# Getting Started with X-12-ARIMA Input Files on Your PC – DRAFT

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Before running X-12-ARIMA (or X-12 for short), you must have your data in a form that X-12 can read, and you must create an input specifications file (or "spec file"). This document will explain the basics of X-12 data formats and of writing a spec file. You will find more details in the *X-12-ARIMA Reference Manual* (US Census Bureau, 2002) and the X-12-ARIMA Quick Reference (US Census Bureau, 2002).

The authors of this paper assume the reader has a general understanding of time series, 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 detailed information on the X-11/X-12 method for seasonal adjustment, see Ladiray and Quenneville (2001). For information about new features in X-12-ARIMA, see Findley, Monsell, Bell, Otto and Chen (1998). For a more advanced treatment of ARIMA time series modeling and time series analysis, see Box, Jenkins, and Riensel (1994) or Brockwell and Davis (2002).

To download X-12-ARIMA for your PC, please see the US Census Bureau website at http://www.census.gov/srd/www/x12a/x12down_pc.html. At the web site, you will find program files for the latest PC version of X-12-ARIMA and the companion graphics package, X-12-Graph; files containing the *X-12-ARIMA Reference Manual*; and a link to the instructions for downloading the program.

This document is organized into the following topics:
- ▸ Overview of X-12-ARIMA data formats
- ▸ Definition of an X-12-ARIMA specification file
- ▸ General syntax
- ▸ Example "initial" input file
- ▸ Details for the series spec
- ▸ Running X-12-ARIMA in DOS
- ▸ Options for "production"
- ▸ Additional output
- ▸ Command-line options in X-12-ARIMA
- ▸ Composite spec

**Overview of X-12-ARIMA Data Formats**

The first step in running X-12-ARIMA is to get your time series data in a form that can be read by X-12. X-12 can't read files from spreadsheet programs like Excel. If your data is stored in a spreadsheet program, then you will need to ask the program to output the data to a text file.

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

One option is to type the data directly into the input file. We'll cover this later in the document when we talk about input specification files.

We recommend keeping the data in a separate text file. There are several predefined formats available in X-12. We'll review the datevalue format, free format, X-11 formats, and the X12save format.

For most series, using the datevalue format is the best approach. The date is stored along with the value, and this format is very easy to use and to read.

If you have a lot of series and file management might be a problem for you, then you might want to consider using an "X-11" format because you can store more than one series in a file. X-11 formats aren't recommended when you have a series with real zero values at the beginning or end of the series.

*Datevalue Format*

The "datevalue" format is the year, a tab or space, the month/quarter, a tab or space, and then the value for the series. This format can be particularly useful if you have your data stored in columns in a spreadsheet. If you also have the year and month/quarter stored, then it is fairly simple to ask the spreadsheet program to output the columns in a text file.

With the datevalue format, only one series can be stored in each separate file.

Example Datevalue Format, selected dates only:

```
1998 1     97.5
1998 2     102.5
1998 3     118.6
1998 4     109.0
1998 5     105.1
1998 6     112.3
1998 7     113.1
1998 8     95.6
1998 9     100.7
1998 10    101.5
1998 11    98.4
1998 12    97.7
1999 1     98.7
```

*Free Format*

Free format means that the data are entered with either tabs or spaces separating the numbers. Only the data is in the file. Additional information, like dates, is not allowed.


*X-11 Formats*

X-11 formats are a family of formats, four of which are
　　1R – one line per year with year and label on right
　　2R – two lines per year with year and label on right
　　1L – one line per year with label and year on left
　　2L – two lines per year with label and year on left

The advantage of X-11 formats is that the data have labels, so you can have more than one series inside a data file. These labels can be at most 6 characters long, and are left justified.

The disadvantage of using X-11 formats is that if you have series with 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."

The data are stored in 6 or 12 character fields, depending on whether one or two lines per year is used. Only the final two digits of the year are used to denote the year of the observations. By default, X-12 assumes that any year read from an X-11 format that is less than or equal to 45 occurs in the 21$^{st}$ century; otherwise, the year is assumed to occur in the 20$^{th}$ century.

Piece of a Sample '2L' Data File with the end of one series and the beginning of another series:

```
MWTOT 96     494699     500582     526215     540324     575886     534965
             516057     565268     577409     621912     565056     496747
MWTOT 97     558286     566271     609662     630206     636660     601691
             573106     612178     668663     704814     646872     587746
MWTOT 98     593201     628169     709245     688366     681078     664887
             536477     603478     642580     660612     622998     562297
MWTOT 99     577816     613525     714613     674296     671250          0
                  0          0          0          0          0          0
MW1FAM64       8254.0    11552.0    16806.0    23947.0    24616.0    26846.0
             21784.0    24397.0    20949.0    22082.0    15055.0    10402.0
MW1FAM65       5743.0     6764.0    15291.0    23819.0    26452.0    26702.0
             26935.0    20726.0    18136.0    22935.0    17014.0    15935.0
MW1FAM66       6165.0     9189.0    18859.0    26328.0    21790.0    21299.0
             17373.0    20229.0    15110.0    14112.0    10546.0     8323.0
```

*X12save Format*

The X12save format is the format of files that are saved by X-12. The data are in two columns, date and value, separated with a tab with a two line header at the top of the file.

Example X12save Format, selected dates only:

```
date      MWTOT.a1
------    -----------------------
199601    +0.494699000000000E+04
199602    +0.500582000000000E+04
199603    +0.526215000000000E+04
199604    +0.540324000000000E+04
199605    +0.575886000000000E+04
199606    +0.534965000000000E+04
199607    +0.516057000000000E+04
199608    +0.565268000000000E+04
```

## Definition of an X-12-ARIMA Input Specification File

Once you have the data, the next step is to write an input specification file, or spec file. The spec file is a text file used to specify program options.

> **RULE** – The name of the spec file must be eight characters or less and end with a ".spc" file extension.

Each spec file is made up of functional units called specifications (or "specs"). Each spec inside the spec file controls options for a specific function, for example, the series spec controls options for data input, and the arima spec controls options to specify the ARIMA model. There are 15 different specs that you can use in a spec file. We will discuss all of them to some extent in this document.

## General Syntax

You can enter input in either upper, lower, or mixed case. **Note**: If you have a "name" argument to give a name to a label in your data file, then the name needs to match exactly with the label, including the case.

Dates are in the form *yyyy.period*. For monthly series, the period can be the first three letters of the name of the month, or the number of the month. For quarterly series, the period is the number of the quarter. So January of 1990 can be written as 1990.1 or 1990.jan (also 1990.01 or 1990.Jan or 1990.JAN). First quarter 1990 is written as 1990.1.

Character values, such as titles and file names, should be enclosed in quotes.

X-12 treats everything 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-12 usually assumes a default value.  X-12 only performs the functions you specify (or that are implied by other specs).  You can enter the arguments in any order.

Every spec begins with the name of the spec and a left curly bracket, "{".  After all the arguments for 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.
```

## Example "Initial" X-12 Spec

Example 1 – For a monthly series:

Example 2 – For a quarterly series:

```
series{                              series{
  file="data1.dat"                     file="data2.dat"
  start=1981.1                         start=1981.1
  period=12                            period=4
  title="Example 1"                    title="Example 2"
}                                    }
transform{ function=auto }           transform{ function=auto }
regression{ aictest=(td easter) }    regression{ aictest=(td easter) }
automdl{ }                           automdl{ }
outlier{ }                           outlier{ }
forecast{ maxlead=24 }               forecast{ maxlead=8 }
check{ print=all }                   check{ print=all }
x11{ }                               x11{ }
slidingspans{ }                      slidingspans{ }
history{estimates=(sadj sadjchng)}   history{estimates=(sadj sadjchng)}
```

The spec files given above are a good first step when running X-12 for your series.  Next, we'll review all the specs we've used.

**series** – The main function is to specify the location and format of the data.  This is a very important spec and has several options that depend on the form of the data.  We will cover this spec in detail in the next section.

> **RULE** – The series spec comes first.  All other specs can be in any order.

**transform** – The most common function for the transform spec is to specify a data transformation. The most common transformation for seasonal adjustment is the log transformation. If you know that your series needs a log transformation, you can specify **function=log**. In our example spec, we've set **function=auto**. With **function=auto**, X-12 will do an likelihood comparison to decide whether or not to transform the data. With the automatic transformation test, X-12 also automatically sets the seasonal adjustment mode. If the log transformation is preferred, then X-12 will compute a multiplicative seasonal decomposition. If no transformation is preferred, then X-12 will compute an additive decomposition. If you specify a regARIMA model (with a regression spec, an automdl spec, and/or an arima spec – details to follow), leaving out the transform spec corresponds to no transformation, but then 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-12 will do an AIC test to test for the presence of trading day and Easter effects. If you know you don't have Easter effects, you may want to change the argument to **aictest=td**. If you have an inventory series, you may want to change the argument to **aictest=(tdstock Easter)** or **aictest=tdstock**. Leaving out the regression spec means you don't have any regression variables in your regARIMA model (with the possible exception of outlier variables from the outlier spec).

**automdl** – Automatic ARIMA model selection procedure. No arguments are required. Leaving out this spec could cause problems if you're trying to fit a regression model or search for outliers (unless you specify an ARIMA model explicitly with the arima spec – more about that later).

**outlier** – Automatic outlier identification procedure for point outliers, level changes, and temporary change outliers. No arguments are required, but then, by default, X-12-ARIMA identifies only point outliers and level shifts. To identify all three types of outliers, use **types=all**. Leaving out this spec means there will be no automatic outlier identification.

**forecast** – Generates forecasts from the estimated regARIMA model. Without a forecast spec, in the presence of a regARIMA model and an x11 spec, X-12 will forecast one year ahead. (If the automdl procedure couldn't find an acceptable model, then you won't get any forecasts.) In the example "initial" spec above, we've added the argument **maxlead=24** so the program will forecast two years ahead for the monthly series or **maxlead=8** for the quarterly series.

**check** – Generates diagnostics for the fit of the estimated regARIMA model. To see all the diagnostics available in with the check spec, we have added the argument **print=all**. This spec is an optional diagnostic spec. Leaving out this spec has no effect on the model or model estimates, but X-12 doesn't print out some diagnostics to the output file.

**x11** – Generates the seasonal adjustment using X-11 seasonal adjustment methods and filters. No arguments are required unless you omit the transform spec, and in that case, you will need to add the argument **mode=add** for an additive decomposition. Without an x11 spec you will not get a seasonally adjusted series.

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

**history** – Generates "historical" analysis of seasonal adjustment estimates and/or regARIMA model forecast performance. With **estimates=(sadj sadjchng)**, we have asked for estimates of the seasonally adjusted series and the month-to-month, or quarter-to-quarter, percent changes of the seasonally adjusted series. (For additive adjustments, instead of a percent change, the program calculates differences.) If you don't specify any arguments, you will get estimates for the seasonally adjusted series by default. This spec is an optional diagnostic spec.

### Details for the Series Spec

Again,

> **RULE** – If you have a series spec in your spec file, it must be the first spec listed.

The main function of the series spec is to provide the time series data to X-12. Therefore, you are required to have either a file statement or a data statement. The file statement gives the name of an external data file. The data statement lists the data inside the spec file.

*Data Argument*

Since the data argument is easy to use, we will start with that.

Example 3
```
series {
    data=( 88.0   97.7 102.5   96.9 101.1 102.7   93.6   87.0
           92.1   89.3 103.9 131.0   78.0   93.0   80.6 109.0
           91.3 118.0 113.8   88.9 117.4 122.1 112.3 126.6
          100.8   98.6 114.9 113.6 103.1 112.9 109.8   86.7
           94.4   97.8 119.4 104.9 107.8   89.4 105.4 117.2
           95.0 115.3 112.3   82.4 109.6 113.9 127.6 125.3 )
    start = 1980.1
    period = 4
}
```

There is no set format for the data argument. In the example above, we have two years of a quarterly series on each line.

> **RULE** – With the data argument, a start date is required. X-12-ARIMA will compute the rest of the dates for the series based on the start date.

*File Argument*

Data entered directly in the series spec can be hard to update. Another way to provide data to X-12 is with the file statement. There are several predefined formats available including free format, some "X-11" formats, datevalue, and x12save.

*Free Format*

The default format for the file statement is free format. Free format means that the data are entered with either tabs or spaces separating the numbers. Only the data is in the file. Additional information, like dates, is not allowed.

---

**RULE** – With a free formatted file, a start date is required. X-12-ARIMA will compute the rest of the dates for the series based on the start date. With free format, you are not allowed to have a format statement.

---

Example 4
```
series{ file='example4.dat'
  start = 1982.jan }
```

*X-11 Formats*

X-11 formats are a family of formats, four of which are
   1R – one line per year with year and label on right
   2R – two lines per year with year and label on right
   1L – one line per year with label and year on left
   2L – two lines per year with label and year on left

The advantage of X-11 formats is that the data have labels, so you can have more than one series inside a data file. These labels can be at most 6 characters long, and are left justified.

The disadvantage of using X-11 formats is that if you have series with 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."

The data are stored in 6 or 12 character fields, depending on whether one or two lines per year is used. Only the final two digits of the year are used to denote the year of the observations. By default, X-12 assumes that any year read from an X-11 format that is less than or equal to 45 occurs in the 21$^{st}$ century; otherwise, the year is assumed to occur in the 20$^{th}$ century.

Piece of a Sample '2L' Data File with the end of one series and the beginning of another series:

```
MWTOT 96      494699      500582      526215      540324      575886      534965
              516057      565268      577409      621912      565056      496747
MWTOT 97      558286      566271      609662      630206      636660      601691
              573106      612178      668663      704814      646872      587746
MWTOT 98      593201      628169      709245      688366      681078      664887
              536477      603478      642580      660612      622998      562297
MWTOT 99      577816      613525      714613      674296      671250           0
                   0           0           0           0           0           0
MW1FAM64      8254.0     11552.0     16806.0     23947.0     24616.0     26846.0
             21784.0     24397.0     20949.0     22082.0     15055.0     10402.0
MW1FAM65      5743.0      6764.0     15291.0     23819.0     26452.0     26702.0
             26935.0     20726.0     18136.0     22935.0     17014.0     15935.0
MW1FAM66      6165.0      9189.0     18859.0     26328.0     21790.0     21299.0
             17373.0     20229.0     15110.0     14112.0     10546.0      8323.0
```

The end of a Sample '1R' file:

```
 961   864  1071  1123  1059  1140  1076  1055  1068  1139  1049  107492NE1FAM
 922   873  1126  1074  1094  1252  1165  1171  1097  1208  1118  113493NE1FAM
1078   985  1259  1290  1419  1363  1397  1466  1243  1336  1417  141694NE1FAM
1304  1196  1374  1435  1491  1505  1538  1554  1290  1500  1462  141995NE1FAM
1423  1358  1526  1755  1803  1761  1811  1716  1567  1772  1652  170196NE1FAM
1620  1496  1842  1918  1993  1903  1999  1915  1868  2069  1747  190797NE1FAM
1660  1736  2150  2157  2125  2199  2146  2096  2079  2152  2056  210498NE1FAM
1918  2006  2317  2458  2499  2360  2227  2289  2176  2358            99NE1FAM
```

Because X-11 formats include dates, a start argument isn't required.  (If you want the series to start at a point later than the start date of the file, see the span argument below.)

---

RULE – When using a X-11 format, a name statement is required to identify the series in the data file.  This is one place where X-12-ARIMA is case sensitive.  The value of the name argument and the label in the data file must match exactly.

---

Example 5
```
series{
    file = 'test2L.dat'    format = '2L'
    name = 'MWTOT'
    title = 'Midwest Total Housing Starts'
}
```

*Datevalue and X12save Formats*

The datevalue format is the year, a tab or space, the month/quarter, a tab or space, and then the value for the series.  The X12save format is the format of files that are saved by X-12.  The data are in two columns, date and value, separated with a tab with a two line header at the top of the file.

Both of these formats include dates, so a start argument isn't required.  Labels aren't allowed inside the data file, so a name argument isn't required either.

Example Datevalue Format, selected dates only:

```
1998 1     97.5
1998 2     102.5
1998 3     118.6
1998 4     109.0
1998 5     105.1
1998 6     112.3
1998 7     113.1
1998 8     95.6
1998 9     100.7
1998 10    101.5
1998 11    98.4
1998 12    97.7
1999 1     98.7
```

Example X12save Format, selected dates only:

```
date       MWTOT.a1
------     ----------------------
199601     +0.494699000000000E+04
199602     +0.500582000000000E+04
199603     +0.526215000000000E+04
199604     +0.540324000000000E+04
199605     +0.575886000000000E+04
199606     +0.534965000000000E+04
199607     +0.516057000000000E+04
199608     +0.565268000000000E+04
```

Example 6
```
series{ file = 'MWTOT.a1'    format = 'x12save' }
```

*Other Useful Series Options*

**name** – As we've seen already, the name argument is required with X-11 formats. It is also used in other places as a short name for the series, so it may be useful even if you use a format other than an X-11 format.

**period** – The frequency of the series. The default is 12 (a monthly series), so this argument isn't required unless you have a quarterly series, and then you must have **period=4**.

---

**RULE** – For quarterly series, you must have **period=4** in the series spec.

---

**title** – Title statements are useful and highly recommended. They are used by the log file, the output file, and as secondary titles for graphs in X-12-Graph.

**decimals** – 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 with display either 1 or 2 decimals, depending on the table.) This argument does not affect the format of files produced by the save command. See below for more information on saving files.

**span** – Sets the time interval for the data used for seasonal adjustment
**modelspan** – Sets the time interval for the data used for modeling

The forms of the arguments are **span=**(*startdate*, *enddate*) and **modelspan=**(*startdate*, *enddate*). By leaving the end date blank, you can set only the start date: (*yyyy.period*,   ).  Or 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.

## Running X-12-ARIMA in DOS

Once we have an X-12-ARIMA input file, we can run X-12-ARIMA.

X-12-ARIMA is a DOS program.  To run X-12, you will need to go to a DOS prompt.  (If you can't find a DOS prompt on your computer, try typing "cmd" at the Run option on the Start menu.)  Please see Appendix C for some alternatives to running X-12-ARIMA from a DOS prompt.

**Hint**: At the DOS prompt, you can enter the command
**> loadhigh doskey**
(or maybe just **doskey** on some computers).  This command lets you use the arrow keys to move through previous commands.  If you enter this first, you can recall past calls to X-12, and it is easier to make multiple calls and to fix typing errors.

The first step is to change to the directory where you've installed X-12.
At a DOS prompt, enter
**> cd** *dirname*
where *dirname* is the name of the directory where X-12 is installed.  For example, if the file **x12a.exe** and the spec file is in the directory c:\x12a, then the command would be
**> cd c:\x12a**

Next, at a DOS prompt, enter
**> x12a** *filename*
where *filename*.spc is an input file like the one shown above.

---

**RULE** – Enter the filename without the .spc extension.  The *filename* (without the extension) is used to generate the names of all the output files.

---

For example, to run a spec file named mwtot.spc, then at the DOS prompt, enter
**> x12a mwtot**

The output files will be **mwtot.out** (main output) and **mwtot.err** (error output).

If you want to run X-12 and not overwrite previous output, you can direct the output to another file by entering two filenames on the DOS command line. For example, for the mwtot.spc input file, enter

```
> x12a mwtot mwtot2
```

Now the output files are **mwtot2.out** (main output) and **mwtot2.err** (error output).

**Hint**: To help manage the input files, it can be useful to store spec files in a folder (subdirectory) inside the c:\x12a folder. For example, say you've stored the mwtot.spc in the folder c:\x12a\starts. To run X-12, go to the c:\x12a\starts directory and enter

```
> ..\x12a mwtot
```

Output files will be in the directory c:\x12a\starts.

## Options to Change the "Initial" Options to "Production" Options

Once you've run X-12 initially, you might want to change some of the automatic procedures so that the arguments are fixed to a certain value.

**transform** – If the automatic transformation procedures selects a log transformation, then you can change **transform{function=auto}** to **transform(function=log}**. If the automatic transformation procedures selects no transformation, then you can delete the transform spec or change **transform{function=auto}** to **transform(function=none}**. In the case of no transformation, you also need to add **mode=add** to the x11 spec to tell X-12 you want an additive adjustment. Again, with the automatic transformation test, X-12 automatically sets the x11 mode to additive when no transformation is selected.

**regression** – If the test for TD or Easter accepts these variables in the model, and if any outliers are found, you can specify these variables directly in the regression spec with the variables argument. For example, a series with a trading day effect, an eight-day Easter effect, one point outlier (or AO, additive outlier) at January 1990 and one level shift at July 1992 could have a regression spec similar to the one below.

```
regression{variables=(td Easter[8] ao1990.1 LS1992.jul) }
```

And a new spec (not shown in the "initial" spec files above),
**arima** – Specifies the ARIMA part of a regARIMA model. The results from the automatic modeling procedure can be entered into X-12 with the arima spec. For example, if the automatic modeling procedure select the model (0 1 1)(0 1 1), then you can specify this with the command

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

Please see Appendix A for a list of other specs, and see Appendix B for the options to run X-12 as if it were X-11.

**Additional Output**

*Controlling Printing to the Output File*

Every spec (except the arima spec) contains a print argument to control the tables that are sent to 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.

Also, an individual table can be added or removed 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 irregulars (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)**. If you only wanted to see 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-12-ARIMA Quick Reference (US Census Bureau, 2002).

*The Log File*

Log files are produced for every X-12 run. If requested, the log file contains a summary of some of the modeling and seasonal adjustment diagnostics. You control which diagnostics are saved to the log file with the **savelog** argument.

The name of the log file has the same name as the output file with a .log extension. For example, if you enter the command
```
> x12a mwtot
```
then the log file is mwtot.log. If you enter the command
```
> x12a mwtot mwtot2
```
then the log file is mwtot2.log.

For a list of all the diagnostics available to save to the log, please see the X-12-ARIMA Quick Reference (US Census Bureau, 2002).

Example 7 on the next page shows a spec file with some of our favorite savelog arguments.

Example 7 – For a monthly series:

```
series{
  file="example1.dat"
  start=1981.1
  period=12
  title="Example 1"
  savelog = peaks
}
transform{ function=auto savelog=atr }
regression{ aictest=(td easter) savelog=ats }
automdl{ savelog=amd }
outlier{ }
forecast{ maxlead=24 }
check{ print=all savelog=lbq }
x11{ savelog=(q2 q m1 m7 m8 m9 m10 m11 fd8) }
slidingspans{ savelog=pct }
history{ estimates=(sadj sadjchng) savelog=(asa ach) }
```

*Saving Files*

You may want to save some of the tables in individual files. For example, particularly in production, you may want to save the seasonally adjusted series or the seasonal factors instead of reading them from the output file.

The save argument is available for all specs except the arima spec. The save argument's function is to cause X-12 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 filename 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-12-ARIMA Quick Reference (US Census Bureau, 2002).

Example 8 shows a sample spec file name test.spc where we are saving the seasonal factors.

Example 8 – test.spc

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

If you run
**> x12a test**
then X-12 stores the seasonal factors in test.d10. If you run
**> x12a test c:\x12test\test2**
then X-12 stores the seasonal factors in c:\x12test\test2.d10.

Most save files have two columns. The columns are delimited by a tab character. Dates are in the format *yyyymm* (199706 for June 1997). The corresponding series values are given in scientific notation to 15 decimals places. Every save file has a two line header.

Example of the top of a Save File:

```
Date      MWTOT.d10
------    ----------------------
198201    +0.952159433845930E+00
198202    +0.905457980509606E+00
198203    +0.904145921415339E+00
198204    +0.908306333090025E+00
198205    +0.992194160349269E+00
198206    +0.102848507677265E+01
198207    +0.106552609238023E+01
   .
   .
   .
```

**Command-Line Options for X-12-ARIMA**

Input Flags are input options that are specified on the command line. Some of the input flags require arguments immediately following the flag. For example,
**> x12a -m usmeta -w**

We will review some of the most often used input flags.

*X-12-ARIMA  Metafiles*

Besides running the series one at a time, you can also run X-12-ARIMA in "multi-series" mode. Running in multi-series mode can save some typing. It also provides an easier way to look at the diagnostics since the diagnostics from all the series are written to the same log file.

To run more than one series with one call to X-12, you can create a metafile. The metafile is a text file with the extension .mta with a list of the input specification files you want to run. Up to 500 input files can be listed. We run an X-12 metafile with the –m input flag.

The command for running an X-12 metafile is
**> x12a -m** *metafile*
where *metafile*.mta is the name of the metafile.

> **RULE** – Enter the metafile name without the .mta extension.

Say that the contents of starts.mta is
    nehs
    mwhs
    sohs
    wehs

Then X-12 will run the input files nehs.spc, mwhs.spc, sohs.spc, and wehs.spc.  The output files will be named nehs.out, mwhs.out, sohs.out, and wehs.out.  The log file will be named starts.log.

If you want to specify an alternate name for the output files, you can have two filenames listed on each line.  This is not required.  If you have two filenames, the first filename is used for the name of the input specification file, and the second is used to form the name of the output files.  If a second filename isn't specified, then the output filename is taken from the name of the input specification file.

*Data Metafiles*

Another way to run multiple series is to run one spec file for multiple data files.  While this is maybe not quite so useful for production, it can be very useful in some cases, perhaps when running the series with an "initial" spec file.  To run X-12 in "data metafile mode," you need to create a list of the data files for the series you want to run.  This list is called a *data metafile*.  The data metafile is a text file with the extension .dta.  Up to 500 data files can be listed.

The command for running an X-12 data metafile is
**> x12a** *filename* **-d** *datameta*
where *filename* is the name of the input specification file and *datameta*.dta is the name of the metafile.

---

**RULE** – Enter the filename without the .spc extension and the data metafile name without the .dta extension.

---

If your data files have extensions, you will need to include their extensions in the list in the data metafile.

Say that the contents of starts.dta is
    nehs.dat
    mwhs.dat
    sohs.dat
    wehs.dat

One possible spec files for this series would be the example in Example 9 shown on the next page.

Example 9 – "Initial" Spec file to use with a Data Metafile

```
series{
  title="Example 9"
  format=datevalue
  savelog = peaks
}
transform{ function=auto savelog=atr }
regression{ aictest=(td easter) savelog=ats }
automdl{ savelog=amd }
outlier{ }
forecast{ maxlead=24 }
check{ print=all savelog=lbq }
x11{ savelog=(q2 q m1 m7 m8 m9 m10 m11 fd8) }
slidingspans{ savelog=pct }
history{ estimates=(sadj sadjchng) savelog=(asa ach) }
```

Note that we don't need a file or data statement because the name of the file will be provided by the data metafile.

If our spec file is called initstar.spc, we would run X-12-ARIMA with the command
```
> x12a initstar -d starts
```
to run the input file initstar.spc for the data files nehs.dat, mwhs.dat, sohs.dat, and wehs.dat. The resulting output files would be named nehs.out, mwhs.out, sohs.out, and wehs.out. The log file would be named initstar.log.

If you want to specify an alternate name for the output files, you can have two names listed on each line. This is not required. If you have two names, the first name must be the name of the data file with any extension on the file. The second name, without an extension, is used to form the name of the output files. If a second filename isn't specified, then the output filename is taken from the name of the data files without the extension.

*Graphics Mode*

Another input flag, –g, calls the graphics export option. The –g flag precedes the directory name where X-12 will output the files that can be used by external graphics routines. (For more information on time series diagnostics graphs, see Hood (2000, 2001) and Findley and Hood (2000).)

For example, to run mwtot.spc in graphics mode and save the graphics files to the directory c:\x12a\graphics, enter the command
```
> x12a mwtot -g c:\x12a\graphics
```

The directory name provided must
• be a complete path for the operating system (for example, c:\graphics, not \graphics),
• already exist, and
• be a different directory from the directory used for the output file to avoid filename conflicts.

The graphics files generated include
- the graphics metafile (extension .gmt) which contains the series codes and filenames for all files generated by X-12-ARIMA in the graphics directory
- the diagnostics files (extension .xdg and .mdg) which contain information about the series and the modeling and seasonal adjustment options used
- the series to be graphed.  The specific series that are included depend on the options specified in the input specification file.

*Other Run-time Flags*

Some other useful Input Flags
–n     : Only tables specified by the user are printed in the main output
–w    : Wide printout format (132 characters)
–p     : No pagination in main output
–s     : Additional diagnostics files are created with extensions .xdg and .mdg
–v     : Only check spec files for errors, no further processing
–c     : Sum components of a composite adjustment, but only model and adjust the total (see next section for discussion of composite adjustments)

Input flags can be entered in any order after the spec filename and any alternate output filename. They can be entered in upper or lower case.

**Composite Spec**

The main function of the composite spec is to generate indirect and direct adjustments of an aggregate series from a set of component series.

What is an indirect or direct adjustment?  For example, the Census Bureau publishes Housing Starts information for four regions of the US (Northeast, Midwest, South and West) and the total for the US.  We can either sum the four regional series first and then seasonally adjust at the US level (the 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 US level (the indirect adjustment).

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

There are four steps when asking X-12 to calculate a composite seasonal adjustment.
Step 1:     Create spec files for component series
Step 2:     Create a spec file for composite series
Step 3:     Create a metafile that lists the component and composite series
Step 4:     Run X-12-ARIMA

Let's go back to our Housing Starts example.  Single-Family Housing Starts for the Northeast, Midwest, South and West will be summed together to get the total for the US.

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

We create spec files called ne1fhs.spc, mw1fhs.spc, so1fhs.spc, and we1fhs.spc.

In the spec files for the individual regions, we need to tell X-12 how we want the series combined. In this case, we want to add the series, so we use the argument **comptype=add**. The comptype argument is the only change that we need to make from a usual spec file for the series.

Example 10 – Spec file for Northeast (ne1fhs.spc)
```
series {
  title = "Northeast 1 Family HS"
  file = "ne1hs.ori"
  name = "NE1HS"
  format = "2R"
  comptype = add
  savelog = peaks
}
transform{ function=log }
arima{ model=(0 1 1)(0 1 1)}
outlier{ }
forecast{ maxlead=24 }
check{ print=all savelog=lbq }
x11{ savelog=(q2 q m1 m7 m8 m9 m10 m11 fd8) }
slidingspans{ savelog=pct }
history{ estimates=(sadj sadjchng) savelog=(asa ach) }
```

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

We will store the spec file for the total in us1fhs.spc

Example 11 – Spec file us1fhs.spc
```
composite {
   title = "Total 1 Family HS"
}
transform{ function=log }
arima{ model=(0 1 1)(0 1 1)}
outlier{ }
forecast{ maxlead=24 }
check{ print=all savelog=lbq }
x11{   }
slidingspans{ savelog=pct }
history{ estimates=(sadj sadjchng) savelog=(asa ach) }
```

**Note**: For a composite (aggregate) series, the direct seasonal adjustment of the series is controlled by the x11 spec. Modeling options given in this spec file are applied to the composite series only. Print, save, and savelog options for the indirect adjustment are controlled by the composite spec. Print, save, and savelog options for the direct adjustment are controlled by the x11 spec.

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

We create the metafile tot1f.mta with the following five lines:

```
ne1fhs
mw1fhs
so1fhs
we1fhs
us1fhs
```

> **RULE** – The spec file for the composite series is listed last in the metafile.

*Step 4 – Run X-12-ARIMA*

We run the metafile like any other metafile.

```
> x12a -m tot1f
```

X-12 stores the output for both the direct and indirect adjustments in us1fhs.out. Diagnostics for all the series are in the file tot1f.log.

## Other X-12-ARIMA Options

There are many other options available for X-12-ARIMA. Details on all the options are given in the *X-12-ARIMA Reference Manual*.

## Appendix A — Other X-12-ARIMA Specs

**estimate** – Estimate model specified in regression and arima specs

**identify** – produces ACF and PACF plots for all combinations for specified orders of differencing (useful for choosing appropriate orders of differencing and ARMA model orders)

**x11regression** – irregular component regression options

**Appendix B — Alternative Options for Some Common Situations**

*Options to Run X-12-ARIMA as If it Were X-11*

If you want to run X-12-ARIMA 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="example.dat"
  start=1981.1
  period=12
  title="Example"
}
x11{ }
```

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

```
series{
  file="example.dat"
  start=1981.1
  period=12
  title="Example"
}
x11{  mode = add  }
```

If you want the program to choose the seasonal adjustment mode, include the **transform** spec:

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

```
series{
  file="example.dat"
  start=1981.1
  period=12
  title="Example"
}
transform {  function=auto  }
x11 { }
```

*Options to Run X-12-ARIMA  for Forecasting Only*

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

In the example below, we've widened the prediction intervals of the forecasts from 95% (the default) to 90%.  We've also saved the forecasts and the prediction intervals.

Example A.4
```
series{
  file="example.dat"
  start=1981.1
  period=12
  title="Example"
  savelog = peaks
}
transform{ function=auto savelog=atr }
automdl { savelog = amd }
regression { aictest=(td Easter) savelog=ats }
outlier { }
forecast {
  maxlead = 24
  probability=0.90
  save = fct
}
identify { }
check { print=all savelog=lbq }
```

*Options to Run X-12-ARIMA  for Short Series*

For short series, you may want to consider some alternative options.  For example, it is difficult to get 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.  Also, you might not have enough data for the sliding spans and history procedures in X-12-ARIMA.

Below is a suggested spec file for running a short series.

Example A.5
```
series{
  file="example.dat"
  start=1981.1
  period = 12
  title="Example"
}
transform{ function=auto }
arima { model = (0 1 1)(0 1 1) }
outlier { }
forecast { maxlead = 24 maxback = 24 }
check { print=all }
x11 { }
```

**Appendix C — Alternatives to a DOS Prompt**

We realize that in the age of Microsoft Windows®, running programs in a DOS Window can sometimes be a difficult adjustment. We have found a few alternatives to a DOS prompt. Most of the programs are not supported by the Census Bureau, and we offer no endorsements or guarantees.

The Census Bureau does support a set of SAS® programs we wrote that will run X-12 from SAS. If you are interested in more information, please contact Catherine Hood at catherine.c.hood@census.gov.

You may want to download a program called Programmers' File Editor (PFE). PFE is a good alternative to Notepad and has the ability to run and capture the output of DOS programs. PFE is not supported or endorsed by the Census Bureau, but we have used it to run X-12 as an alternative to running X-12 from a DOS prompt. The final release of PFE is version 1.01, which is available for Windows 3.1x, Windows 9x, Windows NT, and Windows 2000. Unfortunately, the developer is not working on new versions of the software and will not reply to PFE-related e-mail. But it is freeware that you can download from a number of sites, including Winsite at http://www.winsite.com/.

Another alternative to a DOS prompt is a program called OxEdit. OxEdit is a powerful text editor that runs under Windows 95, 98, ME and Windows NT/2000, with features such as syntax highlighting, searching for text within a set of files, and running outside programs through the use of modules. For more information on OxEdit (including how to download the latest version) please see the web site at http://www.oxedit.com.

OxEdit is one of a suite of programs currently supported by Timberlake Consultants. One of the programs distributed by Timberlake is called PcGive Professional – an interactive econometric modeling package with several modules. One of the modules is an X12arima module that provides a Windows interface to a limited number of X-12-ARIMA options. For more information, please see the Timberlake web site at http://www.timberlake-consultancy.com/.

PFE, OxEdit, and PcGive Professional are not supported or endorsed by the Census Bureau.

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