

**Overview on  
Seasonal Adjustment  
in the  
Current Employment Statistics Program**

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# Seasonal Adjustment in the Current Employment Statistics Program

## Introduction

Many Current Employment Statistics (CES) data users are interested in the seasonally adjusted over-the-month changes as a primary measure of overall national economic trends. Therefore, accurate seasonal adjustment is an important component in the usefulness of these monthly data. The CES Program employs concurrent seasonal adjustment methodology to seasonally adjust its National estimates of employment, hours, and earnings. Under concurrent methodology, new seasonal factors are calculated each month, using all relevant data up to and including the current month.

This documentation discusses in detail the seasonal adjustment methodology and software employed by the Current Employment Statistics Program. It is important to note that this describes seasonal adjustment only as it relates to the CES Program's implementation. There are other aspects of seasonal adjustment that are not discussed here.

## Getting Started with X-12 ARIMA

The CES Program uses X-12 ARIMA software developed by the U.S. Census Bureau to seasonally adjust the monthly estimates. The X-12 ARIMA software is available on the U.S. Census Bureau web site at <http://www.census.gov/srd/www/x12a/>. The site contains the following information:

- Program files for the latest PC version of X-12 ARIMA
- Program files for the latest UNIX workstation version of X-12 ARIMA
- Program files for X-12 Graph, a companion graphics package
- Installation instructions
- Reference manual

The remainder of this documentation describes how the CES Program employs X-12 ARIMA for seasonal adjustment purposes. Specifically, it describes the input files used in the CES Program's implementation, and commands used to invoke the software. This is not a substitute for formal X-12 ARIMA training. There are other uses and features of X-12 ARIMA that are not discussed in this documentation. The U.S. Census Bureau offers more intensive training for X-12 ARIMA and seasonal adjustment. Contact the Census Bureau or visit their website at <http://www.census.gov> for more details.

## Current Employment Statistics Seasonal Adjustment Procedures

For published series, the CES Program generally seasonally adjusts at the 3-digit NAICS level and aggregates to the higher levels. In a few cases, the CES Program seasonally adjusts published series at a level lower than the 3-digit NAICS level. However, these lower level cells are not used when aggregating to the higher levels – for published series, aggregation begins at the 3-digit NAICS level.

The CES Program's current implementation of seasonal adjustment controls for several calendar effects:

- **4 vs. 5 week adjustment** -- This adjusts for inconsistencies in the seasonally adjusted series that arise because of variations of 4 or 5 weeks between reference periods in any given pair of months. In highly seasonal months and industries, this variation can be an important determinant of the magnitude of seasonal hires or layoffs that have occurred at the time the survey is taken, thereby complicating seasonal adjustment.
- **Length of pay adjustment** -- This adjusts for distortions in CES hours and earnings series caused by differences in the number of working days in a pay period from month-to-month.

- **Floating holiday adjustment** -- This adjusts for significant effects associated with the relative timing of the reference period of the survey and the Easter and Labor Day holidays. These holidays do not occur at exactly the same time every year which complicates the seasonal adjustment process.

More information about the calendar-related fluctuations in CES data is available on the BLS website at <http://www.bls.gov/ces/cesfltxt.htm> .

All controllable variables remain fixed during the year. For example, the ARIMA model, outliers, transformation specification, and historical data are held constant, and the same calendar treatments are used throughout the year. Once a year, as part of the annual CES benchmark procedure, all seasonal adjustment specifications are reviewed for each series. Any changes are implemented and kept constant until the next annual benchmark. Also during the annual benchmark, estimates from the five most recent years are re-seasonally adjusted using the new specifications. After 5 years of revisions, seasonally adjusted data are frozen.

The CES Program uses the following input files when seasonally adjusting estimates:

- Specification file
- Input data file
- Prior-adjustment file
- User-defined regression variables (dummy variables) file
- Metafile

More details follow on each input.

### **Specification File**

An input specification file, or a “spec” file, is a text file used to specify program operations. The spec file is composed of functional units called specifications (or “specs”). Each “spec” unit contained in the spec file controls the options for a specific function. There are 15 different specs that can be used in a spec file; however, the CES Program’s implementation typically employs only 8 specs. These specs are:

- SERIES spec – this specifies the location and format of the data
- TRANSFORM spec – this specifies a data transformation
- REGRESSION spec – this specifies any regression components
- ARIMA spec – this specifies the ARIMA model to be used
- ESTIMATE spec – this estimates the regARIMA model
- FORECAST spec – this generates forecasts of seasonal factors
- OUTLIER spec – this specifies automatic outlier detection
- X11 spec – this generates and controls the seasonal adjustment process
- COMPOSITE spec – this is a special spec used only during indirect seasonal adjustment

Each spec used by the CES Program is covered in greater detail at the end of this document in Appendix A, entitled “Anatomy of a Spec File”.

In the CES Program’s implementation, each 3-digit employment series has its own spec file ending in a “.spc” file extension. The “.spc” extension is not recognizable by all operating systems and usually needs to be opened with a text editor such as TextPad, Wordpad, or Notepad. Also, it is important to remember that when running X-12 ARIMA in DOS, the name of the spec file must be 8 characters or less. This is a limitation of DOS, not X-12 ARIMA. All of the spec files currently used in production can be downloaded from <http://www.bls.gov/ces/cesseasadj.htm>.

### Input Data File

The input data file consists of non-seasonally adjusted CES estimates at the 3-digit NAICS level and is referred to in the SERIES spec of the spec file. The CES implementation reads input data from a text file in “free format” style. In the free-format style, data are delimited with either tabs or spaces, and only the input data is included – dates and other descriptive information are excluded. Instead, information describing the data is specified in the SERIES spec using the START and PERIOD arguments. The full path and name of the input data file is specified using the FILE argument (see Figure 1).

**Figure 1. Input Data File Specifications**

```
SERIES{
  TITLE = "Computer and electronic products"
  START = 1993.01
  PERIOD = 12
  SAVE = A1
  PRINT = BRIEF
  NAME = '31334000 - AE'
  FILE = 'c:\AE31334000.dat' }
```

CES data can be extracted from the BLS website at <http://www.bls.gov/ces/home.htm> . However, in some cases, non-seasonally adjusted data extracted from the BLS website will differ from what the CES Program actually uses in seasonal adjustment. In particular, data extracted from the BLS website will reflect any strikes or other prior adjustments that have taken place. Before running seasonal adjustment, the CES Program will reverse these effects so that they will not be considered when calculating the seasonal factors. Also, the CES Program uses unrounded data when running seasonal adjustment -- data on the BLS website are rounded.

### Prior Adjustment File

As mentioned in the previous section, in some cases the CES Program will modify the non-seasonally adjusted estimates (input data) before running X-12 ARIMA. This is done to ensure that non-seasonal events such as strikes are not included in the calculation of the seasonal factors. Once the seasonal factors are calculated, they are applied to the original data – i.e., the non-seasonally adjusted data that reflects the non-seasonal event – to calculate the seasonally adjusted estimate. To read more about the impact of strikes on CES data, visit the BLS website at <http://www.bls.gov/ces/cesstrk.htm> .

**Figure 2. Prior Adjustment File Format**

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1481000000000003	2000					1200	1200	86700	1200				
1481000000000003	2001					1400	5700	2800	1200	1200	2600	2600	
1481000000000003	2002							1500			1600		
1481000000000003	1993	5100				9100	12000	18800	16500	16500	16500	16500	
1481000000000003	1994	5100				9100	12000	18800	16500	16500	16500	16500	
1511000000000003	1993	5100				9100	12000	18800	16500	16500	16500	16500	
1511000000000003	1994	5100				9100	12000	18800	16500	16500	16500	16500	
1521200000000003	1993	5100				9100	12000	18800	16500	16500	16500	16500	
1521200000000003	1994	5100				9100	12000	18800	16500	16500	16500	16500	
1521200000000003	1993	5100				9100	12000	16200	16500	16500	16500	16500	
1521200000000003	1994	5100				9100	12000	16200	16500	16500	16500	16500	
1521200000000003	1995	5100				9100	12000	16200	16500	16500	16500	16500	
1521200000000003	1996	5100				9100	12000	16200	16500	16500	16500	16500	
1521200000000003	1997	5100				9100	12000	16200	16500	16500	16500	16500	
1521200000000003	1998	5100				9100	12000	16200	16500	16500	16500	16500	
1521200000000003	1999	5100				9100	12000	16200	16500	16500	16500	16500	
1521200000000003	2000					4000	4000	4000	4000	4000	4000	4000	
1521200000000003	2001					4000	4000	4000	4000	4000	4000	4000	
1521200000000003	2002					4000	4000	4000	4000	4000	4000	4000	
1521200000000003	1993	5100				5100	8000	12200	12500	12500	12500	12500	
1521200000000003	1994	5100				5100	8000	12200	12500	12500	12500	12500	
1521200000000003	1995	5100				5100	8000	12200	12500	12500	12500	12500	
1521200000000003	1996	5100				5100	8000	12200	12500	12500	12500	12500	
1521200000000003	1997	5100				5100	8000	12200	12500	12500	12500	12500	
1521200000000003	1998	5100				5100	8000	12200	12500	12500	12500	12500	
1521200000000003	1999	5100				5100	8000	12200	12500	12500	12500	12500	
1521200000000003	2000					2600							
1521200000000003	2001					2600							
1521200000000003	2002					2600							

The latest prior adjustment file used in the seasonal adjustment of CES data is can be downloaded from <http://www.bls.gov/ces/cesseasadj.htm>. The first column contains the 14-digit BLS NAICS tabcode. The second column contains the year, and the next 12 columns represent the months of the year in sequential order (January through December). The file contains both positive and negative numbers. The positive numbers reflect a strike and are added to the non-seasonally adjusted data before running X-12

ARIMA. The negative numbers reflect the buildup of employment associated with the decennial census and are subtracted from the non-seasonally adjusted data before calculating the seasonal factors.

### User-Defined Regression Variable File

As mentioned earlier, the CES Program’s current implementation of seasonal adjustment controls for several non-economic calendar related fluctuations in the estimates. This is done with the inclusion of user-defined regression (or “dummy”) variables. The dummy variables are defined in the REGRESSION

spec of the spec file. The dummy files vary depending upon the type of calendar event being treated. Table 1 lists the dummy files used and the calendar event(s) they are used to treat.

**Table 1. Dummy Files with Calendar Treatment**

Dummy File	Calendar Event Treated
Fdum8606.dat	4 vs. 5 week effect
Fdumpc96.dat	4 vs. 5 week effect <i>plus</i> a special adjustment for the presence/absence of poll workers in local government
Fdumpcw6.dat	4 vs. 5 week effect <i>plus</i> a special adjustment for the presence/absence of poll workers in local government (used with Women Worker series only)
Fdumel96.dat	4 vs. 5 week effect <i>plus</i> Easter/Labor Day adjustment
Dumlp06.dat	10/11 day effect
Dumlpel6.dat	10/11 day effect <i>plus</i> Easter/Labor Day adjustment

The dummy values are usually 1 and 0, with weights assigned so that the effect over a 10 year period sums to zero. The latest user-defined regression files used in the seasonal adjustment of CES data can be downloaded from <http://www.bls.gov/ces/cesseasadj.htm>.

### Metafile

The metafile is a text file ending in a “.mta” file extension and is used when running X-12 ARIMA on more than one series. It is essentially a list of the complete path and filename – without the extension – of all of the input specification (spec) files. Only one spec file is listed per row. As with the individual spec files, it is important to remember that when running X-12 ARIMA in DOS, the name of the metafile must be 8 characters or less.

## Running X-12 ARIMA

### Running X-12 on a Single Series

Use the following command at the DOS prompt when running X-12 ARIMA on a single series:

*{path1}\x12a {path2}\specfile name -options*

where *{path1\}* = path of the X-12 ARIMA program  
*x12a* = command informing X-12 program to execute  
*{path2\}* = path of the spec file  
*filename* = name of the input spec file you want to adjust (without the extension)  
*options* = see X-12 manual for list of options

Example: At the DOS prompt, type:

**c:\x12s\x12a c:\x12\seasadj\AE113310 -w**  
 (where AE113310.spc is the series you want to adjust)

### Running X-12 on a Multiple Series

Use the following command at the DOS prompt when running X-12 ARIMA on more than one series:

*{path1}\x12a -m {path2\}metafile name -options*

where *{path1\}* = path of the X-12 ARIMA program  
 x12a = command informing X-12 program to execute  
 -m = flag that informs X-12 that the subsequent named file is a metafile  
*{path2\}* = path of the metafile  
*metafile name* = name of the metafile (without the extension) containing the input spec files  
*options* = see x-12 manual for list of options

Example: At the DOS prompt, type:

```
c:\x12s\x12a -m c:\x12\seasadj\pubAE -w
(where pubAE.mta is the metafile you are using)
```

### Output from X-12 ARIMA

When X-12 ARIMA is run, several output files are generated by default. The output files are saved in the same location as the input specification files.

- Main output file (\*.out)
- Error output file (\*.err)
- Log output file (\*.log)

More details follow on each of the output files.

#### Main Output File (\*.out)

The X-12 ARIMA output is written to a text file ending in a “.out” extension. Output from the CES implementation contains many different tables and statistics, including:

- Table displaying the original, non-seasonally adjusted series
- Table displaying the final seasonally adjusted series
- Table displaying the final seasonal factors
- Statistics related to model selection
- Statistics related to outlier detection
- A summary of seasonal adjustment diagnostics
- Quality control statistics

Individual specs in the spec file control their contribution to this output using optional PRINT arguments. For example, within the X11 spec, BRIEF specifies that only certain tables or plots are printed, while the minus sign in front of a name (such as -SPECESA or -SPECIRR) means that particular table or plot should be suppressed from the output.

In this example, without the options -SPECESA and -SPECIRR, both of the plots would be printed by default under the BRIEF option.

**Figure 3. The PRINT Argument in the X11 Spec**

```
X11{
  MODE = MULT
  PRINT = (BRIEF -SPECESA -SPECIRR)
  SAVE = (D10 D11 D16)
  APPENDFCST = YES
  FINAL = USER
  SAVELOG = (Q Q2 M7 FB1 FD8 MSF)
}
```

It is important to remember that every time X-12 ARIMA is run on a particular series, the \*.out file is overwritten, unless an alternate name or directory is specified.

### **Error Output File (\*.err)**

Input errors are written to a text file ending in an “.err” extension. If the error is fatal, **ERROR:** will be displayed before the error message. If the error is not fatal, **WARNING:** will be printed before the message. Non-fatal errors (or warnings) will not stop the program, but should be an alert to use caution and to check input and output carefully.

It is important to remember that, as is the case with all output files, every time X-12 ARIMA is run on a particular series, the \*.err file is overwritten, unless an alternate name or directory is specified.

### **Log Output File (\*.log)**

A summary of modeling and seasonal adjustment diagnostics are written to a text file ending in a “.log” extension. Individual specs in the specification file control their contribution to this output using optional SAVELOG arguments. When X-12 is run on an individual spec file, the log file is stored with the same name and directory as the spec file. However, when X-12 is run using a metafile, the log file is stored with the same name and directory as the metafile. As is with all output files, every time X-12 is run, the \*.log file is overwritten unless an alternate name or directory is specified.

### **Other Output Files**

Other output files are generated as specified in the spec file using the SAVE argument. In the CES Program’s implementation, the following additional output files are generated:

- **\*.a1** – This file contains the non-seasonally adjusted data with associated dates and is specified in the SERIES spec
- **\*.ao** – This file contains outlier factors with associated dates and is specified in the REGRESSION spec
- **\*.d10** – This file contains final seasonal factors with associated dates and is specified in the X11 spec
- **\*.d11** – This file contains final seasonally adjusted data with associated dates and is specified in the X11 spec
- **\*.d16** – This file contains combined seasonal and trading day factors with associated dates and is specified in the X11 spec
- **\*.td** – This file contains final trading day factors with associated dates and is specified in the REGRESSION spec

### **Indirect Seasonal Adjustment**

The CES Program generally seasonally adjusts published series directly at the 3-digit NAICS level and aggregates to the higher levels. However, there are some exceptions to this rule. In a few of the All Employees series, the CES Program will seasonally adjust at a level lower than the 3-digit NAICS level. In these instances, the CES Program seasonally adjust the 3-digit series indirectly; i.e., all of the component (lower level) series are seasonally adjusted directly and aggregated up to the composite (3-digit) level. Indirect seasonal adjustment is performed on these series because some of the individual component series that aggregate to the composite series exhibit different seasonal patterns that may be masked if seasonally adjusted directly at the aggregate level.

The spec file for the composite series differs somewhat from normal CES implementation. The most significant difference is at the beginning of the spec file, where the SERIES spec is replaced with the COMPOSITE spec. Running X-12 employing the COMPOSITE spec produces an indirect seasonal adjustment of the composite series as well as a direct adjustment. Output from the indirect adjustment is saved under non-standard file extensions.

- Aggregated non-seasonally adjusted data with associated dates are saved in a text file with the extension \*.cms (instead of \*.a1 under direct seasonal adjustment)
- Final indirect (aggregated) seasonally adjusted data with associated dates are saved in a text file with the extension \*.isa (instead of \*.d11 under direct seasonal adjustment)
- Final seasonal factors for aggregated series with associated dates are saved in a text file with the extension \*.isf (instead of \*.d16 under direct seasonal adjustment)

The COMPOSITE spec is covered in greater detail at the end of this document in Appendix A.

Spec files for the component series are constructed the same way as a standard X-12 run (because they are only adjusted directly, as is standard practice).

Below is an updated list of 3-digit NAICS industries that are indirectly seasonally adjusted, along with their component series. Keep in mind that, for any given 3-digit NAICS series, not all of the component series are published. In the table below, component series published with the first preliminary data release are denoted with an asterisk (\*).

**Table 2. Three-Digit NAICS Series Published with the First Preliminary Estimates**

<b>Composite series</b>	<b>Component series</b>
10212000	10212100*, 10212200, 10212300
20236000	20236115, 20236116, 20236117, 20236118, 20236210, 20236220
20238000	20238110, 20238120, 20238130, 20238140, 20238150, 20238160, 20238170, 20238190, 20238210, 20238220, 20238290, 20238310, 20238320, 20238330, 20238340, 20238350, 20238390, 20238910, 20238990
31334000	31334100*, 31334200*, 31334300, 31334400*, 31334500*, 31334600
42441000	42441100*, 42441200, 42441300
42452000	42452100*, 42452900
55522000	55522100*, 55522200, 55522300
60541000	60541100*, 60541200*, 60541300*, 60541400, 60541500*, 60541600*, 60541700, 60541800, 60541900
60561000	60561100, 60561200, 60561300*, 60561400*, 60561500, 60561600, 60561700*, 60561900
65621000	65621100*, 65621200, 65621300, 65621400*, 65621500, 65621600*, 65621900
65623000	65623100*, 65623200, 65623300, 65623900
65624000	65624100, 65624200, 65624300, 65624400*



## Appendix A: An Overview - Anatomy of a Spec File

### Input File used for Seasonal Adjustment of Current Employment Statistics Data

For published series, the Current Employment Statistics (CES) Program generally seasonally adjusts at the 3-digit NAICS level and aggregates to the higher levels. One of the main inputs to the seasonal adjustment process is a unique file called a specification (or spec) file. The spec file contains a set of specifications or specs that give X-12 ARIMA various information about the data and the desired seasonal adjustment options and output. Each spec inside the spec file controls options for a specific function. For example, the **SERIES** spec contains specifications on the location and format of the data, while the **X11** spec sets seasonal adjustment options such as seasonal adjustment mode, output files to save, and diagnostic statistics to print.

The image shows a screenshot of a TextPad window titled "TextPad - [D:\BMK\seasadj\AE10113310t.spc]". The window displays the contents of a specification file. Red arrows point from callout boxes to specific lines in the file. The callouts are as follows:

- SERIES spec**: Information about the series being adjusted, including the **title** (Logging) and **name** (10113310-AE) of the series, the **start** date (Jan. 1993), **period** or frequency (12 or monthly), and the location of the data **file** (c:\AE10113310.dat).
- TRANSFORM spec**: Specifies a data **transformation** for the series.
- REGRESSION spec**: Specifies the **regression** components of a regARIMA model, including the **start** date (Jan. 1986), a list of the dummy variables used (dum1, dum2, ..., dum11), and the locations of the dummy **file** (c:\FDUM8606.dat).
- ARIMA spec**: Specifies the **ARIMA model** {(2 1 0) (0 1 1)} to be used.
- ESTIMATE spec**: **Estimates** the regARIMA model specified in the REGRESSION and ARIMA specs.
- FORECAST spec**: Generates **forecasts** from the estimated regARIMA model.
- X11 spec**: Sets seasonal adjustment options such as seasonal adjustment **mode** (multiplicative), output files to **save** (\*.D10, \*.D11, \*.D16), and diagnostic statistics to print (Q, Q2, M7, etc.).
- OUTLIER spec**: Sets specifications for automatic **outlier** detection, such as the **critical** value (3.5) at which an observation should be considered an outlier and the **types** of outliers to detect (AO or point outliers only).

```

SERIES{
  TITLE = "Logging"
  START = 1993.01
  PERIOD = 12
  SAVE = A1
  PRINT = BRIEF
  NAME = '10113310 - AE'
  FILE = 'c:\AE10113310.dat'}

TRANSFORM{FUNCTION = LOG}

REGRESSION{
  VARIABLES = (AO1995.02 AO1996.01 AO1999.01)
  USER = (dum1 dum2 dum3 dum4 dum5 dum6 dum7 dum8 dum9 dum10 dum11)
  START = 1986.01
  FILE = 'c:\FDUM8606.dat'
  USERTYPE = TD
  SAVE = (TD AO)
}

ARIMA{MODEL = (2 1 0) (0 1 1)}

ESTIMATE{MAXITER = 1000}

FORECAST{MAXLEAD = 24}

OUTLIER{
  CRITICAL = 3.5
  TYPES = AO
}

X11{
  MODE = MULT
  PRINT = (BRIEF -SPEC SA -SPECIRR)
  SAVE = (D10 D11 D16)
  APPENDFCST = YES
  FINAL = USER
  SAVELOG = (Q Q2 M7 FB1 FD8 MSF)
}
  
```

The spec file is free format, and blank spaces, tabs, and blank lines may be used as desired to make the spec file more readable. The order of the specification statements in the spec file (with one exception), and the order of the arguments within the braces of any spec do not matter. The only requirement is that the SERIES spec or COMPOSITE spec must be the first spec.

More detail on each spec used by CES follows.

## 1. SERIES spec

```
SERIES{  
  TITLE = "Logging"  
  START = 1993.01  
  PERIOD = 12  
  SAVE = A1  
  PRINT = BRIEF  
  NAME = '10113310 - AE'  
  FILE = 'c:\AE10113310.dat'}
```

The main function of the SERIES spec is to specify details about the input data series such as the name, format, and location of the data. The Current Employment Statistics (CES) implementation employs 7 options or arguments with the SERIES spec.

- TITLE – A descriptive title for the series. In this example, the title is “**Logging**”.
- START – The start date of the time series being adjusted. In this example, the start date is **January, 1993**.
- PERIOD – Seasonal period of the series. In this example, the period is **12** (which means monthly).
- SAVE – Specifies output to be saved. In this example, the time series data with associated dates will be saved in an output file called **AE10113310.A1**.
- PRINT – Specifies output to be printed. In this example, **BRIEF** specifies that only certain tables are printed.
- NAME – The name of the time series. In this example, the name is “**10113310 – AE**”.
- FILE – The complete path and name of the file containing the time series data. In this example, the complete path and filename is “**c:\AE10113310.dat**”.

## 2. TRANSFORM spec

```
TRANSFORM{FUNCTION = LOG}
```

The main function of the TRANSFORM spec is to transform or adjust the time series prior to estimating a regARIMA model. The CES implementation employs 1 argument with the TRANSFORM spec.

- FUNCTION – Specifies the method to transform the time series. In this example, the transformation method is **log** transformation, which means X-12 will compute a multiplicative seasonal decomposition.

### 3. REGRESSION spec

```
REGRESSION{  
  VARIABLES = (AO1995.02 AO1996.01 AO1999.01)  
  USER = (dum1 dum2 dum3 dum4 dum5 dum6 dum7 dum8 dum9 dum10 dum11)  
  START = 1986.01  
  FILE = 'c:\FDUM8606.dat'  
  USERTYPE = TD  
  SAVE = (TD AO) }
```

The main function of the REGRESSION spec is to specify the regression components of a regARIMA model. The CES implementation employs up to 6 options with the REGRESSION spec.

- **VARIABLES** – Specifies any predefined regression variables to be included in the model. In the CES implementation, predetermined outliers are listed after the VARIABLES argument. In this example, predetermined outliers include **AO1995.02** (February 1995), **AO1996.01** (January 1996), and **AO1999.01** (January 1999).
- **USER** – Specifies the names for any user-defined regression variables. CES defines regression variables to adjust for significant effects associated with calendar related events such as (1) the relative timing of the reference period of the survey and the Easter and Labor Day holidays; (2) variations of 4 or 5 weeks between reference periods in any given pair of months, and; (3) differences in the number of working days in a pay period from month-to-month. In this example, the regression variables are named **dum1, dum2, dum3, dum4, dum5, dum6, dum7, dum8, dum9, dum10, and dum11**.
- **START** – Specifies the start date for the data values for the user-defined regression variables. In this example, the start date is **January, 1986**.
- **FILE** – The complete name of the file containing the data values for the user-defined regression variables, including the path. In this example, the filename, including the path, is “**c:\FDUM8606.dat**”.
- **USERTYPE** – Specifies a type of model-estimated regression effect to each user-defined regression variable. In this example, the type of model-estimated regression effect is defined as **TD**, or trading day.
- **SAVE** -- Specifies output to be saved. In this example, trading day factors with associated dates will be saved in an output file called **AE10113310.TD**, and outlier factors with associated dates will be saved in an output file called **AE10113310.AO**.

Note: Not every option is used in every spec file. For example, if no predetermined outliers exist, then the VARIABLES argument will not be used. Likewise, if we are not treating a particular series for calendar effects, then the USER, START, FILE, and USERTYPE arguments will not be used.

### 4. ARIMA spec

```
ARIMA{MODEL = (2 1 0) (0 1 1)}
```

The main function of the ARIMA spec is to specify the ARIMA part of a regARIMA model. The CES implementation employs 1 option with the ARIMA spec.

- **MODEL** – Specifies the actual ARIMA model to be used. In this example, the model is **(2 1 0) (0 1 1)**.

## 5. ESTIMATE spec

```
ESTIMATE {MAXITER = 1000}
```

The main function of the ESTIMATE spec is to estimate the regARIMA model specified by the REGRESSION and ARIMA specs. The CES implementation employs 1 argument with the ESTIMATE spec.

- MAXITER – Specifies the maximum number allowed of ARMA iterations (nonlinear iterations for estimating the AR and moving MA parameters). **ARMA** stands for Autoregressive Moving Average and is a time-series model that includes both AR (autoregressive) and MA (moving average) components. In this example, the maximum number allowed of ARMA iterations is 1000.

## 6. FORECAST spec

```
FORECAST {MAXLEAD = 24}
```

The main function of the FORECAST spec is to generate forecasts (and/or backcasts) for the time series model given in the SERIES spec using the estimated regARIMA model. The CES implementation employs 1 argument with the FORECAST spec.

- MAXLEAD – Specifies the number of forecasts produced. In this example, the number of forecasts specified is **24** months.

## 7. OUTLIER spec

```
OUTLIER {  
  CRITICAL = 3.5  
  TYPES = AO  
}
```

The main function of the OUTLIER spec is to perform automatic detection of point outliers, temporary change outliers, level shifts, or any combination of the three. The CES implementation uses this spec to automatically detect point outliers only. CES employs 2 arguments with the OUTLIER spec.

- CRITICAL – Specifies the value to which the absolute values of the outlier t-statistics are compared to detect outliers. In this example, the critical value is **3.5**.
- TYPES – Specifies the types of outliers to detect. The CES implementation uses the OUTLIER spec to automatically detect point outliers only. In this example, the outlier type is **AO** (which is point outliers).

## 8. X11 spec

```
X11 {  
  MODE = MULT  
  PRINT = (BRIEF -SPECSEA -SPECIRR)  
  SAVE = (D10 D11 D16)  
  APPENDFCST = YES  
  FINAL = USER  
  SAVELOG = (Q Q2 M7 FB1 FD8 MSF) }
```

The function of the X11 spec is to control certain aspects of the seasonal adjustment process. For example, the CES implementation uses the X11 spec to control the type of seasonal adjustment decomposition calculated (mode). CES employs 6 arguments with the X11 spec.

- **MODE** – Specifies the mode of the seasonal adjustment decomposition to be performed. There are four choices: multiplicative, additive, pseudo-additive, and log-additive. In the CES implementation, only the multiplicative or additive modes are employed. In this example, the mode specified is **MULT** (multiplicative).
- **PRINT** – Specifies output to be printed. In this example, **BRIEF** specifies that only certain tables or plots are printed. The minus sign in front of a name means that particular table or plot should be suppressed. In this example, **-SPECESA** specifies that a spectral plot of differenced, seasonally adjusted series be suppressed, while **-SPECIRR** specifies that a spectral plot of outlier-modified irregular series be suppressed. Without these options, both plots would be printed under the BRIEF option by default.
- **SAVE** – Specifies output to be saved. In this example, final seasonal factors with associated dates will be saved in an output file called **AE10113310.D10**; the final seasonally adjusted series with associated dates will be saved in an output file called **AE10113310.D11**; and combined seasonal and trading day factors with associated dates will be saved in an output file called **AE10113310.D16**.
- **APPENDFCST** – Determines if forecasts of seasonal factors will be included in the X-11 output files and tables that were selected in the SAVE option. If APPENDFCST = yes, then forecasted seasonal factors will be stored. In this example, the APPENDFCST value is **YES**.
- **FINAL** – Specifies the types of prior adjustment factors (obtained from the REGRESSION and OUTLIER specs) that are to be applied to the final seasonally adjusted series. In this example, FINAL = **USER**, which means that factors derived from user-defined regressors (or in this example, the dummy variables) are to be applied to the final seasonally adjusted series, removing significant effects associated with calendar related events.
- **SAVELOG** – Specifies the diagnostic statistics to be printed to the log file. In this example, the following diagnostics will be printed:
  - **Q**, which is the overall index of the acceptability of the seasonal adjustment. The adjustment may be poor if  $Q > 1$ .
  - **Q2**, which is the Q statistic computed without the M2 Quality Control Statistic. The M2 values can sometimes be misleading if the trend shows several changes of direction.
  - **M7**, which measures the moving seasonality relative to the stable seasonality found in the series. Any  $M > 1$  indicates a source of potential problems for the adjustment procedure.
  - **FB1**, which is an F-test for stable seasonality, performed on the original series.
  - **FB8**, which is an F-test for stable seasonality, performed on the final ratio of the seasonal-to-irregular components.
  - **MSF**, which is an F-test for moving seasonality.

As previously mentioned, the CES Program generally seasonally adjusts published series at the 3-digit NAICS level and aggregates to the higher levels. However, there are a few cases in which CES seasonally adjusts published series at a level lower than the 3-digit NAICS level. In these instances, CES seasonally adjusts the 3-digit NAICS level indirectly; i.e., all of the component or lower level series are seasonally adjusted directly aggregated up to the 3-digit level. When this happens, the **SERIES** spec is replaced by the **COMPOSITE** spec in the specification file of the 3-digit series.

## 9. COMPOSITE spec

```
COMPOSITE {  
  TITLE = "Construction of buildings"  
  SAVE = (ISF ISA CMS)  
  PRINT = BRIEF  
  NAME = '20236000 - AE'  
  SAVELOG = (INDTEST INDQ)  
}
```

The COMPOSITE spec is used as part of the procedure for obtaining both indirect and direct adjustments of a composite series data series. This spec is required for obtaining composite adjustments and is used in place of the SERIES spec. The COMPOSITE spec can also specify details about the input data series such as the name of the series and which tables are to be printed or stored. The Current Employment Statistics (CES) implementation employs 5 options or arguments with the COMPOSITE spec.

- TITLE – A descriptive title for the series. In this example, the title is “**Construction of buildings**”.
- SAVE – Specifies output to be saved. In this example, the aggregated time series data with associated dates will be saved in an output file called AE20236000.CMS, the final seasonal factors for the indirect adjustment with associated dates will be saved in an output file called AE20236000.ISF, and the final indirect seasonally adjusted series with associated dates will be saved in an output file called AE20236000.ISA.
- PRINT – Specifies output to be printed. In this example, **BRIEF** specifies that only certain tables are printed.
- NAME – The name of the time series. In this example, the name is “**10113310 – AE**”.
- SAVELOG – Specifies the diagnostic statistics to be printed to the log file. In this example, the following diagnostics will be printed:
  - **IND TEST**, which is a test for adequacy of composite adjustment.
  - **IND Q**, which is an overall index of the acceptability of the indirect seasonal adjustment.