Basic Overview of X-13ARIMA-SEATS

Seasonal Adjustment With X-13ARIMA-SEATS

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Economic Statistical Methods Division

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Objectives

- **At the end of this unit, you should understand –**
  - General syntax of input specifications files (spec files)
  - What types of output files X-13ARIMA-SEATS (X-13A-S) produces

X-13ARIMA-SEATS Input/Output

- X-13A-S input
  - Spec files
- X-13A-S output
  - Output files – either text (*.out, *.log) or html (*.html, *_log.html)
  - Save files
  - "Graphics" files

X-13ARIMA-SEATS Input

Spec File

- Text file that specifies model and adjustment options
- File extension *.**spc**

- Use any text editor (Win X-13, Notepad, Textpad, etc.) to edit a spec file
  - Avoid editors with formatting (Word)

Specs in a Spec File

- Each spec file is made up of functional units called specs

- Each spec inside the spec file controls a specific function
  - **`series`** controls data input
  - **`transform`** controls data transformations
  - **`arima`** controls the ARIMA model

Example Spec File

```
series{ file = "my data.dat"
  format = datevalue
  span = (1998.1,)
}
transform{ function=log }
arima{model = (0 1 1)(0 1 1)}
outlier{ types = (ao ls tc) }
forecast{  }
x11{seasonalma = s3x5 trendma = 13}
```

Writing a Spec File

- Dates have form *yyyy.period*
  - 1999.Jan or 1999.1 or 1999.01
- Multiple values for a given argument must be enclosed in parentheses
  - `outlier{ types = (ao ls tc) }`
- Character values, like titles and file names, should be in quotation marks
  - Double or single quotes

Writing a Spec File (continued)

- Most arguments and values are not case sensitive
  - Use uppercase/lowercase/mixed case
  - Exceptions: titles, names, metadata values
- Everything after "#" on one line is considered a comment

General Input Syntax

```
specname{
 argument1 = value      # I am a comment
 argument2 = ( value1 value2 value3 )
 # multiple arguments can be on one line:
 argument3 = "character value" argument4 = 2000.apr
#  2000.apr is equivalent to 2000.4
#  argument5 = "ignore this" - This is
#### a comment.
}
## Comments are not executed.
```

Arguments Common to Most Specs

savelog = (*value1 value2 value3*)

Saves diagnostic information to the log file

save = (*file1 file2*)

Saves specific output files

print = (*level +table*)

Determines what the output file contains

`Series` Spec

- **`series`** is required and must be before all other specs except **`metadata`** (an optional spec discussed later)

- Only exception is when **`composite`** replaces **`series`**
  - More about **`composite`** later

Simple Yet Functional* Spec File

```
series{
  title="U.S. Total Building Permits"
  file="BldgPmts.dat"
  format="datevalue"
}
```

*This spec will run without errors, but no modeling or seasonal adjustment occurs.

`Series` Spec – Main Function

- Determines how to read the time series data
- Requires either a **`file`** argument or a **`data`** argument (with one exception, to be covered later)

Spec File – Example 1

```
series{
   title="Retail Sales: Shoe Stores"
   span = (1992.1, )
   file = "shoers.dat"
   format = "datevalue"
}

# We prefer the file argument
# over the data argument.
```

Spec File – Example 2

```
series{
 title="ICMETI: Communications Equipment"
 start=1968.01
 data=(
   1654  1712  1784  1797  1857  1865
   1855  1880  1869  1891  1906  1915
   1938  1881  1916  1912  1979  1972
. . .
 )
}
```

X-13ARIMA-SEATS Must Be Able to Read the Time Series

- Keep series in files outside the spec file
  - Strong suggestion but not requirement
- Export spreadsheets to text files
  - Requirement
  - X-13-Data can export series from Excel spreadsheets to text files

Predefined Formats for Data Files

- **`datevalue`**
- **`X13save (X12save)`**
- **`free`**

- See manual for less-common formats

Datevalue Format

- Data in three columns: year, month/quarter, series value
  - Separated by tab or space
  - No header rows
- Easy to convert back and forth to a spreadsheet
- Used at the Census Bureau

Format = "Datevalue"

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

`X13save` Format ("Save Files")

- Usually two columns separated by a tab
  - Dates as *yyyymm* (or *yyyyqq*): 199703 for March 1997 or 3rd Quarter 1997
    - Different from the spec file date format
  - Series values in scientific notation
- Two-line header
- Fairly easy to convert back and forth to a spreadsheet

Format = "X13Save"

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

`Free` Format

- Default format if no format statement
- Tabs, spaces, or line returns separate the numbers
- File contains only data
  - Additional information, like dates, is not allowed so the spec file requires a **`start`** date
  - If the series is not monthly, the **`period`** argument is also necessary
  - Only one series can be stored in each separate data file

Format = "Free"

```
97.5  102.5
118.6  109.0
105.1
112.3
113.1
95.6  100.7  101.5
98.4
97.7  98.7
```

Series Spec – **Span** Argument

```
span = (1991.Jan, 2006.Dec)

span = (1996.Aug, )

span = ( ,2007.Jun)
```

Sets the span of analysis/adjustment within the range of data available in the file (or in the spec file)

Series Spec – **Start** Argument

start = 1997.2

- Sets the **start** date when dates are not associated with the data (**free** format or the **data** statement)
- Not for use with **datevalue** or **X13save** formats!
  - Can get unexpected results, just do not use

Series Spec – **Name** Argument

name = "BPMW1U"

- Required for some old formats
  - CASE sensitive (UPPERCASE/lowercase must match the name in the file)
- Appears in some output
  - Some prefer to omit, most output shows the file name

Series Spec – **Title** Argument

title="Building Permits MW Single Family"

- Not required
- Appears in output; X-13-Graph uses it
  - Some prefer to omit, most output shows the file name

- Note: when trying different settings for the same series either change or eliminate the **title** argument, otherwise graphs and other output are difficult to distinguish

Series Spec – **Decimals** Argument

Decimals = 2

- Controls how many decimals are given in main output file tables
  - Default is 0
    - Not ideal for small-valued series
  - Maximum is 5
- Does not control how many decimals are in saved files or how many are used for calculations

Decimals = 2

Building Permits Midwest Total PAGE 11, SERIES MWTOT

D 11 Final seasonally adjusted data
(also adjusted for trading day)
From 1984.Jan to 1998.Jan
Observations 169

	Jan	Feb	Mar	Apr	
	May	Jun	Jul	Aug	
	Sep	Oct	Nov	Dec	TOTAL
1984	17812.71	20190.38	15024.69	17645.26	
	17088.73	18674.74	17618.62	16587.79	
	16978.42	17972.23	19963.13	18239.99	213796.71

. . .

X-13ARIMA-SEATS Output

Two Different X-13ARIMA-SEATS Programs

1) Produces text output files
2) Produces accessible HTML output files
   - Conforms to Section 508

- Computations are the same; only the output format differs

Output File

- Produced for every run
- Usually has same name as the spec file but with extension *.out or *.html
  - Can specify alternate output name
- Fairly large: many tables and diagnostics, although user specifies print settings

Log File

- Produced for every run
- Has same name as the output file but with *.log or *_log.html extension
  - If using alternate output name, log file also is renamed
  - If running a metafile (covered later), log file name matches the metafile name

Log File (continued)

- Summarizes modeling and seasonal adjustment diagnostics
  - Only diagnostics specified in the spec file with the **`savelog`** argument are listed
    - Some specs can use **`savelog=all`**
- Is much shorter than the output file
  - Abbreviated content; little context

Examples of **Savelog** Argument (1)

```
series{file="BP MW BP Single Family.dat"
  format="datevalue"
}
transform{function=auto savelog=atr}
regression{
  variables=(td1coef easter[1] TC2008.Dec) }
outlier{ types=(AO LS TC) lsrun=3 }
arima{ model=(1 1 0)(0 1 1) }
forecast{ maxlead=60 print=none }
x11{ seasonalma=s3x5 savelog=(msr icratio) }
```

Log File Example (1)

```
Log for X-13ARIMA-SEATS program (Version 1.1 Build 48)
May 8, 2018 17.05.00
Log Entry for the monthly series BP Midwest Single Family
X-13ARIMA-SEATS run of BP Midwest Single Family

AIC test for transformation
AICC(no log)      1948.8914
AICC(log)              1878.7040
Automatic transformation test       Log Transformation

X-11 Seasonal Adjustment Diagnostics
Moving seasonality ratio   3.645
I/C Ratio                  1.195
```

Error File

- Created for every series run
- Extension *.err or *_err.html
- If X-13A-S encounters a problem running a spec file, the error file usually contains a description

Diagnostics File (.udg)

- Provides *very abbreviated* summary and diagnostic information
  - More detail than log file
  - udg file entries are not specified by the user (with one exception)
  - Can be hard to read – scientific notation, abbreviated keywords, etc.

- <keyword>: <value(s)>

Diagnostics File Example

```
date: Jul 23, 2010
time: 11.06.01
version: 1.0
build: 148
output: html
srstit: Building Permits MW Total
srsnam: MWTOT
freq:    12
span:  1st month,1984 to  1st month,1998
startspec:  2nd month,1990
constant:     0.0000000000E+00
transform: Log(y)
nfcst:    60
. . .
```

Metadata Spec

- Creates user-defined metadata to save to a diagnostics file (*.udg)
- Not required but is useful

- ***Users*** set keywords and values
- First available in X-12-ARIMA Version 0.3

Metadata Spec – Example

```
metadata {keys = ("contact"
 "review.date" "last.change.year"
 "units.of.measure" "favorite.color"
)
values = ("Patrick Star"
  "June 15, 2014"   "2008"
  "Millions of Dollars"    "Pink"
)
}
```

Diagnostics File (*.udg) Metadata

```
metadata.contact: Patrick Star
metadata.review.date: June 15, 2014
metadata.last.change.year: 2008
metadata.units.of.measure: Millions of Dollars
metadata.favorite.color: Pink
```

Save Files

- Use `save` arguments to save specified tables to individual files
- Files stored
  - In `x13save` format
  - In same directory as the main output file
  - With same filename as the main output file
  - With distinct file extension of up to 3 characters (table abbreviation)
    - Table A1 => <filename>.a1

Example spec file with **save** arguments

```
series{ file = "Legal services.dat" period = 4
   format = datevalue  save = b1 }
transform{ function = none }
outlier{ types = all }
arima{ model = (1 1 0)(0 1 1) }
forecast{ maxlead = 8 save = fct }
x11{ seasonalma = s3x5 save = (d10 d11 d12) }
```

**Saves five additional files, with the extensions *.b1 (prior-adjusted series), *.fct (forecasts), *.d10 (seasonal factors), *.d11 (seasonally adjusted series), and *.d12 (trend-cycle)*

Graphics Files

- Graphics files are identical to save files, except
  - The files saved aren't selected by the user; all graphics files relevant to the series are saved automatically when X-13A-S is run in graphics mode
  - Graphics files are saved to the specified graphics directory (which should be different than the output directory, or you will encounter errors)

Customizing the Output

- **`Print`** argument
  - Set according to need – maybe longer output during annual review but shorter output for production
  - Specify tables to include or exclude in the output file
    - + includes
    - - excludes

Print Levels (Spec Specific)

- **`Print=none`**
  - No tables
- **`Print=brief`**
  - Reduced number of tables
- **`Print=default`**
  - Default tables
- **`Print=alltables`**
  - All tables but no plots (text graphs)
- **`Print=all`**
  - All available tables and plots

- Appendix B.1 of the manual lists which tables fall into which print level for each spec

Example (**X11** Spec)

- With brief output, to see the irregulars (Table D13) but not the calendar effects (Table D18)
  - **print=(brief +irregular –calendar)**
    or **print=(brief +d13 –d18)**
- To see only the final seasonally adjusted series
  - **print = (none +d11)**

Example Complete Spec File

```
series { #name = 'MWTOT'
   title='Building Permits Midwest Total'
   decimals = 2
   file='bp_mwtot.dat' format='datevalue'
}
spectrum { savelog=all }
transform { function = log }
arima { model=(2 1 0)(0 1 1) }
regression { variables=td }
outlier { types=(ao ls tc) }
forecast { maxlead=42 print=none }
check { print=all savelog=all } estimate { print=all }
x11 { seasonalma = s3x5
   savelog = all
   save = d11
   print=(brief +c17 +d8 +d9a +trend -tdy)
}
```