

## Analysis of Seasonal Fluctuation based on X-12-ARIMA -- A case Study of Su Ning Electric Appliance

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### Abstract

*The sales data sequence of the enterprise often has the seasonal effect, this paper uses X-12-ARIMA method to analyze the enterprise sales data, to eliminate the influence of the seasonal fluctuation, and provide support for the enterprise.*

*Supply and demand is the survival and development of every enterprise, a company's sales in a certain extent, the company's production and business activities, and business sales data will show the development and change of economic time series, but the seasonal factors of production will be more, so the study of enterprise sales data seasonal changes, the following will be a clear understanding of seasonal fluctuations in corporate sales data.*

**Keywords:** *seasonal adjustment; X-12-ARIMA; stability;*

However, the current literature data, from the perspective of seasonal fluctuations in the sales data is not many, in 1999 Han Liyan to Beijing residents of the actual data and consumption data for example, analyzed the characteristics of the risk level, the conclusion of seasonal adjustment may destroy the cointegration. 2006 Li Rui, the division should be to the Wuhan area real estate prices by the seasonal dynamics of the Wuhan area real estate prices, find and measure the impact of economic policies and seasonal factors on the real estate prices, and to establish the relevant evaluation model, and the model test price trend of seasonal factors and policy factors on the real estate prices, based on the new X12 seasonal adjustment method for Wuhan area real estate prices seasonal factors, and establish a X12 seasonal adjustment model. <sup>1</sup>

In 2007, Wang Shuping, Gao Lijun, Xu Weixuan and Li Jianping published the seasonal fluctuation of heating oil price based on X-11-ARIMA method, and analyzed the X-11-ARIMA seasonal adjustment method in detail, which provides useful exploration for further research and application of seasonal adjustment method. The X-11-ARIMA seasonal fluctuation of international heating oil price analysis, explore the movement of oil prices, for China's oil imports and to provide decision support in 2008 Wang Shuping, short in Brent crude price of seasonal fluctuation analysis on oil prices to be seasonal effects are analyzed, the Bren analysis using the X-12-ARIMA method, explore the movement of oil prices, to provide decision support for China's oil imports. 2011 Yan Shifeng Ji Yunhua wrote seasonal adjustments for a foreign exchange revenue and expenditure data and the long-term characteristic analysis of the article, based on the X-12-ARIMA model, to January 2002 to July 2010, Jiangsu Province, monthly income and expenditure in foreign exchange of time series data as a sample for seasonal

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adjustment, the adjustment of foreign exchange revenue and expenditure data display (cycle) and seasonal obvious characteristics of the long-term trend of foreign capital flows and trade, foreign investment, foreign debt, profit remittances, foreign divestment, personal remittance main foreign exchange income and expense items showed different seasonal characteristics. 2014 tangliang in Qinshan nuclear power plant 320MW unit operation mode in summer seasonal adjustment the use seasonal conversion adjusting the operation mode of the method through the analysis of the system design and operation mode, combined with the actual environmental temperature change, the summary of hot weather in the summer for the operation of the system brings challenges, recognize the limitations of system design, clear the seasonal conversion method of adjusting operation mode, and puts forward corresponding suggestions.

From the above literature data to see the use of X-12-ARIMA to study the seasonal adjustment of the enterprise sales data, analysis of the impact of seasonal factors, so we will use the X-12-ARIMA to study the seasonal adjustment of the sales data, to analyze how the seasonal factors of the business impact on business sales.

## Method Introduction

The sales data is also a part of the economic time series, so it will be influenced by many factors, which can be divided into: trend, cycle, seasonal and irregular factors. The seasonal factor is a regular change of the response time series around the trend and cycle year after year. There are many factors, such as the production of its own seasonal, some social and historical factors, holidays, *etc.*. So in the study of economic time series because of seasonal factors such as the existence of the enterprise sales and other data and can not complete a real change law, so that it will affect the decision of the enterprise, so the data is seasonal adjustment, so that eliminate the seasonal factors, the impact of the data is more than that, a better response to economic change.

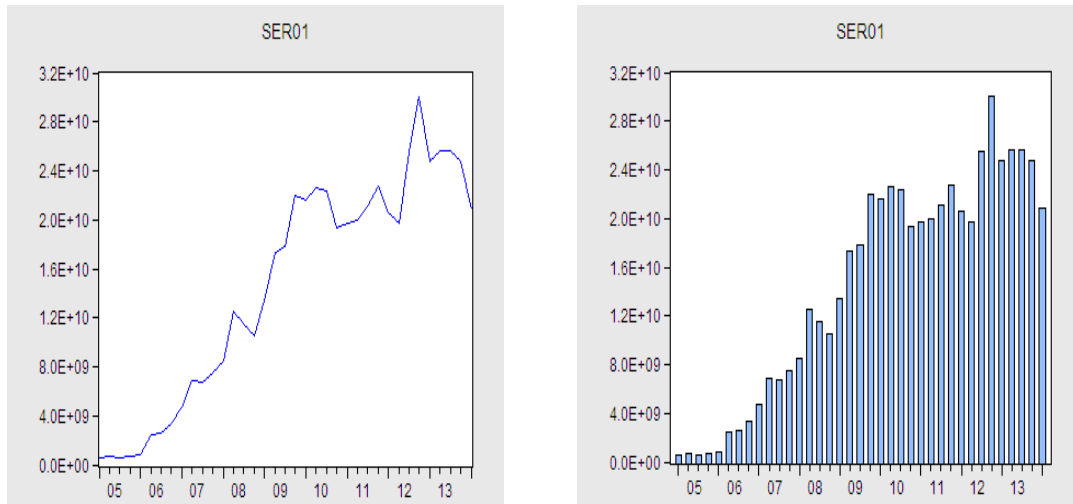
Seasonal adjustments are usually made of the procedures, mainly X-11 or X-12-ARIMA, X-11-ARIMA and TRAMO/SEATS, *etc.*. X-12-ARIMA method is basically consistent with X-11-ARIMA. However, X-12-ARIMA is more abundant in data preprocessing, detection and correction of different types of outliers, estimated and eliminated the impact of calendar factors, the effect of seasonal adjustment more stringent diagnostic test. While X-12-ARIMA and TRAMO/SEATS these two methods to deal with the time requirements of the data, X-11 this method every time to add a new data, it is necessary to carry out a seasonal adjustment of all the data in the past. Then first to introduce the source of X-11, in 1954, the U.S. Census Bureau of the Shiskin first developed a seasonal adjustment program can run on the computer, known as the Census Bureau model I, after each of the program to X plus serial number said. 1965 launch a relatively complete X-11 of the seasonal adjustment program, and soon become the standard method for the whole world statistical agencies, X-11 is based on the seasonal adjustment method, the user can adjust the purpose of various seasonal adjustment formula, so as to adapt to the nature of various economic indicators. But X-11 is a method based on experience, which has been criticized by the statistical community. It has a lot of shortcomings, so the experts and scholars have to find a new model. Box and Jenkins (1970) the results of the ARIMA model have made a great contribution to the development of the model based seasonal adjustment method. Dagum (1975/1988), the X-11 () developed the X-11-ARIMA method, which is based on the introduction of the idea of modeling to ensure the integrity of the data in the process of using the moving average of the seasonal adjustment, so as to make up for the defects of X-11 method. X-12-ARIMA method is basically consistent with the X-11-ARIMA, the main change is to adjust the regARIMA of the module, the data is more abundant in

the preprocessing, detection and correction of different types of discrete groups, and eliminate the impact of calendar factors. A more rigorous diagnosis of the effect of seasonal adjustment. Later, after some practice and modification, in 1998 the United States Census Bureau officially launched the X-12-ARIMA method and the supporting program, which is currently the most widely used method of seasonal adjustment. The forward prediction and backward prediction of the ARIMA model are extended to the time series of the seasonal adjustment. The forward prediction and backward prediction are extended to make the initial seasonal adjustment, which overcomes the defects of the original X-11 trend estimation procedure in the sequence of the sequence, and makes the correction (see Findl (2003), SoulCUp (1999), Dominique (200L) in the future. Some improvements, such as the quality of the seasonal adjustment and the comparison between the indirect and direct seasonal adjustment, are also included. At present, the relevant statistical analysis department of various countries using the X-12-ARIMA software is based on the X-11-ARIMA software, to learn from the United States, Canada, the United Kingdom, Germany, New Zealand and Japan's central bank and statistical departments in the work of the time series of seasonal adjustment, the United States Bureau of Statistics to further improve.

At present, there are not many literatures on the X-12-ARIMA seasonal adjustment in China. Zhang Mingfang (2004) using X-12-ARIMA method of seasonal adjustment, analysis and forecast of Shanghai CPI sequence, and the combined use of TRAMO/ seats solve the problem of China and foreign countries was significantly different from that of the Spring Festival holiday factors adjust, finally puts forward the problem faced by China's seasonal adjustment; 2011 Zhanghu, Li Wei, Yu stop also the X-12-ARIMA method were studied, they will be its application in China's consumer price index sequence analysis, to detect the influence of various calendar effects on the CPI index, comparative analysis of the three kinds of seasonal adjustment model, it is found that the China's CPI is subject only to the conclusion of the impact of the Spring Festival. Li Hui, Pan Shengchu and Chen Yanda in the study of China's premium income monthly data using the X-12-ARIMA addition model, and then to China's premium income monthly data set up a short-term forecasting model. The Spring Festival effect model of the method of the seasonal adjustment in 2012 is discussed, and the time series of the thermal power generation in China is analyzed in the empirical analysis, and the effect of the Chinese New Year is studied in the empirical analysis. 2013 Li Jian, Song Changming summand Chaoyang to soybean and wheat as an example, using X-12-ARIMA model of Chinese grain price series seasonal adjustment.

## **Two, Data Sources and Empirical Analysis**

This article all data from the "China Statistical Yearbook" and "EPS global statistical data / analysis platform database", Suning Appliance sales data from the first quarter of 2005 to the first quarter of 2014, the first quarter of, as shown in the following quarter data time series.



**Figure 1. Suning Appliance in the First Quarter of 2014 to the First Quarter of 2005, the time series**

From the time sequence diagram can be seen, Suning Appliance sales are increasing year by year, but 11 years and 10 years have dropped somewhat, but in the end of 12 there has been a substantial increase, and in every year in the four quarter, the highest in the first or fourth quarters of the obvious characteristics of seasonal sequence.

### 1, Stationary Test

For time series, the time series must be stable, if it is not necessary to become a smooth time series of research, then the following first look at the stability of this sequence, we use the relevant map and partial correlation analysis, analysis as follows:

Date: 04/29/15 Time: 10:48  
 Sample: 2005Q1 2014Q1  
 Included observations: 37

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob
1	0.930	0.930	34.704	0.000	
2	0.850	-0.120	64.473	0.000	
3	0.778	0.028	90.139	0.000	
4	0.697	-0.115	111.39	0.000	
5	0.601	-0.150	127.69	0.000	
6	0.504	-0.058	139.54	0.000	
7	0.421	0.028	148.07	0.000	
8	0.356	0.081	154.37	0.000	
9	0.286	-0.083	158.58	0.000	
10	0.215	-0.053	161.04	0.000	
11	0.146	-0.080	162.23	0.000	
12	0.077	-0.089	162.57	0.000	
13	0.005	-0.076	162.58	0.000	
14	-0.054	0.053	162.76	0.000	
15	-0.139	-0.280	164.03	0.000	
16	-0.221	-0.027	167.41	0.000	

**Figure 2. The Correlation Diagram of the Time Series of the Suning Appliance**

Dependent Variable: SER01  
Method: Least Squares  
Date: 05/29/15 Time: 15:28  
Sample (adjusted): 2005Q3 2014Q1  
Included observations: 35 after adjustments  
Convergence achieved after 3 iterations

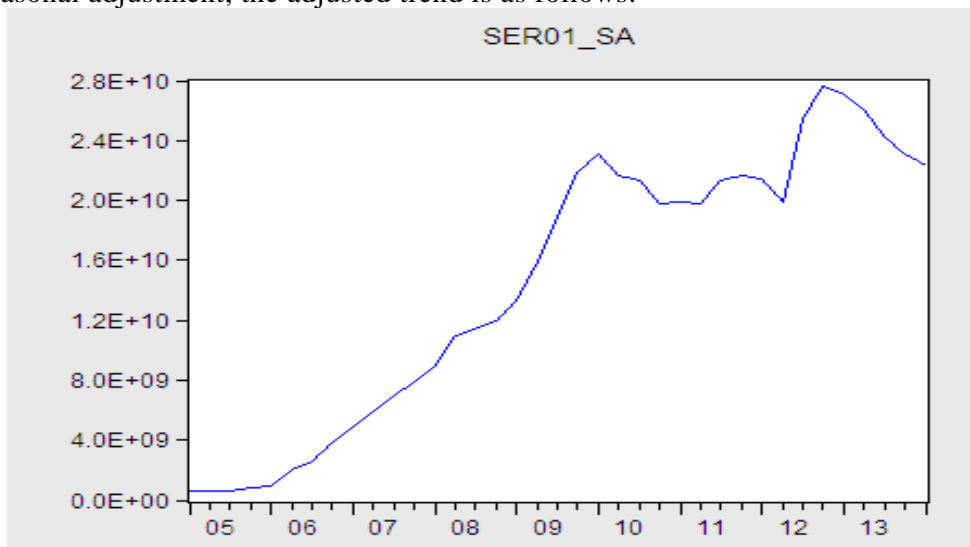
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.53E+10	6.32E+09	2.426054	0.0211
AR(1)	1.013343	0.190217	5.327298	0.0000
AR(2)	-0.079612	0.187420	-0.424778	0.6738
R-squared	0.933539	Mean dependent var		1.53E+10
Adjusted R-squared	0.929385	S.D. dependent var		8.84E+09
S.E. of regression	2.35E+09	Akaike info criterion		46.07440
Sum squared resid	1.77E+20	Schwarz criterion		46.20771
Log likelihood	-803.3019	Hannan-Quinn criter.		46.12042
F-statistic	224.7414	Durbin-Watson stat		1.914315
Prob(F-statistic)	0.000000			
Inverted AR Roots	.93	.09		

**Figure 3. Time Series Model Estimates**

From Figure 2 and Figure 3, we can see that the correlation is not very slow. We can see in Figure 2, =10 as an example, and the probability of a statistic greater than 0 is 161.04. Observe Figure 3 model selection AR (1), the model parameters through the t test, the bottom of the characteristics of the root of the 0.93 so meet the requirements of stability, then we can determine the time series is smooth, so we carry out the next step of the research.

## 2, Seasonal Adjustment

The original sequence is stable below we carry out the seasonal adjustment, the original sequence has obvious seasonal variation, we use EViews6.0 to adjust the seasonal adjustment, the adjusted trend is as follows:

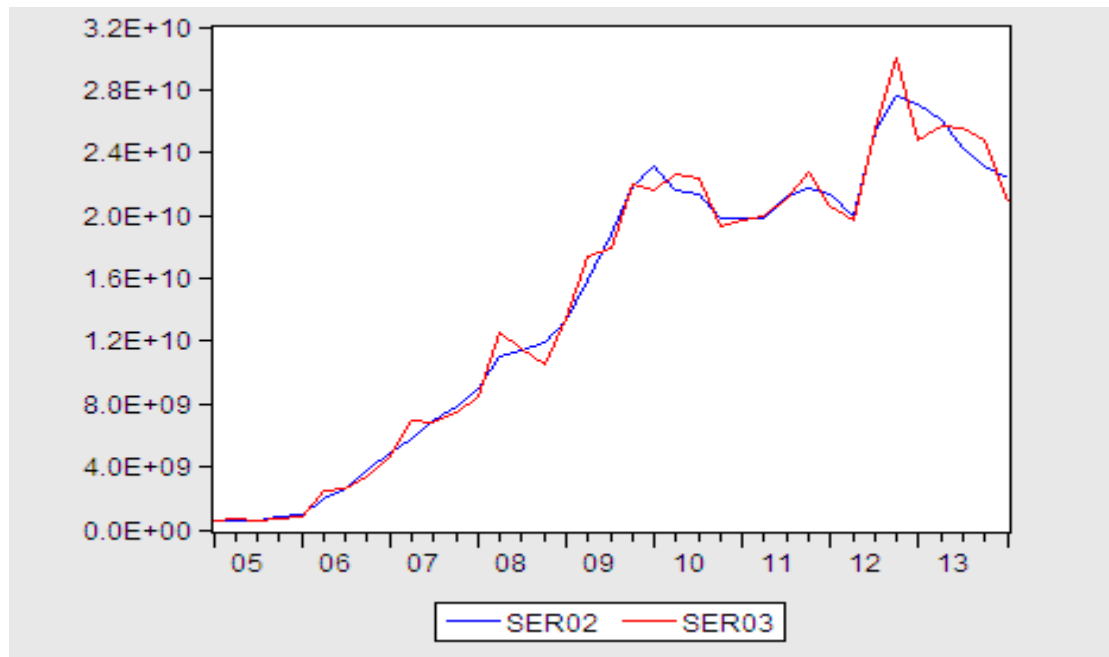


**Figure 4. The Trend Chart of the Original Sequence of Seasonally Adjusted**

From the trend chart can be seen, the adjusted sequence of apparent smooth many, the specific data is shown in Table 1, we see the average percentage of the original sequence is significantly smaller than the adjusted sequence, which also shows the adjusted sequence will become smooth, while the Q value is 1, this value is small in 0.05 is acceptable, the overall effect of the seasonal adjustment is better.

**Table 1. The Average Percentage Change of the Sequence of Suning Appliance**

Interval number	1	2	3	4	5	6
Original sequence%	6.745	9.932	12.345	15.464	17.481	19.004
Adjusted sequence%	6.103	9.324	11.908	14.976	16.403	18.453
Interval number	7	8	9	10	11	12
Original sequence%	20.043	20.908	22.345	23.987	24.674	26.354
Adjusted sequence%	19.347	19.541	21.308	22.682	23.987	25.557



**Figure 5. A Comparison Chart before and after the Season**

From Figure 5 you can see the change in the sequence of the season, and the peak value is significantly more smooth.

### 3, Seasonal Inspection

We carry out seasonal inspection of the adjusted sequence, and the test results are as follows:

**Table 2. Results of the Seasonal Inspection of Suning Appliance (1)**

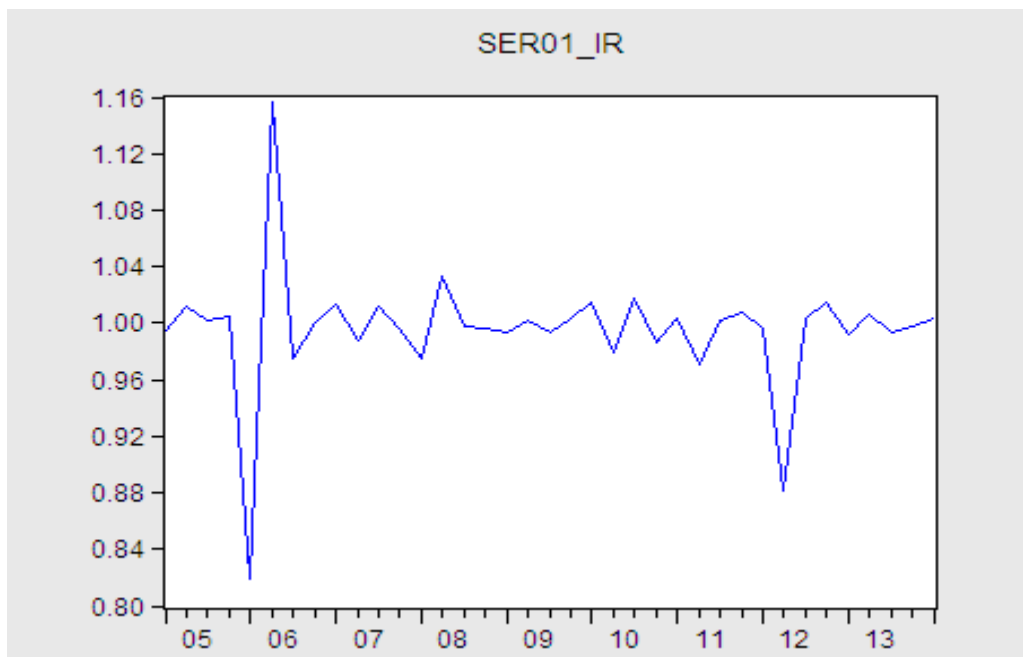
	Square sum	Freedom	Mean square	F-measure
Quarterly	2140.754	11	193.452	4.5392
Residual	9538.976	211	43.6531	
Total	11483.6	213		

**Table 3. Results of the Seasonal Inspection of Suning Appliance (2)**

	Square sum	Freedom	Mean square	F-measure
Annual	1177.754	17	69.52	3.85142
Residual	3338.976	187	17.6522	

Seasonal test showed that the Suning Appliance has stable seasonality and seasonal movement, also is the seasonal fluctuations significantly, the fluctuation not only changes with the quarter, and with the change.

Seasonal adjustment factors are important to the impact of seasonal factors on the turnover of enterprises, the following analysis of factors in the seasonal adjustment factors, the factors of circulation, seasonal and irregular factors.



**Figure 6. Schematic Diagram**

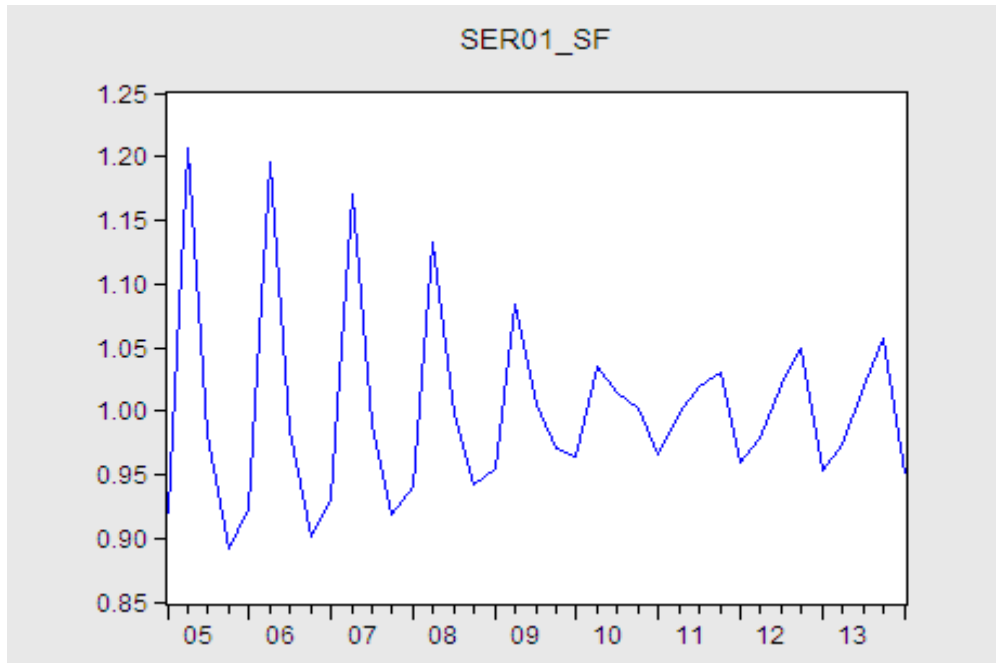


Figure 7. Seasonal Factors

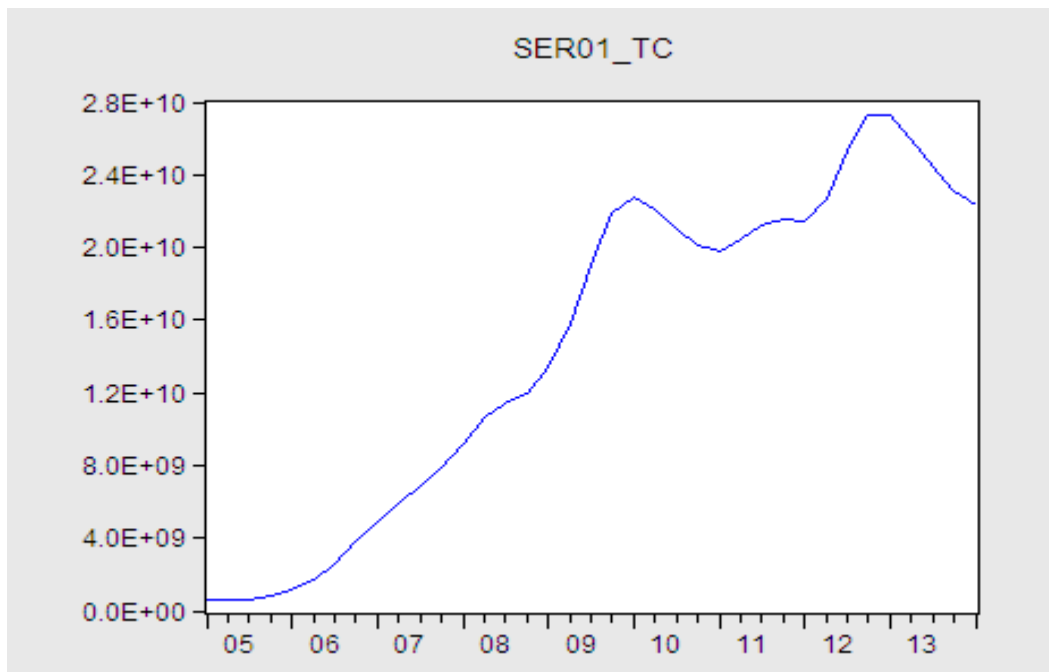
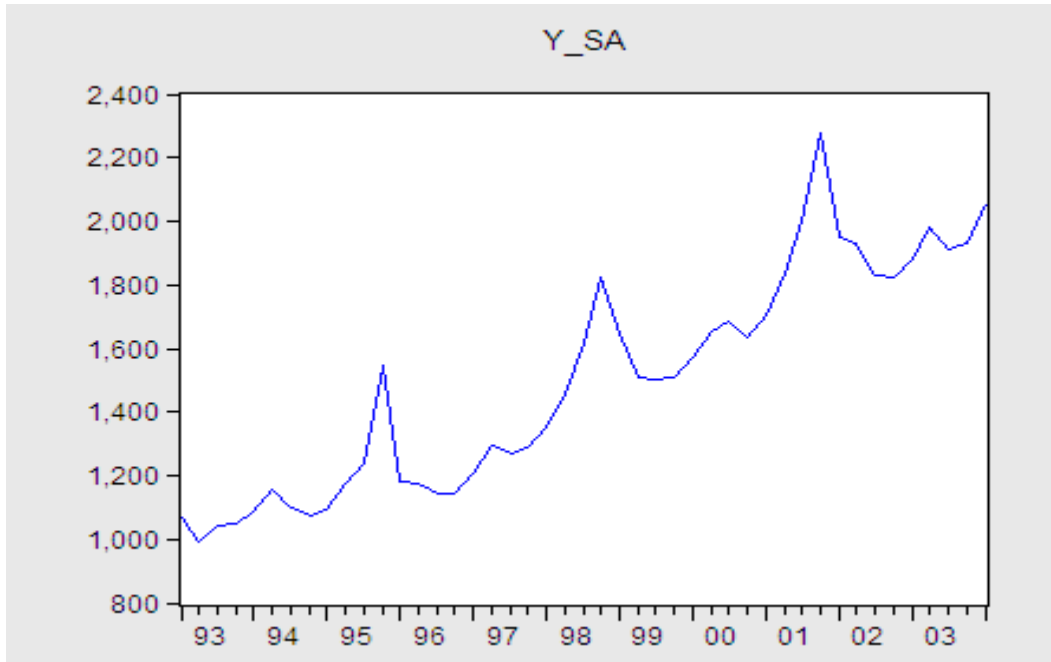


Figure 8. Schematic Diagram of the Trend Factor





**Figure 9. A Schematic Diagram of the Cycle Factor**

From the above four chart we can see that the impact of irregular factors on the sales of Suning Appliance has a certain regularity, a sharp fluctuations in the first quarter, and a substantial volatility in the first quarter of six years, the volatility of more than 8%. We can see that the change of the sales of Suning Appliance is mainly influenced by the factors of the circulation and the seasonal factors, and the trend is less. The influence of seasonal factors is gradually reduced, and the effect of cyclic factors is gradually enhanced.

### **Three, Conclusion**

According to the previous analysis, the sales of Suning Appliance has a significant seasonal fluctuation, and its fluctuation is a certain rule, so we make the following suggestions for the enterprises to make the sales plan and inventory budget:

(1) for the preparation of the inventory to be considered to be seasonal changes

Because of the seasonal factors, the impact of the sales of Suning Appliance is more, so the seasonal factors should be fully considered in the process of inventory. The impact of seasonal factors, although the annual reduction, but in the one or two quarter of the annual sales of the highest peak, so in the one or two quarter of the time to focus on the preparation of inventory.

(2) note that the impact of irregular time on sales volume

Suning Appliance Sales of short-term changes are caused by irregular time, the way to deal with the establishment of at least two months of preparation inventory, the impact of irregular events is generally relatively large, but there is a certain law, Suning Appliance sales will be reduced or increased significantly in six years, there is an abnormal fluctuations, we should pay more attention to.

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