

# Getting Started with X-12-ARIMA Output Files on Your PC — DRAFT

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After running X-12-ARIMA (or X-12 for short), you will find that the program has written several different output files. This document will explain the basic formats of and the information included in the various output files. You will find more details in the *X-12-ARIMA Reference Manual* (U.S. Census Bureau, 2003) and the “X-12-ARIMA Quick Reference” (U.S. Census Bureau, 2003).

X-12-ARIMA sends error messages and warnings to the screen. The program also usually generates several different output files in a single run. Unless you request that they are suppressed, for every run, X-12 will generate an output file (\*.out), an error file (\*.err), and a log file (\*.log). It is also possible to generate some optional output files such as the summary file (\*.udg) and several different files from the “save” option in X-12 or produced as graphics output files.

For this document, we assume that you have already read either “Getting Started with X-12-ARIMA Input Files on Your PC, DOS” (Hood and Monsell, 2002) or “Getting Started with X-12-ARIMA Input Files on Your PC, Windows” (Hood and Feldpausch, 2004) and have a basic understanding of how to run X-12. This information is not essential to reading the output, but this document will not explain how to run X-12. We will not attempt to review all the diagnostics output. That information is covered in the paper “Getting Started with X-12-ARIMA Diagnostics” (Hood, McDonald-Johnson, and Feldpausch, 2004).

We also 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).

The output files have changed very little in different versions of the program. The only difference in output files between Versions 0.2.x and 0.3 is that there were two diagnostics files produced (with extensions .xdg and .mdg) instead of the one diagnostics file with the .udg extension. We assume for this paper that you are running Version 0.3 of X-12-ARIMA in either Windows or DOS.

This document is organized into the following topics:

1. Screen Errors, Warnings, and Notes
2. The Output File
3. The Error File
4. The Log File
5. The Summary File
6. Save Files
7. Graphics Files

## 1. Screen Errors, Warnings, and Notes

Error messages, warnings, and notes are sent to the screen by default. The messages on the screen are a very important part of the X-12 output. The example below shows what a screen message looks like for a series with no errors or warnings. The message in Example 1 is for the input specification file named civ.spc.

### Example 1.

```
X-12-ARIMA Seasonal Adjustment Program
Version Number 0.3 Build 129
Execution began Jan 23, 2004 15.19.39
```

```
Reading input spec file from civ.spc
Storing any program output into civ.out
Storing any program error messages into civ.err
```

```
Execution complete for civ.spc
```

If you run in batch mode, then the screen output lists all the series in the metafile. Example 2 shows an example from a batch run and also shows what the screen output looks like with an error message.

### Example 2.

```
X-12-ARIMA Seasonal Adjustment Program
Version Number 0.3 Build 129
Execution began Jan 23, 2004 15.45.18
```

```
Reading input metafile from EXAMPLE2.mta
```

```
Reading input spec file from mwlfam.spc
Storing any program output into mwlfam.out
Storing any program error messages into mwlfam.err
```

```
ERROR: Multiplicative or log-additive seasonal adjustment cannot be
done with a series with zero or negative values.
```

```
No seasonal adjustment this run
**Correct input and rerun mwlfam.spc**
```

```
Check error file mwlfam.err
```

```
Reading input spec file from mwtot.spc
Storing any program output into mwtot.out
Storing any program error messages into mwtot.err
```

```
Execution complete for mwtot.spc
```

```
NOTE: Correct input errors in the order they are detected
since the first one or two may be responsible for
the others (especially if there are errors in the
SERIES or COMPOSITE spec).
```

```
Check EXAMPLE2.log to see which input files defined in EXAMPLE2.mta
were terminated due to errors.
```

In the example above, the message tells us that we're trying to do a multiplicative adjustment (and take the logs) of a series with zero values. We could change the input specification file, `mw1fam.spc`, and set `function=none` in the transform spec to fix the problem. For this series, we expect a problem with the data because we feel that the series should have all positive values, so we need to fix the data file instead.

A very common warning message is a message about spectral peaks. An example of this type of message is shown in Example 3 below. This is a message that could mean there is residual seasonality or calendar effects in the series, or that the original series itself is seasonal but isn't being adjusted. For more information on spectral diagnostics, see the "Getting Started with X-12-ARIMA Diagnostics" (Hood, McDonald-Johnson, Feldpausch) paper.

### Example 3.

```
X-12-ARIMA Seasonal Adjustment Program
Version Number 0.3 Build 129
Execution began Jan 23, 2004 15.19.39
```

```
Reading input spec file from civ.spc
Storing any program output into civ.out
Storing any program error messages into civ.err
```

```
WARNING: At least one visually significant seasonal peak has been found
         in the estimated spectrum of the regARIMA residuals.
```

```
Execution complete for civ.spc
```

To suppress warnings and notes and see only the error messages on the screen, you can run X-12-ARIMA in quiet mode. Quiet mode isn't recommended for novice users.

## 2. The Output File

The output file will have the extension `.out` and will be named for the spec files unless you specify an alternate output name when running X-12.

The output file easily can be 50-100 pages. To help you look for some of the most important tables, we've listed some below.

- The original series is in Table A1.
- The prior-adjusted series (if there are prior adjustments) is in Table B1. (If there are no prior adjustments, then Table B1 and Table A1 are identical.)
- The seasonally adjusted series is in Table D11.
- The trend-cycle is in Table D12.
- The combined (seasonal, trading day, and holiday) factors are in Table D16.
- The seasonal factors alone (no trading day or holiday) are in Table D10.
- The original series divided by the final seasonally adjusted series is in Table E16. This will match Table D16 for multiplicative adjustments. For additive adjustments with nonnegative values, Table E16 gives a set of seasonal factors that are centered on 1 and can be divided into the original series.

For all of these tables we would be looking for anything unusual. It is often better to look at graphs of the series and components below instead of looking at tables. X-12 has a companion graphics package called X-12-Graph.

Some tables for looking at the extreme value procedure are below. We will talk more about this procedure in Section 2.2 below.

- Weights for extreme values are in Table C17.
- The last SI values (the detrended series) are in Table D8.
- The SI replacement values are in Table D9.

Some additional useful information is listed in Section 2.3. See Section 2.4 for more information on the print arguments that control which tables are sent to the output file.

For a list of all the tables with their names and codes, please see Table 1 of the X-12-ARIMA Quick Reference (U.S. Census Bureau, 2003).

## 2.1 Standard Format for Pages and Tables

Pages have a one line header at the top with the title of the series, the page number, and the series name. The title and the name are set in the series spec of the X-12 input specification file.

Most of the output tables are organized with the table name at the beginning of a two- to four-line header. After the header information comes a list of the months or quarters. For quarterly data, each year is generally given on one line. For monthly data, the number of months per line depends on the size of the numbers in the table and could be six months or as few as two months across.

Example 4 below shows the top of Table A1, the original series, for a civilian labor force series. Example 5 shows the top part of the original series for a U.S. import series which has much larger values. You can see the difference in the two formats.

If you would like to see all the monthly values on one line, you can run X-12-ARIMA in wide output mode. This makes every row in the output file wider and may allow for all the data for the year to fit on one line.

### Example 4.

```

X-12-ARIMA run for CIV                                PAGE 2, SERIES civlf

A 1 Time series data (for the span analyzed)
  From 1978.Jan to 2003.Apr
  Observations      304
-----
          Jan      Feb      Mar      Apr      May      Jun
          Jul      Aug      Sep      Oct      Nov      Dec      TOTAL
-----
1978      99664.    99640.    100166.    100610.    101092.    104010.
          104512.    103946.    102748.    103474.    103586.    103565.          1227013.

1979      102802.    103185.    103606.    103198.    103476.    106210.
          107096.    106489.    105510.    106084.    105871.    106040.          1259567.

1980      . . .

```

**Example 5.**

U.S. Imports of Rubber

PAGE 2, SERIES Imrubr

A 1 Time series data (for the span analyzed)

From 1989.Jan to 2002.Dec

Observations 168

	Jan	Feb	Mar	
	Apr	May	Jun	
	Jul	Aug	Sep	
	Oct	Nov	Dec	TOTAL
1989	221193059.00	166563923.00	244108688.00	
	195587392.00	220191183.00	191808167.00	
	196973908.00	177601246.00	164176577.00	
	177539973.00	176125940.00	145689339.00	2277559395.00
1990	179856116.00	149132611.00	187536238.00	
	160422086.00	172766543.00	174700905.00	
	174866119.00	154469392.00	171658752.00	
	164978370.00	179405927.00	160290498.00	2030083557.00
1991	. . .			

You can see in the examples above that the table in Example 4 has no decimals printed and the table in Example 5 has two decimals printed (even though they are all zeros). The number of decimals printed is zero by default. The argument to have X-12 print decimal places is the decimal argument in the series spec. The command we used for the table in Example 5 was "decimals=2". Though perhaps not so useful in this example above, we do see some decimal values in the seasonally adjusted series, as shown in Example 6 below.

**Example 6.**

D 11 Final seasonally adjusted data

(also adjusted for trading day)

From 1989.Jan to 2002.Dec

Observations 168

	Jan	Feb	Mar	
	Apr	May	Jun	
	Jul	Aug	Sep	
	Oct	Nov	Dec	TOTAL
1989	215289892.87	183352538.60	219569381.20	
	203329832.48	207090900.02	187478779.86	
	189504534.28	177437470.21	175646755.86	
	175378603.49	175747715.48	166555633.65	2276382037.99
1990	172325709.19	163323818.54	165613473.61	
	163346587.75	162785100.03	173820430.27	
	164392309.68	159100753.51	188603234.99	
	160874429.30	178785110.06	178368198.08	2031339155.03
1991	. . .			

To reduce some of the white space shown in the tables, you can also run X-12 in reduced output mode. This prints the tables with an empty line between every five years of data instead of between every year. An example is in Example 7 below.

**Example 7.**

B 1 Original series (prior adjusted)  
 (adjusted for regARIMA factors)  
 From 1978.Jan to 2003.Apr  
 Observations 304

	Jan Jul	Feb Aug	Mar Sep	Apr Oct	May Nov	Jun Dec	TOTAL
1978	101409.	101385.	101911.	102355.	102837.	105755.	
	106257.	105691.	104493.	105219.	105331.	105310.	1247948.
1979	104547.	104930.	105351.	104943.	105221.	107955.	
	108841.	108234.	107255.	107829.	107616.	107785.	1280502.
1980	107089.	107157.	107255.	107337.	107978.	110056.	
	111013.	110149.	108734.	109418.	109277.	108754.	1304212.
1981	108630.	108760.	109379.	109651.	110331.	111649.	
	112487.	111844.	110018.	110989.	110924.	110319.	1324976.
1982	109759.	110069.	110506.	110559.	111659.	113314.	
	114271.	113632.	112291.	112512.	112600.	112222.	1343389.
1983	111524.	111392.	111618.	111620.	112053.	115128.	
	115725.	115323.	113942.	113787.	113892.	113540.	1359539.
1984	112770.	113113.	113573.	113897.	114996.	117138.	
	117943.	116821.	115588.	115995.	115860.	115773.	1383462.
1985	115220.	115337.	116139.	116070.	116635.	118317.	
	119281.	118424.	117595.	118091.	117842.	117525.	1406471.
1986	117176.	117470.	118054.	118062.	118944.	121389.	
	122048.	121216.	119989.	120444.	120368.	119794.	1434949.
1987	. . .						

**2.2 Tables Associated with the Extreme Value Procedure**

X-12-ARIMA has two different procedures to protect against extreme values. The worst outliers are prior-adjusted out of the series using regARIMA models. There is also an extreme value procedure inside the X-11 module. We usually use the word *outliers* to refer to “outliers” in the regARIMA model and *extreme values* for “outliers” identified in the X-11 algorithms.

For these tables, we are looking for any year or any month/quarter with a lot of extreme values, or a particular month/quarter with several extreme values in consecutive years.

The Basic Extreme Value Algorithm:

1. Estimate a standard error from the irregular
2. Eliminate the influence of points with large irregular, compared to the standard error. By default, points with irregulars
  - less than 1.5 times the standard are not replaced and are given a weight of 100,
  - more than 2.5 times the standard error are replaced entirely and are given a weight of 0, and
  - between 1.5 and 2.5 are partially replaced. The weight function is a linear interpolation between 0 and 100 based on the value of the irregular.

The final weights for the irregular component are in Table C17. In the example below, you can see values that X-12 found to be extreme. For example, May 1979 had a value greater than 2.5 times the standard error because that point has a weight of zero. March 1979 had a value slightly less than 2.5 times the standard error because the point has a weight of only 8. May and June of 1978 were also partially replaced.

By default, the cutoffs for the calculations are 1.5 and 2.5. You can see them listed as the sigma limits in the heading information in the table. You can change the sigma limits in the program with the argument `sigmalim` in the `x11` spec. Higher values for the sigma limits would identify fewer extreme values.

### Example 8.

C 17 Final weights for irregular component

From 1978.Jan to 2003.Apr

Observations 304

Lower sigma limit 1.50

Upper sigma limit 2.50

	Jan Jul	Feb Aug	Mar Sep	Apr Oct	May Nov	Jun Dec	S.D.
1978	100. 100.	100. 100.	100. 100.	100. 100.	68. 100.	48. 100.	13848.
1979	100. 100.	100. 100.	8. 100.	100. 100.	0. 100.	100. 100.	13848.
1980	. . . .						

Tables D8 and D9 contain the Final Unmodified SI Ratios and the Final Replacement Values for the SI Ratios. For multiplicative adjustments, the SI Ratio is the ratio of the original series to the estimated trend (for additive adjustments, the SI Ratio is the original series minus the trend), so it is an estimate of the detrended series. It can also be thought of as the seasonal-irregular component. You will notice in the example below that the months that contain replacement values correspond to the months with weights less than 100 in the Table C17 above.

### Example 9.

D 8 Final unmodified SI ratios

From 1978.Jan to 2003.Apr

Observations 304

	Jan Jul	Feb Aug	Mar Sep	Apr Oct	May Nov	Jun Dec	AVGE
1978	99.2 102.0	98.9 101.2	99.1 99.8	99.1 100.2	99.2 100.1	101.7 99.8	100.0
1979	98.9 101.9	99.2 101.1	99.4 100.0	98.9 100.3	99.0 99.8	101.3 99.8	100.0
1980	. . . .						

D 9 Final replacement values for SI ratios

From 1978.Jan to 2003.Apr

Observations 304

	Jan Jul	Feb Aug	Mar Sep	Apr Oct	May Nov	Jun Dec
1978	***** *****	***** *****	***** *****	***** *****	99.3 *****	101.4 *****
1979	***** *****	***** *****	99.1 *****	***** *****	99.5 *****	***** *****
1980	. . . .					

## 2.3 Additional Information Not Listed in Standard Format Tables

We mentioned above that the sigma limit information is found in the header for Table D8. Below we list some other useful information that is found in the table headers. Filter information is in Sections 2.3.1 and 2.3.2. A brief list of the diagnostic information is in Section 2.3.3.

X-12-ARIMA has automatic procedures for choosing the length of the seasonal and the trend filters based on noise-to-signal ratios. Shorter filters are preferred when the irregular is small and the movement in the seasonal or trend is large. Longer filters are preferred when the irregular is large or when the estimates of the seasonal or trend are reasonably stable.

### 2.3.1 Seasonal Filter Length Used

The *seasonal filters* (or *seasonal moving averages*) are the filters used to estimate the seasonal component. The seasonal filters available in X-12-ARIMA consist of weighted averages of consecutive values within a given month or quarter. An  $n \times m$  *moving average* is an  $m$ -term simple average taken over  $n$  consecutive sequential spans.

An example of a 3x5 filter for January 1999 (or Quarter 1, 1999) is:

$$\begin{array}{r} 1996.1 + 1997.1 + 1998.1 + 1999.1 + 2000.1 + \\ 1997.1 + 1998.1 + 1999.1 + 2000.1 + 2001.1 + \\ 1998.1 + 1999.1 + 2000.1 + 2001.1 + 2002.1 \\ \hline 15 \end{array}$$

The seasonal filter used by X-12 to compute the final seasonal factors is listed in the header of Table D10 (the seasonally adjusted series).

#### Example 10.

```
D 10 Final seasonal factors
From 1978.Jan to 2003.Apr
Observations      304
Seasonal filter   3 x 5 moving average
```

X-12 provides the following seasonal filter options: 3x1, 3x3, 3x5, 3x9, 3x15 and stable. (A *stable seasonal filter* uses all the values for the particular month or quarter.) The user can specify a seasonal filter to use for every month or quarter or specify different filters for different months. By default, X-12 will choose one seasonal filter to use for every month or quarter.

X-12's built-in procedure to choose the filter length is based on the *Global Moving Seasonality Ratio* (MSR) which is a measure of the average change in the irregular divided by the average change in the seasonal for the entire series. For the last iteration through the data, X-12-ARIMA chooses either a 3x3, 3x5, or 3x9 moving average. The most common choice for the seasonal filter is 3x5.

### 2.3.2 Trend Filter Used

*Trend filters* are weighted averages of consecutive months or quarters used to estimate the trend component. In X-12-ARIMA a simple 2x12 (or 2x4 for quarterly series) trend filter is used for the first rough estimate of the trend. The other trend-cycle estimates come from very complex filters known as Henderson filters. Henderson filters are designed to estimate curves.

The final Henderson filter (and the associated I/C ratio) is listed in the header of Table D12 (the trend-cycle).



**Example 11.**

```

D 12 Final trend cycle
From 1978.Jan to 2003.Apr
Observations      304
Trend filter      9-term Henderson moving average
I/C ratio         0.84

```

For monthly series X-12-ARIMA will choose either a 9-, 13-, or 23-term Henderson filter automatically, based on the I/C ratio — the irregular divided by the trend. X-12-ARIMA chooses a 9-term Henderson filter when the I/C ratio is small to pick up the changes in the trend-cycle and chooses a 23-term filter when the I/C ratio is large so that the filter is less susceptible to extreme values. For quarterly series, X-12-ARIMA will choose either a 5-term or a 7-term Henderson filter.

For more on seasonal and trend filters, see the X-12 Reference Manual (U.S. Census Bureau, 2003).

**2.3.3. Diagnostic Information**

There are several tables that contain only diagnostic information. We mention the tables here briefly. For more details on the diagnostics, please see the paper on diagnostics. Table D8.A contains some F-tests for the presence of stable and moving seasonality. Tables that begin with F contain diagnostics that are familiar to many because they first came about in X-11-ARIMA. Table F3 contains the Monitoring and Quality (Ms and Q) diagnostics first introduced by Statistics Canada in X-11-ARIMA. Tables that begin with G contain line-printer plots of the spectral graphs. Tables that begin with R contain revision history diagnostics and summaries. Tables that begin with S contain sliding spans diagnostics and summaries.

**2.4 Controlling the Tables Sent to the Output File**

Which tables are sent to the output file is controlled by the input specification file. In the input file you can specify either printout levels or lists of individual tables that you would like printed to the output file.

For more information on how to change the tables that are printed, please see the “Getting Started with X-12-ARIMA Input Specification Files on Your PC, Windows” Section 4.1 (Hood and Feldpausch, 2004) or the X-12-ARIMA Reference Manual (U.S. Census Bureau, 2003). For a list of all the tables with their names and codes, please see Table 1 of the X-12-ARIMA Quick Reference (U.S. Census Bureau, 2003).

**3. The Error File**

The error file will have the extension .err and will be named for the spec files unless you specify an alternate output name. The messages that are sent to the screen are also in the error file.

**Example 12.**

```

Error messages generated from processing the X-12-ARIMA spec file
civ.spc:

```

```

WARNING: At least one visually significant seasonal peak has been found
in the estimated spectrum of the regARIMA residuals.

```

The error file will exist even if there are not errors. The example below shows the error file once we've corrected the problem with the spectral peaks.

#### Example 13.

Error messages generated from processing the X-12-ARIMA spec file civ.spc:

### 4. The Log File

The log file has the extension .log. If you are running in single-spec mode, the log file will be named for the spec file unless you specify an alternate output name. If you are running in batch mode, the log file will be named for the metafile.

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. For a list of all the diagnostics available to save to the log, please see Table 2 of the X-12-ARIMA Quick Reference (U.S. Census Bureau, 2003).

#### Example 14.

1

```
Log for X-12-ARIMA (Version 0.3 Build 129) Jan 23, 2004 16.33.47
*-----*
```

Type of Adjust.	Series Ident.	Additional Identifiers	Series title
-----------------	---------------	------------------------	--------------

M-MLT	civlf	-----	X-12-ARIMA run for CIV
-------	-------	-------	------------------------

Automatic model chosen : (0 1 1) (0 1 1)

AICtd : rejected

AICeaster : rejected

Stable Seasonal F, D8 table : 237.418

M07 : 0.268

#### Example 15.

1

```
Log for X-12-ARIMA (Version 0.3 Build 129) Jan 23, 2004 17.45.18
*-----*
```

Type of Adjust.	Series Ident.	Additional Identifiers	Series title
-----------------	---------------	------------------------	--------------

Error messages for the input files defined in EXAMPLE2.mta

Input or runtime errors were found in the following files:

mwlfam.spc (Error messages stored in mwlfam.err)

## 5. Summary File

Some of the information found in the output is also found in the summary file. The summary file has the extension .udg. The summary file is colon delimited so that you can read it easily into other programs, such as spreadsheet programs. An example file is shown below.

### Example 16.

```

date: Jan 23, 2004
time: 16.37.32
version: 0.3
build: 129
srstit: X-12-ARIMA run for CIV
srsnam: civlf
freq: 12
span: 1st month,1978 to 4th month,2003
transform: Log(y)
samode: multiplicative seasonal adjustment
siglim: 1.5 2.5
seasonalma: M.S.R.
trendma: default
automdl: (0 1 1)(0 1 1)
aictest.td: no
aictest.e: no
autoout: 0
sfmsr: 3x5

```

## 6. Save Files

You can also save specific tables to separate files that can be read easily into other software, such as spreadsheet programs. For more details on saving files with the save argument, please see the paper “Getting Started with X-12-ARIMA Input Files on Your PC.”

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 Table 1 of the X-12-ARIMA Quick Reference (U.S. Census Bureau, 2003).

Most save files have two columns. The columns are delimited by a tab character. Dates are in the format *yyyymm* (for example, 199704 for April 1997 or Quarter 4, 1997). The corresponding series values are given in scientific notation to 15 decimal places. Every save file has a two line header.

### Example 17.

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
.	
.	
.	

## 7. Graphics Output Files

When you run X-12 in graphics mode, it creates graphics files that correspond to the X-12 options you choose. X-12 also creates a graphics metafile, identified by the extension .gmt. The metafile contains a list of all the graphics output files produced during the run. To run the program in graphics mode, you must supply the name of an existing directory where X-12-ARIMA will store the graphics files. You must use the full path name of the directory. (Because of output filename conflicts, this should be a different directory from where the output file will be stored.) For more information, see Section 2.7 of the X-12-ARIMA Reference Manual. The codes are in Table 4 of the Quick Reference.

Many of the files that you may want to save, like the seasonal factors, are also saved when you run in graphics mode. Running X-12 in graphics mode is a common and simple way to get some of the output you want in “save” format without having to rewrite input commands to save the files.

## Acknowledgments

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## Appendix

### X-11 Tables in B, C, and D Iterations

I have highlighted the tables that are most useful to me when reviewing a seasonal adjustment.

Raw or prior-adjusted series	<b>B1</b>	C1	D1
Trend estimation #1 – T(1)	B2	C2	D2
SI estimation #1 – SI(1)	B3	C4	D4
Replacement values #1 – RSI(1)	B4	---	---
Seasonal estimation #1 – S(1)	B5	C5	D5
SA series #1 – A(1)	B6	C6	D6
Trend estimation #2 – T(2)	B7	C7	D7
SI estimation #2 – SI(2)	B8	C9	<b>D8</b>
Replacement values #2 – RSI(2)	B9	---	<b>D9</b>
Moving Seasonality Ratios	---	---	<b>D9A</b>
Seasonal estimation #2 – S(2)	B10	C10	<b>D10</b>
SA series #2 – A(2)	B11	C11	<b>D11</b>
SA series with totals revised	---	---	D11A
Irregular estimation – I(2)	B13	C13	---
Trend estimation #3 – T(3)	---	---	<b>D12</b>
Irregular estimation – I(3)	---	---	<b>D13</b>
Weights for irregular – W	B17	<b>C17</b>	---
Adjusted series – X	B20	C20	---
TD regression	B15	C15	---
TD Factors	B16	C16	---
Combined seasonal and TD factors	B18	C18	<b>D16</b>
Original series / Final SA series			<b>E16</b>

## 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.
- Feldpausch, R.M. (2003), "X-12 Runner: A Windows Program to Run X-12-ARIMA, Users' Guide, Version 1.0," Washington, DC: U.S. Census Bureau, U.S. Department of Commerce.
- Feldpausch, R.M. (2003), "X-12-Data: An Excel<sup>®</sup> Macro for X-12-ARIMA Data Files, Users' Guide, Version 1.0," Washington, DC: U.S. Census Bureau, U.S. Department of Commerce.
- 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.
- Hood, C.C. (2001), "X-12-Graph: A SAS/GRAPH<sup>®</sup> Program for X-12-ARIMA Output, User's Guide for the X-12-Graph Interactive for PC/Windows, Version 1.2," Washington, DC: U.S. Census Bureau.
- Hood, C.C. and R.M. Feldpausch (2004), "Getting Started with X-12-ARIMA Input Files on Your PC, Windows," Washington, DC: U.S. Census Bureau.
- Hood, C.C. and B.C. Monsell (2004), "Getting Started with X-12-ARIMA Input Files on Your PC, DOS," Washington, DC: U.S. Census Bureau.
- Ladiray, D. and B. Quenneville (2001), *Seasonal Adjustment with the X-11 Method*. Springer-Verlag: New York, NY.
- 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.
- McDonald-Johnson, K.M. and R.M. Feldpausch (2003), "X-12-Rvw: The Review Sheet Program, Users' Guide to the Interactive SAS/AF<sup>®</sup> Version," Washington, DC: U.S. Census Bureau, U.S. Department of Commerce.
- U.S. Census Bureau (2003), *X-12-ARIMA Reference Manual, Final Version 0.2*, Washington, DC: U.S. Census Bureau, U.S. Department of Commerce. The self-extracting zip file:  
<http://www.census.gov/ts/x12a/final/pc/omegapdf.exe>
- U.S. Census Bureau (2003), *X-12-ARIMA Quick Reference for DOS, Final Version 0.2*, Washington, DC: U.S. Census Bureau, U.S. Department of Commerce.  
<http://www.census.gov/ts/TSMS/SADoc/qrefdos.pdf>