

Programming Homework 4

Trever Yoder

Task 1: Conceptual Questions

Load Packages and Create a List of Questions

```
library(tidyverse)
```

Warning: package 'ggplot2' was built under R version 4.4.2

Warning: package 'lubridate' was built under R version 4.4.3

```
-- Attaching core tidyverse packages ----- tidyverse 2.0.0 --
v dplyr      1.1.4      v readr      2.1.5
v forcats    1.0.0      v stringr    1.5.1
v ggplot2    3.5.1      v tibble     3.2.1
v lubridate  1.9.4      v tidyr      1.3.1
v purrr      1.0.2
```

```
-- Conflicts ----- tidyverse_conflicts() --
```

```
x dplyr::filter() masks stats::filter()
```

```
x dplyr::lag()     masks stats::lag()
```

```
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become
```

```
library(httr)
library(jsonlite)
```

Attaching package: 'jsonlite'

The following object is masked from 'package:purrr':

flatten

```
#Create a list with the requested questions
my_list1 <- list("1. What is the purpose of the lapply() function?
                  What is the equivalent purrr function?",
"2. Suppose we have a list called my_list.
Each element of the list is a numeric data frame (all columns
are numeric). We want use lapply() to run the code
cor(numeric_matrix, method = kendall)
on each element of the list. Write code to do this below!
(I'm really trying to ask you how you specify
method = kendall when calling lapply())",
"3. What are two advantages of using purrr functions
instead of the BaseR apply family?",
"4. What is a side-effect function?",
"5. Why can you name a variable sd in a function and
not cause any issues with the sd function?")

#print the questions/list
my_list1
```

```
[[1]]
[1] "1. What is the purpose of the lapply() function? \n
                                What is the equivalent purrr function?"

[[2]]
[1] "2. Suppose we have a list called my_list.\nEach element of the list is a numeric data frame (all columns are numeric). We want use lapply() to run the code cor(numeric_matrix, method = kendall) on each element of the list. Write code to do this below! (I'm really trying to ask you how you specify method = kendall when calling lapply())"

[[3]]
[1] "3. What are two advantages of using purrr functions\ninstead of the BaseR apply family?"

[[4]]
[1] "4. What is a side-effect function?"

[[5]]
[1] "5. Why can you name a variable sd in a function and \nnot cause any issues with the sd function?"
```

Question 1

`lapply()` is used to apply functions across many rows/columns and the “l” ensures R always outputs a list.

Question 2

```
#create data frames
df1 <- data.frame(a = c(1:3), b = c(4:6))
df2 <- data.frame(x = c(7:9), y = c(10:12), z = c(13:15))

#create list
my_list <- list(df1, df2)

#write/show lapply function
lapply(my_list, cor, method = "kendall")
```

```
[[1]]
  a b
a 1 1
b 1 1

[[2]]
  x y z
x 1 1 1
y 1 1 1
z 1 1 1
```

Question 3

Two advantages of using **purrr** functions instead of **BaseR** apply family are: 1. Greater consistency between functions. For example, you can predict the output type exclusively from the function name, which isn't always true for **BaseR** apply functions. 2. **Purrr** also has some functions to fill in some gaps such as `imap()` where you can map simultaneously over **x** and its indices.

Question 4

A side-effect function does something beyond its function return value. For example, write files to a disk. If we want the side effect of `hist` (which is the visual part) we can use the `walk()` function to only print the histogram.

Question 5

We can name a variable `sd` in a function and not cause any issues with the `sd` function because functions have their own temporary environment. So, once the function executes, all variables within that function are “gone” or in other words, not saved to the main environment.

Task 2: Writing R Functions

Question 1

Here I will create a function that calculates RMSE. There is an ellipses in the function to allow for additional arguments.

```
getRMSE <- function(response, predicted, ...){  
  add <- list(...)  
  remove <- isTRUE(add$na.rm)  
  if (remove) {  
    dropmissing <- !is.na(response) & !is.na(predicted)  
    response <- response[dropmissing]  
    predicted <- predicted[dropmissing]  
  }  
  sqrt(mean((response-predicted)^2))  
}
```

Question 2

Let's run some code to create some response values and predictions.

```
set.seed(10)  
n <- 100  
x <- runif(n)  
resp <- 3 + 10*x + rnorm(n)  
pred <- predict(lm(resp ~ x), data.frame(x))  
  
#now let's test our RMSE function using this data!  
getRMSE(resp, pred)
```

```
[1] 0.9581677
```

```
#Add 2 missing vlaues to resp
resp[c(1,5)] <- NA_real_

#Test with and without specifying what R should do with the missing values
getRMSE(resp, pred)
```

```
[1] NA
```

```
getRMSE(resp, pred, na.rm = TRUE)
```

```
[1] 0.9646971
```

Question 3

Let's create a similar function, except it calculates the MAE instead of the RMSE.

```
getMAE <- function(response, predicted, ...){
  add <- list(...)
  remove <- isTRUE(add$na.rm)
  if (remove) {
    dropmissing <- !is.na(response) & !is.na(predicted)
    response <- response[dropmissing]
    predicted <- predicted[dropmissing]
  }
  mean(abs(response-predicted))
}
```

Question 4

Now let's create some data and test our MAE function using the data.

```
set.seed(10)
n <- 100
x <- runif(n)
resp <- 3 + 10*x + rnorm(n)
pred <- predict(lm(resp ~ x), data.frame(x))

#Let's test our MAE function
getMAE(resp, pred)
```

```
[1] 0.8155776
```

```
#Add 2 missing vlaues to resp
resp[c(1,5)] <- NA_real_

#Test with and without specifying what R should do with the missing values
getMAE(resp, pred)
```

```
[1] NA
```

```
getMAE(resp, pred, na.rm = TRUE)
```

```
[1] 0.8210863
```

Question 5

Now we want to create a wrapper function that can be used to get either both metrics or a single functioned called.

```
#Create the wrapper function
my_wrapper <- function(response, predicted, metrics = c("MAE", "RMSE"), ...) {
  if (!(is.vector(response) && is.atomic(response) && is.numeric(response))) {
    message("Error: 'response' must be a numeric atomic vecotr.")
    return(invisible(NULL))
  }
  if (!(is.vector(predicted) && is.atomic(predicted) && is.numeric(predicted))) {
    message("Error: 'predicted' must be a numeric atomic vecotr.")
    return(invisible(NULL))
  }

  #create empty list for results
  results <- list()

  #calculate metrics
  if ("MAE" %in% toupper(metrics)) {
    results$MAE <- getMAE(response, predicted, ...)
  }
  if ("RMSE" %in% toupper(metrics)) {
    results$RMSE <- getRMSE(response, predicted, ...)
  }
}
```

```
    return(results)
  }
```

Question 6

Now let's test our wrapper function in a similar way that we tested our previous functions.

```
#create data
set.seed(10)
n <- 100
x <- runif(n)
resp <- 3 + 10*x + rnorm(n)
pred <- predict(lm(resp ~ x), data.frame(x))

#call individually then together
my_wrapper(resp, pred, metrics = "MAE")
```

```
$MAE
[1] 0.8155776
```

```
my_wrapper(resp, pred, metrics = "RMSE")
```

```
$RMSE
[1] 0.9581677
```

```
my_wrapper(resp, pred, metrics = c("MAE", "RMSE"))
```

```
$MAE
[1] 0.8155776
```

```
$RMSE
[1] 0.9581677
```

```
#test again but with 2 NA values in resp
resp[c(1,5)] <- NA_real_
my_wrapper(resp, pred, metrics = "MAE")
```

```
$MAE
[1] NA
```

```
my_wrapper(resp, pred, metrics = "RMSE", na.rm = TRUE) #tested excluding NA
```

```
$RMSE  
[1] 0.9646971
```

```
my_wrapper(resp, pred, metrics = c("MAE", "RMSE"))
```

```
$MAE  
[1] NA
```

```
$RMSE  
[1] NA
```

```
#Test by passing a data frame created in Task 1 Question 2.  
my_wrapper(df1, df1, metrics = c("MAE", "RMSE"))
```

Error: 'response' must be a numeric atomic vector.

```
my_wrapper(resp, df1, metrics = c("MAE", "RMSE"), na.rm = TRUE)
```

Error: 'predicted' must be a numeric atomic vector.

Task 3: Querying an API and a Tidy-Style Function

Question 1

```
URL_ids <- "https://newsapi.org/v2/everything?q=war&from=2025-06-25&sortBy=popularity&apiKey=  
id_info <- GET(URL_ids)  
  
str(id_info, max.level = 1)
```

```
List of 10  
 $ url      : chr "https://newsapi.org/v2/everything?q=war&from=2025-06-25&sortBy=popularity  
 $ status_code: int 200  
 $ headers   :List of 16  
 ..- attr(*, "class")= chr [1:2] "insensitive" "list"  
 $ all_headers:List of 1
```



```

$ cookies      : 'data.frame':   0 obs. of  7 variables:
$ content      : raw [1:46] 7b 22 73 74 ...
$ date         : POSIXct[1:1], format: "2025-06-25 21:34:38"
$ times        : Named num [1:6] 0 0.0574 0.0987 0.1411 0.2073 ...
..- attr(*, "names")= chr [1:6] "redirect" "namelookup" "connect" "pretransfer" ...
$ request      : List of 7
..- attr(*, "class")= chr "request"
$ handle       : Class 'curl_handle' <externalptr>
- attr(*, "class")= chr "response"

```

Question 2

```

parsed_data <- fromJSON(rawToChar(id_info$content))
as_tibble(parsed_data)

```

```

# A tibble: 0 x 3
# i 3 variables: status <chr>, totalResults <int>, articles <list>

```

Question 3

```

API_function <- function(title, date, key) {
}

```

```

URL_ids <- "https://newsapi.org/v2/everything?q=gamestop&from=2025-05-27&sortBy=popularity&api-key=..."
id_info <- GET(URL_ids)
parsed_data <- fromJSON(rawToChar(id_info$content))
as_tibble(parsed_data)

```

```

# A tibble: 100 x 3
  status totalResults articles$source$id $author $title $description $url
  <chr>      <int> <chr>                <chr>    <chr> <chr>      <chr>
1 ok          1137 the-verge         David Imel A nig~ "I'm standi~ http~
2 ok          1137 the-verge         Brandon Wid~ The V~ "Amazon's m~ http~
3 ok          1137 the-verge         Ash Parrish The S~ "With the S~ http~
4 ok          1137 <NA>                Kyle Barr   Targe~ "Check to m~ http~
5 ok          1137 <NA>                James Pero  Did t~ "Maybe orde~ http~
6 ok          1137 <NA>                James Pero  Someo~ "There's on~ http~

```

```

7 ok          1137 <NA>          Luc Olinga   Your ~ "The new he~ http~
8 ok          1137 <NA>          Kyle Barr a~ Ninte~ "The Switch~ http~
9 ok          1137 <NA>          Nicholas Su~ Motor~ "The Motoro~ http~
10 ok         1137 <NA>          Oscar Gonza~ You C~ "Nintendo a~ http~
# i 90 more rows
# i 4 more variables: articles$source$name <chr>, articles$urlToImage <chr>,
#   $publishedAt <chr>, $content <chr>

```

```
str(id_info, max.level = 1)
```

List of 10

```

$ url          : chr "https://newsapi.org/v2/everything?q=gamestop&from=2025-05-27&sortBy=popu
$ status_code : int 200
$ headers      :List of 17
..- attr(*, "class")= chr [1:2] "insensitive" "list"
$ all_headers :List of 1
$ cookies      :'data.frame': 0 obs. of 7 variables:
$ content      : raw [1:86365] 7b 22 73 74 ...
$ date         : POSIXct[1:1], format: "2025-06-25 21:34:38"
$ times        : Named num [1:6] 0 0.000046 0 0.000122 0.071249 ...
..- attr(*, "names")= chr [1:6] "redirect" "namelookup" "connect" "pretransfer" ...
$ request      :List of 7
..- attr(*, "class")= chr "request"
$ handle       :Class 'curl_handle' <externalptr>
- attr(*, "class")= chr "response"

```

```
id_info$headers
```

```
$date
```

```
[1] "Wed, 25 Jun 2025 21:34:38 GMT"
```

```
$`content-type`
```

```
[1] "application/json; charset=utf-8"
```

```
$`transfer-encoding`
```

```
[1] "chunked"
```

```
$connection
```

```
[1] "keep-alive"
```

```
$`content-encoding`
```

```

[1] "gzip"

$`cache-control`
[1] "no-cache"

$pragma
[1] "no-cache"

$expires
[1] "-1"

$x-cached-result`
[1] "true"

$x-cache-remaining`
[1] "99"

$x-cache-expires`
[1] "Wed, 25 Jun 2025 21:35:32 GMT"

$`cf-cache-status`
[1] "DYNAMIC"

$`report-to`
[1] "{\"endpoints\": [{\"url\": \"https://\\a.nel.cloudflare.com\\report\\v4?s=v0ksaRvBx9NI

$nel
[1] "{\"success_fraction\":0,\"report_to\":\"cf-nel\", \"max_age\":604800}"

$server
[1] "cloudflare"

$`cf-ray`
[1] "95579710784ad703-IAD"

$`server-timing`
[1] "cfL4;desc=?proto=TCP&rtt=36867&min_rtt=29827&rtt_var=22198&sent=6&recv=8&lost=0&retrai

attr("class")
[1] "insensitive" "list"

93563897e7a24afaaac43bd50c70d0af

```