

# Getting Started with X-13ARIMA-SEATS Input Files (Accessible Output)

Brian C. Monsell<sup>1</sup>, Demetra Lytras<sup>2</sup>, David F. Findley<sup>3</sup>

Last update: March 1, 2016

**Disclaimer:** This report is released to inform interested parties of ongoing research and to encourage discussion of work in progress. The views expressed on statistical, methodological, technical, or operational issues are those of the authors and not necessarily those of the U.S. Census Bureau.

This document is based on one originally developed in 2002 by Catherine Hood and Brian Monsell (and later revised by Hood and Roxanne Feldpausch with the development of Win X-12) to assist users of X-12-ARIMA. It explains what to do before running X-13ARIMA-SEATS. Released to the public in July of 2012, X-13ARIMA-SEATS is a merger of X-12-ARIMA and the seasonal adjustment module of the TRAMO-SEATS program (Gómez and Maravall, 1996), produced in collaboration with the Bank of Spain (Monsell, 2007 and 2009).

This document provides the basics of the data formats and of writing or editing a specification (command) file, or spec file. The *X-13ARIMA-SEATS Reference Manual* (U.S. Census Bureau, 2016a, 2016c) and the *X-13ARIMA-SEATS Quick Reference* (U.S. Census Bureau, 2016b, 2016d) provide more details. Here we show how to create spec files using Win X-13, the Windows Interface to X-13ARIMA-SEATS, and how to run the spec file to seasonally adjust the series. The official version of Win X-13 is available on the Census Bureau website at

<http://www.census.gov/srd/www/winx13/index.html>

and is currently supported by Demetra Lytras ([Demetra.P.Lytras@census.gov](mailto:Demetra.P.Lytras@census.gov)). Instructions on the use of this software in this document assume that the program has been successfully installed and set up on your computer; see Section 3 of the Win X-13 documentation (Lytras, 2016) for instructions.

This document is organized into the following topics:

1. X-13ARIMA-SEATS Data Formats
  - 1.1 Datevalue Format
  - 1.2 x12save Format
  - 1.3 Free Format
2. X-13ARIMA-SEATS Input Specification Files
  - 2.1. General Syntax
  - 2.2. Creating X-13ARIMA-SEATS Spec Files with Win X-13
  - 2.3. Details for the `Series Spec`
3. Running X-13ARIMA-SEATS in Windows
  - 3.1. Single Spec Mode
  - 3.2. Batch Mode
  - 3.3 Options When Running in Windows
4. Output Overview
5. Indirect and Direct Adjustments
6. Other X-13ARIMA-SEATS Specs

---

<sup>1</sup>Center for Statistical Research and Methodology, U. S. Census Bureau ([brian.c.monsell@census.gov](mailto:brian.c.monsell@census.gov))

<sup>2</sup>Economic Statistical Methods Division, U.S. Census Bureau ([demetra.p.lytras@census.gov](mailto:demetra.p.lytras@census.gov))

<sup>3</sup>Retired, U. S. Census Bureau

We assume the reader has a general understanding of time series, autoregressive integrated moving average (ARIMA) modeling, and the basic concepts of seasonal adjustment. For basic information on ARIMA time series modeling and basic seasonal adjustment, see Makridakis, Wheelwright, and Hyndman (1998). For information about the basic methods of X-12-ARIMA within X-13ARIMA-SEATS, see Findley, Monsell, Bell, Otto and Chen (1998). In particular, for detailed information on its X-11 method for seasonal adjustment, see Ladiray and Quenneville (2001). For a more advanced treatment of ARIMA time series modeling and time series analysis, see Box, Jenkins, and Reinsel (1994) or Brockwell and Davis (2002). Findley, Lytras and Maravall (2016) provides a tutorial on the model-based seasonal adjustment method of the SEATS and its implementation in X-13ARIMA-SEATS.

Note that there are currently two versions of X-13ARIMA-SEATS – one produces output to text files (as did previous versions of the X-12-ARIMA program), and the other produces output in accessible HTML files. This document covers the version that produces output to accessible HTML files – another “Getting Started” document is available on the website for the other version of the software.

## 1. X-13ARIMA-SEATS Data Formats

The first step in running X-13ARIMA-SEATS is to get the time series into a format the program can read. X-13ARIMA-SEATS cannot read files from spreadsheet programs like Excel. If your series is stored in a spreadsheet, then you need to output the series to a text file. A program called X-13-Data will help export from Excel spreadsheets to an appropriate format. See Appendix B for more information on X-13-Data (Czaplicki, 2015).

You have several options when deciding on a format for the series.

One option is to enter the series directly into the input file. We cover this approach in Section 2.4.

We recommend keeping each series in its own separate text file; Win X-13’s option to create a spec file works best when the data are stored in this way. X-13ARIMA-SEATS can read several predefined formats; we will review the `datevalue` format, the `x12save/x13save` format, and the `free` format. X-13ARIMA-SEATS supports the legacy X-11 data formats as well, which are described in Appendix C.

### 1.1 `datevalue` Format

For most series, using the `datevalue` format is our suggested approach. The date is stored along with the value, and this format is very easy to use and to read. This format can be particularly useful if you store the series in columns in a spreadsheet. A file in `datevalue` format must contain only one series.

A `datevalue` file has three columns: year, month/quarter, and series value, separated by a tab or a space. It has no header rows. Example 1 shows the `datevalue` format.

### 1.2 `x12save` or `x13save` Format

The `x12save` format is the format X-13ARIMA-SEATS uses to save files. The file has two columns: date and series value, separated with a tab and it has a two-line header at the top. Note that another name for this format is `x13save`; the program will accept either `x12save` or `x13save`.

Example 2 shows the `x12save` format.

Example 1 – Datevalue format, selected dates only:

2011 1	2.114
2011 2	2.209
2011 3	2.538
2011 4	2.935
2011 5	3.642
2011 6	4.827
2011 7	5.131
2011 8	5.642
2011 9	5.893
2011 10	5.406
2011 11	4.391
2011 12	2.816
2012 1	1.813

Example 2 – X12save format, selected dates only:

date	MWBP.a1
-----	-----
199401	+0.1224700000000000E+05
199402	+0.1386800000000000E+05
199403	+0.2714700000000000E+05
199404	+0.2957900000000000E+05
199405	+0.3280300000000000E+05
199406	+0.3159100000000000E+05

### 1.3 Free Format

Free format means that the series values have tabs, spaces, or line breaks separating the numbers. The file contains series values only. This format does not allow additional information (for example, dates). Only one series can be stored in the file.

## 2. X-13ARIMA-SEATS Input Specification Files

Once you have the data file(s), the next step is to write an input specification file, or spec file, or perhaps modify the spec file produced by Win X-13, the Windows interface program discussed in Section 2.2. A spec file is a text file used to specify program options. Because it is a text file, use a text-editing program, like Notepad (or the editor within Win X-13) to create or edit the file. The file must have the extension **.spc** and not **.txt**, for example, **test.spc**.

Each input spec file has functional units called specs. Each spec inside the spec file controls options for a specific function; for example, the `series` spec controls options for series input, and the `arima` spec controls options to specify the ARIMA model. There are 20 different specs, but the choice of some specs for a spec file excludes the use of others in the same file. For example, when the `arima` spec is specified in a spec files, the `automdl` and `pickmdl` specs cannot be specified. We will discuss almost all of the 20 specs to some extent in this document.

**RULE** – The name of the spec file must end with the ".spc" file extension.

## 2.1 General Syntax

Enter input in upper, lower, or mixed case. **Note:** If you have a "name" argument to give a name to a label in your data file, as legacy X-11 formats require, then the name must match the label exactly, including the case. (See Examples C.1 and C.2 of Appendix C for examples with labels.) Dates are in the form *yyyy.period*. For monthly series, the period can be the number of the month or the first three letters of the name of the month. For quarterly series, the period is the number of the quarter. So users can write January of 1990 as 1990 . 1 or 1990 . jan (also 1990 . 01 or 1990 . Jan or 1990 . JAN), or write the first quarter of 1990 as 1990 . 1.

Enclose character values, such as titles and file names, in quotes (single or double).

X-13ARIMA-SEATS treats everything on a line of a spec file after a "#" as a comment.

You can set a variety of arguments within each spec. If you have more than one value for an argument, you must enclose all values in parentheses. If an argument is not specified, X-13ARIMA-SEATS usually assumes a default value. X-13ARIMA-SEATS only performs the functions you specify (or that are implied by other specs). You can enter the arguments within an individual spec in any order.

The first spec in a spec file must be a *series*, *composite*, or *metadata* spec. If you have a *metadata* spec, then it must be first, and the next spec must be either a *series* or *composite* spec. After that, the specs can appear in any order.

Every spec begins with the name of the spec and a left curly bracket, "{". Following all the arguments of the spec, close the spec with a right curly bracket, "}".

### *General Input Syntax*

```
specname{
  argument1 = value
  argument2 = ( value1 value2 value3 )
  argument3 = "A string value"
  argument4 = 2000.apr
}
# This is a comment.
# It is not executed.
```

## 2.2 Creating an X-13ARIMA-SEATS Spec File with Win X-13

In this section, we demonstrate how to create a basic spec file with default options with Win X-13 for the purpose of seasonal adjustment. We discuss how Win X-13 chooses the options you see in the spec file and provide some guidance in editing them further.

From the main Win X-13 screen, select 'Spec file' from the Create menu. The window shown in Figure 1 will appear. In the 'Data file or data metafile' box, enter the full path and file name, including the extension, of your data file. Win X-13 will save the new spec file to the data file's directory. Unless you change the name in the 'Name of the new spec file' box, the spec file will have the same file name as the data file but with a .spc extension.

Once you select an existing data file, the controls in the 'Spec file options' box will be enabled. From the 'Data format' box, select the format of your data file. Section 1 of this document gives a description of common data

formats. If you use free format, you must also provide the date of the first observation (in *yyyy.period* format as described in Section 2.1) in the ‘Start date’ box.

If you use one of the X-11 formats described in Appendix C, you must give the series name in the ‘Name’ box; recall that the name must match the label in the data file exactly, including case. From the ‘Period’ box, choose 12 for monthly data, 4 for quarterly data, and 1 for annual data. (Note that you cannot seasonally adjust annual data, but X-13ARIMA-SEATS can model and forecast it.)

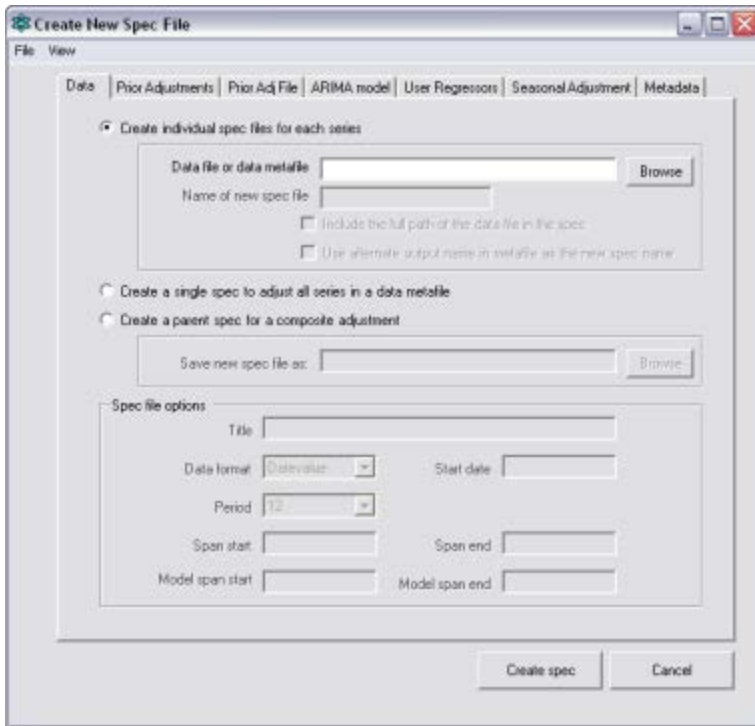


Figure 1 - Create New Spec File Window

If the series is an inventory/stock series, check the ‘This is a stock series’ box on the Prior Adjustments tab.

The options described thus far are the only ones *necessary* for creating a spec file. This document also covers optional settings.

When you set only these necessary options and press ‘Create Spec,’ Win X-13 will produce the spec file in Example 3. You will not see this spec file unless the input specification has a problem, such as an incorrect data format. It provides instructions for X-13ARIMA-SEATS to run with default settings. Win X-13 runs this initial spec file and produces from the run a second spec file containing the options selected from the first run for the user to read and accept or change.

### Example 3 – Default Win X-13 initial spec file

#C:\data\retail\AutomotivePartsStores.spc was created on 8/31/2012 10:00:00 AM

```
series{
  file = "AutomotivePartsStores.dat"
  period = 12
  format = free
  start = 2000.1
}
transform{
  function = auto
}
regression{
  variables = ()
  aictest = ( td easter )
  savelog = aictest
}
outlier{
  types = ( AO LS )
}
automdl{
  savelog = amd
}
forecast{
  maxlead = 12
  print = none
}
x11{
  seasonalma = MSR
  savelog = all
}
```

This section discusses the specs shown above; Section 4 contains a discussion on the `savelog` and `print` arguments.

**series** – Specifies the location and format of the series. This is a very important spec and has several options that depend on the form of the data. We cover this spec in detail in Section 2.3.

**RULE** – The `series` spec comes first, unless there is a metadata spec. If there is a metadata spec, it must come first, in which case the `series` spec must be second. All other specs can be in any order.

**transform** – Specifies a data transformation. The most common transformation for seasonal adjustment is the log transformation. In the Win X-13 example spec, the argument `function = auto` instructs X-13ARIMA-SEATS to do a likelihood comparison to decide whether to log transform the data. With the automatic transformation comparison, X-13ARIMA-SEATS also sets the seasonal adjustment mode. If the program prefers the log transformation, then X-13ARIMA-SEATS will compute a multiplicative seasonal decomposition. If the program prefers no transformation, then X-13ARIMA-SEATS will compute an additive decomposition. A spec file created with Win X-13 will always have a transform spec. If you create a spec file without the transform spec and specify a regARIMA model (with a regression spec and either an automdl spec or an arima spec - details to follow), no transformation will be used and you must set `mode=add` in the x11 spec.

**regression** – Specifies the regression components of a regARIMA model. With the argument `aictest = ( td Easter )`, X-13ARIMA-SEATS will test using Akaike's Information Criterion corrected for sample size (AICC) for the presence of trading day (td) and Easter effects. For the td test, X-13ARIMA-SEATS will model

the series with no `td` effects, with a six-coefficient `td` effect, and with a one-coefficient `td` effect, and will include in the model the one that has the lowest AICC. For the Easter test, X-13ARIMA-SEATS will model the series with no Easter and with Easter effects with a one-day, an eight-day, and a fifteen-day window, and include the effect that yields the lowest AICC. If you know the series has no Easter effects, change the argument to `aictest = td`; with Win X-13, you do this by unchecking the ‘Easter’ box in the ‘AIC test’ box of the ‘Prior Adjustments’ tab. If you have an inventory or stock series, change the argument to `aictest = (tdstocklcoef Easterstock)` or `aictest = tdstocklcoef`; Win X-13 will automatically make this change if you check the ‘This is a stock series’ box on the ‘Prior Adjustments’ tab.

**outlier** – Identifies additive outliers (point outliers), level shifts, and temporary changes. No arguments are required; however, by default, X-13ARIMA-SEATS identifies only point outliers and level shifts. To identify all three types of outliers for monthly or quarterly series, also check ‘TC’ in the ‘Types of Outlier to Test for’ box in the ‘Prior Adjustments’ tab. This selection will change the argument to `types = ( AO LS TC )`. If you are editing the spec file by hand, note that this is equivalent to `types = all`. Leaving out this spec means there will be no automatic outlier identification.

**automdl** – Selects an ARIMA model and tests for significance of a constant regressor. No arguments are required. For X-13ARIMA-SEATS and Version 0.3 of X-12-ARIMA, the automatic model identification procedure is based on that of TRAMO, whose main details are described in Gómez and Maravall (2001). If you would like to use the procedure of earlier versions of X-12-ARIMA, picking a model from a stored list of models, use the `pickmdl` spec instead of the `automdl` spec. Users must specify the `pickmdl` spec manually; Win X-13 does not support the `pickmdl` spec. Omitting `automdl` could cause problems if you are trying to fit a regression model or search for outliers unless you specify an ARIMA model explicitly with the `arima` spec (details on `arima` later in this section).

**forecast** – Generates forecasts from the estimated `regARIMA` model. Without a `forecast` spec, in the presence of a `regARIMA` model and an `x11` spec, X-13ARIMA-SEATS will forecast one year ahead. (If the automatic model identification procedures of `automdl` or `pickmdl` cannot find an acceptable model, then the program does not generate any forecasts.) Without a `forecast` spec, in the presence of a `regARIMA` model and a `seats` spec, X-13ARIMA-SEATS will forecast three years ahead. In the example spec above, `maxlead = 12` asks for one year (12 observations) of forecasts. To change this number, select the ‘Number of years to forecast’ from the ‘ARIMA model’ tab, or edit the argument manually. The argument `maxlead = 24` will cause X-13ARIMA-SEATS to forecast two years ahead for a monthly series while `maxlead = 8` or `maxlead = 2` will do the same for a quarterly series or an annual series, respectively. To get no forecasts, set `maxlead = 0`. In certain cases, X-13ARIMA-SEATS can backcast the series; use the argument `maxback = xxx` to select the number of observations to backcast. In Win X-13, select ‘Customize Spec Arguments’ from the File menu of the ‘Create New Spec File’ window; see the Win X-13 manual for details.

**x11** – Generates the seasonal adjustment using X-11 seasonal adjustment methods and filters. No arguments are required unless you omit the `transform` spec and use a `regARIMA` model, and in that case, you need to add the argument `mode = add` for an additive decomposition. The argument `seasonalma = MSR` given in the example spec file is the spec’s default option; it requests X-13ARIMA-SEATS to choose the length of the seasonal filter used to seasonally adjust the series. Without an `x11` or a `seats` spec, you will not get a seasonally adjusted series; the `seats` spec is described at the end of this section.

After Win X-13 has created this initial spec file, it runs the spec file and reads the results from the unified diagnostics file (also called the *.udg file*; this file is described in the X-13ARIMA-SEATS manual). It then creates a spec file with the options hard-coded to the selected settings. Example 4 shows an example of such a spec file. In what follows, we use the term “hard-coded” to mean that the desired options are explicitly written in the spec file, even those that are the default options of the software.

#### Example 4 – Win X-13 created spec file with hard-coded options

#c:\data\retail\AutomotivePartsStores.spc was created on 8/31/2012 10:00:02 AM  
#Created using X-13ARIMA-SEATS version 1.0 build 149

```
series{
  file = "AutomotivePartsStores.dat"
  period = 12
  format = Datevalue
}
spectrum{
  savelog = peaks
}
transform{
  function = log
}
regression{
  variables = ( td easter[15] AO2000.Sep LS2001.Jan )
  #aicstest = ( td easter )
  #savelog = aicstest
}
outlier{
  types = ( AO LS )
}
arima{
  model = (0 1 1)(0 1 1)
}
forecast{
  maxlead = 12
  print = none
}
estimate{
  print = (roots regcmatrix acm)
  savelog = (aicc aic bic hq afc)
}
check{
  print = all
  savelog = (lbq nrm)
}
x11{
  seasonalma = s3x5
  savelog = all
}
slidingspans{
  savelog = percent
  additivesa = percent
}
history{
  estimates = (fcst aic sadj sadjchng trend trendchng)
  savelog = (asa ach atr atc)
}
```

Note that, with the exception of hard-coding the seasonal adjustment filter choice, running the spec with the automatic options and running it with these choices written into the spec file will not affect the seasonal adjustment. The main reason to fix the selections to their desired value is to keep the program from changing its decision later when the spec file is used in production. If you want to use any settings other than the default



selections, you will also have to hard-code the options, so understanding how to change these settings is important.

Note that for a production setting, we recommend hard-coding selections as Example 4 shows and as described below:

**transform** – Specifies a data transformation. Since the automatic transformation procedure selected a log transformation, the initial spec’s `transform{function=auto}` was changed to `transform(function=log}`. If the automatic transformation procedure had selected no transformation, then this would have become `transform(function=none}`. Deleting the `transform` spec would also result in no transformation, but if you delete the `transform` spec entirely you need to add `mode=add` to the `x11` spec if you want an additive adjustment. When the automatic transformation test selects no transformation or if `function=none` is in the `transform` spec, X-13ARIMA-SEATS automatically sets the seasonal adjustment mode to additive.

If you know when creating your spec file that the series needs a log (or no) transformation, you can select ‘Log’ (or ‘None’) from the ‘Transformation’ box in the ‘Prior Adjustments’ tab of the Create Spec window.

**regression** – Specifies the regression components of a regARIMA model. If the test for trading day or Easter accepts these variables in the model, if the program identifies any outliers, or if the constant regressor was significant, these variables will appear in the variables argument. For example, for this series a trading day effect, a fifteen-day Easter effect, one point outlier (or AO, additive outlier) at September 2000 and one level shift at January 2001 were selected, and the following appeared in the spec file:

```
regression{ variables=( td easter[15] AO2000.Sep LS2001.Jan ) }
```

If the AICC test had instead selected one-coefficient `td`, `td1coef` would be in the argument; for a stock series, `tdstock[31]` and `tdstock1coef[31]` represent the six-coefficient and one-coefficient effects when the inventory occurs on the last day of the month. If the AICC test had instead selected a one-day or eight-day Easter effect; `Easter[1]` or `Easter[8]` would appear in the list of variables. A temporary change will have the form `TCyyy.period`. Note that it is usually best not to specify outlier regressors for dates whose series values may change with later data revisions.

If you know when creating your spec file that the series has trading day effects in it and you would like to model them, include `variables = td` by unchecking ‘TD’ from the ‘AIC test’ box and checking ‘Trading Day’ in the ‘Regression Variables’ box; other forms of trading day can be added by typing them into the ‘Other variables’ box. Add Easter effects in this same way.

**arima** – Specifies the ARIMA part of a regARIMA model. Enter results from the automatic modeling procedure into X-13ARIMA-SEATS with the `arima` spec. In this example, the automatic modeling procedure requested by the `automdl{}` spec selected the model  $(0 \ 1 \ 1)(0 \ 1 \ 1)$ .

In the new spec, Win X-13 specified this with the command

```
arima{model=(0 1 1)(0 1 1)}
```

Note that the new spec does not include the `automdl{}` spec; only one of `automdl`, `arima`, and `pickmdl` can be in a spec file. Please see Appendix A for the options to run X-13ARIMA-SEATS for some other situations, for example, to run X-13ARIMA-SEATS as if it were X-11.

**spectrum** – With monthly (`period=12`) series, specifies a search to detect spectrum peaks associated with seasonal effects in the differenced, transformed original series and in the regARIMA model residuals, the irregular component, and the differenced seasonally adjusted series. It also detects peaks associated with td effects in these last three series. It has options to specify output, change from autoregressive spectrum and periodogram spectrum estimation, change the start of the span for the spectrum calculation, and change the method or criteria used to identify a "visually significant" peak.

**check** – Generates diagnostics for the fit of the estimated regARIMA model and the significance or insignificance of some estimated regression effects. To show all the diagnostics available with the `check spec`, we added the argument `print=all`. This spec has no effect on the model or model estimates, but without it, the program computes fewer modeling diagnostics. Win X-13 always includes this spec when creating a spec file.

**estimate** – Estimates the regression and ARIMA models. The presence of one of the modeling specs implies estimation of the model, so this spec is not required; however, it controls printing of the model and related diagnostics, so Win X-13 always includes this spec when creating a spec file.

**x11** – Generates the seasonal adjustment using X-11 seasonal adjustment methods and filters. The seasonal filter specified by the argument `seasonalma` is hard-coded in the final Win X-13 spec file. In this example, `seasonalma = s3x5` results in seasonal factors from weighted averages from seven years of surrounding values for each time point (with modifications at the series' ends). Other filters commonly used are `s3x3`, often selected when the seasonal pattern is changing swiftly, and `s3x9`, often selected when the seasonal pattern is more stable or when longer averages are needed for noise suppression to support adequate estimation

**slidingspans** – Generates sliding spans analysis, a seasonal adjustment stability diagnostic. No arguments are required. This spec is optional.

**history** – Generates "historical" diagnostic analysis of seasonal adjustment estimates and/or regARIMA model forecast performance and AIC. With `estimates=(fcst aic sadj sadjchng trend trendchng)`, it generates

- `fcst`: estimates of the squared one-step ahead and one-year ahead forecast errors
- `aic`: Akaike's information criterion
- `sadj`: revisions of the seasonally adjusted series
- `sadjchng`: revisions of the month-to-month, or quarter-to-quarter, percent changes of the seasonally adjusted series
- `trend`: revisions of the trend-cycle
- `trendchng`: revisions of the month-to-month, or quarter-to-quarter, percent changes of the trend-cycle.

(For additive adjustments, instead of percent changes, the program calculates differences.) If no arguments are specified, the spec will generate estimates only for the seasonally adjusted series. This spec is optional.

The following spec is not in the example spec file but is an alternative to the `x11` spec:

**seats** – Generates the seasonal adjustment using the SEATS implementation of the Hillmer-Tiao ARIMA model-based seasonal adjustment methods and filters. Though there are arguments to allow users to duplicate the functionality of the SEATS program, users need no arguments to generate a seasonal adjustment. To select a SEATS adjustment rather than an X-11 adjustment when creating a spec file with Win X-13, select 'SEATS' from the 'Type of adjustment' box in the 'Seasonal Adjustment' tab. Without an `x11` spec or a `seats` spec, you will not get a seasonally adjusted series.

## 2.3 Details for the series Spec

The main function of the `series spec` is to input the time series correctly to X-13ARIMA-SEATS. It must have either a `file` argument or a `data` argument but not both. The `file` argument gives the name of an external data file. The `data` argument lists the series values inside the spec file.

### 2.3.1 Data Argument

To include your series values in the spec file, use the `data` argument and enter the series values within parentheses separated by spaces and line returns. The `data` argument does not require a specific format; Example 5 shows two years of a quarterly series on each line. With a `data` argument, you need a `start` argument to tell X-13ARIMA-SEATS when the series starts. Win X-13 does not support this option; to use it, create or edit the spec file manually.

Example 5 - Series spec with a data argument

```
series {
  data=( 5.738 11.596 13.738 10.053 6.120 10.394 14.261 10.188
        6.033 10.025 13.637 9.600 5.872 10.919 13.053 10.429
        6.480 11.644 15.752 11.302 6.723 12.565 15.734 10.911
        6.948 12.251 16.350 12.129 6.859 13.140 19.114 13.725
        7.593 13.954 20.139 13.501 6.974 13.523 17.722 13.215
        6.861 11.404 16.666 12.613 6.022 12.109 16.940 11.646 )
  start = 2001.1
  period = 4
  title = "Quarterly State and Local Highways Pavement"
}
```

**RULE** - With the `data` argument, a start date is required. X-13ARIMA-SEATS will compute the rest of the dates for the series based on the start date.

### 2.3.2 File Argument

Updating the `data` argument of the `series spec` every month or quarter can be tedious. Another way to provide the series to X-13ARIMA-SEATS is the `file` argument. Section 1 discusses several predefined formats.

To seasonally adjust the series beginning at a time point later than the `start` date of the file, see the `span` argument in Section 2.3.3.

#### 2.3.2.1 Datevalue and x12save Formats

Examples 1 and 2 showed the `datevalue` format and `x12save` format, respectively. Recall that both `datevalue` and `x12save` formats include dates so no `start` argument is used. These formats do not allow labels inside the data file, so a `name` argument is not required either, but users can specify a name and if given, will appear in some output files. Note that currently, the `x12save` format is now named `x13save`; however, the program will still accept the name `x12save`. Example 6 shows how to input the file from Example 2.

Example 6 - Series spec with a file argument and `x12save` format

```
series{ file = "MWBP.a1" format = "x12save" }
```

### 2.3.2.2 Free Format

The default format for the file argument is `free` format. Recall that only the series values are in the file; additional information is not allowed.

Example 7 – Series spec with a `file` argument and `free` format

```
series{ file='example7.dat' start = 1982.jan }
```

**RULE** – With a free-formatted file, a start date is required. X-13ARIMA-SEATS will compute the rest of the dates for the series based on the start date.

### 2.3.3 Other Useful Options for the Series Spec

**name** - Sets a short name for the series. The name argument is required with the X-11 formats described in Appendix C. It also appears in other places, so it may be useful even if you use something other than an X-11 format.

**period** - Specifies the frequency of the series. The default is 12 (a monthly series), so this argument is required only with a different number of sampling periods per year, or for noncalendar data.

**RULE** – For quarterly series, use `period=4` in the series spec. For annual data, use `period=1`.

**title** – Specifies the series title. Titles are useful and highly recommended. The log file and output file use titles, and X-13-Graph uses the specified title as a secondary title for graphs. With Win X-13, users can enter a title in the ‘Data’ tab when creating a spec file.

**decimals** – Specifies the number of decimals shown in the printed output file, except for tables that contain percentages or ratios. The default is 0 - no decimals. (Tables with percentages/ratios will display either 1 or 2 decimals, depending on the table.) This argument does not affect the format of files produced by the `save` argument. See below for more information on saving files. In Win X-13, this option is available in the ‘Customize spec arguments’ from the File menu.

**span** – Sets the time interval for seasonal adjustment. If `modelspan` is not set, it will also set the time interval for modeling.

**modelspan** – Sets the time interval for modeling. This must be the same or a subspan of the span.

The forms of the arguments are:

```
span = (startdate, enddate)
modelspan = (startdate, enddate).
```

By leaving the end date blank, you can set only the start date: (`yyyy.period,` ).

By leaving the start date blank, you can set only the end date: (`, yyyy.period`).

Or you can set both: (`yyyy.period, yyyy.period`).

The default span for seasonal adjustment is the entire series. The default span for modeling is the interval in the `span` argument if given or the entire series if neither span is specified.

The span and model span can be set in the ‘Data’ tab when creating a spec file with Win X-13.

**type** – Indicates the type of series being input. If `type = flow`, the series is assumed to be a flow series; if `type = stock`, the series is assumed to be a stock series. Setting the type can help users avoid conflicts in regressor types. The default is not to assign a type to the series.

### 3. Running X-13ARIMA-SEATS in Windows

Once you have a spec file, you can run the program.

X-13ARIMA-SEATS is a command-line program activated by entering appropriate run information in a Window’s command window (which can be brought up by holding the Window logo key depressed while depressing the **R** key). However, it is usually much more convenient to use Win X-13, which allows you bypass the run prompt.

Open Win X-13. From the main screen (Figure 2 below), use the box on the left to change to the directory where you have saved your spec file.

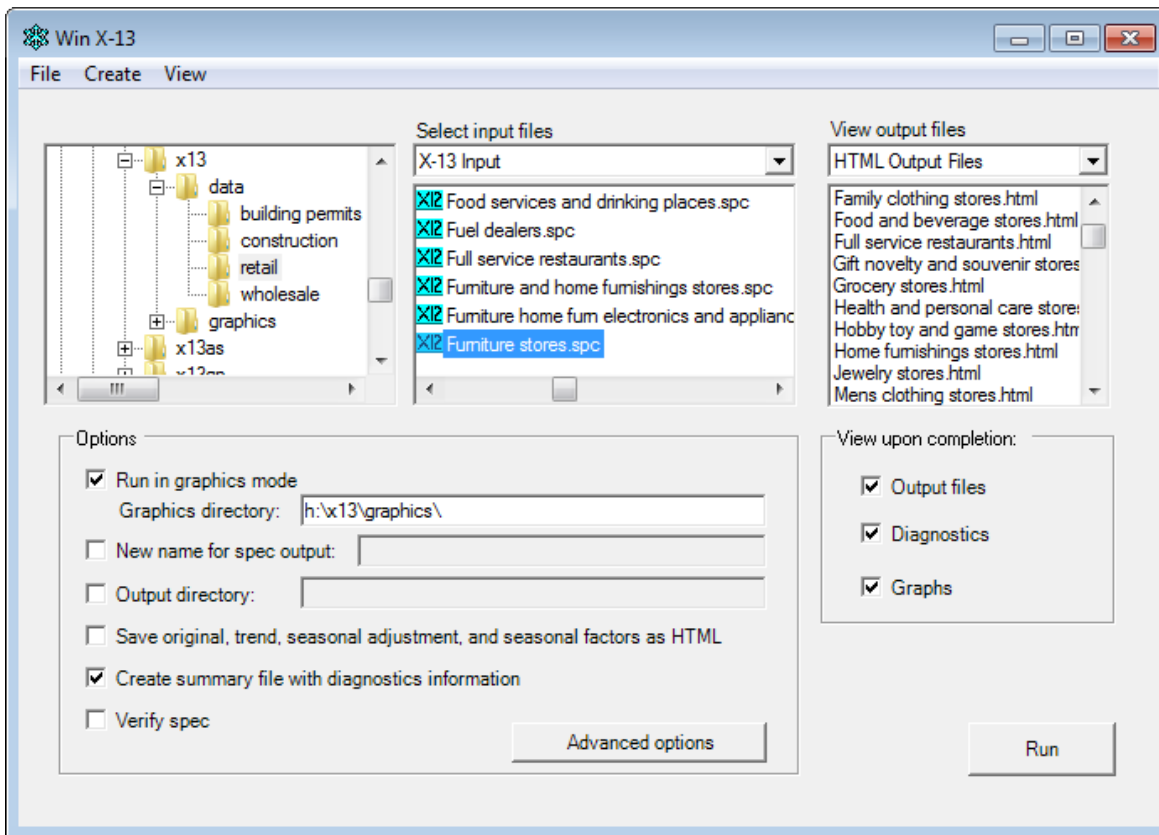


Figure 2 - Win X-13 Main Screen

#### 3.1 Single Spec Mode

To run the spec file, double click on the name of the file (from the middle box), or select the spec file and click on the Run button. The box on the right lists the output files; the drop down menu directly above this box can filter the output file types. The output file has an **.html** extension with the name of the file matching the name of the

spec file (without the **.spc** extension). The log file, a short file with requested diagnostics, has the same name as the output file with “**\_log.html**” appended to the end. You can double click on the files to open them in a web browser, but if the ‘View upon completion: Output files’ box is checked then the output files will open when you run a spec file.

To edit the spec file, either (a) right-click on the spec file name in the center box and select ‘View Input File’, (b) or select the file and choose ‘View file name.spc’ from the View menu, or (c) select the file and press Ctrl+O. Starting with the 2015 release of Win X-13, you can run the spec file directly from inside the spec file window by pressing the Run button. Pressing the arrow button directly next to the Run button allows users to change certain runtime options from the spec file window. These include the graphics directory, the output directory, and the output name. All other options will always be run as they were when the spec file window was opened; no changes to runtime options made on the main screen or in the Settings window are passed to the spec file window.

If you want to run X-13ARIMA-SEATS and not overwrite previous output, you can direct the output to another file by checking the ‘New name for spec output’ box under Options. Then enter the name of the alternate output file in the box. To save the output files to a separate directory, check the ‘Output directory’ box, and enter the new directory in the text box.

### 3.2 Batch Mode

Besides running one series at a time, X-13ARIMA-SEATS also can run in "multiseries" or batch mode. Running in batch mode reduces keystrokes and provides an easier way to look at the diagnostics because the program stores diagnostics from all the runs to the same log file. Note that batch mode also is useful for running competing sets of options for one series; each run requires a separate spec file.

To run more than one series with one call to X-13ARIMA-SEATS, create a metafile. The metafile is a text file with the extension **.mta** listing the spec files you want to run. It can list up to 5,000 spec files. To create a metafile using Win X-13, select ‘Metafile’ from the Create menu.

To run in batch mode, double click the metafile or select it and click ‘Run.’ X-13ARIMA-SEATS will run all the spec files listed inside the metafile.

**RULE** – A metafile must end with the **.mta** extension.

Example 8 – Example of a Metafile, **bps.mta**

```
nebp  
mwbp  
s_bp  
w_bp
```

If you ask X-13ARIMA-SEATS to run the metafile **bps.mta** given in Example 8, then it will run the spec files **nebp.spc**, **mwbp.spc**, **s\_bp.spc**, and **w\_bp.spc**, and will name the output files **nebp.html**, **mwbp.html**, **s\_bp.html**, and **w\_bp.html**. The name of the log file will be **bps\_log.html**. The program also produces a file with links to all of these files, as well as the error files, named **bps\_mta.html**.

To specify an alternate name for the output and save files, list two file names on each line of the metafile. The first file name must be the name of the spec file, and the second file name is the name of the output and save files. If the line lists only one file name, then the program takes the output file names from the names of the spec files.

X-13ARIMA-SEATS will not rename the log file when running a metafile. If you save the metafile to a new name before rerunning it, X-13ARIMA-SEATS will not overwrite the previous log file.

### 3.3 Options for Running in Windows

When running a spec file, you can specify run-time options that affect the X-13ARIMA-SEATS output. The two most common options are running in graphics mode and running in summary mode.

If you check the box ‘Run in graphics mode’ and designate a ‘Graphics directory’ on the main Win X-13 screen, then when a spec file is run X-13ARIMA-SEATS will write several text files to the graphics directory containing various tables from the output. We call these graphics files, and they are used to easily create graphs. The Census Bureau offers a program, X-13-Graph, which can produce many types of graphs from these graphics files. There are two versions of X-13-Graph: the batch version requires SAS (Lytras, 2015a and 2015b), though you do not need to know how to use SAS, and the other version runs in Java (Lytras, 2013). **Appendix B** gives links to these programs.

Win X-13 can produce a limited number of graphs from the output. First, select either ‘Win X-13 JAVA graphs’ or ‘X-13-Graph SAS graphs’ from the ‘Type of graph to create when run in graphics mode’ drop down box on the Settings screen. Then when a spec file is run with ‘Run in graphics mode’ and ‘View upon completion: Graphs’ checked, Win X-13 will create graphs of the original series, seasonally adjusted series, seasonal factors, and various diagnostic graphs and display them on the screen.

Run X-13ARIMA-SEATS in summary mode by clicking ‘Create summary file with diagnostics information.’ Summary mode means that X-13ARIMA-SEATS will create an additional output file called the unified diagnostics file, or udg file, when it runs the spec file. X-13ARIMA-SEATS saves this file to the output directory if you are not running in graphics mode; if you are running in graphics mode, it will be saved to the graphics directory. The file contains a condensed version of the diagnostics and estimates contained in the output file. Though it can be difficult to read since it contains many abbreviations, users can extract a customized set of diagnostics. Running either in summary mode or graphics mode with the ‘View upon completion: Diagnostics’ box is checked, will produce a Diagnostics window with information about the model, the adjustment, and the diagnostics (Figure 3). From this screen, go to **Help -> Diagnostics List** for a description of the columns.

Other run-time options found on the main screen of Win X-13 include the ability to change the output name or output directory, which was described above, and ‘Verify spec,’ which causes X-13ARIMA-SEATS to check the syntax of your spec file but not actually run it. Further options can be found by clicking the ‘Advanced options’ box; see the Win X-13 documentation for more information.

Series Name	View Spec	Filename	Period	Transform	Mode	Span	Seasonal Peaks	TD Peaks
i_42	View Spec	i_42	12	Log(y)	multiplicative	1992.01 to 2009.11	none	none
i_423	View Spec	i_423	12	Log(y)	multiplicative	1992.01 to 2010.06	rsd	none
i_4231	View Spec	i_4231	12	Log(y)	multiplicative	1992.01 to 2009.11	none	none
i_4232	View Spec	i_4232	12	No transformation	additive	1992.01 to 2009.11	none	none
i_4233	View Spec	i_4233	12	Log(y)	multiplicative	1992.01 to 2009.11	rsd	none
i_4234	View Spec	i_4234	12	No transformation	additive	1992.01 to 2009.11	none	none
i_42343	View Spec	i_42343	12	Log(y)	multiplicative	1997.01 to 2009.11	none	none
i_4235	View Spec	i_4235	12	Log(y)	multiplicative	1992.01 to 2009.11	none	rsd ori
i_4236	View Spec	i_4236	12	No transformation	additive	1992.01 to 2009.11	none	none
i_4237	View Spec	i_4237	12	No transformation	additive	1992.01 to 2009.11	rsd	none
i_4238	View Spec	i_4238	12	Log(y)	multiplicative	1992.01 to 2009.11	none	none
i_4239	View Spec	i_4239	12	Log(y)	multiplicative	1992.01 to 2009.11	none	none
i_424	View Spec	i_424	12	Log(y)	multiplicative	1992.01 to 2009.11	rsd	none
i_4241	View Spec	i_4241	12	No transformation	additive	1992.01 to 2009.11	rsd	none

Figure 3 - Diagnostic output from Win X-13

## 4. Output Overview

### 4.1 Controlling Printing to the Output File

Every spec (except the arima and metadata specs) has a `print` argument to control the tables that appear in the output file.

You can specify a printout level.

- `Print = none` corresponds to no tables printed for that particular spec.
- `Print = brief` corresponds to a reduced number of tables printed for that particular spec.
- `Print = default` corresponds to printing the default tables for the spec.
- `Print = alltables` corresponds to printing all the tables but no plots for the spec.
- `Print = all` corresponds to printing all tables and plots for the spec.

Users can add or remove individual tables from a print level. For example, in the `x11` spec, to reduce the number of tables in the output, you can specify a brief printout. Along with the brief output, if you want to see the irregular component (Table D13) but don't want to see the calendar effects (Table D18), use the argument `print = ( brief +irregular -calendar )` or `print = ( brief +d13 -d18 )`. To see only the seasonally adjusted series in the output from the `x11` spec, use the argument `print = ( none +d11 )`

For a list of all the tables with their names and codes, please see the X-13ARIMA-SEATS Quick Reference (U.S. Census Bureau, 2016b and 2016d).

### 4.2 The Log File

Every X-13ARIMA-SEATS run produces a log file. The log file contains a summary of requested modeling and seasonal adjustment diagnostics. You control which diagnostics are saved to the log file with the `save log`



arguments. If you do not request to save any log information, the resulting log file will have only series names, titles, and for batch-mode runs, a list of runs with errors.

For a list of all the diagnostics available to save to the log, please see the X-13ARIMA-SEATS Quick Reference (U.S. Census Bureau, 2016b and 2016d).

The name of the log file has the same name as the output file but with a “**\_log.html**” extension. For example, if you asked X-13ARIMA-SEATS to rename the output file, X-13ARIMA-SEATS will rename the log file as well.

Example 9 – Spec file with some of our favorite `savelog` arguments for a monthly series:

```
series{
  file="series1.dat"
  start=1981.1

  title="Example 9"
}
spectrum{
  savelog = peaks
}
transform{ function=auto savelog=atr }
regression{ aictest=(td) savelog=ats }
automdl{ savelog=amd }
outlier{ }
forecast{ maxlead=42 }
estimate{ print=(default +rcm +acm +rts) savelog=(acc afc) }
check{ print=all savelog=all }
x11{ seasonalma=s3x5 savelog=(all) }
slidingspans{ savelog=pct }
history{ estimates=(sadj sadjchng) savelog=(asa ach) }
```

### 4.3 Saving Files

You may want to save some of the tables in individual files. For example, particularly in production with many series, you may want to save the seasonally adjusted series or the seasonal factors.

The `save` argument is available for all specs except the `arima` and `metadata` specs. The `save` argument causes X-13ARIMA-SEATS to write the specified tables to individual files. Saved tables are stored in files in the same directory as the program output, with the same file name as the program output but with a different extension. The extension is a distinct extension of up to three characters, which also serves as the table abbreviation.

For a list of all the tables with their names and codes, please see the X-13ARIMA-SEATS Quick Reference (U.S. Census Bureau, 2016b and 2016d).

Example 10 – Sample spec file named `test.spc` that saves the seasonally adjusted series

```
series{
  file = "test.dat"
  start = 1987.jan
}
x11{ save = seasadj }
```

If you ask X-13ARIMA-SEATS to rename the output, X-13ARIMA-SEATS will also rename the saved files. For example, if you run the spec file **test.spc**, the output file will be **test.html**, and the seasonally adjusted series will be in **test.d11**. If you run the same spec file, but ask to rename the output to **c:\x12test\test2**, then the output file will be **c:\x12test\test2.html** and the seasonally adjusted series will be in **c:\x12test\test2.d11**. In Win X-13, the user can change the name and directory of the output in separate input boxes on the main screen (see Figure 2).

Most saved files have two columns. A tab character delimits the columns. Dates are in the format *yyyymm* (199706 for June 1997). The corresponding series values are in scientific notation to 15 decimal places. Every saved file has a two-line header. See Example 2 for an example of a file saved in *x12save* format.

Note that the graphics files for the output tables are the same as the saved files, and if production runs are in graphics mode, production systems could read these files from the graphics directory.

Win X-13 has an alternate way of saving the seasonally adjusted series, the combined adjustment factors (seasonal combined with calendar factors), and the trend-cycle. When using Win X-13, check the ‘Save original, trend, seasonal adjustment, and seasonal factors as HTML’ box on the main screen before running the spec file or metafile; this will save these series to the output directory as HTML files (which can easily be opened in Excel), creating a separate HTML file for each element.

For example, if you run *airline.spc*, *airline\_SeasAdjSeries.html* will contain the seasonally adjusted series. If you run the metafile *bps.mta*, then *bps\_Trend.html* will contain the trend-cycles of all the series in the metafile.

## 5. Indirect and Direct Adjustments

What is an indirect adjustment or a direct adjustment? The Census Bureau publishes Building Permits information for four regions of the U.S. (Northeast, Midwest, South and West) and the total for the U.S. We can sum the four regional series first and then seasonally adjust at the U.S. level (direct adjustment), or we can adjust the four regional series first and then sum the four seasonally adjusted series to get an adjustment at the U.S. level (indirect adjustment).

To generate both direct and indirect adjustments of an aggregated series from a set of components, you need to create a spec file with a composite spec.

**RULE** – The *composite spec* replaces the *series spec* and must come first (or second after the *metadata spec*) in the spec file for the composite (or aggregate) series.

There are four steps when using X-13ARIMA-SEATS to calculate a composite seasonal adjustment.

- Step 1: Create a spec file for each component series
- Step 2: Create a spec file for the composite series
- Step 3: Create a metafile for the component and composite series
- Step 4: Run X-13ARIMA-SEATS

In our Building Permits example, Building Permits for the Northeast, Midwest, South and West are summed for the for the U.S. total.

*Step 1 – Create spec files for the component series*

Create spec files called **nebp.spc**, **mwbp.spc**, **s\_bp.spc**, and **w\_bp.spc**.

The spec files for the individual regions need to tell X-13ARIMA-SEATS how to combine the series. In this case, we want to add the series, so we use the argument `comptype = add`. Often, the `comptype` argument is the only change that we need to make from the usual spec file for the series. If you are creating a spec file with Win X-13, add this argument to the spec file by selecting the proper option from the 'How should the series be combined into the aggregate?' box in the 'Seasonal Adjustment' tab.

All component series must have the same starting and ending dates. If they are not the same, include a `span` argument in the `series` spec that achieves this.

To generate stability diagnostics for the indirect seasonal adjustment, set the same length of the sliding spans and the same start date of the history diagnostics for all component series and for the composite series. If a nondefault value is needed for the number of sliding spans it should be set in for every component series and for the composite series as well.

Example 11 – Spec file for Northeast (**nebp.spc**)

```
series {
  title = "Northeast Building Permits"
  file = "nebp.ori"
  format = "datevalue"
  name = "NEBP"
  comptype = add
  span = (1988.1,)
}
transform{ function=log }
arima{model=(0 1 1)(0 1 1)}
regression { aictest=td }
outlier{ }
forecast{ maxlead=24 }
estimate{ print=(default +rcm +acm +rts) savelog=all }
check{ print=all savelog=all }
x11{ seasonalma=s3x5 savelog=all }
slidingspans{ length=96 savelog=pct }
history{ start=2000.Jan estimates=(sadj sadjchng) savelog=(asa ach) }
```

*Step 2 – Create a spec file for the composite series*

Win X-13 can create a spec file for the composite series. Select 'Create a parent spec for a composite adjustment' from the 'Data' tab, and enter the full path and file name, along with the `.spc` extension, of the new composite spec file in the appropriate box.

Store the spec file for the total as **usbp.spc**.

Example 12 – Spec file for Total U.S. (usbp.spec)

```
composite {
  title = "Total U.S. Building Permits"
  savelog=all
}
transform{ function=log }
arima{model=(0 1 1)(0 1 1)}
regression { aictest=td savelog=aictest}
outlier{ }
forecast{ maxlead=24 }
estimate{ print=(default +rcm +acm +rts) savelog=all }
check{ print=all savelog=all }
x11{ savelog=all }
slidingspans{ length=96 savelog=pct }
history{start=2000.Jan estimates=(sadj sadjchng) savelog=(asa ach iaa)}
```

**Note:** For a composite (aggregate) series, the `x11` or `seats` spec controls the direct seasonal adjustment of the series. Modeling options in this spec file apply to the composite series only. The `composite` spec controls `print`, `save`, and `savelog` options for the indirect adjustment. The `x11` spec controls `print`, `save`, and `savelog` options for the direct adjustment. In this example, we used several automatic selection options, but for a production setting, we recommend hardcoding the regression model and seasonal adjustment filters.

*Step 3 – Create a metafile for the component and composite series*

Create the metafile **totbp.mta** with the following five lines:

```
nebp
mwbp
s_bp
w_bp
usbp
```

**RULE** – List the spec file for the composite series last in the metafile.

*Step 4 – Run X-13ARIMA-SEATS*

Run the metafile like any other metafile. The program stores the output for both the direct and indirect adjustments in **usbp.html**. Diagnostics for all the series are in the file **totbp\_log.html**.

## 6. Other X-13ARIMA-SEATS Specs

Highlights of specs and additional options not described above include:

**estimate** – Allows you to:

- Obtain more information about the properties of model parameter estimates.
- Store the estimated model.
- Recall a stored model.

**identify** – Produces autocorrelation function (ACF) and partial autocorrelation function (PACF) plots for all combinations of specified orders of differencing (useful for choosing appropriate orders of differencing and ARMA model orders). Use the ‘ARIMA Model’ tab of the Create Spec window to include this spec.

**metadata** – Writes information to the diagnostics file. Users can specify any text to save, such as the name of the spec file creator, the date the spec file was last reviewed, etc. Use the ‘Metadata’ tab of the Create Spec window to include this spec.

**regression** – Specifies user-defined regression variables in addition to the regression variables included in the program. For example, use the regression spec to include user-defined Chinese New Year or Ramadan moving holiday regressors. See Appendix B for information on Win Genhol, a program to help create such regressors. The ‘User Regressors’ tab of the Create Spec window allows you to add them to the regression spec.

**transform** – Transforms the series (by subtraction or division, generally) before regARIMA modeling and seasonal adjustment. Built-in options include a length-of-month (lom) or length-of-quarter (loq) and a leap year (lpyear) adjustment. Add these in the ‘Customize Spec Arguments’ screen, using the adjust argument. You can supply your own transformation via an external file; use the Create Spec screen and the ‘Prior Adj File’ tab.

Many other options are available in X-13ARIMA-SEATS. The *X-13ARIMA-SEATS Reference Manual* (U. S. Census Bureau 2016a and 2016b) gives details on all the options.

## Appendix A – Alternative Options for Some Occasional Situations

### Options to Run X-13ARIMA-SEATS As If It Were X-11

To run X-13ARIMA-SEATS as if it were X-11 (no forecasting, no regARIMA models, and no outlier identification), you need only two specs: **series** and **x11**.

Example A.1 – A multiplicative "X-11 only" run for a monthly series

```
series{
  file="data1.dat"
  start=1981.1

  title="Example of Multiplicative X-11"
}
x11{ }
```

Example A.2 – An additive run "X-11 only" for a monthly series

```
series{
  file="data1.dat"
  start=1981.1

  title="Example of Additive X-11"
}
x11{ mode = add }
```

To make the program choose between the additive and multiplicative seasonal adjustment modes, include the **transform** spec:

Example A.3 – A monthly series in "automatic X-11 only" mode

```
series{
  file="data1.dat"
  start=1981.1

  title="Example of Automatic Transformation"
}
transform { function=auto }
x11 { }
```

### Options to Run X-13ARIMA-SEATS for Forecasting Only

To use the regARIMA modeling features of X-12-ARIMA but not seasonally adjust your series, you need the following specs, **series**, **transform**, **automdl** (or **arima**), **regression**, **outlier**, and **forecast**. For diagnostics, you may also want the **identify**, **estimate**, and **check** specs.

Example A.4 widens the prediction intervals of the 24 forecasts from 95% (the default) to 90% and saves the forecasts and the prediction intervals.

Example A.4 - An X-13ARIMA-SEATS spec file that forecasts only

```
series{
  file="data1.dat"
  start=1981.1

  title="Example with Forecasts"
}
transform{ function=auto savelog=atr }
automdl { savelog = amd }
regression { aictest=(td Easter) savelog=ats }
outlier { }
forecast {
  maxlead = 24
  probability=0.90
  save = fct
}

estimate { print = (roots rcm acm) }
check { print=all savelog=lbq }
```

### Options to Run X-13ARIMA-SEATS for Short Series

For short series, you may want to consider some alternatives. For example, it is difficult to select a good ARIMA model with less than 60 points, so for quarterly series of less than 15 years or monthly series of less than five years, you might want to specify an airline model instead of using the automatic modeling procedure. In addition, the series might not be long enough for the sliding spans and history diagnostics.

Example A.5 - Example X-13ARIMA-SEATS spec file for short series

```
series{
  file="short.dat"
  start=1981.1

  title="Example Short Series"
}
transform{ function=auto }
arma { model = (0 1 1)(0 1 1) }
outlier { }
forecast { maxlead = 12 maxback = 12 } #Long fore/backcasts not advised
estimate { print = (roots rcm acm) }
check { print=all }
x11 { }
```

### Options to Run X-13ARIMA-SEATS Using a Single Spec File for Multiple Series

You can use a data metafile to run multiple series with the same spec file. A data metafile is a list of data file names including the file extensions; it has a .dta extension. You can create one with Win X-13 by selecting 'Data Metafile' from the Create menu on the main screen.

The spec file used for these data files cannot have a `file` or `data` argument. You can create one with Win X-13 by selecting 'Create a single spec to adjust all series in a data metafile' from the 'Data' tab of the Create Spec screen. To run, double click on the data metafile. A screen will appear asking you to select the spec file to use. The resulting output files are similar to those of running a regular metafile. Data metafiles are primarily for research when wanting to use the same settings for all series; we recommend against using data metafiles to produce official adjustments.

## Options to Run X-13ARIMA-SEATS for Alternate Periodicities

X-13ARIMA-SEATS is generally used for adjusting quarterly or monthly series. It cannot be used to adjust series with a period different from 4 or 12 with the `x11` spec; series with a period of 2, 4, or 6 can be seasonally adjusted using the `seats` spec. In addition, a trend component can be estimated for annual series with a `seats` spec. This program cannot adjust weekly or biweekly series. The program can model and forecast series of other periodicities, such as annual series.

A couple of examples follow.

Example A.6 – Spec file for annual data

```
series{
  title="Example with Annual Data"
  file="data3.dat" format="datevalue"
  start=2001
  period=1}
transform{ function=auto }
regression{ } # This is a place holder where you can enter
              # regressors for any detected outliers
outlier{ }
automdl{ }
forecast{ maxlead=2 }
estimate { print = (roots rcm acm) }
check{ print=all }
```

Example A.7 – Spec file for a model-based seasonal adjustment of a bimonthly series

```
Series { Title="Model-based adjustment of Bimonthly exports"
         Start = 1995.1 File = "Xports6.Ori" Period = 6 }
Transform { Function = Log }
regression{ } # This is a place holder where you can enter
              # regressors for any detected outliers
Arima { Model = (0 1 1)(0 1 1) }
Outlier { types = (ao ls tc) }
Forecast { Maxlead = 18 }
Seats { save = (S11 S10 S12) }
```



## Appendix B – Useful Utilities When Running X-13ARIMA-SEATS

**X-13-Data** (Czaplicki, 2015) converts time series data stored in Excel spreadsheets into a format that X-13ARIMA-SEATS can read. It can also convert X-12-ARIMA and X-13ARIMA-SEATS input and output files to Excel.

This program is available to download at:

[http://www.census.gov/srd/www/winx13/winx13\\_down.html#x13datadown](http://www.census.gov/srd/www/winx13/winx13_down.html#x13datadown)

Documentation is available online at

<http://www.census.gov/srd/www/winx13/X13DataDoc.html>

The **Win Genhol** (Czaplicki, 2015) program creates holiday regressors using the same procedure as X-13ARIMA-SEATS uses to create regressors for the U. S. holidays of Easter, Labor Day, and Thanksgiving. Users can generate separate regressors for the effect in intervals before and after-holidays, as well as an intermediate effect around the holiday. Users can specify more than one holiday, and the user can center these regressors using either their overall means or their calendar-month means (calendar-quarter means in the case of regressors for modeling quarterly data or calendar-bimonthly means in the case of regressors for modeling bimonthly data).

The program serves as an interface to the Genhol utility (Monsell, 2012) that has been distributed for some time. The stand-alone version of this utility is also available, but must be run from a command window.

Win Genhol can generate X-13ARIMA-SEATS commands that users can copy into spec files to use these regressors in a regARIMA model for X-13ARIMA-SEATS runs. For more details on specific options for user-defined regressors, read chapter 7.20 on the regression spec in U. S. Census Bureau (2016a and 2016c).

To download the software, access

[http://www.census.gov/srd/www/genhol/genhol\\_downloads.html](http://www.census.gov/srd/www/genhol/genhol_downloads.html)

For more information, access the Win Genhol website at

<http://www.census.gov/srd/www/genhol/index.html>

**X-13-Graph** can create a variety of graphs from X-13ARIMA-SEATS graphic output files. There are two versions of the program. The batch version runs in SAS, but users need no knowledge of SAS to run the program (Lytras 2015a). The batch version submits a (user-selected) list of all the types of graphs to create for a list of series to the SAS program, which produces all graphs in one run. A Windows interface is available to create the lists of graphs and series, to allow you to select options for the graphs' appearance and for saving the graphs, and to run the SAS program to create the graphs (Lytras, 2015b). The Java version of X-13-Graph version is interactive, generating every graph as it is requested (Lytras, 2013).

Download X-13-Graph Batch and X-13-Graph Java from

<http://www.census.gov/srd/www/x13graph/>

## Appendix C – X-11 Formats

X-11 formats are a family of formats, five of which are

- 1L - one line per year with label and year on left
- 2L - two lines per year with label and year on left
- 1R - one line per year with year and label on right
- 2R - two lines per year with year and label on right
- 2L2 - two lines per year with labels and year on left, four digit year.

The advantage of X-11 formats is that the data have labels, so you can have more than one series inside a data file, with different series having different labels. The labels can be at most 6 characters long (8 digits for the 2L2 format) and are left justified.

The disadvantage of using X-11 formats is that if the series have real zero values at the beginning or end of the series, X-11 formats can be difficult to work with because they treat zeros at the beginning or end of the series as "zero filled." By default, the X-13ARIMA-SEATS program ignores the zeros at the beginning or end of the series. To include zeros at the end or beginning of the series, set `trimzero = yes` in the `series spec`, and specify the ending or beginning date of the series in the `span` argument.

The series values are stored in 6 or 12 character fields (11 characters for 2L2), depending on whether one or two lines per year are used. No space is required between values. Except for 2L2 format, only the final two digits of the year denote the year of the observations. By default, X-13ARIMA-SEATS assumes that any year read from an X-11 format that is less than or equal to 45 occurs in the 21<sup>st</sup> century; otherwise, the year is assumed to occur in the 20<sup>th</sup> century.

**Example C.1** shows a `series spec` that uses an X-11 format. **Examples C.2 - C.5** show various X-11 formats. Because X-11 formats include dates, do not use a `start` argument with them. However, a `name` argument is required because each file can contain more than one series.

**RULE** – When using an X-11 format, a `name` argument is required to identify the series in the data file. This is one place where X-13ARIMA-SEATS is case sensitive. The value of the `name` argument and the label in the data file must match exactly.

Example C.1 – Series spec with a `file` argument and an X-11 format

```
series{
  file = "test2L.dat"  format = "2L"
  name = "BPMW-1"
}
```

Example C.2 – The end of a sample '1L' data file

```
BPNE-182 1655 1831 4822 6161 6215 6290 5955 6108 6786 7591 7188 5126
BPNE-183 3668 3433 8179 9192 11740 12959 11517 12245 11446 11078 9092 7775
BPNE-184 5194 6943 10543 13778 16303 14832 13536 13977 12104 13770 11212 9019
BPNE-185 8131 8202 13432 17997 18648 16198 16045 17199 15274 17376 14357 10643
BPNE-186 8801 7878 14636 22438 20963 21133 21980 18938 20365 19451 14071 13107
BPNE-187 9049 10666 18194 20513 19193 21060 20124 16366 17221 16110 13410 12092
BPNE-188 7889 8394 18461 16120 17646 18207 15174 15871 13803 13676 11432 9352
BPNE-189 8070 6871 10754 13980 14084 13307 10763 12357 10995 10726 9581 8181
```

Example C.3 – A piece of a sample ‘2L’ data file with the end of one series and the beginning of another series

BPNE-194	4.476	4.773	8.776	11.018	12.840	13.323
	12.752	11.904	10.544	10.209	9.778	8.686
BPNE-195	6.180	4.700	8.782	9.547	10.985	10.569
	9.418	10.559	9.395	9.753	8.030	6.627
BPNE-196	4.497	5.424	8.893	10.937	11.757	10.699
	11.061	10.594	9.646	9.989	8.334	6.988
BPNE-197	6.050	5.666	8.588	10.075	10.623	10.446
	10.803	9.492	9.754	0	0	0
BPMW-182	1.418	1.666	4.293	6.420	6.883	7.102
	6.319	6.939	7.679	7.692	6.682	4.503
BPMW-183	3.432	4.630	9.927	11.236	13.477	14.340
	11.716	12.488	11.435	11.003	8.831	4.929
BPMW-184	4.918	7.039	9.530	13.670	15.348	13.601
	11.607	11.489	9.810	10.839	8.485	5.180

Note: The end of the series is zero-filled. By default, the program ignores the zeros at the beginning or end of the series.

Example C.4 – The end of a sample '1R' data file

```

6.620 6.637 9.982 9.42110.361 9.846 8.765 8.417 6.848 8.3856.490 4.69990BPNE-1
3.695 3.858 6.418 9.453 9.729 9.261 9.134 9.261 7.990 9.836 7.254 5.90891BPNE-1
5.439 5.528 9.04310.29910.75110.98810.633 9.760 9.634 9.949 8.880 7.56492BPNE-1
5.957 5.860 7.85910.31510.87511.61510.73210.48810.93411.265 9.549 8.29993BPNE-1
4.476 4.773 8.77611.01812.84013.32312.75211.90410.54410.209 9.778 8.68694BPNE-1
6.180 4.700 8.782 9.54710.98510.569 9.41810.559 9.395 9.753 8.030 6.62795BPNE-1
4.497 5.424 8.89310.93711.75710.69911.06110.594 9.646 9.989 8.334 6.98896BPNE-1
6.050 5.666 8.58810.07510.62310.44610.803 9.492 9.754 97BPNE-1

```

Example C.5 – A piece of a ‘2L2’ data file:

Ex2L2mo 1992	5439.	5528.	9043.	10299.	10751.	10988.
	10633.	9760.	9634.	9949.	8880.	7564.
Ex2L2mo 1993	5957.	5860.	7859.	10315.	10875.	11615.
	10732.	10488.	10934.	11265.	9549.	8299.
Ex2L2mo 1994	4476.	4773.	8776.	11018.	12840.	13323.
	12752.	11904.	10544.	10209.	9778.	8686.
Ex2L2mo 1995	6180.	4700.	8782.	9547.	10985.	10569.
	9418.	10559.	9395.	9753.	8030.	6627.

## References

Box, G.E.P., G.M. Jenkins, and G. Riensel (1994). *Time Series Analysis: Forecasting and Control*, 3<sup>rd</sup> Edition. Prentice-Hall: New York, NY.

Brockwell, P.J. and R.A. Davis (2002), *Introduction to Time Series and Forecasting*, 2<sup>nd</sup> Edition. Springer-Verlag: New York, NY.

Czaplicki, Nicole (2015), “Win Genhol, Version 1.0” Washington, DC: U.S. Census Bureau, U.S. Department of Commerce.

<https://www.census.gov/srd/www/genhol/wingeholdoc.html>

Czaplicki, Nicole (2015), "X-13-Data Version 2.0" Washington, DC: U.S. Census Bureau, U.S. Department of Commerce.

<http://www.census.gov/srd/www/winx13/X13DataDoc.html>

Findley, D. F., D. P. Lytras, A. Maravall (2016), "Illuminating ARIMA Model-Based Seasonal Adjustment with Three Fundamental Seasonal Models," *SERIEs* :1-42.

<http://link.springer.com/article/10.1007/s13209-016-0139-4>

Findley, D.F., B.C. Monsell, W.R. Bell, M.C. Otto and B.-C. Chen (1998), "New Capabilities and Methods of the X-12-ARIMA Seasonal Adjustment Program" (with discussion), *Journal of Business and Economic Statistics*, 16: 127-176.

<http://www.census.gov/ts/papers/jbes98.pdf>

Gómez, V. and A. Maravall (1996). Programs TRAMO and SEATS : Instructions for the user (beta version: June 1997). Banco de España, Servicio de Estudios, DT 9628. Updates and additional documentation can be found at

<http://www.bde.es/webbde/es/secciones/servicio/software/econom.html>

Gómez, V. and A. Maravall (2001). "Automatic modeling methods for univariate series", in D. Pena, G. C. Tiao, and R. S. Tsay (Eds.), *A Course in Time Series Analysis*. New York, NY: J. Wiley and Sons.

Ladiray, D. and B. Quenneville (2001), *Seasonal Adjustment with the X-11 Method*. Springer-Verlag: New York, NY.

Lytras, D.P. (2013), "X-13-Graph Java, Version 2.1," Washington, DC: U.S. Census Bureau, U.S. Department of Commerce.

[http://www.census.gov/srd/www/x13graph/x13javadoc/x13graph\\_java\\_doc.html](http://www.census.gov/srd/www/x13graph/x13javadoc/x13graph_java_doc.html)

Lytras, D.P. (2016), "Win X-13 Version 2.4 : A Windows Interface for X-13ARIMA-SEATS" Washington, DC: U.S. Census Bureau, U.S. Department of Commerce.

<http://www.census.gov/srd/www/winx13/WinX13Doc.html>

Lytras, D.P. (2015a), "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 2.1," Washington, DC: U.S. Census Bureau, U.S. Department of Commerce.

[http://www.census.gov/srd/www/x13graph/x13gbdoc/x13gbat\\_doc.html](http://www.census.gov/srd/www/x13graph/x13gbdoc/x13gbat_doc.html)

Lytras, D.P. (2015b), "X-13-Graph: A SAS/GRAPH® Program for X-13ARIMA-SEATS Output, User's Guide for the Windows Interface to X-13-Graph, Version 2.2," Washington, DC: U.S. Census Bureau, U.S. Department of Commerce.

[http://www.census.gov/srd/www/x13graph/x13gbidoc/x13gb\\_interface\\_doc.html](http://www.census.gov/srd/www/x13graph/x13gbidoc/x13gb_interface_doc.html)

Makridakis, S.G., S.C. Wheelwright, and R.J. Hyndman (1998), *Forecasting: Methods and Applications*, 3<sup>rd</sup> edition. John Wiley & Sons, Inc.: New York, NY.

Monsell, B. C. (2012) "Genhol", Washington, DC: Census Bureau, U. S. Department of Commerce

<http://www.census.gov/srd/www/genhol/>

Monsell, B. C. (2009) “An Update on the Development of X-13ARIMA-SEATS.” In JSM Proceedings, Business and Economic Statistics Section. Alexandria, VA: American Statistical Association.  
<http://www.census.gov/ts/papers/jsm09bcm.pdf>

Monsell, B. C. (2007) “The X-13ARIMA-SEATS Seasonal Adjustment Program.” 2007 Proceedings of the Federal Committee on Statistical Methodology Research Conference, Washington, DC.

U.S. Census Bureau (2016a), *X-13ARIMA-SEATS Reference Manual*, Washington, DC: U.S. Census Bureau, U.S. Department of Commerce.  
<http://www.census.gov/ts/x13as/docX13AS.pdf>

U.S. Census Bureau (2016b), *X-13ARIMA-SEATS Quick Reference for DOS*, Washington, DC: U.S. Census Bureau, U.S. Department of Commerce.  
<http://www.census.gov/ts/x13as/pc/qrefX13ASpc.pdf>

U.S. Census Bureau (2016c), *X-13ARIMA-SEATS Reference Manual (Accessible Output)*, Washington, DC: U.S. Census Bureau, U.S. Department of Commerce.  
<http://www.census.gov/ts/x13as/docX13AS.pdf>

U.S. Census Bureau (2016d), *X-13ARIMA-SEATS Quick Reference for DOS (Accessible Output)*, Washington, DC: U.S. Census Bureau, U.S. Department of Commerce.  
<http://www.census.gov/ts/x13as/pc/qrefX13ASpc.pdf>