Challenges

Overview

Initial analysis of survey Q9: "How frequently have you encountered the following challenges while working on open-source projects?"

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")))
```

Load data

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

Wrangle data

```
challenges <- data %>%
  select(
    starts_with("challenges")
  )

head(challenges)
```

```
  challenges_1 challenges_2 challenges_3 challenges_4 challenges_5 challenges_6
1       Always       Always       Always       Always       Always       Always
2   Frequently Occasionally Occasionally Occasionally Occasionally       Rarely
3   Frequently       Always Occasionally       Always Occasionally   Frequently
4       Always       Always   Frequently Occasionally   Frequently       Always
5       Always       Always       Rarely Occasionally   Frequently        Never
6
  challenges_7 challenges_8 challenges_9 challenges_10 challenges_11
1       Always       Always       Always        Always        Always
2   Frequently Occasionally   Frequently    Frequently    Frequently
3   Frequently Occasionally Occasionally        Rarely        Rarely
4 Occasionally       Rarely       Rarely    Frequently        Rarely
5        Never        Never        Never        Always  Occasionally
6
  challenges_12 challenges_13 challenges_14
1        Always        Always        Always
2    Frequently    Frequently  Occasionally
3        Always        Always        Always
4  Occasionally    Frequently    Frequently
5  Occasionally        Rarely        Always
6
```

STOP!! Presumably, "challenges_1" corresponds to the first option, "challenges_2" corresponds to the second option, etc., but we still need to check. I am manually comparing the answers in this data frame to those in the Qualtrics interface, which shows the whole response, i.e. "Limited time for writing new code", not just "challenges_1". To be extra confident that I am comparing the same rows between the two tables, I am looking at responses associated with a particular email. After this code chunk, I go back to using the data frame that doesn't contain the emails.

Since this code only needed to be run once, I've commented it out.

```
# pii <- load_qualtrics_data("pii.tsv")
# emails <- pii %>%
#     select(starts_with("stay_in_touch_email"))

# t <- cbind(emails, challenges)

# # Next, I run this line repeatedly with different emails,
# # to make sure that this person's response to "challenges_1"
# # matches their response to "Limited time for writing new code", etc.
# subset(t, startsWith(stay_in_touch_email, "PERSON_EMAIL_HERE"))
```

My assumption above was correct; the options are ordered as expected.

Next, remove empty rows, i.e. rows from respondents who didn't receive this question. As with many questions in this survey, we can cut some corners in the code because the question was mandatory. For example, no need to worry about incomplete answers.

```
nrow(challenges)
```

```
[1] 332
```

```
challenges <- exclude_empty_rows(challenges) # from scripts/utils.R
nrow(challenges)
```

```
[1] 233
```

Let's reshape the data from wide to long format for easier plotting later.

```
long_data <- challenges %>%
  pivot_longer(
    cols = starts_with("challenges"),
    names_to = "challenge",
    values_to = "challenge_level"
  )

long_data <- long_data %>%
  mutate(
    challenge = recode(
      challenge,
      "challenges_1" = "Coding time",
      "challenges_2" = "Documentation time",
      "challenges_3" = "Managing issues",
      "challenges_4" = "Attracting users",
      "challenges_5" = "Recognition",
      "challenges_6" = "Hiring",
      "challenges_7" = "Security",
      "challenges_8" = "Finding peers",
      "challenges_9" = "Finding mentors",
      "challenges_10" = "Education time",
      "challenges_11" = "Educational resources",
      "challenges_12" = "Legal",
      "challenges_13" = "Finding funding",
```

```
      "challenges_14" = "Securing funding"
    )
  )

long_data <- long_data %>%
  mutate(
    challenge_score = recode(
      challenge_level,
      "Never"           = 0L,
      "Non-applicable"  = 0L,
      "Rarely"          = 1L,
      "Occasionally"    = 2L,
      "Frequently"      = 3L,
      "Always"          = 4L
    )
  )
# Using interger literals 0L, 1L, etc., ensures that
# the new column will be integers, not doubles.

long_data
```

```
# A tibble: 3,262 x 3
   challenge          challenge_level challenge_score
   <chr>              <chr>                    <int>
 1 Coding time        Always                       4
 2 Documentation time Always                       4
 3 Managing issues    Always                       4
 4 Attracting users   Always                       4
 5 Recognition        Always                       4
 6 Hiring             Always                       4
 7 Security           Always                       4
 8 Finding peers      Always                       4
 9 Finding mentors    Always                       4
10 Education time     Always                       4
# i 3,252 more rows
```

Next, let's calculate some simple descriptive statistics. I will choose: * The total "score", that is, the total number of "points" a challenge received ("Never" = 0, "Non-applicable" = 0,"Rarely" = 1, "Occasionally" = 2, "Frequently" = 3, "Always" = 4) * The mean (which might be misleading if 0s drag it down, and also, who's to say what a 2.5 really means? Are the distances between the Likert points equal? We don't know.) * The mode * The standard deviation

```r
# Helper to compute the (numeric) mode
get_mode <- function(x) {
  ux <- unique(x)
  ux[which.max(tabulate(match(x, ux)))]
}

summary_df <- long_data %>%
  group_by(challenge) %>%
  summarise(
    total  = sum(challenge_score),
    mean   = mean(challenge_score, na.rm = TRUE),
    mode   = get_mode(challenge_score),
    st_dev = sd(challenge_score, na.rm = TRUE)
  ) %>%
  ungroup()

# Order by highest total "score"
summary_df <- summary_df %>%
    arrange(desc(total))

summary_df
```

```
# A tibble: 14 x 5
   challenge             total  mean  mode st_dev
   <chr>                 <int> <dbl> <int>  <dbl>
 1 Documentation time      686  2.94     3   1.08
 2 Coding time             606  2.60     3   1.24
 3 Education time          539  2.31     3   1.26
 4 Managing issues         451  1.94     2   1.29
 5 Attracting users        442  1.90     0   1.45
 6 Securing funding        438  1.88     0   1.74
 7 Finding funding         432  1.85     0   1.68
 8 Educational resources   369  1.58     1   1.19
 9 Recognition             334  1.43     0   1.35
10 Legal                   333  1.43     0   1.24
11 Finding mentors         323  1.39     0   1.31
12 Security                307  1.32     0   1.31
13 Hiring                  291  1.25     0   1.53
14 Finding peers           267  1.15     0   1.13
```

Cool! It looks like finding the time for documentation, coding, and self-education are the

challenges encountered most frequently. These are the only responses that had a mode of 3 ("Frequently") and a mean of **greater** than 2 ("Occasionally").

Out of curiosity, how does it look when we order by variability?

```
sd_df <- summary_df %>%
    arrange(desc(st_dev))

sd_df
```

```
# A tibble: 14 x 5
   challenge             total  mean  mode st_dev
   <chr>                 <int> <dbl> <int>  <dbl>
 1 Securing funding        438  1.88     0   1.74
 2 Finding funding         432  1.85     0   1.68
 3 Hiring                  291  1.25     0   1.53
 4 Attracting users        442  1.90     0   1.45
 5 Recognition             334  1.43     0   1.35
 6 Security                307  1.32     0   1.31
 7 Finding mentors         323  1.39     0   1.31
 8 Managing issues         451  1.94     2   1.29
 9 Education time          539  2.31     3   1.26
10 Legal                   333  1.43     0   1.24
11 Coding time             606  2.60     3   1.24
12 Educational resources   369  1.58     1   1.19
13 Finding peers           267  1.15     0   1.13
14 Documentation time      686  2.94     3   1.08
```

Fascinating! The greatest standard deviations are from securing funding, finding funding, and hiring. This makes sense, as these are, at least in my perception, "manager tasks"–tasks that only some people face, but they're likely to be a big challenge for those who face them. I would guess that these might show a bimodal distribution. Let's plot them and find out!

Plot the distributions

Prepare data for plotting

```
ordered_levels <- c(
  "Non-applicable",
  "Never",
  "Rarely",
```

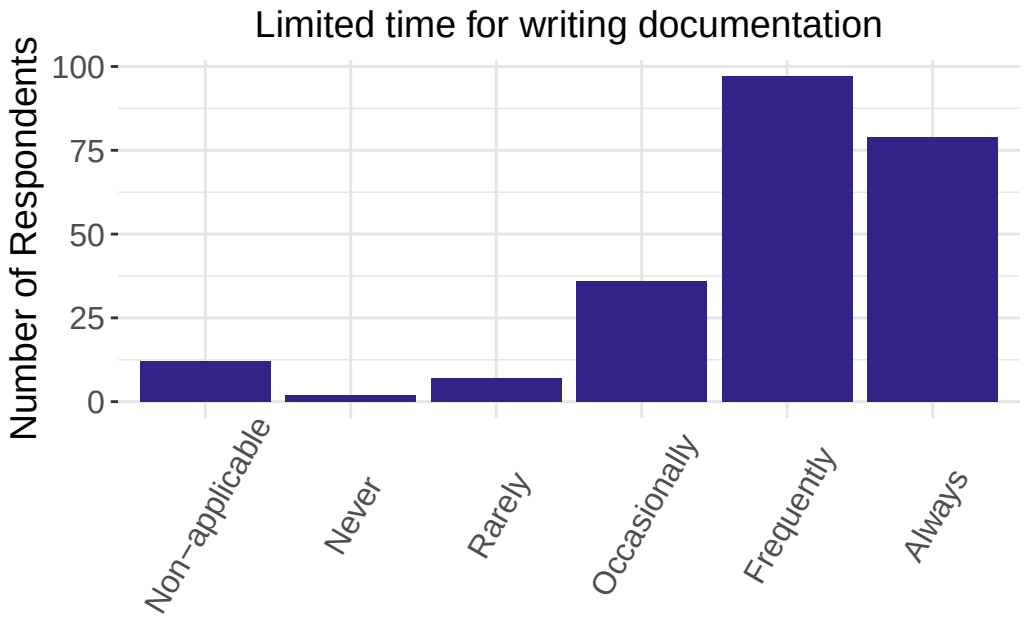
```
  "Occasionally",
  "Frequently",
  "Always"
)

to_plot <- long_data %>%
  mutate(challenge_level = factor(challenge_level, levels = ordered_levels)) %>%
  count(
    challenge,
    challenge_level,
    name = "total"
  ) %>%
  ungroup()

to_plot
```

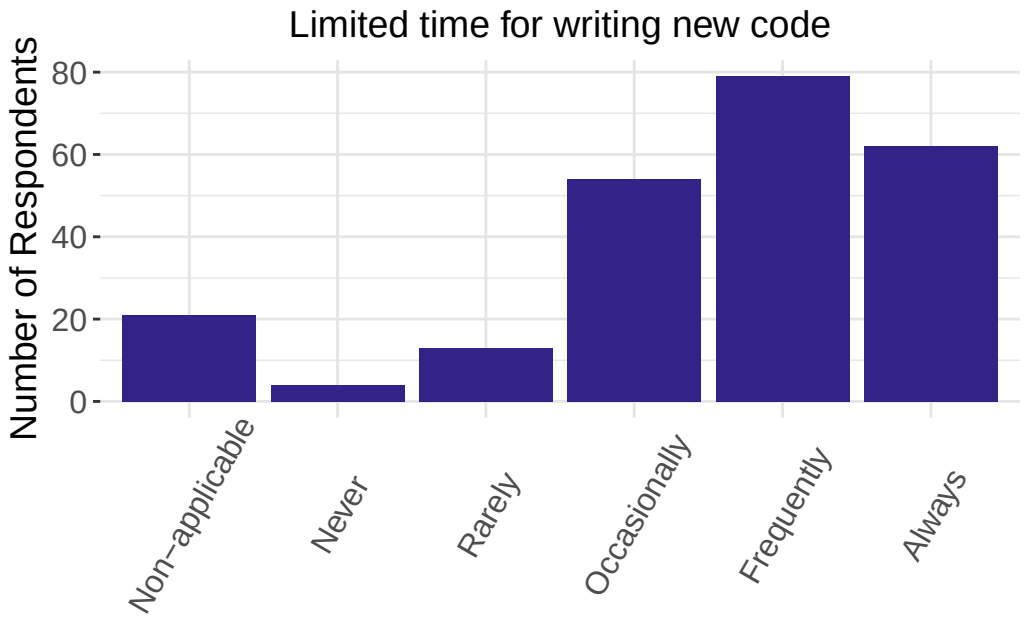
```
# A tibble: 84 x 3
   challenge        challenge_level total
   <chr>            <fct>           <int>
 1 Attracting users Non-applicable     50
 2 Attracting users Never              15
 3 Attracting users Rarely             24
 4 Attracting users Occasionally       53
 5 Attracting users Frequently         52
 6 Attracting users Always             39
 7 Coding time      Non-applicable     21
 8 Coding time      Never               4
 9 Coding time      Rarely             13
10 Coding time      Occasionally       54
# i 74 more rows
```

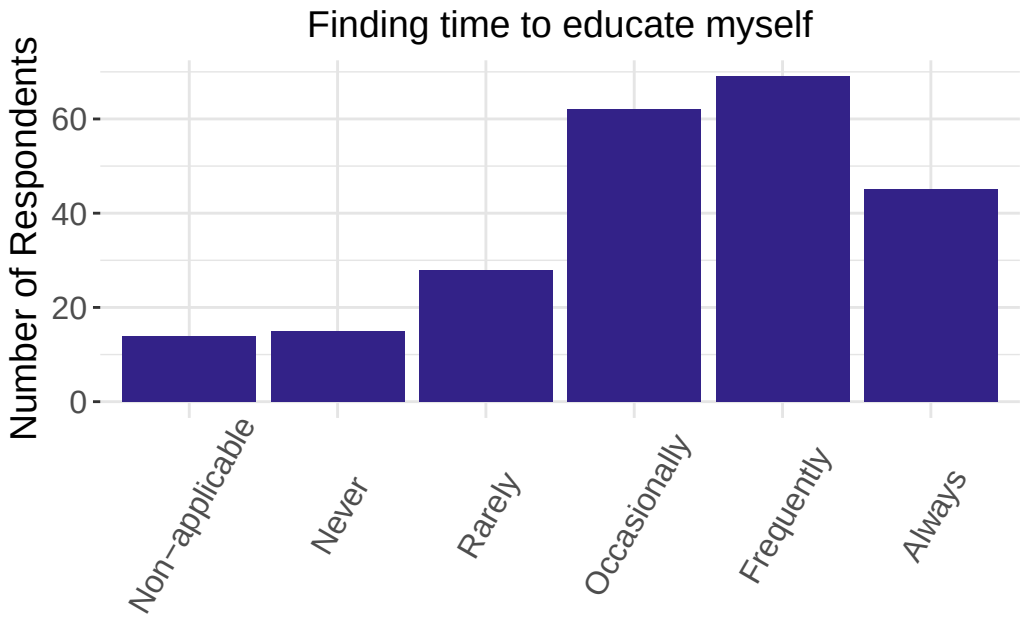
Create a plot for each “challenge”

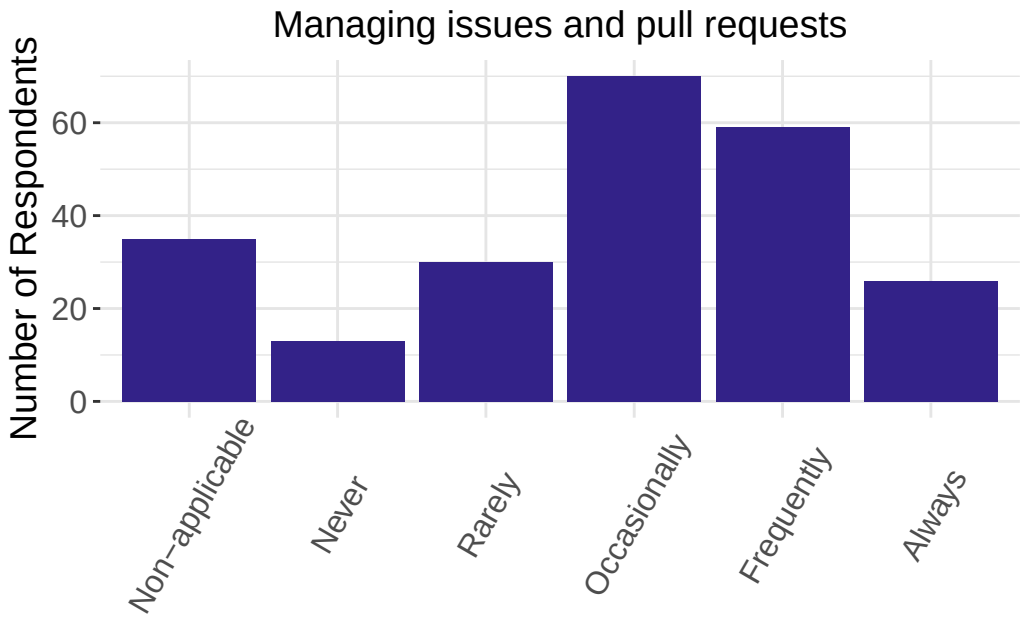
```
titles <- list(
    "Coding time" = "Limited time for writing new code",
    "Documentation time" = "Limited time for writing documentation",
    "Managing issues" = "Managing issues and pull requests",
    "Attracting users" = "Attracting users and/or contributors",
    "Recognition" = "Receiving recognition for my contributions",
    "Hiring" = "Finding and hiring qualified personnel",
    "Security" = "Managing security risks",
```

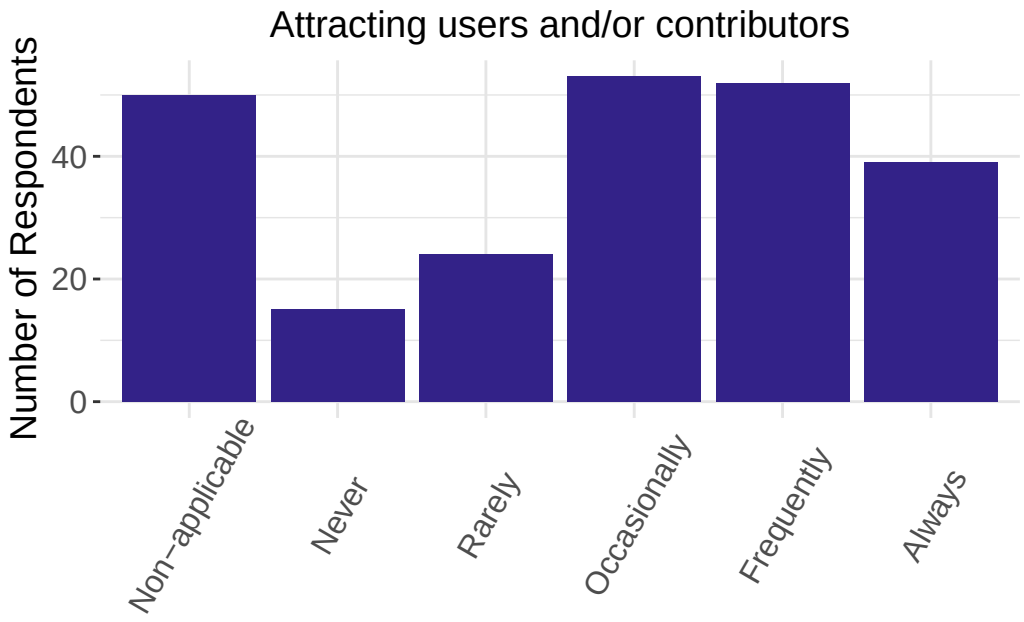
```
    "Finding peers" = "Finding a community of peers who share my interests",
    "Finding mentors" = "Finding mentors",
    "Education time" = "Finding time to educate myself",
    "Educational resources" = "Identifying helpful educational resources",
    "Legal" = "Navigating licensing and other legal issues",
    "Finding funding" = "Identifying potential funding sources\nfor my open source projects"
    "Securing funding" = "Securing funding for my open source projects"
)


for (ch in unique(summary_df$challenge)) {
    # use summary_df to get ordered levels
  df_ch <- filter(to_plot, challenge == ch)
  plot_title <- titles[[ch]]
  p <- basic_bar_chart(
    df_ch,
    x_var     = "challenge_level",
    y_var     = "total",
    title     = plot_title,
    show_grid = TRUE
  )
  print(p) # need to explicitly print
}
```

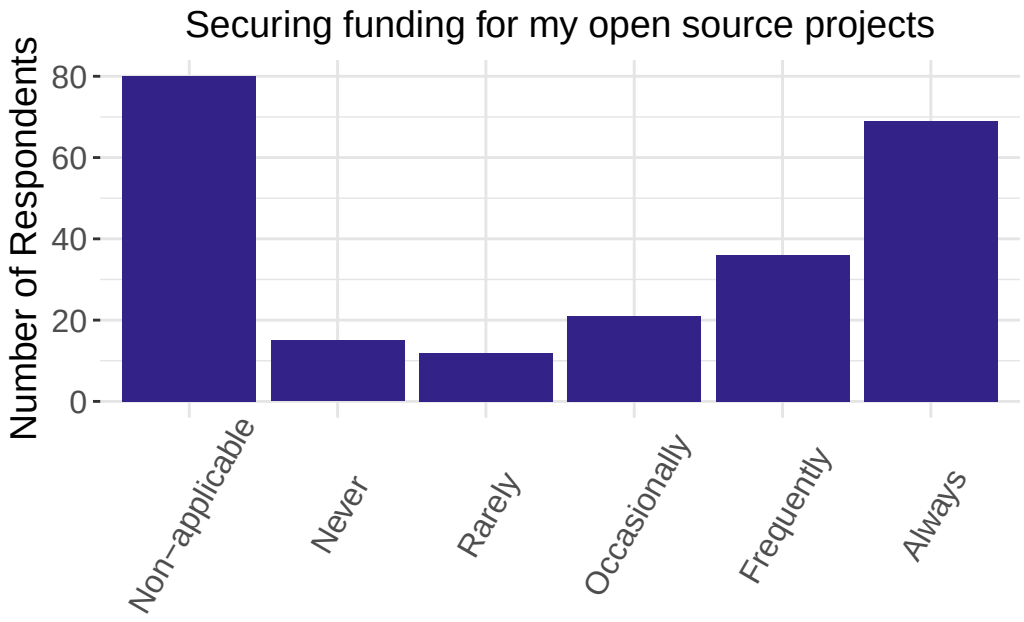

Limited time for writing documentation
Number of Respondents
100
75
50
25
0
Non−applicable
Never
Rarely
Occasionally
Frequently
Always

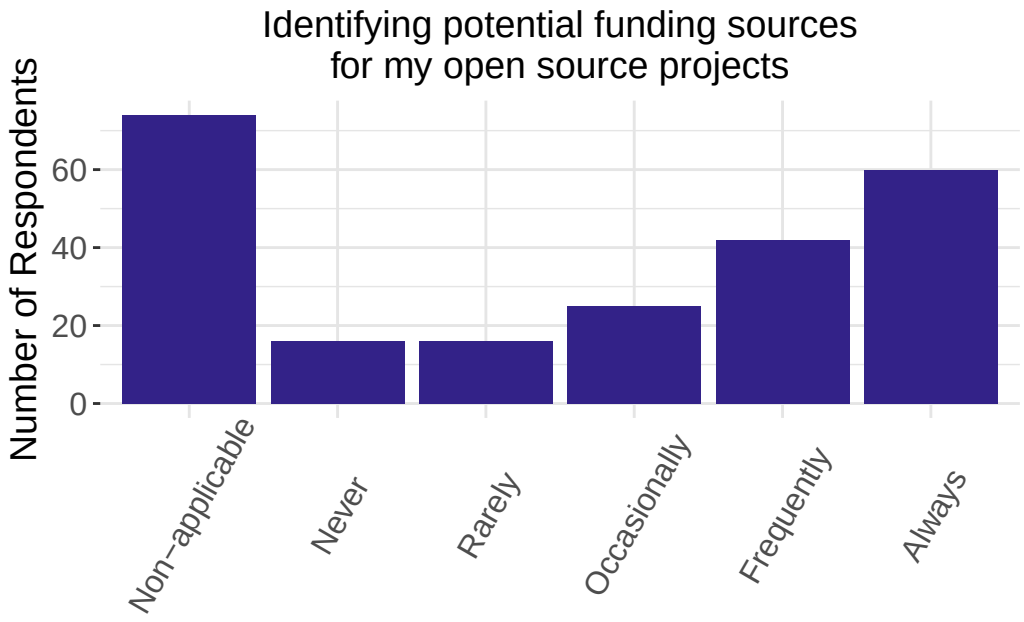

Limited time for writing new code
Number of Respondents
80
60
40
20
0
Non−applicable
Never
Rarely
Occasionally
Frequently
Always

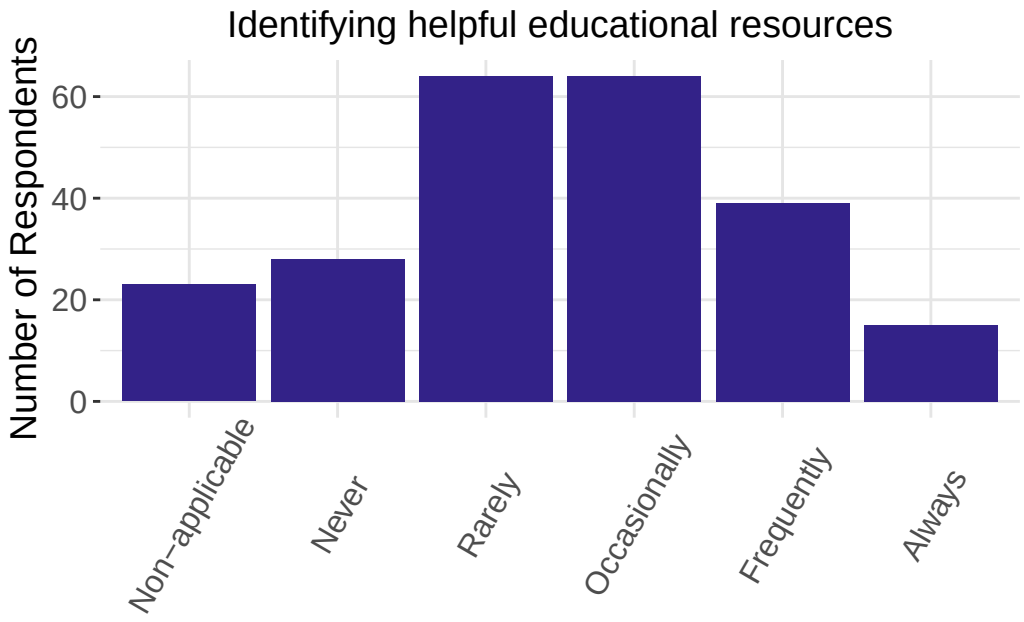

Finding time to educate myself
Number of Respondents
0
20
40
60
Non−applicable
Never
Rarely
Occasionally
Frequently
Always

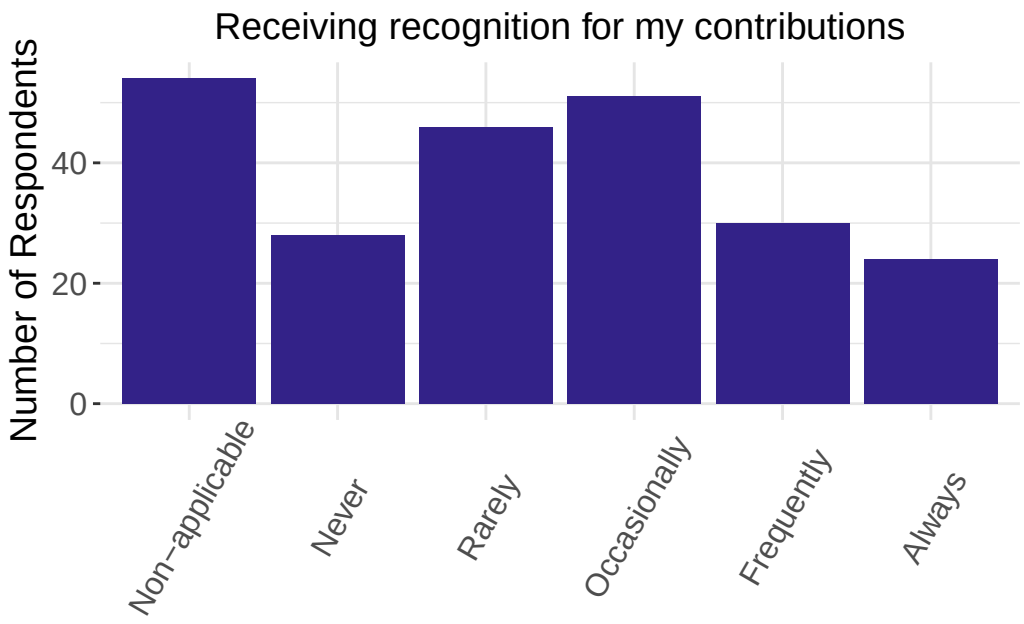

Managing issues and pull requests
Number of Respondents
0
20
40
60
Non−applicable
Never
Rarely
Occasionally
Frequently
Always

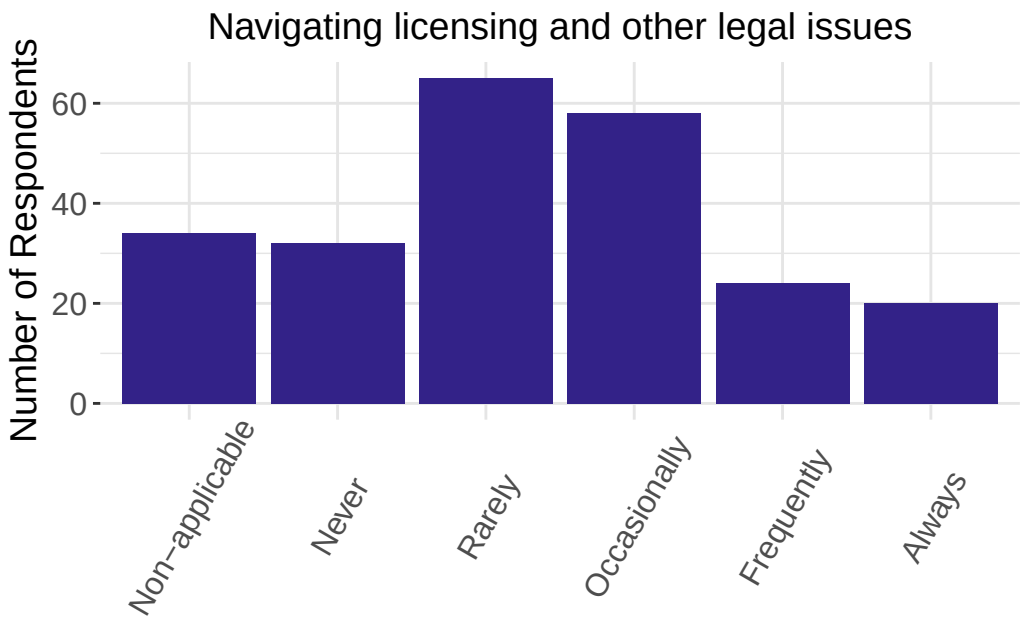

Attracting users and/or contributors
Number of Respondents
0
20
40
Non−applicable
Never
Rarely
Occasionally
Frequently
Always

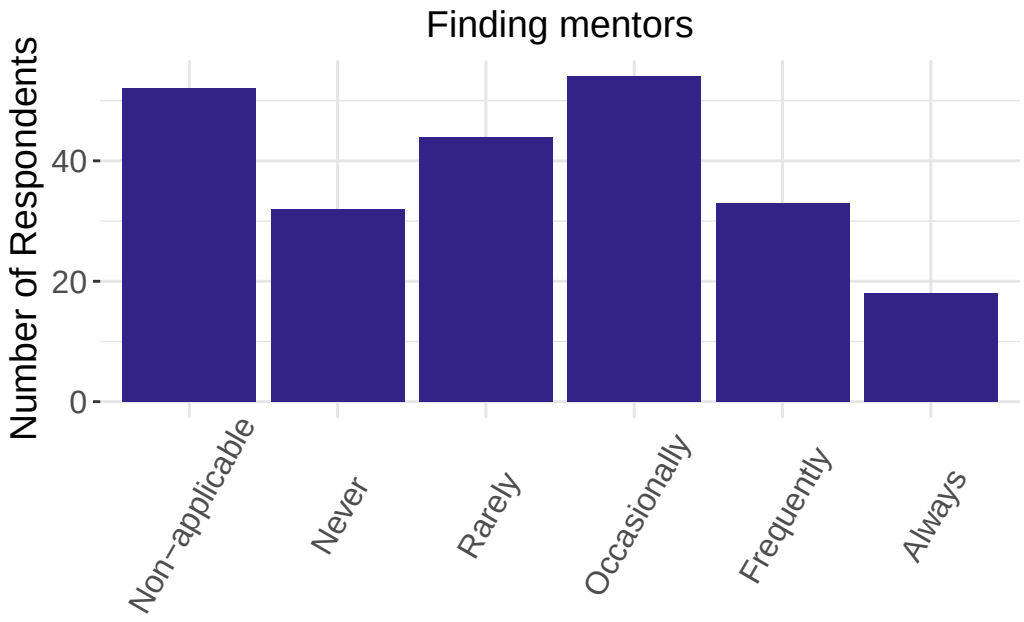

Securing funding for my open source projects
Number of Respondents
0
20
40
60
80
Non−applicable
Never
Rarely
Occasionally
Frequently
Always

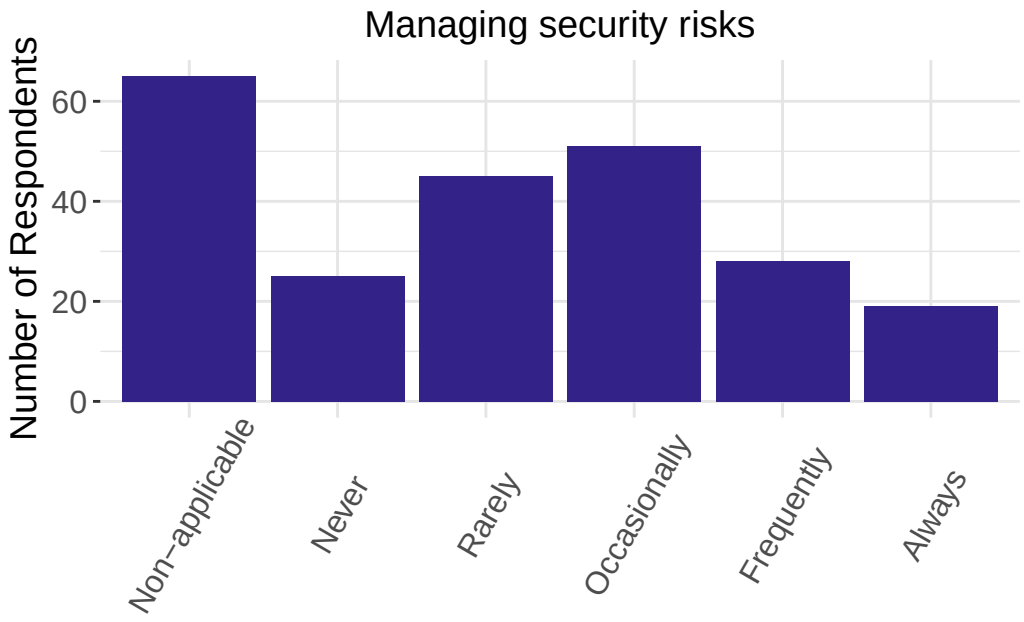

Identifying potential funding sources
for my open source projects
Number of Respondents
0
20
40
60
Non−applicable
Never
Rarely
Occasionally
Frequently
Always


Identifying helpful educational resources
Number of Respondents
0
20
40
60
Non−applicable
Never
Rarely
Occasionally
Frequently
Always

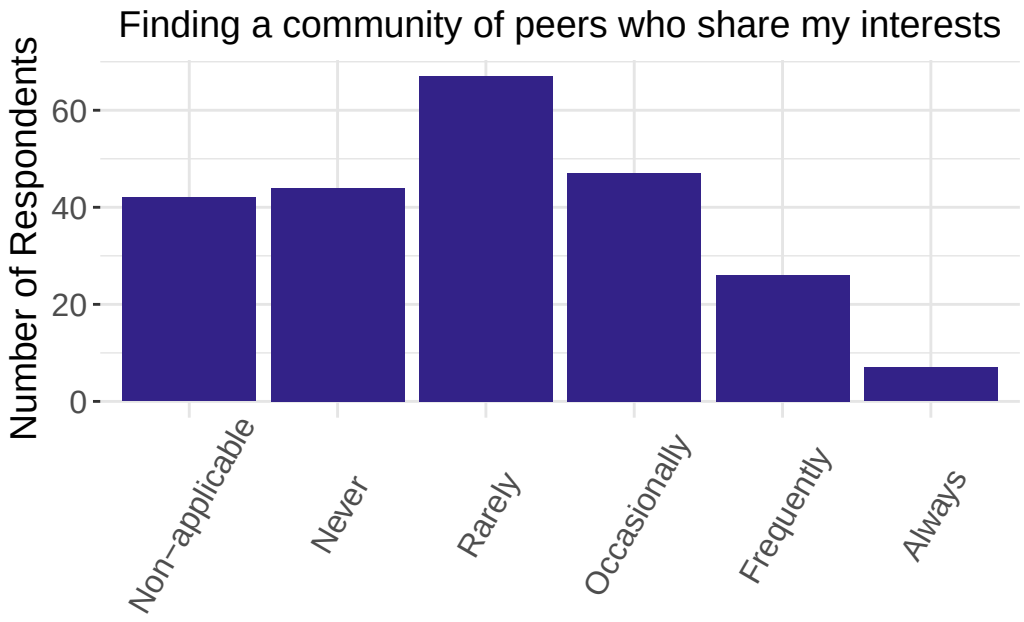

Receiving recognition for my contributions
Number of Respondents
0
20
40
Non−applicable
Never
Rarely
Occasionally
Frequently
Always


Navigating licensing and other legal issues
Number of Respondents
0
20
40
60
Non−applicable
Never
Rarely
Occasionally
Frequently
Always


Finding mentors
Number of Respondents
0
20
40
Non−applicable
Never
Rarely
Occasionally
Frequently
Always


Managing security risks
Number of Respondents
0
20
40
60
Non−applicable
Never
Rarely
Occasionally
Frequently
Always


Finding and hiring qualified personnel
Number of Respondents
90
60
30
0
Non−applicable
Never
Rarely
Occasionally
Frequently
Always


Finding a community of peers who share my interests
Number of Respondents
60
40
20
0
Non−applicable
Never
Rarely
Occasionally
Frequently
Always