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Release Notes for Version 0.3 of X-12 ARIMA

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Abstract

This document gives details about the recently released Version 0.3 of the X-12-ARIMA seasonal adjustment software. New features are highlighted, and differences between Version 0.3 and Version 0.2.10 of X-12-ARIMA are detailed. Several software defects were corrected in this version; details of these are given.

Key Words: seasonal adjustment, ARIMA model selection, composite adjustment, metadata.

Disclaimer

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1 Introduction

Version 0.3 of X-12-ARIMA has been under development for many years, and includes several new features. Details are given in Section 2.

In addition, many options and defaults have been changed from previous versions of X-12-ARIMA. This paper will document the new features and changes in the software, including changes in the Reference Manual.

For users of the Windows operating system, there is now a Windows Interface to the `X-12-ARIMA` program. This program provides a point and click interface for running X-12-ARIMA for PCs running Windows 2000 (or higher), and also creates basic input specification files (spec files) and metafiles for the user. For more details, consult Feldpausch (2007).

Note that throughout this document, arguments and spec names used in the X-12-ARIMA input will be presented in `this font`.

2 New features of Version 0.3 of X-12-ARIMA

The most important new features of Version 0.3 are described below:

- an alternative automatic model identification procedure;

- a new force spec which incorporates new options for forcing the yearly totals of the seasonally adjusted series to match those of the original series;
- revised procedures for composite seasonal adjustment;
- a unified diagnostics file;
- a new metadata spec which allows users to incorporate their own metadata into the unified diagnostics file;
- new options to render X-12-ARIMA's output accessible for people with limiting conditions;
- a technique for running X-12-ARIMA with files that have spaces in their names.

Other new features of the software will be noted as well.

2.1 New automatic model selection procedure

The automatic ARIMA model selection procedure implemented into Version 0.3 is based on the procedure in the TRAMO time series modeling program developed by Víctor Gómez and Agustín Maravall (Gómez and Maravall, 1997). It is very similar to TRAMO's procedure but contains modifications to make use of X-12-ARIMA's model estimation procedure, regARIMA modeling options, transformation and outlier identification procedures and model diagnostics.

Consequently, the model selected by Version 0.3 can differ from the model TRAMO selects. Testing has shown that the models selected are usually at least as good as those selected by TRAMO (Hood, 2002a).

The TRAMO procedure is largely documented in Gómez and Maravall (2000), but the actual implementation of the procedure in the current TRAMO program differs from the description that appears in that paper.

The procedure can be summarized in five stages:

- **default model estimation:** a default model (almost always the airline model) is estimated, initial outlier identification and regressor tests are performed, and residual diagnostics are generated;
- **identification of differencing orders:** empirical unit root tests are performed to determine the orders of differencing needed for the model;
- **identification of ARMA model orders:** an iterative procedure is applied to determine the order of ARMA parameters using a revised version of the BIC model comparison criteria of Schwarz (1978);
- **comparison of identified model with default model:** the identified model is compared to the default model and possibly replaced;
- **final model checks:** the final model is checked for adequacy.

The second stage is optional, as the user can specify the orders of regular and seasonal differencing using the `diff` argument of the `automdl` spec.

An overview of the procedure is given in Monsell (2002) and Census (2007).

2.1.1 New `pickmdl` spec

The procedure previously used in X-12-ARIMA can still be selected by the user with the `pickmdl` spec. A comparison documented in Dent, Hood, McDonald-Johnson, and Feldpausch (2005) showed little difference in the models selected by the two procedures, but expressed a preference for the new procedure due to the new method's flexibility in iterating over a number of possible seasonal and nonseasonal ARMA orders.

Note that in previous versions of X-12-ARIMA, a model file named `x12a.mdl` was used as a default to supply the models considered for the ARIMA model selection procedure. In Version 0.3, the program can generate the default models needed for the selection procedure used by `pickmdl`; therefore, the `x12a.mdl` file is no longer needed and is not distributed with the program.

Users still can specify their own model file by using the `file` argument of the `pickmdl` spec.

2.2 New forcing option

Some users wish to produce a seasonally adjusted series where the totals of each calendar (or fiscal) year match the totals of the original series. Earlier versions of X-12-ARIMA provided only the Denton proportional method Denton (1971) as implemented in X-11-ARIMA (Dagum, 1980) to force the totals of the seasonally adjusted series to match those of the original series. This method ensures that the differences between the annual totals is distributed over the seasonally adjusted values in a way that approximately preserves the month-to-month (or quarter-to-quarter) movements of the original series for an additive seasonal adjustment, and tries to keep the ratio of the forced and unforced values constant for multiplicative adjustments. For more details see Huot (1975), Cholette (1978) and Ladiray and Quenneville (2001).

However, this method can lead to problems with the changes between years of observation, and there can be large revisions at the ends as data are added to the series. In response to this, Statistics Canada developed several benchmarking methods for this and other problems. One of them is a regression-based method that uses two parameters: λ, which is used to determine the weight matrix for the regression equation, and ρ, the value of an AR(1) parameter. More details on this method are contained in Quenneville, Cholette, Huot, Chiu, and DiFonzo (2004).

A special case of the regression method arises when $\rho \rightarrow 1$; here one gets the same formulas as the Denton method. Choosing values of ρ close to one and $\lambda = 1$ allows the user to get values that are close to the Denton method, but with smaller revisions to the forced data in incomplete years as new observations

come in. Hood (2005) presents comparison results for the regression method with various choices of λ and ρ and for other forcing methods.

To incorporate this functionality into Version 0.3 of X-12-ARIMA, a new spec was added - the `force` spec. This spec allows users to choose between the Denton method and the Statistics Canada regression method for forcing the totals of seasonally adjusted series. An example of an X-12-ARIMA spec file using the `force` spec is given in Table 1.

Forcing the agreement of annual totals is convenient for certain purposes, but it should be kept in mind that it can lower the quality of the seasonal adjustment when the seasonal effects are multiplicative or are not stable over time; see the Details section for the `force` spec in the X-12-ARIMA Reference Manual (Census, 2007).

```
series{
  title= "Retail Shoe Store Sales"
# show how to specify force spec
  format="datevalue"
  file="shoers.dat"
  name="shoers" }
x11 { }
force { type = regress
  lambda = 1.0
  rho = 0.95
  save = saa
}
```

Table 1: X-12-ARIMA Version 0.3 input file demonstrating use of `force` spec

2.2.1 Other new options related to the `force` spec

In addition, the `force` spec contains several other new features:

- The `target` argument, which specifies which series is used as the target for forcing the totals of the seasonally adjusted series. The user can choose between the original series (`target = original`), the calendar adjusted original series (`target = caladjust`), the original series adjusted for permanent prior adjustment factors (`target = permprioradj`), or the original series adjusted for both calendar and permanent prior adjustment factors (`target = both`). The default is `target = original`.

- The `usefcst` argument, which determines if forecasts are appended to the series processed by the benchmarking routines used to force the yearly totals of the seasonally adjusted series (`usefcst = yes` is the default). This provides forcing factors for the time interval of the forecasts specified by the `forecast` spec.

- The `indforce` arugment, which allows the user to choose how the indirect seasonally adjusted series is forced. If `indforce = yes`, the indirect seasonally adjusted series will be forced using the same method used to force the direct adjustments as specified in the `force` spec. If `indforce = no`, the seasonally adjusted component series with forced yearly totals will be combined (assuming all component series have been forced) to form the indirect seasonally adjusted series with forced yearly totals. The default is `indforce = yes`.

2.3 Revised composite adjustment procedures

Like X-11-ARIMA (Dagum, 1980), X-12-ARIMA has facilities to enable users to compute and compare composite direct and indirect seasonal adjustments of aggregate series. The **direct** adjustment applies the seasonal adjustment method directly to the sum (or other composite) of the component series. The **indirect** adjustment combines (usually summing) the component seasonal adjustments. The new version of X-12-ARIMA has a few innovations.

2.3.1 Indirect seasonal factors

Along with the indirect seasonal adjustment, X-12-ARIMA develops indirect analogs for other seasonal adjustment components, such as indirect seasonal factors and an indirect trend. These components are used to derive diagnostics for the indirect adjustment. However, the way some of these components are derived makes comparison to corresponding components of the direct seasonal adjustment somewhat ambiguous.

For example, each indirect seasonal factor for multiplicative seasonal adjustments is computed in Version 0.2.10 of X-12-ARIMA as the aggregate of the original series divided by the aggregate of the seasonally adjusted series, i.e.,

$$SF_t^{ind} = \frac{\sum_{i=1,n} O_t^i}{\sum_{i=1,n} SA_t^i}, t = 1, \ldots, N \tag{1}$$

where O_t^i is component series i at time t, and SA_t^i is the seasonally adjusted series for component series i at time t, n is the number of components in the aggregate adjustment, and N is the length of the series.[1]

When the O_t^i contain calendar effects and prior factors that are no longer present in SA_t^i, then SF_t^{ind} will retain these, and thus be analogous to a combined factor rather than a seasonal factor; see Figure 1.

Our technique for obtaining purely seasonal factors is to replace the O_t^i in (1) with component series $AdjO_t^i$ adjusted for calendar and temporary prior effects. Substituting these into Equation (1) gives us

[1] Note that for series that are not seasonal, options in X-12-ARIMA can be set so that the seasonal adjustment for the original series is defined to be the original series, or the calendar adjusted original series. This means that in some cases, $SA_t^i = O_t^i$.

$$SF_t^{ind} = \frac{\sum_{i=1,n} AdjO_t^i}{\sum_{i=1,n} SA_t^i}, t = 1, \ldots, N \quad (2)$$

In this way, we eliminate the effects of calendar adjustments and temporary prior adjustments. Figure 2 shows that using Equation (2) can lead to smoother indirect seasonal factors. These factors (2) are what now appear in the indirect seasonal factors table. The factors given in (1) appear in the indirect combined adjustment factors table.

2.3.2 Indirect outlier factors

X-12-ARIMA can also derive indirect multiplicative level shift and indirect additive outliers for series with certain kinds of outlier effects. This enhancement can be useful in the case where broadly influential outliers cause problems for the extraction of indirect trend components or seasonal adjustment diagnostics for indirect seasonal adjustments. The `indoutlier` argument in the `composite` spec specifies whether indirect outlier factors and adjustments are produced by the program - the default is `indoutlier = yes`.

These indirect outlier factors are calulated in an analogous way to the indirect seasonal component; let LSO_t^i be the level-shift adjusted series for component series i at time t. Then the indirect level-shift factors are obtained as shown in Equation (3):

$$LS_t^{ind} = \frac{\sum_{i=1,n} O_t^i}{\sum_{i=1,n} LSO_t^i}, t = 1, \ldots, N \quad (3)$$

where O_t^i is defined as for (1). If level shift outliers are not specified or found for component series i, then $LSO_t^i = O_t^i$. The indirect level change factors are removed from the indirect seasonally adjusted series before the indirect trend component is computed.

Similarly, let AOO_t^i be component series i adjusted for point and temporary change outliers at time t. Then the indirect AO factors can be generated as show in Equation 3:

$$AO_t^{ind} = \frac{\sum_{i=1,n} O_t^i}{\sum_{i=1,n} AOO_t^i}, t = 1, \ldots, N \quad (4)$$

where AOO_t^i is defined as for Equation (1).

Note that the user should check to see if outlier effects in the component series are consistent enough that these indirect outlier factors represent consistent effects. For example, ideally, most or all of the component series would have level shifts in the same observations. If this is not the case, then the user should specify no indirect outlier effects (`indoutlier = no`).

There are analogous indirect outlier factors for additive seasonal adjustment as well.

2.3.3 Other changes in composite adjustment procedures

In previous versions of X-12-ARIMA, only one composite adjustment could be specified within an input metafile and every series in the metafile contributed to the composite. Beginning with version 0.3, variables associated with the composite adjustment process are initialized in such a way that the program can process more than one composite adjustment in a single input metafile. Spec files with a `composite` spec demarcate the different composite adjustments.

Users now need to enter the `comptype` argument of the `series` spec in every component series they wish to include in the composite adjustment. A new argument (`none`) has been added to the `comptype` argument, and this option is the new default for the `comptype` argument. This allows users to include spec files for series they do not want included in the composite adjustment in the same metafile.

The program is now able to add a series consisting of zeros to the composite seasonal adjustment when `type=summary` is set in the `x11` spec.

2.4 Unified diagnostics file

X-12-ARIMA has long had a runtime option (the **-s** flag) to save seasonal adjustment and model diagnostics in a separate file from the main output. In this file, unique identifying keys precede the value of the diagnostic.

Prior to Version 0.3 of X-12-ARIMA, seasonal adjustment diagnostics were stored in a file with an **.xdg** file extension, and model diagnostics were stored in a file with an **.mdg** file extension. In Version 0.3 of X-12-ARIMA, these diagnostics are now stored in a unified diagnostics file, the **.udg** file.

The .udg file is used by new versions of support programs developed by the Time Series Methods Staff of the U. S. Census Bureau, such as the X-12-Graph SAS® program used to generate the graphs for this paper (see Hood (2002b) and Lytras (2007)), and the Windows Interface for X-12-ARIMA (see Feldpausch (2007)).

Details on the format of this file can be found in Monsell (2007).

2.5 User-Defined metadata

Users can now save their own metadata into the unified diagnostics file by using the `metadata` spec. The `metadata` spec allows users to specify keywords along with corresponding values to insert metadata information into the diagnostic summary file stored by X-12-ARIMA. This can be useful to provide additional information about the data or the production process for later use.

An example of the `metadata` spec is given in table 2; the records given in Table 3 would be stored in the summary diagnostics file as a result.

2.6 Accessibility concerns

Section 508 of the U. S. government's Rehabilitation Act that requires Federal agencies to make their electronic and information technology accessible to people

```
metadata {
   keys = (
      "analyst"
      "date.reviewed"
      "units.of.measure"
   )
   values = (
      "Allen Smithee"
      "June 15, 2006"
      "Millions of Dollars"
   )
}
```

Table 2: Example of a `metadata` spec

```
metadata.analyst:  Allen Smithee
metadata.date.reviewed:  January 15, 2007
metadata.units.of.measure:  Millions of Dollars
```

Table 3: Metadata output in summary diagnostics file

with disabilities and limiting vision conditions. To make X-12-ARIMA compliant with this act, two things are needed: (a) a utility to convert the current X-12-ARIMA output to accessible HTML and (b) another tool to convert the X-12-ARIMA Reference Manual and Quick Reference to an accessible format.

We have addressed the first issue by developing a utility that converts the output of X-12-ARIMA Version 0.3 into a fully accessible HTML file. The standards and techniques used to achieve this are given in W3C (2000a) and W3C (2000b).

The user first must run Version 0.3 with a new runtime option for accessible output (the **-a** flag), which places codes into the X-12-ARIMA output that the utility reads and uses to convert specific output to HTML.

After the output file has been generated, a utility named `cnvOut2HTML` can then be used to read in the annotated X-12-ARIMA output file and generate an HTML version of the output that is fully accessible. In addition, links are included that allow the user to move easily from table to table in the output, allowing ease of navigation through the HTML file.

This software converts the log and error files generated by the X-12-ARIMA program as well, and can take as input X-12-ARIMA output, log, error, or metafiles. When the utility is reading in a metafile, it will attempt to convert all the output files referenced in the metafile as well as error files for the individual runs, and the log file generated by the metafile run.

The utility is written in the Icon programming language, see Griswold and Griswold (1997); source code is available upon request. It should be noted that the converted output files can become rather large.

This utility has been integrated into the Windows Interface for X-12-ARIMA, developed by Roxanne Feldpausch at the Census Bureau. This allows the user to convert the X-12-ARIMA program output into HTML automatically and also has procedures to write X-12-ARIMA spec files with a menu driven interface. For more details, see Feldpausch (2007).

The original documentation for X-12-ARIMA was written in TEX; it has been converted into LATEX to make it easier to convert to HTML. Our goal is to create HTML such that users with commercial screen reading software (such as Jaws®) will be able to navigate the document successfully, and use MathML to render the mathematical equations. Our current efforts are centered on rendering the PDF files generated for the Reference Manual and Quick References in such a way that they can be made accessible - the CommonLook Section 508 product for Adobe® Acrobat, developed by NetCentric™Technologies, is now being used for this task.

2.7 Running X-12-ARIMA on files with blanks in their names

In many current operating systems, it is permissable to have blank spaces in file names or paths - for example, `c:\My Spec Files\test.spc`. Previous versions of X-12-ARIMA cannot handle such blank spaces in many situations, e.g. in the input specification filename - the program would assume that the filename of the input specification file was only the text up to the first space in the filename.

In Version 0.3, such a file can be specified as an input specification file if the user encloses the entire filename with quotation marks ("), as below:

```
x12a "c:\export specs\xuu1"
```

The same technique can be used for any argument specified at runtime. Below is an example that could be run on the Linux or Unix operating systems.

```
x12a -m "/vol/us trade/exports" -g "/vol/us trade/graph/"
```

Similarly, quotation marks can be used within input metafiles and data metafiles to allow the use of files with blanks in their names. An example of an input metafile using this technique is given below:

```
"c:\export specs\xuu1"
"c:\export specs\xuu2"
"c:\export specs\xuu3"
```

2.8 Other new features

2.8.1 New input formats in Version 0.3

There are three new choices for the `format` argument that appears in many specs.

- Free format can now be specified as `format = free`, and continues to be the default format for the argument;
- the `freecomma` option assumes the data are in free format, and a comma is used in each observation instead of a period to denote the position of the decimal point;
- The `datevaluecomma` option assumes that the data are formatted in the same manner as the `datevalue` option, but assumes the use of a comma rather than a period to denote the position of a decimal point.

2.8.2 New arguments related to the spectrum diagnostic

Several arguments related to the X-12-ARIMA spectrum diagnostics can be set in the either the `series` or the `composite` spec. Three new arguments have been added in Version 0.3:

- The `maxarspec` argument, which sets the maximum order of the AR spectrum used in the default type of spectrum plot. If this value is not set, then the maximum order used will be 30 for monthly series, and 10 for quarterly series[2].
- The `peakwidth` argument, which allows the user to set the number of frequencies on either side of a target frequency that will be used to determine a spectral peak. The default is one.
- The `spectrumseries` argument, which allows the user to choose the series used for the spectrum of the original data. There is a choice between the original series (`spectrumseries = original`), the original series adjusted by regARIMA outliers (`spectrumseries = outlieradjoriginal`), the original series adjusted for user specified and regARIMA prior effects (`spectrumseries = adjoriginal`), and the original series modified for extremes (`spectrumseries = modoriginal`). The default is `spectrumseries = adjoriginal`.

The defaults are recommended for all but rare situations.

2.8.3 Constant argument in `transform` spec

The `constant` argument of the `transform` spec allows the user to specify a positive constant that will be added to every observation of the series before modeling and adjustment and then removed from the final seasonally adjusted series.

This can sometimes be helpful when adjusting a series with an anomalous negative value - by adding a constant to all the observations large enough to

[2]Note that this is a change from previous versions of X-12-ARIMA - the maximum order was set to be 30 for all series. The program now uses the formula $maxAR = \frac{30*Sp}{12}$ to set the maximum order of the AR spectrum, where Sp denotes the value of period in the `series` spec.

make the anomalous value (or values) positive, the user can use multiplicative seasonal adjustment where it could not be applied before.

2.8.4 New total adjustment factor table

Many users wish to have a single factor series that can be used to generate the final seasonally adjusted series from the original data. Most of the time, the final combined adjustment factors (Table D 16) suffice for this task, as they are the combination of the seasonal and calendar component. However, when permanent prior adjustment factors are used, the user must take these into account as well.

There can also be problems in production situations where additive and multiplicative seasonal adjustments are done - one needs to know what kind of adjustment was done before using the factor. Also, the combined adjustment factors are not the correct factors to use when the user has specified no adjustment (as in a run with `type=summary`).

Version 0.3 has added a new table, the total adjustment factors (Table E 18), to handle these types of situations. The total adjustment factors are defined as

$$TA_t = O_t / SA_t$$

where O_t is the original series and SA_t is the seasonally adjusted series, both at time t.[3]

2.8.5 Save tables as percentages rather than ratios

Table 4 gives the table names and abbreviations that can be used with the **save** argument in the `composite`, `force` and `x11` specs to save specific output tables as percentages rather than ratios.

The percentages are only produced when multiplicative or log-additive seasonal adjustment is specified by the user in the `mode` argument of the `x11` spec; these quantities will be expressed as differences if `mode = add`. (Specifying these table names in the `print` argument of these specs will not change the output (`.out` file) of the program.)

2.8.6 Additional new features

- Version 0.3 of X-12-ARIMA allows the user to print (or save) the reg-ARIMA backcasts by specifying `print=backcast` in the `forecast` spec, as well as the transformed backcasts (`print = transformedbcst`).

- An `appendbcst` argument has been added to the `composite`, `series`, and `x11` specs to enable the user to append the backcasts generated by the program to selected tables. In addition, the `appendfcst` option of the

[3] When at least one value of the seasonally adjusted series is less than or equal to zero, a code is substituted for the factor and it is not printed out. Another table is then produced of the differences between the original and seasonally adjusted series.

Table 4: Tables that can be saved as percentages with the `save` argument

name	*short*	*spec*	*description of table*
indadjustfacpct	ipa	composite	indirect combined adjustment factors expressed as percentages
indcalendaradjchangespct	ip8	composite	percent changes in original series adjusted for calendar effects
indirregularpct	ipi	composite	indirect irregular component expressed as percentages
indrevsachangespct	ipf	composite	percent changes for indirect seasonally adjusted series with forced yearly totals
indrndsachangespct	ipr	composite	percent changes for rounded indirect seasonally adjusted series
indsachangespct	ip6	composite	percent changes for indirect seasonally adjusted series
indseasonalpct	ips	composite	indirect seasonal component expressed as percentages
indtrendchangespct	ip7	composite	percent changes for indirect trend component
origchangespct	ip5	composite	percent changes for composite series
revsachangespct	p6a	force	percent changes in seasonally adjusted series with forced yearly totals
rndsachangespct	p6r	force	percent changes in rounded seasonally adjusted series
adjustfacpct	paf	x11	combined adjustment factors, expressed as percentages
calendaradjchangespct	pe8	x11	percent changes in original series adjusted for calendar factors
irregularpct	pir	x11	final irregular component, expressed as percentages
origchangespct	pe5	x11	percent changes in the original series
sachangespct	pe6	x11	percent changes in seasonally adjusted series
seasonalpct	psf	x11	final seasonal factors, expressed as percentages
trendchangespct	pe7	x11	percent changes in final trend cycle

Name gives the name of each plot for use with the `save` argument.
Short gives a short name for the tables of the `save` argument.
Spec indicates which spec the tables are defined for.

x11 spec has been added to the series and composite specs as well, to make these options available to users when X-11 seasonal adjustment is not performed.

- The model input only allows users to enter specific lags for ARMA parameters in increasing order - for example, model = ([1 3 5] 1 0)(0 1 1) rather than model = ([3 1 5] 1 0)(0 1 1).
- Version 0.3 introduces a check for the case where differencing annihilates the original series, leaving only zeros. In previous versions of the X-12-ARIMA program, this situation would cause the program to attempt to estimate the model on a series of zeros, which would cause the program to stop.
- A skewness test of the regARIMA residuals has been added to the check spec.
- A centerseasonal argument was added to the x11 spec which centers seasonal factors combined with user-defined regression effects assigned to the seasonal component (centerseasonal = yes).
- A prior argument was added to the x11regression spec to allow users to run irregular regression as a prior adjustment always, rather than only when a regARIMA model is present.
- An error message is now generated when dates are surrounded by quotation marks in the input.
- The program now checks whether the multiplicative indirect trend is negative and prints an appropriate warning message if it is.
- The program now checks whether a series or composite spec has been specified in the input specification file; if neither spec is specified, an error message is printed.
- There are now checks to avoid division by zero errors in the automatic outlier identification procedure when producing t-statistics.
- Error messages are produced when the deviance used for maximum likelihood estimation is found to be equal to zero.
- During sliding spans and history analysis, checks to see if more than one type of outlier if specified for the last observation of a span or revisions history run. If so, outliers are removed (level shifts are always removed, temporary changes are removed before point outliers) until only one outlier remains in the model for that data point.
- For the type=denton option of the force spec, the indirect forced seasonally adjusted series will be extended to the full observation interval if there are observations beyond those that are forced. This is done the same way as the program extends the direct forced seasonally adjusted series.

- A setting has been added to the `savelog` argument of the `x11` and `composite` specs (`savelog = all`) which will send all diagnostics controlled by the `savelog` argument of these specs to the log file.
- Table 5 gives a listing of new tables included in the X-12-ARIMA printout.
- Table 6 gives a listing of new graphics metafile (`.gmt` file) codes included in the graphics metafile output.

Table 5: New tables in existing specs since version 0.2.10

Table Name	*Abbreviation*	*Spec*
adjcompositeplot	b1p	composite
adjcompositesrs	b1	composite
calendaradjcomposite	cac	composite
indadjustfac	iaf	composite
indadjustmentratio	i18	composite
indaoutlier	iao	composite
indcalendar	ica	composite
indcalendaradjchanges	ie8	composite
indtotaladjustment	ita	composite
backcasts	bct	forecast
transformedbcst	btr	forecast
dailyweights	tdw	regression
permprioradjusted	a3p	transform
permprioradjustedptd	a4p	transform
prioradjustedptd	a4d	transform
seriesconstant	a1c	transform
seriesconstantplot	acp	transform
calendaradjchanges	e8	x11
seasadjconst	sac	x11
totaladjustment	tad	x11
trendconst	tac	x11
outlierfinaltests	xft	x11regression

3 Changes to X-12-ARIMA options and output with Version 0.3

There have been many changes in program options and improvements in the output with the release of Version 0.3 of X-12-ARIMA.

A change many users must note is that the prior adjusted original series (Table B1) as well as the plot for the prior adjusted original series must now be specified in the `series` and `composite` specs rather than then `x11` spec.

Table 6: New graphics metafile codes since version 0.2.10

Code	*description of table*
adjcori	composite series (prior adjusted)
arat	final adjustment ratios
bct	point backcasts and prediction intervals on the original scale
btr	point backcasts and standard errors for the transformed data
cad	regARIMA calendar adjusted original data
chss	sliding spans of the changes in the seasonally adjusted series
cmpcad	regARIMA calendar adjusted composite data
cmpoad	regARIMA outlier adjusted composite data
cmppadj	prior adjusted composite data
frfc	factors applied to get adjusted series with forced yearly totals
indao	indirect additive outlier adjustment factors
indarat	indirect final adjustment ratios
indcaf	indirect combined adjustment factors
indcal	indirect calendar component
indchss	sliding spans of the changes in the indirect seasonally adjusted series
indfrfc	factors applied to get indirect adjusted series with forced yearly totals
indls	indirect level change adjustment factors
indmirr	irregular component modified for extremes from indirect adjustment
indsass	sliding spans of the indirect seasonally adjusted series
indsfss	sliding spans of the indirect seasonal factors
indyyss	sliding spans of the year-to-year changes in the indirect seasonally adjusted series
oricnt	time series data plus constant (for the span analyzed)
padj	prior-adjusted data
padjt	prior-adjusted data (including prior trading day adjustments)
ppradj	permanent prior-adjusted data
ppradjt	permanent prior-adjusted data (including prior trading day adjustments)
pprior	permanent prior-adjustment factors
sac	final seasonally adjusted series with constant value added
sass	sliding spans of the seasonally adjusted series
sfss	sliding spans of the seasonal factors
tadj	total adjustment factors
tdss	sliding spans of the trading day factors
tprior	temporary prior-adjustment factors
xcal	final calendar factors from irregular component regression
yyss	sliding spans of the year-to-year changes in the seasonally adjusted series

Users with input specification files which save or print this table can download the `cnvfinal03` utility from the X-12-ARIMA website to convert their spec files for Version 0.3.

Other changes in program options and output will be given in the next two sections.

3.1 Changes in program output

This section describes changes not only in the main output of the program, but also in other files produced by X-12-ARIMA, including the log file and the error file.

As mentioned in Section 2.4, the diagnostics output for X-12-ARIMA has been consolidated into one file. There have been other changes to the diagnostic output as well, including

- an entry that indicates if the sliding spans percentage output is produced for this run[4];
- entries that indicate if one of the intermediate adjustment or modeling runs used to generate history or sliding spans diagnostics has failed, implying that the program will not be able to produce these diagnostics;
- entries from the breakdown tables for the revisions history diagnostics;
- more information about the regARIMA model when the estimation of the model does not converge;
- standardized labels for the irregular regression diagnostics so that they are analogous to those used for the regARIMA regression diagnostics;
- entries that display the setting for the `spectrumdiff` argument, the spectrum starting date, the component weights and type when composite adjustment is performed, "almost outliers" from the automatic outlier output.

For more information on the format of the unified diagnostics file, see Monsell (2007).

Other changes to the output include:

- A time and date stamp of the X-12-ARIMA run (as well as program version information) is now produced in the diagnostic summary output, as well as on the screen when running X-12-ARIMA.
- Titles longer than 79 characters are now truncated with a warning message - previous versions would cease execution.

[4]The output for the sliding spans percentages is not produced when (a) additive seasonal adjustment is performed and `additivesa=diff` is specified in the slidingspans spec or (b) the range of the seasonal factors is less than 10 percent.

- A warning message is now printed when seasonal adjustment is performed and no spectral peaks are found in the original series. This message is suppressed when seasonal adjustment is not performed on the series.
- When a sliding spans and/or revisions history analysis is performed, the program now prints labels and messages to the error file only when an error is found.
- The printing of the "examine error file" message during runtime is now suppressed when the error file cannot be generated.
- The output of the sliding spans has been changed to provide footnotes rather than symbols to represent where an observation is flagged, or whether a change of sign or turning point is found in the sliding spans of a given observation time. A key is provided with each table to give a clearer indication of what the footnotes mean.
- The table of the roots for the ARIMA model is not printed when there are no ARMA parameters in the model.
- Output for the Ljung-Box Q statistics is now included in the automatic model identification output generated by the `pickmdl` spec.
- The regression correlation matrix can now be printed out when a reg-ARIMA model with no ARMA coefficients is specified.
- Many of the graphics codes used by the X-12-Graph program have been changed to make them more consistent. Several codes in the graphics metafile were changed to be seven characters long or less. Table 7 gives the old and new codes along with a brief description of the table being saved.

3.2 Changes in program options

- The default for the maximum number of lags printed out for the ACF and PACF plots (controlled by the `maxlag` argument of the `check` spec) has changed from three years to two years.
- The default for the maximum number of iterations for the estimation of the regARIMA model (controlled by the `maxiter` argument of the `estimate` spec) has changed from 500 to 1500.
- The default for the start of the spectral plots (the `spectrumstart` argument of the `series` and `composite` specs) has changed from 8 years before the end of the span to 96 observations before the end of the span.
- For the `aictest` argument in the `regression` and `x11regression` specs, `td` is now an acceptable entry for `aictest` for any type of trading day specified in the `variables` argument.

Table 7: Graphics Metafile Codes Changed Since Version 0.2.10

Old Code	*New Code*	*description of table*
adjori	ador	Prior-Adjusted Original Series
fincal	cal	Combined Calendar Factors
imirr	indmirr	Irregular Component Modified for Extremes from Indirect Adjustment
imori	indmori	Original Data Modified for Extremes from Indirect Adjustment
imsa	indmsa	Seasonally Adjusted Data Modified for Extremes from Indirect Adjustment
isahst	indahst	History of the Indirect Seasonal Adjustment Values
modirr	mirr	Irregular Component Modified for Extremes
modori	mori	Original Data Modified for Extremes
modsa	msa	Seasonally Adjusted Data Modified for Extremes
oadori	oad	Outlier-Adjusted Original Series
odjcmp	cmpoad	Outlier Adjusted Composite Data
sahst	ahst	History of the Seasonally Adjusted Series
sarnd	sar	Seasonally Adjusted Series with Rounding
satot	sat	Seasonally Adjusted Series with Forced Annual Totals
spccmp	cmpspor	Spectrum of the Composite Series
spciir	indspir	Spectrum of the Indirect Modified Irregular
spcirr	spirr	Spectrum of the Modified Irregular
spcisa	indspsa	Spectrum of the Indirect Seasonally Adjusted Series
spcori	spor	Spectrum of the Original Series
spcrsd	sprsd	Spectrum of the regARIMA model Residuals
spcsa	spsa	Spectrum of the Seasonally Adjusted Series

Old Code gives the graphics code used in Version 0.2.10 of X-12-ARIMA.

New Code gives the graphics code used in Version 0.3 of X-12-ARIMA.

- For the `save` argument found in several specs, the input routine has been updated so that tables that cannot be saved will not be accepted and will generate an error message.
- When `type=trend` is specified in the `x11` spec and trading day regressors are specified using the `td` argument in the `regression` spec, length of month prior adjustment factors (or regressors, depending on the power transformation specified in the `transform` spec) are used rather than leap-year prior adjustment factors (or regressors).
- In the irregular regression procedure, the AIC test is now performed during the B iteration of the procedure. This was done in the C iteration by pervious versions of X-12-ARIMA.
- The default for the `outlier` argument of the `slidingspans` spec is now `outlier = keep`. This is consistent with the default choice of the same argument in the `history` spec.
- Users can now specify `savelog = percents` as well as `savelog = percent` in the `slidingspans` spec (the results are the same).

4 Program defects fixed in Version 0.3

- Corrected label lengths associated with the `cansim` and `cansim2` formats and ensured that the correct number of observations were read from each record when quarterly data were input to the program using `cansim` and `cansim2`. Also corrected problems reading in quarterly series with the `2l2` data format.
- Corrected output to summary diagnostics files when the seasonal frequency was not monthly or quarterly; also corrected problems related to modeling yearly time series.
- Improved error handling for the forecast error diagnostic in the regARIMA modeling output.
- Ensured correct number of observations were saved when `save=spans` was specified in the `slidingspans` spec.
- Corrected runtime errors when `shortsf=yes`.
- Corrected initialization problems for user defined regressors.
- Corrected the printing of spectral plots and regARIMA forecasts when the end of the model span is not the same as the end of the series span.
- Corrected problems with data pointers associated with using the exclude option of the forecast spec.

- Ensured fixed user defined regressors are processed correctly when reading in a model using the `file` argument of the `estimate` spec.
- Corrected the `x11default` seasonal filter setting of `seasonalma` in the `x11` spec to ensure that a 3x5 seasonal filter is applied in the second iteration to the SI ratios of the first calendar month/quarter of the series.
- Corrected an error in the routines for generating the F-statistic of the seasonally adjusted series for the last 3 years of data for monthly series of length 36, 37 or 38.
- Ensured the program will estimate all models associated with the AIC test for Easter, as well as the Statistics Canada Easter regressor.
- Corrected the X-axis of the line printer plots when the series ends in November or the 3rd quarter; also corrected line printer plot axis when series starts in December or the 4th quarter.
- Corrected length of quarter correction to trading day regressors generated for quarterly data.
- Corrected the initial span of the moving standard deviation for determining X-11 extreme values when the first observation of the series is December (or the 4th quarter).
- Corrected errors in storing seasonal peak information into the summary diagnostic files.
- Corrected output problems in sliding spans analysis, including ensuring that the number of columns is printed correctly in error messages for the sliding spans analysis.
- Corrected labels for indirect seasonal adjustment diagnostics in the summary diagnostic file and log file.
- Corrected the calculation of the Jacobian formula for the likelihood statistics when the logistic transformation is used. The output used to describe the likelihood statistics was corrected as well.
- Ensured the regression matrix would be updated correctly after outlier identification by the automatic model identification procedure.
- The program will now check for peaks in the spectrum even if none of the series are printed.
- Ensured that the regression matrix is set up correctly when fixed regressors are used at the same time as user-defined regressors.
- Fixed a problem with specifying length of month/leap year preadjustments when the automatic transformation selection option is used.

- Revised the input routine so that the program processes hard tabs correctly in input specification files.
- Ensured that extreme value adjustments from X-11 are not included when `spectrumseries = adjoriginal`.
- Revised the backcasting procedure within the regARIMA modeling procedure to ensure it gives correct output when different Fortran optimization levels are used to compile the routine.
- Ensured that invalid dates would not be allowed in arguments such as `start` in the `series` spec regardless of where the `period` argument was specified.
- Fixed problems with leap-year regressors in models when the AIC tests of the regression spec are used.
- Fixed problems in composite seasonal adjustment when the number of backcasts specified for the component series does not match the number of backcasts specified for the composite series.
- Fixed problems with trading day factors when `noapply=td` is specified in the `regression` spec.
- Revised the model output when differencing is specified for an annual time series.
- Ensured that three years is the lower limit for the length of a sliding span.
- Corrected problems related to using the `exclude` option of the `forecast` spec when a seasonal adjustment is being performed.

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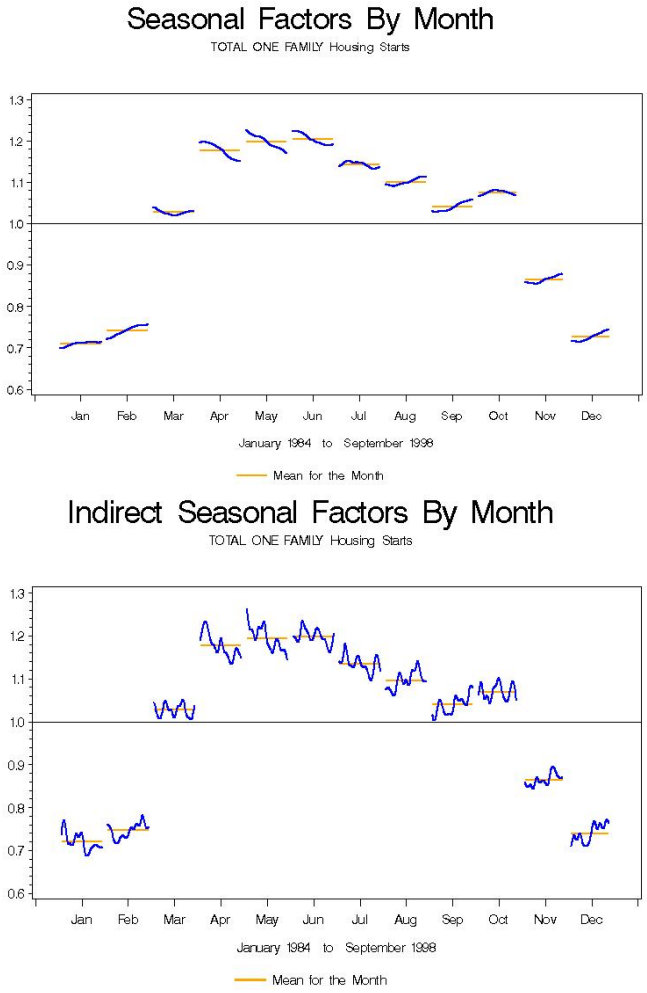

Figure 1: Direct and Indirect seasonal factors for Total One-Family Housing Starts [source: U. S. Census Bureau]

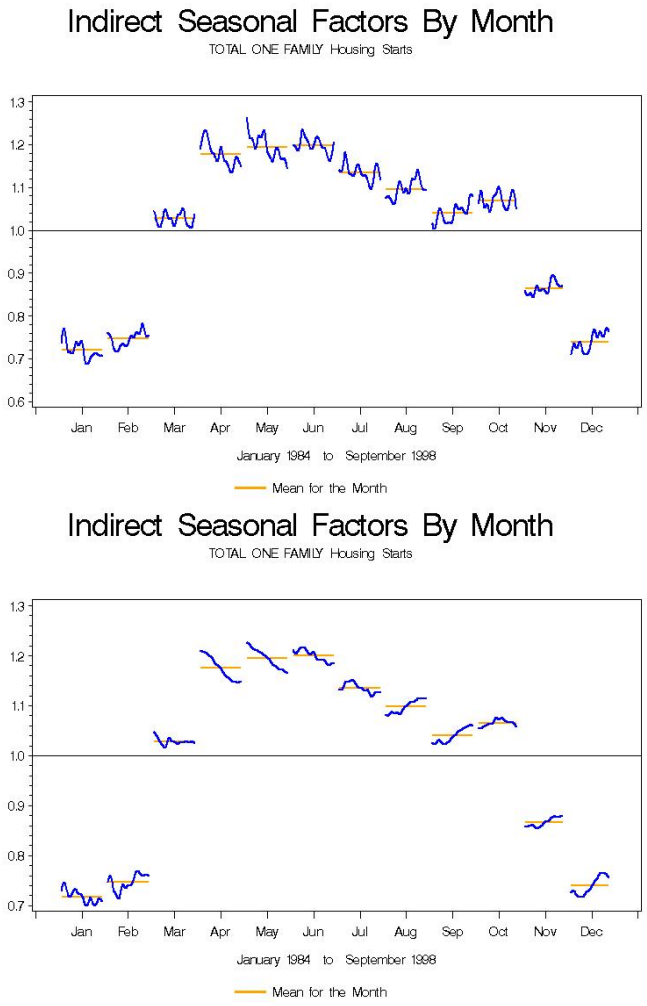

Figure 2: Indirect seasonal factors for Total One-Family Housing Starts produced by X-12-ARIMA Versions 0.2.10 (top) and 0.3 (bottom) [source: U. S. Census Bureau]