as Bangladesh, the government of then-West Pakistan implemented policies that encouraged discrimination and stunted the development of major enterprises. The most difficult task, therefore, seems to be rebuilding a war-torn nation with limited resources. But the one business that has been unquestionably contributing to the nation's economic expansion is the ready-made clothing sector (Hasan, 2014). Garments industries of Bangladesh are the country's largest industrial sector. Through Dhakai Muslin, the history of the ready-to-wear industry began in the Indian subcontinent during the Mughal Empire. It was well-known around the world and in high demand, especially in Europe (Abdin, 2010). As per the report, this industry accounts for 81% of the nation's overall export earnings. Bangladesh's economy is growing quickly as a result. The export of ready-made clothing (RMG) is essential to the nation's ability to maintain its position in the global economy and generate foreign exchange. The 1980s saw the beginning of Bangladesh's apparel industry, which is currently in its current state. Readymade clothing was invented in Bangladesh by Nurool Quader Khan, who sadly passed away (Hasan, 2014). The majority of fabrics used to make Bangladeshi apparel are knit or woven. Knit clothes are clothing made of knitted materials, whilst woven clothes are clothing made of woven materials. T-shirts, polo shirts, and undergarments such bras, hoodies, briefs and panties are examples of knit clothing. Formal shirts, trousers, denim jeans, suits, chiffon and georgette gowns are examples of woven apparel (Sarkar, 2016).

Development in a tiny developing nation like Bangladesh may happen extremely slowly, with contributions from a variety of industries and sectors, including the financial market, manufacturing and industry, agriculture, investment, and external commerce. The return received at a predetermined point in the future from an investment made in a financial asset today should be viewed as a random variable. Only a model can adequately describe such a variable (Saeed et al., 2018).

Bangladesh though, is a little developing nation. This nation's economy is mostly reliant on import-export, agriculture, overseas remittances, etc. This nation's overall development was primarily reliant on agriculture. But things have changed in the modern day. Recently, the import and export of many goods has increased in importance. In order to use this sector for economic development, researchers must examine the economic behavior of various sectors using suitable time series or econometric models. But the majority of these financial records are time series. Time series data include things like GDP, CPI, production, export-import, etc (Saeed , 2019).

Seasonal variation is a crucial component of time series, which consist of four distinct components. If one is unaware of seasonal fluctuations, one could misinterpret a seasonal upturn as a sign of improving business circumstances and a seasonal downturn as a sign of worsening business conditions. For this reason, time series data needs to be adjusted for seasonal variations in order to accurately comprehend the behavior of the events in the time series. Usually, quarterly, monthly, or weekly statistics exhibit seasonal fluctuations. It is challenging to determine if changes in data for a certain time represent significant increases or decreases in the level of the data or are the result of regularly occurring variance because of seasonal swings in the data. Measuring and removing seasonal variations from a given series are the two goals of seasonal variation research (Gupta and Kapoor, 2000). There are several X-based and conventional seasonal adjustment techniques available. Several traditional techniques include moving averages, seasonal ARIMA, simple averages, ratios to trends, and more. Methods based on X include X-11, X-11-ARIMA, X-12, and so on. However, Bangladeshi time series data do not support the actual application of these seasonal correction methods. Different seasonal adjustment techniques are used by industrialised nations like Singapore, Australia, and the United States to deseasonalize time series data.

Literature review

The general situation of the RMG sector, its economic impact, and the obstacles to its expansion are depicted in the literature review. Hasan (2014) provided an explanation of how the RMG sector contributed to Bangladesh's economic expansion and was essential in keeping the nation competitive in the global economy so it could generate foreign exchange. Chowdhury & Zabeen (2020) used Porter's diamond model of national competitiveness to investigate why the RMG industry attained this position. According to Chowdhury et al. (2014), there were 0.12 million jobs overall in 1984–85, but by 2012–13, that number had increased to 4 million. The report also listed the following as obstacles to the growth of RMG exports: the lack of raw materials in the home nation, the power crisis, the lack of loans, strikes, political instability, lead time management, unskilled labour, unhygienic and unsafe working conditions, worker unrest, and fire occurrences. Tasnim (2021) provided an explanation of the training and development issue facing Bangladesh's RMG industry. The results of his investigation showed that there were not enough training programme sessions, not enough training equipment, the training programme was out of date, and employees didn't consistently show up for it. Berg et al. (2021) demonstrated how Bangladesh's RMG industry has significantly addressed growth challenges in the last ten years, especially when it comes to diversifying clients and items, improving worker and supplier performance, and bolstering compliance and sustainability. In their study, Saha et al. (2021) examined various strategic plans to start sustainable development and provided explanations of obstacles such as lack of a life security system, political hurdles, and corruption barriers. Islam et al. (2020) illustrated how Covid-19 affected Bangladesh's RMG industry and offered some suggestions for resolving this pressing issue. Based on their research, the government, industry leaders, and other interested parties should take action to protect Bangladesh's RMG industry, which accounts for 11.2 percent of the nation's GDP and is the second-largest RMG enterprise globally.

Materials and Methods

The Seasonal Component

The effect of seasonality is seen as constant in deterministic time series analysis, meaning that the seasonality's magnitude in comparable time periods is assumed to be constant over the course of the time series. However, the stochastic analysis does not meet the requirement of constant seasonality; in this instance, the techniques employed also account for what is known as changing seasonality. One advantage of this approach is that it can prevent under- and overcorrection that could be caused by a set seasonal rhythm. When analyzing the time series, choosing between additive and multiplicative decompositions is mostly crucial from the perspective of determining the seasonal component. Time series data often makes it easy to see which decomposition model is most suited to explaining the data's behavior (Foldesi 2007).

Reasons for studying seasonal variation

Studying seasonal fluctuation is important for various reasons.

(i) An enhanced comprehension of the influence this element has on a certain series is offered by the explanation of the seasonal effect.

(ii) Once the seasonal pattern has been established, techniques for removing it from the time-series can be used to examine the impact of additional elements such cyclical and irregular fluctuations. Seasonal adjustment of data is the term used to describe this removal of the seasonal influence.

(iii) Understanding seasonal fluctuations is essential for forecasting future trends, as it allows one to extrapolate past patterns into the future.

Different Seasonal Adjustment Methods

There are three types of seasonal adjustment methods.,

1) Filter based seasonal adjustment method (based on filters)
2) Non filter based seasonal adjustment method (does not rely on filters)

1) The most commonly used filter based seasonal adjustment methods are;

(i) X-11
(ii) X-11-ARIMA and
(iii) X-12-ARIMA.

2) The most commonly used non filter based seasonal adjustment methods are;

(i) Method of simple average
(ii) Ratio to trend method
(iii) Moving average method and
(iv) Link relative method.

Using Deseasonalized Data to Forecast

For the purpose of correcting a time series for seasonal swings, for instance, a set of typical indices is highly helpful. Deseasonalized or seasonally adjusted series are the terms used to describe the ensuing series. Deseasonalization is the process of removing seasonal changes from a series in order to study the trend and cycle. Seasonally adjusted forecasts can be produced by combining the process for trend identification with the seasonal adjustments. We use the deseasonalized historical data to find the least squares trend equation, which helps us identify the trend. After that, we project this trend into upcoming times, and lastly, we modify these trend values to take seasonal aspects into consideration. Now the deseasonalized data will follow a straight line. Hence it is reasonable to develop a linear trend equation based on this deseasonalized data. The deseasonalized trend equation is:

$$Y' = a + bt$$

where,

Y' (estimated trend value for the series for the period t.)
a (intercept of the trend line at time 0.)
b (slope of the line.)
t (coded time period.)

Assuming n sales periods, we can predict future values using the trend equation. Take quarterly statistics as an example. In the fitted model (a), the values for the following years can be derived by substituting t=n+1, n+2, n+3, and n+4. This is the predicted data set prior to taking seasonality into account. Lastly, we need to multiply this predicted series by the seasonal index to obtain the original series. According to Lind, Marchal, and Wathen (2005), the predicted series is thus ultimately obtained.

Different Measures of the Forecasting Errors

It is possible to summarize the errors made by a certain forecasting approach in a number of ways. The majority of these metrics rely on averaging what are often known as residuals, which are functions of the difference between the actual values (Hanke and Wichern 2005). The performance of the forecasting process is evaluated using various metrics for forecasting errors. To compute the errors from anticipated values, common metrics like mean absolute deviation (MAD), mean absolute percent error (MAPE), percent mean absolute deviation (PMAD), and root mean squared error (RMSE) are employed.

Results and Discussion

Over the past two decades, Bangladesh's readymade garment exports have achieved remarkable success that has beyond even the most optimistic predictions. In modern Bangladesh, the export of ready-made clothing has undoubtedly had one of the biggest social and economic effects. There have been far-reaching effects on Bangladeshi society and economy from the growth of the garment export sector, which employs over 1.5 million women in semi-skilled and skilled occupations making garments for export (Quddus and Rashid, 1999). The values that were originally calculated and those that were predicted using various seasonal adjustment algorithms are presented in the table below.

Table 1: Original and forecasted values with their sample mean ± SE obtained by different seasonal adjustment methods for export of readymade garment series

Original	MA	SARIMA	X-11	X-12-ARIMA
8213	8307.87	8899.01	8340.37	8314.73
7488	8371.75	8683.98	7928.34	7730.16
9472	8435.62	9102.75	8941.79	8944.71
9052	8499.49	8712.07	8238.31	8541.28
10188	8563.37	8895.10	8455.32	9460.93
10924	8627.24	9112.69	8982.19	9850.80
10449	8691.11	8791.66	9704.94	9937.50
9305	8754.99	9035.78	10002.16	10011.02
12012	8818.86	9187.27	9125.95	12162.01
10370	8882.73	8888.89	8625.37	8610.28
9532	8946.60	9206.20	7481.76	8782.73
8647	9010.48	9269.65	7777.00	7750.07
9637.67±357.96	8659.18±66.48	8982.09±57.12	8633.62±218.67	9174.69±353.84

We may now compute several forecasting error metrics, such as MAPE, PMAD, MAD, and RMSE, using the given table. The calculated values of the various forecasting accuracy metrics are displayed in the following table.

Table 2: Measuring forecasting accuracy of different seasonal adjustment methods for Export of Readymade Garment series.

Methods of seasonal adjustment	Measuring forecasting accuracy			
	MAPE	PMAD	MAD	RMSE
MA	11.75%	12.47%	12.02%	14.82%
SARIMA	10.70%	11.13%	10.73%	13.10%
X-11	11.99	12.61%	12.15%	14.52%
X-12-ARIMA	8.11%	8.18%	7.88%	9.36%

As can be seen from the above table, when compared to the forecasting errors obtained from the MA, SARIMA, and X-11 methods, the X-12-ARIMA seasonal adjustment approach yields the lowest forecasting mistakes, including MAPE, PMAD, MAD, and RMSE. Thus, we can conclude that the X-12-ARIMA process has worked effectively for this series' forecasting needs in terms of the minimum error method.

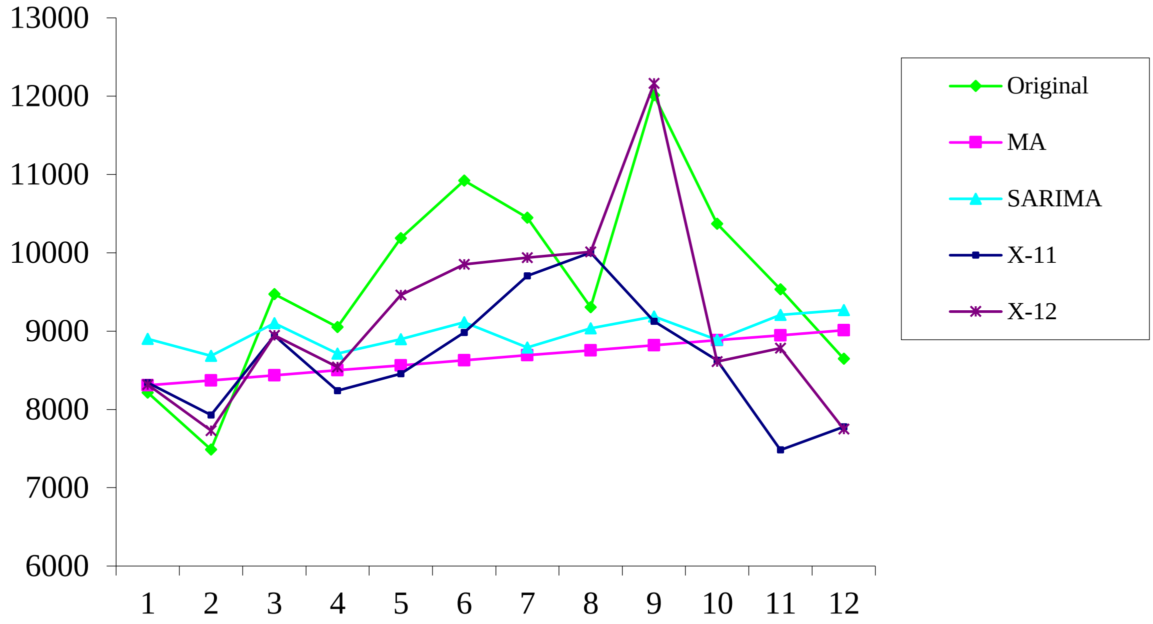

Figure 1: Original and forecasted values for different seasonal adjustment methods for export of Readymade Garments series.

The above chart makes it clear that, in comparison to anticipated values derived by other approaches; those acquired by the X-12-ARIMA method are much closer to the actual series. Thus, we can say that the seasonal adjustment approach of X-12-ARIMA is more suitable for this series.

CONCLUSIONS

It is imperative to compensate for seasonality when analysing time series data. We have utilised various seasonal adjustment techniques, including X-based and classical methods, to analyse the yearly economic trend of ready-made garment exports gathered from Bangladesh Bank. Different forecasting errors (the MAPE, PMAD, MAD, and RMSE) calculated for the seasonal adjustment methods of MA, SARIMA, X-11, and X-12-ARIMA have been noted. Here, we found that, when compared to predicting mistakes obtained from the MA, SARIMA, and X-11 methods, the X-12-ARIMA technique yields the lowest forecasting errors. Additionally, a comparison line graph between the original and forecasted values, derived from several seasonally adjusted methods, was seen. This graph also shows that, for the export of ready-made clothing, predicted values derived from the X-12-ARIMA approach are more similar to the original series.

Applications

Economic indicators including GDP, inflation, unemployment, and stock prices are frequently predicted using time series analysis. Economists can create models to forecast trends and make educated policy choices by examining past time series data. Organizations can learn the underlying causes of systemic patterns or long-term trends through time series analysis. Data visualizations allow business users to observe patterns over time and investigate their causes. These visuals can now do a lot more than just time series analysis with the help of modern analytics tools.

Limitations and future research directions

Time series analysis stands as a crucial method for forecasting future patterns and trends by leveraging historical data. Yet, like any analytical tool, it encounters limitations and challenges.

One fundamental issue lies in the assumption of data stationarity, a cornerstone of time series analysis, which clashes with the prevalent non-stationarity observed in real-world data. Consequently, applying standard time series models becomes daunting. Moreover, the presence of seasonal patterns or long-term trends in time series data complicates forecasting endeavors, potentially leading to inaccuracies if not appropriately addressed. Additionally, anomalies and outliers pose significant threats to the reliability of prediction models by skewing statistical characteristics. Addressing these outliers necessitates meticulous examination to discern genuine observations and employing robust statistical approaches like outlier detection algorithms or robust regression models. Thus, a comprehensive understanding of the limitations and challenges inherent in time series analysis is imperative. By recognizing and mitigating issues related to non-stationarity, seasonality, trends, and outliers, analysts can enhance the reliability of time series forecasting models, ensuring more accurate predictions.

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