Solutions

Overview

This script makes some plots from Q10, which is about what solutions participants would find most useful.

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

Wrangle data

```r
solutions <- data %>%
  select(
    starts_with("solution_offerings")
  )
```

```r
head(solutions)
```

```
  solution_offerings_1 solution_offerings_2 solution_offerings_3
1          Very useful          Very useful          Very useful
2               Useful          Very useful          Very useful
3          Very useful          Very useful          Very useful
4      Not very useful               Useful               Useful
5               Useful      Not very useful               Useful
6
  solution_offerings_4 solution_offerings_5 solution_offerings_6
1          Very useful          Very useful          Very useful
2      Not very useful               Useful       Non-applicable
3          Very useful               Useful               Useful
4          Very useful      Not very useful               Useful
5          Very useful      Not very useful      Not very useful
6
  solution_offerings_7 solution_offerings_8 solution_offerings_9
1          Very useful          Very useful          Very useful
2          Very useful          Very useful          Very useful
3               Useful      Not very useful          Very useful
4      Not very useful      Not very useful               Useful
5               Useful          Very useful               Useful
6
  solution_offerings_10 solution_offerings_11 solution_offerings_12
1           Very useful           Very useful           Very useful
2                Useful           Very useful                Useful
3           Very useful           Very useful           Very useful
4       Not very useful           Very useful           Very useful
5                Useful           Very useful                Useful
6
```

STOP!! Presumably, “solution_offerings_1” corresponds to the first option, “solution_offerings_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. “Access to free, feature-rich computing environments”, not just “solution_offerings_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, solutions)

# # Next, I run this line repeatedly with different emails,
# # to make sure that this person's response to "solution_offerings_1"
# # matches their response to "Access to free, feature-rich computing environments", etc.
# subset(t, startsWith(stay_in_touch_email, "PERSON_NAME_HERE"))
```

My assumption above was correct; the options are ordered as expected. Let's rename the columns accordingly.

```
codes <- c(
  "Computing environments" = "solution_offerings_1",
  "Publicity" = "solution_offerings_2",
  "Containerization" = "solution_offerings_3",
  "Documentation help" = "solution_offerings_4",
  "A learning community" = "solution_offerings_5",
  "Event planning" = "solution_offerings_6",
  "Mentoring programs" = "solution_offerings_7",
  "Education" = "solution_offerings_8",
  "Legal support" = "solution_offerings_9",
  "Industry partnerships" = "solution_offerings_10",
  "Sustainability grants" = "solution_offerings_11",
  "Help finding funding" = "solution_offerings_12"
)
solutions <- rename(solutions, any_of(codes))
```

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(solutions)
```

```
[1] 332
```

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

```
[1] 233
```

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

```
long_data <- solutions %>%
  pivot_longer(
    cols = everything(),
    names_to = "solution",
    values_to = "utility"
  )

long_data <- long_data %>%
  mutate(
    utility_score = recode(
      utility,
      "Non-applicable" = 0L,
      "Not very useful" = 0L,
      "Useful" = 1L,
      "Very useful" = 2L
    )
  )
# Using interger literals 0L, 1L, etc., ensures that
# the new column will be integers, not doubles.

long_data
```

```
# A tibble: 2,796 x 3
   solution                utility     utility_score
   <chr>                   <chr>               <int>
 1 Computing environments  Very useful             2
 2 Publicity               Very useful             2
 3 Containerization        Very useful             2
 4 Documentation help      Very useful             2
 5 A learning community    Very useful             2
 6 Event planning          Very useful             2
 7 Mentoring programs      Very useful             2
 8 Education               Very useful             2
 9 Legal support           Very useful             2
10 Industry partnerships   Very useful             2
# i 2,786 more rows
```

Next, let's calculate some simple descriptive statistics. I will choose: * The total "score", that is, the total number of "points" a solution received (see scoring scheme in previous code chunk) * The mean (which might be misleading if 0s drag it down, and also, who's to say what a 1.5 really means? Are the distances between the Likert points equal? We don't know.) * The mode * The standard deviation

```
# 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(solution) %>%
  summarise(
    total  = sum(utility_score),
    mean   = mean(utility_score, na.rm = TRUE),
    mode   = get_mode(utility_score),
    st_dev = sd(utility_score, na.rm = TRUE)
  ) %>%
  ungroup()

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

summary_df
```

```
# A tibble: 12 x 5
   solution                total  mean  mode st_dev
   <chr>                   <int> <dbl> <int>  <dbl>
 1 Sustainability grants     353 1.52      2  0.732
 2 Help finding funding      316 1.36      2  0.764
 3 Computing environments    301 1.29      2  0.783
 4 A learning community      251 1.08      1  0.733
 5 Documentation help        248 1.06      1  0.788
 6 Legal support             242 1.04      1  0.762
 7 Education                 236 1.01      1  0.801
 8 Industry partnerships     232 0.996     0  0.838
 9 Publicity                 232 0.996     1  0.817
10 Mentoring programs        216 0.927     1  0.776
11 Containerization          203 0.871     0  0.820
```

```
12 Event planning           190 0.815     0  0.807
```

Cool. It looks like sustainability grants are by far the most popular, with assistance identifying funding sources and free computing environments in second and third place. These were the only three solutions that had a mode of 2.

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

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

sd_df
```

```
# A tibble: 12 x 5
   solution                total  mean  mode st_dev
   <chr>                   <int> <dbl> <int>  <dbl>
 1 Industry partnerships     232 0.996     0  0.838
 2 Containerization          203 0.871     0  0.820
 3 Publicity                 232 0.996     1  0.817
 4 Event planning            190 0.815     0  0.807
 5 Education                 236 1.01      1  0.801
 6 Documentation help        248 1.06      1  0.788
 7 Computing environments    301 1.29      2  0.783
 8 Mentoring programs        216 0.927     1  0.776
 9 Help finding funding      316 1.36      2  0.764
10 Legal support             242 1.04      1  0.762
11 A learning community      251 1.08      1  0.733
12 Sustainability grants     353 1.52      2  0.732
```

This analysis doesn't seem as interesting as it was for the challenges. Industy partnerships, Containerization, and Publicity all show high variance/stdev. These were also somewhat less popular.

Out of curiosity, how many people said they would all be very useful?

```
t <- solutions %>%
    filter(if_all(.cols=everything(), ~ . == "Very useful"))

nrow(t)
```

```
[1] 14
```

Ah, ok. Not that many.

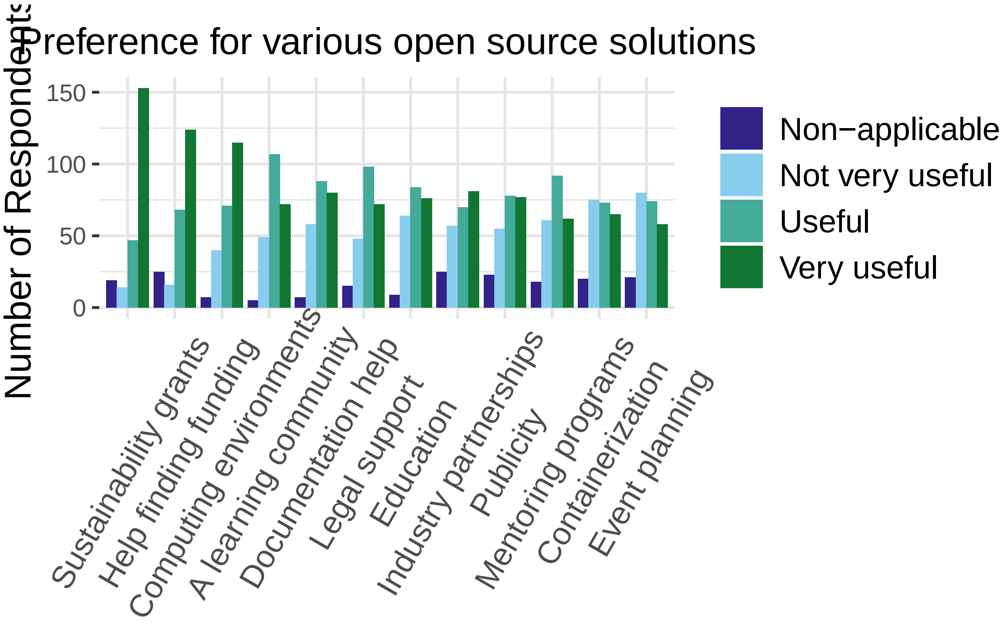
Plot the distributions

Prepare data for plotting.

```
ordered_levels <- (summary_df %>%
    arrange(desc(total)))$solution

long_data$solution <- factor(long_data$solution, levels = ordered_levels)
```

Grouped bar chart showing the distributions of answers.

```
grouped_plot <- grouped_bar_chart(
  df = long_data,
  x_var = "solution",
  fill_var = "utility",
  title = "Preference for various open source solutions"
)

grouped_plot
```



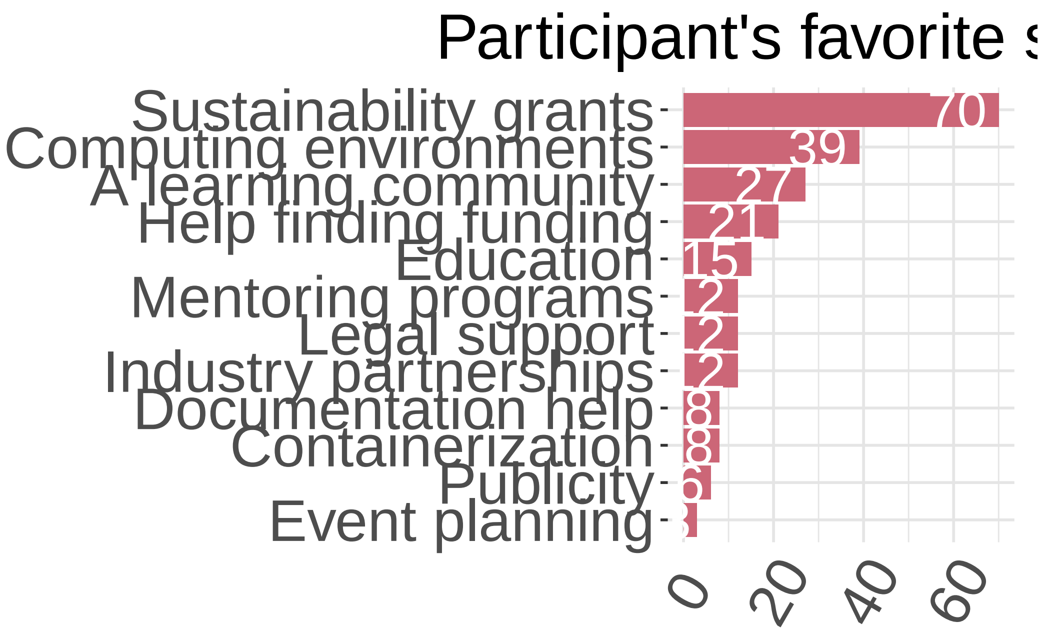
Save the plot if you wish.

```
save_plot("fave_solutions.tiff", 10, 6, p=grouped_plot)
```

Now let's make a simpler bar plot from the next question, which asked participants to choose their favorite solution.

```
favorites <- data.frame(data$favorite_solution)
favorites <- exclude_empty_rows(favorites) # from scripts/utils.R

codes2 <- c(
  "Access to" = "Computing environments",
  "Assistance promoting" = "Publicity",
  "Assistance creating" = "Containerization",
  "Assistance writing" = "Documentation help",
  "An open source" = "A learning community",
  "Assistance with" = "Event planning",
  "A mentor" = "Mentoring programs",
  "Educational" = "Education",
  "Legal" = "Legal support",
  "Assistance building" = "Industry partnerships",
  "Dedicated" = "Sustainability grants",
  "Assistance identifying" = "Help finding funding"
)

favorites <- shorten_long_responses(favorites, codes2)

fav_to_plot <- data.frame(table(favorites[,1]))
# from scripts/utils.R
fav_to_plot <- reorder_factor_by_column(
  df = fav_to_plot,
  factor_col = Var1,
  value_col = Freq,
  descending = FALSE
)
```

```
faves_plot <- basic_bar_chart(
  df = fav_to_plot,
  x_var = "Var1",
  y_var = "Freq",
  title = "Participant's favorite solution",
  show_axis_title_y = FALSE,
  ylabel = "Number of Respondents",
  show_bar_labels = TRUE,
  color_index = 7,
  horizontal = TRUE
)

faves_plot
```



Save the plot if you wish.

```
save_plot("fave_solutions.tiff", 10, 6, p=faves_plot)
```