

Welcome!

Welcome to *week 13*!

Record the meeting

Breakout rooms!

Starting with whomever has the most pets:

- What is something about R you've learned working on your final project that goes beyond what we've covered in class?

Prepare one–three responses to each of the above questions to share with the whole class!

A recap of last week (on functional programming)

- R has built in functions from packages, but you can write your own too!
- The purrr package offers tools to do multiple iterations of operations

Checking-in on final projects

Responses to feedback – we will be checking tomorrow!

Reminder – final project and recording due by May 5

Homework highlights

Model 2: Adds intrinsic goal orientation and problem solving pre-course as predictors.

Term	Est	Std Error	Stat	P Value
(Intercept)	306.243	22.523	13.597	0.000
conscient.	1.019	0.412	2.476	0.014
IntGoalOrient	0.167	0.745	0.224	0.823
Prob_solve_pre	3.243	0.665	4.881	0.000

r^2	Adj r^2	Sigma	Stat	P Value	Deg of Freedom	Log-Likelihood	AIC	BIC	Deviance of Model	DF Residual	# Obs
0.068	0.062	72.449	11.341	0	3	-2672.149	5354.298	5375.051	2440752	465	469

The additional variables now account for 6.2% of the variance in the model.

Homework highlights

```
## Model 2: Adds intrinsic goal orientation and problem solving pre-course as predictors.

```{r}
model2 <- lm(PROJ_TOTAL ~conscient. + IntGoalOrient + Prob_solve_pre,data=data1)
m2 <- tidy(model2)
kable(tidy(model2),
 col.names = c("Term","Est","Std Error","Stat","P Value"),
 align = "c",
 digits=3)
kable(glance(model2),
 col.names = c("r^2","Adj r^2","Sigma","Stat","P Value", "Deg of Freedom", "Log-Likelihood",
 "AIC", "BIC", "Deviance of Model", "DF Residual", "# Obs"),
 align = "c",
 digits=3)
```
```

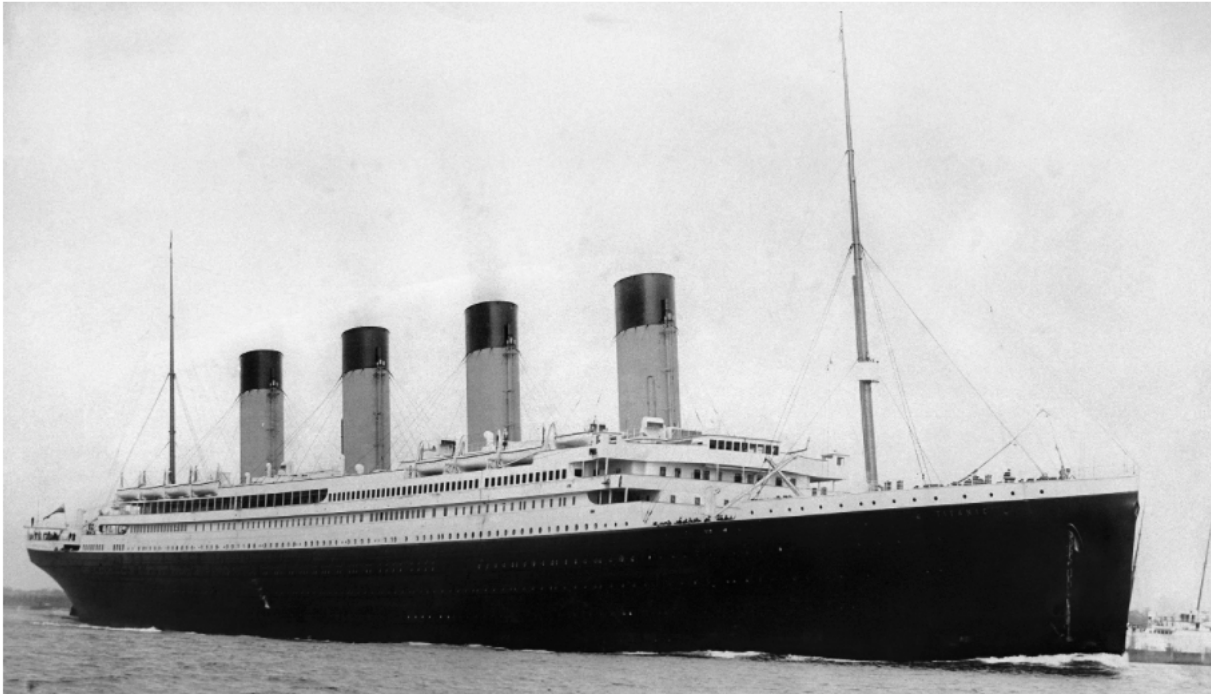
Homework highlights

Discussion

These findings are consistent with what we know about the sinking of Titanic. While I thought Embarkation may have had more effect, it did not. This is likely because at each embarkation point, passengers from all three classes boarded. Passengers also disembarked at each point. This data set is incomplete, which limits the ability to extract information about the full population of Titanic passengers. Titanic has approximately 1300 passengers on her maiden voyage, along with 885 crew. Additionally, some ticket-holders did not board the ship, and not every ticket-holder was on board for the crossing. Finally, we know one crew member sneaked off at Queenstown by hiding under the mailbags being moved ashore.

Titanic is a unique historical case that would not be repeated today. Because of Titanic's sinking, the International Convention for the Safety of Life at Sea (SOLAS) was implemented as maritime treaty. SOLAS required ships to have sufficient lifeboats for all passengers and required continuous radio watches. SOLAS has been periodically updated and is still in effect today.

Given the limited data set we have here, the best use of this data is to explore statistics and programming rather than to learn about individual's chances of survival in a shipwreck.



Chunk options

For a single chunk:

- `eval = FALSE`
- `echo = FALSE`
- `warning = FALSE`
- `message = FALSE`

For the entire document:

- `knitr::opts_chunk$set(echo = FALSE, echo = FALSE, warning = FALSE, message = FALSE)`

Topics for today

Record the meeting

- A. Continued discussion on purrr – Iteration (or, *applying* functions)
- B. Introduction to missing data procedures with MICE
- (C. On creating maps using ggplot2)

A. Iteration

Iteration is another name for your computer carrying out some step(s) multiple times.

Iteration is helpful when, even after writing a function, you find yourself copying and pasting the same code (with modifications)

A. Iteration

Iteration can be helpful when you want to apply a function multiple times.

The map functions can help with this. There are different ones based on the type of object returned.

The key to understanding (and writing) functions is understanding what kind of input they take and what kind of output they return.

`map()` – Applies function to every element of a list and return a list `map2()` – Applies function to every element from 2 lists and return a list

Lists are ordered collections of any other type of object. You can have a list of vectors, a list of data frames, and a list of different types of objects.

`map_chr()` – returns a char vector of objects created `map_dbl()` – returns a numeric vector of objects created `map_dfc()` – objects created become columns of data frame `map_dfr()` – objects created become rows of a data frame

A. Iteration

Example: COVID vaccine data



NFL Memes
@NFL_Memes



Pfizer, Johnson & Johnson, Moderna



2:44 PM · Apr 11, 2021



♡ 10.5K



See the latest COVID-19 information on Twitter

A. Iteration

Example: COVID vaccine data – Read in the data

One way to load data:

```
pfi <- read_csv(here("data", "COVID", "COVID-19_Vaccine_Distribution_Allocations_by_Jurisdiction_-_Pfizer"))
mod <- read_csv(here("data", "COVID", "COVID-19_Vaccine_Distribution_Allocations_by_Jurisdiction_-_Moderna"))
jan <- read_csv(here("data", "COVID", "COVID-19_Vaccine_Distribution_Allocations_by_Jurisdiction_-_Janet"))
```

```
## # A tibble: 378 x 3
##   Jurisdiction `Week of Allocations` `1st Dose Allocations`
##   <chr>        <chr>                                <dbl>
## 1 Connecticut  04/12/2021                                6400
## 2 Maine        04/12/2021                                2500
## 3 Massachusetts 04/12/2021                               12300
## 4 New Hampshire 04/12/2021                                2500
## 5 Rhode Island  04/12/2021                                2000
## 6 Vermont       04/12/2021                                1200
## 7 New Jersey    04/12/2021                               15600
## 8 New York      04/12/2021                               19800
## 9 New York City 04/12/2021                               15100
## 10 Puerto Rico  04/12/2021                                6100
## # ... with 368 more rows
```

A. Iteration

Example: COVID vaccine data – Read in the data

```
vaccines <- c("Pfizer", "Moderna", "Janssen")
file_base <- "/COVID-19_Vaccine_Distribution_Allocations_by_Jurisdiction_-_"
file_ext <- ".csv"

file_names <- str_c(here("data", "COVID"), file_base, vaccines, file_ext)

vax_files <- file_names %>% map(read_csv)
names(vax_files) <- vaccines
vax_files
```

```
## $Pfizer
## # A tibble: 1,134 x 4
##   Jurisdiction `Week of Allocations` `1st Dose Allocations` `2nd Dose Allocations`
##   <chr>        <chr>                <dbl>                <dbl>
## 1 Connecticut  04/12/2021                51480                51480
## 2 Maine        04/12/2021                19890                19890
## 3 Massachusetts 04/12/2021                97110                97110
## 4 New Hampshire 04/12/2021                19890                19890
## 5 Rhode Island  04/12/2021                15210                15210
## 6 Vermont       04/12/2021                 9360                 9360
## 7 New Jersey    04/12/2021               124020               124020
## 8 New York      04/12/2021               156780               156780
## 9 New York City 04/12/2021               119340               119340
## 10 Puerto Rico  04/12/2021                49140                49140
## # ... with 1,124 more rows
##
## $Moderna
## # A tibble: 1,071 x 4
##   Jurisdiction `Week of Allocations` `1st Dose Allocations` `2nd Dose Allocations`
##   <chr>        <chr>                <dbl>                <dbl>
## 1 Connecticut  04/12/2021                37400                37400
## 2 Maine        04/12/2021                14300                14300
## 3 Massachusetts 04/12/2021                72100                72100
## 4 New Hampshire 04/12/2021                14300                14300
## 5 Rhode Island  04/12/2021                11300                11300
## 6 Vermont       04/12/2021                 6700                 6700
```

A. Iteration

Example: COVID vaccine data – Rename the data

```
# write my rename function
rename_vaccine_data <- function(dat){
  dat <- dat %>% rename("State" = "Jurisdiction",
                        "Week" = "Week of Allocations",
                        "First Dose" = "1st Dose Allocations",
                        "Second Dose" = "2nd Dose Allocations")
  dat
}

# map it to every data set in the list
vax_files %>% map(rename_vaccine_data)
```

Error: Can't rename columns that don't exist. x Column **2nd Dose Allocations** doesn't exist.

A. Iteration

Example: COVID vaccine data – Rename the data

```
rename_vaccine_data <- function(dat) {  
  if(ncol(dat) == 4) {  
    dat <- dat %>% rename("State" = "Jurisdiction",  
                          "Week" = "Week of Allocations",  
                          "First Dose" = "1st Dose Allocations",  
                          "Second Dose" = "2nd Dose Allocations")  
  
    dat  
  } else {  
    dat <- dat %>% rename("State" = "Jurisdiction",  
                          "Week" = "Week of Allocations",  
                          "First Dose" = "1st Dose Allocations")  
  
    dat  
  }  
}  
  
vax_files <- vax_files %>% map(rename_vaccine_data)  
vax_files$Pfizer
```

```
## # A tibble: 1,134 x 4  
##   State      Week      `First Dose` `Second Dose`  
##   <chr>      <chr>      <dbl>        <dbl>  
## 1 Connecticut 04/12/2021    51480        51480  
## 2 Maine       04/12/2021    19890        19890  
## 3 Massachusetts 04/12/2021    97110        97110  
## 4 New Hampshire 04/12/2021    19890        19890  
## 5 Rhode Island 04/12/2021    15210        15210  
## 6 Vermont     04/12/2021     9360         9360  
## 7 New Jersey   04/12/2021   124020       124020  
## 8 New York     04/12/2021   156780       156780  
## 9 New York City 04/12/2021   119340       119340  
## 10 Puerto Rico 04/12/2021    49140        49140  
## # ... with 1,124 more rows
```

B. Multiple Imputation of missing data with MICE

`lm()` default way of dealing with missing data: listwise deletion

Better way to deal with missing data: imputation

Basic idea:

If data missing, you can fill in values that let you estimate your model on whole data

Good: Mean imputation

Better: Model based imputation

Best: Multiple imputation

B. Multiple Imputation of missing data with MICE

The MICE package: Multiple Imputation using Chained Equations

Dealing with missing data is a big idea, and the nuances can be tricky

Our goal is to show you that you need not be intimidated by approaching this task in R

If you are doing inferential models in your analyses, MI is a tool that should be in your toolkit

B. Multiple Imputation of missing data with MICE

Example: Regression model

```
ug_data <- read_csv(here("data", "undergrad_data.csv"))  
vis_dat(ug_data)
```

B. Multiple Imputation of missing data with MICE

Example: Regression model

```
fit <- lm(PROJ_TOTAL ~ Prob_solve_pre + extraversion + agreeableness + conscient. + stability + openness,
          data = ug_data)
```

B. Multiple Imputation of missing data with MICE

Example: Regression model

```
summary(fit)

##
## Call:
## lm(formula = PROJ_TOTAL ~ Prob_solve_pre + extraversion + agreeableness +
##      conscient. + stability + openness + Metacog. + SelfEfficacy +
##      IntGoalOrient + ExtGoalOrient, data = ug_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -334.72  -16.93   23.01   44.39   97.40
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    307.7820    35.8305   8.590 < 2e-16 ***
## Prob_solve_pre     3.3656     0.7639   4.406 1.34e-05 ***
## extraversion    -0.2442     0.3854  -0.634  0.527
## agreeableness   -0.1068     0.4867  -0.219  0.826
## conscient.       0.9207     0.4823   1.909  0.057 .
## stability        0.2047     0.3803   0.538  0.591
## openness         0.3604     0.5615   0.642  0.521
## Metacog.        -0.1107     0.5011  -0.221  0.825
## SelfEfficacy    -0.2373     0.5916  -0.401  0.689
## IntGoalOrient     0.1982     1.0673   0.186  0.853
## ExtGoalOrient     0.1893     0.8883   0.213  0.831
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 73.46 on 416 degrees of freedom
## (187 observations deleted due to missingness)
## Multiple R-squared:  0.07321,    Adjusted R-squared:  0.05093
## F-statistic: 3.286 on 10 and 416 DF,  p-value: 0.0004114
```

B. Multiple Imputation of missing data with MICE

The MICE package: viewing missing data pattern

```
library(mice)  
md.pattern(ug_data)
```

B. Multiple Imputation of missing data with MICE

The MICE package: Generating imputed data sets with `mice()`

```
ug_data_imp <- mice(ug_data, m = 5)

##
## iter imp variable
## 1 1 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 1 2 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 1 3 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 1 4 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 1 5 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 2 1 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 2 2 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 2 3 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 2 4 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 2 5 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 3 1 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 3 2 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 3 3 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 3 4 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 3 5 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 4 1 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 4 2 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 4 3 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 4 4 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 4 5 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 5 1 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 5 2 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 5 3 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 5 4 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met
## 5 5 Prob_solve_pre Prob_solve_post extraversion agreeableness conscient. stability openness Met

## Warning: Number of logged events: 276
```


B. Multiple Imputation of missing data with MICE

The MICE package: Examining missing data

```
ug_data_imp$imp$SelfEfficacy
```

```
##      1  2  3  4  5
## 3    45 52 45 28 49
## 18   38  8 21 40 32
## 35   49 50 56 43 56
## 42   38 40 39 56 32
## 90   47 39 49 55 34
## 94   31 38 42 36 39
## 100  33 34 47 46 47
## 111  50 23 53 40 52
## 124  32 51 39 56 28
## 134  46 47 41 44 33
## 137  42 32 49 35 50
## 148  32 49 35 42 42
## 166  39 42 29 37 25
## 171  46 48 47 31 32
## 176  56 29 34 56 47
## 190  42 51 21 20 45
## 193  42 50 40 32 37
## 208  39 42 48 35 28
## 225  39 41 37 47 33
## 226  41 34 34 40 45
## 236  25 46 43 44 56
## 237  45 34 41 48 50
## 238  42 41 37 38 48
## 242  32 30 55 39 43
## 246  29 32 48 22 46
## 250  48 39 55 45 54
## 257  49 41 53 31 56
## 259  34 42 32 34 25
## 260  28 38 41 48 36
## 267  36 51 48 56 53
## 283  24 44 41 46 39
## 287  34 52 45 42 49
## 299  41 46 56 52 45
```

B. Multiple Imputation of missing data with MICE

The MICE package: Extracting data sets with `complete()`

```
comp_data <- complete(ug_data_imp, 2)
comp_data
```

| ## | X1 | Stud_ID | PROJ_TOTAL | Proj01 | Proj02 | Proj03 | Proj04 | Proj05 | Proj06 | Proj07 | Proj08 | Proj09 | Proj10 | Proj11 | Tot |
|-------|----|-----------|------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|-----|
| ## 1 | 1 | e75ab8254 | 347 | 14 | 19 | 13 | 25 | 27 | 35 | 40 | 47 | 44 | 35 | 48 | |
| ## 2 | 2 | 07ee7a263 | 427 | 14 | 20 | 20 | 38 | 45 | 42 | 41 | 50 | 52 | 53 | 52 | |
| ## 3 | 3 | 9c02eb000 | 393 | 14 | 18 | 16 | 37 | 42 | 44 | 45 | 41 | 50 | 37 | 49 | |
| ## 4 | 4 | 52fb2d1ca | 397 | 14 | 18 | 19 | 0 | 43 | 43 | 50 | 50 | 52 | 53 | 55 | |
| ## 5 | 5 | a4d76f570 | 316 | 14 | 20 | 12 | 36 | 8 | 34 | 0 | 41 | 52 | 49 | 50 | |
| ## 6 | 6 | 94ea75daa | 435 | 14 | 20 | 19 | 36 | 45 | 45 | 50 | 50 | 55 | 46 | 55 | |
| ## 7 | 7 | 5e9c38d44 | 375 | 13 | 20 | 20 | 36 | 43 | 38 | 46 | 40 | 50 | 22 | 47 | |
| ## 8 | 8 | e5a5608e8 | 398 | 14 | 17 | 19 | 39 | 45 | 41 | 49 | 20 | 55 | 47 | 52 | |
| ## 9 | 9 | f2abdba22 | 350 | 14 | 18 | 18 | 37 | 44 | 0 | 45 | 43 | 51 | 40 | 40 | |
| ## 10 | 10 | 21d036526 | 354 | 13 | 18 | 17 | 32 | 40 | 33 | 16 | 39 | 52 | 40 | 54 | |
| ## 11 | 11 | 3fc8237b5 | 295 | 13 | 20 | 20 | 34 | 43 | 41 | 50 | 19 | 55 | 0 | 0 | |
| ## 12 | 12 | 72ccca5a0 | 440 | 14 | 20 | 20 | 40 | 45 | 45 | 50 | 48 | 55 | 48 | 55 | |
| ## 13 | 13 | ca5073861 | 52 | 14 | 12 | 0 | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| ## 14 | 14 | 7e2674224 | 441 | 14 | 20 | 20 | 38 | 44 | 45 | 50 | 48 | 55 | 53 | 54 | |
| ## 15 | 15 | bc0032340 | 385 | 14 | 20 | 10 | 27 | 38 | 34 | 50 | 42 | 51 | 45 | 54 | |
| ## 16 | 16 | 56bb07c2e | 370 | 10 | 18 | 18 | 37 | 29 | 43 | 40 | 34 | 49 | 40 | 52 | |
| ## 17 | 17 | 74afe8807 | 332 | 14 | 18 | 18 | 35 | 43 | 0 | 43 | 39 | 35 | 47 | 40 | |
| ## 18 | 18 | 70653b198 | 279 | 14 | 20 | 18 | 32 | 43 | 0 | 0 | 43 | 51 | 42 | 16 | |
| ## 19 | 19 | c19bd5d09 | 406 | 14 | 20 | 16 | 37 | 41 | 45 | 50 | 38 | 47 | 45 | 53 | |
| ## 20 | 20 | 758e0f2e4 | 340 | 15 | 20 | 20 | 40 | 32 | 43 | 44 | 21 | 50 | 0 | 55 | |
| ## 21 | 21 | 2e3be0621 | 372 | 14 | 13 | 15 | 28 | 44 | 43 | 50 | 0 | 55 | 55 | 55 | |
| ## 22 | 22 | f7fc7c540 | 410 | 15 | 20 | 20 | 39 | 44 | 45 | 50 | 45 | 27 | 50 | 55 | |
| ## 23 | 23 | 8a78da3d7 | 448 | 15 | 20 | 20 | 40 | 45 | 45 | 50 | 50 | 53 | 55 | 55 | |
| ## 24 | 24 | d032ddcba | 408 | 15 | 20 | 10 | 25 | 45 | 45 | 50 | 49 | 48 | 48 | 53 | |
| ## 25 | 25 | f5fbfaa43 | 437 | 15 | 20 | 20 | 40 | 45 | 40 | 48 | 46 | 53 | 55 | 55 | |
| ## 26 | 26 | 897c10248 | 348 | 15 | 18 | 14 | 0 | 37 | 42 | 44 | 44 | 55 | 28 | 51 | |
| ## 27 | 27 | 006a7e31c | 119 | 15 | 19 | 10 | 40 | 4 | 31 | 0 | 0 | 0 | 0 | 0 | |
| ## 28 | 28 | d7ebdcc64 | 299 | 13 | 20 | 20 | 40 | 39 | 45 | 14 | 4 | 34 | 30 | 40 | |
| ## 29 | 29 | 2f9655115 | 392 | 13 | 20 | 17 | 33 | 39 | 45 | 49 | 45 | 52 | 34 | 45 | |
| ## 30 | 30 | 1158a4bb2 | 446 | 15 | 20 | 20 | 38 | 43 | 45 | 50 | 50 | 55 | 55 | 55 | |
| ## 31 | 31 | da8783e45 | 438 | 15 | 20 | 9 | 40 | 45 | 45 | 50 | 50 | 55 | 54 | 55 | |
| ## 32 | 32 | 34d07adfb | 172 | 0 | 12 | 14 | 28 | 42 | 25 | 0 | 22 | 0 | 5 | 26 / 244 | |

B. Multiple Imputation of missing data with MICE

The MICE package: fitting models with `with()`

```
fit_imp <- with(data = ug_data_imp, exp = lm( PROJ_TOTAL ~ Prob_solve_pre + extraversion + agreeablen
fit_imp
```

```
## call :
## with.mids(data = ug_data_imp, expr = lm(PROJ_TOTAL ~ Prob_solve_pre +
##     extraversion + agreeableness + conscient. + stability + openness +
##     Metacog. + SelfEfficacy + IntGoalOrient + ExtGoalOrient))
##
## call1 :
## mice(data = ug_data, m = 5)
##
## nmis :
##           X1           Stud_ID      PROJ_TOTAL      Proj01      Proj02
##           0           0           0           0           0
##           Proj06      Proj07      Proj08      Proj09      Proj10
##           0           0           0           0           0
##           Exam2      Exam3  Prob_solve_pre  Prob_solve_post  extraversion
##           0           0           43           63           74
##           openness      Metacog.      SelfEfficacy      IntGoalOrient      ExtGoalOrient
##           85           67           67           67           67
##
## analyses :
## [[1]]
##
## Call:
## lm(formula = PROJ_TOTAL ~ Prob_solve_pre + extraversion + agreeableness +
##     conscient. + stability + openness + Metacog. + SelfEfficacy +
##     IntGoalOrient + ExtGoalOrient)
##
## Coefficients:
## (Intercept)  Prob_solve_pre  extraversion  agreeableness  conscient.
## 265.0499      4.2987      -0.5032      0.9338      1.8218
## SelfEfficacy  IntGoalOrient  ExtGoalOrient
## 2.1564      -0.5502      -0.9591
##
##
```

B. Multiple Imputation of missing data with MICE

The MICE package: pooling output with `pool()`

```
summary(pool(fit_imp))
```

| ## | term | estimate | std.error | statistic | df | p.value |
|-------|----------------|-------------|------------|------------|-----------|--------------|
| ## 1 | (Intercept) | 271.5011154 | 40.4152064 | 6.7177961 | 344.97500 | 7.628786e-11 |
| ## 2 | Prob_solve_pre | 3.9000045 | 0.8897957 | 4.3830339 | 139.48549 | 2.286385e-05 |
| ## 3 | extraversion | -0.3155109 | 0.4803986 | -0.6567689 | 61.72007 | 5.137710e-01 |
| ## 4 | agreeableness | 0.2144628 | 0.7299623 | 0.2937999 | 15.23696 | 7.728750e-01 |
| ## 5 | conscient. | 1.5682241 | 0.5802449 | 2.7026936 | 72.90016 | 8.551675e-03 |
| ## 6 | stability | -0.2868440 | 0.5418402 | -0.5293885 | 22.49430 | 6.017220e-01 |
| ## 7 | openness | -0.1683978 | 0.8777501 | -0.1918517 | 13.46462 | 8.507215e-01 |
| ## 8 | Metacog. | -1.2448930 | 0.6581634 | -1.8914648 | 24.99763 | 7.020398e-02 |
| ## 9 | SelfEfficacy | 2.0062024 | 0.7086756 | 2.8309177 | 42.41115 | 7.067348e-03 |
| ## 10 | IntGoalOrient | -0.3345007 | 1.2582796 | -0.2658397 | 72.97797 | 7.911123e-01 |
| ## 11 | ExtGoalOrient | -0.3349265 | 1.2381577 | -0.2705039 | 24.38956 | 7.890486e-01 |

```
broom::tidy(fit)
```

```
## # A tibble: 11 x 5
```

| ## | term | estimate | std.error | statistic | p.value |
|-------|----------------|----------|-----------|-----------|----------|
| ## | <chr> | <dbl> | <dbl> | <dbl> | <dbl> |
| ## 1 | (Intercept) | 308. | 35.8 | 8.59 | 1.77e-16 |
| ## 2 | Prob_solve_pre | 3.37 | 0.764 | 4.41 | 1.34e- 5 |
| ## 3 | extraversion | -0.244 | 0.385 | -0.634 | 5.27e- 1 |
| ## 4 | agreeableness | -0.107 | 0.487 | -0.219 | 8.26e- 1 |
| ## 5 | conscient. | 0.921 | 0.482 | 1.91 | 5.70e- 2 |
| ## 6 | stability | 0.205 | 0.380 | 0.538 | 5.91e- 1 |
| ## 7 | openness | 0.360 | 0.562 | 0.642 | 5.21e- 1 |
| ## 8 | Metacog. | -0.111 | 0.501 | -0.221 | 8.25e- 1 |
| ## 9 | SelfEfficacy | -0.237 | 0.592 | -0.401 | 6.89e- 1 |
| ## 10 | IntGoalOrient | 0.198 | 1.07 | 0.186 | 8.53e- 1 |
| ## 11 | ExtGoalOrient | 0.189 | 0.888 | 0.213 | 8.31e- 1 |

C. Mapping with ggplot2

A brief introduction for those interested, focused on the sf R package:

<https://joshuamrosenberg.com/post/2020/06/08/basic-sf-functionality-for-analyzing-and-plotting-geospatial-data/>

Data Science Certificate

https://docs.google.com/document/d/1shNL9fY-vhBKK-zJw_V_iVhAKDtZ1Wgen4maJFnsWQ4/edit

Curating a data science resource

<https://making-data-science-count.github.io/s21-intro-to-data-sci-methods-in-ed/assignment-curating-a-data-science-resource.html>

Logistics

This week

- Homework 13: Available tomorrow by noon; **Due by Thursday, 4/22**
- Readings: <https://r4ds.had.co.nz/iteration.html#the-map-functions>
<https://www.statisticssolutions.com/multiple-imputation-for-missing-data/>

Schedule

- The product for your final project and a recording that will serve as your presentation of it are both due by the end of the day on May 5
- *There is no portfolio!*
- Exam 3 is available now, due before class on April 22
- The revised data ethics statement is due April 29
- The curating a resource assignment is due by the same date/time as the final project – May 5

Wrapping up

In your base group's Slack channel:

- What is one thing you learned today?
- What is something you want to learn more about?
- Share your feelings in GIF form!