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TSACE-TSAUG Meeting # 10

RJDemetra tools for statistical production

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Presentation Overview

- **Pt.1: Tool for specification conversion**
  - JD_JSON format
  - TRAMO-SEATS (Gomez & Maravall) to RJDemetra (v2) / JDemetra+

- **Pt.2: RJDemetra Processor:**
  an RJDemetra processing pipeline ready for you
  - Architecture
  - Adaptable input interfaces to suit your context

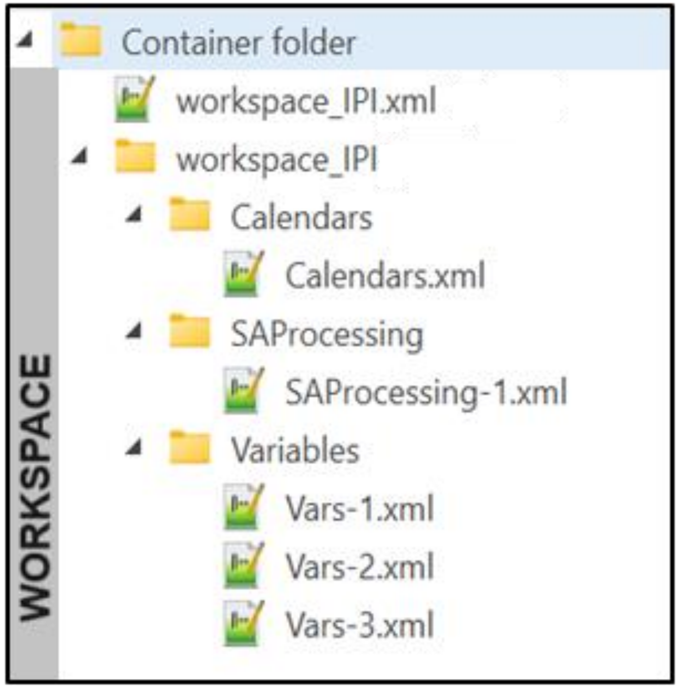
Pt.1: Tool for specification conversion

(TRAMO-SEATS to JDemetra+ and RJDemetra)

Specifications in JDemetra+ and RJDemetra

JDemetra+ specifications can be retrieved from:

- the workspace (XML files into nested folders)
- .cfgx files
- .RData files (only RJDemetra and rjd3)



Why do we need this?

We found **difficulties** in handling specifications/workspaces **in memorization stage**:

- limited transparency
    - workspace XML are verbous
    - .cfgx or .RData files are not human-readable
- our database stores individual time series information, workspaces are designed for multiple time series
- one workspace for time-series is not practical for seasonal adjustment in JD+
- need a directory storage system (on filesystem or BLOB type field on DB) for workspaces
- workspaces store data, specifications, and external regressors together
- difficulties for the users in refreshing data (input time series and external regressors).
    - JD+ providers keep searching for data in the exact same location where they were originally loaded

JD_JSON format

- **JSON format**:
  - simple and widely recognized format → many libraryes in any languages to handle it
  - JavaScript types to represent the data → similar and easy to be mapped in R/Java types
  - "key":value pairs, divided by comma, enclosed in { }; arrays enclosed in [ ]; nested JSONs allowed
  - easy to read and write for users

- **Key-values specifications format:**
  - same as **c("SA_spec", "TRAMO_SEATS")** class attributes from **RJDemetra** (v2)
  - **little additions**
    - series name → to link specification and data
    - external regressors info → information to retrieve ext.reg., preferred to values for readability
  - comments with JavaScript/Java format (// inline, /* … */ multiline)

JD_JSON: examples

```
{
"series_name" : "FATEXP_10",
"spec"        : "RSA0",
"transform.function"      : "Log", // inline Comment
"usrdef.outliersEnabled" : true,
"usrdef.outliersType"    : ["AO",          "LS"],
"usrdef.outliersDate"    : ["2010-06-01", "2009-01-01"],
"arima.mu"               : false
}
```

```
{
"series_name" : "C_DEFL",
"spec"        : "RSA0",
"transform.function"     : "Log",
"usrdef.outliersEnabled" : true,
"usrdef.outliersType"    : ["AO",          "LS",          "AO",          "AO",          "AO",          "AO"],
"usrdef.outliersDate"    : ["2007-12-01", "2008-11-01", "2020-03-01", "2020-04-01", "2020-05-01", "2020-06-01"],
"userdef.varFromFile"    : true,

"userdef.varFromFile.infoList": [ { "file_name": "tdu02m.txt", "start":"2002-01-01", "frequency":12},
                                  { "file_name": "lym_02.txt", "start":"2002-01-01", "frequency":12}],
"usrdef.varEnabled"      : true,
"usrdef.varType"         : ["Calendar", "Calendar"],
"tradingdays.option"     : "UserDefined",
"arima.mu"               : false
}
```

JD_JSON: attributes borrowed from RJDemetra class c("SA_spec", "TRAMO_SEATS")

SOURCE: RJDemetra documentation

tramoseats_spec	*TRAMO-SEATS model specification*

Description

Function to create (and/or modify) a c("SA_spec", "TRAMO_SEATS") class object with the SA model specification for the TRAMO-SEATS method. It can be done from a pre-defined 'JDemetra+' model specification (a character), a previous specification (c("SA_spec", "TRAMO_SEATS") object) or a seasonal adjustment model (c("SA", "TRAMO_SEATS") object).

Usage

```
tramoseats_spec(
  spec = c("RSAfull", "RSA0", "RSA1", "RSA2", "RSA3", "RSA4", "RSA5"),
  preliminary.check = NA,
  estimate.from = NA_character_,
  estimate.to = NA_character_,
  estimate.first = NA_integer_,
  estimate.last = NA_integer_,
  estimate.exclFirst = NA_integer_,
  estimate.exclLast = NA_integer_,
  estimate.tol = NA_integer_,
  estimate.eml = NA,
  estimate.urfinal = NA_integer_,
  transform.function = c(NA, "Auto", "None", "Log"),
  transform.fct = NA_integer_,
  usrdef.outliersEnabled = NA,
  usrdef.outliersType = NA,
  usrdef.outliersDate = NA,
  usrdef.outliersCoef = NA,
  ...
```

Arguments

spec a TRAMO-SEATS model specification. It can be the 'JDemetra+' name (character) of a predefined TRAMO-SEATS model specification (see *Details*), an object of class c("SA_spec","TRAMO_SEATS") or an object of class c("SA", "TRAMO_SEATS"). The default is "RSAfull".

preliminary.check a logical to check the quality of the input series and exclude highly problematic series e.g. the series with a number of identical observations and/or missing values above pre-specified threshold values.

The time span of the series, which is the (sub)period used to estimate the regarima model, is controlled by the following six variables: estimate.from, estimate.to, estimate.first, estimate.last, estimate.exclFirst and estimate.exclLast; where estimate.from and estimate.to have priority over the remaining span control variables, estimate.last and estimate.first have priority over estimate.exclFirst and estimate.exclLast, and estimate.last has priority over estimate.first. Default= "All".

estimate.from a character in format "YYYY-MM-DD" indicating the start of the time span (e.g. "1900-01-01"). It can be combined with the parameter estimate.to.

estimate.to a character in format "YYYY-MM-DD" indicating the end of the time span (e.g. "2020-12-31"). It can be combined with the parameter estimate.from.

estimate.first numeric, the number of periods considered at the beginning of the series.

estimate.last numeric, the number of periods considered at the end of the series.

estimate.exclFirst numeric, the number of periods excluded at the beginning of the series. It can be combined with the parameter estimate.exclLast.

...

JD_JSON: additional attributes
with respect to RJDemetra c("SA_spec", "TRAMO_SEATS")

- **series_name**: a character string indicating the name of the time series. Mandatory, because it allows the matching between specification and rawdata.

- **userdef.varFromFile**: logical indicating whether user-defined variable data will be read from the files specified by *userdef.varFromFile.infoList*, instead of *userdef.var* (raw data). If TRUE, the *userdef.var* field is ignored; if FALSE, *userdef.varFromFile.infoList* is ignored. Default = FALSE.

- **userdef.varFromFile.infoList**: A vector of JSON elements, each with the attributes:
  - container: character string representing the name of the file/entity containing the external regressor data;
  - start: a character string in the format "YYYY-MM-DD" indicating the starting time of the external regressor data;
  - n_var: number of variables contained in the file (in general =1 or =6 for 6TD setting)

JD_JSON: additional attributes with respect to RJDemetra c("SA_spec", "TRAMO_SEATS")

- **frequency**: numeric. Frequency of the data: E.g. frequency=4 → quarterly data frequency=12 → monthly data.
- **method**: "TS" for TRAMO-SEATS, "X" for X13 (X13 not implemented yet).
- **intervention_variables**: a vector of JSON elements, each one with the attributes:
  - delta: Numeric;
  - delta_s: Numeric;
  - sequences: JSON array: every element has the fields
    - start: a character string in the format "YYYY-MM-DD"
    - end: a character string in the format "YYYY-MM-DD"
- **ramps**: a vector of JSON elements, each with the attributes:
  - start: a character string in the format "YYYY-MM-DD" indicating the starting time of the ramp;
  - end: a character string in the format "YYYY-MM-DD" indicating the end time of the ramp;
  - fixed_coef: a numeric or a "NA" if not set

EX. of RAMPs: [{"start":"2020-01-01","end":"2020-12-31", "fixed_coef":"NA"},
{"start":"2008-01-01","end":"2009-01-01", "fixed_coef":1}]

EX. of IVs: [{"delta":1,"delta_s":1,"seq":[{"start":"2001-01-01","end": "2001-12-31" }]},
{"delta":0.75,"delta_s":0,"seq":[{"start":"2004-01-01","end":"2005-12-31"}]}]

JD_JSON: additional attributes with respect to RJDemetra c("SA_spec", "TRAMO_SEATS")

```
{
"series_name" : "FATEXP_10",
"spec"        : "RSA0",
"transform.function"      : "Log", // inline Comment
"usrdef.outliersEnabled"  : true,
"usrdef.outliersType"     : ["AO",          "LS"],
"usrdef.outliersDate"     : ["2010-06-01", "2009-01-01"],
"arima.mu"                : false
}
```

Series name

External regressors information

```
{
"series_name" : "C_DEFL",
"spec"        : "RSA0",
"transform.function"      : "Log",
"usrdef.outliersEnabled" : true,
"usrdef.outliersType"     : ["AO",          "LS",          "AO",          "AO",          "AO",          "AO"],
"usrdef.outliersDate"     : ["2007-12-01", "2008-11-01", "2020-03-01", "2020-04-01", "2020-05-01", "2020-06-01"],
"userdef.varFromFile"     : true,

"userdef.varFromFile.infoList": [ { "file_name": "tdu02m.txt", "start":"2002-01-01", "frequency":12},
                                  { "file_name": "lym_02.txt", "start":"2002-01-01", "frequency":12}],
"usrdef.varEnabled"       : true,
"usrdef.varType"          : ["Calendar", "Calendar"],
"tradingdays.option"      : "UserDefined",
"arima.mu"                : false
}
```

JD_JSON: features

- Already documented in large part → see tramoseats_spec function in RJDemetra doc.
- Easy to read and write for users → no nested objects, apart from *userdef.varFromFile.infoList*
- Easy to be stored into a DB → TEXT/VARCHAR or JSON* field DB types

  * some DBMS allow querying fields directly from JSON!

- Easy to be handled in R and Java → many libraries available (R: jsonlite/rjson, Java: jackson)

  → easy to be read by RJDemetra

- Facilitates synthesis → like specifying arguments to the tramoseats_spec function → default specification to assign values not provided by the user (e.g. "*RSA0*")

  → tools to produce the full version (see slide 13)

From full to synthetic version and vice versa


```
{
"series_name":"FATEXP_15",
"spec":"RSA0",
"usrdef.outliersEnabled":true,
"usrdef.outliersType":["AO",       "LS"],
"usrdef.outliersDate":["2009-09-01", "2009-03-01"],
"arima.mu":false,
"arima.p":1,
"arima.d":0,
"arima.q":0,
"arima.bq":0
},
```


JD_JSON.R

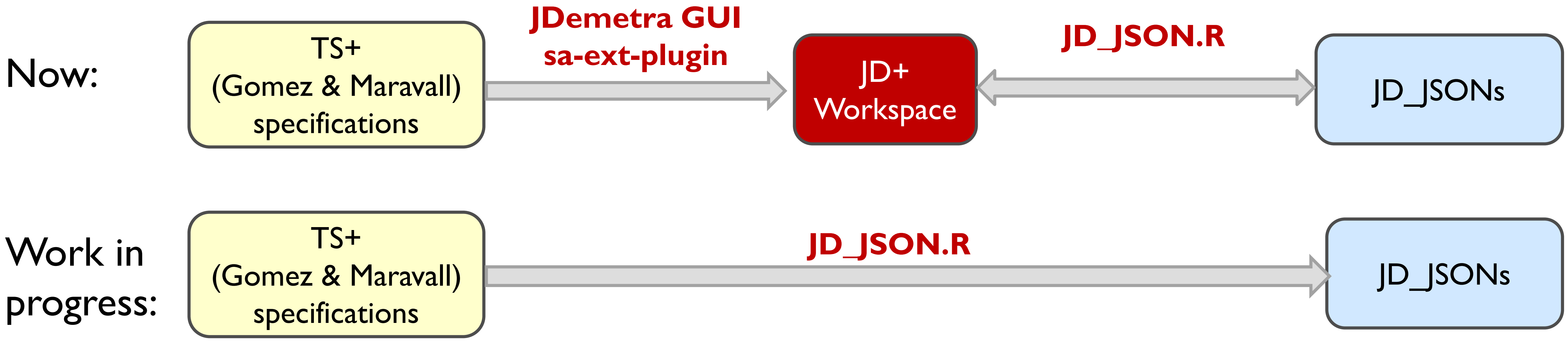
- **from_reduced_to_full_JD_JSON_file(…)**
- **from_full_to_reduced_JD_JSON_file(…)**


```
{
"series_name":"FATEXP_15",
"spec":"RSA0",
"preliminary.check":true,
"estimate.from":"NA",
"estimate.to":"NA",
"estimate.first":"NA",
"estimate.last":"NA",
"estimate.exclFirst":0,
"estimate.exclLast":0,
"estimate.tol":1e-07,
"estimate.eml":true,
"estimate.urfinal":0.96,
"transform.function":"None",
"transform.fct":0.95,
"usrdef.outliersEnabled":true,

...

"arima.mu":false,
"arima.p":1,
"arima.d":0,
"arima.q":0,
"arima.bp":0,
"arima.bd":1,
"arima.bq":0,
"arima.coefEnabled":false,
"arima.coef":"NA",
"arima.coefType":"NA",
"fcst.horizon":-2,
"seats.predictionLength":-1,
"seats.approx":"Legacy",
"seats.trendBoundary":0.5,
"seats.seasdBoundary":0.8,
"seats.seasdBoundary1":0.8,
"seats.seasTol":2,
"seats.maBoundary":0.95,
"seats.method":"Burman"
},
```

Workflow & Software



JD_JSON.R

- JD_JSON_from_virtual_workspace(…)
- JD_JSON_to_virtual_workspace(…)
- JD_JSON_to_TSplus (…)*
- JD_JSON_from_materialized_workspace(…)
- JD_JSON_to_materialized_workspace(…)
- JD_JSON_from_TSplus(…)*

interoperability with JD+

- from_reduced_to_full_JD_JSON_obj (…)
- from_full_to_reduced_JD_JSON_obj(…)

* = work in progress

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Pt.2: RJDemetra Processor: an RJDemetra processing pipeline ready for you

General overview

JD_JSON format is a component of a larger processing system that is:

- **R/RJDemetra based**
- **Object Oriented** → S4 Object System for R
- **Modular architecture**

This system is the response of our needs of:

- **a semi-automated production pipeline, interoperable with the JD+ suite**

  → workspaces as interoperability tool
- **use RJDemetra API with many time series without "hardcoding" specifications**

  → JD_JSON format
- **a tool expandable and adaptable to many situations**

  → adapting to various input formats/producing custom output
- **a platform mantainable also by statisticians without expertise in Java**

  → building R prototypes converted into Java by IT teams

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Building blocks

Responsibility

JD_JSON_file_processor.R

- JD_JSON_file_processor (input_data_reader, ext_reg_data_reader, spec_file_name, output_workspace_dir, series_to_proc_names)

Processing and output of the results

JD_JSON.R

Interaction with workspace and input-output of specifications

c ("Extended_tramoseats_spec")

- Extends c("SA_spec", "TRAMOSEATS") from RJDemetra
- Attributes
- Constructor(…)

- to_JD_JSON(…)
- from_JD_JSON(…)
- to_named_list(…)
- from_named_list(…)
- to_sa_spec(…)
- from_sa_spec(…)
- to_tramoseats_spec_args(…)

Interaction with RJDemetra

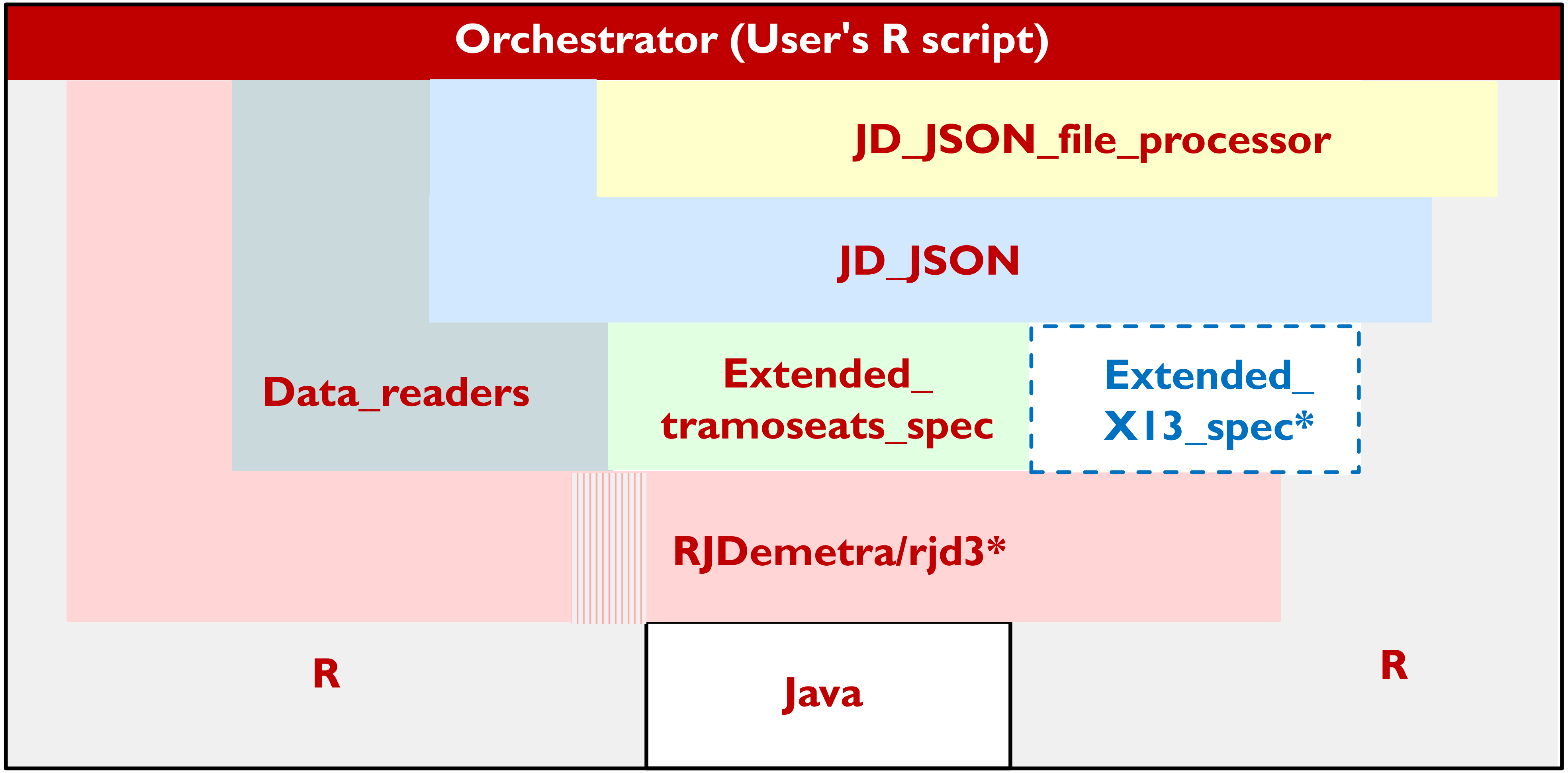
DATA_READERS

c ("Data_reader") **c ("Data_reader_ext_reg")**

Acquisition of the input data

Full JDProcessor Stack + possible extensions(*)

Notation: when a block lies on top of another, it means that it uses (or could use) it. → dependencies description



Adapt to your environment through PROVIDER interfaces

- To utilize JDProcessor in your environment, simply **implement the Provider and Provider_ext_reg interfaces** to read your data and external regressors.
  - flexible input, strict rules for the output
  - e.g. Provider_csv, Provider_txt, Provider_jdbc
- Then, pass the Providers to the processor.

Provider:

- Constructor's arguments:
  - input_source: "ANY"
- **read_data(...)** method:
  - **output: mts** (multivariate time series) obj., with time series names and dates
  - no specific input (…)

	FATEXP_10	FATEXP_11	FATEXP_13
2006-09-01	14,2	18,8	42,2
2006-10-01	14,9	21,3	43,6
2006-11-01	14	18,4	45,1
2006-12-01	13	15	45,8
2007-01-01	14,2	19,7	45,8
2007-02-01	14,9	20,2	44,4

PROVIDER_EXT_REG interface

Provider_ext_reg:

- Constructor: input_source (type : "ANY")
- **read_ext_reg_data** (var_info=NULL, time_series_info=NULL, …):

how to read data from var. info.

  - var_info = list with filename, start_date and frequency
  - time_series_info = series_name,
  - output: ts (time series) object

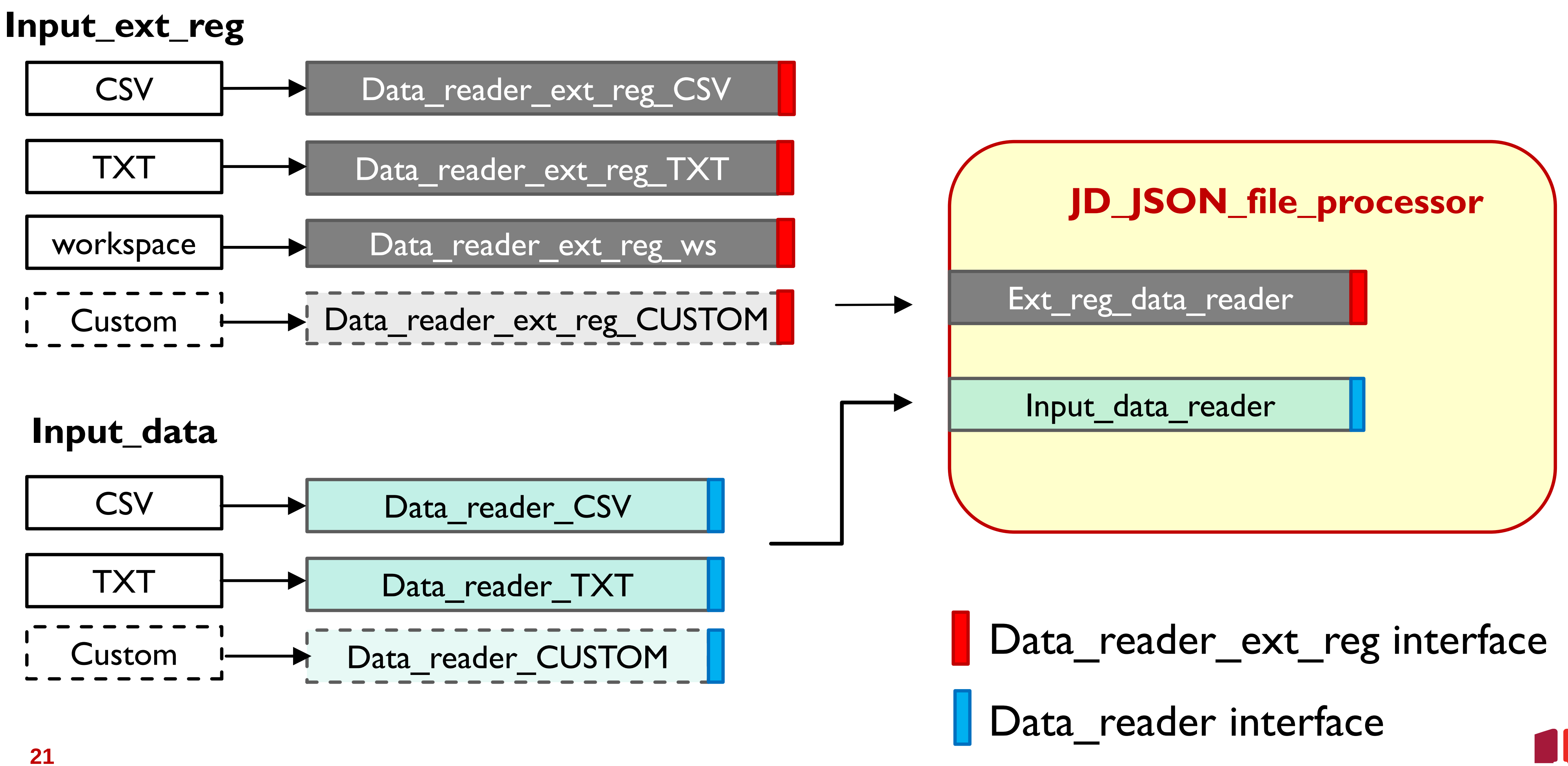
- **read_ext_reg_info** (var_info_container, …):

how to produce var. info. (metadata)

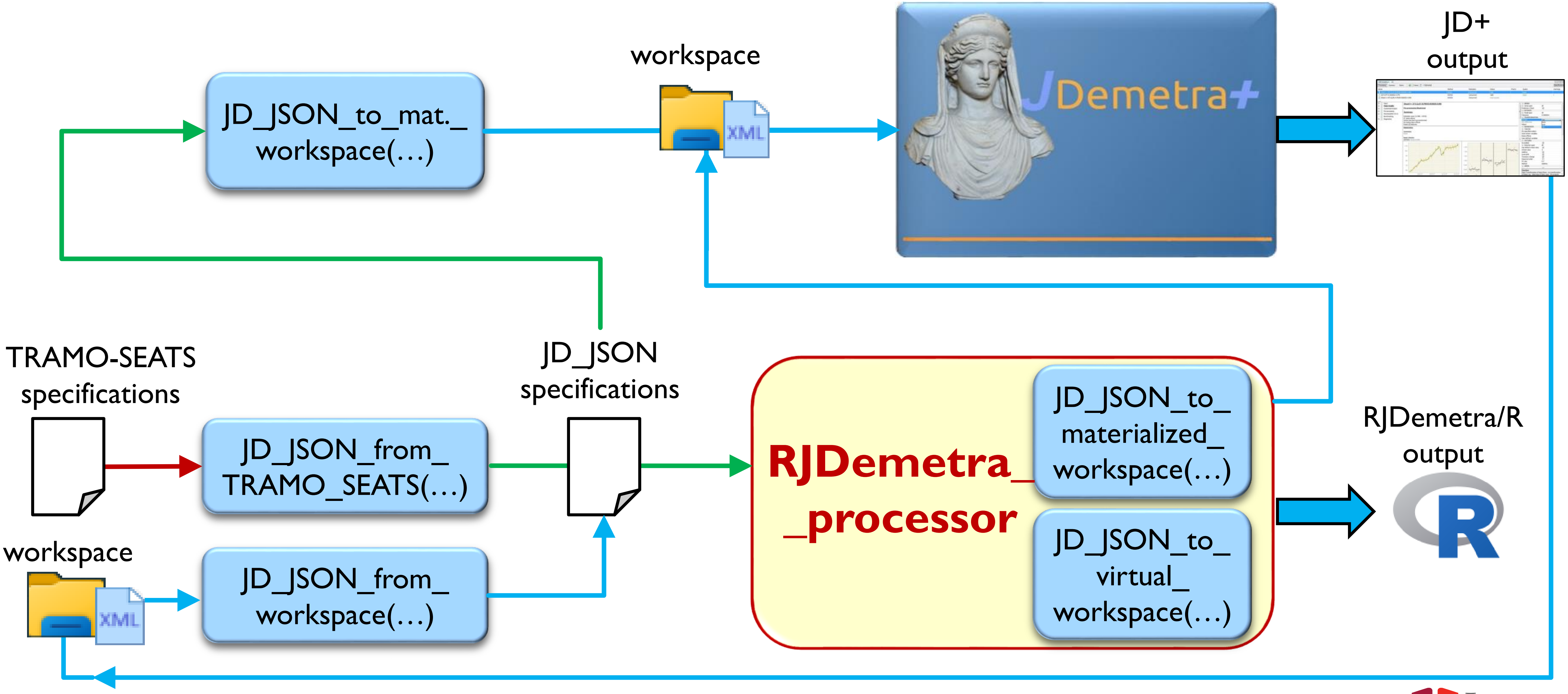
  - e.g. var_info_container = ext_reg_files_folder
  - **output: list of ext_var_info** for each ts →

Name	Type	Value
all_jmodel_vars	list [105]	List of length 105
FATEXP_10	list [0]	List of length 0
C_DEFL	list [2]	List of length 2
[[1]]	list [3]	List of length 3
file_name	character [1]	'tdu02m.txt'
start	character [1]	'2002-01-01'
frequency	double [1]	12
[[2]]	list [3]	List of length 3
file_name	character [1]	'lym_02.txt'
start	character [1]	'2002-01-01'
frequency	double [1]	12

Adapt the processor with your Data Readers



Interoperability with JDemetra+ (GUI, Cruncher, …) through Workspace



Example of use: orchestrator.R

```r
input_workspace_directory <- "C:\\Workspace-dir\\WS-FAT.xml" #Built with sa_ext plugin
input_data_file_name      <- "C:\\SITIC-FAT\\raw_data.csv"
regr_directory            <- "C:\\SITIC-FAT\\TS_regr" #Folder with external regressors
spec_file_name            <- "C:\\JD_JSON_specifications.txt"

diff <- TRUE  # Reduced JSON if diff=TRUE, Full JD_JSON format otherwise

################################# Operational flow #################################

input_data_provider    <- Provider_csv_istat_format(input_data_file_name)
ext_reg_input_provider <- Provider_ext_reg_tsplus(regr_directory)

JD_JSON_from_materialized_workspace(input_workspace_directory, ext_reg_input_provider,
                               JSON_file_name = spec_file_name, diff)

models <- JD_JSON_file_processor(input_data_provider, ext_reg_input_provider,
                          spec_file_name, "output_workspace_container")#RJDemetra models

from_reduced_to_full_JD_JSON_file(spec_file_name, "JD_JSON_specifications_full.txt")
```

Future developments

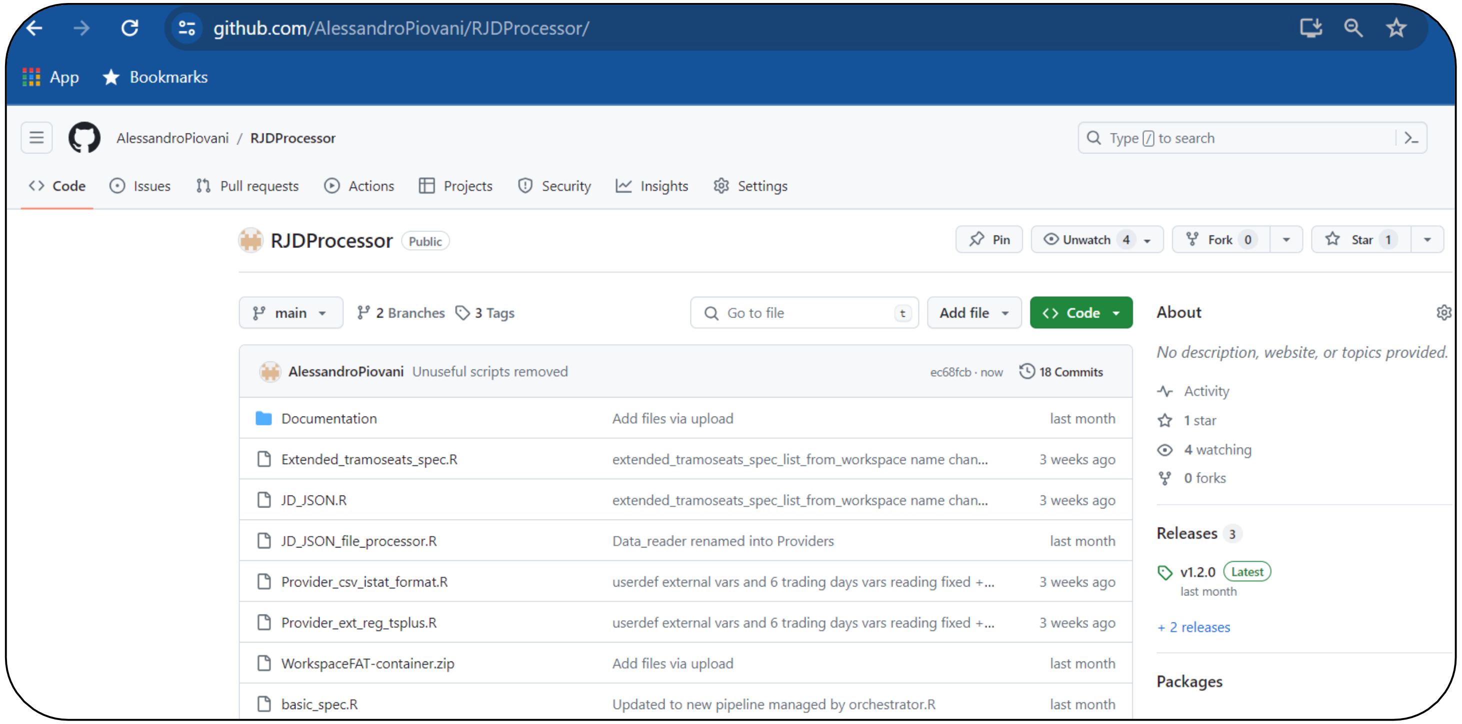
- X13 integration
- Developing some default input providers
- Creating a rjd3-based version instead of RJDemetra
- Production of output formatting components
- Enhancing code performance by using RJDemetra functions that operate directly on Java objects rather than R ones
- Add other custom fields to JD_JSON ("Keep_ARIMA_coefficients_fixed", …) and relative functionalities in the processor
- Addition of detailed error messages
- Additional testing

Source code

Source code is available on GitHub:

https://github.com/AlessandroPiovani/RJDProcessor

For information contact me at:



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Thanks for your attention!

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