X-13-Graph: A SAS/GRAPH® Program for X-13ARIMA-SEATS Output
User's Guide for the Batch Program on the PC or Unix, Version 3.0

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1. New Features in X-13-Graph

X-13-Graph Batch 3.0 includes two new types of graphs: graphs of the (transformed) original series with various orders of differencing applied, and graphs to compare the sliding spans diagnostic from two adjustments. The special seasonal graphs were also expanded to include graphs of the irregular component, original series, and percent change of the original and seasonally adjusted series by period. The graphics codes for the boxplots of the irregular components, found in the special seasonal graphs, have been changed to accommodate these new graphs. Graphs comparing the SI ratios of two adjustments are now also available by period. Additionally, some graphs now have a slightly different name to be consistent with the graphs in X-13-Graph Java (U.S. Census Bureau 2020a)

Licensing information for this software can be found at https://www.census.gov/data/software/x13as/disclaimer.html.

Return to contents.

2. Installing X-13-Graph

2.1 Requirements

X-13-Graph Batch is a SAS® program using SAS/GRAPH® (SAS Institute, Inc. 2017). It requires SAS Version 9.1 or higher. The macro catalogs supplied with the program were created for a 64-bit Windows operating system. To run the program in another operating system contact us.

X-13-Graph Batch produces graphs using output files created by X-13ARIMA-SEATS (U.S. Census Bureau 2020b) or Version 0.2.8 or higher of X-12-ARIMA.

No knowledge of SAS is required to use X-13-Graph. A Windows interface is available for X-13-Graph Batch.

X-13-Graph will open the ods listing destination and does not close it; it also defines many global macro variables. It is recommended that any additional SAS programs be run in a separate SAS window.

Return to contents.

2.2 Installing X-13-Graph

The version of X-13-Graph Batch available on the internet is compiled for a 64-bit Windows operating system. If you want to run the program on another operating system, please contact the developers for instructions.

Before you can use X-13-Graph, you must copy it to your computer:

1. Create a directory for the program; **c:\x13graph** will be used throughout this document.
2. Copy the file **x13gbat.zip** to the **c:\x13graph** directory.
3. Double Click on **x13gbat.zip** in Windows® Explorer to uncompress the files.

X-13-Graph Batch consists of a SAS program, a subdirectory with three SAS files, and an images subdirectory, as well as this document. After uncompressing **x13gbat.zip**, the following files should be in the **c:\x13graph** directory:

x13gbat.sas
x13gbat.html

The **c:\x13graph\appl** directory should contain the following files:

Namelist.sas7bdat
Sasmacr.sas7bcat
Templt.sas7bcat

There should also be a directory **c:\x13graph\images** containing examples of the graphs that can be created.

The three SAS files in the **appl** subdirectory must be in the same directory for the program to run. The SAS program x13gbat.sas can be stored in any directory.

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Return to contents.

3. Instructions for Running X-13-Graph in Batch Mode

3.1 Running X-13ARIMA-SEATS in Graphics Mode

Before you can create any graphs with X-13-Graph, you must run X-13ARIMA-SEATS in graphics mode to produce the necessary output files. Running X-13ARIMA-SEATS in graphics mode creates graphics files corresponding to the X-13ARIMA-SEATS options given in the input specification (*.spc) file. X-13ARIMA-SEATS also creates a graphics metafile, identified by the extension .gmt, which contains a list of all the graphics output files produced during the X-13ARIMA-SEATS run.

If you run X-13ARIMA-SEATS from an interface like Win X-13, make sure the appropriate option to run in graphics mode is selected. If you run X-13ARIMA-SEATS from the command prompt, you must provide the name of an existing directory after the flag -g; X-13ARIMA-SEATS will store all graphics files in this specified directory. Because of filename conflicts, it is recommended that the graphics directory be different from the directory containing your input files. For example, when running X-13ARIMA-SEATS with the command

x13a bshors -g c:\x13a\graphics,

the graphics output files for the series bshors will be stored in the directory **c:\x13a\graphics**. (For more information, see Section 2.7 of the X-13ARIMA-SEATS Reference Manual (U.S. Census Bureau 2020b).)

To obtain graphs for several different series from a single run of this batch program, you must run X-13ARIMA-SEATS in graphics mode with the same directory after the -g option for each series.

Note: The SAS program uses the title statement from the X-13ARIMA-SEATS run to assign secondary titles to the graphs. This allows you to assign meaningful titles to the graphs within the X-13ARIMA-SEATS .spc file. If you are creating graphs for one series at a time, you can also use the subtitle option to assign a subtitle to the graph. Details are given in Section 3.6.4.

Return to contents.

3.2 Additional Files Needed

You will need two additional files to run X-13-Graph: a graph list file, identified by the extension .gls, and a graphics metafile list, identified by the extension .mls. Both files must have the same filename. (The default input filenames in the batch program are **x13g.gls** and **x13g.mls**, but these can be changed.)

The graph list file and the graphics metafile list file both must be in the graphics directory specified after the -g option in the X-13ARIMA-SEATS runs.

3.2.1 The Graph List (.gls) File

The graph list file is a list of commands telling the program which graphs to produce.

The basic format of a command in the graph list file is

keyword: element1 <element2 <element3 <element4>>>

The keyword tells the program which type of graph to produce and the elements tell the program which graphical elements to include in the graph.

Important: The keyword must be followed by a colon.

The current version of the program can produce fifteen types of graphs for each series, and eight types of graphs to compare two different series or adjustments.

Graph Types and Keywords

Graph Type	Keyword
Overlay Graphs	overlay
Spectrum Graphs	spectrum
Component Graphs	cmpnent
Special Seasonal Graphs	seas
Forecast Graphs	forecast
History Graphs	history1
ACF/PACF graphs	acfpacf
Outlier T-Value Graphs	tvalue or abtvalue
First Difference Graphs	fstdiff
Differenced Original Series Graphs	diff
Year on Year Graphs	yronyr
Sliding Spans Graphs	sspans
SEATS Filter, Time Shift, and Squared Gain Graphs	filter

Graph Types and Keywords

Graph Type	Keyword
SEATS Diagnostic Graphs	seats
Power Graphs	power
Overlay Graphs for Two Adjustments	overlay2
Component Graphs for Two Adjustments	cmpnent2
History Graphs for Two Adjustments	history2
SI Ratio Graphs for Two Adjustments	rsi2
Forecast Graphs for Two Adjustments	fcast2
Spectrum Graphs for Two Adjustments	spect2
Seasonal Overlay Graphs for Two Adjustments	seas2
Sliding Spans Graphs for Two Adjustments	sspans2

Examples of graphical elements are the original series, the trend components, the seasonal factors, etc. A list of all possible elements for each type of graph is given in the Details section. With a few exceptions, they have the same abbreviations used by X-13ARIMA-SEATS in the graphics metafile (.gmt). These exceptions are given in Appendix A.

You must give at least one element for each keyword specified, but no more than four elements for each line. The keywords and elements must be on the same line.

You can put many different commands in the graph list file, but each command must be on a separate line. You can ask for a certain type of graph more than once with different elements each time.

For example, to graph the original series by itself, the seasonally adjusted series superimposed with the trend, spectrum plots of both the original series and the seasonally adjusted series, the seasonal factors by month, a component plot for the seasonal factors and the irregular, and a forecast graph on the transformed scale, you would need the following seven commands in the graph list file.

overlay: ori
overlay: sa trn
spectrum: spcori spcsa
seas: sf
cmpnent: sf irr
forecast: ftr

You can add comment lines, or comment out keywords and the associated options, by putting a **#** sign in the first column of the line.

The elements you choose should correspond to elements that are available for every series you want to graph. For example, if you ask for a graph of the outlier adjusted series, there will be an error for every series that does not have an outlier adjusted series.

The format of the command for overlay graphs for comparing two series and seasonal factor by month graphs for comparing two series is slightly different. See the Overlay Comparison or Seasonal Factor Comparison sections for details.

3.2.2 The Graphics Metafile List (.mls) File

The graphics metafile list file is a list of the series you want to graph. Each series should be listed at the beginning of a separate line, except when comparing two models.

If you want to compare two models using the overlay, component, history, or rsi graphs for two adjustments, then you must enter the names of the two series on the same line in the .mls file. This will produce the comparison graphs you request in the .gls file; additionally, all the remaining graphs you request will be produced for each series as if they had been entered on separate lines. Again, you can add comment lines or comment out series by putting a **#** sign in the first column of the line.

For example, if your .mls file is:

"Clothing Stores"
FurnitureStores
#BookStores
"Shoe Stores Model 1" "Shoe Stores Model 2"

then all the single-series graphs listed in the .gls file will be created for the series "Clothing Stores" (note the quotation marks necessary because of the space in the series name), FurnitureStores, "Shoe Stores Model 1", and "Shoe Stores Model 2". Additionally, any comparison graphs in the .gls file will be created for the two shoe store series. As BookStores is commented out, no graphs will be created for this series.

Return to contents.

3.3 Running the Batch Program

Once X-13ARIMA-SEATS has been run in graphics mode and the .gls and .mls files have been created, you can run X-13-Graph by following these steps:

1. Open the SAS system on your operating system. (For example, in Windows, double-click on the SAS icon.)

2. Open the X-13-Graphics Batch program, **x13gbat.sas**, either by clicking on the open file button or by using the File pull-down menu.

3. Change the SAS libname, input filenames, graphics directory, the number of graphs printed on a page, and the device name, as needed.

Note: SAS uses semicolons to end commands. Each line **must** end with a semicolon.

SAS Libname

Enter the name of the directory where X-13-Graph is installed where the program reads:

%let x13gappl = c:\x13graph\appl;

Typically, the directory would be **c:\x13graph\appl** on a PC.

Input Filenames

Enter the filename of the graph list file and the graphics metafile list file where the program reads:

%let inptfile = x13g ;

For example, if you have named the input files **allx13g.gls** and **allx13g.mls** then this line should read:

%let inptfile = allx13g ;

Graphics Directory

Enter the name of the graphics directory where the program reads:

%let inptdir = c:\x13a\graphics\ ;

The graphics directory is the directory that was specified after the -g option in the X-13ARIMA-SEATS runs.

Number of Graphs Per Page

Enter the number of graphs you want printed on each page where the program reads:

%let perpage=1;

The only values allowed are **1**, **2**, or **3**.

Note: All the graphs for one series print, then all the graphs for the next, and so on. If you specify two graphs to print per page, but ask for three graphs for each series, then the third graph for the first series will be on the same page as the first graph for the second series.

Device Name

Enter the device name of your printer where the program reads:

%let devname = WIN ;

Setting the device equal to **WIN** will send the graphs to the screen. To save the graphs as images, you can use devices such as **PNG** or **JPEG**, and then see Section 3.5 for instructions on specifying a directory and filename for saving the graphs. Printer device names depend on the printer used. For example, the SAS device name for a LaserJet 5SI PostScript printer is **LJ5SIPS**. So to print the graphs on a LaserJet 5SI PostScript printer, this line should read:

%let devname = LJ5SIPS ;

To see a list of available SAS devices:

1. Go to the command line. This is the text entry area on the tool bar, usually at the left side. Enter the command **dir sashelp** to bring up the Directory Window.

2. Double click on the catalog called **DEVICES** This brings up a list of all the SAS devices available for your version of SAS.

Note: If you are sending the output to a printer, you should disable banner pages before you begin if possible. SAS sends each graph to the printer separately.

4. Once you have made any necessary changes, run **x13gbat.sas** by clicking the Submit button (the person running) or selecting Submit from the Run pull-down menu.

Return to contents.

3.4 Important Things to Remember

The two input files (the graph list file and the graphics metafile list file) must have the same filename, specified in **x13gbat.sas** by the **inptfile** variable.

X-13ARIMA-SEATS must be run in graphics mode with the same directory specified by the -g option for each series listed in the graphics metafile list file. This directory is specified in **x13gbat.sas** by the **inptdir** variable. The two input files (the graph list file and the graphics metafile list file) must also be in this directory.

X-13-Graph can only create graphs if the required graphics file was produced by X-13ARIMA-SEATS. Make sure that you run X-13ARIMA-SEATS with the necessary spec or option to create the files you want.

Each keyword in the graph list file must be followed by a **colon** and then by at least one element. A keyword and its elements must be on the same line. Each command must be on a separate line.

When modifying the SAS program, remember to end each line with a **semicolon**.

Return to contents.

3.5 Output Options

To display graphs in SAS or to send them to a printer, see the discussion on Device Name in Section 3.3. This section describes to how save graphs. You can save each graph to its own file, or you can save all graphs in one file.

To save each graph individually:

1. Set the **devname**. SAS allows you to save a graph in many formats; this variable selects the file type. Options include pdf, gif, png, jpeg, bmp, or dib.

2. Set **graphoutdir** as the directory to which the graphs should be saved.

3. Name the files using the **graphfilename** option. This sets a base name for the graphs; each new graph has a number appended to this base name. So **%let graphfilename = X13Graphs;** may create graphs X13Graphs1.png, X13Graphs2.png, etc. To let the base name be the name of the series, set **%let graphfilename = series**.

To save graphs in one file:

1. Set **psappend** to yes (to create one file for all the graphs) or to series (to create one file per series). Keep in mind that if the file you're writing to exists, the new graphs will be appended to the end.

2. Set **devname** to ps or pscolor for a PostScript file in black and white (ps) or in color (pscolor). This file extracts to a PDF. Set **devname** to html to save all graphs as .gif files and create an HTML file to view them all.

3. Set **graphoutdir** as the directory to which the graphs should be saved.

4. Name the file using the **graphfilename** option. This is ignored if **psappend** is set equal to series.

Return to contents.

3.6 Global Options in the Batch Program

There are many options available to customize the appearance of the graphs. This is done by changing the value of certain variables which appear at the top of the program. All these variables appear in the first hundred lines of the X-13-Graph Batch program, before the section "Instructions for setting macro variables." Many of these variables are case-sensitive, so follow the instructions for setting them carefully. Also, make certain that each variable definition is followed by a semicolon; the SAS program will not run correctly if there is a missing semicolon.

3.6.1 Subspans

By default, the batch program graphs all available years. To see a shorter span of the series, change the values of **substart** and **subend** in the x13gbat.sas program, which read:

```
%let substart = year.mon;
%let subend = year.mon;
```

Substart is the year and month (or quarter) of the beginning of the desired subspan; **subend** denotes the end of the subspan. If the value entered is blank or outside the span of the series, the program will default back to the original dates. All dates are in X-13ARIMA-SEATS date format, yyyy.mon, yyyy.mm, or yyyy.q (that is, 2006.Feb, 2006.02, or 2006.1).

Return to contents.

3.6.2 Graph Colors

To change the colors of the graphs and the labels, use the **color0** through **color6** and **colorg** variables in the program, which read:

```
%let color0 = black;
%let color1 = blue;
...
%let color6=red;
%let colorg = black;
```

Color0 is the color of the graph text: that is, the titles, subtitles, labels, graph values, and footnotes. The default color is black. **Color1** through **color6** give the colors of the graphs. In graphs with more than one element superimposed, the first is assigned **color1**, the second **color2**, and so on. In some graphs, certain gridlines are also assigned these colors. The remainder of the gridlines are assigned the color specified in the variable **colorg**.

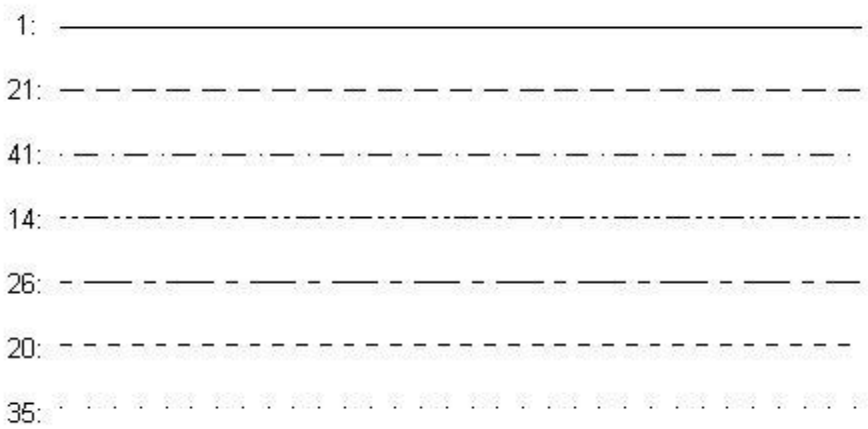
Some options for colors are black, blue, green, red, orange, yellow, pink, purple, magenta, gray, brown, or cyan.

Return to contents.

3.6.3 Line Types and Widths

The line types and widths of the graphs can be changed using the variables **ltype1** through **ltype6** and **lw1** through **lw6**; the line type of most gridlines can be changed using **ltypeg**. In graphs with more than one element superimposed, the first is assigned line **ltype1** with width **lw1**, the second **ltype2** with width **lw2**, and so on.

Line types are assigned using a number between 1 and 46; each number requests a specific pattern. The X-13-Graph Batch program supports the following line types:



Other line types available in SAS can be used, but the footnotes in some graphs will not show the correct line when they are used.

The width of the line is a number, usually 1 or 2. The line becomes thicker as the number increases.

The default setting for line types and widths is:

%let ltype1 = 1;
%let ltype2 = 21;
%let ltype3 = 41;
%let ltype4 = 14;
%let ltype5 = 20;
%let ltype6 = 26;
%let ltypeg = 35;
%let lw1 = 2;
...
%let lw6 = 2;

Return to contents.

3.6.4 Subtitles, Footnotes, and Labels

The main title of each graph denotes what is being plotted; the graph's subtitle tells which series is being plotted. By default, the subtitle is the title given in the `series` spec of the .spc file before it is run with the X-13ARIMA-SEATS program. If a title is not supplied, the default subtitle is the series name. However, the subtitle can be changed using the variables **subtitle** and **subtitle2**.

If these variables are left blank, the default subtitles will be used. Otherwise, the value of **subtitle** is used for the first series plotted and the value of **subtitle2** is used for the second series for comparison graphs. The subtitle requested should be between the equal sign and the semicolon; quotation marks are not needed. The following is a valid assignment:

%let subtitle=Construction Starts Through 2005;

Use **printfootnotes** to instruct the program not to print footnotes for overlay, forecast, seasonal, spectrum, tvalue, and history graphs, and not to print axis labels for all graphs. When this variable is set to

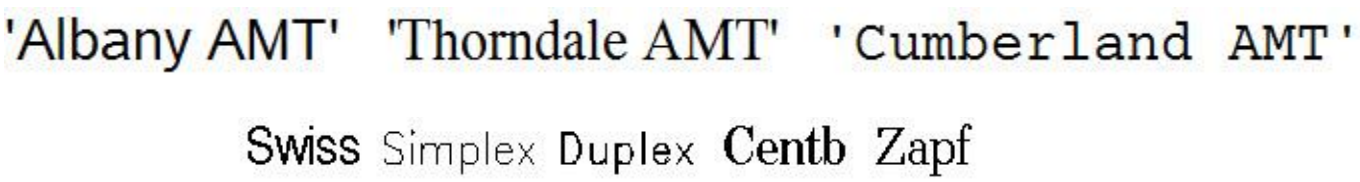
%let printfootnotes=no;

the footnotes and graph labels are not printed; otherwise, they are. Setting **%let printfootes = all** will print ARIMA model information to certain SEATS diagnostic graphs in addition to other footnotes.

Return to contents.

3.6.5 Fonts

The font used for the title and subtitle can be changed using the variable **font1**, and that of the labels and footnotes can be changed with **font2**. There are not many fonts available in SAS; a complete list can be found in the catalog Sashelp.Fonts, or using the SAS Help. Some available fonts are:



The default font, used if no font is entered or if the font chosen is not valid, is 'Albany AMT'.

The size of the font can be changed using the **fontsize** argument. This changes the font as a percentage of the program default. A setting of **%let fontsize = 120** will therefore make the font 120% of the default size. The spectrum graphs use the letters S and T printed within the graph to flag visually significant peaks. To change the size of these letters in the graph as a percentage of the default, use the **spectsize** argument. The size of these letters will change based on many factors, including the graph size and the output format, so some experimentation may be necessary.

Return to contents.

3.6.6 Y-Axis Options

The values on the y-axis can be changed in two ways: the range of values can be specified, and the values can be scaled by a requested divisor.

To change the range of the graph, a value must be supplied for both the variables **yaxmin** and **yaxmax**, the minimum and maximum y-value to be plotted. If desired, a value can also be provided for **yaxby**, which is used to increment the values. If this variable is left blank, the program will create the increment automatically. If these variables are set to:

```
%let yaxmin=2000;
%let yaxmax=8000;
%let yaxby=2000;
```

then the y-axis will have tick marks at values 2000, 4000, 6000, and 8000. Note that if no tick mark created with **yaxby** falls on **yaxmax**, then the maximum y-value will be the largest tick mark less than **yaxmax**. That is, if **yaxmin** is 2000, **yaxmax** is 8000, and **yaxby** is 2500, the y-axis will have tick marks at 2000, 4500, and 7000. The y-axis will not go all the way to 8000.

To scale the y-axis by a divisor, change the value of the variable **ydivisor**. For example, if the data ranges from two million to six million, then

%let ydivisor=1000000;

will divide the y-variable by one million, so the y-axis will range from two to six, and will also create the label 'In Millions' for that axis unless the **ftnoteyn** variable is set to 'N'. If the y-divisor is not a power of ten, then the label will read 'Units=ydivisor.' This label will be printed sideways along the y-axis unless the variable **anglelabel** is changed to no:

%let anglelabel=no;

In this case, the label will be printed at the top of the y-axis.

If both a change in the range and a change of scale are requested, then the values requested for the y-axis maximum and minimum should be in the original scale.

These options are available for most graphs. However, neither are available for component graphs, seasonal si graphs, or outlier t-value graphs, and the y-divisor option is not available for any element on the log scale, spectrum graphs, seasonal graphs, and seasonal factor history graphs.

Return to contents.

3.6.7 Reference Gridlines

By default, the program automatically creates a reference line at the first month or quarter of the graph. To move the reference lines to another month or quarter in order to highlight some particular month, change the variable **gridlinemo**. For example,

%let gridlinemo = 7;

will put reference lines at July, if it is a monthly series. The color and style of this reference line can be changed with the variables **colorg** and **ltypeg**, as described in Sections 3.6.2 and 3.6.3. A label will automatically be added to the graph indicating which month or quarter the gridline represents unless the **ftnoteyn** variable is set to no. Note that if the variable **gridlinemo** is left blank, the reference line will be at the first month or quarter but no label will be included; if the variable **gridlinemo** is set to 1, then the label 'Gridlines at January' will be added to the graph.

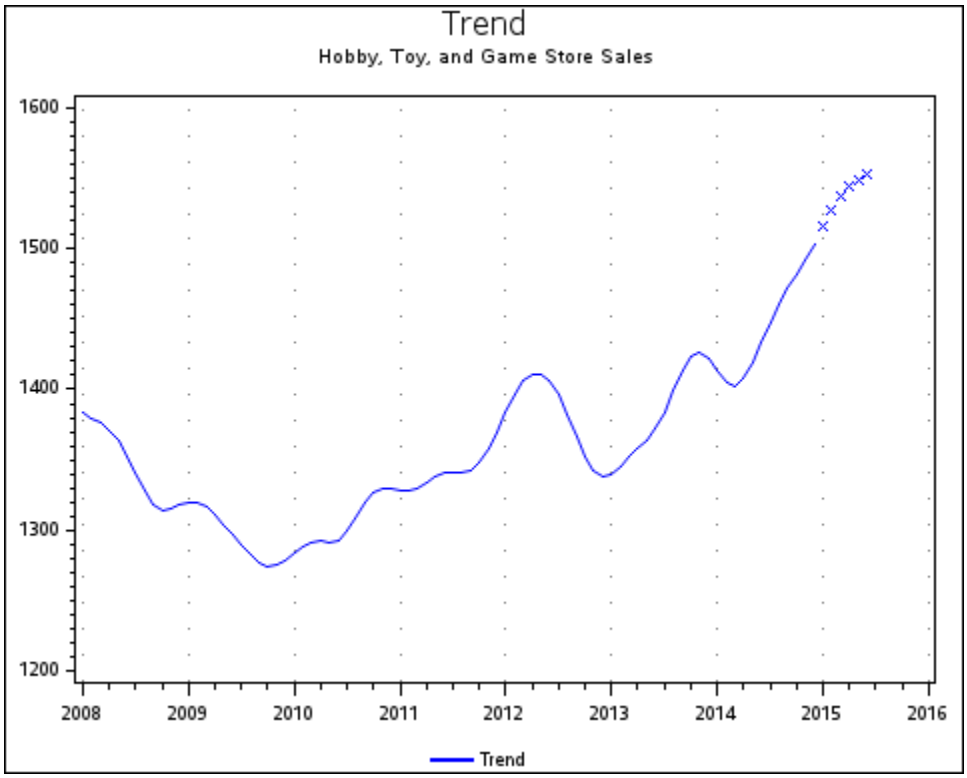
Return to contents.

3.6.8 Noting Trend Uncertainty

When plotting the trend with overlay or overlay2 graphs, you can emphasize the uncertainty of the last few trend estimates by plotting an 'X' for a specified number of points using the variable **numtrendx**. For example, the assignment

%let numtrendx=3;

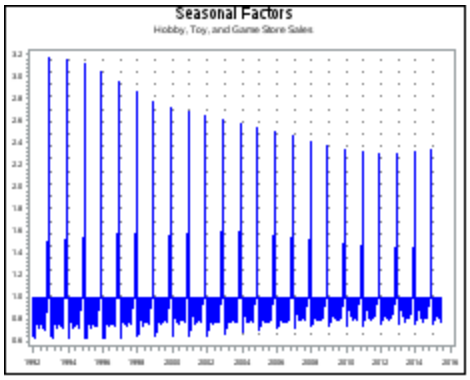
would result in the following trend graph:

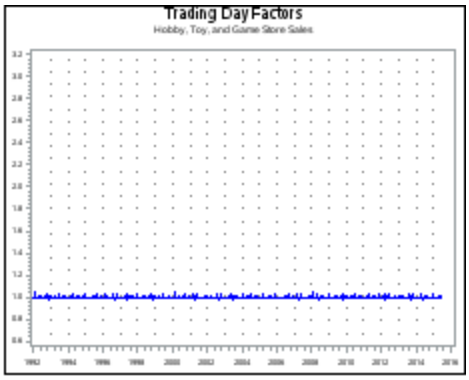


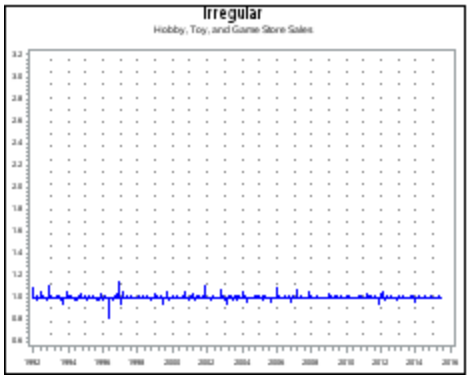
Return to contents.

3.6.9 Component Graph Formats

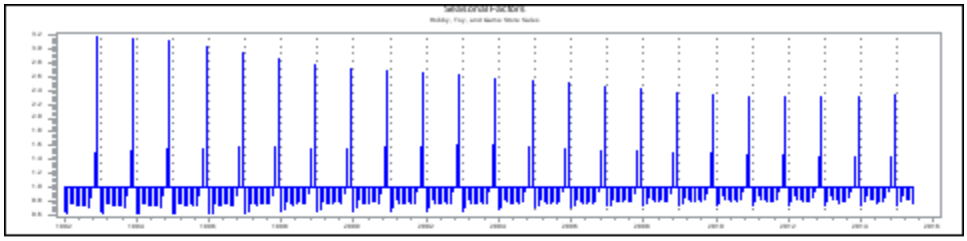
When more than one element is requested for the component graphs, the program prints all the requested graphs on one page. If there are two elements, the graphs are printed with the second graph below the first. If there are four elements, the graphs are printed in two columns with two rows each. If there are three elements, the format used to print the graphs can be changed. By default, the program prints the graphs in two columns, with the first two graphs on left and the third graph on the right, as such:

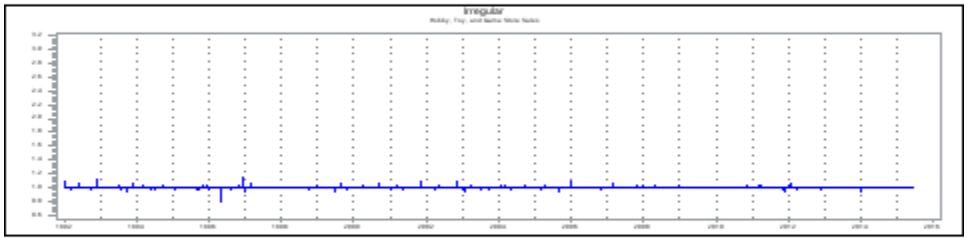


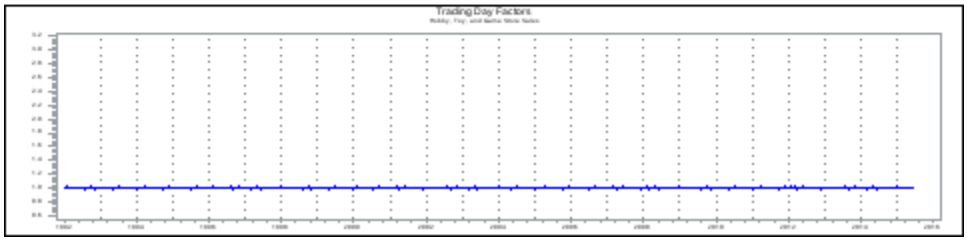




The variable **threegraphformat** can be used to change the format, printing the three graphs in one column with three rows, as such:







To print the graphs in two columns, use **%let threegraphformat = 2**. To print them in one column, use **%let threegraphformat = 1**.

Return to Component Graphs.

Return to contents.

3.6.10 Year on Year Graph Options

The color scheme of year on year graphs can either use the colors and line types chosen (as described in Section 3.6.2 and 3.6.3), or can use darkening shades of a single color.

To use the colors and line types chosen, use **%let YYonecolor = no**. Then the first six years will use color1-color6 with the line type and width of line 1; the second six years will use color1-color6 with the line type and width of line 2; and the last six years will use color1-color6 with the line type and width of line 3. If the series is longer than 18 years, only the last 18 years will be graphed.

An alternate color scheme uses a single color; each successive year is a slightly darker shade of the same color. To set this, use the **YYonecolor** variable, and set it to gray, green, red, or blue. This color scheme helps detect patterns in the series which have changed over time, but can make it hard to identify each individual year. To help, use the **dashevery** argument. Setting it to 2 will put a dashed line every two years; setting it to 3 will put a dashed line every three years, and so on.

Return to contents.

4. Details of Graphs Available in X-13-Graph Batch

The following sections describe each type of graph available in X-13-Graph and list the element codes necessary to create each graph.

4.1 Overlay Graphs

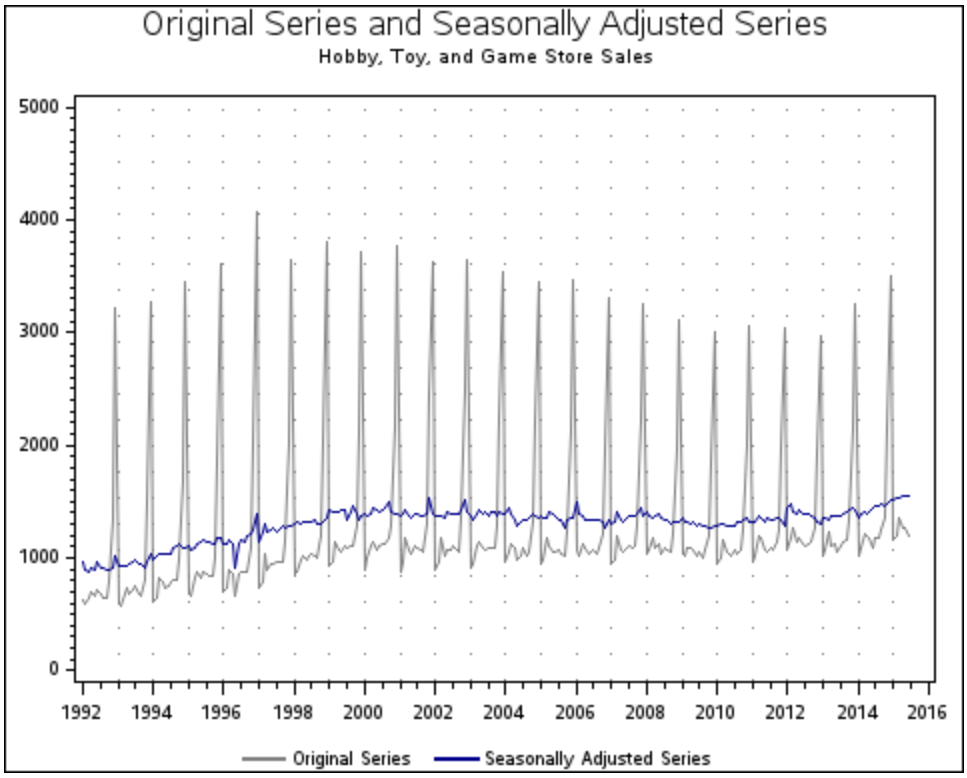
You can select from one to three different graphical elements to plot above a single axis. The program superimposes the elements. The order in which the elements are listed determines the order of the names in the title and legend and also the color and line used for each element. The keyword for overlay graphs is **overlay**.

If any of the elements requested does not exist for a series, then that graph will not be created. For example, if the statement

overlay: oadori trn sa

is in the .gls file, and the series has no outliers, and thus no outlier adjusted series, then the entire graph will not be created, even if the seasonally adjusted series and the trend component exist.

Note: For overlay graphs, choose series on the same scale, i.e., do not choose elements on the original scale and the log scale. If elements on the original scale and the log scale are requested, the graph will not be created.



Available Elements for Overlay Graphs

Element	Element Code
Original or Composite Series	ori
Calendar Adjusted Original Series	cad
Original Series Adjusted by Prior Factors	priadj
Original Series Modified for Extremes	mori
Original Series with Replaced Missing Values	mvadj
Original Series with Additive Outlier Adjustments	oriao
Outlier Adjusted Original Series	oadori
Prior Adjusted Original Series	adjori
Seasonally Adjusted Series	sa
Seasonally Adjusted Series with Forced Annual Total	satot

Available Elements for Overlay Graphs

Element	Element Code
Seasonally Adjusted Series Modified for Extremes	msa
Trend	trn
Indirect Seasonally Adjusted Series	indsa
Indirect Seasonally Adjusted Series with Forced Annual Total	indsat
Original Series Modified for Indirect Extremes	indmor
Indirect Seasonally Adjusted Series Modified for Extremes	indmsa
Indirect Trend	indtrn
Logged Original or Composite Series	lori
Logged Calendar Adjusted Original Series	lcad
Logged Original Series Adjusted by Prior Factors	lpriadj
Logged Original Series Modified for Extremes	lmori
Logged Original Series with Replaced Missing Values	lmvadj
Logged Original Series with Additive Outlier Adjustments	loriao
Logged Outlier Adjusted Original Series	loadori
Logged Prior Adjusted Original Series	ladjori
Logged Seasonally Adjusted Series	lsa
Logged Seasonally Adjusted Series with Forced Annual Total	lsatot
Logged Seasonally Adjusted Series Modified for Extremes	lmsa
Logged Trend	ltrn
Logged Indirect Seasonally Adjusted Series	lindsa
Logged Indirect Seasonally Adjusted Series with Forced Annual Total	lindsat
Logged Original Series Modified for Indirect Extremes	lindmor
Logged Indirect Seasonally Adjusted Series Modified for Extremes	lindmsa
Logged Indirect Trend	lindtrn

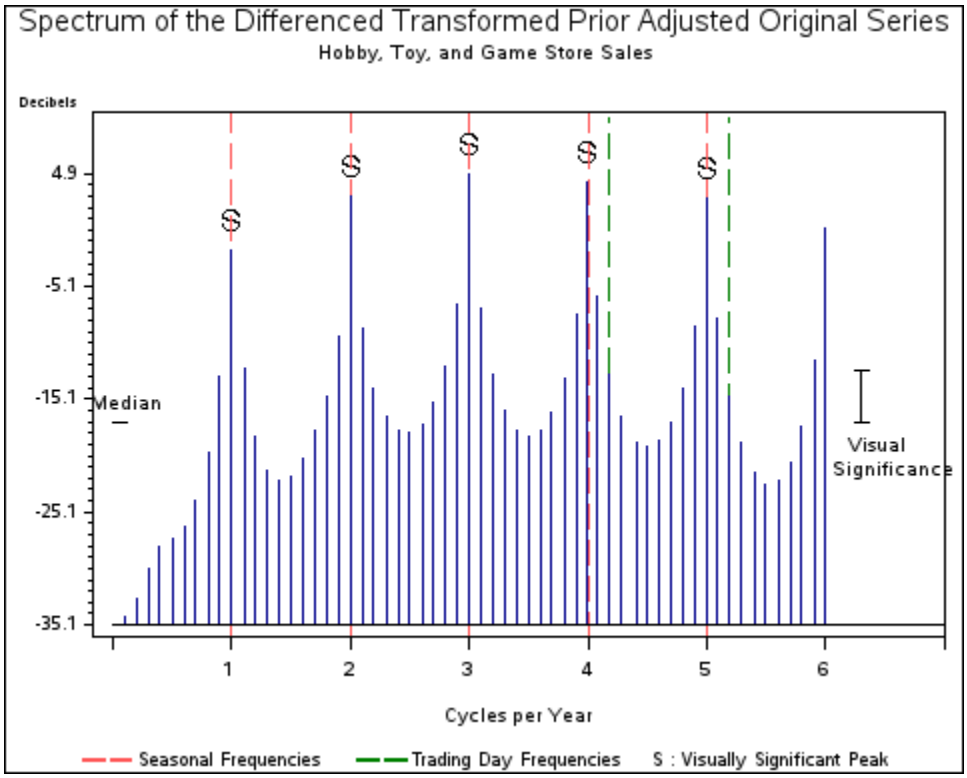
Return to contents.

4.2 Spectrum Graphs

Graphs of 10 times the $\log_{10}$ of the spectrum amplitudes are similar to those in the X-13ARIMA-SEATS .out file. The keyword for spectrum graphs is **spectrum**.

Vertical lines identify the amplitudes at seasonal and trading day frequencies. Cleveland and Devlin (1980) identified the trading day frequencies of this graph as the frequencies most likely to have spectral peaks if a flow series has a trading day component. Note that the color and line type of these reference lines are not controlled with the **colorg** and

ltypeg options, but rather seasonal frequencies use the **color3** and **ltype3** variables, while trading day frequencies use the **color4** and **ltype4** variables.



Available Elements for Spectrum Graphs

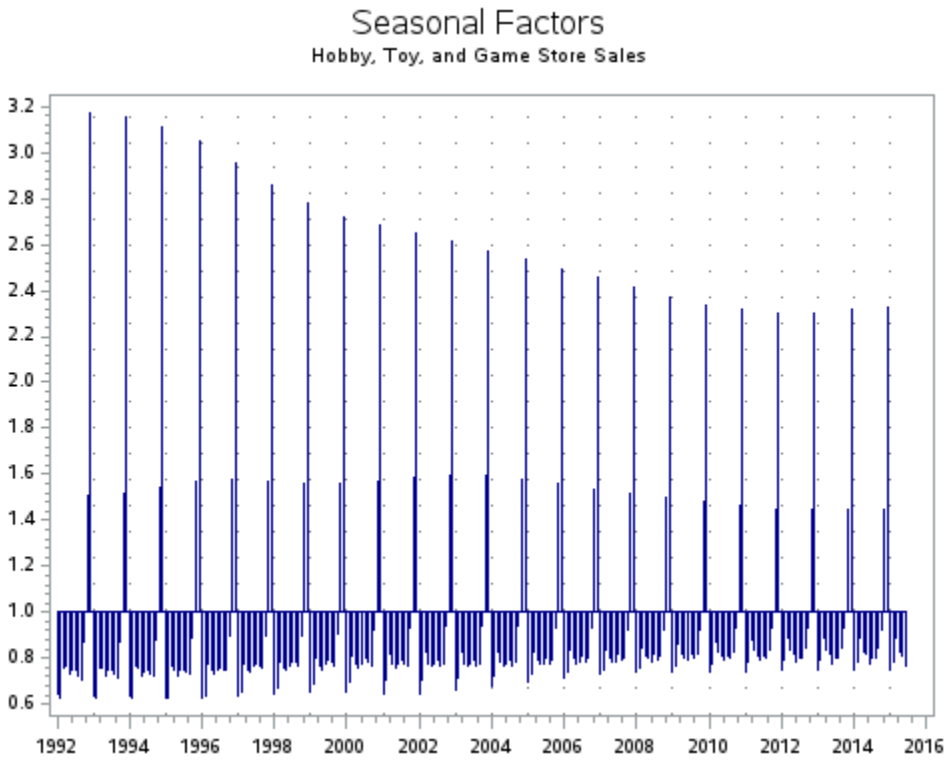
Element	Element Code
Original Series	spcori
Seasonally Adjusted Series	spcsa
Modified Irregular	spcirr
RegARIMA Model Residuals	spcrsd
Original and Seasonally Adjusted Series	spcosa
Indirect Modified Irregular	spciir
Indirect Seasonally Adjusted Series	spcisa

Return to contents.

4.3 Component Graphs

Component graphs allow you to select from one to four different seasonal decomposition component elements to plot. If you choose more than one, all components are graphed in reduced size on one page. See component graph formats for more information. You can scroll up to see the larger graphs of each component individually. If the selected

graphs are of the same type- that is, outlier graphs, or factor graphs- then the graphs will have the same y-axis scale for easy comparisons. The keyword for component graphs is **cmpnent**.



Available Elements for Factor Component Graphs

Element	Element Code
Combined Holiday and TD Factors	cal
Combined Holiday and TD Factors (from X11regression)	ccal
Combined Adjustment Factors	caf
Final Adjustment Ratios	arat
Holiday Factors	hol
Indirect Adjustment Ratios	indarat
Indirect Combined Adjustment Factors	indcaf
Indirect Irregular	indirr
Indirect Seasonal Factors	indsf
Irregular	irr
Modified Irregular	mirr
Irregular Modifed for Extremes from Indirect	indmirr
Prior Adjustment Factors	prior
Seasonal Factors	sf

Available Elements for Factor Component Graphs

Element	Element Code
Seasonal Factors with User-Defined Regressors	sfr
Trading Day Factors	td
Total Adjustment Factors	totadj
User-Defined Regression Factors	usrdef
User-defined Seasonal Regression Factors	rgseas
X-11 Easter Factors	xeastr

Available Elements for Overlay Component Graphs

Element	Element Code
Original (or Composite) Series	ori
Calendar Adjusted Original Series	cad
Original Series Adjusted by Prior Factors	priadj
Original Series Modified for Extremes	mori
Original Series with Replaced Missing Values	mvadj
Outlier Adjusted Original Series	oadori
Prior Adjusted Original Series	adjori
Seasonally Adjusted Series	sa
Seasonally Adjusted Series with Forced Annual Total	satot
Seasonally Adjusted Series Modified for Extremes	msa
Trend	trn
Indirect Seasonally Adjusted Series	indsa
Indirect Seasonal Adjustment with Forced Annual Total	indsat
Indirect Trend	indtrn
Original Modified for Indirect Extremes	indmor
Indirect Seasonally Adjusted Series Modified for Extremes	indmsa

Available Elements for Overlay Logs Component Graphs

Element	Element Code
Logged Original (or Composite) Series	lori
Logged Original with Replaced Missing Values	lmvadj
Logged Outlier Adjusted Original Series	loadori
Logged Prior Adjusted Original Series	ladjori
Logged Seasonally Adjusted Series	lsa
Logged Trend	ltrn

Available Elements for Outlier Component Graphs

Element	Element Code
Additive Outliers	ao
Combined Outliers	otl
Level Shifts	ls
Temporary Changes	tc
Seasonal Outliers	so
Indirect Additive Outliers	indao
Indirect Level Shifts	indls

Available Elements for Outlier Logs Component Graphs

Element	Element Code
Logged Additive Outliers	lao
Logged Combined Outliers	lotl
Logged Level Shifts	lls
Logged Temporary Changes	ltc

Available Elements for Weight Component Graphs

Element	Element Code
Irregular Weights	irrwt

Return to contents.

4.4 Special Seasonal Graphs

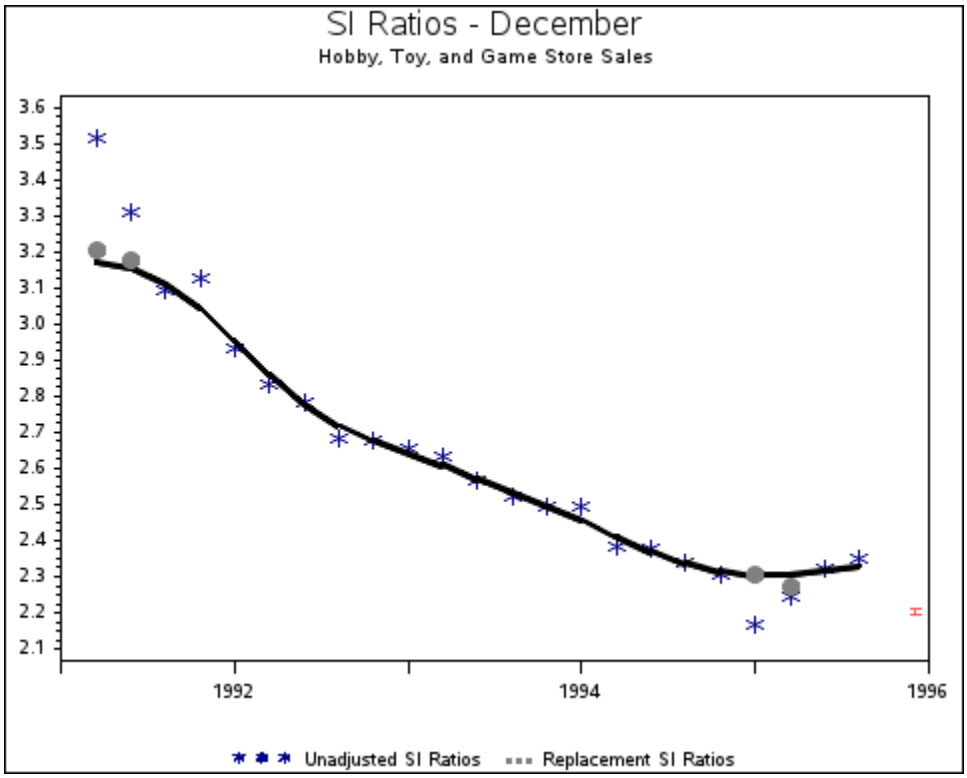
Seasonal graphs display components by month or quarter. Available elements include seasonal factors, SI ratios (detrended series values) with seasonal factors, the original series, and the irregular. The irregular can also be displayed as boxplots by period. The keyword for special seasonal factor graphs is **seas**.

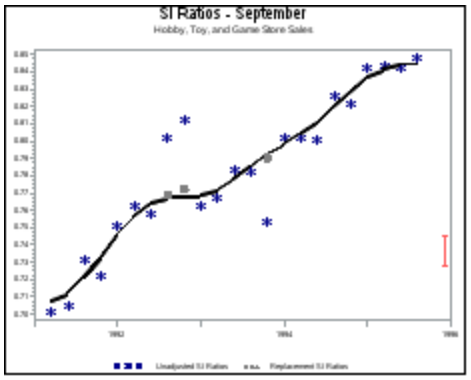
Both SI ratio graphs and monthly seasonal factor graphs are due to Cleveland and Terpenning (1982).

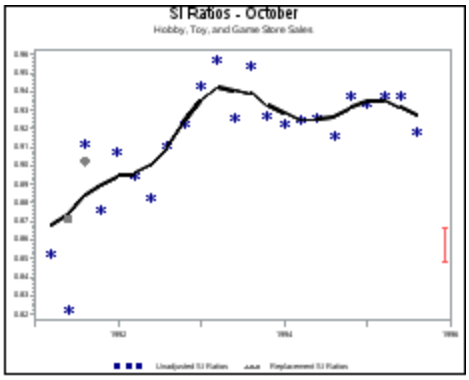
SI Ratios with Seasonal Factors by Month or Quarter

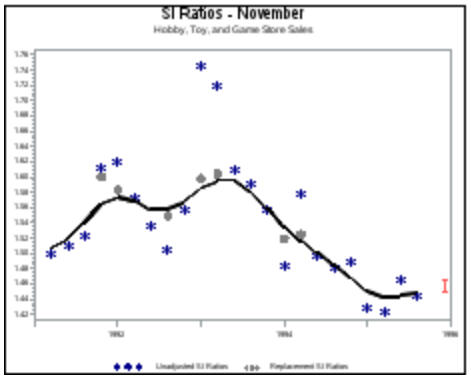
When created with the element code si, the program produces as many as 16 graphs. There is one graph for each month or quarter, along with graphs with four months or quarters per page. With monthly series, there is also a graph of all 12 months on one page.

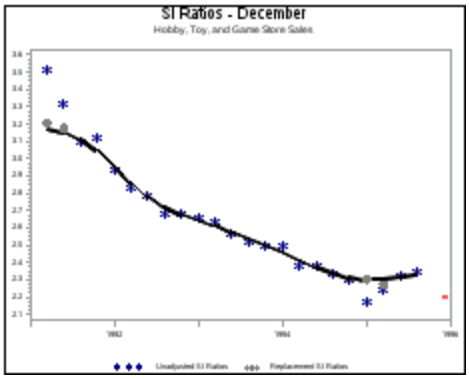
When the element code siall is used, the SI ratio plots for all twelve months or four quarters are graphed on one plot with the same scale.

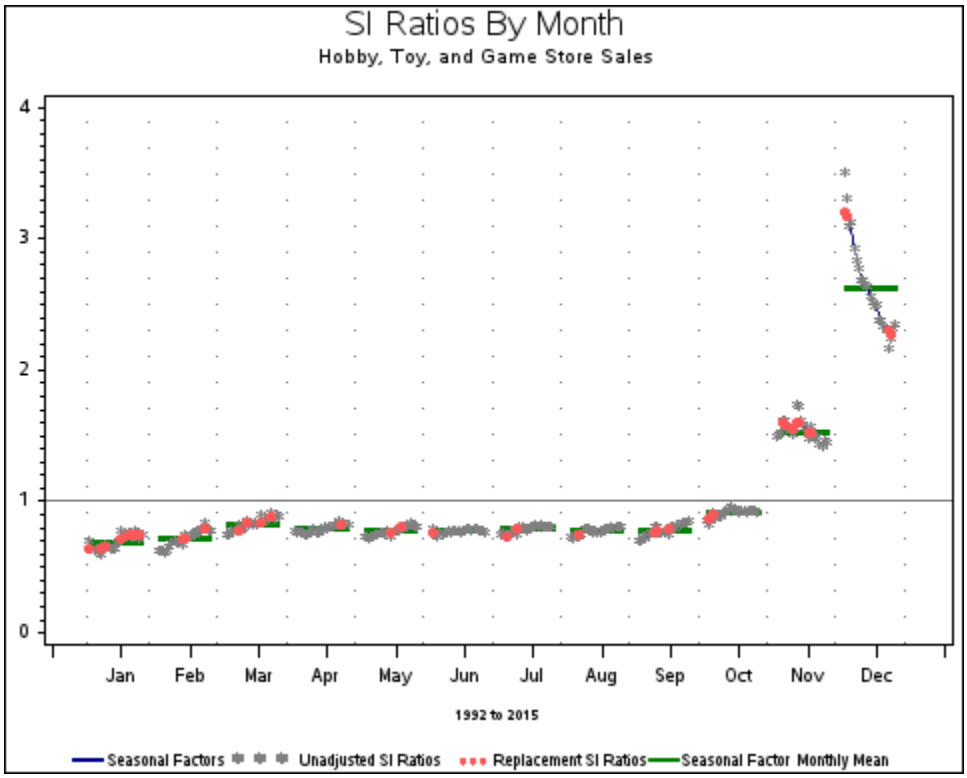






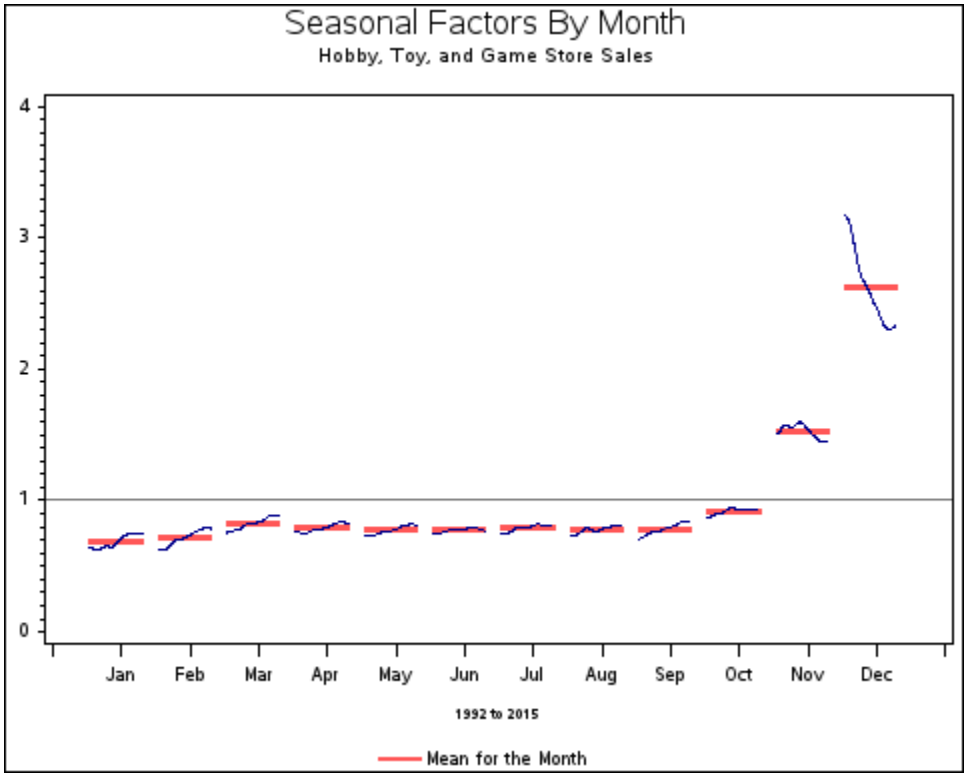






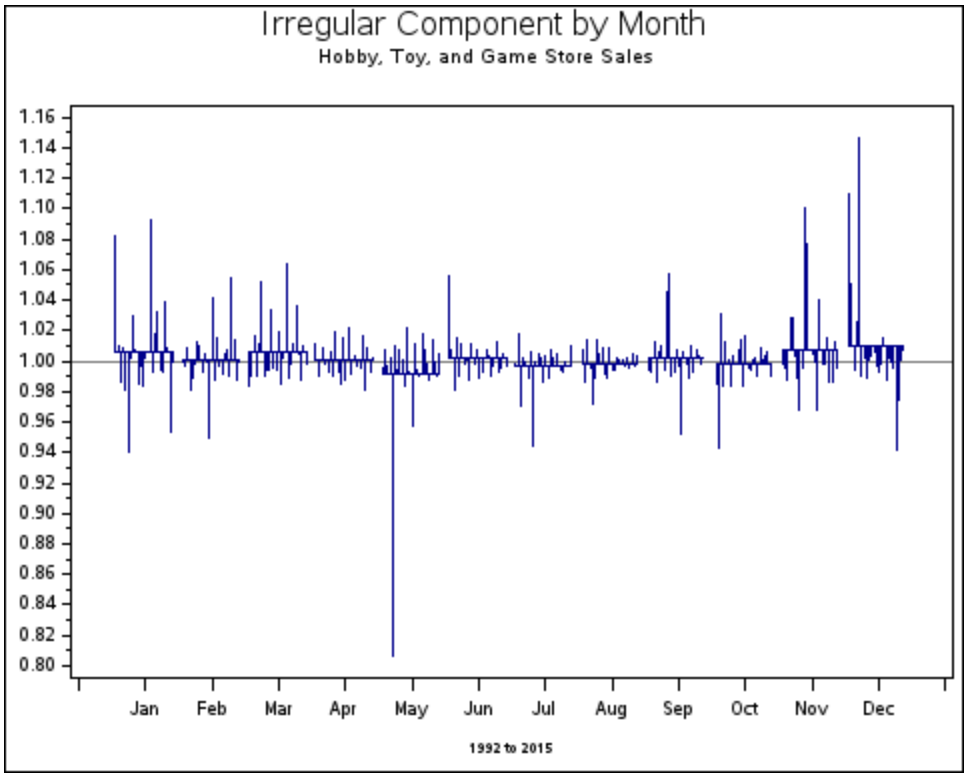
Seasonal Factors by Month or Quarter

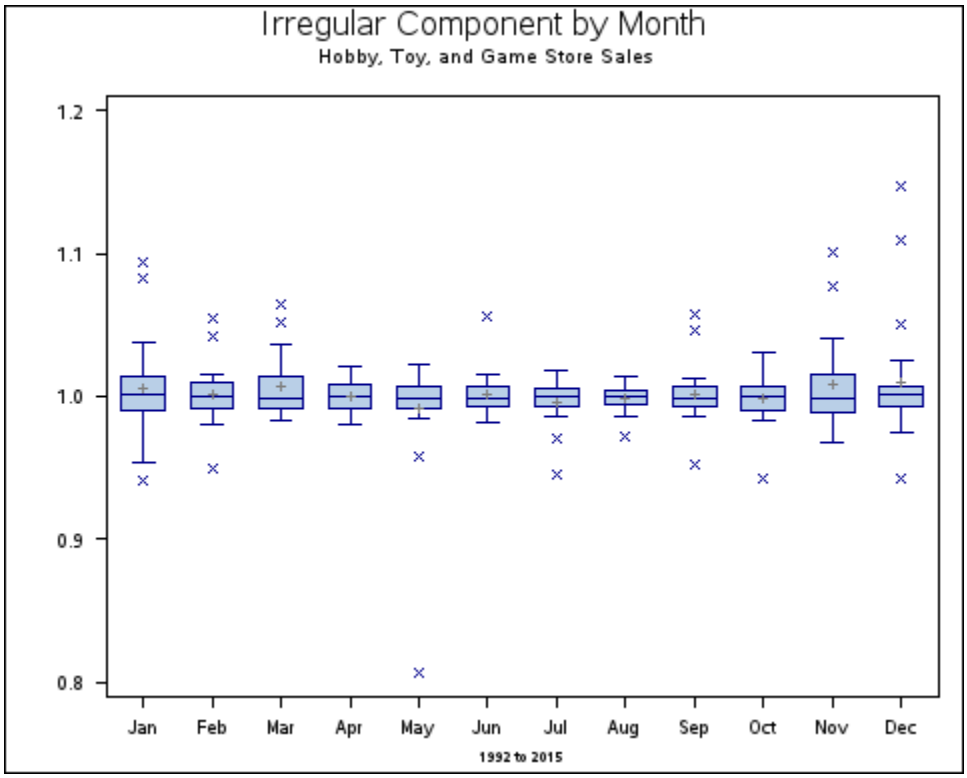
The program graphs seasonal factors by calendar month or quarter. Each calendar period has a year axis drawn at the level of its factor mean. You can graph either the seasonal factors (X-13ARIMA-SEATS's D 10 table) or the combined factors, which are the seasonal, trading day, holiday, and user-defined factors combined (X-13ARIMA-SEATS's D 16 table).



Irregular Component

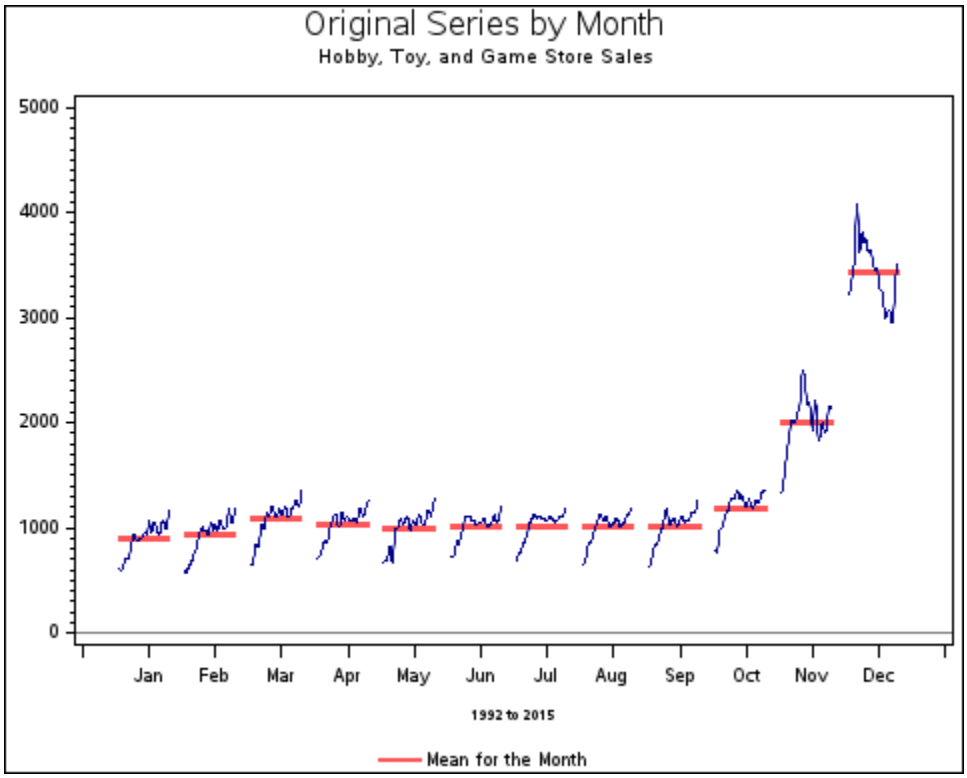
You can plot the irregular component by period, with each period's values centered around the period's mean. You can also create boxplots of the irregular component by month or quarter to compare the spread of the irregular component for each period. For both types of graphs, the irregular component (D 13 table) or the irregular component modified for extreme values (E 3 table) can be plotted, as well as the indirect adjustment's versions of these tables.





Original Series

The original series or the logged original series can be plotted by month or quarter. Each period's values is overlaid over a line representing the period's mean.



Percent Change Graphs

Period-to-period percent changes of the original series or seasonally adjusted series by month or quarter can also be plotted.

Available Elements for Special Seasonal Factor Graphs

Element	**Element Code**
Individual SI Ratio Plots	si
SI Ratios	siall
Seasonal Factors	sf
Combined Seasonal Factors	caf
Indirect Seasonal Factors	indsf
Indirect Combined Seasonal Factors	indcaf
Irregular	irr
Modified Irregular	mirr
Indirect Irregular	indirr
Box Plots of the Irregular	boxirr

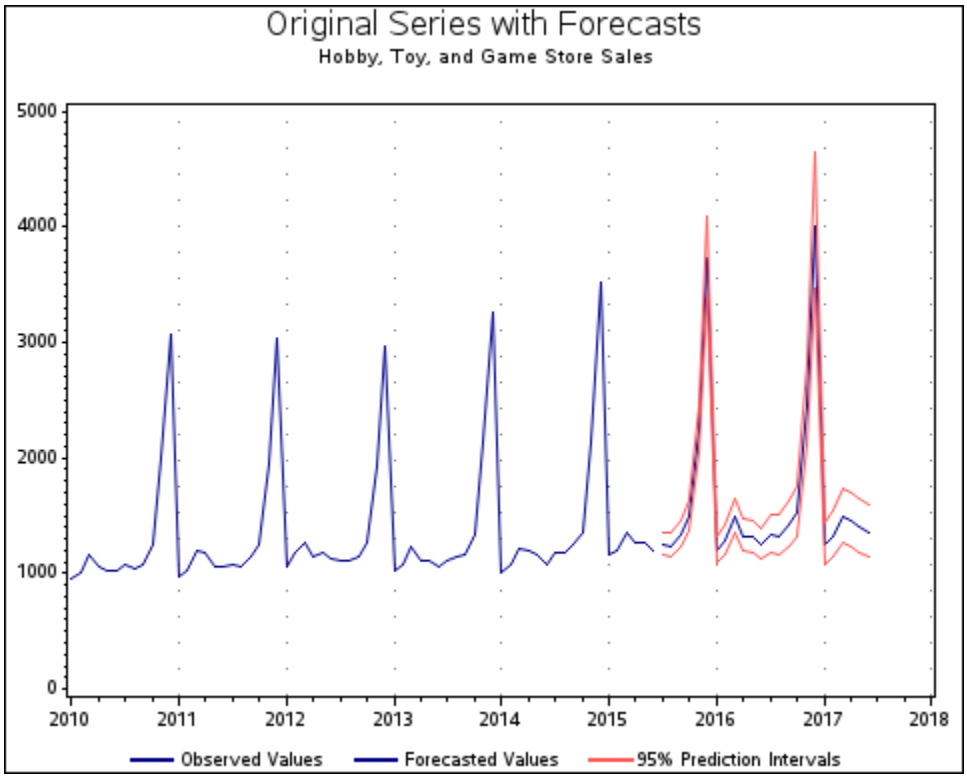
Available Elements for Special Seasonal Factor Graphs

Element	Element Code
Box Plots of the Modified Irregular	boxmirr
Box Plots of the Indirect Irregular	boxindirr
Original Series	ori
Logged Original Series	lori
Percent Change of the Original Series	pcori
Percent Change of the Seasonally Adjusted Series	pcsa
Percent Change of the Indirect Seasonally Adjusted Series	pcindsa

Return to contents.

4.5 Forecast Graphs

The program graphs the original series, the forecasts, and the confidence intervals for the forecasts. If you chose a transformation in the X-13ARIMA-SEATS run, you can also graph the series and forecasts on the transformed scale. The keyword for the forecast graphs is **forecast**.



Available Elements for Forecast Graphs

Element	Element Code
Original Series with Forecasts	fct
Original Series with Forecasts on the Transformed Scale	ftr

Return to contents.

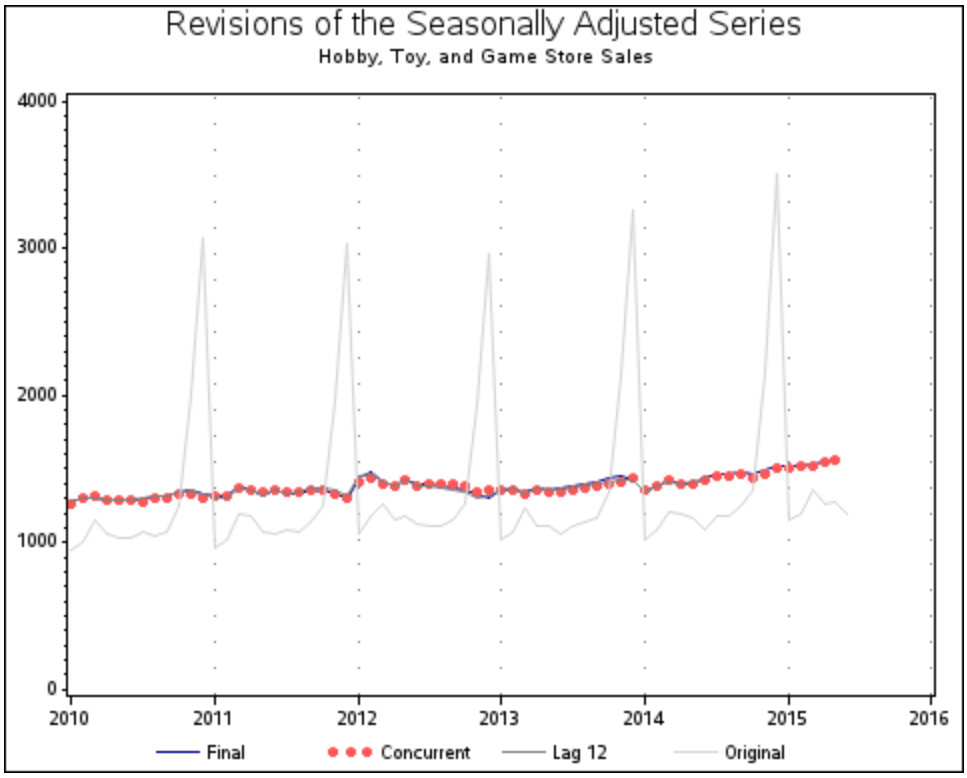
4.6 History Graphs

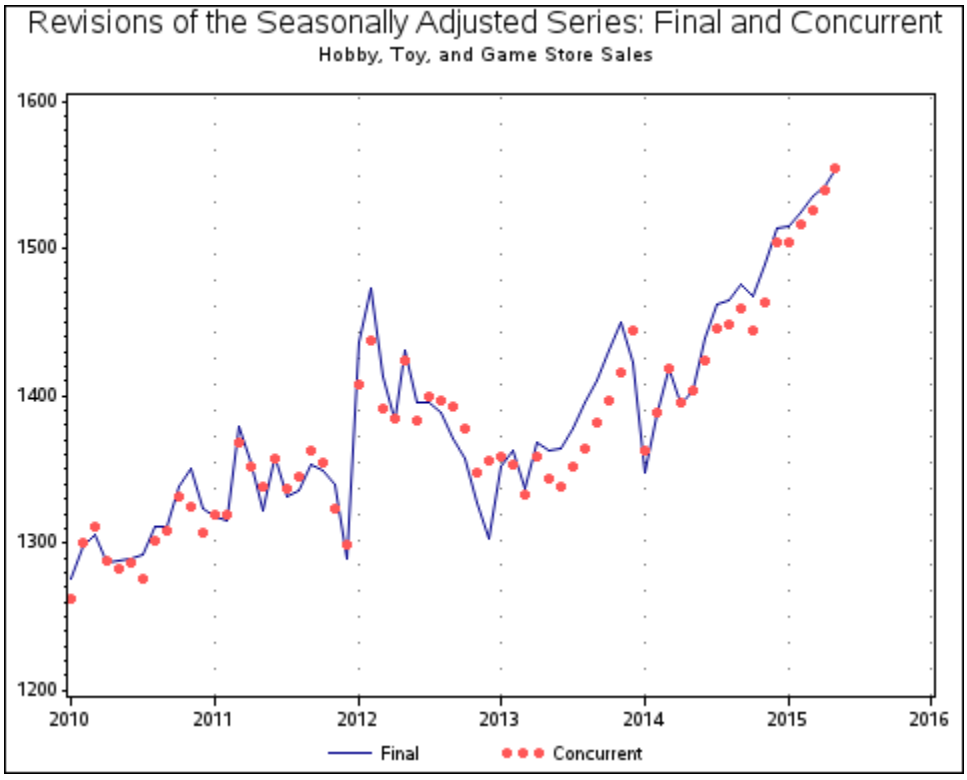
You can create graphs to study the revisions for the seasonal adjustment, seasonal factors, trend, and forecasts of a series. The keyword for history graphs is **history1**.

You can create the following four types of history graphs:

Overlay Graphs

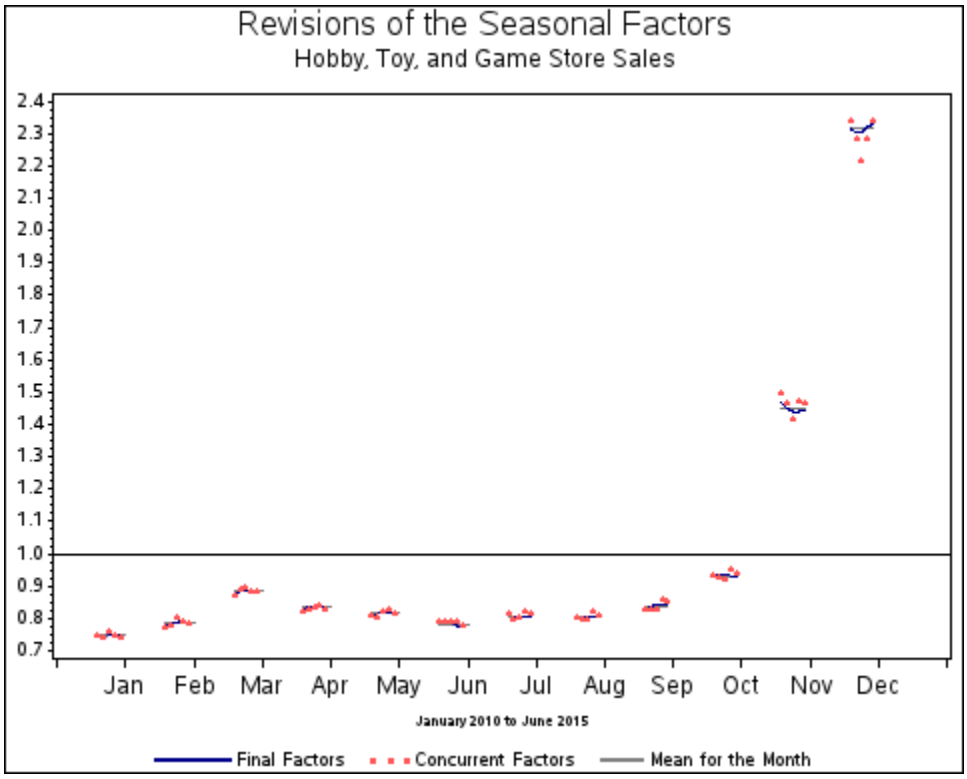
If you request a graph of the "Seasonal Adjustment Values", "Indirect Seasonal Adjustment Values", or "Trend Values" (elements ahst, indahst, and trhst, respectively), you will get a graph of the concurrent and the final estimates of that value overlaid with the original series. If you requested additional history information at certain lags when running X-13ARIMA-SEATS, the graph will also include those estimates. A second graph with only the concurrent and final estimates is also produced.





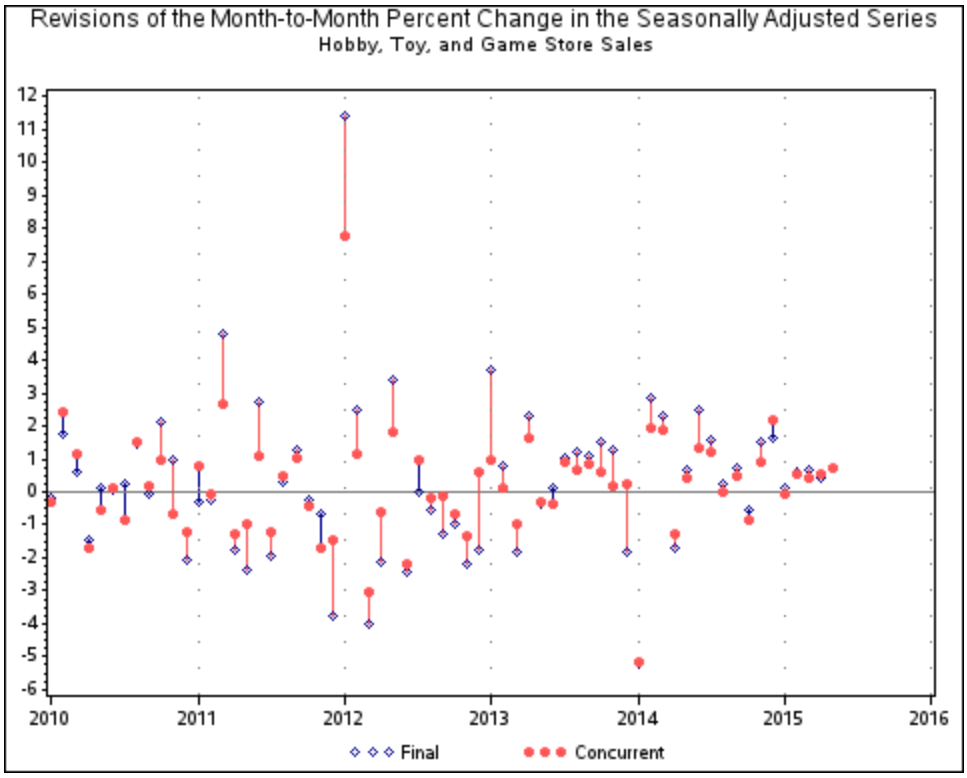
Seasonal Factor Graphs

Graphs of the seasonal factor history plot the initial and the final seasonal factor estimates by calendar period. For each month or quarter, the final seasonal factors are plotted as a line and the initial seasonal factors as circles, and a year axis is drawn at the period's factor mean.



Percent Change Graphs

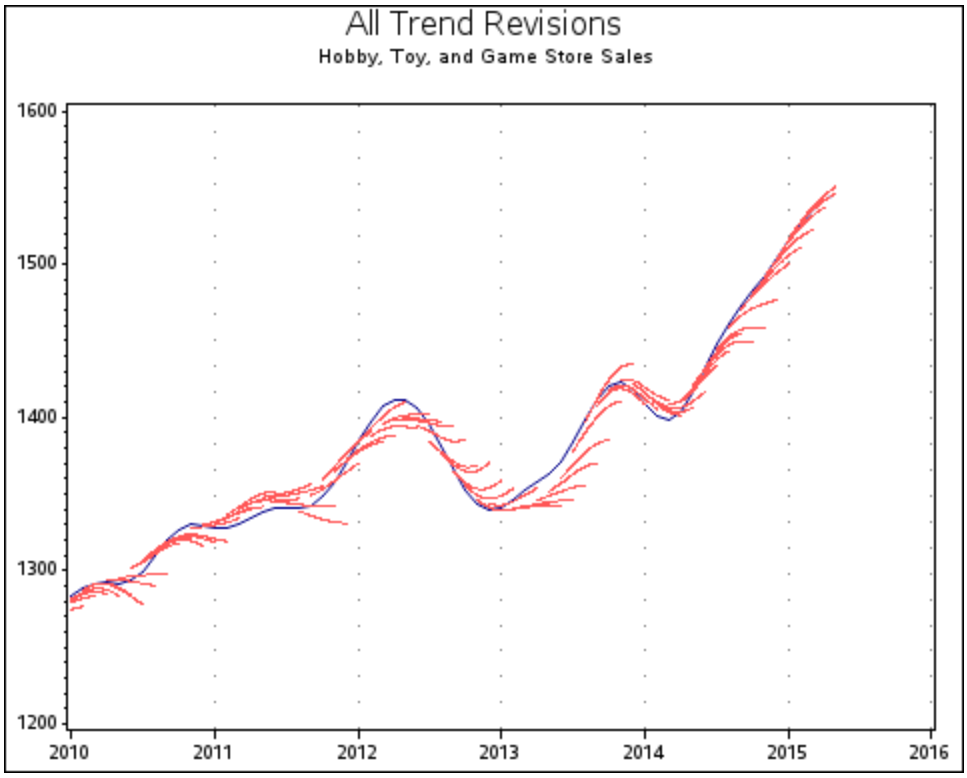
Three graphs are created when "Percent Changes in the Seasonal Adjustment Values" or "Percent Changes in the Trend Values" (elements csahst and ctrhst, respectively) are requested. Each graph plots two of the following for each observation: the percent change (from the previous observation) of the final estimate, the percent change of the initial estimate, and the percent change of the original series. Each is plotted as a circle or diamond, with a vertical line connecting them; the line color belongs to the element which is smaller in absolute value.



Special Trend Graphs

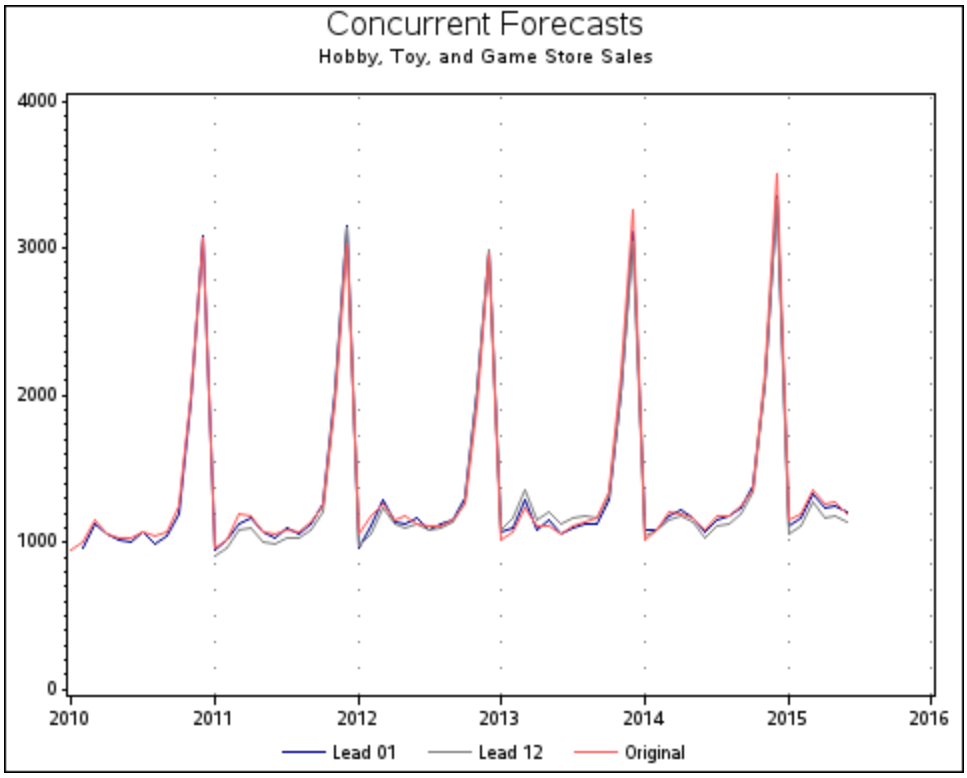
If you request graphs for "All Trend Revisions," "Trend Revisions for the Ending Date," or "Trend Revisions over the Lag Interval," the program produces graphs that connect the estimates for trend from the lags requested when X-13ARIMA-SEATS was run. This shows the direction a trend was taking for a particular date. Each graph has a continuous line representing the final trend estimate. There is a shorter line connecting all the estimates for a particular date from the requested lags. That is, if lags 1, 2, 3, and 4 were requested, then for December 1999, the initial trend estimate is connected to the Lag 1 estimate from November, the Lag 2 estimate from October, the Lag 3 estimate from September, and the Lag 4 estimate from August to see where the trend was heading.

The graph "for the ending date" shows the trend lags only for the last date on the graph, while the graph "over the lag interval" shows trends from the end of the series back however many lags were requested, and the graph for "all trend revisions" shows the trend lags for all dates.



Concurrent Forecasts and Forecast Errors

Graphs for "Concurrent Forecasts" (element cfchst) plot the original series and the within-sample forecasts for the lags specified in the `history` spec. Graphs for "Concurrent Forecast Errors" (element cfehst) plot the difference between the original series and the within-sample forecasts for the specified lags.



Available Elements for History Graphs

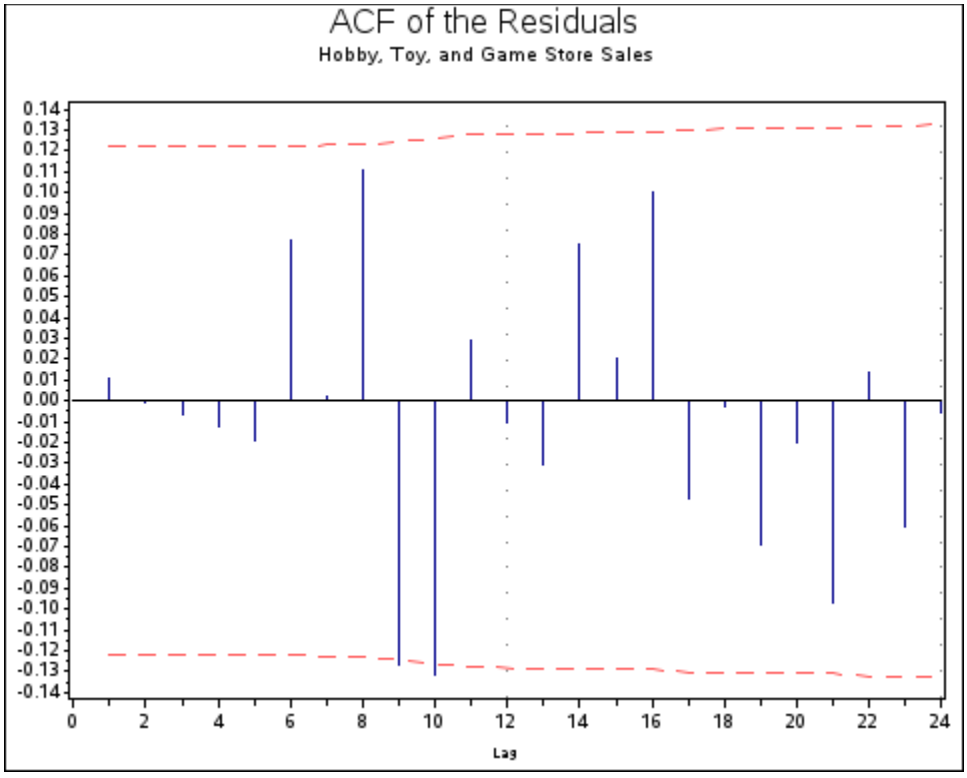
Element	Element Code
Seasonally Adjusted Series	ahst
Indirect Seasonally Adjusted Series	indahst
Trend Values	trhst
Seasonal Factors	sfhst
Percent Change in the Seasonally Adjusted Values	csahst
Percent Change in the Trend Values	ctrhst
All Trend Revisions	trhall
Trend Revisions for the Ending Date	trhend
Trend Revisions over the Lag Interval	trhlag
Concurrent Forecasts	cfchst
Concurrent Forecast Errors	cfehst

Return to contents.

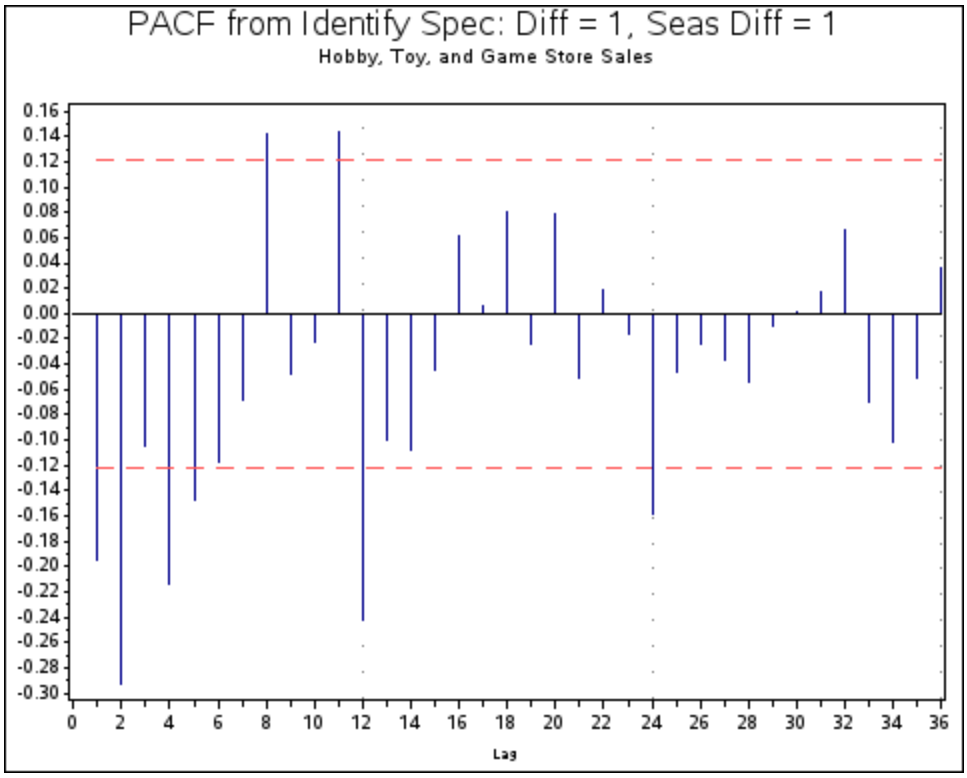
4.7 ACF/PACF Graphs

Graphs of the autocorrelation function and the partial autocorrelation function are available for the residuals and, if the `identify` spec was included in the spec file, for the original series. Both types have the keyword **acfpacf**.

You can create ACF and PACF plots of the residuals, or ACF plots of the squared residuals:



If you included the `identify` spec, you can create ACF and PACF plots from the original series. The program will create an ACF and a PACF graph for each combination of differencing and seasonal differencing that was given in the identify spec. That is, if you asked for nonseasonal differencing of 0 and 1 and seasonal differencing of 0 and 1 when you ran X-13ARIMA-SEATS, you will get eight graphs; the order of differencing is included in the title:



Available Elements for ACF/PACF Graphs

Element	Element Code
ACF of the Residuals	acf
PACF of the Residuals	pacf
ACF of the Squared Residuals	acf2
ACF and PACF from Identify Spec	idacf

Return to contents.

4.8 Maximum Outlier T-Value Graphs

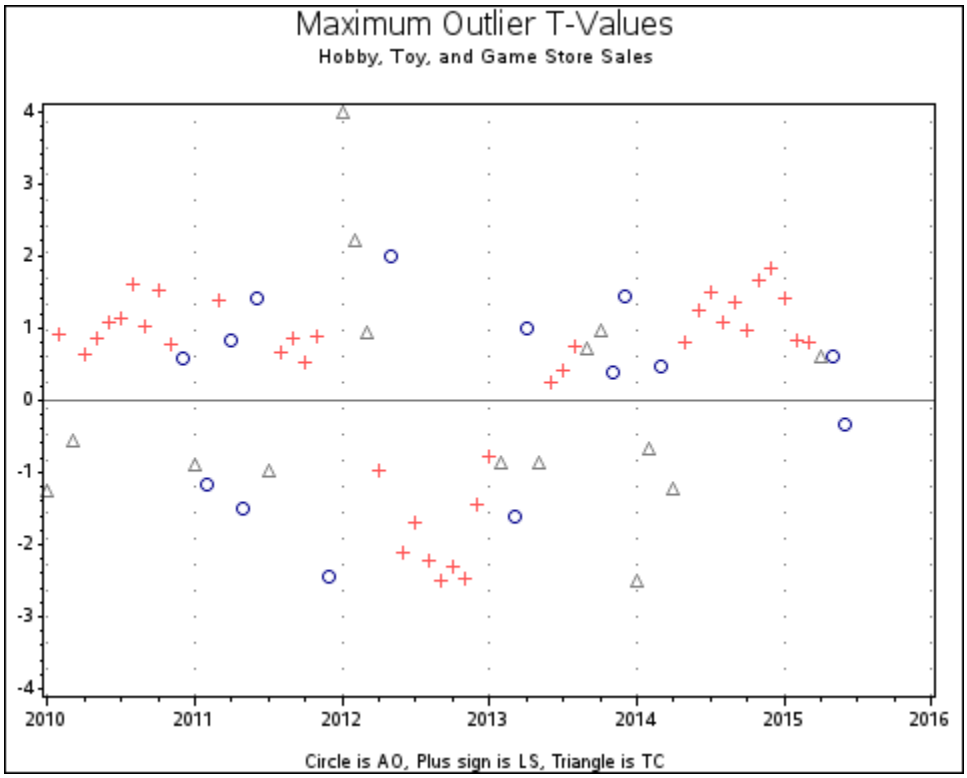
Maximum Outlier T-Value Graphs allow you to compare the maximum absolute t-values from the automatic outlier procedure. There are two types of graphs you can produce; each has its own keyword.

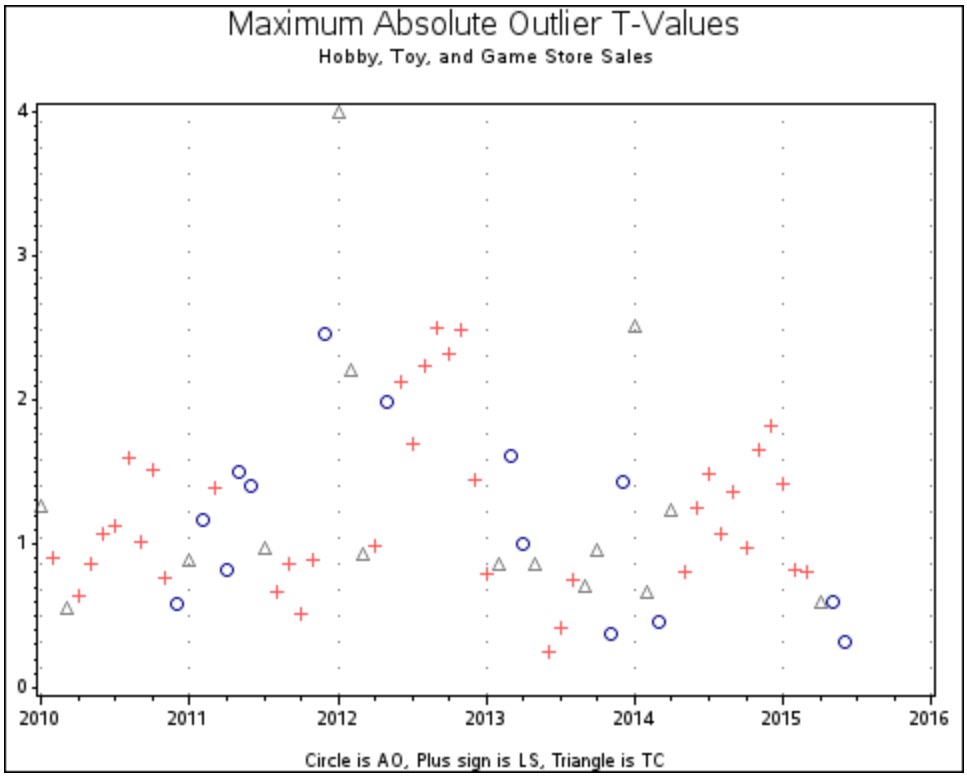
We have used the graphs for research into ways for finding regARIMA outliers, with only limited success. For more information, see McDonald-Johnson and Hood (2001).

Information for the Outlier T-Value graphs comes from the automatic outlier procedure from the final t-value table. By default, X-13ARIMA-SEATS only looks for additive outliers (AO) and level shifts (LS), but it can also look for temporary changes (TC) if you request it.

The t-value graphs will plot the maximum absolute t-values for each data point. That is, if for one particular month, say June 1989, X-13ARIMA-SEATS calculates an AO t-value of 3.1, an LS t-value of 2.2, and a TC t value of 2.7, at June 1989 the graph shows only the AO t-value at 3.1. Another helpful feature of the maximum absolute t-value plot is that X-13ARIMA-SEATS assigns a t-value of 0 to any identified outlier. That is, if X-13ARIMA-SEATS identifies a particular month, say August 1998, as an LS, then the August 1998 LS t value would be 0, although X-13ARIMA-SEATS would calculate valid t-values for the AO and TC effects. The greater (in absolute value) of the AO and TC t-values would appear on the graph.

If you use the keyword **tvalue**, the actual value of the maximum absolute t-value will be plotted, with the correct sign. If you use the keyword **abtvalue**, the absolute value of the maximum absolute t-value will be plotted. The first graph below was created with the keyword tvalue, and the second with the keyword abtvalue. Both keywords use the same elements.





Available Elements for Outlier T-Value Graphs

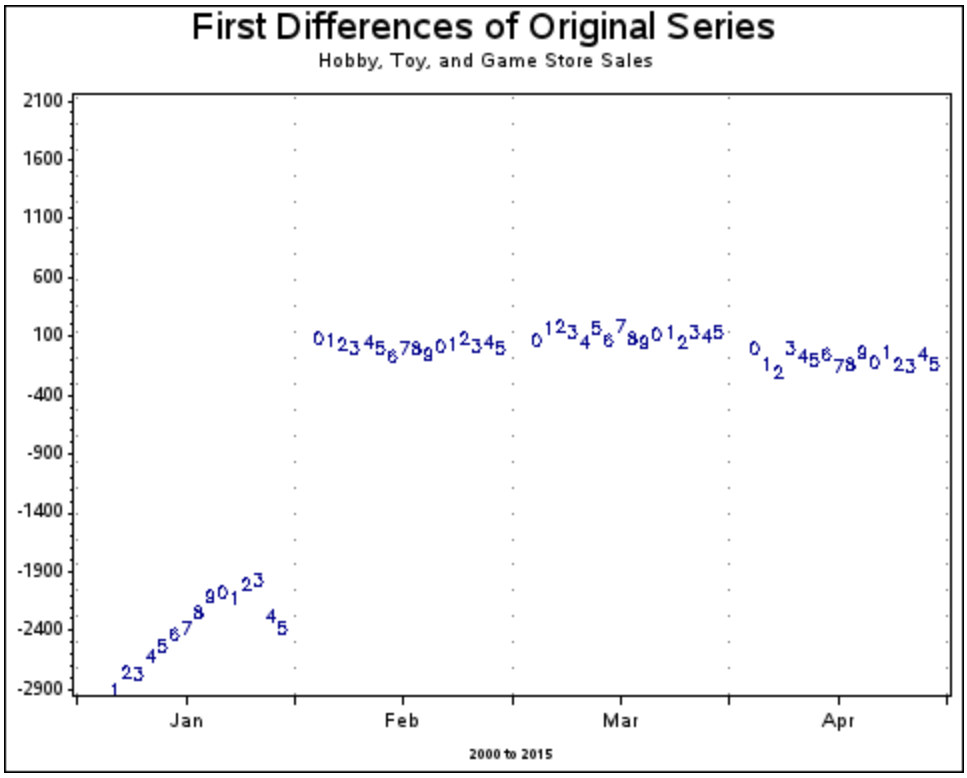
Element	Element Code
T-Values for Additive Outliers	ao
T-Values for Level Shifts	ls
T-Values for Temporary Changes	tc

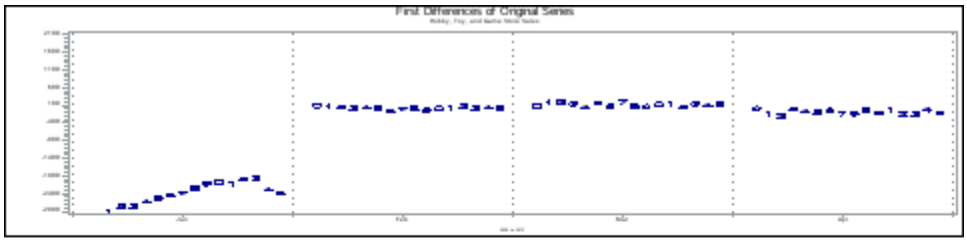
Return to contents.

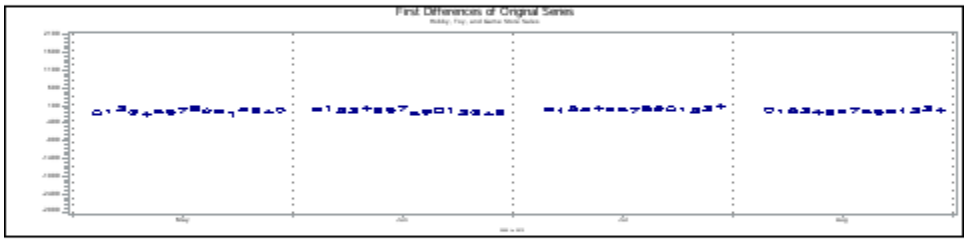
4.9 First Difference Graphs

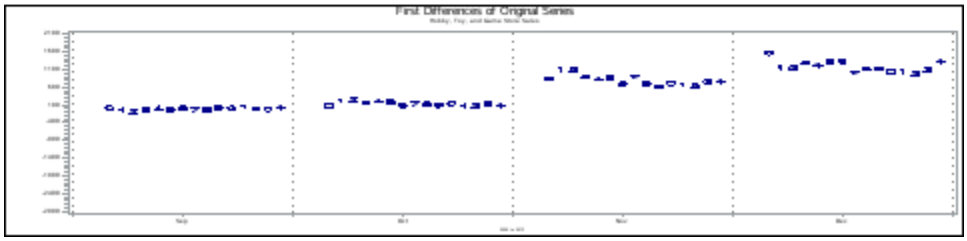
The program graphs the first differences of the selected element by period. If the series is monthly, the differences of each month are plotted together with four months per graph; a graph of all twelve months together is also produced. The number on the graph is the last digit of the difference's year. The keyword for first difference graphs is **fstdiff**.

The form of the first difference graphs was developed by Stuart Scott at the Bureau of Labor Statistics where it has been used to detect outliers in the original time series. See Scott (1987) and Buszuwski and Scott (1988) for examples of using first difference graphs to identify different types of outliers.


First Differences of Original Series
Hobby, Toy, and Game Store Sales
2100
1600
1100
600
100
-400
-900
-1400
-1900
-2400
-2900
Jan
Feb
Mar
Apr
2000 to 2015







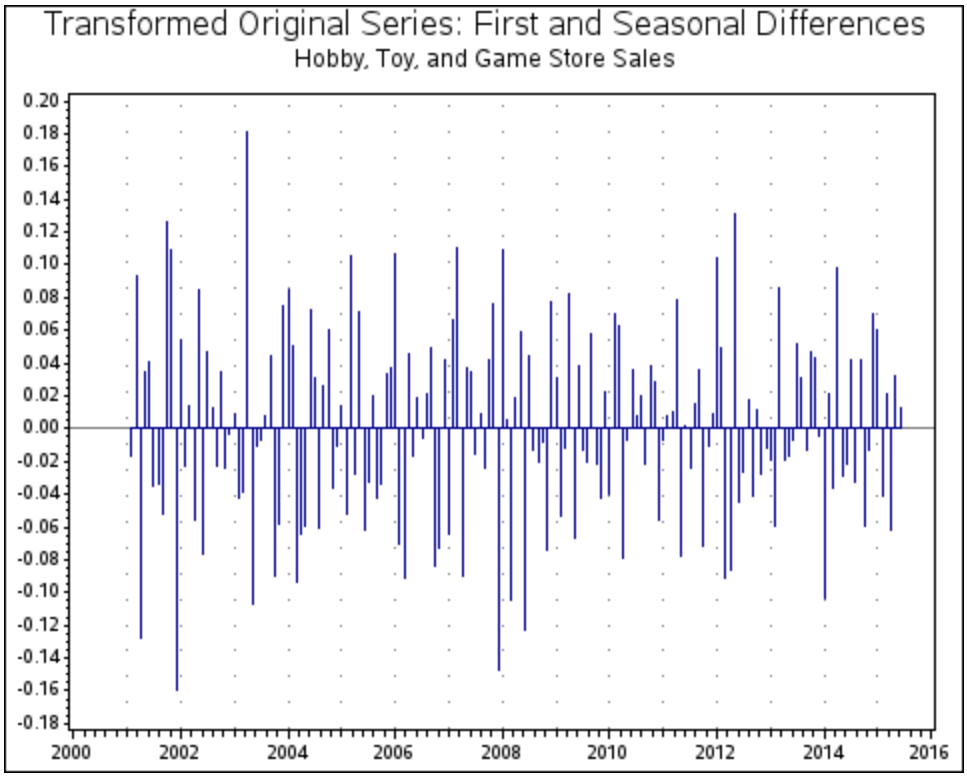
Available Elements for First Difference Graphs

Element	Element Code
Original Series	ori
Calendar Adjusted Original Series	cad
Original Series Adjusted by Prior Factors	priadj
Original Series Modified for Extremes	mori
Original Series with Replaced Missing Values	mvadj
Prior Adjusted Original Series	adjori
Seasonally Adjusted Series	sa
Seasonally Adjusted Series Modified for Extremes	msa
Trend Cycle	trn
Indirect Seasonally Adjusted Series	indsa
Indirect Seasonally Adjusted Series Modified for Extremes	indmsa
Indirect Trend	indtrn
Original Series Modified for Indirect Extremes	indmori

Return to contents.

4.10 Differenced Original Series Graphs

The program graphs the differenced original or transformed original series with zero, one, or two first differences and zero or one seasonal differences. The keyword for these graphs is **diff**.



Available Elements for Differenced Original Series Graphs

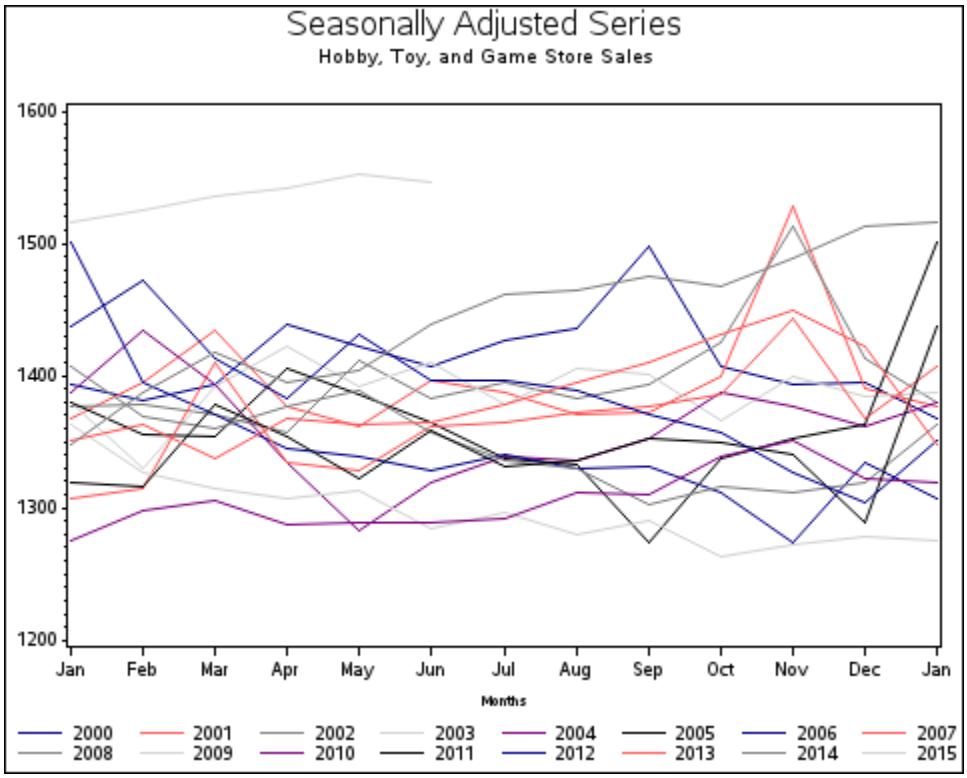
Element	Element Code
Original Series: First Difference	1
Original Series: Second Difference	2
Original Series: Seasonal Difference	s
Original Series: First and Seasonal Differences	1s
Original Series: Second and Seasonal Differences	2s
Transformed Original Series: First Difference	l1
Transformed Original Series: Second Difference	l2
Transformed Original Series: Seasonal Difference	ls
Transformed Original Series: First and Seasonal Differences	l1s
Transformed Original Series: Second and Seasonal Differences	l2s

Return to contents.

4.11 Year on Year Graphs

Year on Year graphs plot the requested element by year in order to look for seasonal patterns in the data. The keyword for these graphs is **yronyr**.

The program will graph only 18 years of data. If the series is longer then 18 years, then the last 18 will be graphed. To change this span, use the **subspan** option.



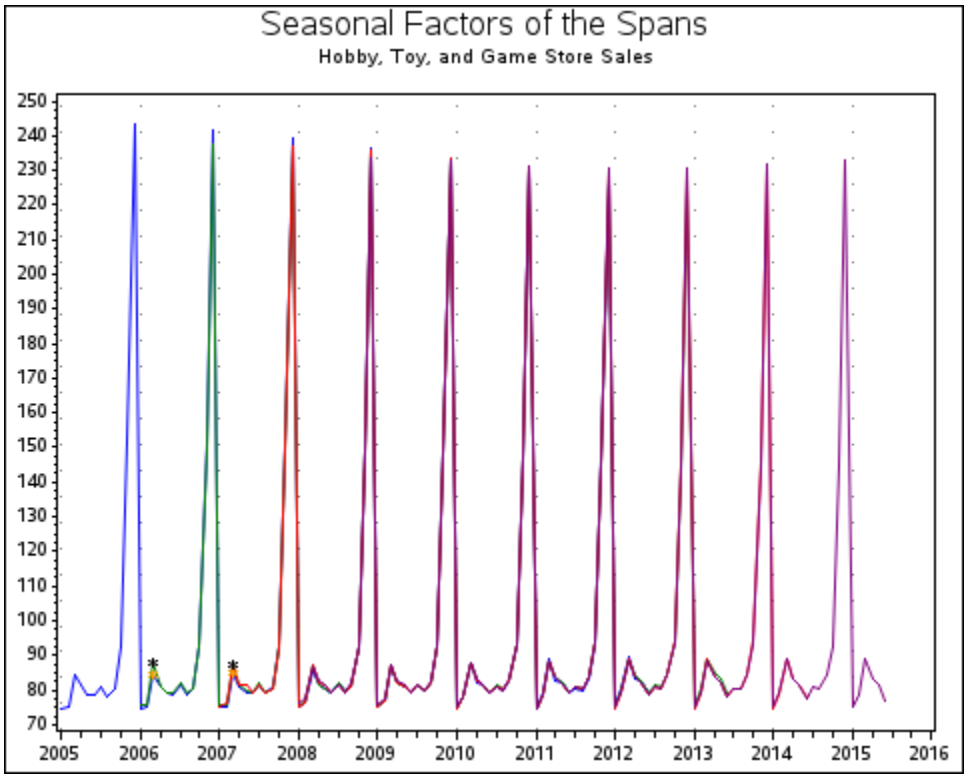
Available Elements for Year on Year Graphs

Element	**Element Code**
Original Series	ori
Detrended Original Series	dtrn
Detrended Original Series (Crude)	dtrnc
Calendar Adjusted Original Series	cad
Original Series Adjusted by Prior Factors	priadj
Original Series Modified for Extremes	mori
Original Series with Replaced Missing Values	mvadj
Prior Adjusted Original Series	adjori
Seasonally Adjusted Series	sa
Seasonally Adjusted Series Modified for Extremes	msa
Trend Cycle	trn
Indirect Seasonally Adjusted Series	indsa
Indirect Seasonally Adjusted Series Modified for Extremes	indmsa
Indirect Trend	indtrn
Original Series Modified for Indirect Extremes	indmori

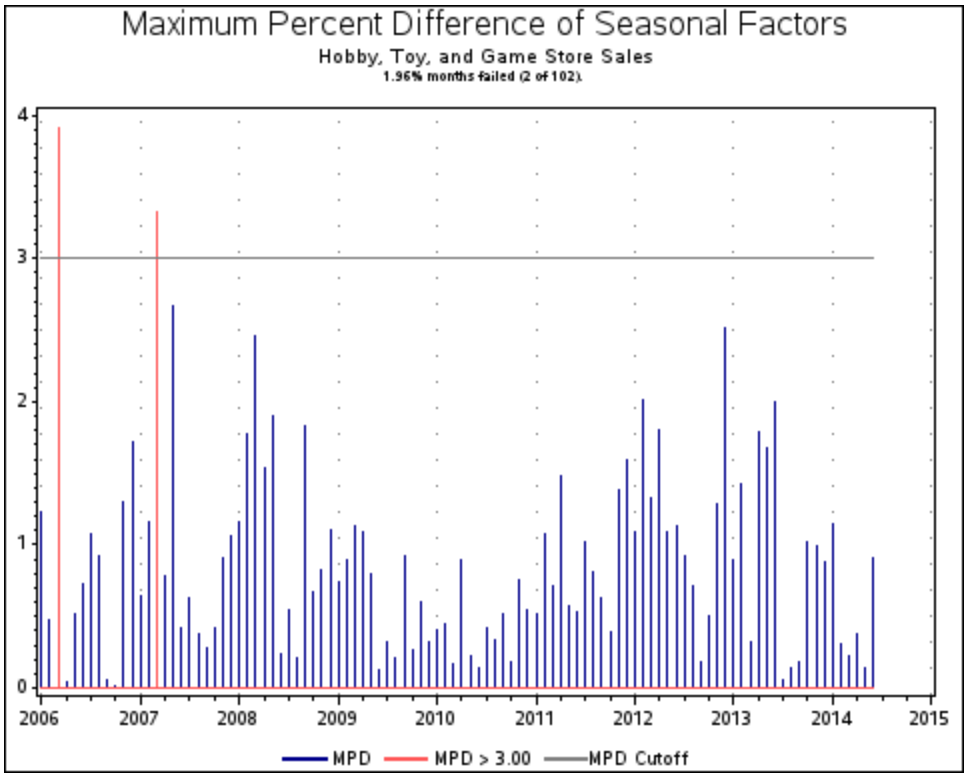
Return to contents.

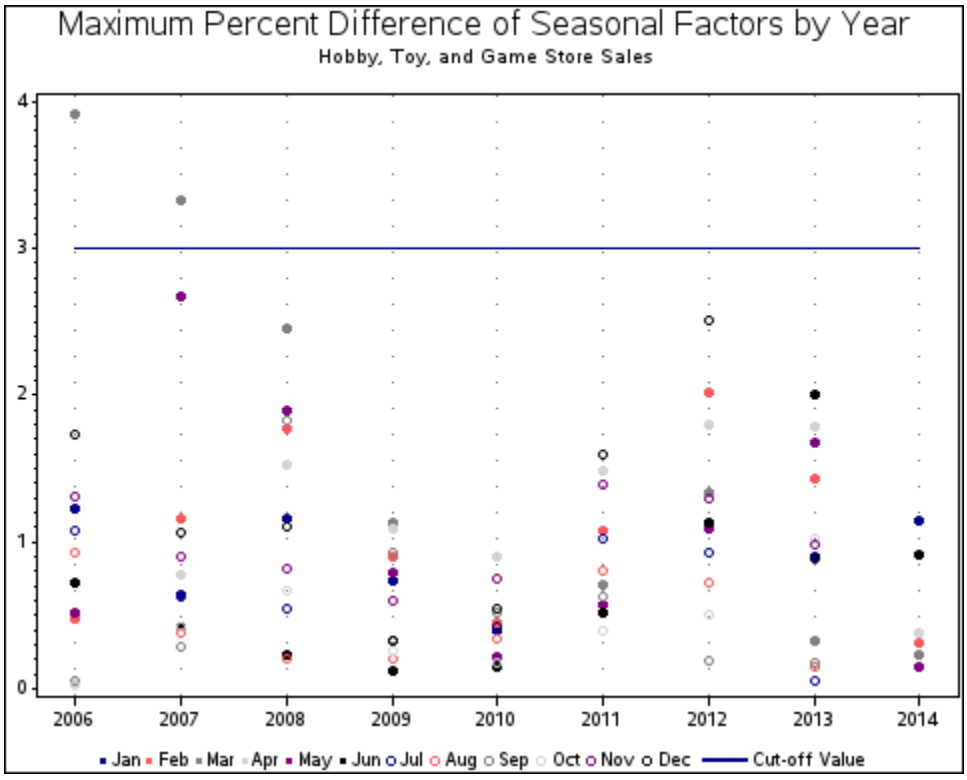
4.12 Sliding Spans Graphs

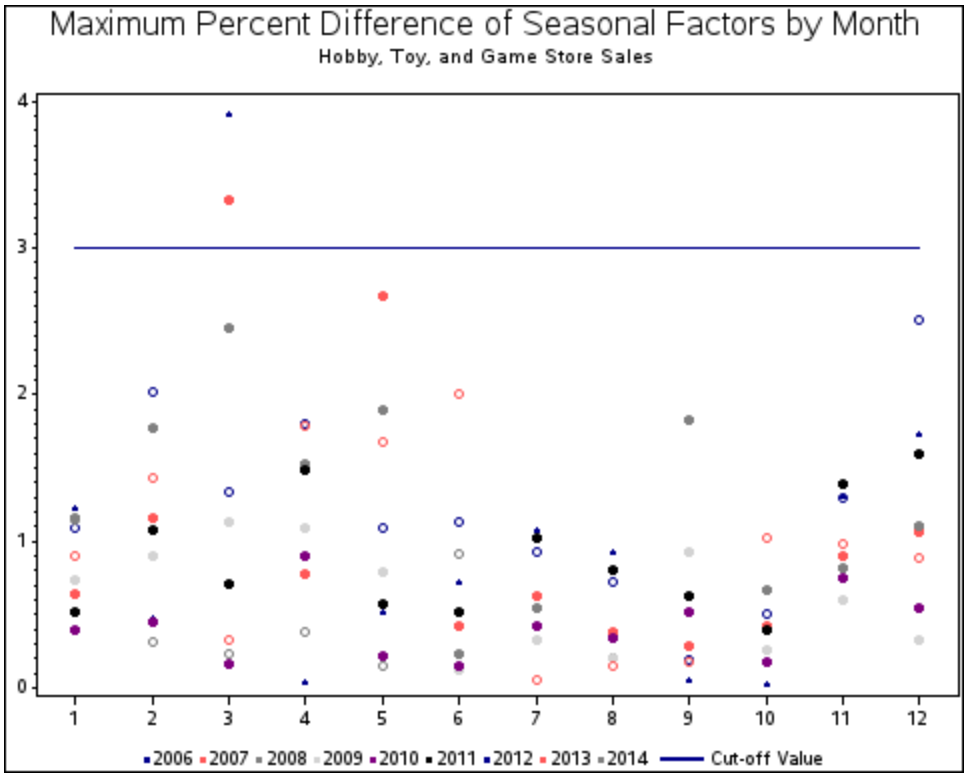
The sliding spans diagnostic creates up to four overlapping subspans of your data, seasonally adjusts each subspan, and compares the resulting seasonally adjusted values. To create graphs for this diagnostic, use the keyword **sspans**.



You can create four types of sliding spans graphs. The first is an overlay graph of the seasonal factors of each span; if the percent difference between the largest and smallest value is greater than the cutoff value, usually 3, this graph will also show dots indicating the maximum and minimum value.


Maximum Percent Difference of Seasonal Factors
Hobby, Toy, and Game Store Sales
1.96% months failed (2 of 102).
4
3
2
1
0
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
MPD
MPD > 3.00
MPD Cutoff


Maximum Percent Difference of Seasonal Factors by Year
Hobby, Toy, and Game Store Sales
4
3
2
1
0
2006
2007
2008
2009
2010
2011
2012
2013
2014
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Cut-off Value



You can also create a graph of these maximum percent differences chronologically, by year, or by month or quarter. In each case, a horizontal line showing the cutoff value will also be graphed.

These four graphs can be created for the seasonal factors (or seasonally adjusted value, depending on your transformation type), the month-to-month or quarter-to-quarter percent changes of the seasonally adjusted series, the indirect seasonal factors, and the indirect month-to-month or quarter-to-quarter percent changes.

Available Elements for Sliding Spans Graphs

Element	Element Code
Seasonal Factors of the Spans	sfspan
Maximum Percent Difference (MPD) of Seasonal Factors	sfmpd
MPD of Seasonal Factors by Year	sfmpdy
MPD of Seasonal Factors by Period	sfmpdp
Period-to-Period Changes in Seasonal Adjustment of the Spans	chspan
MPD of Period-to-Period Changes in Seasonal Adjustment	chmpd
MPD of Period-to-Period Changes in Seasonal Adjustment by Year	chmpdy
MPD of Period-to-Period Changes in Seasonal Adjustment by Period	chmpdp
Indirect Seasonal Factors of the Spans	isfspan

Available Elements for Sliding Spans Graphs

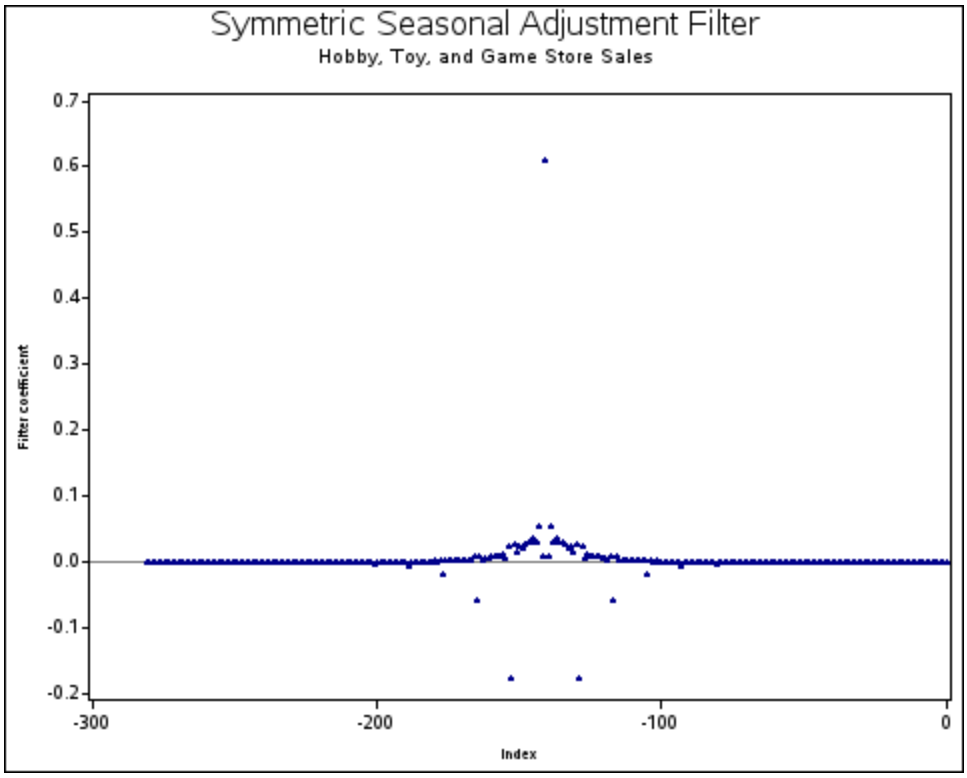
Element	Element Code
MPD of Indirect Seasonal Factors	isfmpd
MPD of Indirect Seasonal Factors by Year	isfmpdy
MPD of Indirect Seasonal Factors by Period	isfmpdp
Period-to-Period Changes in Indirect Seasonal Adjustment of the Spans	ichspan
MPD of Period-to-Period Changes in Indirect Seasonal Adjustment	ichmpd
MPD of Period-to-Period Changes in Indirect Seasonal Adjustment by Year	ichmpdy
MPD of Period-to-Period Changes in Indirect Seasonal Adjustment by Period	ichmpdp
Maximum Percent Differences of the Direct and Indirect Seasonal Factors	isfcomp
Maximum Percent Differences of the Direct and Indirect Period-to-Period Changes in Seasonal Adjustment	ichcomp

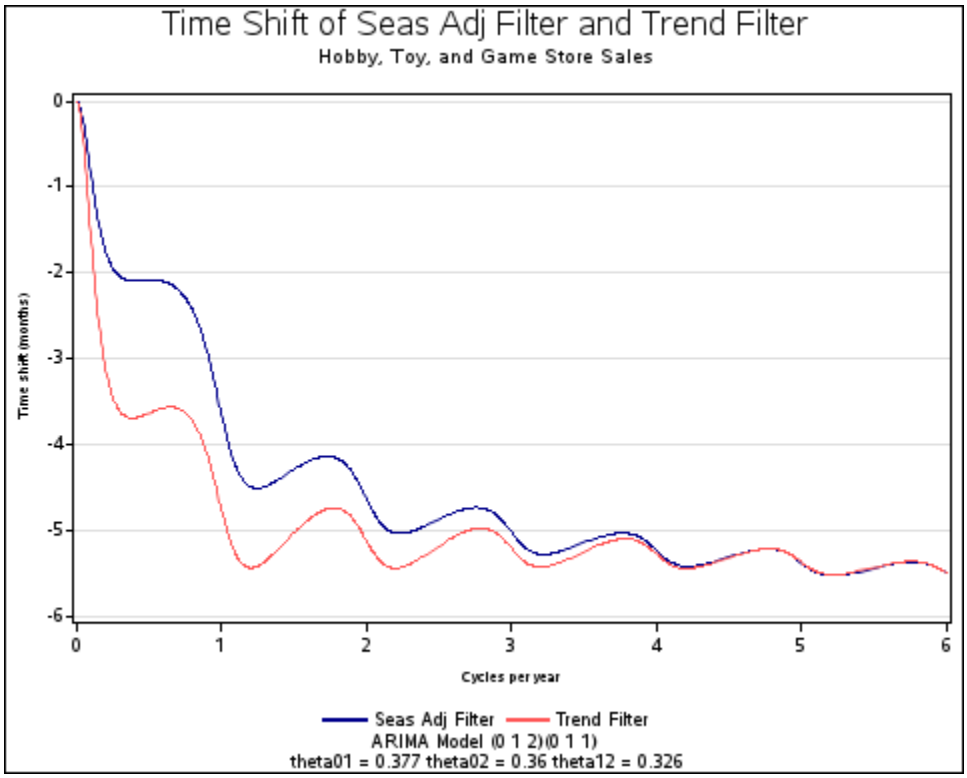
Return to contents.

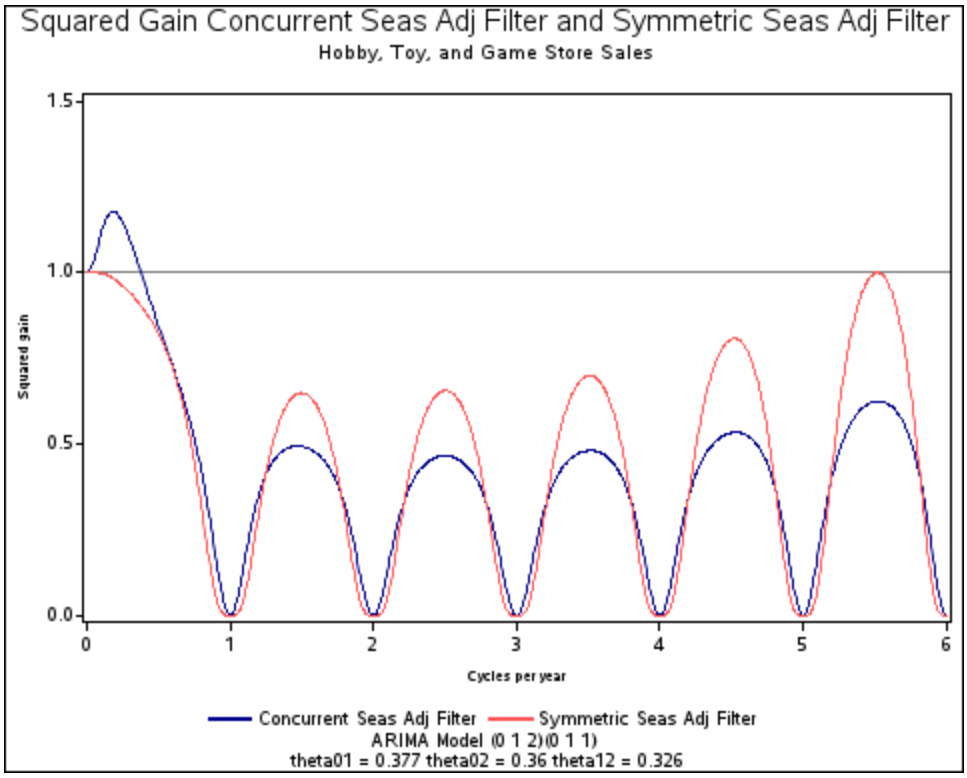
4.13 SEATS Filter and Diagnostic Graphs

Four types of graphs using two keywords can be created for SEATS adjustments. Note that to create these graphs, X-13 must be run with `finite = yes` in the `seats` spec.

To graph filters used in SEATS adjustments and their time shifts and squared gains, use the keyword **filter**. You can list up to four elements on each line of the graph list file (.gls) for these filter graphs. Each filter will be plotted in its own graph; however, all the requested time shift graphs found on one line will be plotted together, as will all requested squared gain graphs.


Symmetric Seasonal Adjustment Filter
Hobby, Toy, and Game Store Sales
Filter coefficient
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-300
-200
-100
0
Index

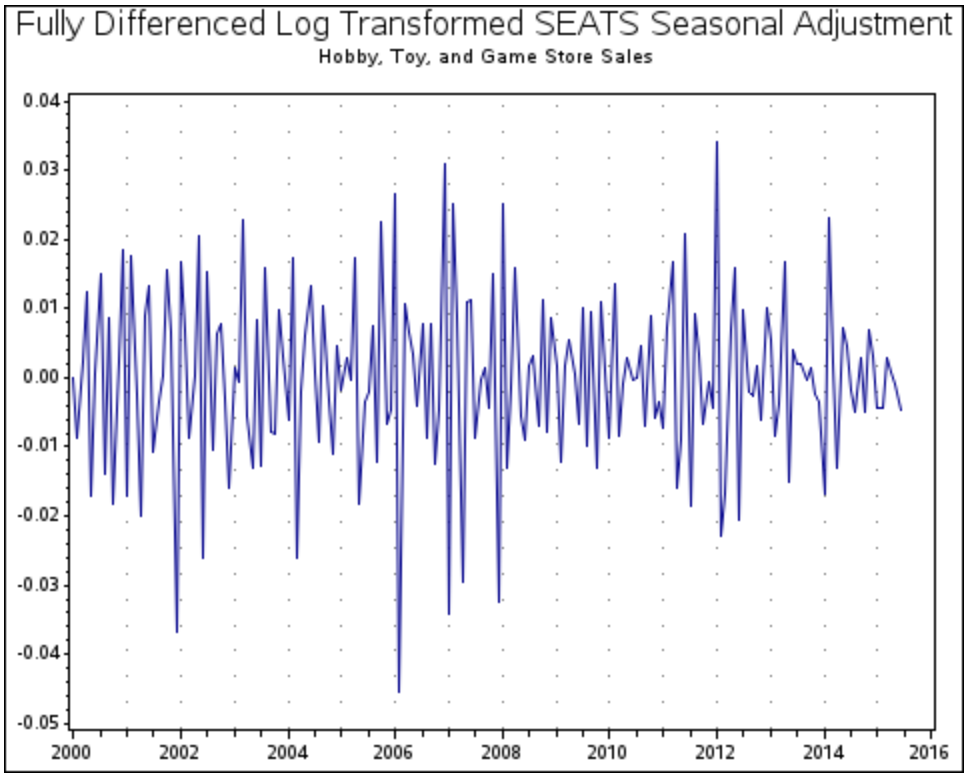

Time Shift of Seas Adj Filter and Trend Filter
Hobby, Toy, and Game Store Sales
Time shift (months)
0
-1
-2
-3
-4
-5
-6
0
1
2
3
4
5
6
Cycles per year
Seas Adj Filter
Trend Filter
ARIMA Model (0 1 2)(0 1 1)
theta01 = 0.377 theta02 = 0.36 theta12 = 0.326

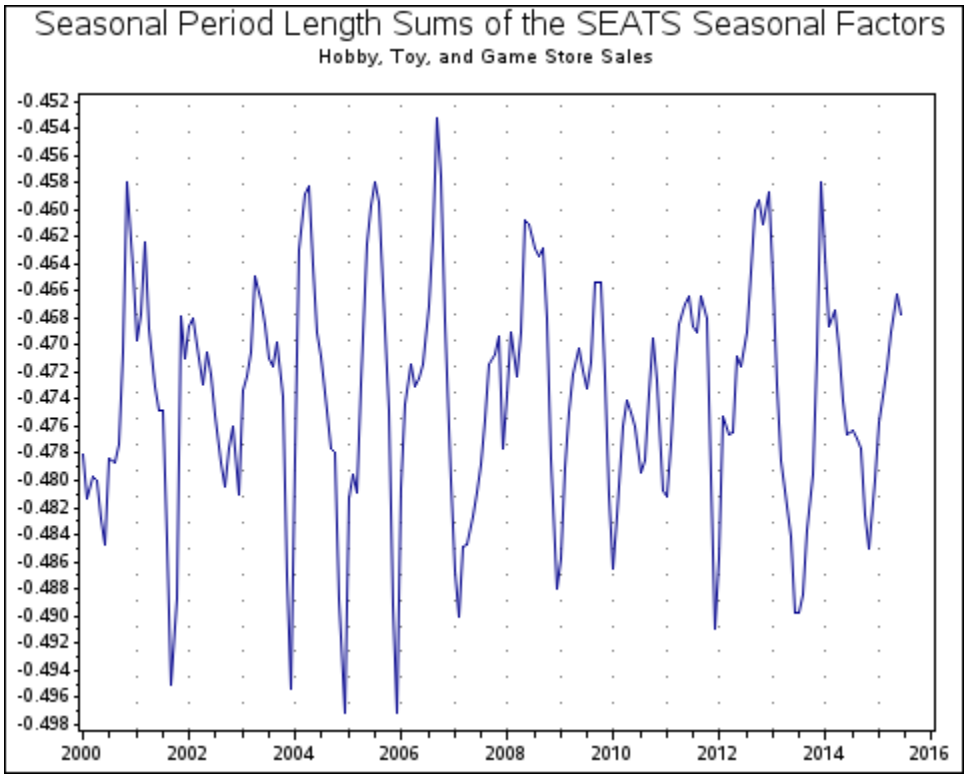


Available Elements for SEATS Filter Graphs

Element	Element Code
Concurrent Seasonal Adjustment Filter	fltsac
Concurrent Trend Filter	flttrnc
Symmetric Seasonal Adjustment Filter	fltsaf
Symmetric Trend Filter	flttrnf
Time Shift of Concurrent Seasonal Adjustment Filter	tssac
Time Shift of Concurrent Trend Filter	tstrnc
Squared Gain of Concurrent Seasonal Adjustment Filter	sgsac
Squared Gain of Concurrent Trend Filter	sgtrnc
Squared Gain of Symmetric Seasonal Adjustment Filter	sgsaf
Squared Gain of Symmetric Trend Filter	sgtrnf

SEATS diagnostic graphs can be graphed using the keyword **seats**. These show the fully differenced SEATS seasonal adjustment or SEATS trend, and the seasonal period length sums of the SEATS seasonal factors. See the X-13ARIMA-SEATS manual (U.S. Census Bureau, 2017) for more information.


Fully Differenced Log Transformed SEATS Seasonal Adjustment
Hobby, Toy, and Game Store Sales
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
2000
2002
2004
2006
2008
2010
2012
2014
2016


Seasonal Period Length Sums of the SEATS Seasonal Factors
Hobby, Toy, and Game Store Sales
-0.452
-0.454
-0.456
-0.458
-0.460
-0.462
-0.464
-0.466
-0.468
-0.470
-0.472
-0.474
-0.476
-0.478
-0.480
-0.482
-0.484
-0.486
-0.488
-0.490
-0.492
-0.494
-0.496
-0.498
2000
2002
2004
2006
2008
2010
2012
2014
2016

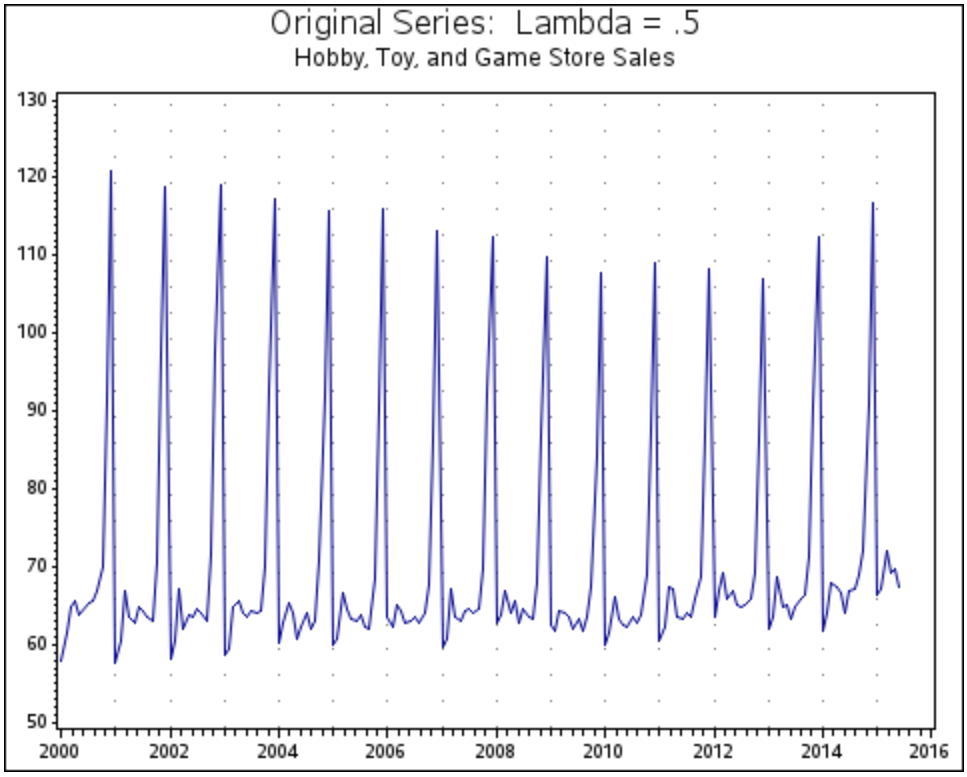
Available Elements for SEATS Diagnostic Graphs

Element	Element Code
Fully Differenced SEATS Seasonal Adjustment	seatdsa
Fully Differenced SEATS Trend	seatdtr
Seasonal Period Length Sums of the SEATS Seasonal Factors	seatssm

Return to contents.

4.14 Power Graphs

Power graphs are plots of the original series with a Box-Cox power transformation applied. The keyword for these graphs is **power**. The elements for these graphs is the Box-Cox power λ. Setting $\lambda = 1$ will produce a graph of the original series; $\lambda = 0$ produces a graph of the logged series.



Return to contents.

4.15 Overlay Graphs for Comparing Two Series

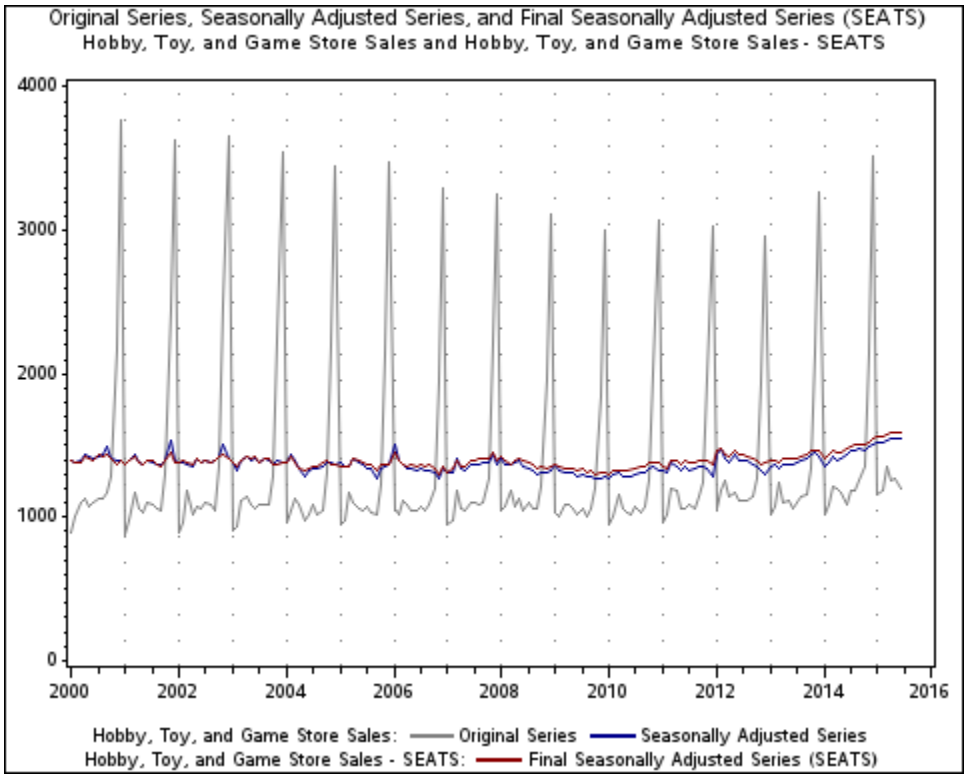
Overlay graphs of two series can be produced to compare the adjustments. The keyword for these graphs is **overlay2**.

These overlay graphs need two different models to compare. Enter the names of the graphics metafiles for the two models on the same line in the graphics metafile list file (the .mls file). An example is given in the examples below.

Up to three elements can be chosen for each series. The elements do not have to be the same for each series. In the graphics list file (the .gls file), list the elements for the first series after the colon after **overlay2**. If the elements for the second series are the same as those for the first series, you do not need to enter anything else. If different elements are required for the second series, put another colon on the same line, and list the elements for the second series. So, to create a graph with the original series and the seasonally adjusted series of the first model and the seasonally adjusted series for the second series, put the line

overlay2: ori sa: sa

in the .gls file.



The elements available for these graphs match those for overlay graphs.

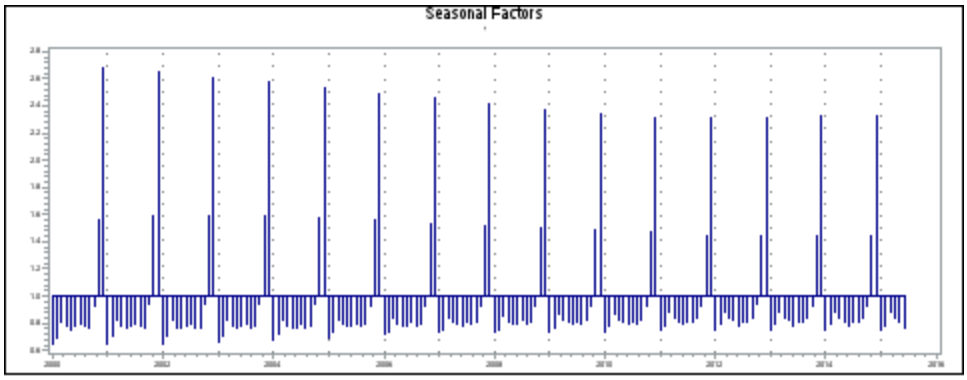
Return to contents.

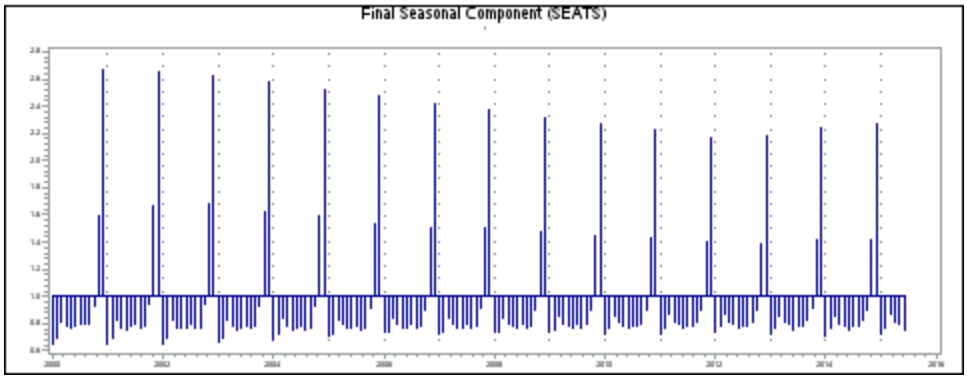
4.16 Component Graphs for Comparing Two Series

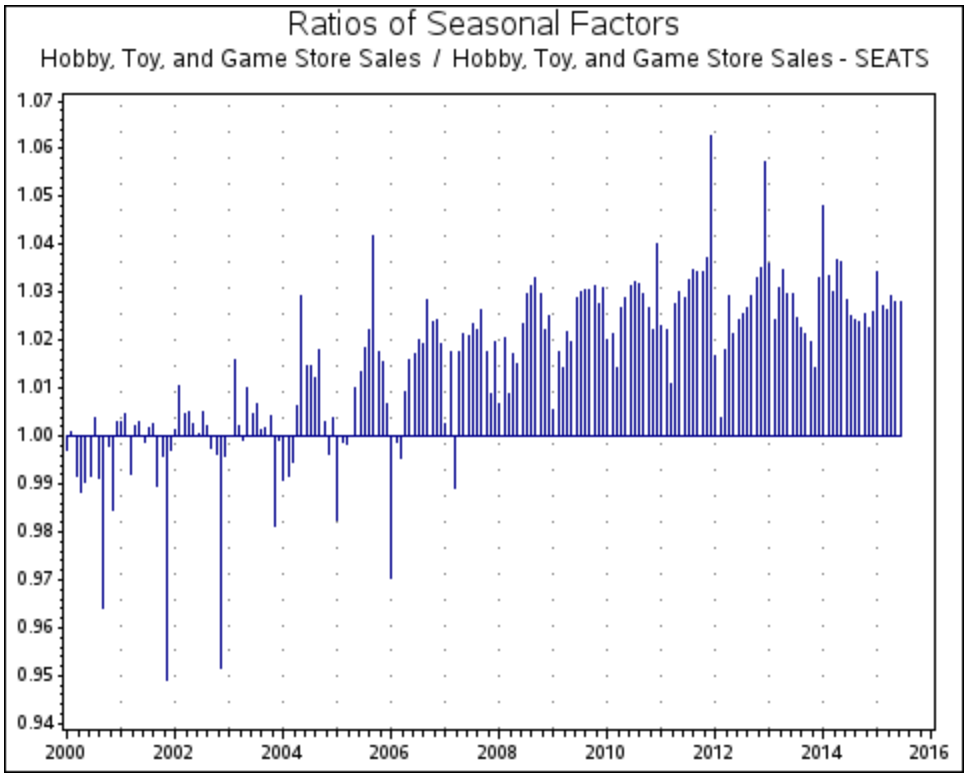
You can compare the components of two different adjustments using the keyword **cmpnent2**.

When you request a component graph to compare two series, the program creates two graphs: the plots of the component for each series on one page, and either the difference or the ratio between the values of that component for each series. The ratio is graphed when the element is either a factor or the irregular and the adjustment is multiplicative, and the difference is graphed otherwise.

As two models are being compared, the two series must both be named on the same line in the graphics metafile list (the .mls file). An example of this is in the examples below.







The elements available for these graphs are the same as those for component graphs.

Return to contents.

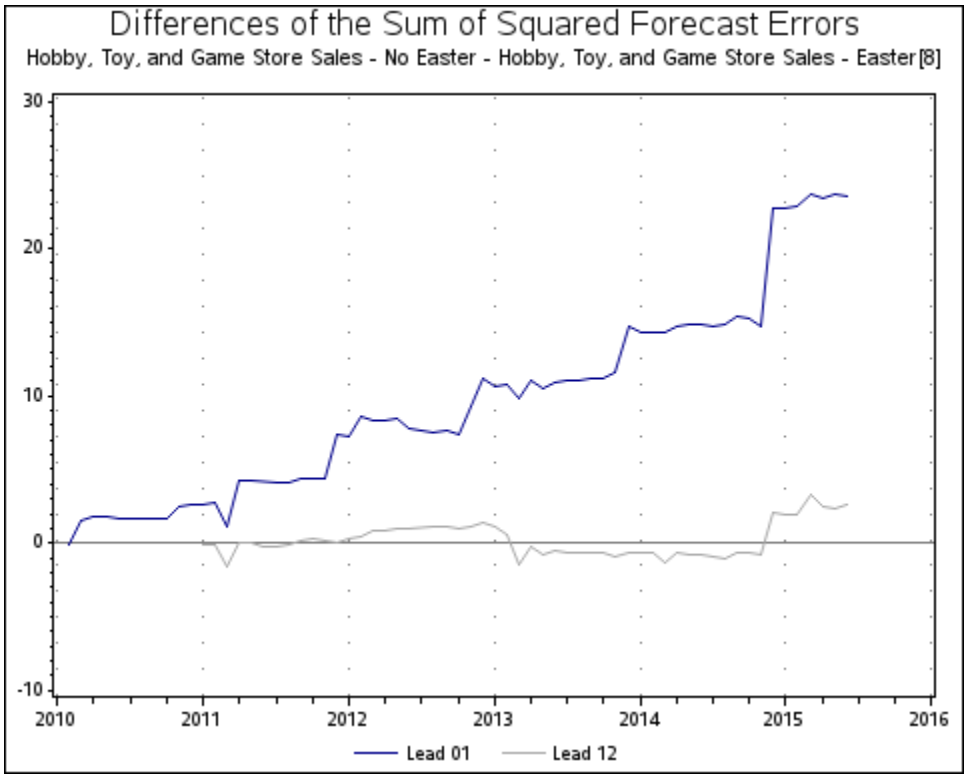
4.17 History Graphs for Comparing Two Adjustments

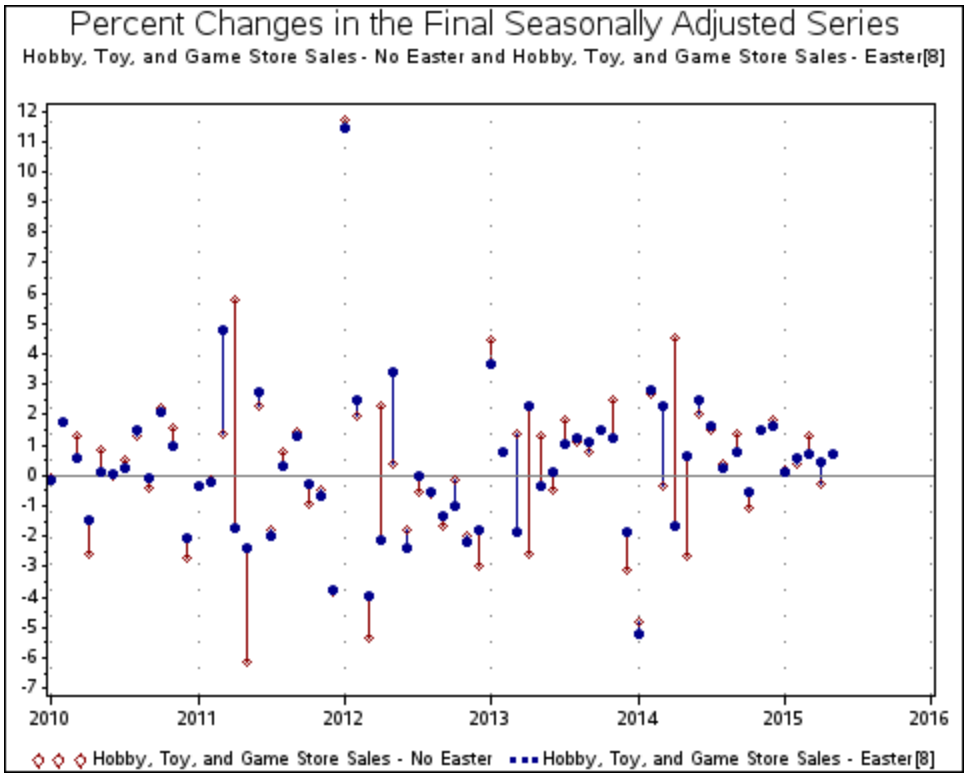
History graphs allow you to compare two models by looking at the AICC Differences History and the Sum of Squared Forecast Error Differences History. For the Sum of Squared Forecast Error Differences graph, the program superimposes all available forecast lags on a single graph. The keyword for history graphs is **history2**.

These history graphs are discussed in Findley, Monsell, Bell, Otto and Chen (1998) and are related to diagnostics presented in Findley (1990, 1991).

You can also create graphs of the Percent Changes in the Seasonally Adjusted Series or the Trend. When you request one of these elements, two graphs are created. One plots the month-to-month change of the concurrent adjustment for both series, connected by a vertical line to highlight the difference. The second does the same for the final adjustment.

History graphs require graphics output from two different models to compare. You must enter the names of the graphics metafiles for the two different models for the history graph on the same line in the graphics metafile list file. An example graphics metafile list file (.mls) is given in the examples below.





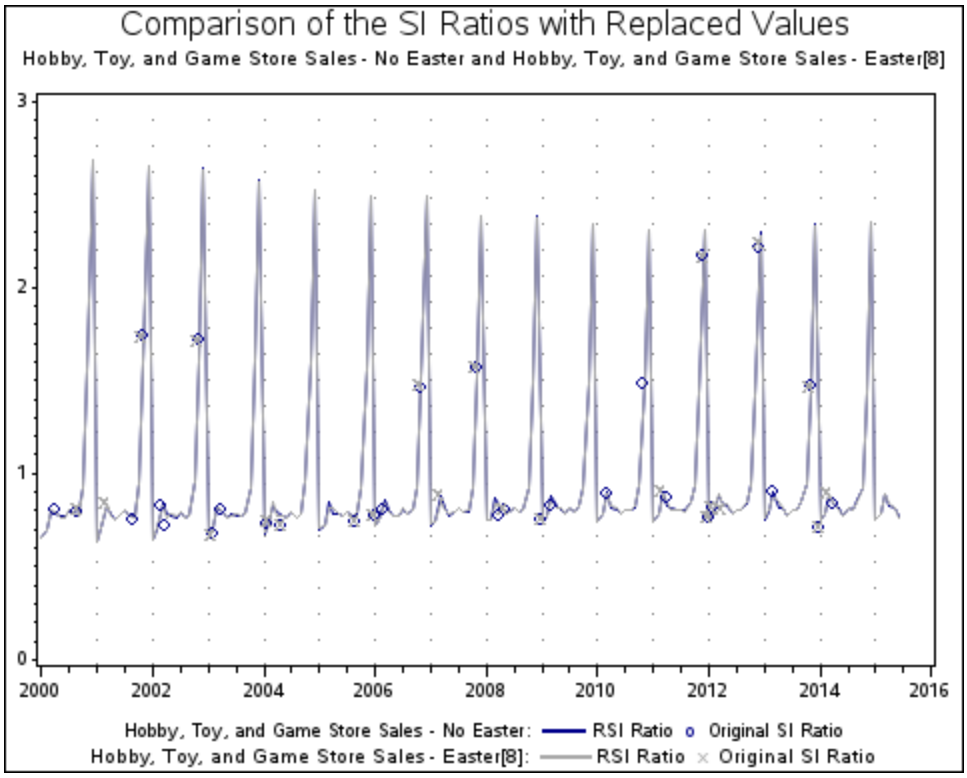
Available Elements for History Graphs

Element	Element Code
Differences of the AICCs	aichst
Differences of the Sum of Squared Forecast Errors	fcthst
Percent Changes in the Seasonally Adjusted Series	csahst
Percent Changes in the Trend	ctrhst

Return to contents.

4.18 SI Ratios for Comparing Two Adjustments

The final seasonal factors in an X-11 adjustment are calculated by applying the seasonal filter to the extreme-value adjusted SI ratios. (SI ratios are the detrended series.) You can compare the SI ratios of two adjustments by plotting the SI ratios, the SI ratios with extreme values replaced, or the replaced SI ratios with the original value. To compare two adjustments, the names of both models must appear on the same line in the graphics metafile list file (.mls); see the Example 3 in Section 5 below. The keyword for these graphs is **rsi2**. Graphs are also available by period.



Available Elements for SI Ratio Graphs

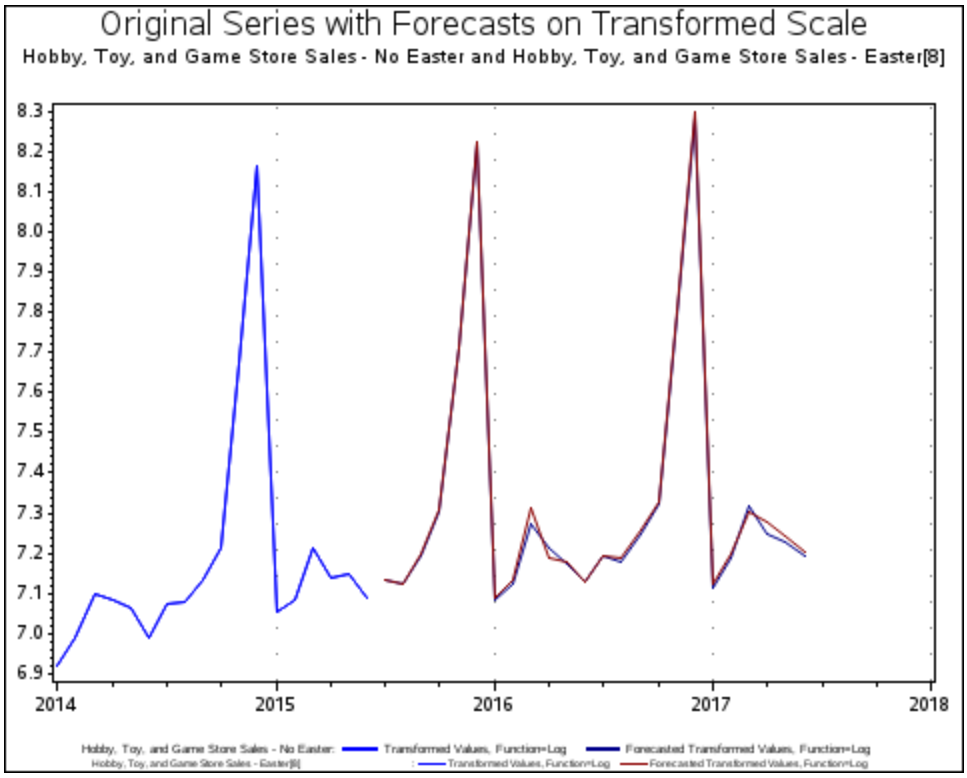
Element	Element Code
SI Ratios	si
Replaced SI Ratios	rsi
SI Ratios with Replaced Values	sirsi
SI Ratios by Period	psi
Replaced SI Ratios by Period	prsi
SI Ratios with Replaced Values by Period	psirsi

Return to contents.

4.19 Forecast Graphs for Comparing Two Adjustments

You can compare the forecasts of two models using the keyword **fcast2**.

To compare two models, the names of each must be on the same line of the graphics metafile list file (.mls); see Example 3 in Section 5 below.



Available Elements for Forecast Comparison Graphs

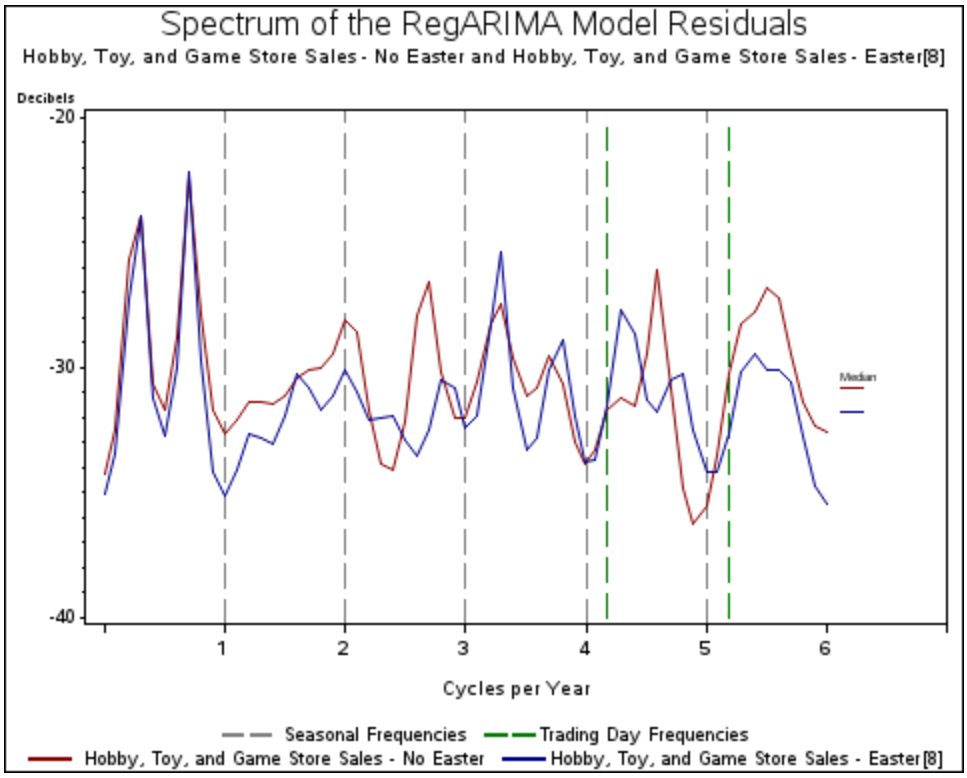
Element	Element Code
Original Series with Forecasts	fct
Transformed Original Series with Forecasts	ftr

Return to contents.

4.20 Spectrum Graphs for Comparing Two Adjustments

You can compare the spectrum plots of two models using the keyword **spect2**.

In order to compare two adjustments, the names of both models must be on the same line of the graphics metafile list file (.mls). See Example 3 in Section 5.



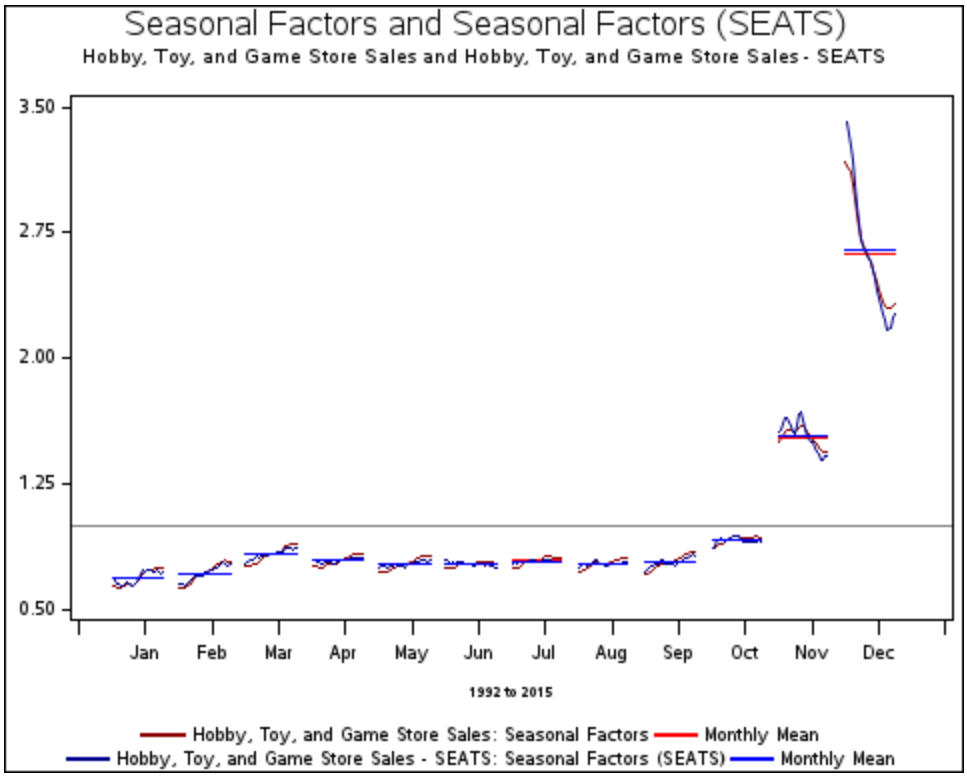
Available Elements for Spectrum Comparison Graphs

Element	Element Code
Spectrum of the Original Series	spcori
Spectrum of the Seasonally Adjusted Series	spcsa
Spectrum of the Modified Irregular	spcirr
Spectrum of the RegARIMA Model Residuals	spcrsd
Spectrum of the Indirect Modified Irregular	spciir
Spectrum of Indirect Seasonally Adjusted Series	spcisa

Return to contents.

4.21 Seasonal Factor by Month Graphs for Comparing Two Adjustments

Use the keyword **seas2** to plot the seasonal factors by month for two adjustments on one graph.



Since these graphs compare two adjustments, the names of both models must appear on the same line in the graphics metafile list file (.mls); see Example 3 in Section 5 for an example.

To overlay the seasonal factors, combined adjustment factors, indirect seasonal factors, or indirect combined adjustment factors of both models, the graph list file can just list the required element. However, if you'd like to overlay one type of seasonal factor from the first model with another type of seasonal factor for the second model, you must put the keyword, a colon, the first model's element type, a second colon, and then the second model's element type. For example,

seas2: sf: indsf

will graph the seasonal factors of model one with the indirect seasonal factors of model two. Note that if model one and model two are the same (that is, you list the same series twice on one line in the .mls file), this will create an overlay graph of the direct and indirect seasonal factors for an adjustment.

Available Elements for Seasonal Factor Comparison Graphs

Element	**Element Code**
Seasonal Factors	sf
Combined Adjustment Factors	caf

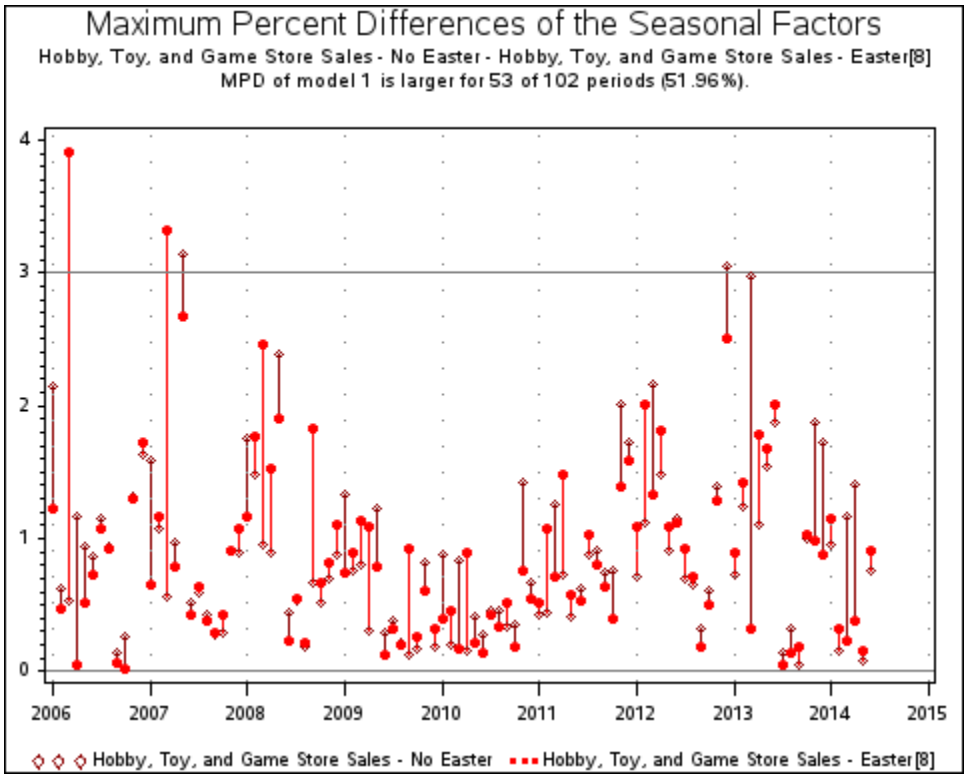
Available Elements for Seasonal Factor Comparison Graphs

Element	Element Code
Indirect Seasonal Factors	indsf
Indirect Combined Adjustment Factors	indcaf

Return to contents.

4.22 Sliding Spans Graphs for Comparing Two Adjustments

Use the keyword **sspans2** to create graphs comparing the sliding spans of two adjustments.



Since these graphs compare two adjustments, the names of both models must appear on the same line in the graphics metafile list file (.mls); see Example 3 in Section 5 for an example.

These graphs plot a dot for the maximum percent difference (or maximum absolute difference) of the seasonal factors or the period-to-period differences of each series, with a line connecting the two points. They include a reference line for the cutoff value (by default 3.0). Each point greater than the cutoff value is considered unstable. An adjustment with fewer unstable points may be preferred.

Available Elements for Sliding Spans Comparison Graphs

Element	Element Code
Seasonal Factors	sfss
Period-to-Period Changes	chss
Indirect Seasonal Factors	indsfss
Indirect Period-to-Period Changes	indchss

Return to contents.

5. Examples

These examples use data from one-family housing starts in the four U.S. geographic regions (Northeast, South, Midwest, and West), as well as the U.S. total one family housing starts. The X-13ARIMA-SEATS spec files are called ne1.spc, mw1.spc, so1.spc, and we1.spc, with us1.spc containing the `composite` spec to create the U.S. total. To run this series, a metafile is needed. The contents of this file, called starts.mta, are:

ne1
mw1
so1
we1
us1

Before creating any graphs, X-13ARIMA-SEATS must run this metafile in graphics mode. To do this in DOS, enter **x13a -m starts -g c:\x13a\graphics** at the command prompt. The -m option informs the program that this is a metafile, the -g option instructs X-13ARIMA-SEATS to produce the graphics output files needed, and the directory after the -g is the destination for the graphics files.

After the graphics output files have been produced, you are ready to run the X-13-Graph Batch program.

Example 1

Goal: To learn to set up the files needed to run the X-13-Graph Batch program.

Suppose you wish to compare the original series with the seasonally adjusted series for all four regions and for the total, and the original series with the outlier adjusted series in the case of those series with outliers.

The first step is to create the .mls and .gls files. These must have the same name; we'll use the name starts. As you want graphs for all five series, the starts.mls file is

mw1
ne1
so1
we1
us1

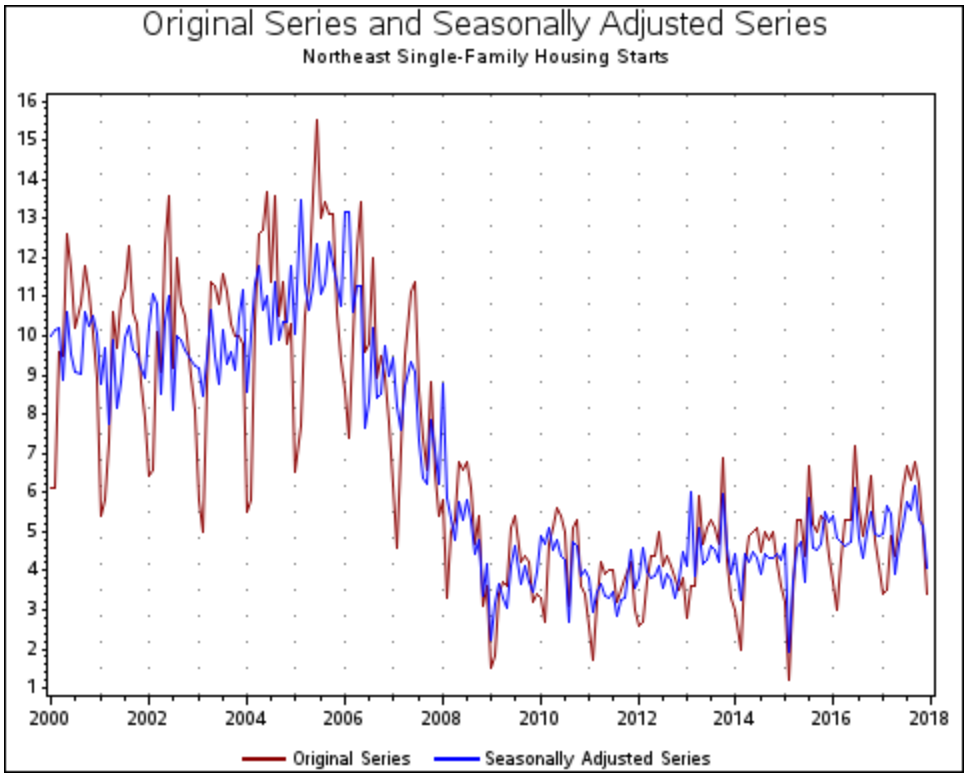
Note that this looks just like the metafile used to run X-13ARIMA-SEATS. The starts.gls file is

overlay: ori sa
overlay: ori indsa
overlay: ori oadori

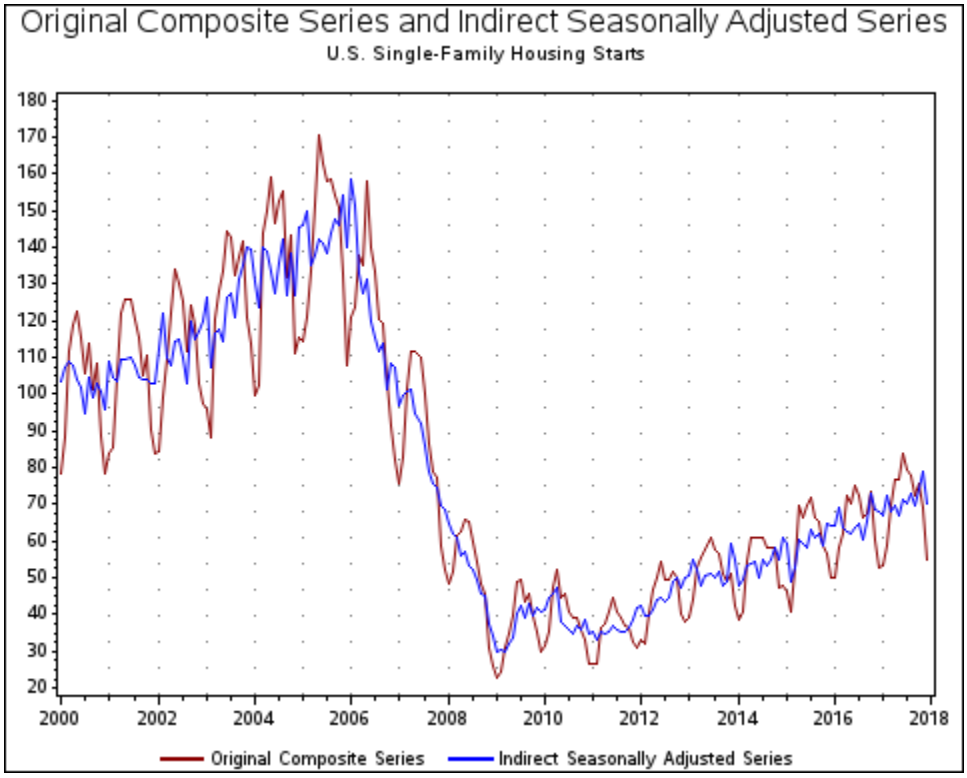
The first command produces the graph of the original series and the seasonally adjusted series superimposed; for the composite adjustment, it superimposes the composite series with the direct seasonal adjustment. The second overlay statement compares the original series with the seasonally adjusted series from the indirect adjustment. As this element exists only for the composite series, **us1**, X-13-Graph produces this graph only for that one series. The third command creates a graph of the original series and the outlier adjusted series. The series for the South and the West have no outliers, so overlay graphs from the third statement are not created for these series.

Next, in x13gbat.sas, set the value of the variable **inptfile** equal to **starts** and the value of **inptdir** equal to the directory specified after the -g option when X-13ARIMA-SEATS was run. Submit the program by pressing the submit button (the running man), or by selecting submit from the Run pull down menu.

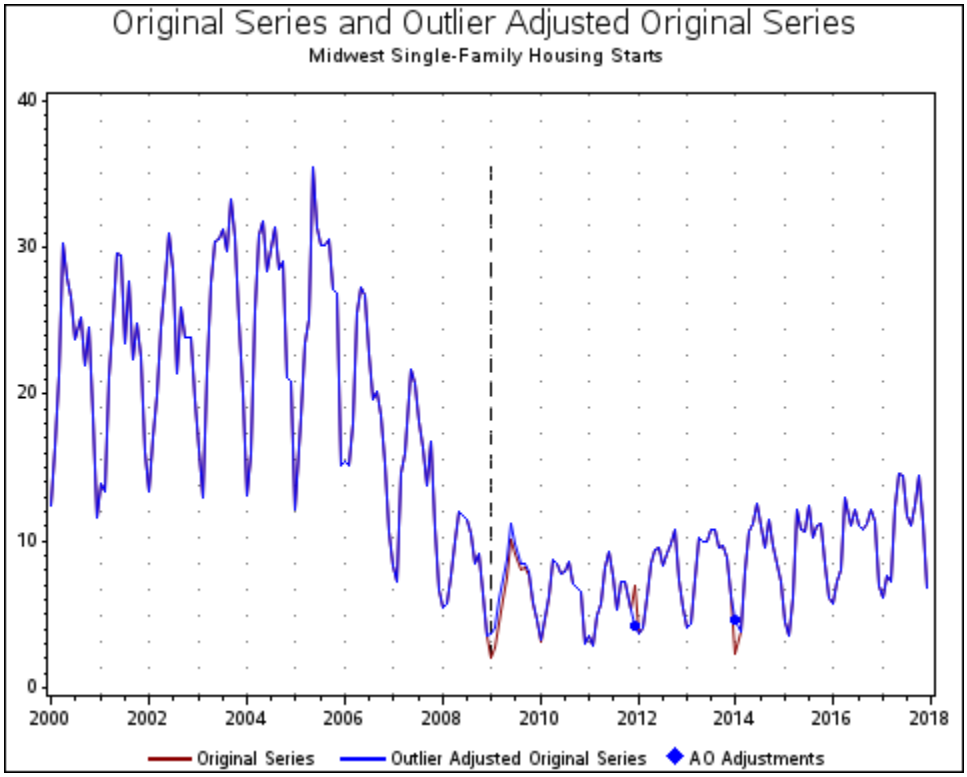
Once the program has run, there will be nine graphs. Examples of them follow:



This is the graph of the original and the seasonally adjusted series of the Northeast data. Similar graphs exist for the other three regions and for the U.S. total.



This graph is the original series for the U.S. totals, along with the seasonally adjusted series from the indirect adjustment. It is the only graph produced from the **overlay: ori indsa** statement in the .gls file.



This is one of three graphs of original series and the outlier adjusted original series; this one is from the Midwest. X-13ARIMA-SEATS found a temporary change in 2009 and additive outliers in 2011 and 2014. In the next example, this portion of the series will be expanded to better see these differences.

Example 2

Goal: To use the color, line width, and subspan global options in creating graphs. Also, to learn to modify the .gls and .mls files without deleting content.

In this example, you will modify a graph of the Midwest region plotted in the previous example in order to better see some of its details, and also create a component graph of this region's additive outliers.

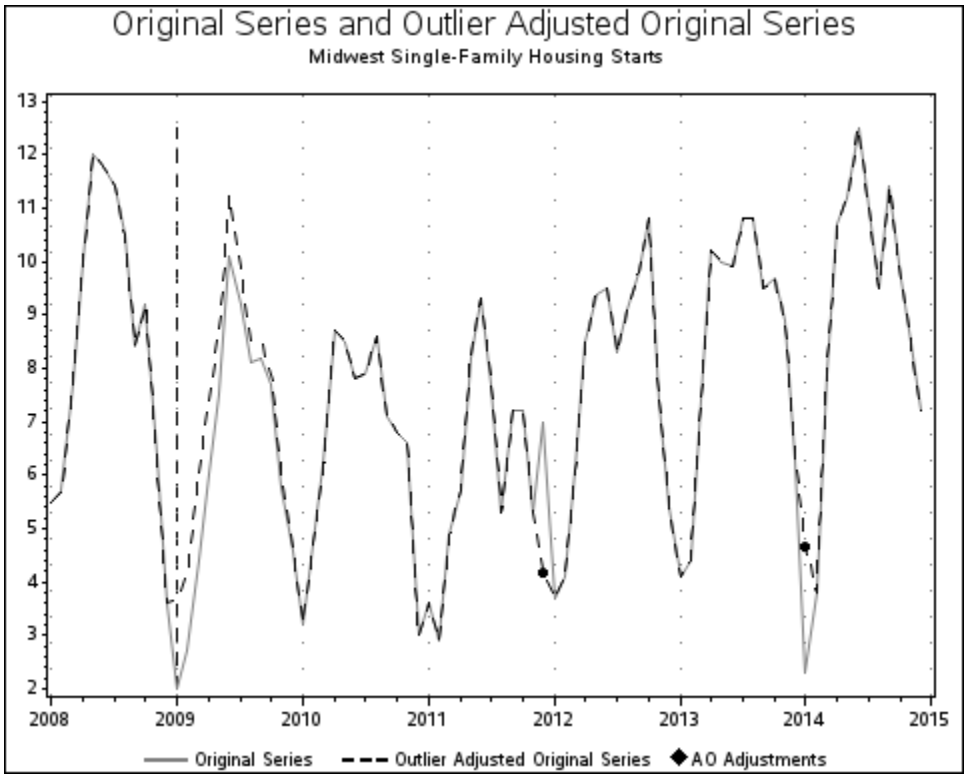
First, modify the starts.gls file, keeping only one of the overlay graphs adding a component graph of the additive outlier factors, so that the graph list file looks like:

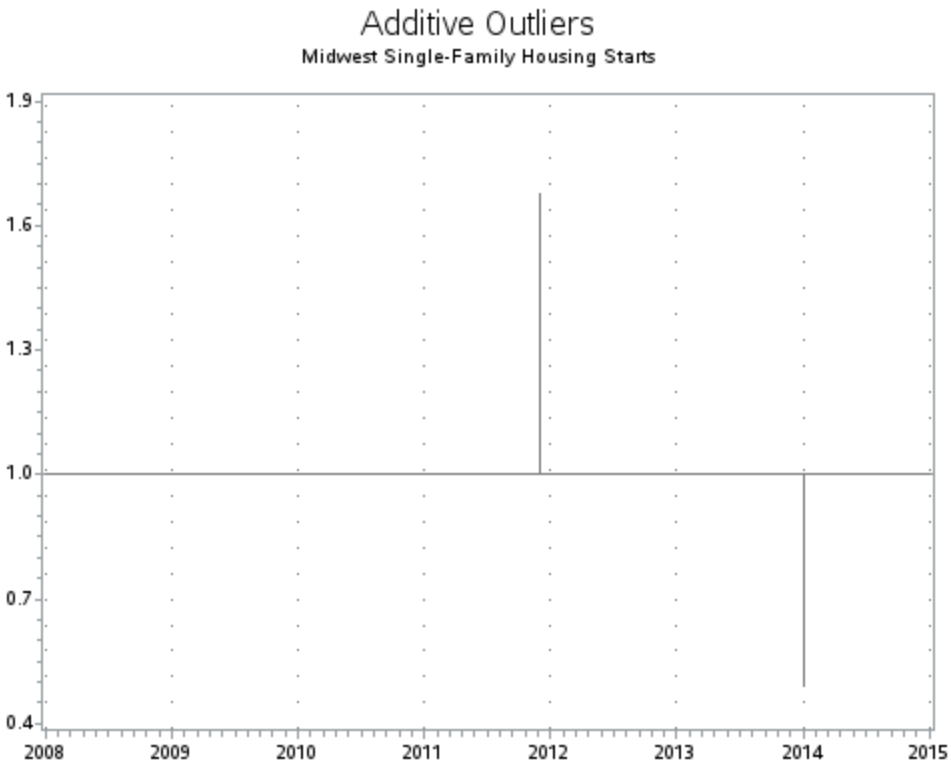
overlay: ori oadori
cmpnent: ao

Next, modify the graphics metafile list, since the only series to be graphed is the Midwest region. One way to do this is to delete the series that aren't being graphed, but as you may want to create more graphs from them later, you can comment them out instead by putting a **#** sign in front of them. Starts.mls will look like:

mw1
#ne1
#so1
#we1
#us1

In order to graph only part of a series, use the subspan option. In the x13gbat.sas program, change **substart** to 2008.Jan, and **subend** to 2014.Dec. Perhaps the graph will be printed in black and white, so it's more difficult to use color to differentiate between the two lines. We can instead change the line type of the outlier adjusted series to a dashed line by setting **ltype2** to 20. We can also change the colors of the graph Changing **color1** to gray and **color2** to black creates the following two graphs after the program is run:





Note that in the overlay graph, the original series, which was listed first in the .gls file, takes the color assigned to **color1**, and the outlier adjusted series, which was listed second, takes the **color2** value. The second graph has only one element, so it takes the color given in **color1**.

Example 3

Goal: To create graphs to compare two series.

X-13-Graph has many graphs available to compare two adjustments. In this example, we'll compare the seasonal adjustments of the Midwest and West regions.

To create graphs to compare two series, the names of the series must be on the same line in the graphics metafile list (.mls) file. To compare the housing starts from the Midwest to those from the West, the .mls file must read:

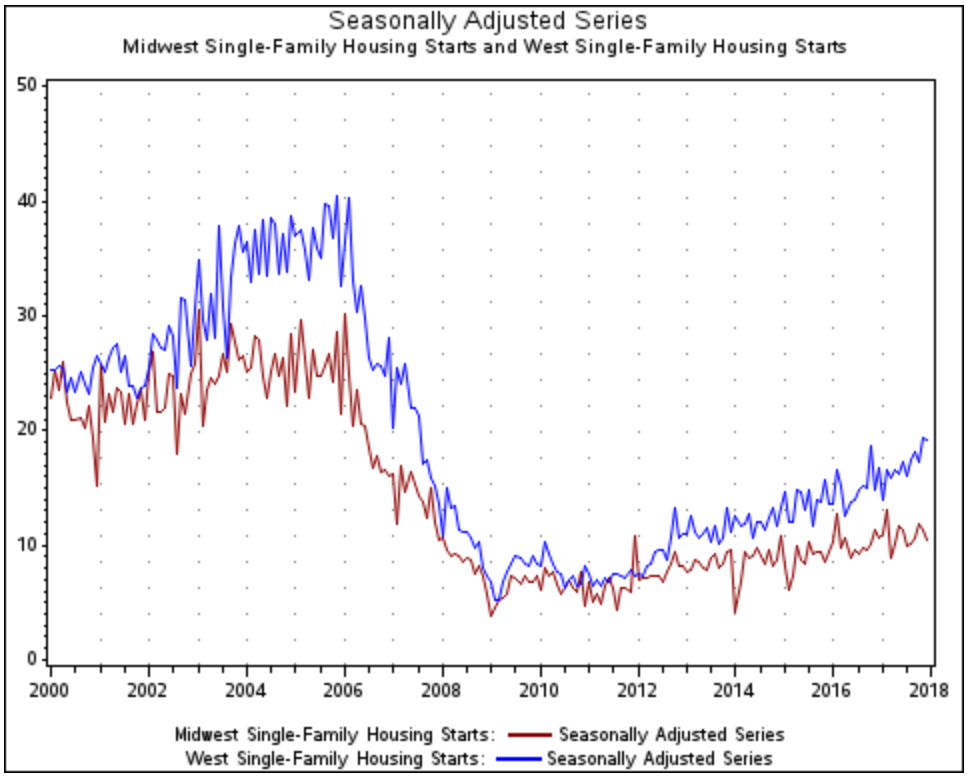
mw1 we1

The graph list file (.gls) must read

overlay2: sa: sa

in order to create graphs for the seasonally adjusted series for each model. (Actually, since the same elements are being plotted for the first and the second series in the overlay graph, the second colon and **sa** are not needed in the **overlay2** command, but including them does no harm.)

The following graph is produced when the program is run using the the same options as we used in Example 1:



Return to contents.

6. Reporting Problems

Please report all problems or provide any feedback to Demetra Lytras by email (demetra.p.lytras@census.gov) or by telephone at (301) 763-7426, or to Kathy McDonald-Johnson either by email (x13@census.gov) or by telephone at (301) 763-7602.

If the program graphs something incorrectly (including titles and legends), or doesn't produce a graph at all, please report the problem as soon as possible.

To help us diagnose the problem, it is helpful if we have

1. the X-13ARIMA-SEATS data file,
2. the X-13ARIMA-SEATS .spc file,

3. the .mls, .gmt and .gls files, and
4. a copy of the SAS Log from that X-13-Graph run.

The SAS Log will be in the file x13GbatLog.sas, located in the directory in which the program is installed, typically c:\x13graph\appl.

Return to contents.

7. Acknowledgements

Brian Monsell wrote the basic SAS code for reading in the X-13ARIMA-SEATS files and for the SI ratio graphs. David Findley and Brian Monsell provided valuable suggestions for the design of the graphs and the documentation. Kellie C. Wills wrote the SAS code for many of the graphs. Many thanks to everyone who gave us suggestions.

Return to contents.

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Return to contents.

Return to top.