Demographics: descriptive statistics

Overview

Let's look at survey participation rates across various groups (demographics). These are mostly just basic descriptive statistics, though there are a couple plots and a z-test relating to aspiring vs. experienced contributors.

Import packages and utilities

```r
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")))
```

Load data

```r
other_quant <- load_qualtrics_data("clean_data/other_quant.tsv")
status <- load_qualtrics_data("clean_data/contributor_status_Q3.tsv")
qual <- load_qualtrics_data("qual_responses.tsv")

raw_data <- cbind(status, other_quant)
nrow(raw_data)
```

```
[1] 332
```

```r
head(raw_data)
```

```
   Past Future           campus      favorite_solution field_of_study
1  True   True UC Santa Barbara  Sustainability grants    Math and CS
2  True   True UC Santa Barbara       Containerization  Life sciences
3  True   True UC Santa Barbara Computing environments     Humanities
4  True   True UC Santa Barbara  Sustainability grants    Math and CS
5  True   True UC Santa Barbara     Documentation help  Life sciences
6 False   True UC Santa Barbara                           Math and CS
          job_category staff_categories
1              Faculty
2             Post-Doc
3 Other research staff
4              Faculty
5              Faculty
6 Other research staff
```

Filter out people who were neither past nor future contributors. We'll use this filtered data frame moving forward.

```r
# Filter duds
data <- raw_data %>%
    filter(!(Past == "" | Future == "")) %>%
    filter(!(Past == "False" & Future == "False"))
```

Experienced vs aspiring

First, let's see how many experienced and aspiring open source contributors took the survey.

Experienced:

```r
total_expd <- nrow(subset(raw_data, Past=="True"))
total_expd
```

```
[1] 233
```

Aspiring:

```
total_asp <- nrow(subset(raw_data, Past=="False" & Future=="True"))
total_asp
```

```
[1] 61
```

```
status_data <- data %>%
  mutate(status = if_else(Past == "True", "Experienced", "Aspiring")) %>%
  select(job_category, status)

stat_sum <- data.frame(
  ftable(xtabs(~ job_category + status, data = status_data))
)
subset(stat_sum, status == "Aspiring") %>% arrange(desc(Freq))
```

```
          job_category   status Freq
1   Non-research Staff Aspiring   20
2         Grad Student Aspiring   17
3 Other research staff Aspiring    9
4              Faculty Aspiring    7
5        Undergraduate Aspiring    6
6             Post-Doc Aspiring    2
```

```
subset(stat_sum, status == "Experienced") %>% arrange(desc(Freq))
```

```
          job_category      status Freq
1   Non-research Staff Experienced   86
2              Faculty Experienced   59
3 Other research staff Experienced   40
4         Grad Student Experienced   26
5             Post-Doc Experienced   15
6        Undergraduate Experienced    7
```

Here we see that we have only 7 experienced undergraduate contributors and only 15 experienced postdocs.

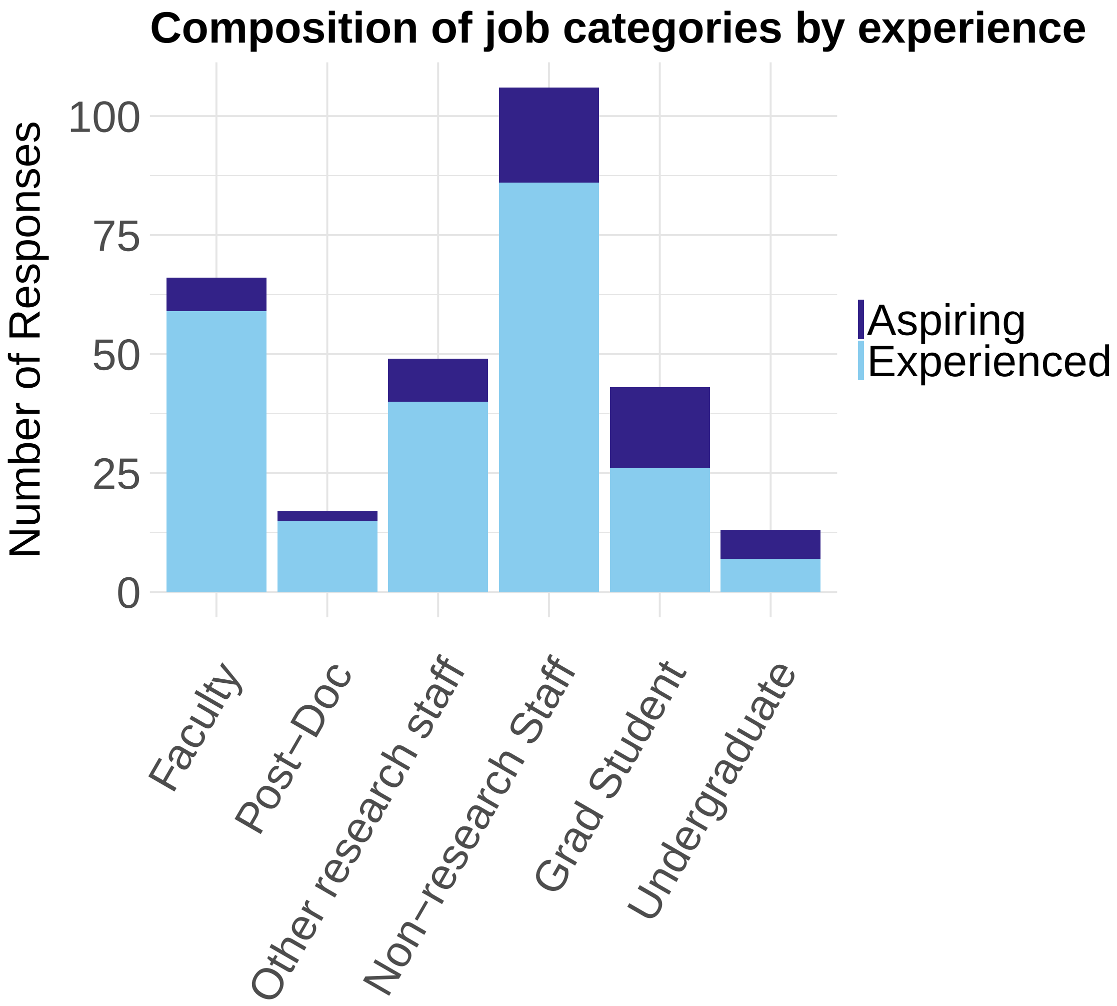
Experienced vs. aspiring by job: plot

Prepare data for plotting

```r
sj_counts <- status_data %>% group_by(job_category, status) %>% count()

# Reorder factor levels by the highest proportion of experienced contributors
ordered_jobs <- sj_counts %>%
  group_by(job_category) %>%
  summarise(
    Aspiring = n[status=="Aspiring"],
    Experienced = n[status=="Experienced"],
    .groups = "drop"
  ) %>%
  mutate(exp_to_asp = Experienced / Aspiring) %>%
  arrange(desc(exp_to_asp)) %>%
  pull(job_category)

sj_counts$job_category <- factor(sj_counts$job_category, levels = ordered_jobs)
```

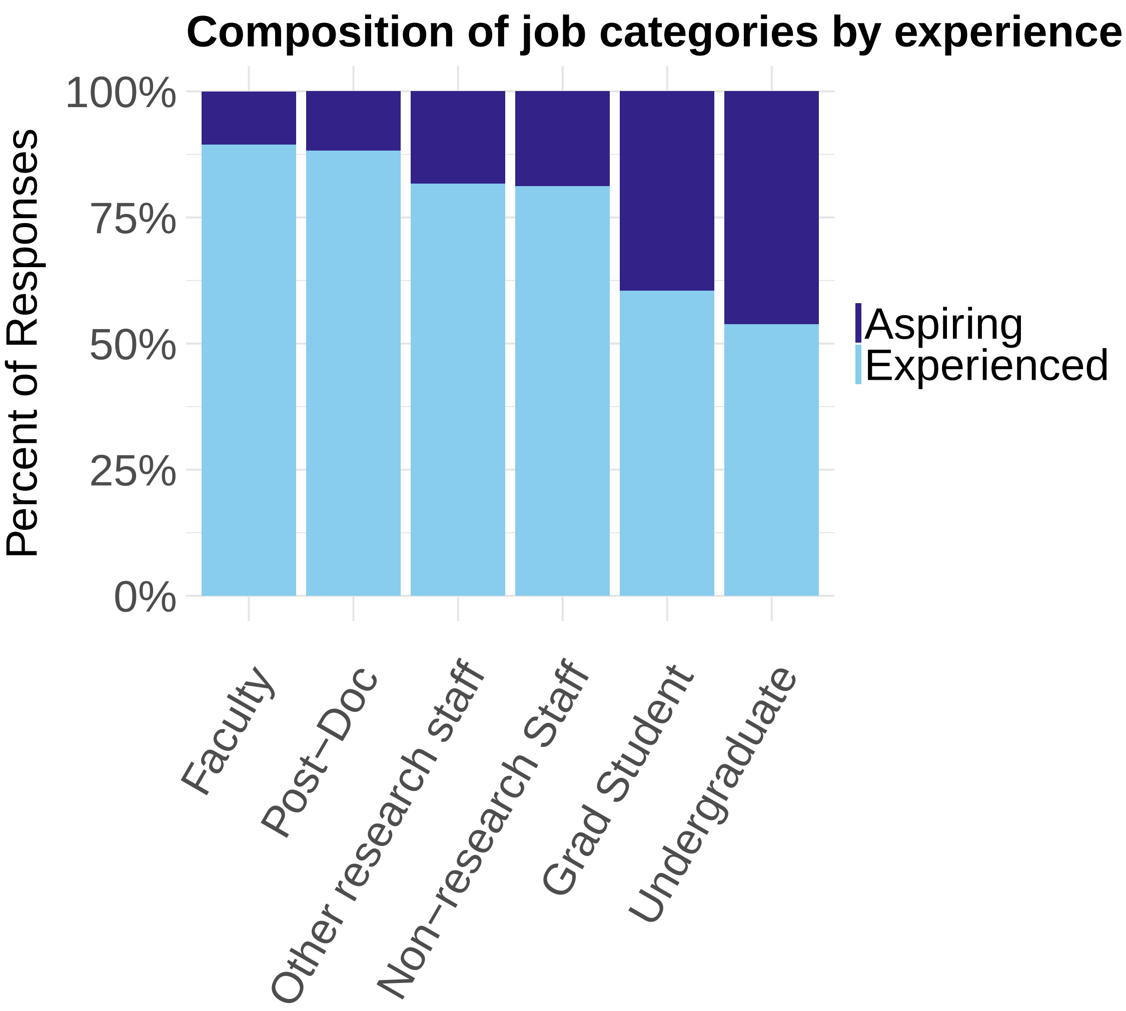
Plot

```r
stack <- stacked_bar_chart(
  df = sj_counts,
  x_var = "job_category",
  y_var = "n",
  fill = "status",
  title = "Composition of job categories by experience")

stack
```



```
save_plot("future_contribs_stack.tiff", 12, 9, p=stack)
```

```
stack_prop <- stacked_bar_chart(
  df = sj_counts,
  x_var = "job_category",
  y_var = "n",
  ylabel = "Percent of Responses",
  fill = "status",
  title = "Composition of job categories by experience",
  proportional = TRUE)

stack_prop <- stack_prop +
  scale_y_continuous(labels = scales::percent)

stack_prop
```



```
save_plot("future_contribs_stack_prop.tiff", 12, 9, p=stack_prop)
```

```
# I have no idea why this is necessary just for these plots...
# but it works
stack <- stack + theme(legend.key.size = unit(rel(1.5), "lines"))
stack_prop <- stack_prop + theme(legend.key.size = unit(rel(1.5), "lines"))
```

```
p_combined <- patchwork::wrap_plots(stack, plot_spacer(), stack_prop) +
  plot_layout(widths = c(1, 0.05, 1)) +
  theme(plot.margin = margin(t = 1, r = 1, b = 1, l = 1, unit = "cm"))

p_combined <- p_combined +
  plot_annotation(tag_levels = "A") &
  theme(plot.tag = element_text(size = 26))

# SVG is higher quality
svglite::svglite(
  file.path(FIGURE_PATH, "figureS1.svg"),
  width = 26,
  height = 10
)
print(p_combined)
dev.off()
```

```
pdf
  2
```

Experienced vs. aspiring by job: stats

I think this might be easier to get a handle on if we combine some of these groups.

```
sj_counts_relabeled <- sj_counts %>%
  mutate(
    job_category = case_when(
      job_category %in% c("Other research staff", "Post-Doc") ~
        "Post-docs and staff researchers",
      job_category %in% c("Grad Student", "Undergraduate") ~ "Students",
      TRUE ~ job_category
    )
  ) %>%
  group_by(job_category, status) %>%
  summarise(n = sum(n, na.rm = TRUE), .groups = "drop")


asp <- subset(sj_counts_relabeled, status == "Aspiring") %>% arrange(desc(n))
expd <- subset(sj_counts_relabeled, status == "Experienced") %>% arrange(desc(n))

asp
```

```
# A tibble: 4 x 3
  job_category                     status       n
  <chr>                            <chr>    <int>
1 Students                         Aspiring    23
2 Non-research Staff               Aspiring    20
3 Post-docs and staff researchers Aspiring    11
4 Faculty                          Aspiring     7
```

```
expd
```

```
# A tibble: 4 x 3
  job_category                     status          n
  <chr>                            <chr>       <int>
1 Non-research Staff               Experienced    86
2 Faculty                          Experienced    59
3 Post-docs and staff researchers Experienced    55
4 Students                         Experienced    33
```

Let's look at the proportions, which will make this even easier to see.

```
sj_counts_prop <- sj_counts %>%
  ungroup() %>%                      # drop existing grouping
  group_by(job_category) %>%         # group only by job_category
  mutate(
    prop = n / sum(n),               # proportion, for statistics
    pct  = round(prop * 100, 1)      # percent, easier to read
  ) %>%
  ungroup()

subset(sj_counts_prop, status == "Aspiring")
```

```
# A tibble: 6 x 5
  job_category          status       n  prop   pct
  <fct>                 <chr>    <int> <dbl> <dbl>
1 Faculty               Aspiring     7 0.106  10.6
2 Grad Student          Aspiring    17 0.395  39.5
3 Non-research Staff    Aspiring    20 0.189  18.9
4 Other research staff Aspiring     9 0.184  18.4
5 Post-Doc              Aspiring     2 0.118  11.8
6 Undergraduate         Aspiring     6 0.462  46.2
```

Undergrads and grad students both have a lot of aspiring contributors–40ish%, twice as much the next highest proportion which is staff.

Quick 2-proportion z-test

Can we do a quick z-test to check whether aspiring contributors make up a higher proportion of students than they do of nr staff, the next-highest proportion?

First, combine students for more statistical power. (Copying the code from previous cell, just on a relabeled data frame.)

```
sj_counts_prop2 <- sj_counts_relabeled %>%
  ungroup() %>%
  group_by(job_category) %>%
  mutate(
    prop = n / sum(n),
    pct  = round(prop * 100, 1)
  ) %>%
  ungroup()

subset(sj_counts_prop2, status == "Aspiring")
```

```
# A tibble: 4 x 5
  job_category                      status       n  prop   pct
  <chr>                             <chr>    <int> <dbl> <dbl>
1 Faculty                           Aspiring     7 0.106  10.6
2 Non-research Staff                Aspiring    20 0.189  18.9
3 Post-docs and staff researchers Aspiring    11 0.167  16.7
4 Students                          Aspiring    23 0.411  41.1
```

Let's start with a power analysis to see whether we have an adequate sample size. I could make this code more concise, but I'm sort of copy-pasting bits from other notebooks here.

```
n_stud <- sum(subset(sj_counts_prop2, job_category == "Students")$n)
n_stud_asp <- subset(
  sj_counts_prop2,
  job_category == "Students" & status == "Aspiring"
)$n

n_staff <- sum(subset(sj_counts_prop2, job_category == "Non-research Staff")$n)
n_staff_asp <- subset(
  sj_counts_prop2,
  job_category == "Non-research Staff" & status == "Aspiring"
)$n
```

```
# Sanity check
n_stud
```

```
[1] 56
```

```
n_stud_asp
```

```
[1] 23
```

```
n_staff
```

```
[1] 106
```

```
n_staff_asp
```

```
[1] 20
```

```
p_stud_asp <- n_stud_asp / n_stud
p_staff_asp <- n_staff_asp / n_staff

p_stud_asp
```

```
[1] 0.4107143
```

```
p_staff_asp
```

```
[1] 0.1886792
```

Calculate Cohen's h, the effect size.

```
h <- pwr::ES.h(p_stud_asp, p_staff_asp)
h
```

```
[1] 0.4925795
```

Now, what ratio of students to nr staff is needed to achieve 80% power? This one-sided test allows us to specify our unequal group sizes.

```
pwr::pwr.2p2n.test(
  h = h,
  n1 = n_stud,
  sig.level = 0.05,
  power = 0.8,
  alternative = "greater"
)
```

```

     difference of proportion power calculation for binomial distribution (arcsine transforma

              h = 0.4925795
             n1 = 56
             n2 = 46.75545
      sig.level = 0.05
          power = 0.8
    alternative = greater

NOTE: different sample sizes
```

So we would need 46 nr staff to achieve 80% power.

```
n_staff
```

```
[1] 106
```

We have 106!

Now proceed with the z-test.

```
# Perform the one-sided prop test (testing if group1 > group2)
stats::prop.test(
  x = c(n_stud_asp, n_staff_asp),
  n = c(n_stud, n_staff),
  alternative = "greater",
)
```

```

    2-sample test for equality of proportions with continuity correction
```

```
data:  c(n_stud_asp, n_staff_asp) out of c(n_stud, n_staff)
X-squared = 8.161, df = 1, p-value = 0.00214
alternative hypothesis: greater
95 percent confidence interval:
 0.08348806 1.00000000
sample estimates:
   prop 1    prop 2 
0.4107143 0.1886792 
```

Sweet. The difference in proportions is statistically significant, according to a simple z-test.

Campus

I already learned while plotting the data that UCSB and UCLA are overrepresented. What proportion of respondents came from these two schools?

```r
unique(data$campus)
```

```
 [1] "UC Santa Barbara" "UC San Diego"     "UC Los Angeles"   "UC Davis"        
 [5] "UC Santa Cruz"    "UC San Francisco" "UC Berkeley"      "Other UC"        
 [9] "UC Irvine"        "UC Merced"       
```

First, a quick glance at the raw data to see how many non-UC respondents we got.

```r
nrow(raw_data)
```

```
[1] 332
```

```r
nrow(
  subset(raw_data, campus != "I'm not affiliated with UC")
)
```

```
[1] 330
```

Only 2 respondents were not UC affiliates.

```
campus_count <- data.frame(table(data$campus))
names(campus_count) <- c("Campus", "Count")
total <- sum(campus_count$Count)
ucsb <- subset(campus_count, Campus=="UC Santa Barbara")[,"Count"]
ucla <- subset(campus_count, Campus=="UC Los Angeles")[,"Count"]
ucsb + ucla
```

```
[1] 139
```

```
total
```

```
[1] 294
```

```
round((ucsb + ucla) / total * 100, digits = 1)
```

```
[1] 47.3
```

So 47% of respondents came from these two campuses.

Field of study

How many respondents were from STEM, social science, and humanities?

```
# Remove people who didn't answer this question--non-research staff
tmp <- data$field_of_study[nzchar(data$field_of_study)]
field_count <- data.frame(table(tmp))
names(field_count) <- c("Field", "Count")
total <- sum(field_count$Count)
stem <- sum(
  subset(
    field_count,
    Field == "Life sciences" |
    Field == "Math and CS" |
    Field == "Physical sciences"
  )[, "Count"]
)
sosc_hum <- sum(
  subset(
    field_count,
    Field == "Humanities" |
    Field == "Social sciences"
  )[, "Count"]
)
# sanity check
total == stem + sosc_hum
```

```
[1] TRUE
```

```
total
```

```
[1] 188
```

```
field_count
```

```
              Field Count
1        Humanities    11
2     Life sciences    43
3       Math and CS    86
4 Physical sciences    33
5   Social sciences    15
```

```
round(stem / total * 100, digits = 1)
```

```
[1] 86.2
```

```
round(sosc_hum / total * 100, digits = 1)
```

```
[1] 13.8
```

So 86% of respondents are from stem, and 14% are from social sciences/humanities.

How many of the STEM respondents are from math or CS?

```r
math_cs <- sum(
  subset(
    field_count,
    Field == "Math and CS"
  )[, "Count"]
)
round(math_cs / stem * 100, digits = 1)
```

```
[1] 53.1
```

53% of STEM respondents are from math or CS.

How many experienced contributors were from humanities or social sciences?

```r
nrow(subset(data, field_of_study=="Humanities" & Past =="True"))
```

```
[1] 4
```

```r
nrow(subset(data, field_of_study=="Social sciences" & Past =="True"))
```

```
[1] 10
```

We had 4 experienced contributors from the humanities, and 10 from the social sciences.

Job category

```r
# Remove people who didn't answer this question--
# neither future nor past contributors
tmp <- data$job_category[nzchar(data$job_category)]
job_count <- data.frame(table(tmp))
names(job_count) <- c("Job", "Count")
total <- sum(job_count$Count)

nr_staff <- subset(job_count, Job == "Non-research Staff")[, "Count"]
academics <- sum(subset(job_count, Job != "Non-research Staff")[, "Count"])

job_count
```

```
                    Job Count
1               Faculty    66
2          Grad Student    43
3   Non-research Staff    106
4 Other research staff     49
5              Post-Doc    17
6         Undergraduate    13
```

```
round(nr_staff / total * 100, digits = 1)
```

```
[1] 36.1
```

```
round(academics / total * 100, digits = 1)
```

```
[1] 63.9
```

36% of survey respondents are non-research staff, while 64% are academics.

Staff categories

What about the job areas of the non-research staff?

```
# Remove everybody except non-research staff
tmp <- data$staff_categories[nzchar(data$staff_categories)]
staff_count <- data.frame(table(tmp))
names(staff_count) <- c("Area", "Count")
total <- sum(staff_count$Count)

staff_count
```

```
                                  Area Count
1          Academic and Research Support    27
2   Administration and General Operations     4
3      Admissions and Enrollment Services     2
4         DevOps or System Administration     8
5                                 Finance     2
6                         Human Resources     1
7             Information Technology (IT)    44
8           Marketing and Communications     2
9                                   Other    15
10          Student Affairs and Services     1
```

```
rs <- subset(staff_count, Area == "Academic and Research Support")[, "Count"]
it <- subset(staff_count, Area == "Information Technology (IT)")[, "Count"]

round( (rs + it) / total * 100, digits = 1)
```

```
[1] 67
```

67% of the non-research staff respondents were from either IT or Academic and Research Support, which we told participants “includes research administration, libraries, and instructional design”.

Qualitative responses: staff categories

Let’s look at the free-response field for staff job categories. These are the non-research staff who selected “other” and wrote in their job area.

```
qual_staff <- qual$staff_categories_13_TEXT[nzchar(qual$staff_categories_13_TEXT)]
```

I looked at these manually, but for the sake of data privacy, I am not printing the free responses here. I can see that the word “Library” and the abbreviation “IT” each occur multiple times.

```
length(qual_staff)
```

```
[1] 13
```

```
sum(str_count(qual_staff, pattern = "Library"))
```

```
[1] 4
```

```
sum(str_count(qual_staff, pattern = "IT"))
```

```
[1] 3
```

So, seven of the free-text responses contained either the word “Library” or “IT” or both. I am looking manually, and I can see that these came from 6 people. (One person put “Library IT”.)

```r
sessionInfo()
```

```
R version 4.4.2 (2024-10-31)
Platform: aarch64-apple-darwin20
Running under: macOS 26.1

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;

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

time zone: America/Los_Angeles
tzcode source: internal

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

other attached packages:
 [1] treemapify_2.5.6      tidyr_1.3.1           svglite_2.2.1
 [4] stringr_1.5.1         scales_1.4.0          readr_2.1.5
 [7] pwr_1.3-0             patchwork_1.3.2       ordinal_2023.12-4.1
[10] lme4_1.1-37           Matrix_1.7-1          languageserver_0.3.16
[13] here_1.0.1            gtools_3.9.5          ggforce_0.5.0
[16] FSA_0.10.0            fpc_2.2-13            forcats_1.0.0
[19] factoextra_1.0.7      ggplot2_3.5.2         emmeans_1.11.2
[22] dplyr_1.1.4           corrplot_0.95         ComplexHeatmap_2.22.0
[25] cluster_2.1.8.1       BiocManager_1.30.26

loaded via a namespace (and not attached):
 [1] Rdpack_2.6.4        rlang_1.1.6         magrittr_2.0.3
 [4] clue_0.3-66         GetoptLong_1.0.5    matrixStats_1.5.0
 [7] compiler_4.4.2      flexmix_2.3-20      systemfonts_1.2.3
[10] png_0.1-8           callr_3.7.6         vctrs_0.6.5
[13] pkgconfig_2.0.3     shape_1.4.6.1       crayon_1.5.3
[16] fastmap_1.2.0       labeling_0.4.3      utf8_1.2.6
[19] rmarkdown_2.29      ggfittext_0.10.2    tzdb_0.5.0
[22] ps_1.9.1            nloptr_2.2.1        purrr_1.1.0
[25] xfun_0.53           modeltools_0.2-24   jsonlite_2.0.0
[28] tweenr_2.0.3        parallel_4.4.2      prabclus_2.3-4
```

```
[31] R6_2.6.1            stringi_1.8.7       RColorBrewer_1.1-3
[34] boot_1.3-31         diptest_0.77-2      numDeriv_2016.8-1.1
[37] estimability_1.5.1  Rcpp_1.1.0          iterators_1.0.14
[40] knitr_1.50          IRanges_2.40.1      splines_4.4.2
[43] nnet_7.3-19         tidyselect_1.2.1    yaml_2.3.10
[46] doParallel_1.0.17   codetools_0.2-20    processx_3.8.6
[49] lattice_0.22-6      tibble_3.3.0        withr_3.0.2
[52] evaluate_1.0.4      polyclip_1.10-7     xml2_1.4.0
[55] circlize_0.4.16     mclust_6.1.1        kernlab_0.9-33
[58] pillar_1.11.0       renv_1.1.5          foreach_1.5.2
[61] stats4_4.4.2        reformulas_0.4.1    generics_0.1.4
[64] rprojroot_2.1.1     S4Vectors_0.44.0    hms_1.1.3
[67] minqa_1.2.8         xtable_1.8-4        class_7.3-22
[70] glue_1.8.0          robustbase_0.99-4-1 mvtnorm_1.3-3
[73] rbibutils_2.3       colorspace_2.1-1    nlme_3.1-166
[76] cli_3.6.5           textshaping_1.0.1   gtable_0.3.6
[79] DEoptimR_1.1-4      digest_0.6.37       BiocGenerics_0.52.0
[82] ucminf_1.2.2        ggrepel_0.9.6       rjson_0.2.23
[85] farver_2.1.2        htmltools_0.5.8.1   lifecycle_1.0.4
[88] GlobalOptions_0.1.2 MASS_7.3-61
```