Implementing main types of international validation rules in national validation processes

Olav ten Bosch, Mark van der Loo *Statistics Netherlands*
Sónia Quaresma *Statistics Portugal*

UNECE Workshop on Statistical Data Editing (SDE), Sep. 2020

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International data validation (1)

- ***Invalid*** data may lead to ***costly*** retransmissions or reprocessing (data ping pong)
- To guarantee overall data ***quality*** and ***efficiency***, the European Statistical System (ESS) is moving towards more harmonised validation activities
- International validation rules are agreed in domain specific ***statistical working groups***
- Data producer (NSIs) and data consumers (international organisations) ***validate*** data against the ***same rules***
- GSDEM context: ***Review***

International data validation (2)

ESSnet Validat Foundation 2015-2

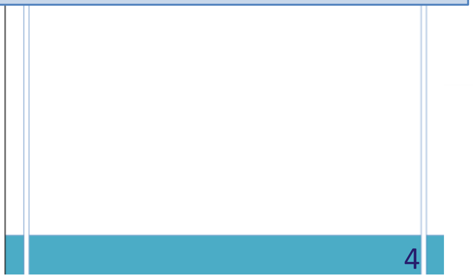
ESSnet Validat Integration, 2017 (

- Handbook on validation
- A study on VTL 1.0
- PoC with 3 national validation la
- Validation principles
- Business architecture scenario’s
- Generic validation report
- Generic / main types of validation rules

Validation principles:

1. *The sooner, the better*
2. *Trust but verify*
3. *Well-documented and appropriately communicated validation rules*
4. *Well-documented and appropriately communicated validation errors*
5. *Comply or explain*
6. *Good enough is the new perfect*

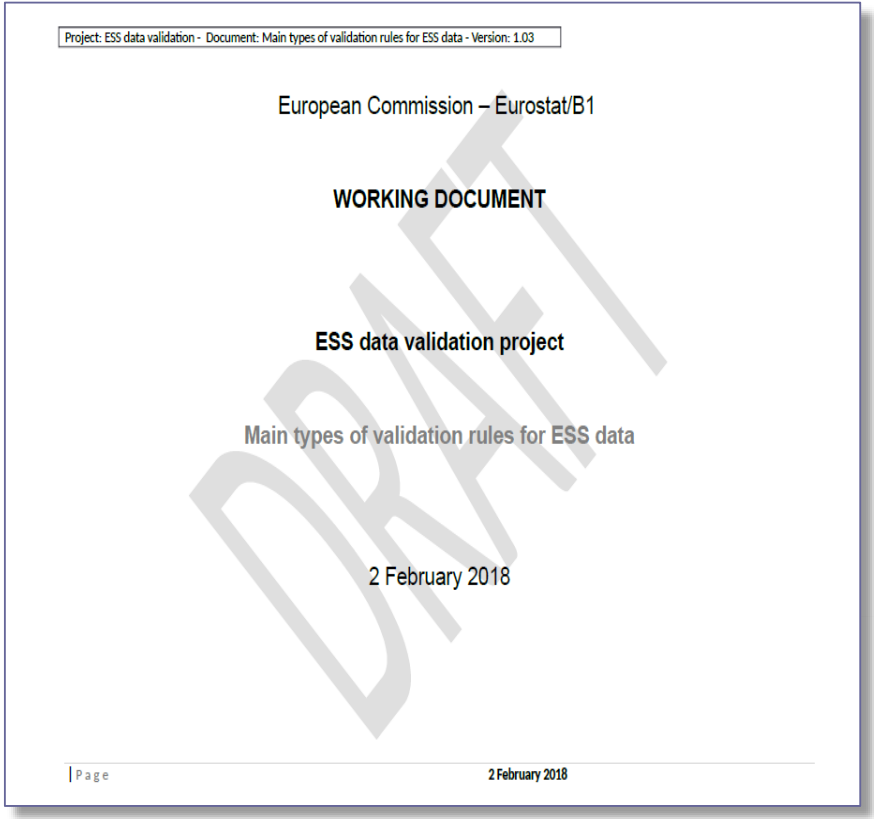
Paper SDE 2019



https://ec.europa.eu/eurostat/cros/content/data-validation-overview_en

Eurostat main types of rules (1)

- 2018: Eurostat identified 21 ‘***main types of validation rules***’ for ESS data
- They reflect the ***majority*** of checks needed in today’s International data validation
- Specified in ***natural language*** and ***VTL***
- Can we implement them in national systems?



Project: ESS data validation - Document: Main types of validation rules for ESS data - Version: 1.03

European Commission – Eurostat/B1

WORKING DOCUMENT

ESS data validation project

Main types of validation rules for ESS data

2 February 2018

DRAFT

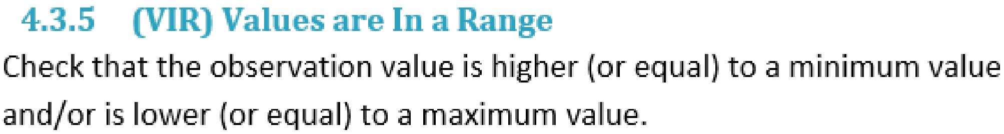
| Page

2 February 2018

Eurostat main types of rules (2)

Examples:

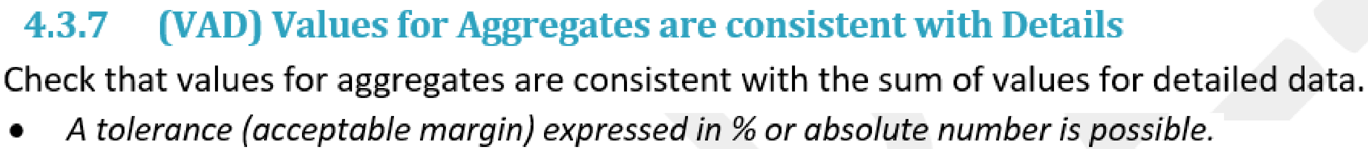
- Range check:



4.3.5 (VIR) Values are In a Range

Check that the observation value is higher (or equal) to a minimum value and/or is lower (or equal) to a maximum value.

- Aggregation check:

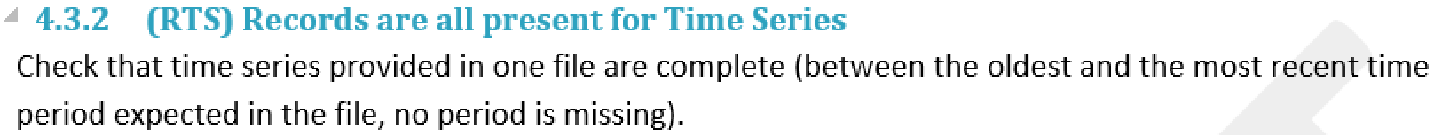


4.3.7 (VAD) Values for Aggregates are consistent with Details

Check that values for aggregates are consistent with the sum of values for detailed data.

- *A tolerance (acceptable margin) expressed in % or absolute number is possible.*

- Completeness of time series:



4.3.2 (RTS) Records are all present for Time Series

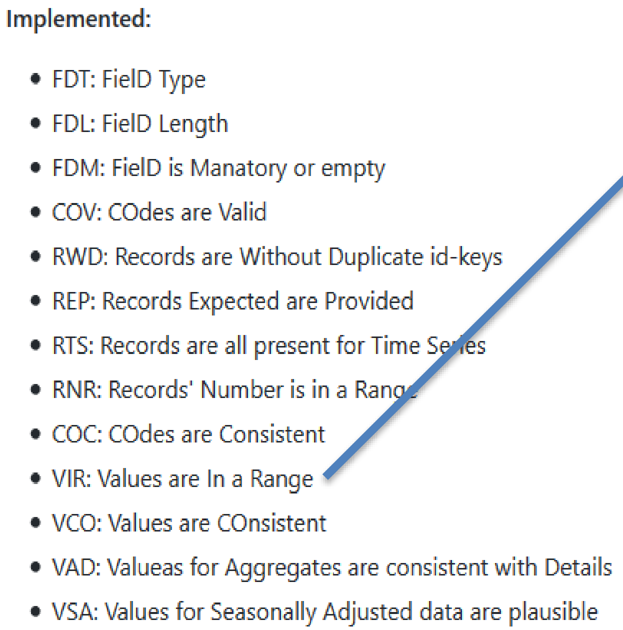
Check that time series provided in one file are complete (between the oldest and the most recent time period expected in the file, no period is missing).

Pilot NL: Implementation in R (1)

ValidatFOSS: validation with Free and Open-Source Software

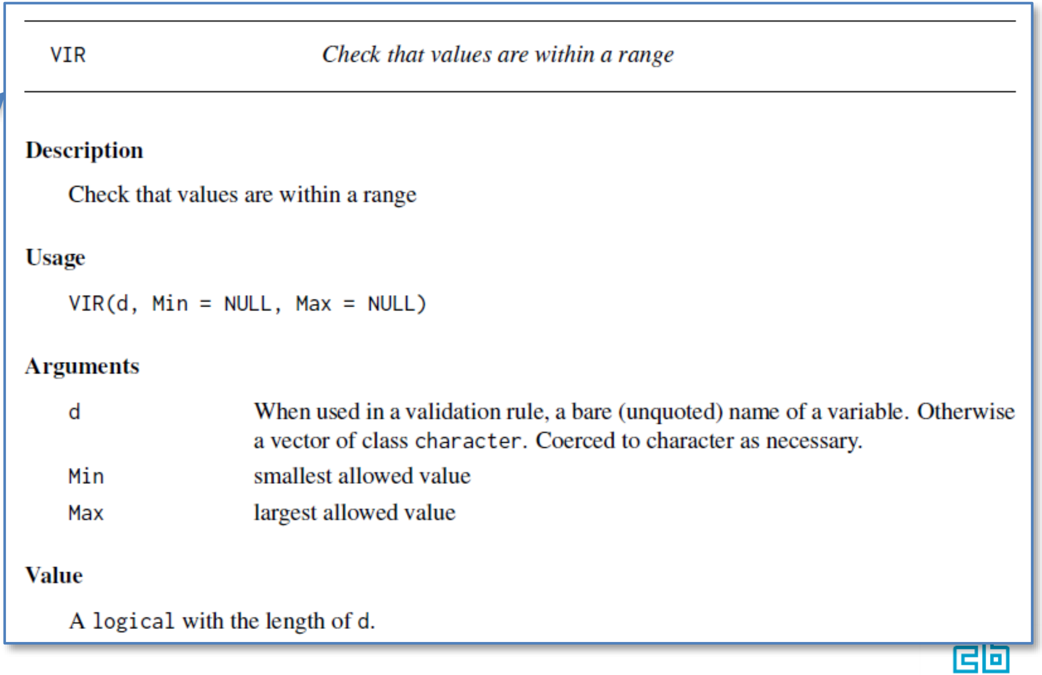
- Short Term Statistics (STS):
  - All rules could be implemented in one line of R-validate code
  - Some of the textual rules descriptions lacked preciseness
- National Accounts (NA):
  - Chain linking formula implemented
  - Majority of code is about selecting the right slice of data from the database, the actual implementation of the rule was only one line of R-validate code
- Eurostat main types of rules:
  - Implemented in R-package
  - Documentation in R-style providing context-sensitive help in R and/or RStudio
  - Example datasets from specification document included
  - Automatic tests defined based on the examples in the specification document

Eurostat main types of rules



Implemented:

- FDT: FielD Type
- FDL: FielD Length
- FDM: FielD is Manatory or empty
- COV: COdes are Valid
- RWD: Records are Without Duplicate id-keys
- REP: Records Expected are Provided
- RTS: Records are all present for Time Series
- RNR: Records' Number is in a Range
- COC: COdes are Consistent
- VIR: Values are In a Range
- VCO: Values are COnsistent
- VAD: Valueas for Aggregates are consistent with Details
- VSA: Values for Seasonally Adjusted data are plausible



VIR *Check that values are within a range*

Description

Check that values are within a range

Usage

```
VIR(d, Min = NULL, Max = NULL)
```

Arguments

d	When used in a validation rule, a bare (unquoted) name of a variable. Otherwise a vector of class `character`. Coerced to character as necessary.
Min	smallest allowed value
Max	largest allowed value

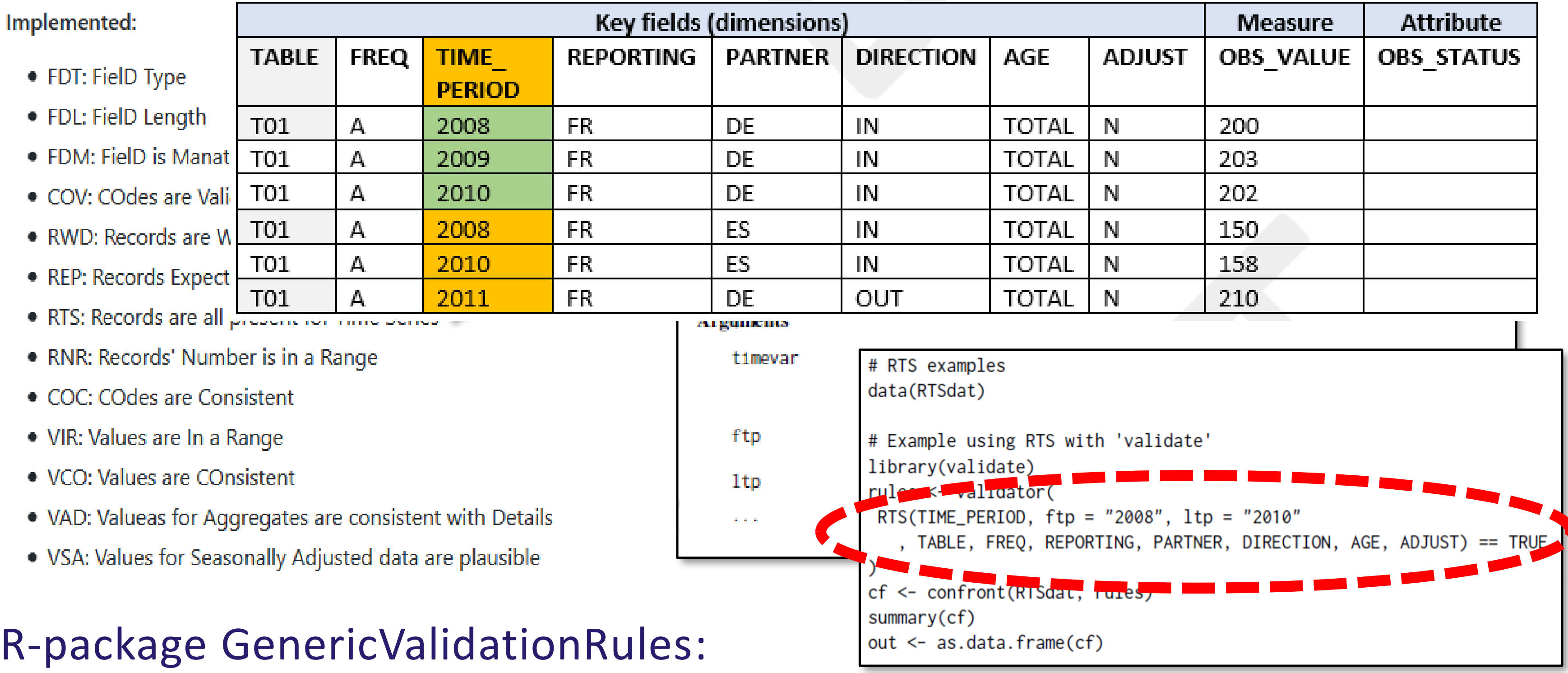
Value

A `logical` with the length of `d`.

R-package GenericValidationRules:

https://github.com/SNStatComp/GenericValidationRules

Eurostat main types of rules



Implemented:

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- RTS: Records are all present for Time Series
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- VCO: Values are COnsistent
- VAD: Valueas for Aggregates are consistent with Details
- VSA: Values for Seasonally Adjusted data are plausible

Key fields (dimensions)								Measure	Attribute
TABLE	FREQ	TIME_ PERIOD	REPORTING	PARTNER	DIRECTION	AGE	ADJUST	OBS_VALUE	OBS_STATUS
T01	A	2008	FR	DE	IN	TOTAL	N	200	
T01	A	2009	FR	DE	IN	TOTAL	N	203	
T01	A	2010	FR	DE	IN	TOTAL	N	202	
T01	A	2008	FR	ES	IN	TOTAL	N	150	
T01	A	2010	FR	ES	IN	TOTAL	N	158	
T01	A	2011	FR	DE	OUT	TOTAL	N	210	

Arguments

timevar

ftp

ltp

...

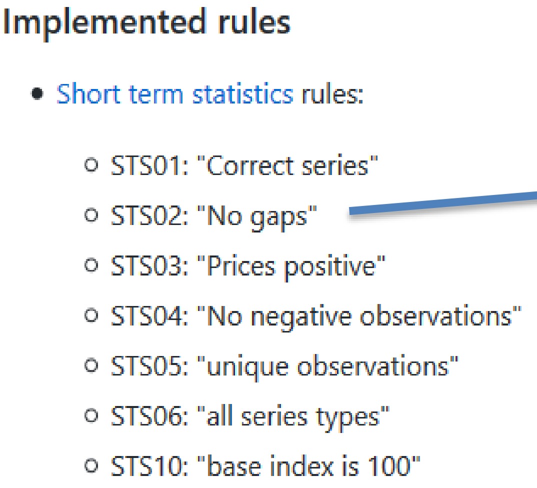
```
# RTS examples
data(RTSdat)

# Example using RTS with 'validate'
library(validate)
rules <- validator(
 RTS(TIME_PERIOD, ftp = "2008", ltp = "2010"
    , TABLE, FREQ, REPORTING, PARTNER, DIRECTION, AGE, ADJUST) == TRUE
)
cf <- confront(RTSdat, rules)
summary(cf)
out <- as.data.frame(cf)
```

R-package GenericValidationRules:

https://github.com/SNStatComp/GenericValidationRules

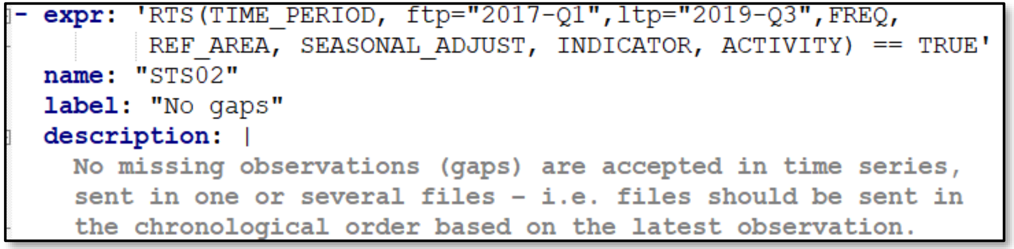
Domain specific validation rules



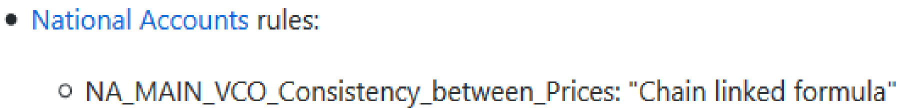
Implemented rules

- Short term statistics rules:
  - STS01: "Correct series"
  - STS02: "No gaps"
  - STS03: "Prices positive"
  - STS04: "No negative observations"
  - STS05: "unique observations"
  - STS06: "all series types"
  - STS10: "base index is 100"

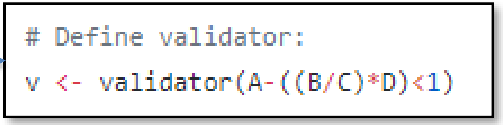
Domain specific rule implemented in main type of rule RTS



```
- expr: 'RTS(TIME_PERIOD, ftp="2017-Q1",ltp="2019-Q3",FREQ,
         REF_AREA, SEASONAL_ADJUST, INDICATOR, ACTIVITY) == TRUE'
  name: "STS02"
  label: "No gaps"
  description: |
    No missing observations (gaps) are accepted in time series,
    sent in one or several files - i.e. files should be sent in
    the chronological order based on the latest observation.
```



- National Accounts rules:
  - NA_MAIN_VCO_Consistency_between_Prices: "Chain linked formula"

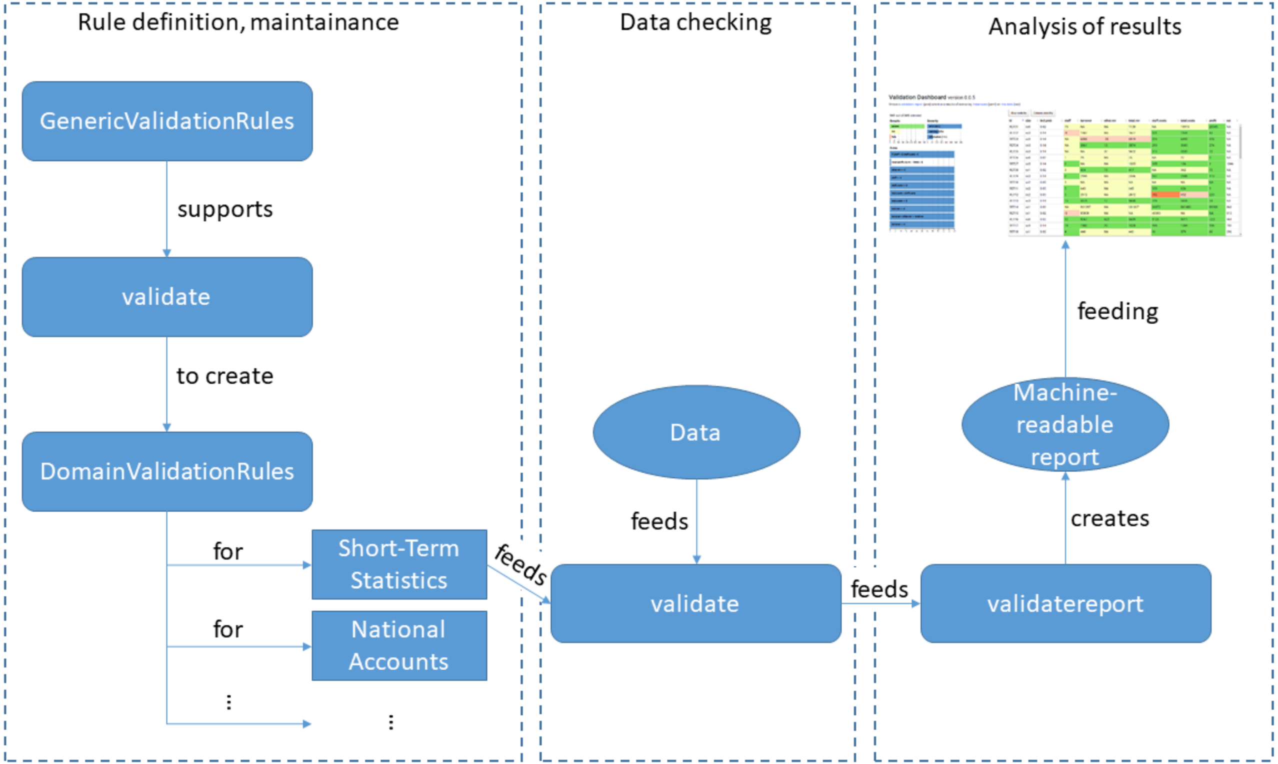


```
# Define validator:
v <- validator(A-((B/C)*D)<1)
```

https://github.com/SNStatComp/DomainValidationRules

Aligns to ESS standards

Data validation workflow



Rule definition, maintainance

GenericValidationRules

supports

validate

to create

DomainValidationRules

for

Short-Term Statistics

for

National Accounts

⋮

⋮

feeds

Data checking

Data

feeds

validate

feeds

Analysis of results

feeding

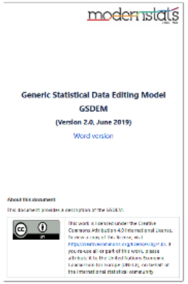
Machine-readable report

creates

validatereport

Methodology for data validation

Handbook on data validation methodology (2015)



modernstats

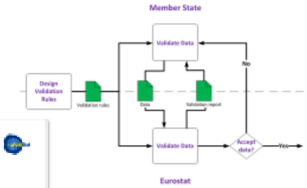
Generic Statistical Data Editing Model

GSDEM

(Version 2.0, June 2019)

Word version

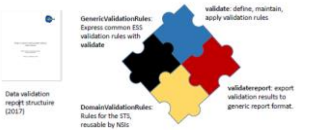
GSDEM (2019)



Business architectures (2016)

Data validation report structuire (2017)

R-based FOSS tooling (CBS)



Data validation report structuire (2017)

GenericValidationRules: Express common ESS validation rules with **validate**

validate: define, maintain, apply validation rules

DomainValidationRules: Rules for the STS, reusable by NSIs

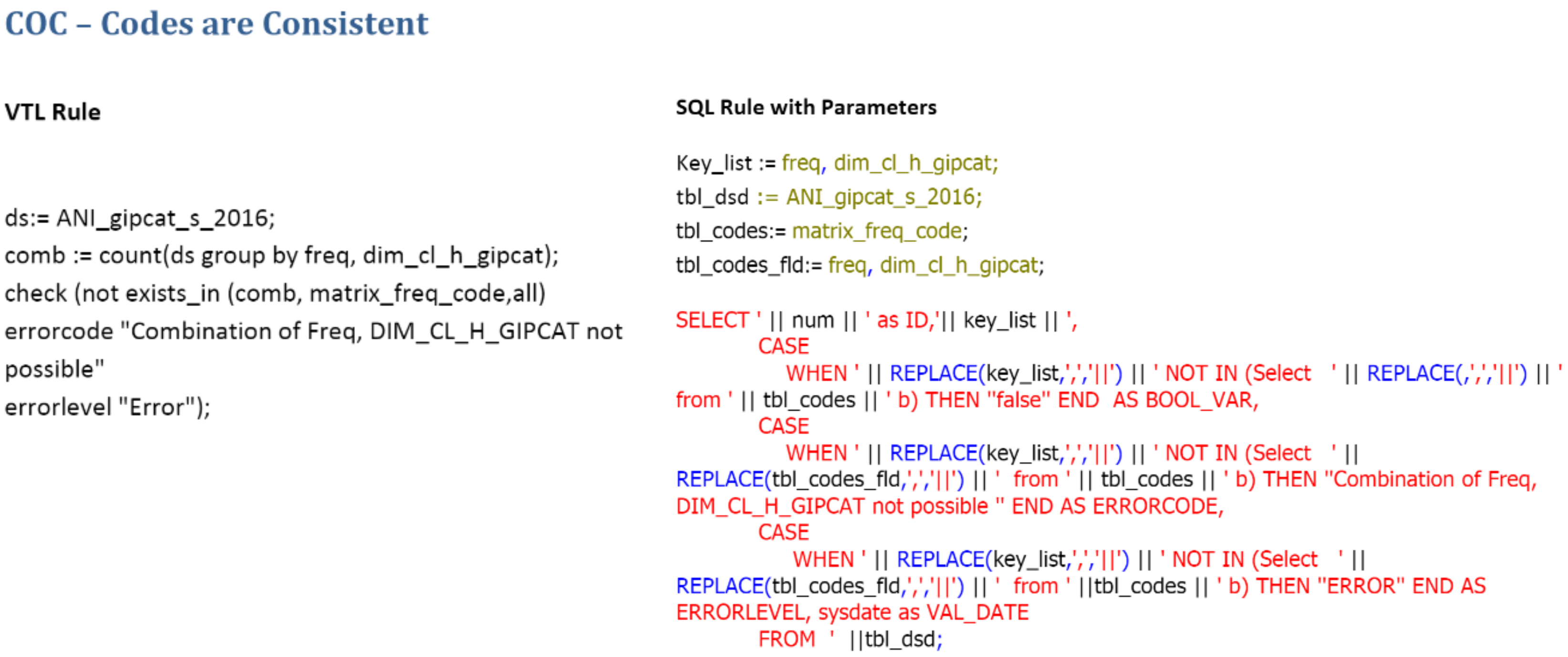
validatereport: export validation results to generic report format.

For all software (and more): **awesomeofficialstatistics.org**

Pilot PT: Implementation in SQL (1)

- ***HyVImp***: Hybrid Validation Implementation Project
- Focus was on rules in domain ***ANIMAL***
- Manual translation of VTL -> parametrized ***SQL***
- Implemented in the central Statistical Data Warehouse (***SDW***)
- Advantages:
  - ***Centralized*** maintenance of main types of validation rules
  - Domain knowledge ***encapsulated*** in parameters; domain specialists do not need IT specialists for implementing rules
  - Solutions in one domain can be ***reused*** in other domains
  - Solution ***integrated*** into existing data reporting environment

Pilot PT: Implementation in SQL (2)



COC – Codes are Consistent

VTL Rule

```
ds:= ANI_gipcat_s_2016;
comb := count(ds group by freq, dim_cl_h_gipcat);
check (not exists_in (comb, matrix_freq_code,all)
errorcode "Combination of Freq, DIM_CL_H_GIPCAT not
possible"
errorlevel "Error");
```

SQL Rule with Parameters

```
Key_list := freq, dim_cl_h_gipcat;
tbl_dsd := ANI_gipcat_s_2016;
tbl_codes:= matrix_freq_code;
tbl_codes_fld:= freq, dim_cl_h_gipcat;

SELECT ' || num || ' as ID,'|| key_list || ',
          CASE
             WHEN ' || REPLACE(key_list,',','||') || ' NOT IN (Select   ' || REPLACE(,',','||') || '
from ' || tbl_codes || ' b) THEN "false" END  AS BOOL_VAR,
          CASE
             WHEN ' || REPLACE(key_list,',','||') || ' NOT IN (Select   ' ||
REPLACE(tbl_codes_fld,',','||') || '  from ' || tbl_codes || ' b) THEN "Combination of Freq,
DIM_CL_H_GIPCAT not possible " END AS ERRORCODE,
          CASE
              WHEN ' || REPLACE(key_list,',','||') || ' NOT IN (Select   ' ||
REPLACE(tbl_codes_fld,',','||') || '  from ' ||tbl_codes || ' b) THEN "ERROR" END AS
ERRORLEVEL, sysdate as VAL_DATE
          FROM  '  ||tbl_dsd;
```

All rules: https://github.com/SoniaQuaresma/MainTypeValidRules

Wrap-up

- Pilots NL and PT show that implementing Eurostat main types of validation rules in national contexts is ***feasible*** and ***effective***
- If international rules are ***expressed in terms of the main types of rules***, this approach could be used to implement validation in national systems
- These main types of rules were identified from ***current practices***. Ideally, we more formally identify a ***minimum*** set of high level, parametrized, generic validation rules that cover ***most*** or ***all*** of the validation needs in the ESS.

Next: ValidatFOSS2 (2020/2021)

- Starting from the main types of rules, develop a ***minimum*** set of ***high level*** and ***easy applicable*** validation ***rules*** for official statistics to be used in all process stages and in all domains
- Connect R-based validation toolset with ***SDMX***
- Build a ***community***: use, share and improve generic and domain specific rule implementations
- Results expected 2021

Questions, ideas, suggestions

?

Olav ten Bosch	o.tenbosch@cbs.nl	@kobosch
Mark van der Loo	mpj.vanderloo@cbs.nl	@markvdloo
Sónia Quaresma	sonia.quaresma@ine.pt	

and keep an eye on:

awesomeofficialstatistics.org