Motivations for contributing to OS: plots

Overview

This script makes some plots from Q6, which is about participants' reasons for contributing to open source.

Import packages and utilities

```
project_root <- here::here() # requires that you be somewhere in the
# project directory (not above it)
# packages
suppressMessages(source(file.path(project_root, "scripts/packages.R")))
# functions and objects used across scripts
suppressMessages(source(file.path(project_root, "scripts/utils.R")))
```

Define functions

get_df_for_job_category

- Arguments:
  - `job`: A string.
  - `raw_data`: The Qualtrics data, unmodified. Don't mess with this. I only made this an argument just to clarify that there's another data structure going into this function besides `job`.
- Details:

  - A function that takes a particular job category of interest and produces a data frame with counts for all motivation categories. By 'count', I mean the number of people who selected that motivation.

- Outputs:
  - A data frame with two columns: `Motivation` and `Count`. Count is the number of 'yes' responses for that motivation for the given job category.

```r
get_df_for_job_category <- function(job, raw_data = data) {
  df <- raw_data %>%
    filter(job_category == job) %>%
    select(
      starts_with("motivations")
    )
  df <- shorten_long_responses(df, codenames)
  # Remove any columns that are all NA or empty strings
  df <- df[, colSums(is.na(df) | df == "") < nrow(df)]
  df <- rename_cols_based_on_entries(df)
  # Remove any rows where they didn't answer the question about motivations
  df <- make_df_binary(df)
  df <- data.frame(
    Motivation = names(df),
    Count = unname(apply(df, 2, function(x) round(sum(x, na.rm = TRUE))))
  )
  return(df)
}
```

```r
stacked_bar_chart <- function(
    df,
    x_var,
    y_var,
    fill,
    title,
    ylabel = NULL,
    proportional = FALSE) {
  # Set position for geom_bar
  position_type <- if (proportional) "fill" else "stack"

  # Determine y-axis label if not provided
  ylabel_final <- if (!is.null(ylabel)) ylabel else if (proportional) "Proportion of Respons

  # Build the plot
```

```
  p <- ggplot(df, aes(x = .data[[x_var]], y = .data[[y_var]], fill = .data[[fill]])) +
    geom_bar(stat = "identity", position = position_type) +
    ggtitle(title) +
    labs(y = ylabel_final) +
    scale_fill_manual(values = colors) +
    theme(
      axis.title.x = element_blank(),
      axis.title.y = element_text(size = 24),
      axis.text.x = element_text(angle = 60, vjust = 0.9, hjust=0.98, size = 24),
      axis.text.y = element_text(size = 24),
      axis.ticks.x = element_blank(),
      axis.ticks.y = element_blank(),
      panel.background = element_blank(),
      legend.title = element_blank(),
      legend.text=element_text(size=24),
      plot.title = element_text(hjust = 0.5, size = 24),
      plot.margin = unit(c(0.3, 0.3, 0.3, 0.3), "cm")
    )
  return(p)
}
```

```
line_plot <- function(df, x_var, y_var, title) {
  p <- ggplot(df, aes(x = .data[[x_var]], y = .data[[y_var]])) +
    geom_point(size = 4) + # Adjust dot size
    labs(
      y = "Proportion of Participants Motivated by\nDesire to Learn New Skills",
      title = title
    ) +
    theme(
      axis.title.x = element_blank(),
      axis.title.y = element_blank(),
      axis.text.x = element_text(angle = 60, vjust = 0.6, size = 24),
      axis.text.y = element_text(size = 24),
      axis.ticks.x = element_blank(),
      axis.ticks.y = element_blank(),
      legend.title = element_blank(),
      plot.title = element_text(hjust = 0.5, size = 24),
      plot.margin = unit(c(0.3, 0.3, 0.3, 0.3), "cm"),
      panel.grid = element_line(linetype = "solid", color = "gray90"),
      panel.background = element_blank()
    )
  return(p)
```

```
}
```

Load data

```
data <- load_qualtrics_data("deidentified_no_qual.tsv")
```

Define codes

```
codenames <- c(
  "Developing open-source" = "Job",
  "To improve the tools" = "Improve Tools",
  "To customize existing" = "Customize",
  "To build a network" = "Network",
  "To give back to" = "Give back",
  "To improve my skills" = "Skills",
  "Because it's fun" = "Fun",
  "Other " = "Other"
)
```

Basic bar plot of contributor motivations

First we wrangle the data using several functions from my utilities script `scripts/utils.R`.

```
motivations <- data %>% select(
  starts_with("motivations")
)
motivations <- shorten_long_responses(motivations, codenames)

# Remove any columns that are all NA or empty strings
# (Which means nobody selected that response)
motivations <- exclude_empty_columns(motivations)
# Remove any rows that are all NA or empty strings
# (The participant did not answer the question
# (because they're not UC or not a contributor))
motivations <- exclude_empty_rows(motivations)
```

```
motivations <- rename_cols_based_on_entries(motivations)
motivations <- make_df_binary(motivations)
head(motivations)
```

```
  Job Improve Tools Customize Network Give back Skills Fun Other
1   1             1         1       1         1      1   1     0
2   0             1         1       1         0      1   0     0
3   0             1         1       0         0      1   1     0
4   1             1         1       0         1      0   0     0
5   0             1         1       0         1      1   1     0
7   0             1         1       0         0      0   0     1
```

Now we sum up counts for each motivation.

```
motivations_to_plot <- data.frame(
  Motivation = names(motivations),
  Count = unname(apply(motivations, 2, function(x) round(sum(x, na.rm = TRUE))))
)
head(motivations_to_plot)
```

```
     Motivation Count
1           Job   109
2 Improve Tools   198
3     Customize   161
4       Network    78
5     Give back   156
6        Skills   142
```

Reorder factor levels based on count.

```
motivations_to_plot <- motivations_to_plot %>%
  mutate(Motivation = fct_reorder(Motivation, Count, .desc = FALSE))
```

And make a plot, using a function in utils.R.

```
myplot <- basic_bar_chart(motivations_to_plot,
  x_var = "Motivation",
  y_var = "Count",
  title = "Reasons for Contributing to Open Source",
```

```
  horizontal = TRUE,
  show_bar_labels = TRUE,
  show_ticks_y = FALSE,
  color_index = 3,
  show_axis_title_y = FALSE,
  show_grid = TRUE
)
```

Save the plot if you wish.

```
#save_plot("motivations_overall.tiff", 10, 6, p=myplot)
```

Stacked bar plots of motivations by role

Now let's make some stacked bar plots of motivations by role (job category). We'll make two: one with the absolute number of responses, and one where all roles are normalized to 1, so we can see the relative proportions of each motivation.

```
faculty <- get_df_for_job_category("Faculty")
nrstaff <- get_df_for_job_category("Non-research Staff")
postdocs <- get_df_for_job_category("Post-Doc")
other_researchers <- get_df_for_job_category(
  "Other research staff (e.g., research scientist, research software engineer)"
)
grads <- get_df_for_job_category("Grad Student")
undergrads <- get_df_for_job_category("Undergraduate")
# Example
faculty
```

```
     Motivation Count
1           Job    23
2 Improve Tools    54
3     Customize    45
4       Network    16
5     Give back    38
6        Skills    23
7           Fun    32
8         Other    13
```

For visual clarity, let's combine post-docs and other research staff into one category.

```
postdocs_other <- bind_rows(postdocs, other_researchers) %>%
  group_by(Motivation) %>%
  summarise(Count = sum(Count, na.rm = TRUE), .groups = "drop")
```

Add a `Role` column and combine these little data frames into one long-format data frame.

```
faculty$Role <- "Faculty"
nrstaff$Role <- "Non-research Staff"
grads$Role <- "Grad Students"
postdocs_other$Role <- "Postdocs and\nStaff Researchers"
undergrads$Role <- "Undergraduates"
composite_df <- rbind(faculty, nrstaff, grads, postdocs_other, undergrads)
head(composite_df)
```

```
     Motivation Count    Role
1           Job    23 Faculty
2 Improve Tools    54 Faculty
3     Customize    45 Faculty
4       Network    16 Faculty
5     Give back    38 Faculty
6        Skills    23 Faculty
```

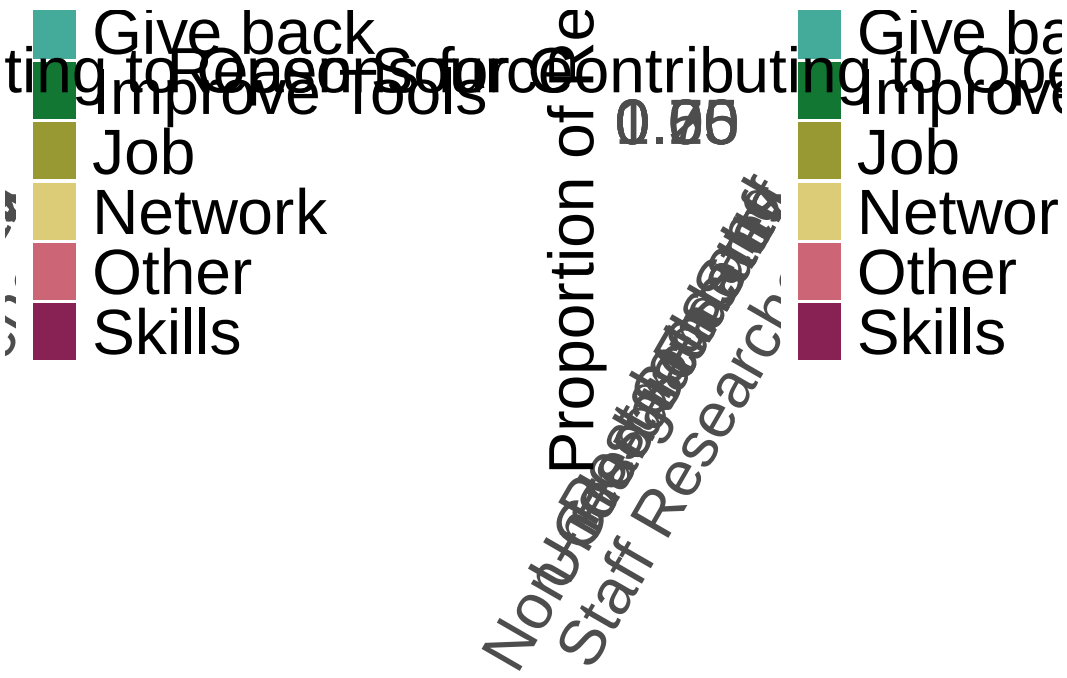
Create one plot with the absolute number of responses on the y-axis, and another plot where all jobs are scaled to 1.

```
stacked_plot_raw <- stacked_bar_chart(composite_df,
  x_var = "Role",
  y_var = "Count",
  fill = "Motivation",
  title = "Reasons for Contributing to Open Source",
)

stacked_plot_proportional <- stacked_bar_chart(composite_df,
  x_var = "Role",
  y_var = "Count",
  fill = "Motivation",
  title = "Reasons for Contributing to Open Source",
  proportional = TRUE
)
```

Visualize

```
stacked_plot_raw + stacked_plot_proportional
```



Save

```
save_plot("motivations_stacks.tiff", 16, 8)
```

Request from Greg: What about IT vs. academics? (Students, Teachers, and Researchers)

```
it <- data %>%
  filter(staff_categories == "Information Technology (IT)") %>%
  select(
    starts_with("motivations")
  )

it <- shorten_long_responses(it, codenames)

# Remove any columns that are all NA or empty strings
# (Which means nobody selected that response)
it <- exclude_empty_columns(it)
# Remove any rows that are all NA or empty strings
```

```r
# (The participant did not answer the question
# (because they're not UC or not a contributor))
it <- exclude_empty_rows(it)

it <- rename_cols_based_on_entries(it)
it <- make_df_binary(it)
head(it)
```

```
  Job Improve Tools Customize Network Give back Skills Fun Other
1   1             0         0       1         1      0   0     0
2   1             1         1       1         1      1   1     0
3   0             1         1       1         1      1   1     0
4   0             1         0       0         0      0   0     0
5   0             1         0       0         1      1   0     0
6   0             1         1       0         1      1   1     0
```

```r
dim(it)
```

```
[1] 33  8
```

```r
it <- data.frame(
  Motivation = names(it),
  Count = unname(apply(it, 2, function(x) round(sum(x, na.rm = TRUE))))
)
it$Role <- "IT"
it
```

```
     Motivation Count Role
1           Job     7   IT
2 Improve Tools    26   IT
3     Customize    23   IT
4       Network    10   IT
5     Give back    27   IT
6        Skills    21   IT
7           Fun    20   IT
8         Other     1   IT
```

```r
academics <- composite_df %>%
  filter(
    Role == "Faculty" |
```

```
      Role == "Grad Students" |
      Role == "Postdocs and Staff Researchers" |
      Role == "Undergraduates"
  )
academics$Role <- "Academic"

it_academics <- rbind(it, academics)
```

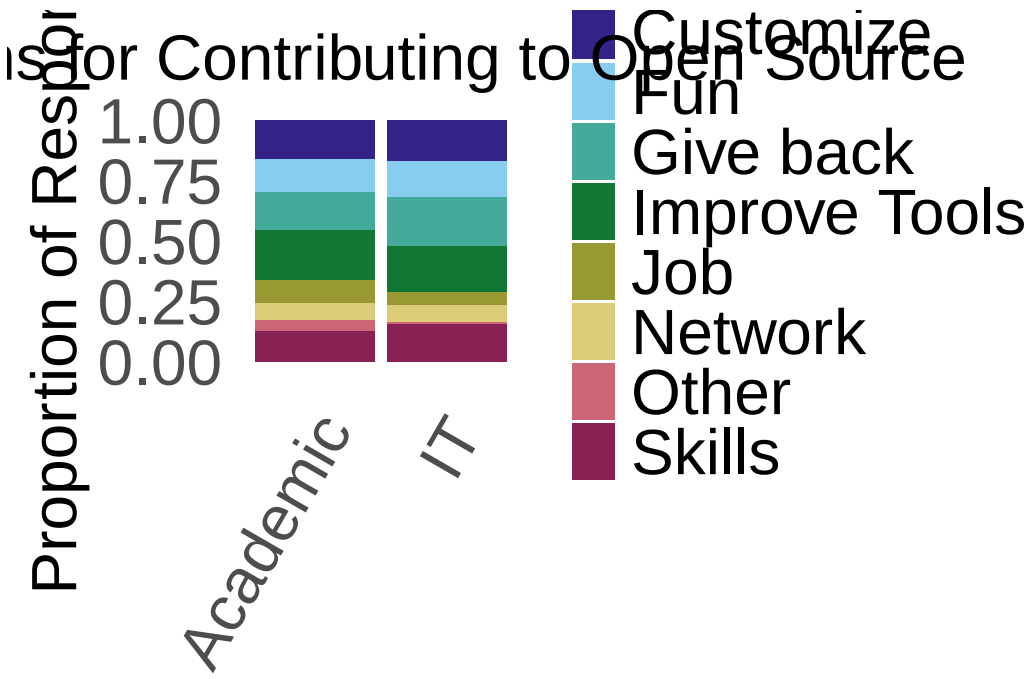
Plot

```
stacked_plot_raw_it <- stacked_bar_chart(
  it_academics,
  x_var = "Role",
  y_var = "Count",
  fill = "Motivation",
  title = "Reasons for Contributing to Open Source",
)

stacked_plot_proportional_it <- stacked_bar_chart(
  it_academics,
  x_var = "Role",
  y_var = "Count",
  fill = "Motivation",
  title = "Reasons for Contributing to Open Source",
  proportional = TRUE
)
```

Visualize

```
stacked_plot_proportional_it
```



Save

```
#save_plot("motivations_stacks_it_academics.tiff", 8, 8)
```

Line plots for particular motivations

All 7 undergraduates selected "Skills" and "Give back" as motivations. This made me curious about whether these motivations decrease as we get older and advance in our careers. Let's make some line plots to investigate.

```
motivations_raw <- data %>% select(
  starts_with("motivations")
)
motivations_raw <- shorten_long_responses(motivations_raw, codenames)
motivations_raw <- rename_cols_based_on_entries(motivations_raw)
motivations_raw$Role <- data$job_category
motivations_raw <- shorten_long_responses(motivations_raw, c("Other research staff" = "Other

# Remove any rows where they didn't answer the question about motivations
motivations_raw <- motivations_raw %>%
  filter(if_any(Job:Other, ~ .x != ""))
```

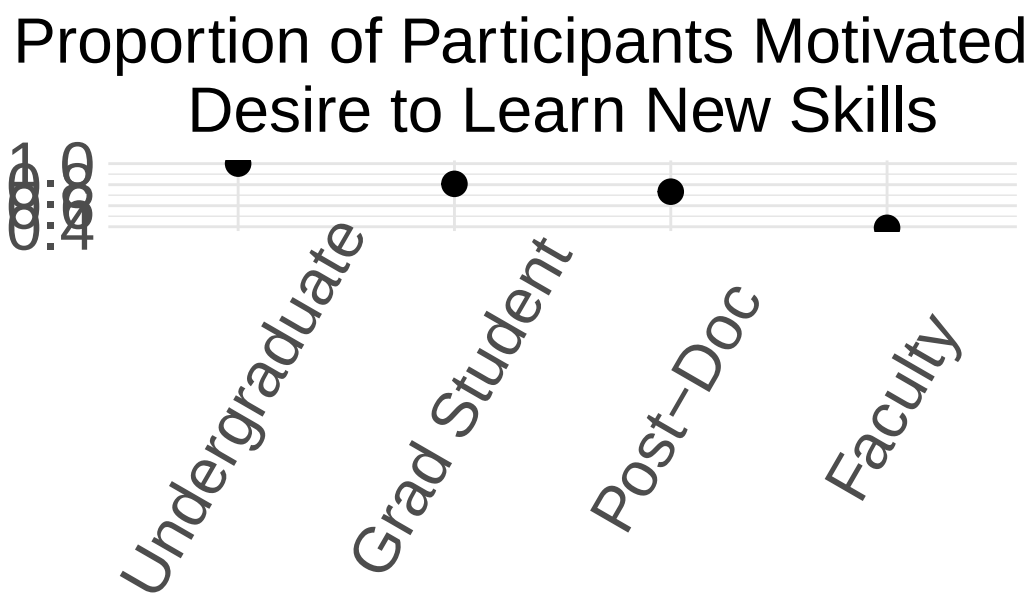
```r
motivation_cols <- as.vector(codenames)
motivations_raw <- make_df_binary(motivations_raw, cols = motivation_cols)


skills_by_role <- motivations_raw %>%
  group_by(Role) %>%
  summarise(
    n_yes = sum(Skills == 1), # number of 1s
    n_tot = n(), # total rows
    Proportion = n_yes / n_tot
  )

skills_by_role_clean <- skills_by_role %>%
  # drop the staff categories
  filter(!Role %in% c("Non-research Staff", "Other research staff")) %>%
  # drop the unnecessary columns
  select(Role, Proportion) %>%
  # order the factor levels
  mutate(Role = factor(Role,
    levels = c(
      "Undergraduate",
      "Grad Student",
      "Post-Doc",
      "Faculty"
    ),
    ordered = TRUE
  )) %>%
  arrange(Role)
```

Plot and visualize

```r
line_plot(skills_by_role_clean,
  x_var = "Role",
  y_var = "Proportion",
  title = "Proportion of Participants Motivated by\nDesire to Learn New Skills"
)
```



Save

```
#save_plot("motivations_skill_by_role.tiff", 10, 8)
```

What about giving back?

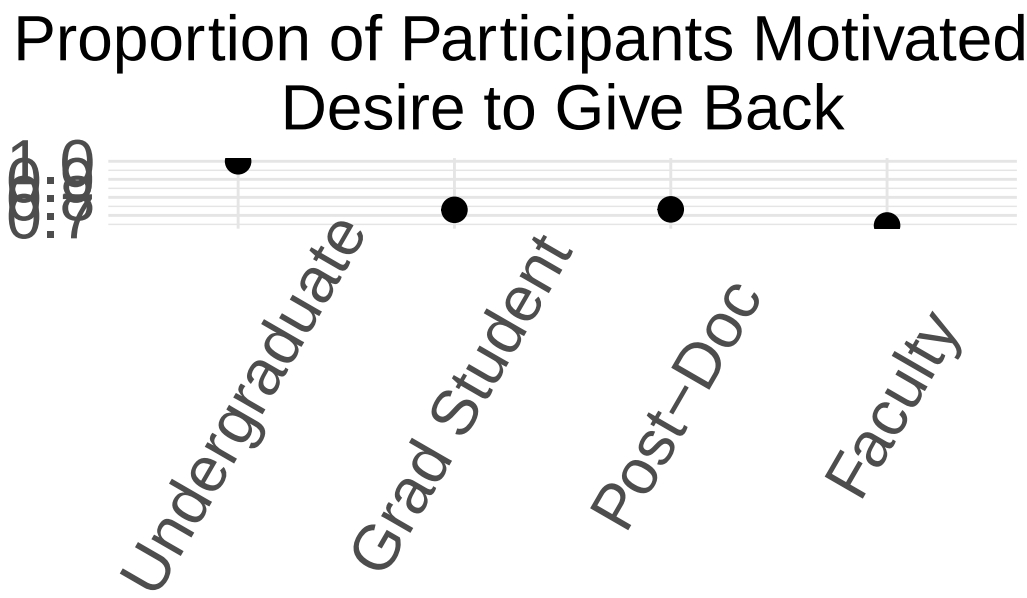
```
give_by_role <- motivations_raw %>%
  group_by(Role) %>%
  summarise(
    n_yes = sum(`Give back` == 1), # number of 1s
    n_tot = n(), # total rows
    Proportion = n_yes / n_tot
  )

give_by_role_clean <- give_by_role %>%
  # drop the staff categories
  filter(!Role %in% c("Non-research Staff", "Other research staff")) %>%
  # drop the unnecessary columns
  select(Role, Proportion) %>%
  # order the factor levels
  mutate(Role = factor(Role,
    levels = c(
      "Undergraduate",
```

```
      "Grad Student",
      "Post-Doc",
      "Faculty"
    ),
    ordered = TRUE
  )) %>%
  arrange(Role)
```

Plot and visualize

```
line_plot(give_by_role_clean,
  x_var = "Role",
  y_var = "Proportion",
  title = "Proportion of Participants Motivated by\nDesire to Give Back"
)
```



Save

```
save_plot("motivations_giveback_by_role.tiff", 8, 6)
```

Session Info

```
sessionInfo()
```

```
R version 4.4.2 (2024-10-31)
Platform: aarch64-apple-darwin20
Running under: macOS Sequoia 15.4.1

Matrix products: default
BLAS:   /Library/Frameworks/R.framework/Versions/4.4-arm64/Resources/lib/libRblas.0.dylib
LAPACK: /Library/Frameworks/R.framework/Versions/4.4-arm64/Resources/lib/libRlapack.dylib;  L

locale:
[1] en_US.UTF-8/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8

time zone: America/Los_Angeles
tzcode source: internal

attached base packages:
[1] tools     stats     graphics  grDevices datasets  utils     methods
[8] base

other attached packages:
 [1] tidyr_1.3.1           stringr_1.5.1         scales_1.4.0
 [4] readr_2.1.5           pwr_1.3-0             patchwork_1.3.0
 [7] mvabund_4.2.1         languageserver_0.3.16 here_1.0.1
[10] gtools_3.9.5          fpc_2.2-13            forcats_1.0.0
[13] factoextra_1.0.7      ggplot2_3.5.2         dplyr_1.1.4
[16] corrplot_0.95         cluster_2.1.8.1

loaded via a namespace (and not attached):
 [1] gtable_0.3.6        xfun_0.52           ggrepel_0.9.6
 [4] processx_3.8.6      lattice_0.22-6      callr_3.7.6
 [7] tzdb_0.5.0          vctrs_0.6.5         ps_1.9.1
[10] generics_0.1.4      stats4_4.4.2        parallel_4.4.2
[13] flexmix_2.3-20      tibble_3.2.1        DEoptimR_1.1-3-1
[16] pkgconfig_2.0.3     RColorBrewer_1.1-3  lifecycle_1.0.4
[19] compiler_4.4.2      farver_2.1.2        statmod_1.5.0
[22] htmltools_0.5.8.1   class_7.3-22        yaml_2.3.10
[25] pillar_1.10.2       prabclus_2.3-4      MASS_7.3-61
[28] diptest_0.77-1      mclust_6.1.1        robustbase_0.99-4-1
```

```
[31] tidyselect_1.2.1    digest_0.6.37       stringi_1.8.7
[34] purrr_1.0.4         kernlab_0.9-33      labeling_0.4.3
[37] rprojroot_2.0.4     fastmap_1.2.0       grid_4.4.2
[40] cli_3.6.5           magrittr_2.0.3      withr_3.0.2
[43] tweedie_2.3.5       rmarkdown_2.29      nnet_7.3-19
[46] modeltools_0.2-24   hms_1.1.3           evaluate_1.0.3
[49] knitr_1.50          rlang_1.1.6         Rcpp_1.0.14
[52] glue_1.8.0          xml2_1.3.8          renv_1.1.4
[55] jsonlite_2.0.0      R6_2.6.1
```