Data validation in R and Python with

2025-01-21

Data is weird

Malcolm 朝精 Barrett @malcolmbarrett.malco.io · 2h

What's the weirdest thing you've ever seen in data? #databs

3 5 2 •••

JD Long

@jdlong.cerebralmastication.com

A screen shot of data in excel copied and pasted into an excel sheet. I couldn’t figure out what was going on and when it registered my soul left my body for a few seconds.

January 19, 2025 at 4:00 PM

1 •••

Data gets weirder

Malcolm 朝精 Barrett @malcolmbarrett.malco.io · 2h

Relatedly, what's the most unexpected way changes in data broke your code?

1 2

Aaron Blackshear @aaronblackshear.bsky.social · 2h

The NBA once accidentally pushed the Chinese version of one of the game files to our FTP server

1

Your Turn 1 (`exercises_r.qmd`, `exercises_py.qmd`)

Discussion: What's the strangest thing you've ever seen in your data? What's are some times changes in data broke your code?

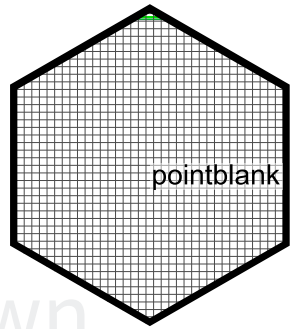
Data validation

1. Values
2. Rows and columns
3. Dataset properties
4. Logical consistency
5. Scientific consistency

> It’s not that we don’t test our code, it’s that we don’t store our tests so they can be re-run automatically. —Hadley Wickham

Writing down and testing expectations about data

pointblank



- methodically validate your data by writing down expectations and testing them

- Works in R and Python, although the Python version is less mature

- Works with local data frames and remote databases

`create_agent()`/`pb.Validate()`

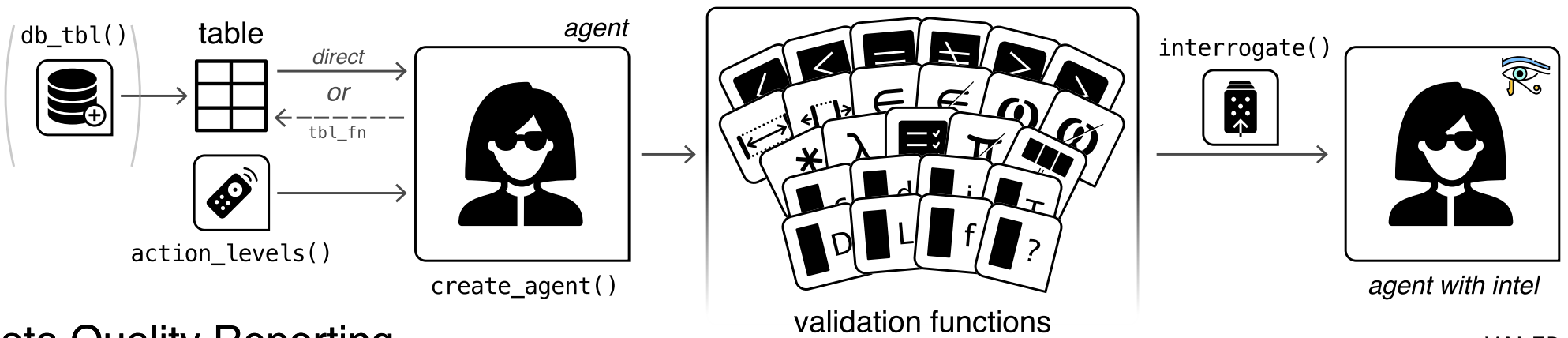
R

```r
library(pointblank)
df |>
  create_agent() |>
  # ... validation steps
  interrogate()
```

Python

```python
import pointblank as pb
validation = (
  pb.Validate(data=df)
  # ... validation steps
  .interrogate()
)
```

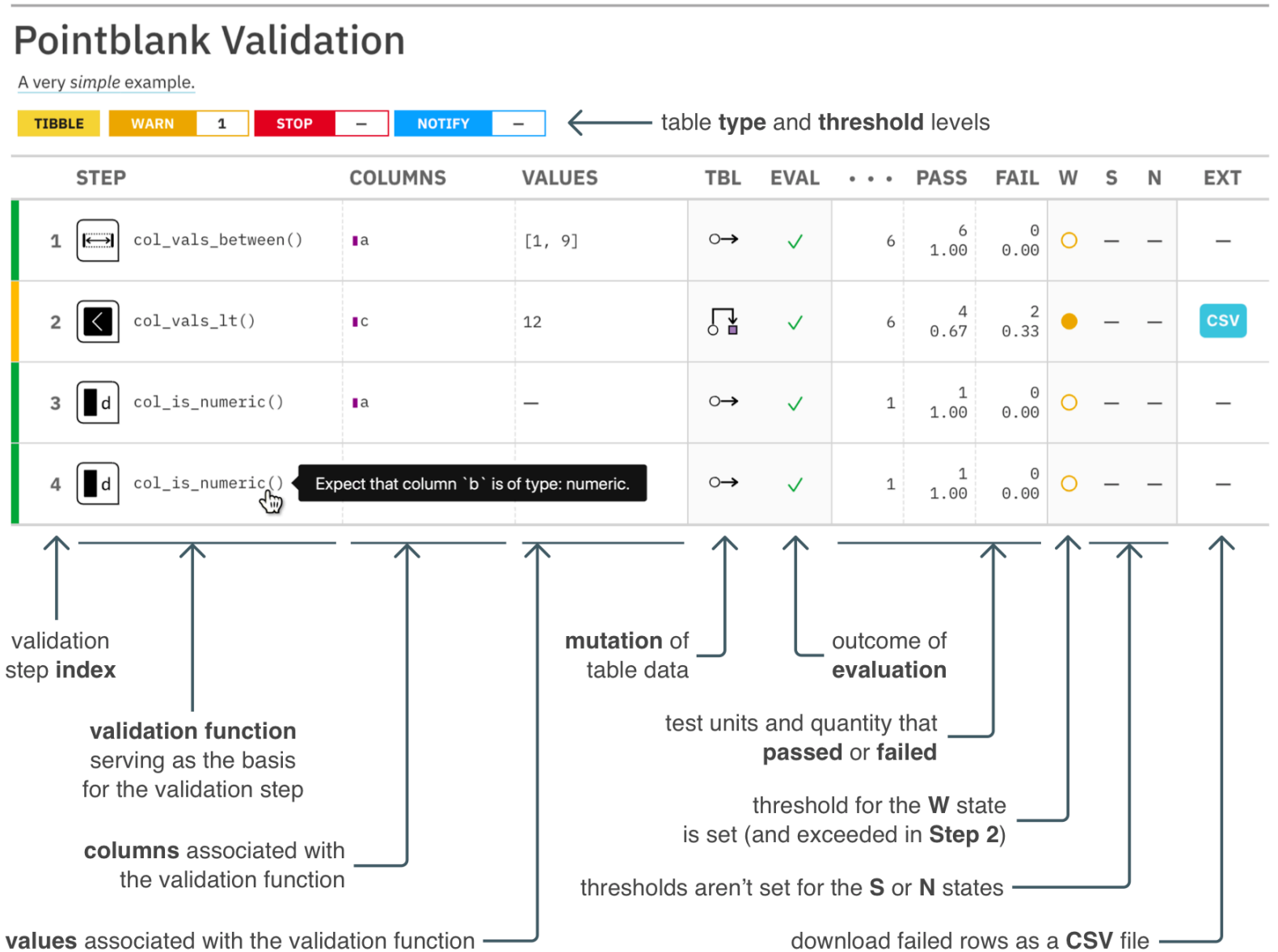
create_agent()/pb.Validate()



Data Quality Reporting

VALID-I

Interoggation reports



small_table / pb.load_dataset("small_table")

```r
library(pointblank)
small_table
```

```
# A tibble: 13 × 8
   date_time           date            a b           c      d
   <dttm>              <date>      <int> <chr>   <dbl>  <dbl>
 1 2016-01-04 11:00:00 2016-01-04      2 1-bcd-…     3  3423.
 2 2016-01-04 00:32:00 2016-01-04      3 5-egh-…     8 10000.
 3 2016-01-05 13:32:00 2016-01-05      6 8-kdg-…     3  2343.
 4 2016-01-06 17:23:00 2016-01-06      2 5-jdo-…    NA  3892.
 5 2016-01-09 12:36:00 2016-01-09      8 3-ldm-…     7   284.
 6 2016-01-11 06:15:00 2016-01-11      4 2-dhe-…     4  3291.
 7 2016-01-15 18:46:00 2016-01-15      7 1-knw-…     3   843.
 8 2016-01-17 11:27:00 2016-01-17      4 5-boe-…     2  1036.
 9 2016-01-20 04:30:00 2016-01-20      3 5-bce-…     9   838.
10 2016-01-20 04:30:00 2016-01-20      3 5-bce-…     9   838.
11 2016-01-26 20:07:00 2016-01-26      4 2-dmx-…     7   834.
12 2016-01-28 02:51:00 2016-01-28      2 7-dmx-…     8   108.
13 2016-01-30 11:23:00 2016-01-30      1 3-dka-…    NA  2230.
# ℹ 2 more variables: e <lgl>, f <chr>
```

Testing cell values: `col_vals_*()`

R

```r
library(pointblank)
small_table |>
  create_agent() |>
  col_vals_gte(a, 0) |>
  interrogate()
```

Python

```python
import pointblank as pb
validation = (
  pb.Validate(
    data=pb.load_dataset("small_table")
  )
  .col_vals_gte("a", 0)
  .interrogate()
)

validation
```

Your Turn 2

```
1 worlds_fairs <- read_csv('https://raw.githubusercontent.com/rfordatascience/tidytuesday/main/
2
3 worlds_fairs
```

```
# A tibble: 70 × 14
   start_month start_year end_month end_year
         <dbl>      <dbl>     <dbl>    <dbl>
 1           4       1851        10     1851
 2           5       1855        11     1855
 3           5       1862        11     1862
 4           4       1867        11     1867
 5           5       1873        10     1873
 6           5       1876        11     1876
 7           5       1878        11     1878
 8          10       1880         4     1881
 9           4       1888        12     1888
10           5       1889        10     1889
# ℹ 60 more rows
# ℹ 10 more variables: name_of_exposition <chr>,
#   country <chr>, city <chr>, category <chr>, theme <chr>,
#   notables <chr>, …
```

Testing cell values: arguments

Your Turn 3

Validate the steps in the exercise file.

Testing columns: `col_is_*()`/`col_schema_match()`

```
create_agent(tbl = small_table) |>
  col_is_date(columns = date) |>
  interrogate() |>
  all_passed()
```

```
[1] TRUE
```

Your Turn 4

Validate the steps in the exercise file.

Testing rows: `row_*()`

- `rows_distinct()`
- `rows_complete()` (R only)
- `rows_distinct(c(var1, var2, ...))`
- `rows_complete(c(var1, var2, ...))` (R only)

```
create_agent(tbl = small_table) |>
  rows_distinct() |>
  interrogate() |>
  all_passed()
```

```
[1] FALSE
```

```
create_agent(tbl = small_table) |>
  rows_complete() |>
  interrogate() |>
  all_passed()
```

```
[1] FALSE
```

Your Turn 5

Validate the steps in the exercise file.

Testing table properties: `*_match()`

- `col_schema_match(schema)`
- `row_count_match(n)`,
  `row_count_match(tbl)`
- `col_count_match(n)`,
  `col_count_match(tbl)`

Testing table properties: `*_match()`

```
create_agent(small_table) |>
  row_count_match(13) |>
  col_count_match(8) |>
  interrogate() |>
  all_passed()
```

```
[1] TRUE
```

Exploring test results

- Extract failures from a given step:
  `get_data_extracts()`

- Get passing or failing rows:
  `get_sundered_data()`

Exploring test results

```
agent <- create_agent(tbl = small_table) |>
  col_vals_gte(a, 0) |>
  col_vals_lt(b, 1110) |>
  rows_complete() |>
  interrogate()

get_agent_x_list(agent)$n_failed
```

```
[1]  0 11  2
```

Exploring test results

```
1 get_data_extracts(agent, i = 3)
```

```
# A tibble: 2 × 8
  date_time           date            a b              c      d
  <dttm>              <date>      <int> <chr>      <dbl> <dbl>
1 2016-01-06 17:23:00 2016-01-06      2 5-jdo-903     NA 3892.
2 2016-01-30 11:23:00 2016-01-30      1 3-dka-303     NA 2230.
# ℹ 2 more variables: e <lgl>, f <chr>
```

Exploring test results

```
1 get_sundered_data(agent)
```

```
# A tibble: 2 × 8
  date_time           date            a b              c      d
  <dttm>              <date>      <int> <chr>      <dbl> <dbl>
1 2016-01-04 11:00:00 2016-01-04      2 1-bcd-345      3 3423.
2 2016-01-15 18:46:00 2016-01-15      7 1-knw-093      3  843.
# ℹ 2 more variables: e <lgl>, f <chr>
```

Exploring test results

```
1 get_sundered_data(agent, type = "fail")
```

```
# A tibble: 11 × 8
   date_time           date            a b            c       d
   <dttm>              <date>      <int> <chr>    <dbl>   <dbl>
 1 2016-01-04 00:32:00 2016-01-04      3 5-egh-…      8 10000.
 2 2016-01-05 13:32:00 2016-01-05      6 8-kdg-…      3  2343.
 3 2016-01-06 17:23:00 2016-01-06      2 5-jdo-…     NA  3892.
 4 2016-01-09 12:36:00 2016-01-09      8 3-ldm-…      7   284.
 5 2016-01-11 06:15:00 2016-01-11      4 2-dhe-…      4  3291.
 6 2016-01-17 11:27:00 2016-01-17      4 5-boe-…      2  1036.
 7 2016-01-20 04:30:00 2016-01-20      3 5-bce-…      9   838.
 8 2016-01-20 04:30:00 2016-01-20      3 5-bce-…      9   838.
 9 2016-01-26 20:07:00 2016-01-26      4 2-dmx-…      7   834.
10 2016-01-28 02:51:00 2016-01-28      2 7-dmx-…      8   108.
```

Exploring test results

```
1 get_sundered_data(agent, pass_fail = "fail")
```

```
# A tibble: 2 × 8
  date_time           date           a b              c     d
  <dttm>              <date>     <int> <chr>      <dbl> <dbl>
1 2016-01-04 11:00:00 2016-01-04     2 1-bcd-345      3 3423.
2 2016-01-15 18:46:00 2016-01-15     7 1-knw-093      3  843.
# ℹ 2 more variables: e <lgl>, f <chr>
```

Severity and action (R)

```r
al <- action_levels(warn_at = .001, stop_at = .2)

agent <- create_agent(
  tbl = small_table,
  actions = al
) |>
  col_vals_gte(a, 0) |>
  col_vals_lt(d, 1110) |>
  interrogate()

get_agent_x_list(agent)$warn
```

```
[1] FALSE  TRUE
```

```r
get_agent_x_list(agent)$stop
```

```
[1] FALSE  TRUE
```

Severity and action (Python)

```python
import pointblank as pb
tld = pb.Thresholds(warn_at=.001, stop_at=.2)
validation = (
    pb.Validate(
      data=pb.load_dataset("small_table"),
      thresholds=tld
    )
    .col_vals_ge("a", 0)
    .col_vals_lt("d", 1110)
    .interrogate()
)

validation.warn()
```

```
{1: False, 2: True}
```

```python
validation.stop()
```

```
{1: False, 2: True}
```

Your Turn 6

Validate the steps in the exercise file.

Your Turn 7: Challenge!

```
1 english_monarchs_marriages <- read_csv('https://raw.githubusercc
2
3 english_monarchs_marriages
```

```
# A tibble: 83 × 5
   king_name          king_age consort_name        consort_age
   <chr>              <chr>    <chr>               <chr>
 1 Æthelwulf          ?        Osburh              ?
 2 Æthelwulf          50(?)    Judith of Flanders  12
 3 Æthelbald          24       Judith of Flanders  14
 4 Æthelberht         —        —                   —
 5 Æthelred           ?        Wulfthryth?         ?
 6 Alfred the Great   19       Ealhswith           16
 7 Edward the Elder   19       Ecgwynn             ?
 8 Edward the Elder   28       Aelffaed            ?
 9 Edward the Elder   31       Eadgifu of Kent     ?
10 Æthelstan          —        —                   —
# ℹ 73
```

Bonus functions! (R only... for now!)

- `data_scan()`
- `draft_validation()`
- Other workflows (testing, YAML, etc)

Data validation

1. Values
2. Rows and columns
3. Dataset properties
4. Logical consistency
5. Scientific consistency