Summarizing Data Part 1

DATA 606 - Statistics & Probability for Data Analytics

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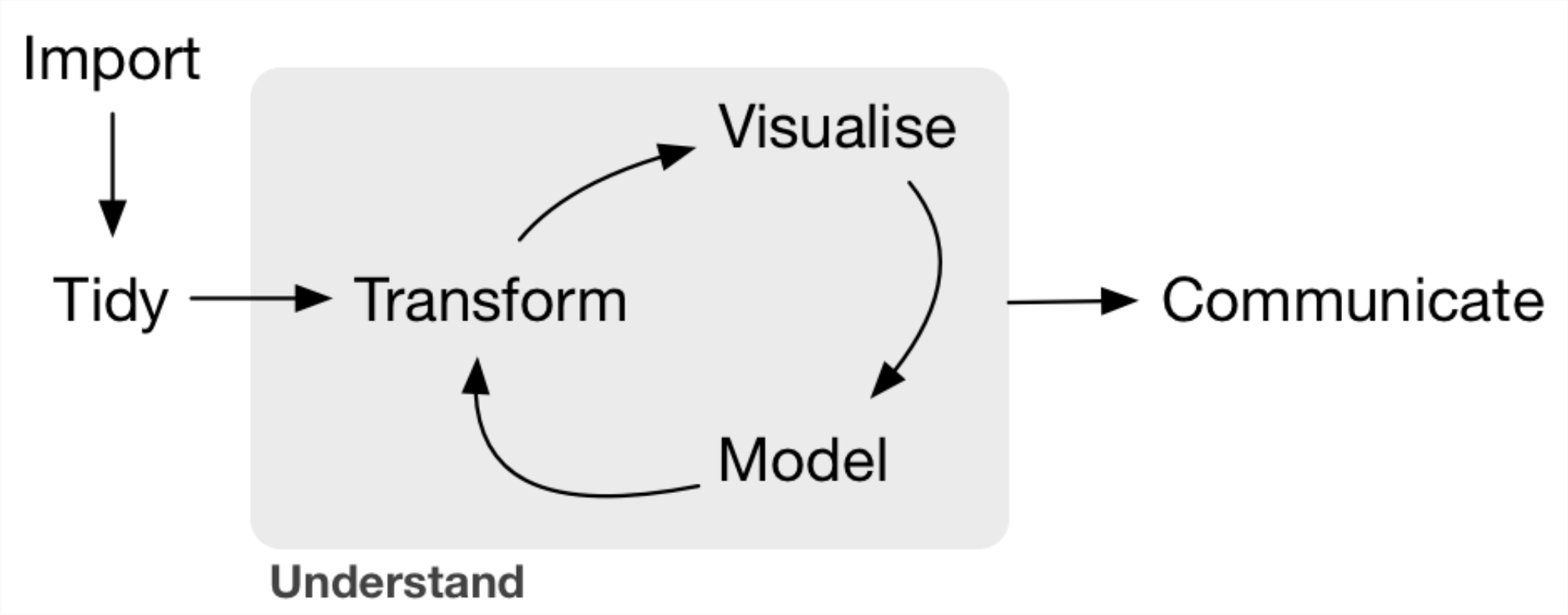
September 6, 2023

One Minute Paper Results

What was the most important thing you learned during this class?

What important question remains unanswered for you?

Workflow



Source: Wickham & Grolemund, 2017

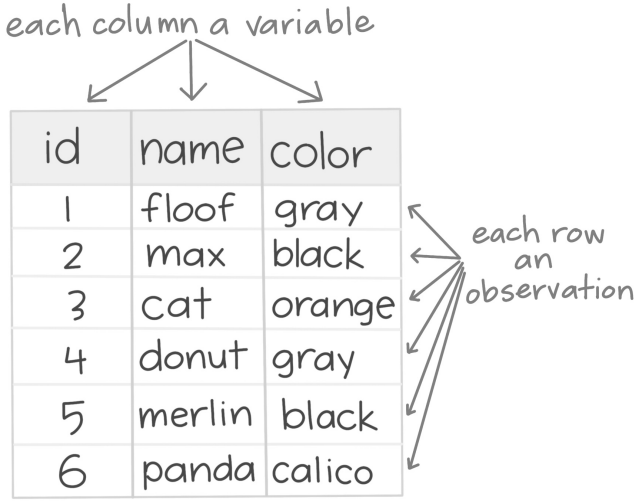
Tidy Data

"TIDY DATA is a standard way of mapping the meaning of a dataset to its structure."

–HADLEY WICKHAM

In tidy data:

- each variable forms a column
- each observation forms a row
- each cell is a single measurement



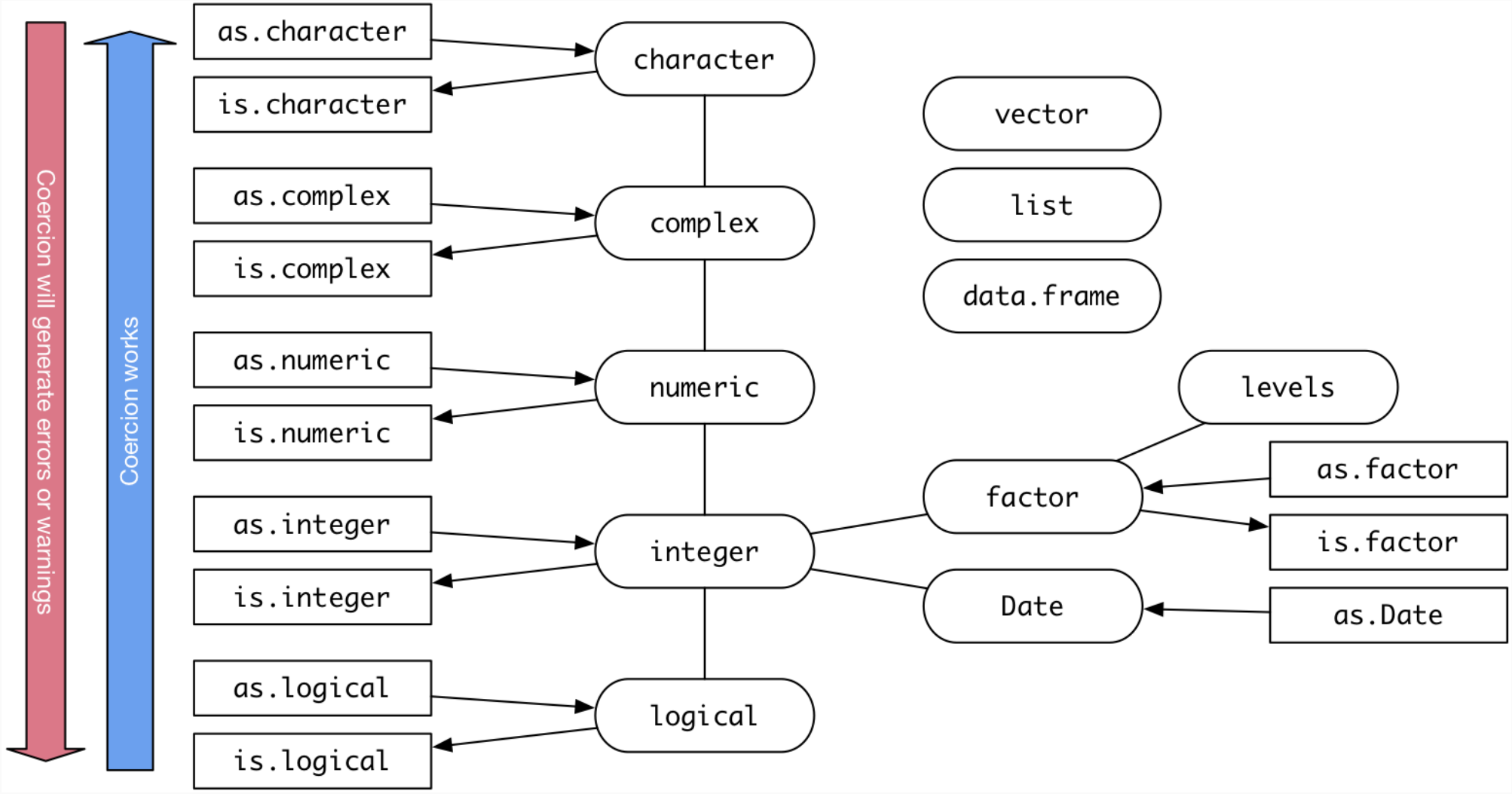
Wickham, H. (2014). Tidy Data. Journal of Statistical Software *59* (10). DOI: 10.18637/jss.v059.i10

See Wickham (2014) Tidy data.

Types of Data

- Numerical (quantitative)
  - Continuous
  - Discrete
- Categorical (qualitative)
  - Regular categorical
  - Ordinal

Data Types in R



Data Types / Descriptives / Visualizations

Data Type	Descriptive Stats	Visualization
Continuous	mean, median, mode, standard deviation, IQR	histogram, density, box plot
Discrete	contingency table, proportional table, median	bar plot
Categorical	contingency table, proportional table	bar plot
Ordinal	contingency table, proportional table, median	bar plot
Two quantitative	correlation	scatter plot
Two qualitative	contingency table, chi-squared	mosaic plot, bar plot
Quantitative & Qualitative	grouped summaries, ANOVA, t-test	box plot

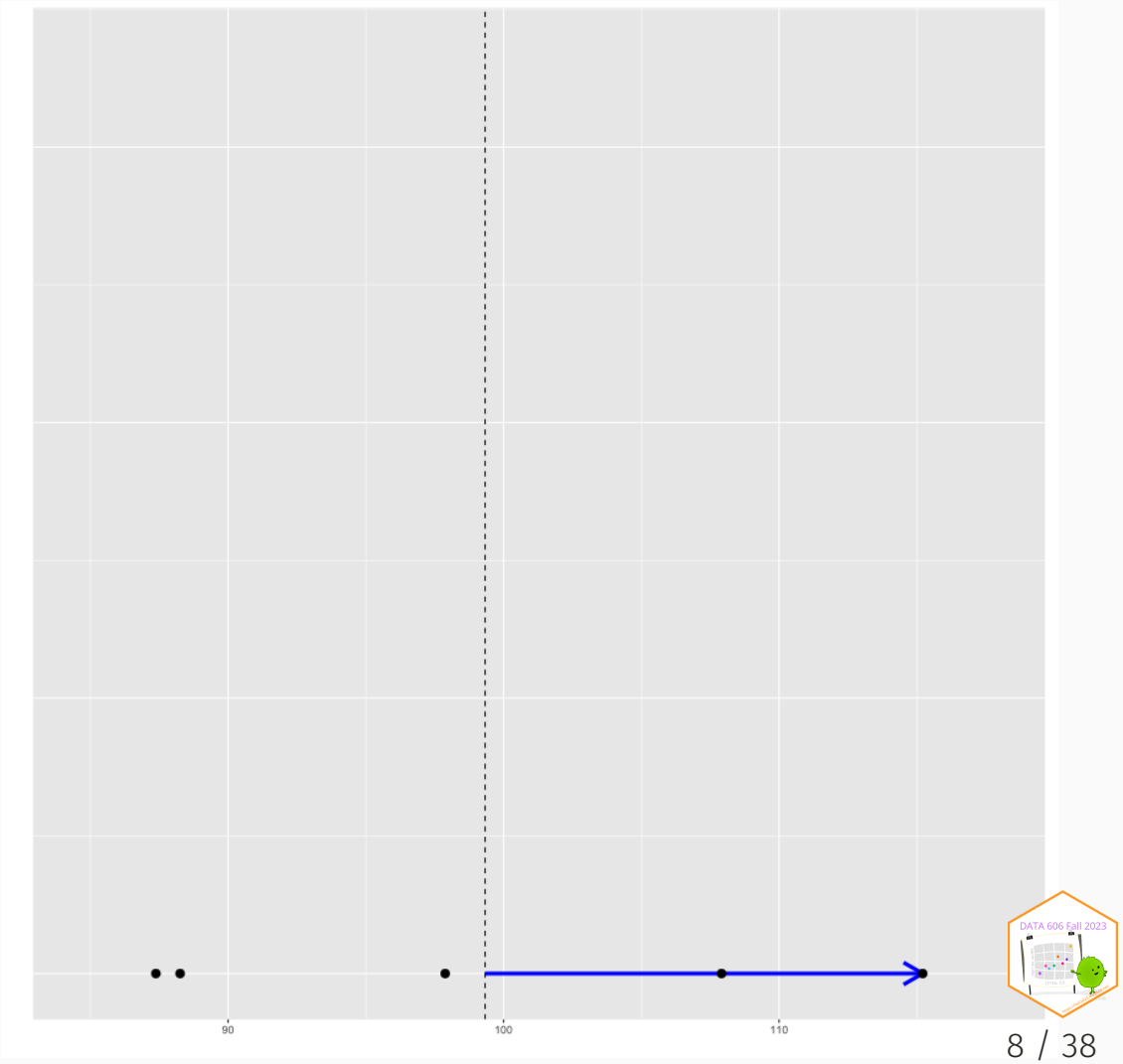
Variance

Population Variance:

$$S^2 = \frac{\Sigma(x_i - \bar{x})^2}{N}$$

Consider a dataset with five values (black points in the figure). For the largest value, the deviance is represented by the blue line ($x_i - \bar{x}$).

See also:
https://shiny.rit.albany.edu/stat/visualizess/
https://github.com/jbryer/VisualStats/

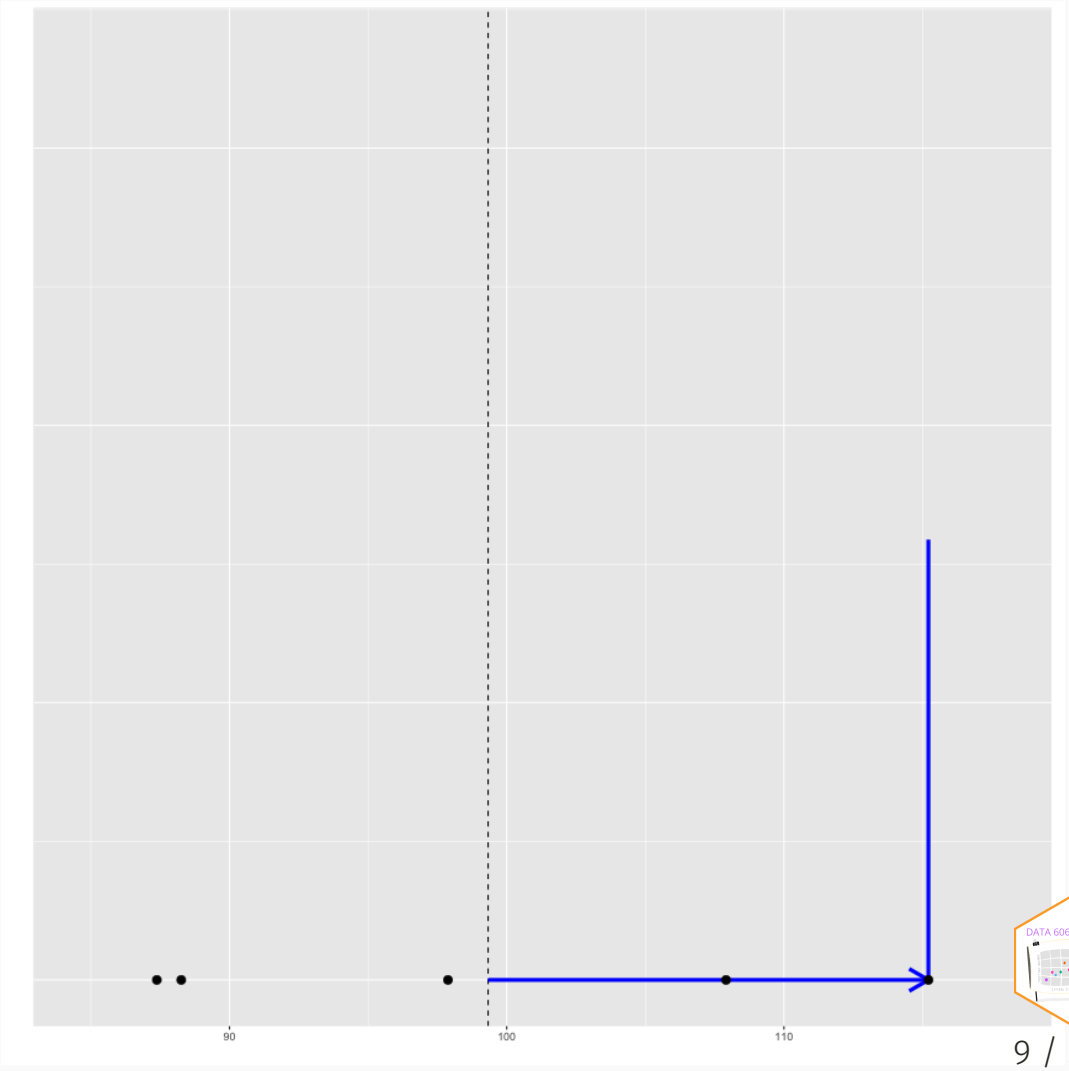


Variance (cont.)

Population Variance:

$$S^2 = \frac{\Sigma(x_i - \bar{x})^2}{N}$$

In the numerator, we square each of these deviances. We can conceptualize this as a square. Here, we add the deviance in the *y* direction.

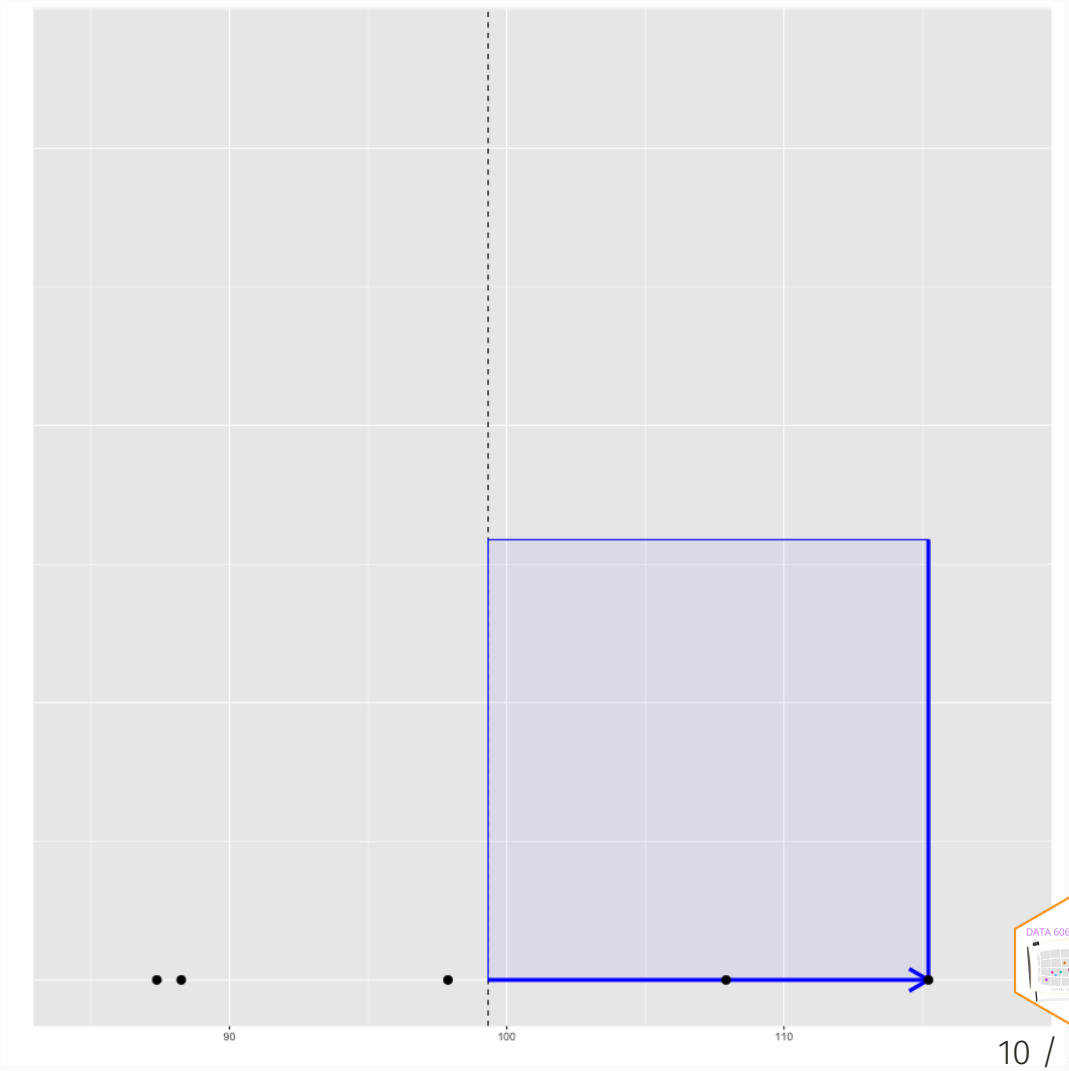


Variance (cont.)

Population Variance:

$$S^2 = \frac{\Sigma(x_i - \bar{x})^2}{N}$$

We end up with a square.

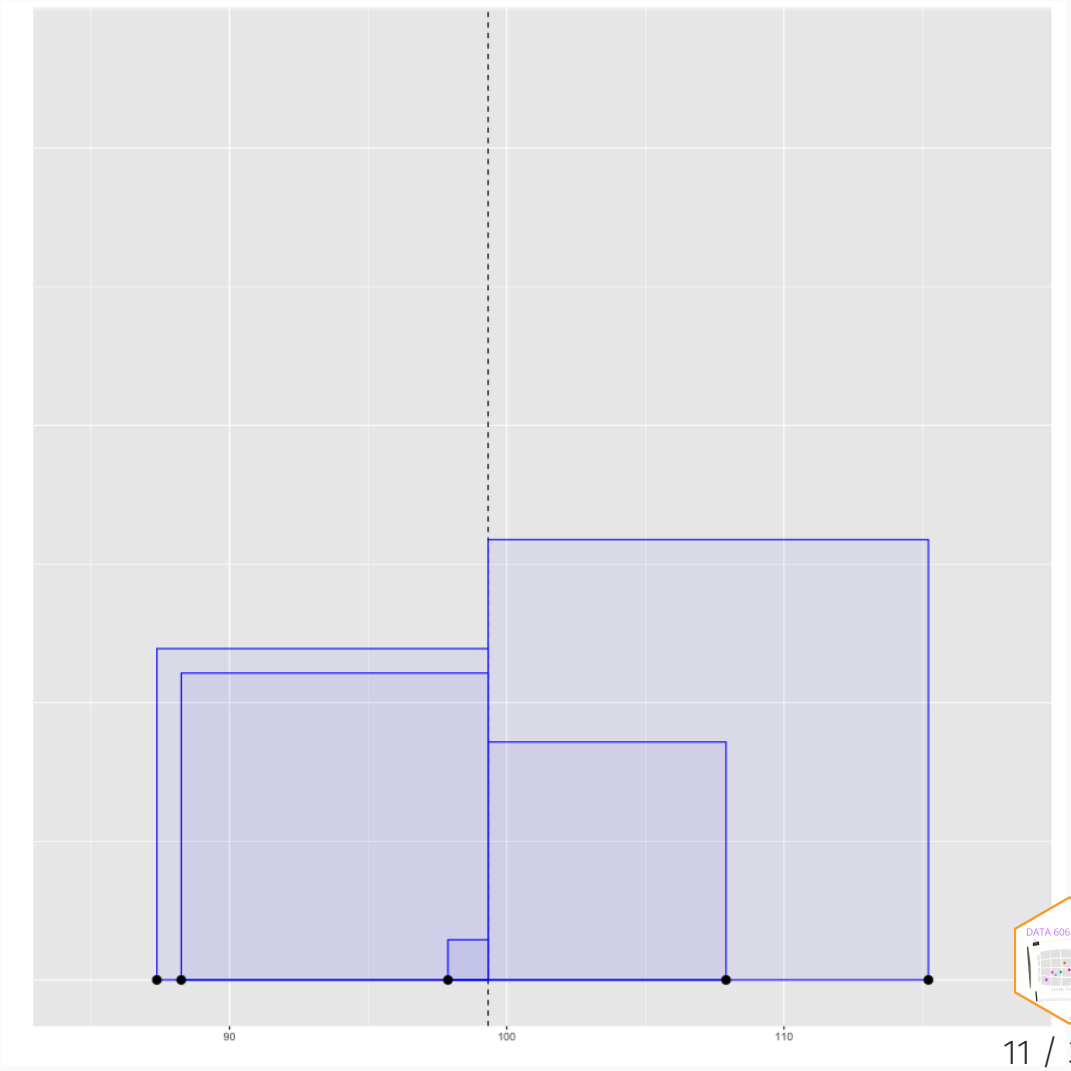


Variance (cont.)

Population Variance:

$$S^2 = \frac{\Sigma(x_i - \bar{x})^2}{N}$$

We can plot the squared deviance for all the data points. That is, each component in the numerator is the area of each of these squares.

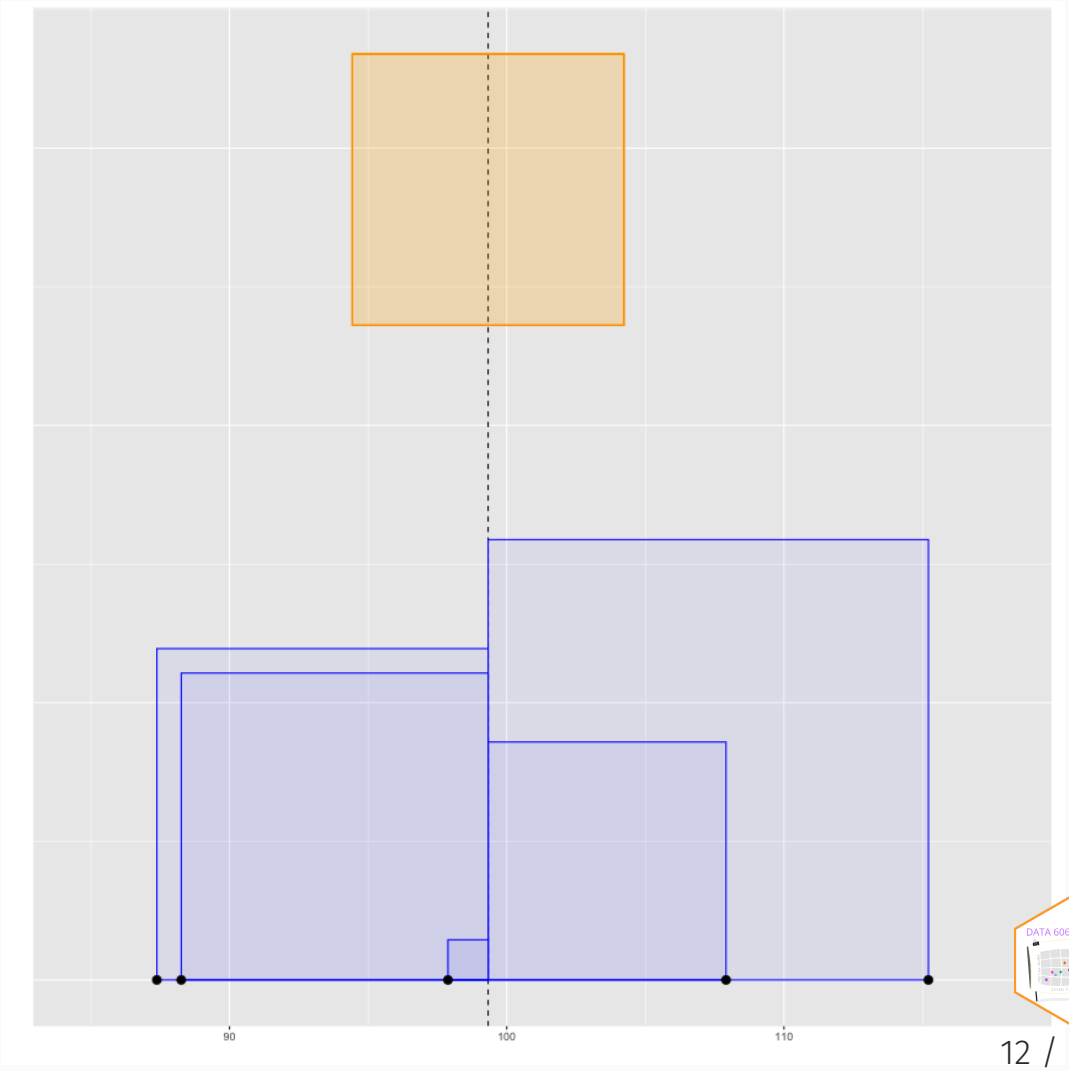


Variance (cont.)

Population Variance:

$$S^2 = \frac{\Sigma(x_i - \bar{x})^2}{N}$$

The variance is therefore the average of the area of all these squares, here represented by the orange square.



Population versus Sample Variance

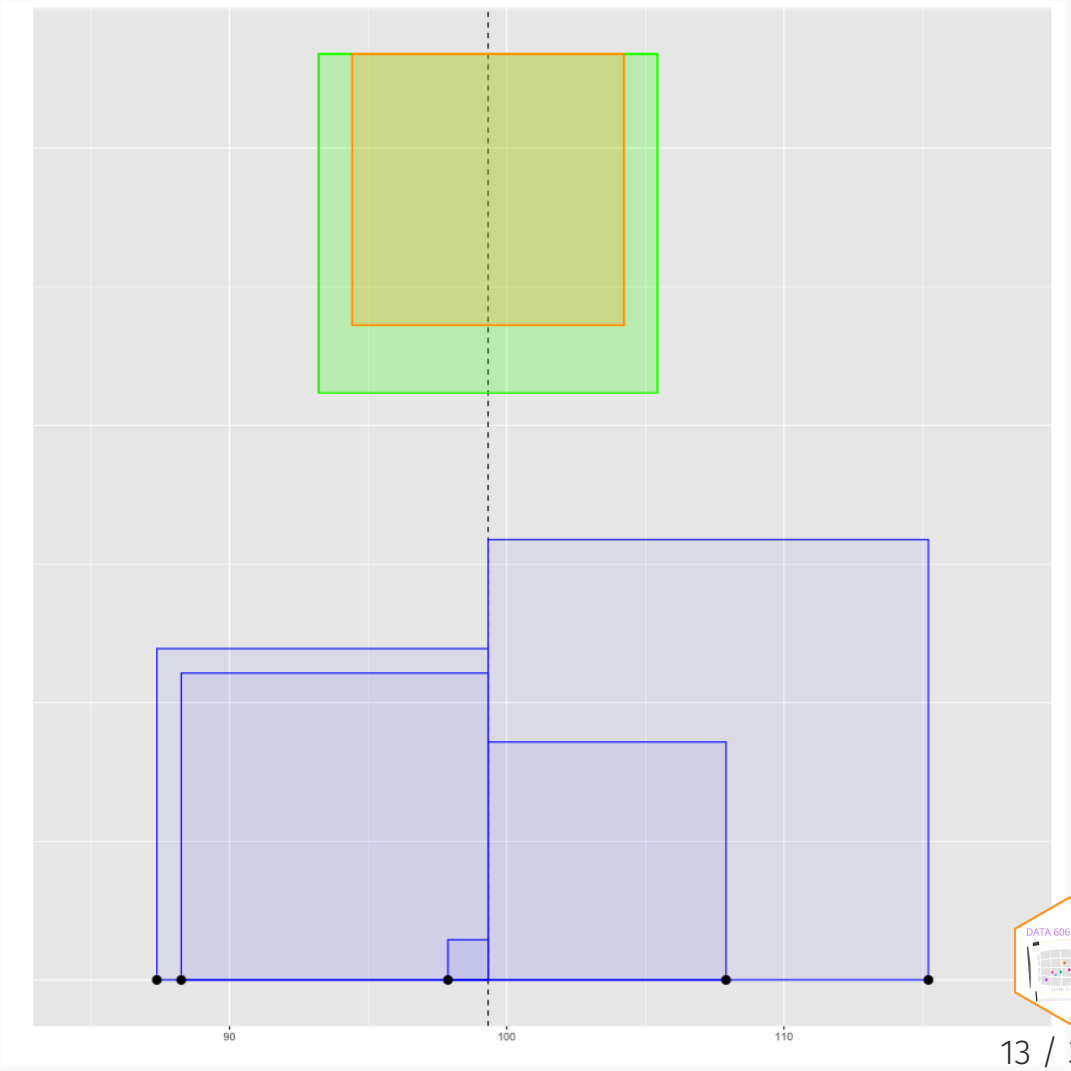
Typically we want the sample variance. The difference is we divide by $n-1$ to calculate the sample variance. This results in a slightly larger area (variance) then if we divide by n.

Population Variance (yellow):

$$S^2 = \frac{\Sigma(x_i - \bar{x})^2}{N}$$

Sample Variance (green):

$$s^2 = \frac{\Sigma(x_i - \bar{x})^2}{n-1}$$



Robust Statistics

Consider the following data randomly selected from the normal distribution:

```
set.seed(41)
x <- rnorm(30, mean = 100, sd = 15)
mean(x); sd(x)
```

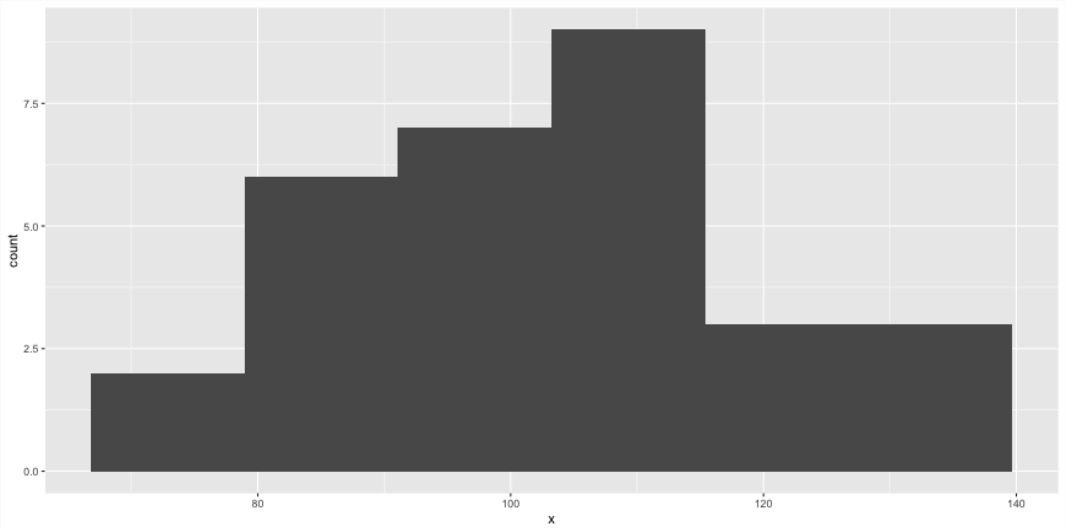
```
## [1] 103.1934
```

```
## [1] 16.8945
```

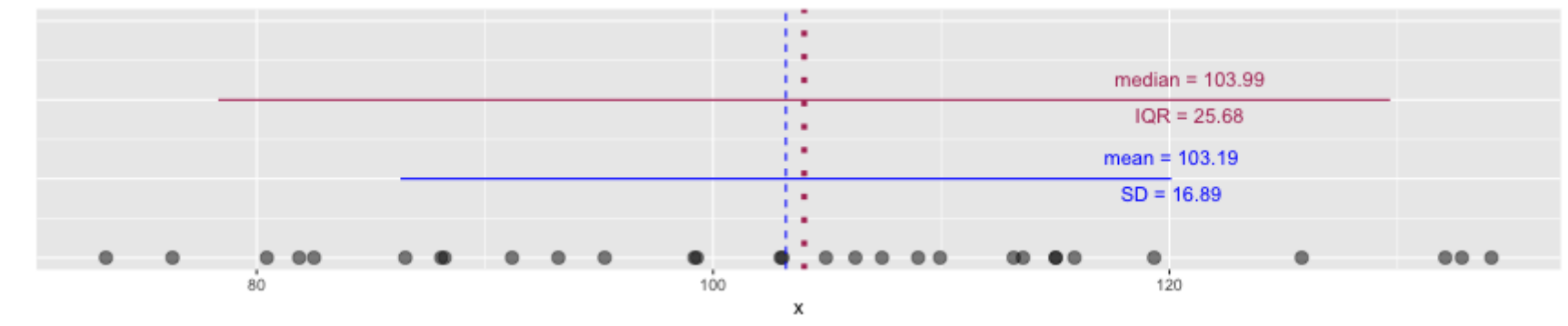
```
median(x); IQR(x)
```

```
## [1] 103.9947
```

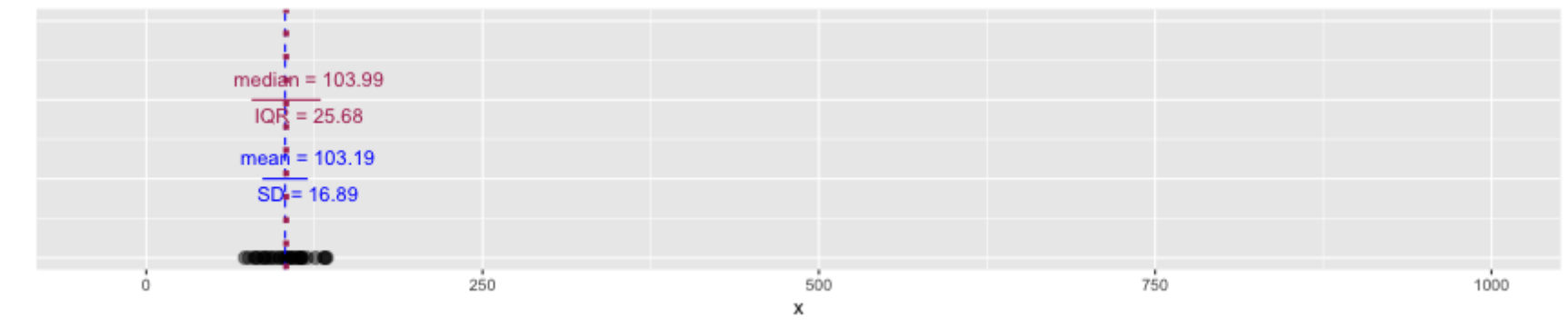
```
## [1] 25.68004
```



Robust Statistics

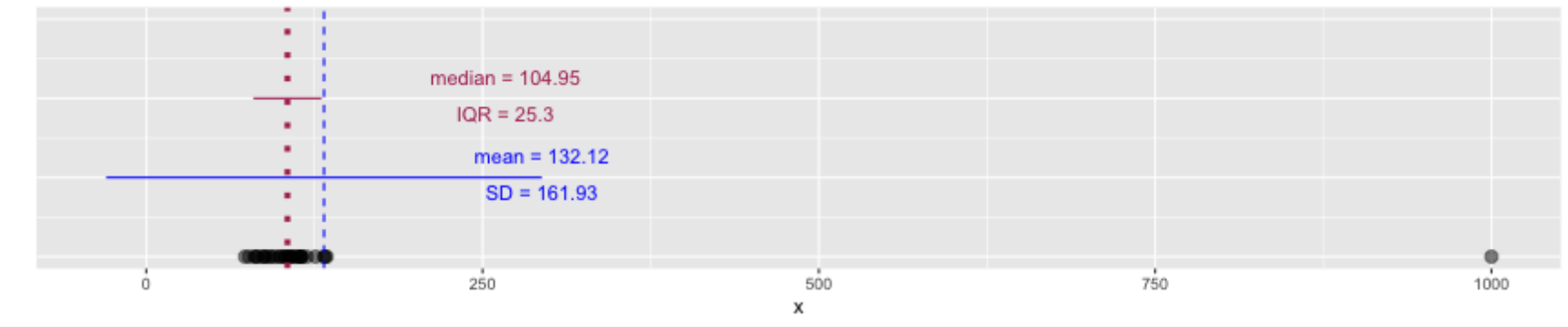


Robust Statistics



Let's add an extreme value:

```
x <- c(x, 1000)
```



Robust Statistics

Median and IQR are more robust to skewness and outliers than mean and SD. Therefore,

- for skewed distributions it is often more helpful to use median and IQR to describe the center and spread
- for symmetric distributions it is often more helpful to use the mean and SD to describe the center and spread

About `legosets`

To install the `brickset` package:

```
remotes::install_github('jbryer/brickset')
```

To load the load the `legosets` dataset.

```
data('legosets', package = 'brickset')
```

The `legosets` data has 18455 observations of 34 variables.

```
names(legosets)
```

```
##  [1] "setID"                "name"                 "year"
##  [4] "theme"                "themeGroup"           "subtheme"
##  [7] "category"             "released"             "pieces"
## [10] "minifigs"             "bricksetURL"          "rating"
## [13] "reviewCount"          "packagingType"        "availability"
## [16] "agerange_min"         "US_retailPrice"       "US_dateFirstAvailable"
## [19] "US_dateLastAvailable" "UK_retailPrice"       "UK_dateFirstAvailable"
## [22] "UK_dateLastAvailable" "CA_retailPrice"       "CA_dateFirstAvailable"
## [25] "CA_dateLastAvailable" "DE_retailPrice"       "DE_dateFirstAvailable"
## [28] "DE_dateLastAvailable" "height"               "width"
## [31] "depth"                "weight"               "thumbnailURL"
## [34] "imageURL"
```

Structure (str)

```
str(legosets)
```

```
## 'data.frame':    18455 obs. of  34 variables:
##  $ setID                : int  7693 7695 7697 7698 25534 7418 7419 6020 22704 7421 ...
##  $ name                 : chr  "Small house set" "Medium house set" "Medium house set" "Large house set" ...
##  $ year                 : int  1970 1970 1970 1970 1970 1970 1970 1970 1970 1970 ...
##  $ theme                : chr  "Minitalia" "Minitalia" "Minitalia" "Minitalia" ...
##  $ themeGroup           : chr  "Vintage" "Vintage" "Vintage" "Vintage" ...
##  $ subtheme             : chr  NA NA NA NA ...
##  $ category             : chr  "Normal" "Normal" "Normal" "Normal" ...
##  $ released             : logi  TRUE TRUE TRUE TRUE TRUE TRUE ...
##  $ pieces               : int  67 109 158 233 NA 1 1 60 65 NA ...
##  $ minifigs             : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ bricksetURL          : chr  "https://brickset.com/sets/1-8" "https://brickset.com/sets/2-8" "https://brickset.com/sets/3-6" "https://brickset.com/sets/4-4" ...
##  $ rating               : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ reviewCount          : int  0 0 1 0 0 0 0 0 0 0 ...
##  $ packagingType        : chr  "{Not specified}" "{Not specified}" "{Not specified}" "{Not specified}" ...
##  $ availability         : chr  "{Not specified}" "{Not specified}" "{Not specified}" "{Not specified}" ...
##  $ agerange_min         : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ US_retailPrice       : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ US_dateFirstAvailable: Date, format: NA NA ...
##  $ US_dateLastAvailable : Date, format: NA NA ...
##  $ UK_retailPrice       : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ UK_dateFirstAvailable: Date, format: NA NA ...
##  $ UK_dateLastAvailable : Date, format: NA NA ...
##  $ CA_retailPrice       : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ CA_dateFirstAvailable: Date, format: NA NA ...
##  $ CA_dateLastAvailable : Date, format: NA NA ...
##  $ DE_retailPrice       : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ DE_dateFirstAvailable: Date, format: NA NA ...
##  $ DE_dateLastAvailable : Date, format: NA NA ...
##  $ height               : num  NA NA NA NA NA ...
##  $ width                : num  NA NA NA NA NA ...
##  $ depth                : num  NA NA NA NA NA NA NA NA 5.08 NA ...
##  $ weight               : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ thumbnailURL         : chr  "https://images.brickset.com/sets/small/1-8.jpg" "https://images.brickset.com/sets/small/2-8.jpg" "https://images.brickset.com/sets/small/3-6.jpg" "https:
##  $ imageURL             : chr  "https://images.brickset.com/sets/images/1-8.jpg" "https://images.brickset.com/sets/images/2-8.jpg" "https://images.brickset.com/sets/images/3-6.jpg" "htt
```

RStudio Eenvironment tab can help

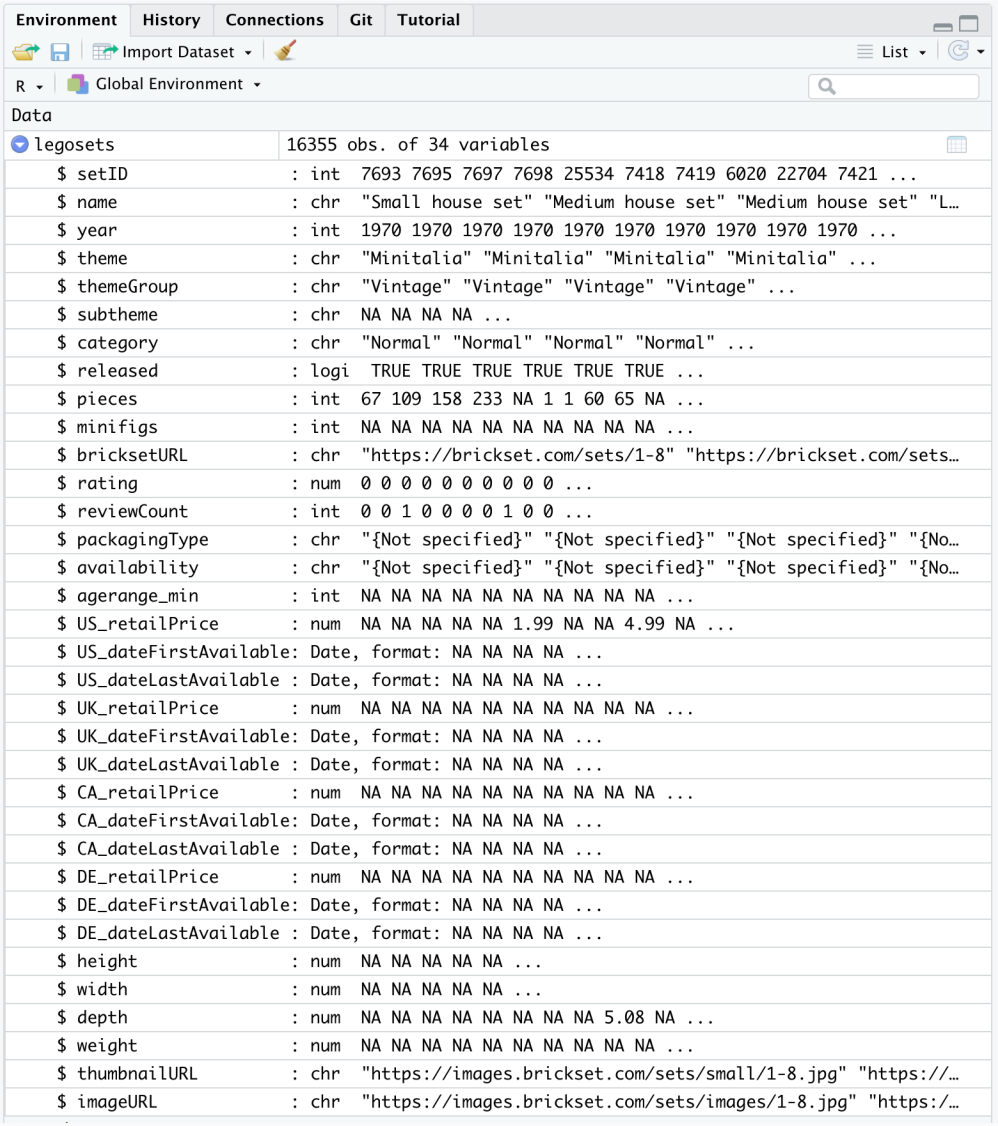


Table View

Show 10 entries

Search:

	setID	name	year	theme	themeGroup	category	US_retailPrice	pieces	minifigs	rating
1	9839	Anaheim Key Chain	2012	Gear	Miscellaneous	Gear				0
2	29031	Imperial Dropship – 20th Anniversary Edition	2019	Star Wars	Licensed	Normal	19.99	125	5	4
3	24652	LEGO Minifigures - Series 14 - Monsters - Complete	2015	Collectable Minifigures	Miscellaneous	Collection		86	16	4.3
4	1454	German Footballer	1998	Town	Modern day	Normal		4	1	0
5	3116	Building Plate, Green	1996	Basic	Basic	Normal	4.99	1		4.1
6	28456	Yorkshire Terrier	2018	Promotional	Miscellaneous	Other		179		0
7	330	Treasure Cart	1992	Castle	Historical	Normal		23	1	3.5
8	33684	Mickey, Minnie and Goofy's Fairground Fun	2022	Disney	Licensed	Normal	34.99	184	3	0
9	30301	Guarded Fortress	2020	Super Mario	Licensed	Normal	49.99	468	3	3.8
10	7220	LEGO Travel Game	2009	Gear	Miscellaneous	Gear	24.99			0

Showing 1 to 10 of 100 entries

Previous 1 2 3 4 5 ... 10 Next

Data Wrangling Cheat Sheet

Data Transformation with dplyr : : CHEAT SHEET

dplyr functions work with pipes and expect **tidy data**. In tidy data:

Each **variable** is in its own **column**

Each **observation**, or **case**, is in its own **row**

pipes

x %>% f(y) becomes **f(x, y)**

Summarise Cases

These apply **summary functions** to columns to create a new table of summary statistics. Summary functions take vectors as input and return one value (see back).

summary function

summarise(.data, …)
Compute table of summaries.
summarise(mtcars, avg = mean(mpg))

count(x, ..., wt = NULL, sort = FALSE)
Count number of rows in each group defined by the variables in … Also **tally**().
count(iris, Species)

VARIATIONS

summarise_all() - Apply funs to every column.
summarise_at() - Apply funs to specific columns.
summarise_if() - Apply funs to all cols of one type.

Group Cases

Use **group_by()** to create a "grouped" copy of a table. dplyr functions will manipulate each "group" separately and then combine the results.

mtcars %>%
group_by(cyl) %>%
summarise(avg = mean(mpg))

group_by(.data, ..., add = FALSE)
Returns copy of table grouped by …
g_iris <- group_by(iris, Species)

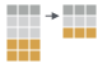
ungroup(x, …)
Returns ungrouped copy of table.
ungroup(g_iris)

Manipulate Cases

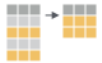
EXTRACT CASES

Row functions return a subset of rows as a new table.

filter(.data, …) Extract rows that meet logical criteria. *filter(iris, Sepal.Length > 7)*

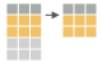


distinct(.data, ..., .keep_all = FALSE) Remove rows with duplicate values.
distinct(iris, Species)



sample_frac(tbl, size = 1, replace = FALSE, weight = NULL, .env = parent.frame()) Randomly select fraction of rows.
sample_frac(iris, 0.5, replace = TRUE)

sample_n(tbl, size, replace = FALSE, weight = NULL, .env = parent.frame()) Randomly select size rows. *sample_n(iris, 10, replace = TRUE)*



slice(.data, …) Select rows by position.
slice(iris, 10:15)

top_n(x, n, wt) Select and order top n entries (by group if grouped data). *top_n(iris, 5, Sepal.Width)*

Logical and boolean operators to use with filter()

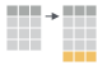
<	<=	is.na()	%in%	|	xor()
>	>=	!is.na()	!	&	

See **?base::logic** and **?Comparison** for help.

ARRANGE CASES

arrange(.data, …) Order rows by values of a column or columns (low to high), use with **desc()** to order from high to low.
arrange(mtcars, mpg)
arrange(mtcars, desc(mpg))

ADD CASES



add_row(.data, ..., .before = NULL, .after = NULL) Add one or more rows to a table.
add_row(faithful, eruptions = 1, waiting = 1)

Manipulate Variables

EXTRACT VARIABLES

Column functions return a set of columns as a new vector or table.

pull(.data, var = -1) Extract column values as a vector. Choose by name or index.
pull(iris, Sepal.Length)

select(.data, …)
Extract columns as a table. Also **select_if()**.
select(iris, Sepal.Length, Species)

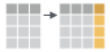
Use these helpers with select (),
e.g. select(iris, starts_with("Sepal"))

contains(match)	**num_range**(prefix, range)	**:**, e.g. mpg:cyl
ends_with(match)	**one_of**(…)	**-**, e.g, -Species
matches(match)	**starts_with**(match)	

MAKE NEW VARIABLES

These apply **vectorized functions** to columns. Vectorized funs take vectors as input and return vectors of the same length as output (see back).

vectorized function



mutate(.data, …)
Compute new column(s).
mutate(mtcars, gpm = 1/mpg)

transmute(.data, …)
Compute new column(s), drop others.
transmute(mtcars, gpm = 1/mpg)

mutate_all(.tbl, .funs, …) Apply funs to every column. Use with **funs()**. Also **mutate_if()**.
mutate_all(faithful, funs(log(.), log2(.)))
mutate_if(iris, is.numeric, funs(log(.)))

mutate_at(.tbl, .cols, .funs, …) Apply funs to specific columns. Use with **funs()**, **vars()** and the helper functions for select().
mutate_at(iris, vars(-Species), funs(log(.)))

add_column(.data, ..., .before = NULL, .after = NULL) Add new column(s). Also **add_count()**, **add_tally()**. *add_column(mtcars, new = 1:32)*

rename(.data, …) Rename columns.
rename(iris, Length = Sepal.Length)

RStudio

Tidyverse vs Base R

R Syntax Comparison : : CHEAT SHEET

Dollar sign syntax

`goal(data$x, data$y)`

SUMMARY STATISTICS:

one continuous variable:
```
mean(mtcars$mpg)
```

one categorical variable:
```
table(mtcars$cyl)
```

two categorical variables:
```
table(mtcars$cyl, mtcars$am)
```

one continuous, one categorical:
```
mean(mtcars$mpg[mtcars$cyl==4])
mean(mtcars$mpg[mtcars$cyl==6])
mean(mtcars$mpg[mtcars$cyl==8])
```

PLOTTING:

one continuous variable:
```
hist(mtcars$disp)

boxplot(mtcars$disp)
```

one categorical variable:
```
barplot(table(mtcars$cyl))
```

two continuous variables:
```
plot(mtcars$disp, mtcars$mpg)
```

two categorical variables:
```
mosaicplot(table(mtcars$am, mtcars$cyl))
```

one continuous, one categorical:
```
histogram(mtcars$disp[mtcars$cyl==4])
histogram(mtcars$disp[mtcars$cyl==6])
histogram(mtcars$disp[mtcars$cyl==8])

boxplot(mtcars$disp[mtcars$cyl==4])
boxplot(mtcars$disp[mtcars$cyl==6])
boxplot(mtcars$disp[mtcars$cyl==8])
```

WRANGLING:

subsetting:
```
mtcars[mtcars$mpg>30, ]
```

making a new variable:
```
mtcars$efficient[mtcars$mpg>30] <- TRUE
mtcars$efficient[mtcars$mpg<30] <- FALSE
```

Formula syntax

`goal(y~x|z, data=data, group=w)`

SUMMARY STATISTICS:

one continuous variable:
```
mosaic::mean(~mpg, data=mtcars)
```

one categorical variable:
```
mosaic::tally(~cyl, data=mtcars)
```

two categorical variables:
```
mosaic::tally(cyl~am, data=mtcars)
```

one continuous, one categorical:
```
mosaic::mean(mpg~cyl, data=mtcars)
```

tilde

PLOTTING:

one continuous variable:
```
lattice::histogram(~disp, data=mtcars)

lattice::bwplot(~disp, data=mtcars)
```

one categorical variable:
```
mosaic::bargraph(~cyl, data=mtcars)
```

two continuous variables:
```
lattice::xyplot(mpg~disp, data=mtcars)
```

two categorical variables:
```
mosaic::bargraph(~am, data=mtcars, group=cyl)
```

one continuous, one categorical:
```
lattice::histogram(~disp|cyl, data=mtcars)

lattice::bwplot(cyl~disp, data=mtcars)
```

The variety of R syntaxes give you many ways to "say" the same thing

read **across** the cheatsheet to see how different syntaxes approach the same problem

Tidyverse syntax

`data %>% goal(x)`

SUMMARY STATISTICS:

one continuous variable:
```
mtcars %>% dplyr::summarize(mean(mpg))
```

one categorical variable:
```
mtcars %>% dplyr::group_by(cyl) %>%
dplyr::summarize(n())
```

the pipe

two categorical variables:
```
mtcars %>% dplyr::group_by(cyl, am) %>%
dplyr::summarize(n())
```

one continuous, one categorical:
```
mtcars %>%  dplyr::group_by(cyl) %>%
  dplyr::summarize(mean(mpg))
```

PLOTTING:

one continuous variable:
```
ggplot2::qplot(x=mpg, data=mtcars, geom = "histogram")

ggplot2::qplot(y=disp, x=1, data=mtcars, geom="boxplot")
```

one categorical variable:
```
ggplot2::qplot(x=cyl, data=mtcars, geom="bar")
```

two continuous variables:
```
ggplot2::qplot(x=disp, y=mpg, data=mtcars, geom="point")
```

two categorical variables:
```
ggplot2::qplot(x=factor(cyl), data=mtcars, geom="bar") +
        facet_grid(.~am)
```

one continuous, one categorical:
```
ggplot2::qplot(x=disp, data=mtcars, geom = "histogram") +
        facet_grid(.~cyl)

ggplot2::qplot(y=disp, x=factor(cyl), data=mtcars,
               geom="boxplot")
```

WRANGLING:

subsetting:
```
mtcars %>% dplyr::filter(mpg>30)
```

making a new variable:
```
mtcars <- mtcars %>%
dplyr::mutate(efficient = if_else(mpg>30,  TRUE, FALSE))
```

SMITH COLLEGE

Pipes %>% and |>

The pipe operator (`%>%`) introduced with the `magrittr` R package allows for the chaining of R operations. Base R has now added their own pipe operator (`|>`). They take the output from the left-hand side and passes it as the first parameter to the function on the right-hand side.

You can do this in two steps:

```
tab_out <- table(legosets$category)
prop.table(tab_out)
```

Or as nested function calls.

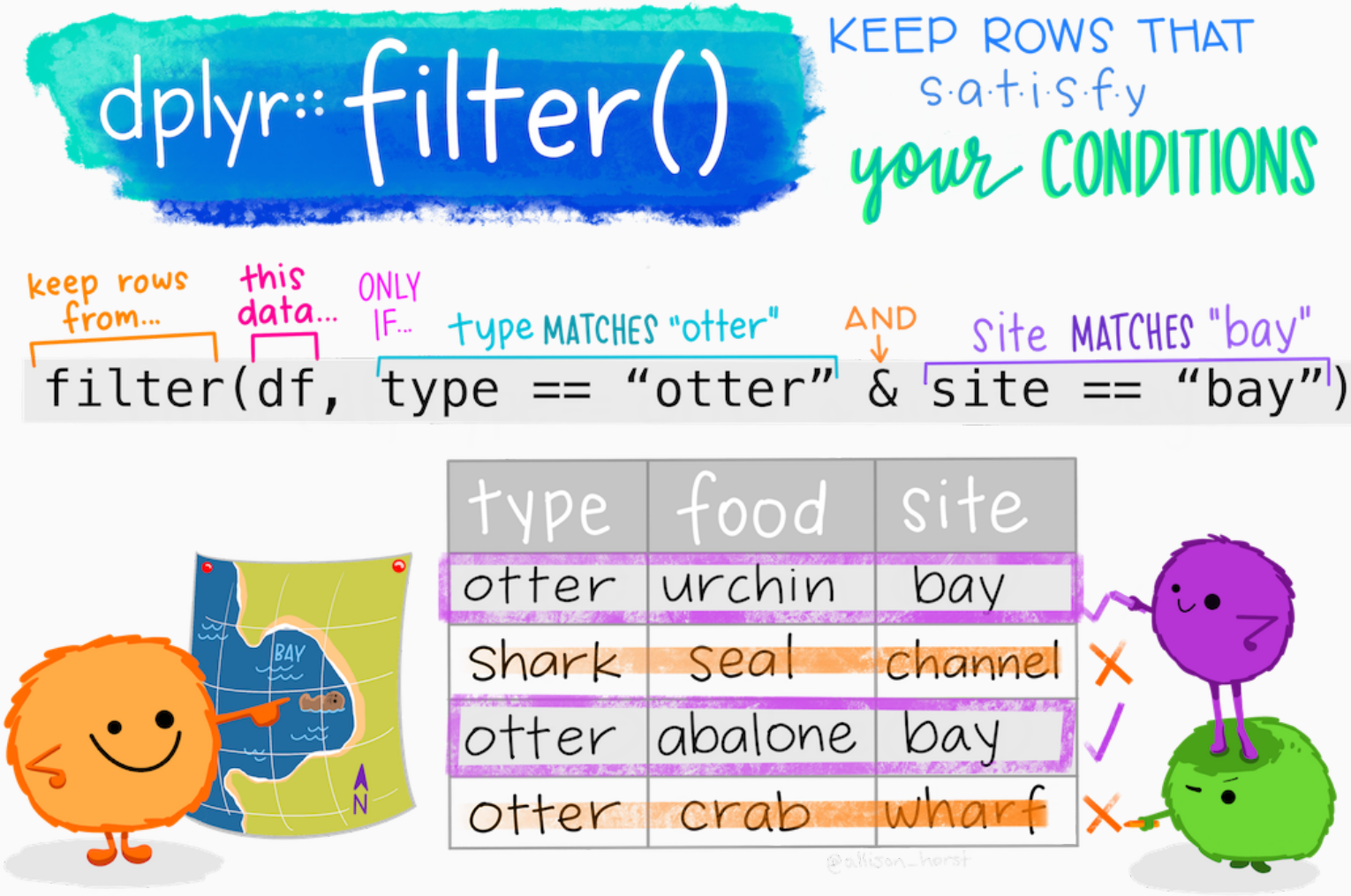
```
prop.table(table(legosets$category))
```

Using the pipe (`|>`) operator we can chain these calls in a what is arguably a more readable format:

```
table(legosets$category) |> prop.table()
```

```
##
##        Book  Collection    Extended        Gear      Normal       Other
## 0.034191276 0.031319426 0.027147115 0.153345977 0.691248984 0.059279328
```

Filter


dplyr::filter()
KEEP ROWS THAT satisfy your CONDITIONS
keep rows from...
this data...
ONLY IF...
type MATCHES "otter"
AND
site MATCHES "bay"
filter(df, type == "otter" & site == "bay")
BAY
N
type food site
otter urchin bay
shark seal channel
otter abalone bay
otter crab wharf
@allison_horst

Logical Operators

- `!a` - TRUE if a is FALSE
- `a == b` - TRUE if a and be are equal
- `a != b` - TRUE if a and b are not equal
- `a > b` - TRUE if a is larger than b, but not equal
- `a >= b` - TRUE if a is larger or equal to b
- `a < b` - TRUE if a is smaller than be, but not equal
- `a <= b` - TRUE if a is smaller or equal to b
- `a %in% b` - TRUE if a is in b where b is a vector

```
which( letters %in% c('a','e','i','o','u') )
```

```
## [1]  1  5  9 15 21
```

- `a | b` - TRUE if a *or* b are TRUE
- `a & b` - TRUE if a *and* b are TRUE
- `isTRUE(a)` - TRUE if a is TRUE

Filter

dplyr

```
mylego <- legosets %>% filter(themeGroup == 'Educational' & year > 2015)
```

Base R

```
mylego <- legosets[legosets$themeGroups == 'Educaitonal' & legosets$year > 2015,]
```

```
nrow(mylego)
```

```
## [1] 92
```

Select

dplyr

```
mylego <- mylego %>% select(setID, pieces, theme, availability, US_retailPrice, minifigs)
```

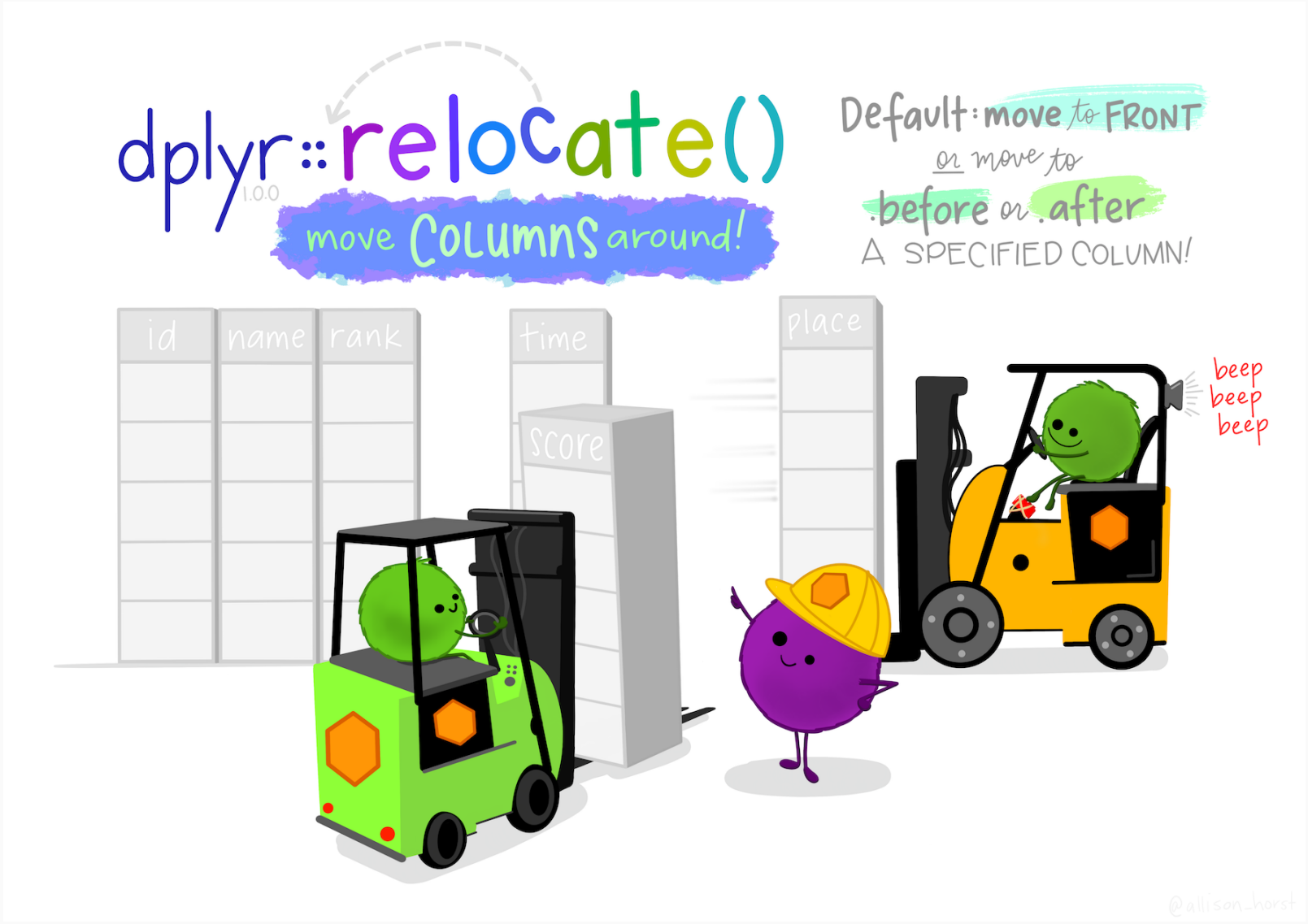
Base R

```
mylego <- mylego[,c('setID', 'pieces', 'theme', 'availability', 'US_retailPrice', 'minifigs')]
```

```
head(mylego, n = 4)
```

```
##   setID pieces     theme    availability US_retailPrice minifigs
## 1 26803    103 Education {Not specified}             NA        6
## 2 26689    142 Education {Not specified}             NA        4
## 3 26804     98 Education {Not specified}             NA        6
## 4 26277    188 Education     Educational          94.95       NA
```

Relocate


dplyr::relocate()
1.0.0
move columns around!
Default: move to FRONT
or move to
.before or .after
A SPECIFIED COLUMN!
id
name
rank
time
score
place
beep
beep
beep
@allison_horst

Relocate

dplyr

```
mylego %>% relocate(where(is.numeric), .after = where(is.character)) %>% head(n = 3)
```

```
##       theme    availability setID pieces US_retailPrice minifigs
## 1 Education {Not specified} 26803    103             NA        6
## 2 Education {Not specified} 26689    142             NA        4
## 3 Education {Not specified} 26804     98             NA        6
```

Base R

```
mylego2 <- mylego[,c('theme', 'availability', 'setID', 'pieces', 'US_retailPrice', 'minifigs')]
head(mylego2, n = 3)
```

```
##       theme    availability setID pieces US_retailPrice minifigs
## 1 Education {Not specified} 26803    103             NA        6
## 2 Education {Not specified} 26689    142             NA        4
## 3 Education {Not specified} 26804     98             NA        6
```

Rename

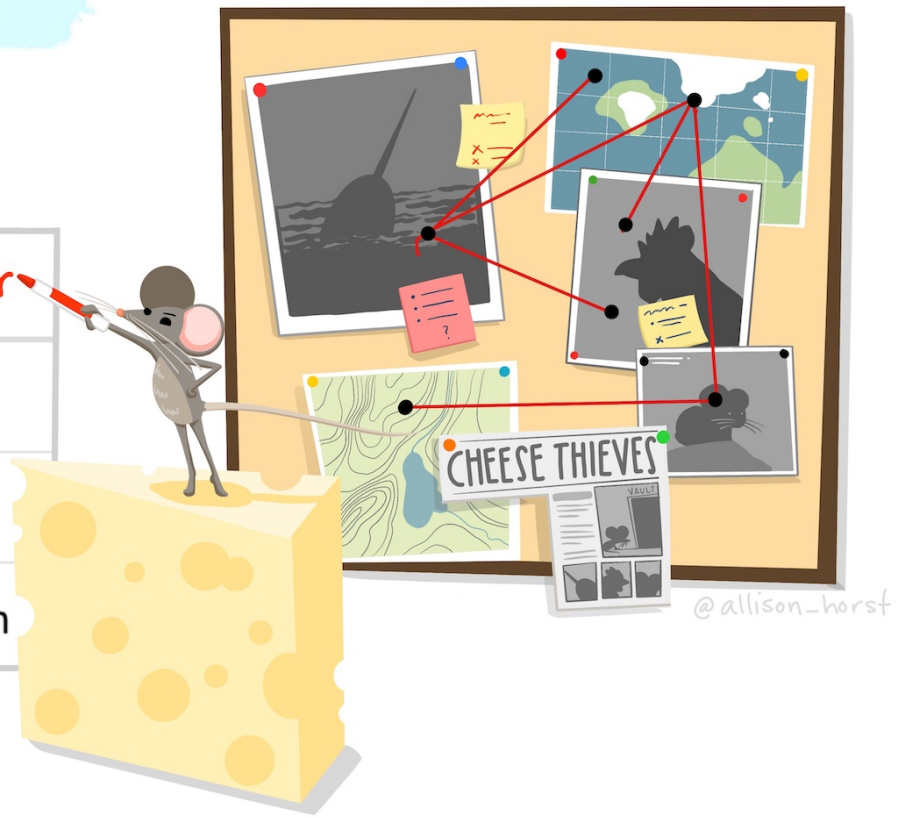
dplyr::rename()

RENAME COLUMNS*

```
df %>% rename(lair = site)
```

~~species~~ nemesis	status	~~site~~ lair
narwhal	unknown	ocean
chicken	active	coop
pika	active	mountain

*See **rename_with()** to rename using a function.



Rename

dplyr

```
mylego %>% dplyr::rename(USD = US_retailPrice) %>% head(n = 3)
```

```
##   setID pieces     theme    availability USD minifigs
## 1 26803    103 Education {Not specified}  NA        6
## 2 26689    142 Education {Not specified}  NA        4
## 3 26804     98 Education {Not specified}  NA        6
```

Base R

```
names(mylego2)[5] <- 'USD'
head(mylego2, n = 3)
```

```
##       theme    availability setID pieces USD minifigs
## 1 Education {Not specified} 26803    103  NA        6
## 2 Education {Not specified} 26689    142  NA        4
## 3 Education {Not specified} 26804     98  NA        6
```

Mutate


dplyr::mutate
add Column(s),
keep existing.
A
B
C
1
5
10
0
2
-3
4
9
6
3
2
14
9
8
THE PLAN:
A
B
C
Horst '18

Mutate

dplyr

```
mylego %>% filter(!is.na(pieces) & !is.na(US_retailPrice)) %>%
    mutate(Price_per_piece = US_retailPrice / pieces) %>% head(n = 3)
```

```
##   setID pieces     theme availability US_retailPrice minifigs Price_per_piece
## 1 26277    188 Education  Educational          94.95       NA       0.5050532
## 2 25949    280 Education  Educational         224.95       NA       0.8033929
## 3 25954      1 Education  Educational          14.95       NA      14.9500000
```

Base R

```
mylego2 <- mylego[!is.na(mylego$US_retailPrice) & !is.na(mylego$Price_per_piece),]
mylego2$Price_per_piece <- mylego2$Price_per_piece / mylego2$US_retailPrice
head(mylego2, n = 3)
```

```
## [1] setID           pieces          theme           availability
## [5] US_retailPrice  minifigs        Price_per_piece
## <0 rows> (or 0-length row.names)
```

Group By and Summarize

```
legosets %>% group_by(themeGroup) %>% summarize(mean_price = mean(US_retailPrice, na.rm = TRUE),
                                                sd_price = sd(US_retailPrice, na.rm = TRUE),
                                                median_price = median(US_retailPrice, na.rm = TRUE),
                                                n = n(),
                                                missing = sum(is.na(US_retailPrice)))
```

```
## # A tibble: 16 × 6
##    themeGroup       mean_price sd_price median_price     n missing
##    <chr>                 <dbl>    <dbl>        <dbl> <int>   <int>
##  1 Action/Adventure       38.3     35.6         30.0  1397     745
##  2 Art and crafts         33.2     46.6         15.0    84       8
##  3 Basic                  20.3     17.8         15.0   863     730
##  4 Constraction           16.4     12.4         13.0   502     284
##  5 Educational           172.     185.          119.    493     457
##  6 Girls                  35.8     24.0         23.0   240     227
##  7 Historical             34.2     32.4         20.0   473     400
##  8 Junior                 22.0     10.1         20.0   227     164
##  9 Licensed               51.8     70.0         30.0  2510     974
## 10 Miscellaneous          20.2     28.5         13.0  5890    3717
## 11 Model making           72.4     90.3         40.0   719     362
## 12 Modern day             37.0     34.9         30.0  2357    1503
## 13 Pre-school             30.2     22.0         25.0  1537    1098
## 14 Racing                 26.8     26.5         15.0   270     176
```

Describe and Describe By

```
library(psych)
describe(legosets$US_retailPrice)
```

```
##    vars    n  mean    sd median trimmed   mad  min    max range skew kurtosis
## X1    1 6979 37.54 54.39  19.99    26.7 16.31 1.49 849.99 848.5 5.44       48
##      se
## X1 0.65
```

```
describeBy(legosets$US_retailPrice, group = legosets$availability, mat = TRUE, skew = FALSE)
```

```
##      item                group1 vars    n       mean         sd   min    max range         se
## X11     1       {Not specified}    1 1928  26.546862  38.647760  1.49 789.99 788.5  0.8801786
## X12     2           Educational    1   12 208.700000 104.362241 14.95 399.95 385.0 30.1267839
## X13     3        LEGO exclusive    1  838  59.133043 108.593395  1.99 849.99 848.0  3.7512966
## X14     4    LEGOLAND exclusive    1    2   4.990000   0.000000  4.99   4.99   0.0  0.0000000
## X15     5             Not sold    1    1  12.990000         NA 12.99  12.99   0.0         NA
## X16     6           Promotional    1    6   5.156667   1.169045  3.99   6.99   3.0  0.4772607
## X17     7 Promotional (Airline)    1    0        NaN         NA   Inf   -Inf  -Inf         NA
## X18     8                Retail    1 3904  36.014985  36.226307  1.99 499.99 498.0  0.5797879
## X19     9      Retail - limited    1  287  63.154983  71.721888  2.49 449.99 447.5  4.2336092
## X110   10               Unknown    1    1   3.990000         NA  3.99   3.99   0.0         NA
```

Additional Resources

For data wrangling:

- `dplyr` website: https://dplyr.tidyverse.org
- R for Data Science book: https://r4ds.had.co.nz/wrangle-intro.html
- Wrangling penguins tutorial: https://allisonhorst.shinyapps.io/dplyr-learnr/#section-welcome
- Data transformation cheat sheet: https://github.com/rstudio/cheatsheets/raw/master/data-transformation.pdf

One Minute Paper

Complete the one minute paper: https://forms.gle/ngYXfC6jwY3TV6FXA

1. What was the most important thing you learned during this class?

2. What important question remains unanswered for you?