

seasonal: R interface to X-13ARIMA-SEATS

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1 Introduction

seasonal is an easy-to-use R-interface to X-13ARIMA-SEATS, a seasonal adjustment software developed by the [United States Census Bureau](#). X-13ARIMA-SEATS combines and extends the capabilities of the older X-12ARIMA (developed by the Census Bureau) and the TRAMO-SEATS (developed by the Bank of Spain) software packages.

If you are new to seasonal adjustment or X-13ARIMA-SEATS, you may use the automated procedures to quickly produce seasonal adjustments of time series. Start with the [Getting started](#) section and skip the rest.

If you are already familiar with X-13ARIMA-SEATS, you may benefit from the equivalent use of its syntax in *seasonal*. Read the [Syntax equivalence](#) section and have a look at the [wiki](#), where almost all examples from the original X-13ARIMA-SEATS manual are reproduced in R. For more details on X-13ARIMA-SEATS, as well as for explanations on the X-13ARIMA-SEATS syntax, see the [manual](#) or the [quick reference](#).

2 Installation

To install the stable version directly from CRAN, type to the R console:

```
install.packages("seasonal")
```

seasonal does not include the binary executables of X-13ARIMA-SEATS. They need to be installed separately from [here](#) (Windows, filename `x13asall.zip`) or [here](#) (Linux, filename `x13asall.tar.gz`). My own compilation for Mac OS-X can be obtained [upon request](#).

Download the file, unzip it and copy the folder to the desired location in your file system. Next, you need to tell *seasonal* where to find the binary executables of X-13ARIMA-SEATS, by setting the specific environmental variable `X13_PATH`. This may be done during your active session in R:

```
Sys.setenv(X13_PATH = "YOUR_X13_DIRECTORY")
```

Exchange `YOUR_X13_DIRECTORY` with the path to your installation of X-13ARIMA-SEATS. Note that the Windows path `C:\something\somemore` has to be entered UNIX-like `C:/something/somemore` or `C:\\something\\somemore`. You can always check your installation with:

```
checkX13()
```

If you want to set the environmental variable permanently, you may do so by adding it to the `Renviron.site` file, which is located in the `etc` subdirectory of your R home directory (use `R.home()` in R to reveal the home directory). `Renviron.site` does not exist by default; if not, you have to create a file named `Renviron.site` with your favorite text editor (on Windows, be careful with the 'show extensions for known file types' option, the extension `.site` may be hidden). Add the following line to the file:

```
X13_PATH = YOUR_PATH_TO_X13
```

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Alternatively, use the system terminal (on Windows, it's called command prompt; also, the `cd` command requires `\` instead of `/`):

```
cd YOUR_R_HOME_DIRECTORY/etc
echo X13_PATH = YOUR_PATH_TO_X13 >> Renviron.site
```

There are other ways to set an environmental variable permanently in R, see `?Startup`.

3 Getting started

`seas` is the core function of the *seasonal* package. By default, `seas` calls the automatic procedures of X-13ARIMA-SEATS to perform a seasonal adjustment that works well in most circumstances. It returns an object of class "seas" that contains all necessary information on the adjustment process, as well as the series. The `final` method for "seas" objects returns the adjusted series, the `plot` method shows a plot with the unadjusted and the adjusted series.

```
m <- seas(AirPassengers)
final(x)
plot(x)
```

The first argument has to be a time series of class "ts". By default, `seas` calls the SEATS adjustment procedure. If you prefer the X11 adjustment procedure (this is what X-12ARIMA does), use the following option (see the next section for more details about the syntax):

```
seas(AirPassengers, x11 = list())
```

Besides performing seasonal adjustment with SEATS, a default call of `seas` invokes the following automatic procedures of X-13ARIMA-SEATS:

- Transformation selection (log / no log)
- Detection of trading day and Easter effects
- Outlier detection
- ARIMA model search

Alternatively, all inputs may be entered manually, as in the following example:

```
seas(x = AirPassengers, regression.variables = c("td1coef", "easter[1]",
"ao1951.May"), arima.model = "(0 1 1)(0 1 1)", regression.aictest = NULL,
outlier = NULL, transform.function = "log")
```

The `static` command reveals the static call from above that is needed to replicate the automatic seasonal adjustment procedure:

```
static(m)
static(m, coef = TRUE) # also fixes the coefficients
```

If you are using RStudio, the `inspect` command offers a way to analyze and modify a seasonal adjustment procedure (see the section below for details):

```
inspect(m)
```

4 Syntax equivalence to X-13ARIMA-SEATS

The X-13ARIMA-SEATS syntax uses *specs* and *arguments*, with each spec optionally containing some arguments. For details, see the [manual](#). These spec-argument combinations can be added to `seas` by separating spec and argument by a dot (`.`). For example, in order to set the `variables` argument of the regression spec equal to `td` and `ao1999.jan`, the input to `seas` looks like this:

```
m <- seas(AirPassengers, regression.variables = c("td", "ao1955.jan"))
```

Note that R vectors may be used as an input. If a spec is added without any arguments, the spec should be set equal to an empty `list()`. Several defaults of `seas` are empty lists, such as the default `seats = list()`. See the help page (`?seas`) for more details on the defaults.

It is possible to manipulate almost all inputs to X-13ARIMA-SEATS in this way. For instance, example 1 in section 7.1 from the [manual](#),

```
series { title = "Quarterly Grape Harvest" start = 1950.1
        period = 4
        data = (8997 9401 ... 11346) }
arima { model = (0 1 1) }
estimate { }
```

translates to R in the following way:

```
seas(AirPassengers,
     x11 = list(),
     arima.model = "(0 1 1)"
)
```

`seas` takes care of the `series` spec, and no input beside the time series has to be provided. As `seas` uses the SEATS procedure by default, the use of `X11` has to be specified manually. When the `x11` spec is added as an input (like above), the mutually exclusive and default `seats` spec is automatically disabled. With `arima.model`, an additional spec-argument is added to the input of X-13ARIMA-SEATS. As the spec cannot be used in the same call as the `automdl` spec, the latter is automatically disabled. The best way to learn about the relationship between the syntax of X-13ARIMA-SEATS and seasonal is to study the comprehensive list of examples in the [wiki](#).

There are several mutually exclusive specs in X-13ARIMA-SEATS. If more than one mutually exclusive spec is included, a set of priority rule is followed, where the lower priority is overwritten by the higher priority:

- Model selection
 1. `arima`
 2. `pickmdl`
 3. `automdl` (default)
- Adjustment procedure
 1. `x11`
 2. `seats` (default)

5 Graphs

There are several graphical tools to analyze a `seas` model. The main plot function draws the seasonally adjusted and unadjusted series, as well as the outliers. Optionally, it also draws the trend of the seasonal decomposition:

```
m <- seas(AirPassengers, regression.aictest = c("td", "easter"))
plot(m)
plot(m, outliers = FALSE)
plot(m, trend = TRUE)
```

The `monthplot` function allows for a monthwise plot (or quarterwise, with the identical function name) of the data. There is a method for "seas" objects:

```
monthplot(m)
monthplot(m, choice = "irregular")
```

Also, many R function can be used to analyze a "seas" model:

```
pacf(resid(m))
spectrum(diff(resid(m)))
plot(density(resid(m)))
qqnorm(resid(m))
```

6 Diagnostical Re-Evaluation

For diagnostical purposes, some functions re-evaluate a "seas" object and capture the full content or parts of the `.out` file from X-13ARIMA-SEATS. Re-evaluation on demand saves computing time and reduces the size of a "seas" object.

The `out` function shows the full content of the `.out` file from X-13ARIMA-SEATS in a console viewer. It can also be searched for an arbitrary term:

```
out(m)
out(m, search = "regARIMA model residuals")
```

The `slidingspans` and `revisions` function call the `slidingspans` and `history spec` of X-13ARIMA-SEATS and show the respective parts of the `.out` file. Note that against the convention, the `history spec` is called by the function `revisions`, in order to avoid a naming collision with the function from the `utils` package. `slidingspans` analyzes the stability of a seasonal adjustment, `history` computes an out-of-sample revision history. A plot method shows a graphical overview of the analysis. For a detailed description of the two specs, consider section 7.16 and 7.8 in the [manual](#).

```
slidingspans(m)
plot(slidingspans(m))

revisions(m)
plot(revisions(m))
```

7 Inspect tool

The `inspect` function is a powerful tool for choosing a good seasonal adjustment model. It uses the `manipulate` package and can only be used with the (free) [RStudio IDE](#). The goal of `inspect` is to summarize all relevant options, plots and statistics that should be usually considered. `inspect` uses a "seas" object as its only argument:

```
inspect(m)
```

The `inspect` function opens an interactive window that allows for the manipulation of a number of arguments. It offers several views to analyze the series graphically. With each change, the adjustment process and the visualizations are recalculated. Summary statistics are shown in the R console.

With the 'Show static call' option, a replicable static call is also shown in the console. Note that this option will double the time for recalculation, as the static function also tests the static call each time.

8 License

seasonal is free and open source, licensed under GPL-3. It has been developed for the use at the Swiss State Secretariat of Economic Affairs and is not connected to the development of X-13ARIMA-SEATS, which is in the Public Domain.

This is a new package, and it may still contain bugs. Please report them on [Github](#) or send me an [e-mail](#). Thank you!