



RJDemetra: A R Interface To JDemetra+ Seasonal Adjustment Software

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Abstract

The abstract of the article.

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1. Introduction

The package **RJDemetra** provides a R interface to the seasonal adjustment software JDemetra+. Note that, JDemetra+ being implemented in Java, **RJDemetra** relies on the **rJava** package and Java SE 8 or later version is required. The two leading seasonal adjustment methods TRAMO/SEATS+ and X-12ARIMA/X-13ARIMA-SEATS can be used with all the specifications defined in JDemetra+.

This article is structured as following. In the first section the .. is presented.

1.1. Seasonal adjustment in brief

The **first step** of seasonal adjustment, both in X-12ARIMA/X-13ARIMA-SEATS and TRAMO-SEATS+, consists of pre-adjusting the time series by removing from it the deterministic effects and estimating missing observations. Among deterministic effects, we distinguish outliers, calendar and regression effects. In this step, also forecasts and backcasts of the pre-adjusted series are estimated which allows applying linear filters at both ends of the series in the second step of the seasonal adjustment. The pre-adjustment, linearization, of the input series is achieved with a **RegARIMA** model (model with ARIMA errors) as specified below.

$$z_t = y_t\beta + x_t$$

where

- z_t - is the original series;
- $\beta = (\beta_1, \dots, \beta_n)$ - a vector of regression coefficients;
- $y_t = (y_{1t}, \dots, y_{nt})$ - n regression variables (outliers, calendar effects, user-defined variables);
- x_t - a disturbance that follows the general ARIMA process:
- $\phi(B)\delta(B)x_t = \theta(B)a_t$; $\phi(B)$, $\delta(B)$ and $\theta(B)$ are the finite polynomials in B ; a_t is a white-noise variable with zero mean and a constant variance.

The polynomial $\phi(B)$ is a stationary autoregressive (AR) polynomial in B , which is a product of the stationary regular AR polynomial in B and the stationary seasonal polynomial in B^s :

$$\phi(B) = \phi_p(B)\Phi_{bp}(B^s) = (1 + \phi_1 B + \dots + \phi_p B^p)(1 + \Phi_1 B^s + \dots + \Phi_{bp} B^{bps})$$

where:

- p - number of regular AR terms (in the package and in JDemetra+ $p \leq 3$);
- bp - number of seasonal AR terms (in the package and in JDemetra+ $bp \leq 1$);
- s - number of observations per year (frequency of the time series).

The polynomial $\theta(B)$ is an invertible moving average (MA) polynomial in B , which is a product of the invertible regular MA polynomial in B and the invertible seasonal MA polynomial in B^s :

$$\theta(B) = \theta_q(B)\Theta_{bq}(B^s) = (1 + \theta_1 B + \dots + \theta_q B^q)(1 + \Theta_1 B^s + \dots + \Theta_{bq} B^{bqs})$$

where:

- q - number of regular MA terms (in the package and in JDemetra+ $q \leq 3$);
- bq - number of seasonal MA terms (in the package and in JDemetra+ $bq \leq 1$);

The polynomial $\delta(B)$ is the non-stationary AR polynomial in B (unit roots):

$$\delta(B) = (1 - B)^d(1 - B^s)^{d_s}$$

where:

- d - regular differencing order (in the package and in JDemetra+ $d \leq 1$);
- d_s - seasonal differencing order (in the package and in JDemetra+ $d_s \leq 1$);

In the **second part** of seasonal adjustment, called the **decomposition**, the pre-adjusted series is decomposed into the following components: trend-cycle (**t**), seasonal component (**s**) and irregular component (**i**). The decomposition can be:

- additive ($y = t + s + i$)
- multiplicative ($y = t * s * i$)
- log-additive ($\log(y) = \log(t) + \log(s) + \log(i)$) or

- pseudo-additive ($y = t \cdot (s + i - 1)$)

The last two decompositions are available only under X13.

The method of decomposing the pre-adjusted series differs between TRAMO-SEATS+ and X-12ARIMA/X-13ARIMA. In TRAMO-SEATS+, SEATS (“Signal Extraction in ARIMA Time Series”) decomposes the observed series with a ARIMA-model based method. Whereas in X-12ARIMA/X-13ARIMA, the X11 algorithm decomposes the time series by means of linear filters. More information on the TRAMO-SEATS+ method can be found on the Bank of Spain website ([link](#)) and on X-12ARIMA/X-13ARIMA, on the U.S. Census Bureau website.

As a result of seasonal adjustment, the final seasonally adjusted series (**sa**) shall be free of seasonal and calendar-related movements.

More details on the methodology used in JDemetra+ can be found in the JDemetra manuals and user guides available at [link](#).

2. RJDemetra basics

The **RJDemetra** package allows to:

- create and modify model specifications
- create and modify models
- import/export JDemetra+ workspaces

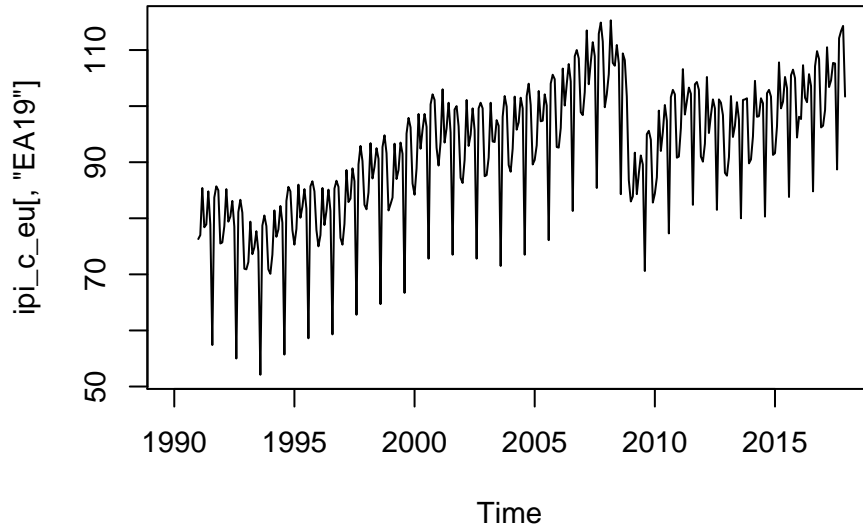
2.1. Dataset

In this package we include the `sts_inpr_m` database of Eurostat, which contains the monthly industrial production indices in manufacturing in the European Union. It contains 37 time series from january 1990 to december 2017 which are considered to be affect by seasonal and working day effects. The data is a **ts** object and can be accessed using the `ipi_c_eu` object. The following snippet of code plot the industrial production index of the Euro aera:

```
R> library(RJDemetra)
R> plot(ipi_c_eu[, "EA19"])
```

Table 1: Pre-defined specification for TRAMO and TRAMO-SEATS

Specification		Trans- formation	Pre-adjust- ment for leap-year	Working days	Trading days	Easter effect	Outliers	ARIMA model
TRAMO	TRAMO- SEATS							
TR0	RSA0	no	no	no	no	no	no	(0,1,1)(0,1,1)
TR1	RSA1	test	no	no	no	no	test	(0,1,1)(0,1,1)
TR2	RSA2	test	no	test	no	test	test	(0,1,1)(0,1,1)
TR3	RSA3	test	no	no	no	no	test	AMI
TR4	RSA4	test	no	test	no	test	test	AMI
TR5	RSA5	test	no	no	yes	test (Standard)	test	AMI
TRfull (default)	RSAfull (de- fault)	test	yes	no	test	test (Include Easter)	test	AMI



3. Estimate a predefined regarima and SA model

As in JDemetra+, **RJDemetra** package allows to perform seasonal adjustment using pre-defined model specifications. The specifications are separately defined for TRAMO-SEATS and X-13ARIMA-SEATS estimation methods. Also, only the first step of seasonal adjustment - RegARIMA estimation - is possible with pre-defined specifications. The pre-defined model specifications are described in tables 1 and 2. They correspond to the most commonly used specifications and users are recommended to start their analysis with one of those specification. Pre-defined specifications are identical for pre-adjustment (column 1) and for seasonal adjustment (column 2).

Table 2: Pre-defined specification for RegARIMA and X-13ARIMA-SEATS

Specification		Trans- formation	Pre-adjust- ment for leap-year	Working days	Trading days	Easter effect	Outliers	ARIMA model
RegARIMA	X-13ARIMA- SEATS							
RG0	X11	no	no	no	no	no	no	(0,1,1)(0,1,1)
RG1	RSA1	test	no	no	no	no	test	(0,1,1)(0,1,1)
RG2c	RSA2c	test	test	test	no	test	test	(0,1,1)(0,1,1)
RG3	RSA3	test	no	no	no	no	test	AMI
RG4c	RSA4c	test	test	test	no	test	test	AMI
RG5c (default)	RSA5 (default)	test	test	no	test	test	test	AMI

The model specification can be defined from an existing model specification or an estimated model, as each of the estimated model contains also its specification.

4. SA object structure

Table 3: SA object structure

Object	Level	Type	When adjusted with:	
			<i>x13/x13_def</i>	<i>tramoseats/tramoseats_def</i>
			Class	Class
sa_object	0	list	SA, X13	SA, TRAMO_SEATS
regarima	1	list	regarima, X13	regarima, TRAMO_SEATS
specification	2	list		
estimate	3	data.frame		
transform	3	data.frame		
regression	3	list		
userdef	4	list		
specification	5	data.frame		
outliers	5	data.frame or NA(empty)		
variables	5	list		
series	6	mts, ts, matrix or NA(empty)		
description	6	data.frame or NA(empty)		
trading.days	4	data.frame		
easter	4	data.frame		
outliers	3	data.frame		
arima	3	list		
specification	4	data.frame		
coefficients	4	data.frame or NA(empty)		
forecast	3	data.frame		
span	3	data.frame		
arma	2	vector - numeric		
arima.coefficients	2	matrix		
regression.coefficients	2	matrix		
loglik	2	matrix		
model	2	list		
spec_rslt	3	data.frame		
effects	3	mts, ts, matrix		
residuals	2	ts		
residuals.stat	2	list		
st.error	3	numeric		
tests	3	data.frame	regarima_rtests, data.frame	
forecast	2	mts, ts, matrix		
decomposition	1	list	decomposition_X11	

specification	2	data.frame	X11_spec, data.frame	
mode	2	character		
mstats	2	matrix		
sl_ratio	2	mts, ts, matrix		
s_filter	2	vector - character		
t_filter	2	character		
decomposition	1	list		decomposition_SEATS
specification	2	data.frame	seats_spec, data.frame	
mode	2	character		
model	2	list		
model	3	matrix or empty list		
sa	3	matrix or empty list		
trend	3	matrix or empty list		
seasonal	3	matrix or empty list		
transitory	3	matrix or empty list		
irregular	3	matrix or empty list		
linearized	2	mts, ts, matrix		
components	2	mts, ts, matrix		
final	1	list		final
series	2	mts, ts, matrix		
forecasts	2	mts, ts, matrix		
diagnostics	1	list		diagnostics
variance_decomposition	2	data.frame		
combined_test	2	list	combined_test	
tests_for_stable_seasonality	3	data.frame		
combined_seasonality_test	3	character		
residuals_test	2	data.frame		
user_defined	1	list		user_defined

4.1. Regarima

Here we can also present the output: print and graphs.

```
R> library(RJDemetra)
R> myseries <- ipi_c_eu[, "FR"]
R> mysa <- x13_def(myseries, spec=c("RSA5c"))
R> mysa$regarima
```

```
y = regression model + arima (0, 1, 1, 0, 1, 1)
```

```
Log-transformation: no
```

```
Coefficients:
```

```

              Estimate Std. Error
Theta(1)    -0.5270      0.048
BTheta(1)   -0.4865      0.051
```

```

              Estimate Std. Error
Monday       -0.133839      0.164
Tuesday      -0.002384      0.163
Wednesday     0.241712      0.163
Thursday     -0.531275      0.163
Friday        0.432474      0.164
Saturday      0.152956      0.163
Leap year    -0.045977      0.501
```

Easter [1]	-1.094082	0.335
LS (11-2008)	-8.441602	1.307
LS (1-2009)	-7.274012	1.306
LS (5-2008)	-5.020079	1.257

Residual standard error: 1.665 on 323 degrees of freedom

Log likelihood = -624.7, aic = 1277 aicc = 1279, bic(corrected for length) = 1.252

4.2. Decomposition

4.3. Final

4.4. Diagnostics

4.5. user defined

5. Model specification: creation and modification

5.1. X13

5.2. TRAMOSEATS

5.3. Regarima

5.4. Wrong specifications corrections

Parler des corrections automatiques ?

6. Manipulate JDemetra+ workspaces

Mise en garde sur ce que l'on ne peut pas faire (problèmes d'imports)

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