Data type constraints

CLEANING DATA IN R

Maggie Matsui
Content Developer @ DataCamp

Course outline

Diagnose dirty data

Course outline

Diagnose dirty data

Side effects of dirty data

Course outline

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Side effects of dirty data

Clean data

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Diagnose dirty data

Side effects of dirty data

Clean data

Chapter 1 - Common data problems

Why do we need clean data?

Why do we need clean data?

Why do we need clean data?

Data type constraints

Data type	Example
Text	First name, last name, address, ...
Integer	Subscriber count, # products sold, ...
Decimal	Temperature, exchange rate, ...
Binary	Is married, new customer, yes/no, ...
Category	Marriage status, color, ...
Date	Order dates, date of birth, ...

R data type
`character`
`integer`
`numeric`
`logical`
`factor`
`Date`

Glimpsing at data types

```
sales <- read.csv("sales.csv")
head(sales)
```

```
  order_id revenue quantity
1     7432   5,454      494
2     7808   5,668      334
3     4893   4,062      259
4     6107   3,936       15
5     7661   1,067      307
6     5908   6,635      235
```

```
library(dplyr)
glimpse(sales)
```

```
Observations: 100
Variables: 3
$ order_id <dbl> 7432, 7808, ...
$ revenue  <chr> "$5454", "$5668", ...
$ quantity <dbl> 494, 334, ...
```

Checking data types

```
is.numeric(sales$revenue)
```

```
FALSE
```

```
library(assertive)
assert_is_numeric(sales$revenue)
```

```
Error: is_numeric : sales$revenue is not of class 'numeric'; it has class 'character'.
```

```
assert_is_numeric(sales$quantity)
```

```

```

Checking data types

Logical checking - returns `TRUE` / `FALSE`

- `is.character()`
- `is.numeric()`
- `is.logical()`
- `is.factor()`
- `is.Date()`
- ...

`assertive` checking - errors when `FALSE`

- `assert_is_character()`
- `assert_is_numeric()`
- `assert_is_logical()`
- `assert_is_factor()`
- `assert_is_date()`
- ...

Why does data type matter?

```
class(sales$revenue)
```

```
"character"
```

```
mean(sales$revenue)
```

```
NA
Warning message:
In mean.default(sales$revenue) :
  argument is not numeric or logical: returning NA
```

Comma problems

```
sales$revenue
```

```
"5,454" "5,668" "4,062" "3,936" "1,067" ...
```

Character to number

```
library(stringr)
revenue_trimmed = str_remove(sales$revenue, ",")
revenue_trimmed
```

```
"5454" "5668" "4062" "3936" "1067" ...
```

```
as.numeric(revenue_trimmed)
```

```
5454 5668 4062 3936 1067 ...
```

Putting it together

```
sales %>%
  mutate(revenue_usd = as.numeric(str_remove(revenue, ",")))
```

```
# A tibble: 100 x 4
   order_id revenue quantity revenue_usd
      <dbl> <chr>       <dbl>       <dbl>
 1     7432 5,454         494        5454
 2     7808 5,668         334        5668
 3     4893 4,062         259        4062
 4     6107 3,936          15        3936
 5     7661 1,067         307        1067
# ... with 95 more rows
```

Same function, different outcomes

```
mean(sales$revenue)
```

```
NA
Warning message:
In mean.default(sales$revenue) :
  argument is not numeric or logical: returning NA
```

```
mean(sales$revenue_usd)
```

```
5361.4
```

Converting data types

- `as.character()`
- `as.numeric()`
- `as.logical()`
- `as.factor()`
- `as.Date()`
- ...

Watch out: factor to numeric

```
product_type
```

```
1000 1000 3000 2000 3000
Levels: 1000 2000 3000
```

```
class(product_type)
```

```
"factor"
```

```
as.numeric(product_type)
```

```
1 1 3 2 3
```

```
as.numeric(as.character(product_type))
```

```
1000 1000 3000 2000 3000
```

Let's practice!

CLEANING DATA IN R

Range constraints

CLEANING DATA IN R

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What's an out of range value?

- SAT score: 400-1600
- Package weight: at least 0 lb/kg
- Adult heart rate: 60-100 beats per minute

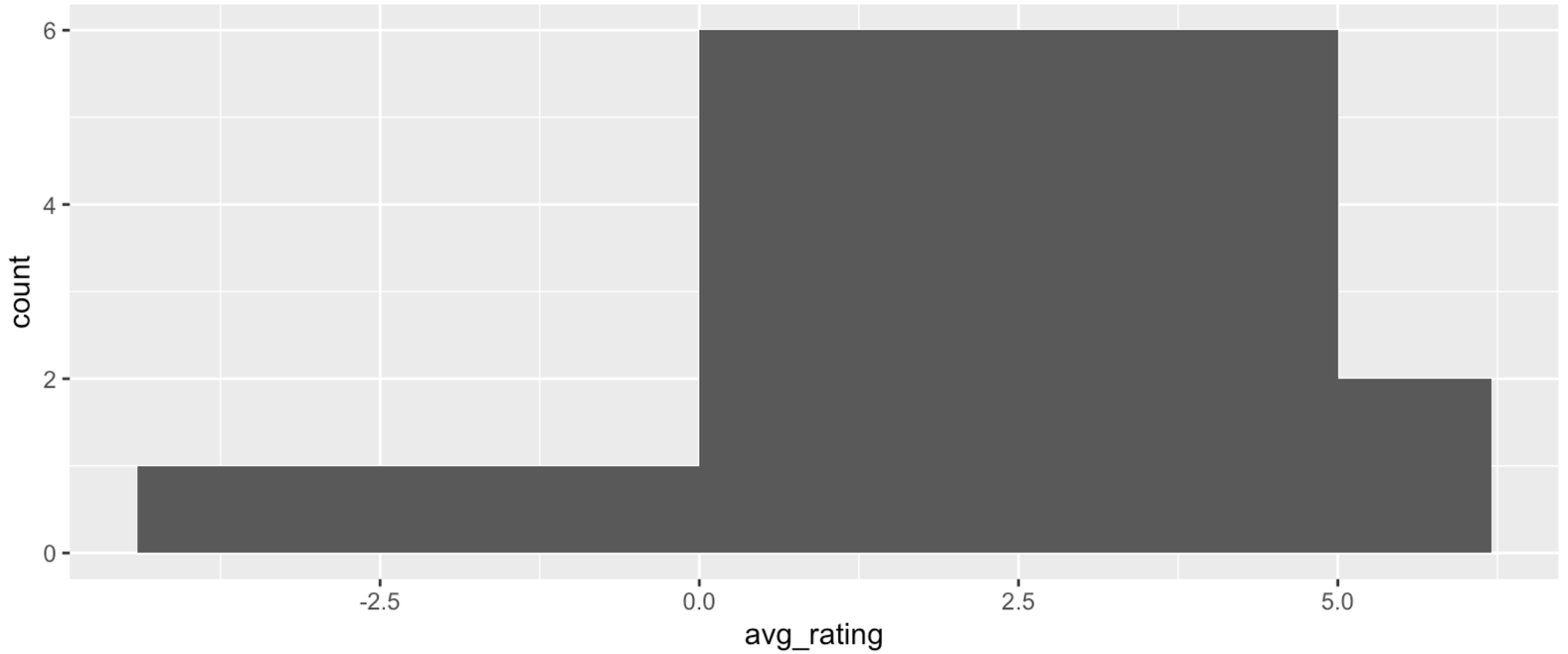
Finding out of range values

```
movies
```

```
  title                 avg_rating
  <chr>                      <dbl>
1 A Beautiful Mind             4.1
2 La Vita e Bella              4.3
3 Amelie                       4.2
4 Meet the Parents             3.5
5 Unbreakable                  5.8
6 Gone in Sixty Seconds        3.3
...
```

Finding out of range values

```
breaks <- c(min(movies$avg_rating), 0, 5, max(movies$avg_rating))
ggplot(movies, aes(avg_rating)) +
    geom_histogram(breaks = breaks)
```



Finding out of range values

```
library(assertive)
assert_all_are_in_closed_range(movies$avg_rating, lower = 0, upper = 5)
```

```
Error: is_in_closed_range : movies$avg_rating are not all in the range [0,5].
There were 3 failures:
  Position Value    Cause
1        5   5.8 too high
2        8   6.2 too high
3        9  -4.4  too low
```

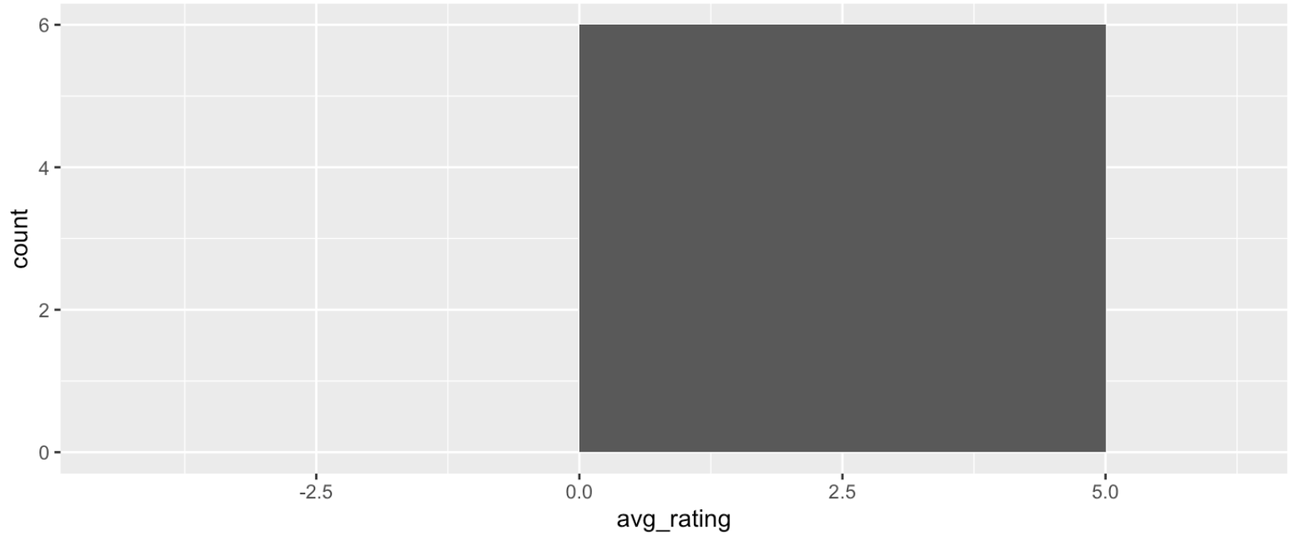
Handling out of range values

- Remove rows
- Treat as missing (`NA`)
- Replace with range limit
- Replace with other value based on domain knowledge and/or knowledge of dataset

Removing rows

```
movies %>%
  filter(avg_rating >= 0, avg_rating <= 5) %>%

  ggplot(aes(avg_rating)) +
  geom_histogram(breaks = c(min(movies$avg_rating), 0, 5, max(movies$avg_rating)))
```



Treat as missing

```
movies
```

```
  title                    avg_rating
  <chr>                         <dbl>
1 A Beautiful Mind                4.1
2 La Vita e Bella                 4.3
3 Amelie                          4.2
4 Meet the Parents                3.5
5 Unbreakable                     5.8
6 Gone in Sixty Seconds           3.3
...
```

```
replace(col, condition, replacement)
```

```
movies %>%
  mutate(rating_miss =
    replace(avg_rating, avg_rating > 5, NA))
```

```
  title                    rating_miss
  <chr>                         <dbl>
1 A Beautiful Mind                4.1
2 La Vita e Bella                 4.3
3 Amelie                          4.2
4 Meet the Parents                3.5
5 Unbreakable                      NA
6 Gone in Sixty Seconds           3.3
...
```

Replacing out of range values

```
movies %>%
  mutate(rating_const =
           replace(avg_rating, avg_rating > 5, 5))
```

```
  title                rating_const
  <chr>                       <dbl>
1 A Beautiful Mind              4.1
2 La Vita e Bella               4.3
3 Amelie                        4.2
4 Meet the Parents              3.5
5 Unbreakable                   5.0
6 Gone in Sixty Seconds         3.3
...
```

Date range constraints

```
assert_all_are_in_past(movies$date_recorded)
```

```
Error: is_in_past : movies$date_recorded are not all in the past.
There was 1 failure:
  Position               Value     Cause
1        3 2064-09-22 20:00:00 in future
```

```
library(lubridate)
movies %>%
  filter(date_recorded > today())
```

```
    title  avg_rating  date_recorded
1  Amelie         4.2  2064-09-23
```

Removing out-of-range dates

```
library(lubridate)
movies <- movies %>%
  filter(date_recorded <= today())
```

```
library(assertive)
assert_all_are_in_past(movies$date_recorded)
```

Remember, no output = passed!

Let's practice!

CLEANING DATA IN R

Uniqueness constraints

CLEANING DATA IN R

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What's a duplicate?

	First name	Last name	Address	Credit score
1	Miriam	Day	6042 Sollicitudin Avenue	313
2	Miriam	Day	6042 Sollicitudin Avenue	313

	First name	Last name	Address	Credit score
1	Tamekah	Forbes	P.O. Box 147, 511 Velit St	356
2	Tamekah	Forbes	P.O. Box 147, 511 Velit St	342

Why do duplicates occur?

Data Entry & Human Error

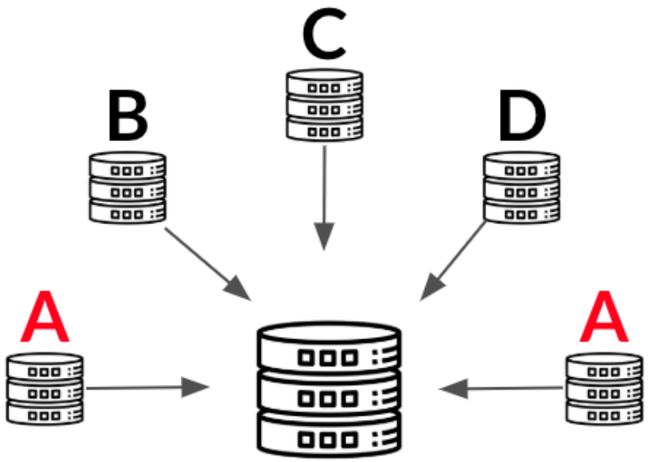
Why do duplicates occur?

Data Entry & Human Error

Bugs and design errors

Why do duplicates occur?

Data Entry &
Human Error



Join or merge
Errors

Bugs and design
errors

Full duplicates

	First name	Last name	Address	Credit score
1	Harper	Taylor	P.O. Box 212, 6557 Nunc Road	655
2	**Miriam**	**Day**	**6042 Sollicitudin Avenue**	**313**
3	Eagan	Schmidt	507-6740 Cursus Avenue	728
4	**Miriam**	**Day**	**6042 Sollicitudin Avenue**	**313**
5	**Katell**	**Roy**	**Ap #434-4081 Mi Av.**	**455**
6	**Katell**	**Roy**	**Ap #434-4081 Mi Av.**	**455**
...	...	...	...	...

Finding full duplicates

```
duplicated(credit_scores)
```

```
FALSE FALSE FALSE TRUE FALSE ...
```

```
sum(duplicated(credit_scores))
```

```
2
```

Finding full duplicates

```
filter(credit_scores, duplicated(credit_scores))
```

```
  first_name last_name                  address credit_score
1     Miriam       Day 6042 Sollicitudin Avenue          313
2     Katell       Roy      Ap #434-4081 Mi Av.          455
```

Dropping full duplicates

```
credit_scores_unique <- distinct(credit_scores)
sum(duplicated(credit_scores_unique))
```

```
0
```

Partial duplicates

	First name	Last name	Address	Credit score
1	Harper	Taylor	P.O. Box 212, 6557 Nunc Road	655
2	Eagan	Schmidt	507-6740 Cursus Avenue	728
3	**Tamekah**	**Forbes**	**P.O. Box 147, 511 Velit Street**	**356**
4	**Tamekah**	**Forbes**	**P.O. Box 147, 511 Velit Street**	**342**
5	**Xandra**	**Barrett**	**P.O. Box 309, 2462 Pharetra Rd.**	**620**
6	**Xandra**	**Barrett**	**P.O. Box 309, 2462 Pharetra Rd.**	**636**
...	...	...	...	...

Finding partial duplicates

```
credit_scores %>%
  count(first_name, last_name) %>%
  filter(n > 1)
```

```
  first_name last_name     n
  <fct>      <fct>     <int>
1 Katell     Roy           2
2 Miriam     Day           2
3 Tamekah    Forbes        2
4 Xandra     Barrett       2
```

Finding partial duplicates

```
dup_ids <- credit_scores %>%
  count(first_name, last_name) %>%
  filter(n > 1)
credit_scores %>%
  filter(first_name %in% dup_ids$first_name,  last_name %in% dup_ids$last_name)
```

```
  first_name last_name                          address credit_score
1     Xandra   Barrett  P.O. Box 309, 2462 Pharetra, Rd.          620
2    Tamekah    Forbes    P.O. Box 147, 511 Velit Street          356
3     Miriam       Day          6042 Sollicitudin Avenue          313
4     Xandra   Barrett  P.O. Box 309, 2462 Pharetra, Rd.          636
5    Tamekah    Forbes    P.O. Box 147, 511 Velit Street          342
...
```

Handling partial duplicates: dropping

Drop all duplicates except one

	First name	Last name	Address	Credit score
1	Tamekah	Forbes	P.O. Box 147, 511 Velit Street	356
2	Tamekah	Forbes	P.O. Box 147, 511 Velit Street	342
3	Xandra	Barrett	P.O. Box 309, 2462 Pharetra Rd.	620
4	Xandra	Barrett	P.O. Box 309, 2462 Pharetra Rd.	636

Handling partial duplicates: dropping

Drop all duplicates except one

	First name	Last name	Address	Credit score
1	Tamekah	Forbes	P.O. Box 147, 511 Velit Street	356
2				
3	Xandra	Barrett	P.O. Box 309, 2462 Pharetra Rd.	620
4				

Handling partial duplicates: dropping

Drop all duplicates except one

	First name	Last name	Address	Credit score
1	Tamekah	Forbes	P.O. Box 147, 511 Velit Street	356
3	Xandra	Barrett	P.O. Box 309, 2462 Pharetra Rd.	620

Dropping partial duplicates

```
credit_scores %>%
  distinct(first_name, last_name, .keep_all = TRUE)
```

```
    first_name   last_name                                address credit_score
1       Harlan      Hebert          P.O. Box 356, 3869 Non Av.          305
2        Drake        Soto                643-1409 Ac Avenue          642
3        Felix     Morales                741-1497 Velit Ave          780
4       Brynne     Charles              313-3757 Ultrices St.          513
5       Aquila      Dillon   P.O. Box 945, 5550 Aliquam Street          748
...
```

Handling partial duplicates: summarizing

Summarize differing values using statistical summary functions (`mean()`, `max()`, etc.)

	First name	Last name	Address	Credit score
1	Tamekah	Forbes	P.O. Box 147, 511 Velit Street	356
2	Tamekah	Forbes	P.O. Box 147, 511 Velit Street	342
3	Xandra	Barrett	P.O. Box 309, 2462 Pharetra Rd.	620
4	Xandra	Barrett	P.O. Box 309, 2462 Pharetra Rd.	636

Handling partial duplicates: summarizing

Summarize differing values using statistical summary functions (`mean()`, `max()`, etc.)

	First name	Last name	Address	Credit score	Mean credit score
1	Tamekah	Forbes	P.O. Box 147, 511 Velit Street	356	349
2	Tamekah	Forbes	P.O. Box 147, 511 Velit Street	342	
3	Xandra	Barrett	P.O. Box 309, 2462 Pharetra Rd.	620	628
4	Xandra	Barrett	P.O. Box 309, 2462 Pharetra Rd.	636	

Handling partial duplicates: summarizing

Summarize differing values using statistical summary functions (`mean()`, `max()`, etc.)

	First name	Last name	Address	Credit score	Mean credit score
1	Tamekah	Forbes	P.O. Box 147, 511 Velit Street	356	349
2					
3	Xandra	Barrett	P.O. Box 309, 2462 Pharetra Rd.	620	628
4					

Handling partial duplicates: summarizing

Summarize differing values using statistical summary functions (`mean()`, `max()`, etc.)

	First name	Last name	Address	Credit score
1	Tamekah	Forbes	P.O. Box 147, 511 Velit Street	349
2				
3	Xandra	Barrett	P.O. Box 309, 2462 Pharetra Rd.	628
4				

Handling partial duplicates: summarizing

Summarize differing values using statistical summary functions (`mean()`, `max()`, etc.)

	First name	Last name	Address	Credit score
1	Tamekah	Forbes	P.O. Box 147, 511 Velit Street	349
3	Xandra	Barrett	P.O. Box 309, 2462 Pharetra Rd.	628

Summarizing partial duplicates

```
credit_scores %>%
  group_by(first_name, last_name) %>%
  mutate(mean_credit_score = mean(credit_score))
```

```
  first_name last_name address                          credit_score mean_score
1 Tamekah    Forbes    P.O. Box 147, 511 Velit Street            356        349
2 Tamekah    Forbes    P.O. Box 147, 511 Velit Street            342        349
3 Xandra     Barrett   P.O. Box 309, 2462 Pharetra, Rd.          636        628
4 Xandra     Barrett   P.O. Box 309, 2462 Pharetra, Rd.          620        628
5 Katell     Roy       Ap #434-4081 Mi Av.                       455        455
...
```

Summarizing partial duplicates

```
credit_scores %>%
  group_by(first_name, last_name) %>%
  mutate(mean_credit_score = mean(credit_score)) %>%
  distinct(first_name, last_name, .keep_all = TRUE) %>%
  select(-credit_score)
```

```
  first_name last_name address                              mean_score
  <fct>      <fct>     <fct>                                      <dbl>
1 Tamekah    Forbes    P.O. Box 147, 511 Velit Street               349
2 Xandra     Barrett   P.O. Box 309, 2462 Pharetra, Rd.            628
3 Katell     Roy       Ap #434-4081 Mi Av.                         455
4 Miriam     Day       6042 Sollicitudin Avenue                    313
...
```

Let's practice!

CLEANING DATA IN R