Implementing main types of international validation rules in national validation processes

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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 2015-2016
ESSnet Validat Integration, 2017 (DE, IT, LT, NL, ESTAT)

• Handbook on validation
• A study on VTL 1.0
• PoC with 3 national validation languages
• 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?
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 Mandatory 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: Values for Aggregates are consistent with Details
- VSA: Values for Seasonally Adjusted data are plausible

R-package GenericValidationRules: https://github.com/SNStatComp/GenericValidationRules
Eurostat main types of rules

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"

- **National Accounts** rules:
  - NA_MAIN_VCO_Consistency_between_prices: "Chain linked formula"

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.
```

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

[GitHub link](https://github.com/SNStatComp/DomainValidationRules)
## Data validation workflow

**Rule definition, maintenance**

 GenericValidationRules
  - supports
  - validate
    - to create

 DomainValidationRules
  - for
    - Short-Term Statistics
    - National Accounts
    - ...

**Data checking**

 Data
  - feeds
  - validate

**Analysis of results**

 Machine-readable report
  - feeding
  - creates
  - validatereport

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For all software (and more): [awesomeofficialstatistics.org](http://awesomeofficialstatistics.org)

Aligns to ESS standards

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[Image references]

- GSDEM (2019)
- GSDEM (2015)
- R-based FOSS tooling (CBS)
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_fid:= 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_fid,','||') | | ' 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_fid,','||') | | ' 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

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