Quiz 1 Solutions

Data Science for Studying Language & the Mind

Estimated time: 30 minutes

You may need more time if programming is completely new to you, or less if you have some experience already.

Instructions

- The quiz is closed book/note/computer/phone
- If you need to use the restroom, leave your exam and phone with the TA
- You have 60 minutes to complete the quiz. If you finish early, you may turn in your quiz and leave early

Name: _____
PennKey: _____

Lab section TA: _____

Score by topic area

R basics: general	
R basics: vectors, operations, subsetting	
Data importing	
Data visualization: basics	
Data visualization: layers	
Data wrangling	
Total	

1 R basics: general

(a) Suppose you run the following code. Which command could you run to remove the `y` variable from the current environment? Choose all that apply.

```
x <- 1 + 2
y <- 3 + 4
z <- 0
```

- ☐ `ls(y)`
- ☐ `rm(list = ls())`
- ☒ `rm(y)`
- ☐ `remove(y)`

We will also accept `rm(list = ls())` in addition to `rm(y)`, since it technically removes `y` (as well as all of the other variables!)

(b) Write an expression that would assign the value `10` to the variable name `my_var`?

```
my_var <- 10
```

We will not accept `my_var = 10` since we discussed explicitly not using the = operator for this purpose in class

(c) Which of the following would install the `praise` package? Choose all that apply.

- ☐ `library(praise)`
- ☐ `install(praise)`
- ☒ `install.packages("praise")`
- ☐ `install.packages(praise)`

(d) Suppose you run the following code. Which functions would return the structure of the object you defined? Choose one.

```
x <- c("bus", "stop")
```

- ☐ `length(x)`
- ☐ `print(x)`
- ☒ `str(x)`
- ☐ `attributes(x)`
- ☐ None of the above

2 R basics: vectors, operations, subsetting

(a) Suppose you run the following code. What will length(x) return? Write your answer in the box below.

```r
x <- 1:5
```

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(b) Suppose you run the following code. What will `y > 4` return? Write your answer in the box below and **show your work**.

```r
x <- seq(2, 8, by = 2)
y <- x[c(-4)]
```

`x returns: 2 4 6 8`

`y returns: 2 4 6`

`y > 4 returns: FALSE FALSE TRUE`

(c) Suppose you run the following code. What will `typeof(x)` return?

```r
x <- c("true", "false", "true", "false")
```

- ☐ `double`
- ☐ `integer`
- ☒ `character`
- ☐ `logical`

(d) Suppose you create the following data frame and assign it to the `df` variable. What will `sum(df$antique)` return?

```
  antique age show
1       1   2    a
2       2   3    b
3       3   4    c
```

- ☐ NULL
- ☐ Error: no columns include value "antique"
- ☒ 6
- ☐ 9
- ☐ 15

3 Data importing

(a) Which of the following will load the `readr` package into the current environment? Choose all that apply.

- ☒ `library(tidyverse)`
- ☒ `library(readr)`
- ☐ `install.packages("tidyverse")`
- ☐ `install.packages("readr")`
- ☐ `import(tidyverse)`
- ☐ `import(readr)`

(b) Suppose `print(x)` returns the following. What will `is.data.frame(x)` return? Write your answer in the box below.

```
# A tibble: 4 x 3
      x     y     z
  <int> <int> <int>
1     1     5     9
2     2     6    10
3     3     7    11
4     4     8    12

is.data.frame(x) returns:  TRUE
```

(c) Suppose you import "junesales.csv", shown below, with the following code. What would `data$Sale` return? Choose one.

```
Year, Month, Day, Sale
2023, June, 1, 0
2023, June, 2, 1
2023, June, 3, 0
2023, June, 4, 1
```

```r
data <- read_csv("junesales.csv",
    col_types = list(Sale = col_logical())
)
```

- ☐ A `double` vector with values `0 1 0 1`
- ☒ A `logical` vector with values `FALSE TRUE FALSE TRUE`
- ☐ A double vector with values `NA NA NA NA`
- ☐ `NULL`

(d) Suppose you import a dataset with `readr`, but when you `print(data)` you notice that the `age` column was identified as `character` when you were expecting `double`. Given the resulting tibble, which of the following arguments could you include in blank in the code below to solve this problem?

```
# A tibble: 4 x 3
  age   graduated   gpa
  <chr> <lgl>     <dbl>
1 18    FALSE      NA
2 na    FALSE       3.8
3 25    TRUE        2.9
4 21    TRUE        3.1
```

```
data <- read_csv("data.csv", ________)
```

- ☐ `.drop = NA`
- ☐ `skip = 1`
- ☐ `guess_max = Inf`
- ☒ `na = c("na")`
- ☐ `col_names = FALSE`

4 Data visualization: basics

Section 5 makes use of the `durationsGe` dataset and plots A, B, and C in the appendix.

(a) Which of the plots above (A and B) did the code blocks below generate?

```
# code 1
ggplot(durationsGe, aes(x = DurationOfPrefix, fill = Sex)) +
    geom_density(fill = "lightgray") +
    theme_classic(base_size = 12) +
    labs(y = "") +
    scale_fill_manual(values = c("white", "gray", "black"))
# code 2
ggplot(durationsGe, aes(x = DurationOfPrefix)) +
    geom_density(fill = "lightgray") +
    theme_classic(base_size = 12) +
    labs(y = "")
```

☐ Code 1 generates plot A, code 2 generates plot B
☐ Code 2 generates plot A, code 1 generates plot B
☒ Code 1 and 2 both generate plot A
☐ Code 1 and 2 both generate plot B
☐ Code 1 and 2 generate neither plot A nor plot B

Because in code 1 the local setting in geom_density overwrites the global fill in ggplot()

(b) Which geoms could be depicted in plots A and B? Choose all that apply.

☐ `geom_histogram()`
☐ `geom_smooth()`
☐ `geom_line()`
☒ `geom_density()`
☐ `geom_bar()`

(c) True or false, the following code blocks generate the same figure. Write your answer in the following box and **explain why**.

```
# code block 1
ggplot(
    data=durationsGe,
    mapping = aes(y = DurationOfPrefix, x = Sex)) +
        geom_bar(stat = "identity")

# code block 2
  ggplot(
    aes(y = DurationOfPrefix, x = Sex),
    durationsGe) +
        geom_bar(stat = "identity")
```

FALSE. In code block 2, ggplot expects data to be the first argument when arguments are implicit

(d) The code below makes use of a new geom, `geom_rug()`, to generate plot C, in which each individual data point is plotted along the x-axis like a "rug". In the box below, rewrite the code such the color of the rug is mapped to the `Sex` variable and the bars of the histogram are filled in with the color "lightblue".

```
ggplot(durationsGe, aes(x = DurationOfPrefix)) +
    geom_rug() +
    geom_histogram() +
    theme_classic(base_size = 12)
```

```
# answer
ggplot(durationsGe, aes(x = DurationOfPrefix)) +
    geom_rug(mapping = aes(color = Sex)) +
    geom_histogram(color = "lightblue") +
    theme_classic(base_size = 12)
```

5 Data visualization: layers

Section 5 makes use of the `durationsGe` dataset and plots D, E, and F in the appendix.

(a) Which of the following would add a small amount of random noise around each point in plot D? Choose all that apply.

- ☒ add the argument `position = "jitter"` to `geom_point()`
- ☐ add the argument `position = "random"` to `geom_point()`
- ☐ add the argument `rand_noise = TRUE` to `geom_point()`
- ☒ replace `geom_point()` with `geom_jitter()`
- ☐ replace `geom_point()` with `geom_noise()`

(b) Which of the following could change plot D to plot E? Choose all that apply

- ☒ add `facet_wrap(~Sex)`
- ☐ add `facet_wrap(~Sex, ncol = 2)`
- ☒ add `facet_wrap(~Sex, ncol = 3)`
- ☐ add `facet_grid(Sex~.)`
- ☒ add `facet_grid(.~Sex)`
- ☐ add `facet(.by = c(Sex))`

(c) Which of the following arguments to `geom_histogram()` could be present in the code that returned plot F? Choose all that apply.

- ☒ `bins=12`
- ☐ `bins=11`
- ☒ `binwidth=1`
- ☐ `binwidth=3`
- ☐ `stat="identity"`

(d) Which of the following layers are required to produce plot F? Note that the plot uses the complete theme `theme_minimal()` and the font is 20pt Palatino. Choose all that apply.

- ☐ `theme_minimal(use=TRUE)`
- ☒ `theme_minimal(base_size = 20, base_family = "Palatino")`
- ☒ `labs(title = "Histogram of speech rate")`
- ☐ `font(size=20, family="Palatino")`
- ☐ `scale_fill_manual(values = c("gray"))`

6 Data wrangling

Section 6 makes use of the `durationsGe` dataset in the appendix.

(a) The `Sex` variable in the `durationsGe` dataset has the following distinct values: `"male"` `"female"` `NA`. How many rows would be in the object returned by the following code block? Write your answer in the box below.

```
durationsGe %>%
    filter(Sex %in% c("female")) %>%
    summarise(minBirthYear=min(YearOfBirth, na.rm=TRUE), .by=c(Sex))
```

1

(b) True or false, the following code options are equivalent.

```
# option 1
durationsGe %>%
    select(Frequency) %>%
    filter(Frequency > 40) %>%
    distinct()

# option 2
just_freq <- select(durationsGe, Frequency)
freq_under_40 <- filter(just_freq, Frequency > 40)
distinct(freq_under_40)
```

☒ True
☐ False

(c) Fill in the blank in the code below such that it returns a new column called "count", which counts of the number of rows in the `durationsGe` dataset per `Sex`

```
ratings %>% group_by(Sex) %>% summarise(_________)
```

`count = n()`

(d) True or false, the following code options are equivalent.

```
# option 1
durationsGe %>%
    select(Freq=Frequency, Speaker:DurationOfPrefix) %>%
    mutate(AgeInYears = 2023 - YearOfBirth, .before = Freq)
```

```r
# option 2
durationsGe %>%
    select(Frequency:DurationOfPrefix) %>%
    rename(Freq = Frequency) %>%
    mutate(AgeInYears = 2023 - YearOfBirth, .before = 1)
```

☒ True
☐ False

This page is intentionally blank in case you need scratch paper

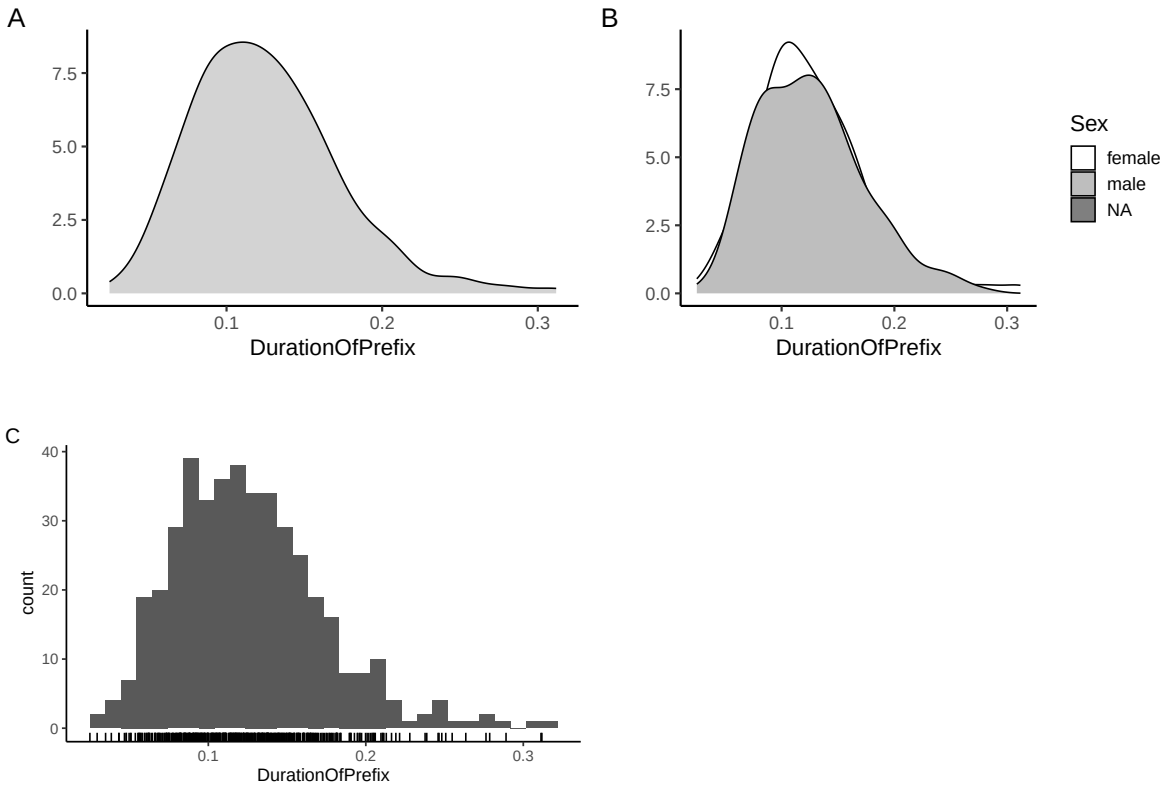
Appendix A: Data

Sections 4-6 make use of `durationsGe` data in the `languageR` package. The dataset includes the duration of the prefix ge- in Dutch by various speakers from the Spoken Dutch Corpus.

```
library(languageR)
glimpse(durationsGe)
```

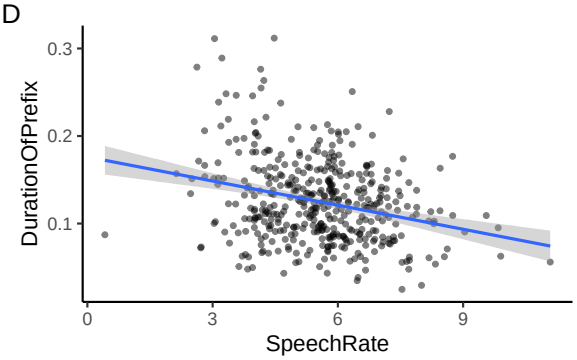
```
Rows: 428
Columns: 8
$ Word                <fct> geprikt, gepresteerd, gevolgd, geprikkeld, gestaak~
$ Frequency           <int> 13, 25, 309, 16, 40, 42, 1301, 10, 73, 19, 39, 6, ~
$ Speaker             <fct> N01159, N01077, N01032, N01128, N01204, N01151, N0~
$ Sex                 <fct> male, male, female, female, female, female, male, ~
$ YearOfBirth         <int> 1944, 1980, 1939, 1979, 1963, 1956, 1979, 1944, 19~
$ DurationOfPrefix    <dbl> 0.238703, 0.082057, 0.120832, 0.106897, 0.133441, ~
$ SpeechRate          <dbl> 3.144654, 6.882591, 6.870229, 7.217848, 5.866667, ~
$ NumberSegmentsOnset <int> 2, 2, 1, 2, 2, 1, 2, 2, 1, 3, 1, 2, 1, 2, 3, 1, 2,~
```

Appendix B: Plots section 4

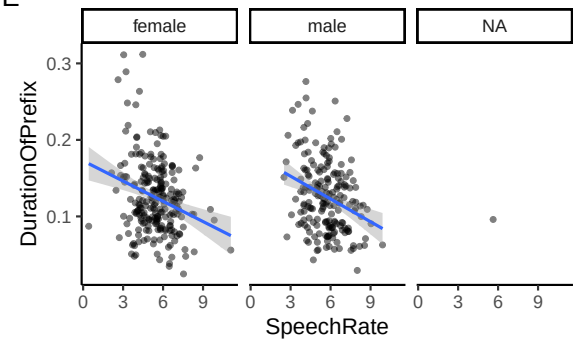


Appendix C: Plots section 5

D



E



F