# Data validation infrastructure: the **validate** package

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# Validate

## Goal

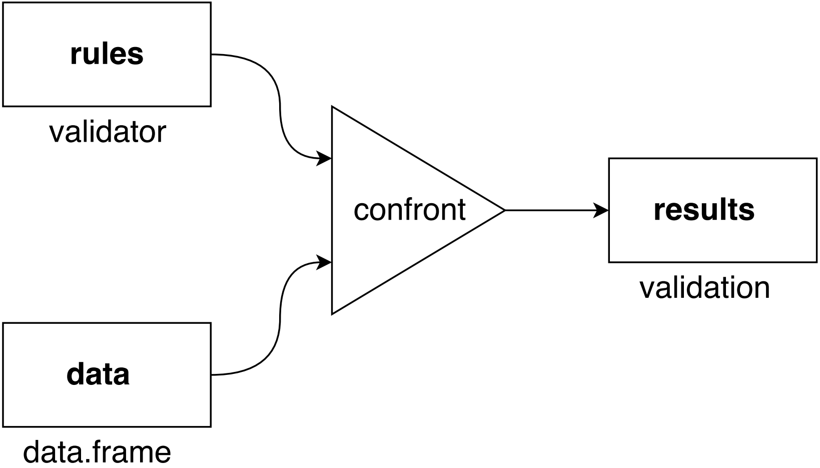
To make checking your data against domain knowledge and technical demands as easy as possible.

## Content of this talk

- Basic concepts and workflow
- Examples of possibilities and syntax
- Outlook

# Basic concepts and workflow

# Basic concepts of the **validate** package



# Example: retailers data

```r
library(validate)
data(retailers)

dat <- retailers[4:6]
head(dat)
```

```
##   turnover other.rev total.rev
## 1       NA        NA      1130
## 2     1607        NA      1607
## 3     6886       -33      6919
## 4     3861        13      3874
## 5       NA        37      5602
## 6       25        NA        25
```

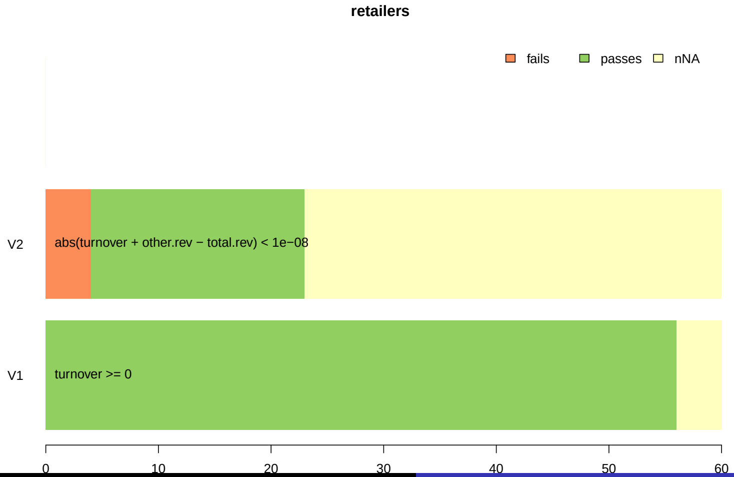
# Basic workflow

```
# define rules
v <- validator(turnover >= 0
  , turnover + other.rev == total.rev)
# confront with data
cf <- confront(dat, v)
# analyze results
summary(cf)
```

```
##   rule items passes fails nNA error warning
## 1   V1    60     56     0   4 FALSE   FALSE
## 2   V2    60     19     4  37 FALSE   FALSE
##                                       expression
## 1                                  turnover >= 0
## 2 abs(turnover + other.rev - total.rev) < 1e-08
```

# Plot the validation

```
barplot(cf, main="retailers")
```



# Get all results

```
# A value For each item (record) and each rule
head(values(cf))
```

```
##          V1    V2
## [1,]    NA    NA
## [2,] TRUE     NA
## [3,] TRUE FALSE
## [4,] TRUE  TRUE
## [5,]    NA    NA
## [6,] TRUE     NA
```

# Shortcut using **check_that()**

```
cf <- check_that(dat
    , turnover >= 0
    , turnover + other.rev == total.rev)
```

Or, using the **magrittr** ‘not-a-pipe’ operator:

```
dat %>%
  check_that(turnover >= 0
    , turnover + other.rev == total.rev) %>%
  summary()
```

# Read rules from file

```
### myrules.txt

# inequalities
turnover >= 0
other.rev >= 0

# balance rule
turnover + other.rev == total.rev
```

```
v <- validator(.file="myrules.txt")
```

# Validation features

# Validating types

**Rule**

*Turnover is a numeric variable*

**Syntax**

```
# any is.-function is valid.
is.numeric(turnover)
```

# Validating metadata

## Rules

- *The variable **total.rev** must be present.*
- *The number of rows must be at least 20*

## Syntax

```
# use the "." to access the dataset as a whole
"total.rev" %in% names(.)
nrow(.) >=  20
```

# Validating aggregates

### Rule

*Mean turnover must be at least 20% of mean total revenue*

### Syntax

```
mean(total.rev,na.rm=TRUE) /
  mean(turnover,na.rm=TRUE) >= 0.2
```

# Rules that express conditions

**Rule**

> *If the turnover is larger than zero, the total revenue must be larger than zero.*

**Syntax**

```
# executed for each row
if ( turnover > 0) total.rev > 0
```

# Functional dependencies

### Rule

*Two records with the same zip code, must have the same city and street name.*

$$zip \rightarrow city + street$$

### Syntax

```
zip ~ city + street
```

# Using transient variables

**Rule**

*The turnover must be between 0.1 and 10 times its median*

**Syntax**

```
# transient variable with the := operator
med := median(turnover,na.rm=TRUE)
turnover > 0.1*med
turnover < 10*med
```

# Variable groups

### Rule

> *Turnover, other revenue, and total revenue must be between 0 and 2000.*

### Syntax

```
G := var_group(turnover, other.rev, total.rev)

G >= 0
G <= 2000
```

# Referencing other datasets

### Rule

> *The mean turnover of this year must not be more than 1.1 times last years mean.*

### Syntax

```
# use the "$" operator to reference other datasets
v <- validator(
  mean(turnover, na.rm=TRUE) <
    mean(lastyear$turnover,na.rm=TRUE))

cf <- confront(dat, v, ref=list(lastyear=dat_lastyear))
```

# Other features

- Rules (**validator** objects)
  - Select from validator objects using `[]`
  - Extract or set rule metadata (label, description, timestamp, . . .)
  - Get affected variable names, rule linkage
  - Summarize validators
  - Read/write to `yaml` format
- Confront
  - Control behaviour on `NA`
  - Raise errors, warnings
  - Set machine rounding limit

```
vignette("intro","validate")
vignette("rule-files","validate")
```

# Outlook

# In the works / ideas

- More analyses of rules
- More programmability
- More (interactive) visualisations
- Roxygen-like metadata specification
- More support for reporting
- . . .

We'd ♡ to hear your comments, suggestions, bugreports

Please also see:

- `vignette("intro","validate")`
- `vignette("rule-files","validate")`

# Validate is just the beginning!

- UNDER CONSTRUCTION `data.log`
- UNDER CONSTRUCTION `dcmodify`
- R `deductive`
- UNDER CONSTRUCTION `errorlocate`
- R `validate`
- R `lintools`

See `github.com/data-cleaning`

# Literature

- Van der Loo (2015) A formal typology of data validation functions. in *United Nations Economic Comission for Europe Work Session on Statistical Data Editing* , Budapest. [pdf]
- Di Zio et al (2015) Methodology for data validation. ESSNet on validation, deliverable. [pdf]
- Van der Loo, M. and E. de Jonge (2016). Statistical Data Cleaning with Applications in R, *Wiley* (in preparation).

# Contact, links

## Code, bugreports

- `cran.r-project.org/package=validate`
- `github/data-cleaning/validate`

## This talk

`slideshare.com/markvanderloo`

## Contact

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