

8/11/2005

MODLER Seasonal Adjustment Routines

X-11 VARIANT OF CENSUS METHOD II

MODLER Information Technologies Press
Cambridge and Philadelphia

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Introduction

The MODLER-compatible versions of the X-11 Variant of Census Method II quarterly and monthly frequency seasonal adjustment programs operate as side-by-side utilities. As needed, each of these is automatically called by any of the major MODLER programs whenever you execute the appropriate command; the only particular requirement is that you keep the program files located either on the execution directory or in the path, so that they can be found.

In each case, the command syntax and the program response is part of the common MODLER family command language; however, because of the familiarity of the X-11 programs, certain of the original display features have been retained, especially whenever the complete set of tables is generated, either as hard copy or disk output. These tables correspond exactly to the tables generated by the original versions of the programs, so that in order to evaluate the output it is possible to use the original documentation of the program, either that produced by the Bureau of the Census or by Statistics Canada; see references at the end of this document. However, the current versions do not preserve the character-based graphical charts of the originals. The principal reason is that much better graphs can be produced by any of the MODLER family programs.

In the MODLER software context, the filename for the X-11 Quarterly Seasonal Adjustment Program is MODX11Q.EXE. The filename for the monthly frequency version is MODX11M.EXE. In most cases, this information is extraneous, but from time to time program updates are issued in which case you may need to know the filenames.

Alternatively, a MODLER-compatible weekly seasonal adjustment program is optionally available that permits true weekly frequency time series to be seasonally adjusted. This program, which is called MODSAWK.EXE in the present context, uses the method devised by William Cleveland for the Board of Governors of the Federal Reserve System.

Quarterly Census X-11 Seasonal Adjustment

MODX11Q.EXE may be loaded onto the hard disk in any PATH directory. It will then be executed more or less automatically. When using the Windows version of MODLER or DataView, seasonal adjustment can be invoked as an onscreen form, by clicking a menu item, Data|Seasonal Adjustment. To use MODX11Q in this way, you need only to fill in the blanks and make your choices.



The screenshot shows a dialog box titled "Quarterly Seasonal Adjustment Facility". It is divided into two main sections: "Data Series" and "Options".

Data Series:

- Resulting Series: [Empty text box]
- Original Series: [Empty text box]
- Save Seasonal Factors:
- Save Trend Cycle Values:
- Save Irregular Component:

Options:

- Multiplicative: (Selected)
- Additive:
- Sigma Limits: Upper: [2.5], Lower: [1.5]
- Supplementary Tables:
 - Printer: [None]
 - Disk File: [None]
- Annual Totals Constrained:
- Modify Trend Cycle for Extremes:

At the bottom of the dialog box are five buttons: Index, Find, OK, Cancel, and Help.

However, alternatively, an explicit command can also be used, the simplest form of which is:

adjseries=SEAS(origseries)

The unadjusted series (origseries) will be retrieved, by name, from an open data bank or memory file. The new, adjusted series (adjseries) will be stored automatically in the memory file or a databank currently open for update (if any). The currently set frequency must be quarterly in order for the seasonal adjustment to take place.

As a general procedure, whenever you issue a SEAS command explicitly or by clicking on the relevant menu item or icon button, MODLER or DataView will attempt to invoke one of the seasonal adjustment programs, which one depending upon the frequency set. In the absence of some execution error, the adjustment program displays relevant

information and statistics on the screen before returning the adjusted series to MODLER or DataView.

The MODX11Q program is computationally identical to the original Census X11 program written by Norman Bakka (March 11, 1966) and Morton Somer (November 1, 1966); in general, you should expect to obtain exactly the same results from the MODLER/DataView version as from the original. The maximum number of series observations is 400, which obviously implies a limit of 100 years per series. The minimum number of observations is 12 per series.

However, there are a few display differences. Most significantly, the MODLER/DataView versions offer added flexibility: by using the optional **Constrain** facility, it is possible to force the annual totals of the adjusted series to equal those of the unadjusted series; this cannot be done using the original programs.

Another difference is that the MODLER/DataView versions of the programs do not produce the crude character graphics charts of the original mainframe versions—but this is advantageous for you can analyse and display the adjusted series and the various component series (if saved) using the normal MODLER/DataView print and plot commands. In addition, by using the SEAS print option it is possible to produce the tables of the original X11Q program. For example, P=0 generates the standard printout of 17 tables described in the X-11 technical paper.

Further information about the Census X-11 Method can be found in Shiskin, Young, and Musgrave: *The X-11 Variant of Census Method II Seasonal Adjustment. Technical Paper No. 15* Washington: Bureau of the Census, U.S. Department of Commerce, 1967.

Defaults

The standard defaults are:

- Multiplicative seasonal adjustment
- Computation and utilization of the Trend Cycle curve without modifications for extremes
- Upper and Lower sigma limits set at 2.5 and 1.5 standard deviations.
- The tables are not printed out

Command Syntax

As noted earlier, the basic form of the seasonal adjustment command is:

adjseries=SEAS(unadjseries)

where **adjseries** is the name to be given to the seasonally adjusted series and **unadjseries** is the name of the original, unadjusted series

Note that although the command is written using function notation, SEAS() is NOT currently available as a MODLER/DataView command function to be used in general algebraic expressions.

Extended Syntax: X11Q Options

The extended syntax that allows the various X11 options to be selected is

adjseries=SEAS(unadjseries, opt ,opt , ...)

where 'opt', the name of an option, may be abbreviated to the first letter.

The option keywords are as follows:

FACTORS - store the series of seasonal factors (these include year-ahead forecasted values)

TREND CYCLE - store the trend cycle series

IRREGULAR - store the series containing the irregular component

(The above three series are optionally stored in addition to the seasonally adjusted series - see below for details).

ADDITIVE - additive adjustments

CONSTRAIN - annual totals for adjusted series constrained to equal those for the original unadjusted series for all full years

MODIFY - modify the trend-cycle for extreme observations **PRINT= n** where n=0,1,2 and 0=17 tables, 1=27 tables, 2=44 tables

DISK = n where n=0,1,2 and 0=17 tables, 1=27 tables, 2=44 tables

UPPER=x - reset the upper sigma limit to x standard deviations

LOWER=x - reset the lower sigma limit to x standard deviations

Examples:

```
GNPS=SEAS(GNP,FACTORS,MODIFY)
EADJ=SEAS(EMPL,A,F,T,I,L=2.5,U=4)
```

Component Series

Component series requested via the FACTORS, TREND CYCLE and IRREGULAR options are computed, captured, and stored in the Memory File or a data bank under the name of the adjusted series with a suffix

_F _T or _I

Examples:

```
GNPS_F
EADJ_F EADJ_T EADJ_I
```

The component series generated by Census X11 satisfy the following additive or multiplicative identities:

```
unadjser = factor . adjser
adjser = trend cycle . irregular
```

where '.' denotes addition or multiplication, depending upon the adjustment method chosen.

Error Conditions

Most errors will be trapped within MODLER/DataView or in the seasonal adjustment program, causing an appropriate error message to be displayed. However, if you should see the message

Bad Command or file name

(or its equivalent in different Windows/DOS versions) this indicates that the side-by-side program MODX11Q could not be located by the operating system. The possible reasons are

- that the programs are not loaded on the machine, or
- that the program files are not correctly named, or
- that the programs are not located in a directory on the current PATH

Census X-11M Monthly Seasonal Adjustment Program

The monthly frequency version of Census X-11 is intended to be computationally identical to the original program written by Morton Somer and internally dated November 1, 1968. You should expect to obtain exactly the same results from running the MODLER version as from the original version. The maximum number of observations per series is 360, implying a limit of 30 years of data per series. The minimum number of observations is 36, implying the need for a monthly series to equal or exceed 3 years of data before it can be seasonally adjusted.

There are, however, certain display differences. Most significantly, the MODLER version does not automatically produce the tables and charts of the original version. The new version allows you to use the display and analysis capabilities of the master program; it also allows you to produce the original hardcopy tables (using the PRINT=n option below). This version is designed to return both the seasonally adjusted and the component series, if requested. Consequently, plots and tables can be produced using MODLER or DataView facilities.

In general, these will be superior in appearance to the original X-11 displays. Perhaps more importantly, since you have control over the data series returned, you are not limited to particular displays, but can conduct whatever data analyses you wish. Prior to executing the seasonal adjustment of a series, you can also make data transformations or evaluate the characteristics of the unadjusted series. However, if you transform the data, you must first evaluate the transformation, storing the results under some series name; only a series name (not an expression) may be used in the SEAS command.

Further information about the Census X-11 Method can be found in Shiskin, Young, and Musgrave (1967).

Command Structure

As implemented here, the X-11 method incorporates the standard defaults. These include:

- Multiplicative seasonal adjustment,
- The computation and utilization of the Trend Cycle curve without modifications for extremes
- Upper and Lower sigma limits set at 2.5 and 1.5 standard deviations.
- The tables are not printed out

Menu Selection

Monthly seasonal adjustment can be invoked by clicking Data|Seasonal Adjustment provided that the default frequency has been set to Monthly. In this case, the form shown just below will be displayed. To perform seasonal adjustment, you need only to fill in the blanks and make your choices of any options. The Help button provides context-sensitive assistance.

The screenshot shows a dialog box titled "Monthly Seasonal Adjustment Facility". It contains several sections for configuring the seasonal adjustment process. The "Data Series" section has two input fields for "Resulting Series" and "Original Series", and three checkboxes: "Save Seasonal Factors", "Save Trend Cycle Values", and "Save Irregular Component". The "Options" section has two radio buttons for "Multiplicative" (selected) and "Additive", and two input fields for "Sigma Limits: Upper" (2.5) and "Lower" (1.5). The "Supplementary Tables" section has two dropdown menus for "Printer" and "Disk File", and two checkboxes: "Annual Totals Constrained" (checked) and "Modify Trend Cycle for Extremes". The "Supplementary Options" section has three dropdown menus: "Variable Trend Cycle Routine" (None), "Seasonal Factor Curves" (None), and "Trading Day Regression" (None), and three input fields: "JanWeight Year" (1947), "Application Date" (1947), and "Sigma Value" (2.5), along with a checked checkbox for "Month Length Variation". At the bottom are buttons for "Index", "Find", "OK", "Cancel", and "Help".

Basic Command Syntax

The most basic form of the SEASonal Adjustment command is:

adjname=SEAS(unadjname)

where **adjname** is the name to be given to the seasonally adjusted series and **unadjname** the name of the original, unadjusted series

Note that the seasonal adjustment command has the syntactic characteristics of a MODLER/DataView function, with an associated argument in parentheses. You must always identify both the original unadjusted series and the name under which the adjusted series is to be stored. These names must be legal series names, beginning with an alphabetic character and containing one to twelve characters, no blanks and no inadmissible non-alphabetic characters. Note also that both the unadjusted and the adjusted series must be expressed as series; neither of these may be an expression. In

addition, at present, the SEAS function cannot be used in any mathematical, statistical, relational, or logical function.

The unadjusted series will not be affected by the seasonal adjustment process. Moreover, it will automatically be retrieved from an open Memory File or Data Bank. In contrast, the adjusted series will be stored either in the Memory File or a Data Bank. The choice between Memory File and Data Bank will be made on the basis of whether or not the master program is in Data Bank UPDATE mode; if so, the series will be stored in the specified Data Bank. Whether or not an existing series with the same name will be overwritten depends upon these circumstances. In general, you have the same storage options and capabilities with the X-11 option that you do with other transformations.

Extended Command Syntax

MODX11Q also allows you to control the way in which the seasonal adjustment is performed--such as choosing between additive and multiplicative adjustment--and to gain access to the decomposition of the series--such as the seasonal factors, the trend cycle, and the irregular. These and other options are invoked using additional arguments. In general, the augmented seasonal adjustment command is:

adjname=SEAS(unadjname,opt1,opt2,...,optn)

where opt1,opt2,...,optn are the selected options, separated by commas. Note, in particular, that the options separated by commas are located after the name of the original, unadjusted series.

The options may be specified by providing, in full, the option keyword name(s); alternatively, the first letter of the option name may be used. The keywords for the present choice of options are as follows:

Hardcopy Tables or Diskfile (DFILE.X11)

- PRINT=n - n=0 standard, n=1 long, n=2 full
- DISK=n - n=0 standard, n=1 long, n=2 full Component Series
- FACTORS - seasonal factors; these include the usual year-ahead forecasted values
- TREND CYCLE - trend cycle curve values
- IRREGULAR - irregular component Adjustment Parameters
- ADDITIVE - invokes additive adjustment

MODIFY - causes trend-cycle to be modified for extreme observations

CONSTRAIN - constrains the annual totals of the adjusted series to equal those for the original, unadjusted series for all full years.

SIGMA LIMITS:

UPPER = x - where x is a real number

LOWER = y - where y is a real number, $x > y$

MOVING AVERAGE FOR VARIABLE TREND-CYCLE ROUTINE

- HEN = 9 - select a 9 term Henderson
- HEN = 13 - select a 13 term Henderson
- HEN = 23 - select a 23 term Henderson

[omitting this parameter causes the program to select an appropriate moving average from among the three]

MOVING AVERAGE FOR SEASONAL FACTOR CURVES

For all iterations:

- E = 1 - select a 3 x 3 moving average
- E = 2 - select a 3 x 5 moving average
- E = 3 - select a 3 x 9 moving average
- E = 4 - select a stable seasonal (average of all values for month)

[omitting this parameter causes the program to select a 3 x 3 for the first estimate of the seasonals in each iteration and a 3 x 5 in the final estimate]

TRADING DAY REGRESSION OPTIONS

- R = 1 - compute the trading-day regression and print the results, but do not adjust the series using the computed factors.
- R = 2 - compute the trading-day regression and adjust the series by the regression estimates.
- R = 3 - compute the trading-day regression, adjust the series using the regression estimates to obtain preliminary weights for the irregular series. However, use the regression estimates for the final weights only if they explain significant variation on the basis of the F test.

[omitting the R parameter excludes the computation of the trading day regression. The parameters described below are then ignored by the program and may be omitted]

JANWEIGHT=yyyy - compute estimates of the trading day weights using only the part of the series beginning with January of the specified year (yyyy).

[If $4 > R > 0$, omitting the COMPUTE DATE causes the trading day regression to be computed using the entire original series]

BAPDATE=yyyy - (BEGIN APPLICATION DATE) apply the trading day regression estimates only to the part of the series beginning with January of the specified year (yyyy).

[If $4 > R > 0$, omitting the BAPDATE causes the trading day regression estimates to be applied to the entire original series]

XSIGMA=value - In estimating trading day variation, irregular values greater than a specific number of standard deviations from 1.0 (under the multiplication option) or 0.0 (under the additive option) are excluded as extreme. The real number value specified here is that number of standard deviations.

[If $4 > R > 0$, omitting XSIGMA causes the default Sigma Limit of 2.5 standard deviations to be used]

GRADMONTH - include length of month variation in the trading day factors, rather than in the seasonal factors. Divisors for all months is 30.4375, the average length of a month. (USE ONLY WITH MULTIPLICATIVE ADJUSTMENTS)

[If $4 > R > 0$ and MULTIPLICATIVE OPTION, omitting GRADMONTH causes the length of month variations to be included with seasonal factors. Divisors used in the construction of monthly weights are 28.25, 30, and 31 for the appropriate months]

Appendix – Side-by-Side Program Installation

The X-11 side-by-side programs, MODX11Q and MODX11M, described in this document usually will automatically be loaded onto your hard disk during the original installation of the program. In this event, they will be loaded into the same directory(ies) as the main program or programs used to call them.

Alternatively, at any time, you can copy these programs to either that directory or a path directory. In the latter case, you should already have created on your hard disk a directory, which will here be assumed to be called MODPROG:

C:\MODPROG

As indicated, this directory should be included in the PATH if you wish to use the programs generally. The PATH is usually specified by the execution of a PATH command located in the AUTOEXEC.BAT file.

Run Time Errors

Generally speaking, any errors that occur during execution will be trapped within the seasonal adjustment program and will cause an error message to be printed. However, there are one or two errors that indicate the operating system's inability to locate a program for execution, such as:

Bad Command or file name

This message generally indicates that you have not correctly specified the Path although it can also instead indicate that the program you are trying to execute cannot be found on your hard disk. To verify the Path setting, type:

PATH

All the MODLER family programs expect for the quarterly seasonal adjustment program to be called MODX11Q.EXE and for the monthly to be called MODX11M.EXE. If you use any other filenames, the above error message will appear in response to a seasonal adjustment command when the series frequency is either monthly or quarterly.

The weekly seasonal adjustment program, the use of which is described elsewhere, is called MODSAWK, and the filename is MODSAWK.EXE.

References

- Dagum, Estella Bee *The X-II-ARIMA Seasonal Adjustment Method*. Ottawa, Ontario: Statistics Canada, 1980.
- Shiskin, Julius, A.H. Young, and J.C. Musgrave *The X-11 Variant of Census Method II Seasonal Adjustment, Technical Paper No. 15*. Washington, DC: Bureau of the Census, U.S. Department of Commerce, 1967.
- Zellner, Arnold (ed) *Seasonal Analysis of Economic Time Series*. Economic Research Report, ER-1, Washington, DC: Bureau of the Census, U.S. Department of Commerce, 1978