

Alexander
Kowarik¹, Angelika
Meraner¹ and
Matthias Templ^{1,2}
1. Statistics Austria
2. Vienna University of
Technology
useR 2015
Aalborg, July 2015

Seasonal Adjustment with the R packages x12 and x12GUI

- ▶ X12-ARIMA is widely used and state-of-the-art in many statistical offices
- ▶ Statistical offices (we) have to apply seasonal adjustment frequently and to many different time series
- ▶ Graphical analysis should always be included in the process
- ▶ Results should be reproducible and easy to modify
- ▶ (X-13-ARIMA-SEATS is the successor if X12-ARIMA, SEATS not yet implemented)

→ R-packages x12 and x12GUI

- ▶ Access to X12-ARIMA directly from within R (no spc, out, ... files)
- ▶ Class oriented command line interface
- ▶ Change tracking for the X12-ARIMA parameters and output
- ▶ Batch processing of multiple time series at once (in parallel)
- ▶ Easy generation of graphical output
- ▶ Import the parameter settings from spc files to R

Objects of class `x12Single` contain the following information

- ▶ `ts` - The original time serie
- ▶ `x12Parameter` - The current X12-ARIMA parameter setting
- ▶ `x12Output` - The current X12-ARIMA results
- ▶ `x12OldParameter` - All previous X12-ARIMA parameter settings
- ▶ `x12OldOutput` - All previous X12-ARIMA results

Methods for this class are:

- ▶ `x12` - (Re)Run X12-ARIMA
- ▶ `setP,getP` - Change/View parameters
- ▶ `prev,cleanHistory` - Revert to a previous X12 parameter setting and output
- ▶ `plot,plotRsdAcf,plotSpec,plotSeasFac` - Plot methods

```
s <- new("x12Single", ts = AirPassengers ,  
        tsName = "air")  
s <- x12(s)  
forecast <- s@x12Output@forecast
```

Objects of class x12Batch

- ▶ Combination of multiple objects of class x12Single
- ▶ Inherit the methods from class x12Single

```
xb <- new("x12Batch", list(AirPassengers ,  
  AirPassengers , AirPassengers ))  
xb <- setP(xb, list(estimate = TRUE,  
  outlier.types = "all")  
xb <- setP(xb, list(outlier.types = "LS", index=1)  
#options(x12.parallel=2)  
xb <- x12(xb)
```

```
> dat <- read.csv2("http://bit.ly/1RTF31S")
> tsObject <- lapply(split(dat[,5], list(dat[,2], dat[,3])),
+ # by state and country of origin
+ ts,start = c(1973,11), frequency = 12)
> length(tsObject)
```

```
[1] 774
```

```
> xb <- new("x12Batch", tsObject[1:3])
> xb <- setP(xb,list(forecast_years=3))
```

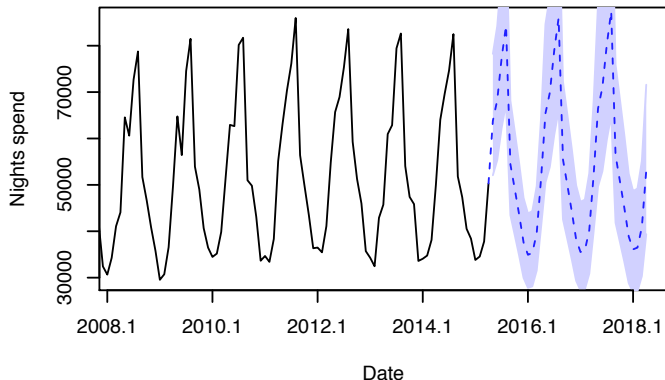
The parameters for all objects are changed.

```
> xb <- x12(xb)
```

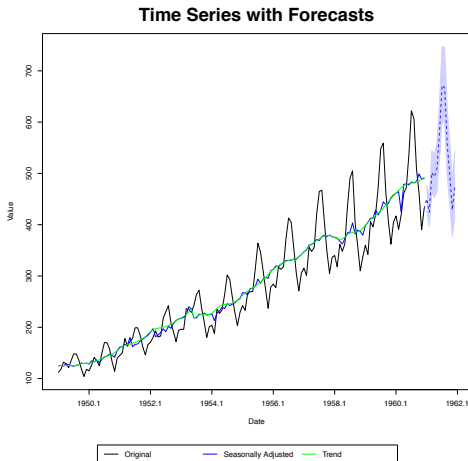
Time difference of 6.766999 secs

```
> plot(xb@x12List[[1]], forecast = TRUE,  
+      span = c(2008,4,2018,4), ylab = "Nights spend")
```

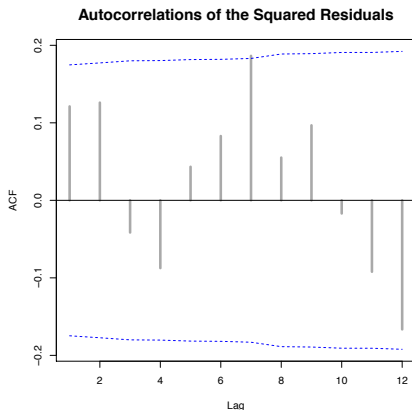
Time Series with Forecasts



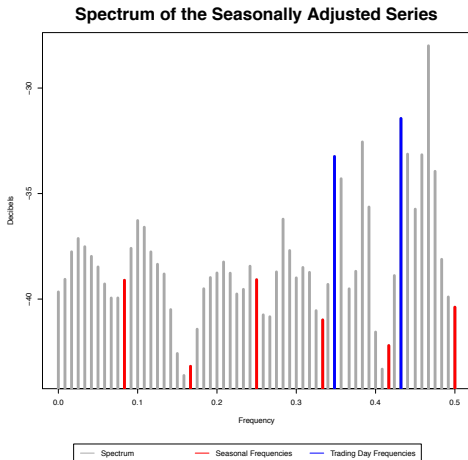
- ▶ Output of the `plot()` method showing trend and forecasts with prediction intervals as well as the seasonally adjusted series.



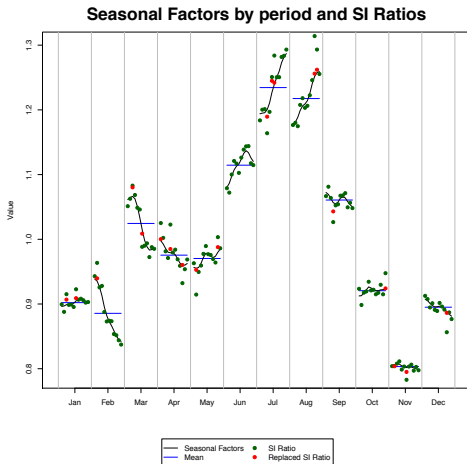
- ▶ Output of the `plotRsdAcf()` function from the R package `x12`, showing the autocorrelations of the squared residuals from the `regARIMA` model.



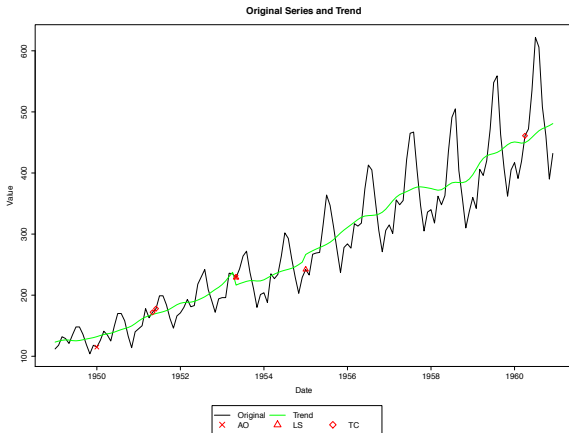
- ▶ Output of the `plotSpec()` function, showing the spectrum of the seasonally adjusted series.



- ▶ Output of the seasonal factor plot (`plotSeasFac()`).



- ▶ Output of the `plot()` method showing outliers in the RegARIMA model.



- ▶ Overview of all (implemented) X12-ARIMA parameters
- ▶ Interactive adjustment of the parameters
- ▶ Interactive graphics
- ▶ Visualisation of the automatically detected outliers
- ▶ Easy addition, removal of manually selected outliers

```
> xbn <- x12GUI(xb)
```

Main View x12GUI

x12 Export

Serieses

Series_1

Series_2

Series_3

Series_4

1

span

start

year: _____ period: _____

end

year: _____ period: _____

modelspan

start

year: _____ period: _____

end

year: _____ period: _____

Transform

function: auto

power:

adjust:

Regression

Regression X11 Regression

variables:

uses:

file: _____ (keine)

user-type:

centeruser: _____

start: _____

Year: _____ Period: _____

aictest:

Outlier

types

all AO

TC LS

critical: all

specific

AO

LS

TC

span: start: _____

year: _____

end: _____

period: _____

method:

Arima

model: 1 1 0

smodel: 0 1 1

Clean Archive

Programms started!

Manual Outliers

Type Year period

4

Remove

Type: _____

Year: _____

Period: _____

Add

Add by Click

Plot

original

seasonally adjusted

trend

log-transformation

show CI

original points

show all outliers

show specific outlier

year: _____

period: _____

Spectral

sa

original

irregular

residuals

Autocorrelation Plot

acf

pacf

acf2

Summary

show full summary

spectral detail

almostout

rsd autocorr

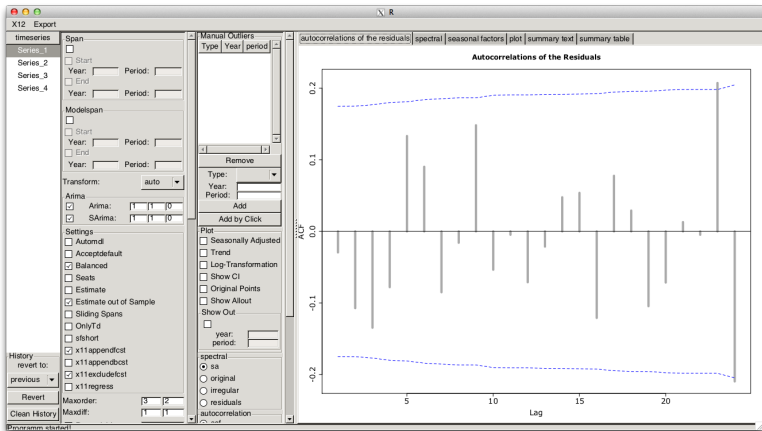
quality stat

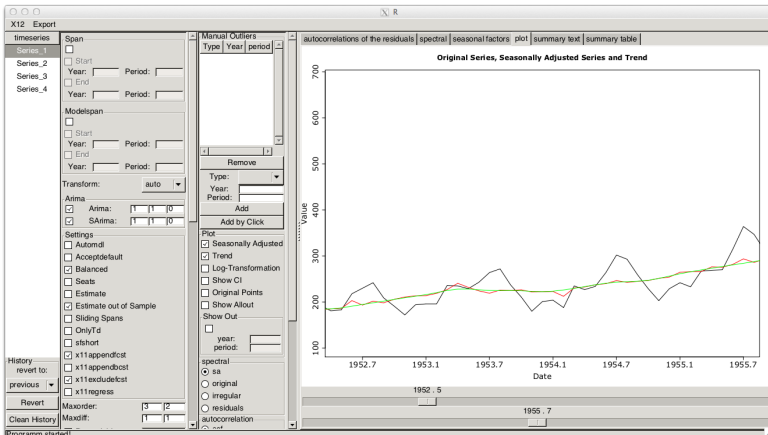
likelihood stat

sspe

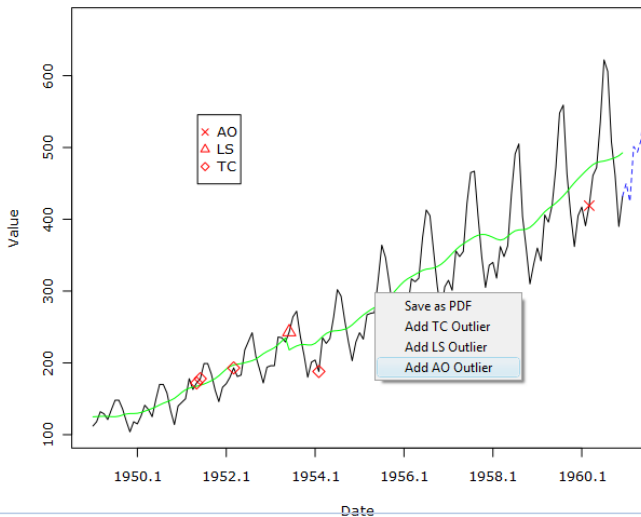
plot	spectral	autocorrelations	seasonal factors	summary test	summary table
				Series_1	Series_2
Frequency				12	12
Span			1st month,1949 to 12th month,1960		1st month,1949 to 12th month,1960
X11 Regression			FALSE	FALSE	FALSE
Model Definition			ARIMA Model: (1,1,0)(0,1,1)	ARIMA Model: (0 1 1)(0 1 1) (Automatic Model Choice)	ARIMA Model: (1,1,0)(0,1,1)
Transformation			Automatic selection : Log(y)	Automatic selection : Log(y)	Automatic selection : Log(y)
Regression Model			none	none	Automatically Identified Outlier
Outlier detection performed			TRUE	TRUE	TRUE
acrit			3.89 *	3.89 *	3.89 *
lscrit			3.89 *	3.5	3.5
lccrit			3.89 *	2.5	2.5
Total Number of Outliers			0	6	6
Nr of Automatically Identified Outliers			0	6	6
Identifiable Seasonality			yes	yes	yes
Seasonal Peaks			rsd	rsd	rsd
Trading Day Peaks			sa wr	rsd	rsd
Q Statistic			0.26	0.2	0.2
Nr of M stats outside limits			0	0	0
SA decomposition			multiplicative	multiplicative	multiplicative
Seasonal moving average			3x3 (Based on mtr size)	3x3 (Based on mtr size)	3x3 (Based on mtr size)
Henderson filter			9-term	9-term	9-term
1 variable, coef, stder, tval			NA	autoutlier_TC1951.May, 0.078, 0.021	
2 variable, coef, stder, tval			NA	autoutlier_TC1951.Jun, -0.099, 0.024	
3 variable, coef, stder, tval			NA	autoutlier_TC1952.Mar, -0.083, 0.021	
4 variable, coef, stder, tval			NA	autoutlier_1_S1953.Jun, -0.090, 0.023	
5 variable, coef, stder, tval			NA	autoutlier_TC1954.Feb, -0.073, 0.021	
6 variable, coef, stder, tval			NA	autoutlier_AC0960.Mar, -0.104, 0.021	
OLD OUTPUT 1			Run 1	Run 1	Run 1
Frequency			12	12	12
Span			1st month,1949 to 12th month,1960		1st month,1949 to 12th month,1960
X11 Regression			FALSE	FALSE	FALSE
Model Definition			ARIMA Model: (1,1,0)(0,1,1) (Automatic Model Choice)	ARIMA Model: (1,1,0)(0,1,1)	ARIMA Model: (1,1,0)(0,1,1)
Transformation			Automatic selection : Log(y)	Automatic selection : Log(y)	Automatic selection : Log(y)
Regression Model			none	none	Automatically Identified Outlier
Outlier detection performed			TRUE	TRUE	TRUE
acrit			3.89 *	3.89 *	3.89 *
lscrit			3.5	3.5	3.5
lccrit			4	2.5	2.5
Total Number of Outliers			0	9	9

6





Original Series and Trend



- ▶ JSS paper “Seasonal Adjustment with the R packages x12 and x12GUI”



- ▶ Contact: Alexander Kowarik alexander.kowarik@statistik.gv.at
- ▶ <https://github.com/alexkowa/x12>