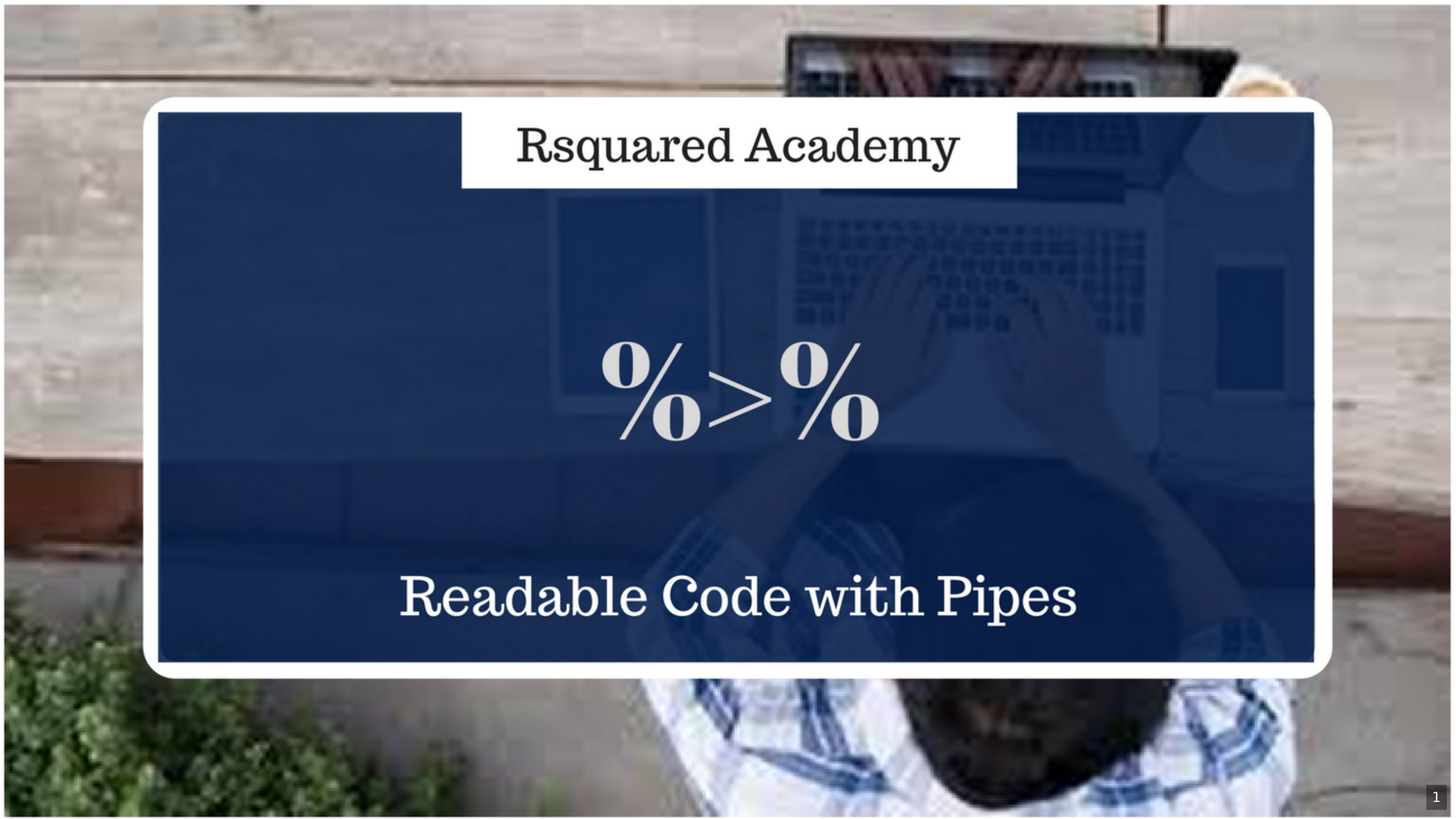

Rsquared Academy
%>%
Readable Code with Pipes

# Agenda

- what are pipes?
- why use pipes?
- what are the different types of pipes?
- combining operations with pipes
- case studies

R code contain a lot of parentheses in case of a sequence of multiple operations. When you are dealing with complex code, it results in nested function calls which are hard to read and maintain. The magrittr package by Stefan Milton Bache provides pipes enabling us to write R code that is readable.

Pipes allow us to clearly express a sequence of multiple operations by:

- structuring operations from left to right
- avoiding
  - nested function calls
  - intermediate steps
  - overwriting of original data
- minimizing creation of local variables

# Pipes

If you are using tidyverse, magrittr will be automatically loaded. We will look at 3 different types of pipes:

- %>% : pipe a value forward into an expression or function call
- %<>%: result assigned to left hand side object instead of returning it
- %$% : expose names within left hand side objects to right hand side expressions

# Libraries

```
library(magrittr)
library(readr)
library(purrr)
library(dplyr)
library(stringr)
```

```
## # A tibble: 1,000 x 4
##    referrer n_pages duration purchase
##    <fct>      <dbl>    <dbl> <lgl>
##  1 google         1      693 FALSE
##  2 yahoo          1      459 FALSE
##  3 direct         1      996 FALSE
##  4 bing          18      468 TRUE
##  5 yahoo          1      955 FALSE
##  6 yahoo          5      135 FALSE
##  7 yahoo          1       75 FALSE
##  8 direct         1      908 FALSE
##  9 bing          19      209 FALSE
## 10 google         1      208 FALSE
## # ... with 990 more rows
```

# Data Dictionary

- referrer: referrer website/search engine
- n_pages: number of pages visited
- duration: time spent on the website (in seconds)
- purchase: whether visitor purchased

# Sample Data

```
ecom_mini <- sample_n(ecom, size = 10)
```

# head

```
head(ecom, 10)
```

```
## # A tibble: 10 x 4
##    referrer n_pages duration purchase
##    <fct>      <dbl>    <dbl> <lgl>
##  1 google         1      693 FALSE
##  2 yahoo          1      459 FALSE
##  3 direct         1      996 FALSE
##  4 bing          18      468 TRUE
##  5 yahoo          1      955 FALSE
##  6 yahoo          5      135 FALSE
##  7 yahoo          1       75 FALSE
##  8 direct         1      908 FALSE
##  9 bing          19      209 FALSE
## 10 google         1      208 FALSE
```

# Using pipe

```
ecom %>% head(10)
```

```
## # A tibble: 10 x 4
##    referrer n_pages duration purchase
##    <fct>      <dbl>    <dbl> <lgl>
##  1 google         1      693 FALSE
##  2 yahoo          1      459 FALSE
##  3 direct         1      996 FALSE
##  4 bing          18      468 TRUE
##  5 yahoo          1      955 FALSE
##  6 yahoo          5      135 FALSE
##  7 yahoo          1       75 FALSE
##  8 direct         1      908 FALSE
##  9 bing          19      209 FALSE
## 10 google         1      208 FALSE
```

# Square Root

```
y <- ecom_mini$n_pages
y <- sqrt(y)

# combine above steps
sqrt(ecom_mini$n_pages)
```

```
##  [1] 2.236068 4.123106 4.242641 2.236068 4.000000 2.449490 3.605551
##  [8] 3.162278 3.741657 1.000000
```

# Square Root - Using pipe

```
# select n_pages variable and assign it to y
ecom_mini %$%
  n_pages -> y

# compute square root of y and assign it to y
y %<>% sqrt()
```

# Square Root

| pages | duration |
|---|---|
| 10 | 436 |
| 8 | 381 |
| 12 | 512 |
| 9 | 472 |
| 10 | 635 |

Expose pages

`data %$% pages`

| pages |
|---|
| 10 |
| 8 |
| 12 |
| 9 |
| 10 |

Compute square root

`%>% sqrt()`

| sqrt(pages) |
|---|
| 3.16 |
| 2.82 |
| 3.46 |
| 3 |
| 3.16 |

# Square Root - Using pipe

```
ecom_mini %$%
  n_pages %>%
  sqrt() -> y

y
```

```
##  [1] 2.236068 4.123106 4.242641 2.236068 4.000000 2.449490 3.605551
##  [8] 3.162278 3.741657 1.000000
```

# Correlation

| pages | duration | purchase |
|---|---|---|
| 10 | 436 | TRUE |
| 2 | 48 | FALSE |
| 5 | 162 | FALSE |
| 8 | 381 | TRUE |
| 7 | 205 | FALSE |
| 12 | 512 | TRUE |
| 3 | 79 | FALSE |
| 6 | 169 | FALSE |
| 9 | 472 | TRUE |
| 4 | 125 | FALSE |
| 10 | 635 | TRUE |

Filter all purchasers

```
subset(data,
purchase == TRUE
```

| pages | duration | purchase |
|---|---|---|
| 10 | 436 | TRUE |
| 8 | 381 | TRUE |
| 12 | 512 | TRUE |
| 9 | 472 | TRUE |
| 10 | 635 | TRUE |

Expose pages & duration

%$%

| pages | duration |
|---|---|
| 10 | 436 |
| 8 | 381 |
| 12 | 512 |
| 9 | 472 |
| 10 | 635 |

Compute correlation

```
cor(pages, duration)
```

**0.42**

```
# without pipe
ecom1 <- subset(ecom, purchase)
cor(ecom1$n_pages, ecom1$duration)
```

```
## [1] 0.4290905
```

# Correlation - Using pipe

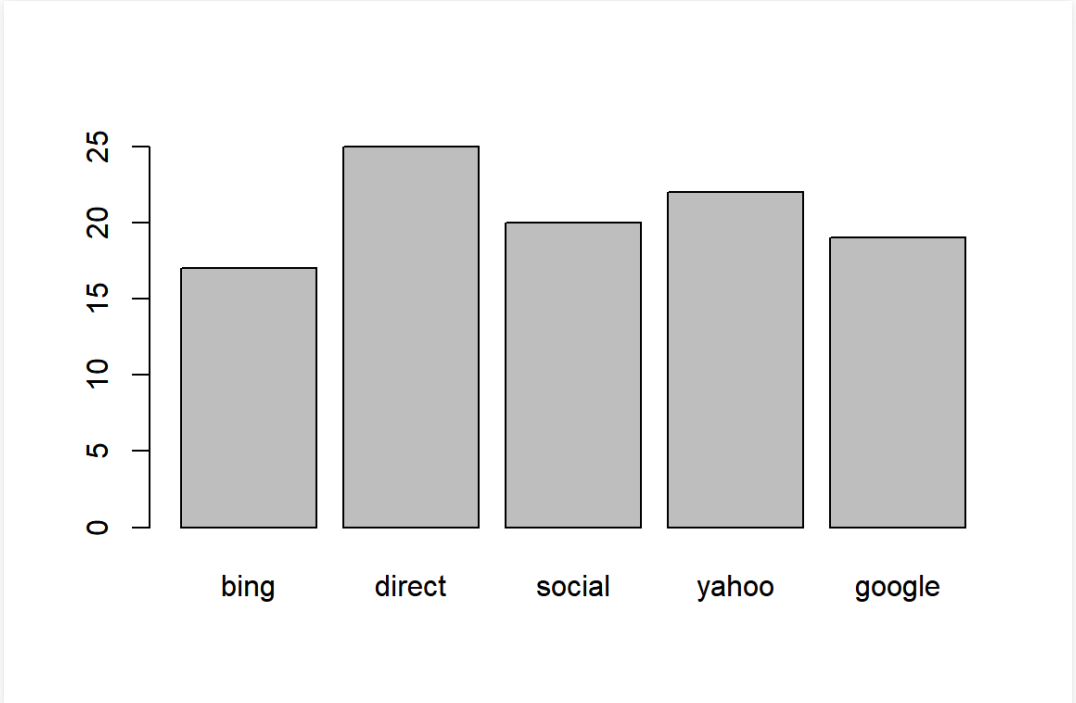
```
# with pipe
ecom %>%
  subset(purchase) %$%
  cor(n_pages, duration)
```

```
## [1] 0.4290905
```

```
# using filter from dplyr and pipe
ecom %>%
  filter(purchase) %$%
  cor(n_pages, duration)
```

```
## [1] 0.4290905
```

```
barplot(table(subset(ecom, purchase)$referrer))
```



# Data Visualization

| Referrer | Device | Purchase |
|---|---|---|
| google | mobile | true |
| yahoo | desktop | false |
| google | tablet | true |
| bing | mobile | false |

subset(purchase == 'true')

| Referrer | Device | Purchase |
|---|---|---|
| google | mobile | true |
| google | tablet | true |

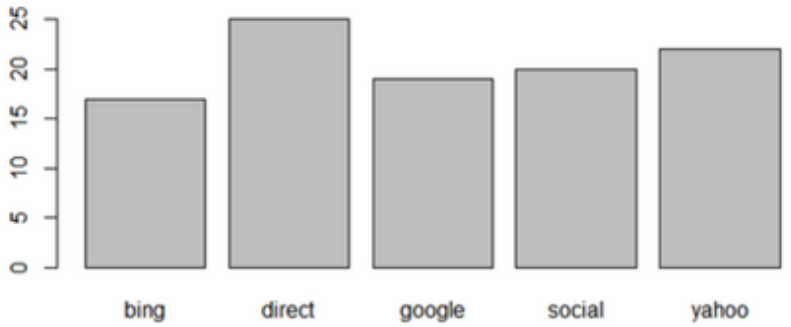
extract(referrer)

| Referrer |
|---|
| google |
| google |
| yahoo |
| bing |

table()

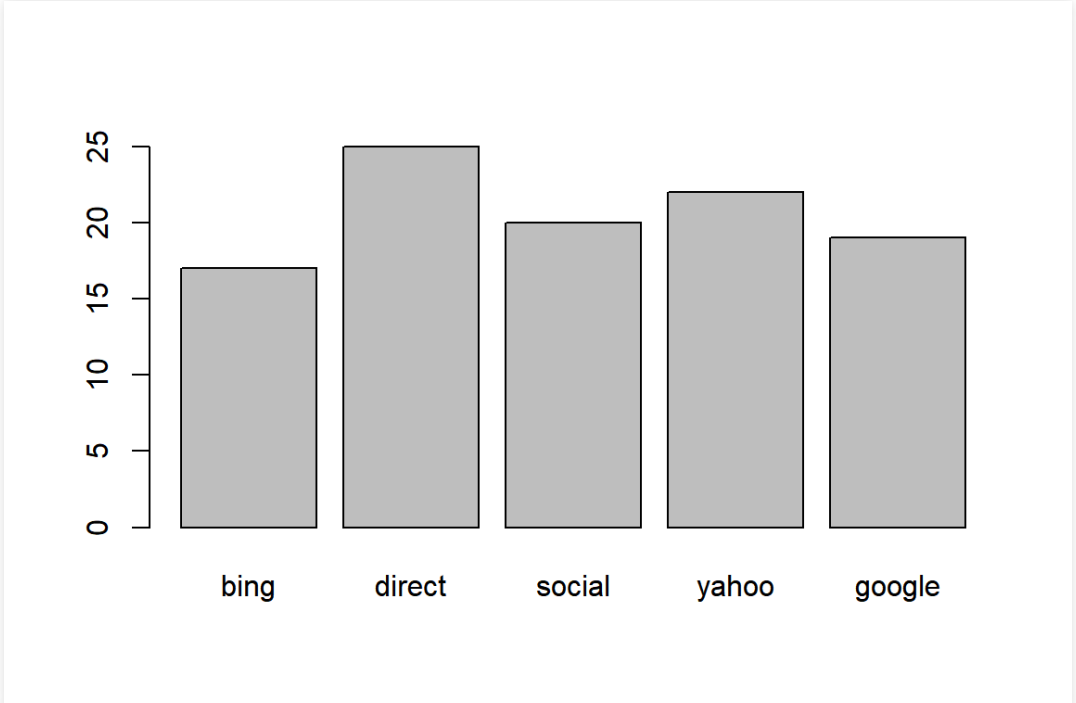
| Referrer | Count |
|---|---|
| google | 18 |
| direct | 25 |
| yahoo | 21 |
| social | 19 |
| bing | 16 |

barplot()



# Visualization - Using pipe

```
ecom %>%
  subset(purchase) %>%
  extract('referrer') %>%
  table() %>%
  barplot()
```



```
summary(lm(duration ~ n_pages, data = ecom))
```

```
##
## Call:
## lm(formula = duration ~ n_pages, data = ecom)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -386.45 -213.03  -38.93  179.31  602.55
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  404.803     11.323  35.750  < 2e-16 ***
## n_pages       -8.355      1.296  -6.449 1.76e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 263.3 on 998 degrees of freedom
## Multiple R-squared:   0.04,  Adjusted R-squared:  0.03904
## F-statistic: 41.58 on 1 and 998 DF,  p-value: 1.756e-10
```

```
ecom %$%
  lm(duration ~ n_pages) %>%
  summary()
```

```
##
## Call:
## lm(formula = duration ~ n_pages)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -386.45 -213.03  -38.93  179.31  602.55
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  404.803     11.323  35.750  < 2e-16 ***
## n_pages       -8.355      1.296  -6.449 1.76e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 263.3 on 998 degrees of freedom
## Multiple R-squared:   0.04,  Adjusted R-squared:  0.03904
```

```
email <- 'jovialcann@anymail.com'

# without pipe
str_to_upper(str_sub(str_split(email, '@')[[1]][1], start = 1, end = 6))
```

```
## [1] "JOVIAL"
```

# String Manipulation - Using Pipe

```
# with pipe
email %>%
  str_split(pattern = '@') %>%
  extract2(1) %>%
  extract(1) %>%
  str_sub(start = 1, end = 6) %>%
  str_to_upper()
```

```
## [1] "JOVIAL"
```

# Data Extraction

- `extract()`
- `extract2()`
- `use_series()`

# Extract Column By Name

```
ecom_mini['n_pages']
```

```
## # A tibble: 10 x 1
##    n_pages
##      <dbl>
##  1       5
##  2      17
##  3      18
##  4       5
##  5      16
##  6       6
##  7      13
##  8      10
##  9      14
## 10       1
```

```
extract(ecom_mini, 'n_pages')
```

```
## # A tibble: 10 x 1
##    n_pages
##      <dbl>
##  1       5
```

# Extract Column By Position

```
ecom_mini[2]
```

```
## # A tibble: 10 x 1
##    n_pages
##      <dbl>
##  1       5
##  2      17
##  3      18
##  4       5
##  5      16
##  6       6
##  7      13
##  8      10
##  9      14
## 10       1
```

# Extract Column By Position

```
extract(ecom_mini, 2)
```

```
## # A tibble: 10 x 1
##    n_pages
##      <dbl>
##  1       5
##  2      17
##  3      18
##  4       5
##  5      16
##  6       6
##  7      13
##  8      10
##  9      14
## 10       1
```

# Extract Column (as vector)

```
ecom_mini$n_pages
```

```
##  [1]  5 17 18  5 16  6 13 10 14  1
```

# Extract Column (as vector)

```
use_series(ecom_mini, 'n_pages')
```

```
##  [1]  5 17 18  5 16  6 13 10 14  1
```

# Sample List

```
ecom_list <- as.list(ecom_mini)
```

# Extract List Element By Name

```
# base
ecom_list[['n_pages']]
```

```
##  [1]  5 17 18  5 16  6 13 10 14  1
```

```
ecom_list$n_pages
```

```
##  [1]  5 17 18  5 16  6 13 10 14  1
```

# Extract List Element By Name

```
# magrittr
extract2(ecom_list, 'n_pages')
```

```
##  [1]  5 17 18  5 16  6 13 10 14  1
```

```
use_series(ecom_list, n_pages)
```

```
##  [1]  5 17 18  5 16  6 13 10 14  1
```

# Extract List Element By Position

```
# base
ecom_list[[1]]
```

```
##  [1] direct social yahoo  direct yahoo  bing   direct social direct g
## Levels: bing direct social yahoo google
```

```
# magrittr
extract2(ecom_list, 1)
```

```
##  [1] direct social yahoo  direct yahoo  bing   direct social direct g
## Levels: bing direct social yahoo google
```

# Extract List Element (as vector)

```
# base
ecom_list$n_pages
```

```
##  [1]  5 17 18  5 16  6 13 10 14  1
```

```
# magrittr
use_series(ecom_list, n_pages)
```

```
##  [1]  5 17 18  5 16  6 13 10 14  1
```

# Arithmetic Operations

- `add()`
- `subtract()`
- `multiply_by()`
- `multiply_by_matrix()`
- `divide_by()`
- `divide_by_int()`
- `mod()`
- `raise_to_power()`

# Addition

```
1:10 + 1
```

```
##  [1]  2  3  4  5  6  7  8  9 10 11
```

```
add(1:10, 1)
```

```
##  [1]  2  3  4  5  6  7  8  9 10 11
```

```
`+`(1:10, 1)
```

```
##  [1]  2  3  4  5  6  7  8  9 10 11
```

# Multiplication

```
1:10 * 3
```

```
##  [1]  3  6  9 12 15 18 21 24 27 30
```

```
multiply_by(1:10, 3)
```

```
##  [1]  3  6  9 12 15 18 21 24 27 30
```

```
`*`(1:10, 3)
```

```
##  [1]  3  6  9 12 15 18 21 24 27 30
```

# Division

```
1:10 / 2
```

```
##  [1] 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
```

```
divide_by(1:10, 2)
```

```
##  [1] 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
```

```
`/`(1:10, 2)
```

```
##  [1] 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
```

# Power

```
1:10 ^ 2
```

```
##   [1]   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
##  [18]  18  19  20  21  22  23  24  25  26  27  28  29  30  31  32  33
##  [35]  35  36  37  38  39  40  41  42  43  44  45  46  47  48  49  50
##  [52]  52  53  54  55  56  57  58  59  60  61  62  63  64  65  66  67
##  [69]  69  70  71  72  73  74  75  76  77  78  79  80  81  82  83  84
##  [86]  86  87  88  89  90  91  92  93  94  95  96  97  98  99 100
```

```
raise_to_power(1:10, 2)
```

```
##  [1]   1   4   9  16  25  36  49  64  81 100
```

```
`^`(1:10, 2)
```

```
##  [1]   1   4   9  16  25  36  49  64  81 100
```

# Logical Operators

- `and()`
- `or()`
- `equals()`
- `not()`
- `is_greater_than()`
- `is_weakly_greater_than()`
- `is_less_than()`
- `is_weakly_less_than()`

# Greater Than

```
1:10 > 5
```

```
##  [1] FALSE FALSE FALSE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE
```

```
is_greater_than(1:10, 5)
```

```
##  [1] FALSE FALSE FALSE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE
```

```
`>`(1:10, 5)
```

```
##  [1] FALSE FALSE FALSE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE
```

# Weakly Greater Than

```
1:10 >= 5
```

```
##  [1] FALSE FALSE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
```

```
is_weakly_greater_than(1:10, 5)
```

```
##  [1] FALSE FALSE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
```

```
`>=`(1:10, 5)
```

```
##  [1] FALSE FALSE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
```

# Thank You

For more information please visit our website
www.rsquaredacademy.com