

R for Data Analytics Part 1, Lecture 2

Michèle Fille

Table of contents

Lecture 2 - R Fundamentals: Functions and Vectors	1
2.1. Functions	1
Exercise 2.1. Functions	1
Exercise 2.1 – Task 1: Calling Built-in Functions	1
Exercise 2.1 – Task 2: Calling Built-in Functions (continued)	2
Exercise 2.1 – Task 3: Writing and Executing Functions	4
Self-Study 2.1. Functions	5
Self-Study 2.1 - Task 1: Using Built-In String Functions	5
Self-Study 2.1 - Task 2: Functions and Conditionals	6
sprintf (additional input from Michèle)	9
2.2. Vectors	9
Exercise 2.2. Vectors	9
Exercise 2.2 – Task 1: Creating Vectors and Operating on Vectors	9
Exercise 2.2 – Task 2: Indexing and Filtering Vectors	11
Self-Study 2.2. Vectors	12
Self-Study 2.2 - Task 1: Creating Vectors and Operating on Vectors	12
Self-Study 2.2 - Task 2: Indexing and Filtering Vectors	15
Self-Study 2.2 - Task 3: Vector Practice	16

Lecture 2 - R Fundamentals: Functions and Vectors

2.1. Functions

Exercise 2.1. Functions

Exercise 2.1 – Task 1: Calling Built-in Functions

a) Create a variable `my_name` that contains your name

b) Create a variable `name_length` that holds how many letters (including spaces) are in your name.

- Hint: Use `nchar()`.

c) Print the number of letters in your name

d) Create a variable `now_doing` that is your name followed by “is programming!”.

- Hint: Use `paste()`.

e) Make the `now_doing` variable upper case. Hint: Use the `toupper()` function.

```
my_name <- "Michèle Fille"
name_length <- nchar(my_name)
name_length
```

```
[1] 13
```

```
now_doing <- paste(my_name, "is programming")
toupper(now_doing)
```

```
[1] "MICHÈLE FILLE IS PROGRAMMING"
```

Exercise 2.1 – Task 2: Calling Built-in Functions (continued)

a) Pick two of your favorite numbers (between 1 and 100) and assign them to variables `fav_1` and `fav_2`

b) Divide each number by the square root of 201 and save the new value in the original variable.

c) Create a variable `raw_sum` that is the sum of the two variables. Use the `sum()` function for practice.

d) Create a variable `round_sum` that is the `raw_sum` rounded to 1 decimal place. Use the `round()` function.

e) Create two new variables `round_1` and `round_2` that are your `fav_1` and `fav_2` variables rounded to 1 decimal places.

f) Create a variable `sum_round` that is the sum of the rounded values.

g) Which is bigger, `round_sum` or `sum_round`? (You can use the `max()` function!)

```
fav_1 <- 7
fav_2 <- 11

fav_1 <- fav_1 / (sqrt(201))
fav_2 <- fav_2 / (sqrt(201))
fav_1
```

```
[1] 0.4937419
```

```
fav_2
```

```
[1] 0.7758802
```

```
raw_sum <- sum(fav_1,fav_2)
raw_sum
```

```
[1] 1.269622
```

```
round_sum <- round(raw_sum, 1)
round_sum
```

```
[1] 1.3
```

```
round_1 <- round(fav_1, 1)
round_2 <- round(fav_2, 1)
round_1
```

```
[1] 0.5
```

```
round_2
```

```
[1] 0.8
```

```
sum_round <- sum(round_1, round_2)
sum_round
```

```
[1] 1.3
```

```
max(round_sum, sum_round)
```

```
[1] 1.3
```

Exercise 2.1 – Task 3: Writing and Executing Functions

- a) Define a function `add_three()` that takes a single argument and returns a value that is 3 greater than the input.
- b) Create a variable `ten` that is the result of passing 7 to your `add_three` function.
- c) Define a function `imperial_to_metric()` that takes in 2 arguments: a number of feet and a number of inches. The function should return the equivalent length in meters.

- Remark: Look up the conversion formula with your preferred web browser.

- d) Create a variable `height_in_meters` by passing your height in imperial to your `imperial_to_metric()` function.

```
add_three <- function(num){
  result <- num + 3
  return(result)
}
```

```
ten <- add_three(7)
ten
```

```
[1] 10
```

```
imperial_to_metric <- function(feet, inches) {
  total_inches <- feet * 12 + inches
  meters <- total_inches * 0.0254
  meters # return the value in meters
}
```

```
height_in_meters <- imperial_to_metric(5,4)
height_in_meters
```

```
[1] 1.6256
```

Self-Study 2.1. Functions

Self-Study 2.1 - Task 1: Using Built-In String Functions

- a) Create a variable lyric that contains the text “I like to eat apples and bananas”.
- b) Use the substr() function to extract the 1st through 13th letters from lyric, and store the result in a variable called intro.

- Hint: Use ?substr to see more about this function.

- c) Use the substr() function to extract the 15th through the last letter of lyric, and store the result in a variable called fruits.

- Hint: Use nchar() to determine how many total letters there are!

- d) Use the gsub() function to substitute all the “a”s in fruits with “ee”. Store the result in a variable called fruits_e.

- Hint: use ?gsub to see more about the function and see <http://www.endmemo.com/program/R/sub.php> for a simple example.

- e) Use the gsub() function to substitute all the “a”s in fruits with “o”. Store the result in a variable called fruits_o

- f) Create a new variable lyric_e that is the intro combined with the new fruits_e ending. Print out this variable.

- g) Without making a new variable, print out the intro combined with the new fruits_o ending.

```
lyric <- "I like to eat apples and bananas."

intro <- substr(lyric, start = 1, stop = 13)
intro
```

```
[1] "I like to eat"
```

```
fruits <- substr(lyric, start = 15, stop = nchar(lyric))
fruits
```

```
[1] "apples and bananas."
```

```
fruits_e <- gsub("a", "ee", fruits)
fruits_e
```

```
[1] "eepples eend beeneenees."
```

```
fruits_o <- gsub("a", "o", fruits)
fruits_o
```

```
[1] "opples ond bononos."
```

```
lyric_e <- paste(intro, fruits_e)
lyric_e
```

```
[1] "I like to eat eepples eend beeneenees."
```

```
paste(intro, fruits_o)
```

```
[1] "I like to eat opples ond bononos."
```

Self-Study 2.1 - Task 2: Functions and Conditionals

a) Define a function `is_twice_as_long()` that takes in two character strings, and returns whether or not (e.g., a boolean) the length of one argument is greater than or equal to twice the length of the other.

- Hint: Compare the length difference to the length of the smaller string

b) Call your `is_twice_as_long()` function by passing it different length strings to confirm that it works.

- Hint: Make sure to check when either argument is twice as long, as well as when neither are!

c) Define a function `describe_difference()` that takes in two strings. The function should return one of the following sentences as appropriate:

- “Your first string is longer by N characters”
- “Your second string is longer by N characters”
- “Your strings are the same length!”

d) Call your `describe_difference()` function by passing it different length strings to confirm that it works.

- Hint: Make sure to check all 3 conditions!

```
is_twice_as_long <- function(string_1, string_2){  
  len_1 <- nchar(string_1)  
  len_2 <- nchar(string_2)  
  
  if (len_1 >= 2 * len_2 || len_2 >= 2 * len_1) {  
    return(TRUE)  
  } else {  
    return(FALSE)  
  }  
}  
  
is_twice_as_long("Michele", "M")
```

```
[1] TRUE
```

```
is_twice_as_long("M", "Michele")
```

```
[1] TRUE
```

```
is_twice_as_long("Michele", "Michele")
```

```
[1] FALSE
```

```
# or
```

```
is_twice_as_long_gwen <- function(str1, str2) {
```

```

diff <- abs(nchar(str1) - nchar(str2))
min_length <- min(nchar(str1), nchar(str2))
diff >= min_length # if difference is more than short
}

```

```
is_twice_as_long_gwen("Michele", "M")
```

[1] TRUE

```

describe_difference <- function(string_1, string_2){
  len_1 = nchar(string_1)
  len_2 = nchar(string_2)

  if (len_1 > len_2) {
    difference = len_1 - len_2
    return(sprintf("Your first string is longer by %d characters", difference))
  } else if (len_2 > len_1) {
    difference = len_2 - len_1
    return(sprintf("Your second string is longer by %d characters", difference))
  } else {
    return("Your strings are the same length!")
  }
}

```

```
describe_difference("Michele", "M")
```

[1] "Your first string is longer by 6 characters"

```
describe_difference("M", "Michele")
```

[1] "Your second string is longer by 6 characters"

```
describe_difference("Michele", "Michele")
```

[1] "Your strings are the same length!"


```
# or

describe_difference_gwen <- function(first, second) {
  diff <- nchar(first) - nchar(second)
  if (diff > 0) {
    sentence <- paste("Your first string is longer by", diff, "characters")
  } else if (diff < 0) {
    sentence <- paste("Your second string is longer by", -diff, "characters")
  } else {
    sentence <- "Your strings are the same length!"
  }
  sentence # return the sentence
}
```

sprintf (additional input from Michèle)

In R, `sprintf()` supports several placeholders for different types of values. Here are the main ones:

- `%d`: Represents an integer value.
- `%f`: Represents a floating-point value (decimal number).
- `%s`: Represents a string value.
- `%x`, `%X`: Represents an integer value in hexadecimal format (lowercase or uppercase).
- `%o`: Represents an integer value in octal format.
- `%e`, `%E`: Represents a floating-point value in scientific notation (lowercase or uppercase).
- `%g`, `%G`: Represents a floating-point value, using `%f` or `%e` depending on the magnitude of the value (lowercase or uppercase).

2.2. Vectors

Exercise 2.2. Vectors

Exercise 2.2 – Task 1: Creating Vectors and Operating on Vectors

- Create a vector `names` that contains your name and the names of 2 people next to you. Print the vector.
- Use the colon operator `:` to create a vector `n` of numbers from 10 to 49.

- Use the `length()` function to get the number of elements in `n`.
- Add 1 to each element in `n` and print the result.

c) Create a vector `m` that contains the numbers 10 to 1 (in that order).

- Hint: use the `seq()` function.

d) Subtract the `m` FROM `n`.

- Remark: Note the recycling!

```
names <- c("Michèle", "Rahel", "Jervin")
print(names)
```

```
[1] "Michèle" "Rahel"   "Jervin"
```

```
n <- 10:49
print(n)
```

```
[1] 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34
[26] 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49
```

```
length(n)
```

```
[1] 40
```

```
print(n+1)
```

```
[1] 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
[26] 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
```

```
m <- seq(10,1)
print(m)
```

```
[1] 10 9 8 7 6 5 4 3 2 1
```

```
result <- n-m  
print(result)
```

```
[1]  0  2  4  6  8 10 12 14 16 18 10 12 14 16 18 20 22 24 26 28 20 22 24 26 28  
[26] 30 32 34 36 38 30 32 34 36 38 40 42 44 46 48
```

Exercise 2.2 – Task 2: Indexing and Filtering Vectors

- Create a vector `first_ten` that has the values 10 through 20 in it (using the colon `:` operator).
- Create a vector `next_ten` that has the values 21 through 30 in it (using the `seq()` function).
- Create a vector `all_numbers` by combining the previous two vectors.
- Create a variable `eleventh` that contains the 11th element in `all_numbers`.
- Create a vector `some_numbers` that contains the 2nd through the 5th elements of `all_numbers`.
- Create a vector `even` that holds the even numbers from 1 to 100.
- Using the `all()` function and the `%%` (modulo) operator, confirm that all of the numbers in your even vector are even.

```
first_ten <- 10:20  
print(first_ten)
```

```
[1] 10 11 12 13 14 15 16 17 18 19 20
```

```
next_ten <- seq(21,30)  
print(next_ten)
```

```
[1] 21 22 23 24 25 26 27 28 29 30
```

```
all_numbers <- c(first_ten, next_ten)  
print(all_numbers)
```

```
[1] 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
```

```
eleventh <- all_numbers[11]
print(eleventh)
```

```
[1] 20
```

```
some_numbers <- all_numbers[2:5]
print(some_numbers)
```

```
[1] 11 12 13 14
```

```
even <- seq(2,100,2) # need to start at 2, as it is 1st even num
print(even)
```

```
[1]  2  4  6  8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
[20] 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76
[39] 78 80 82 84 86 88 90 92 94 96 98 100
```

```
all(even %% 2 == 0)
```

```
[1] TRUE
```

Self-Study 2.2. Vectors

Self-Study 2.2 - Task 1: Creating Vectors and Operating on Vectors

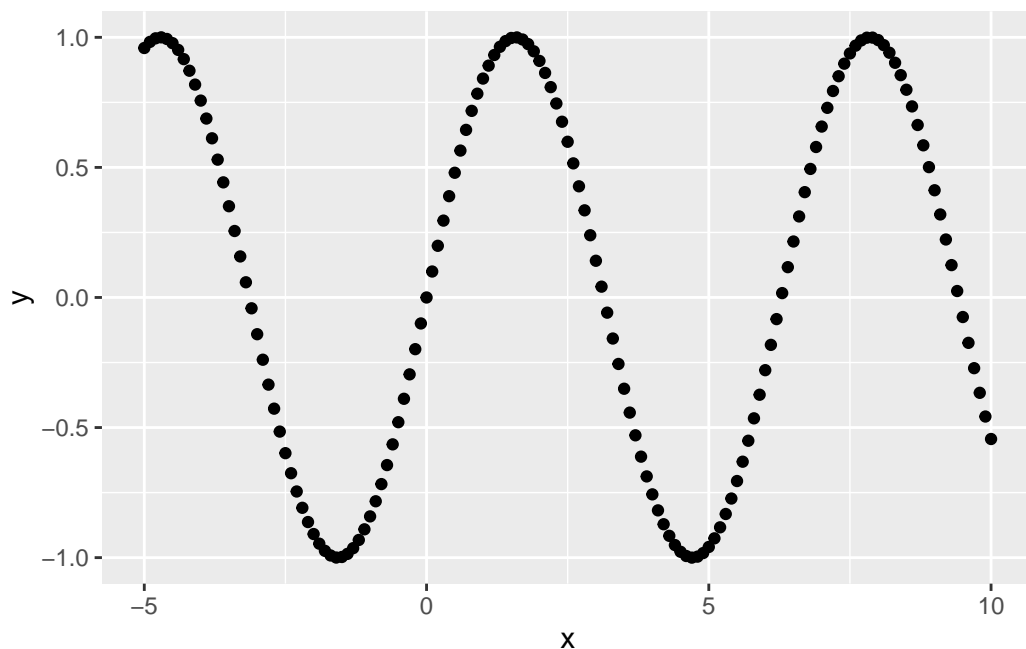
- Use the `seq()` function to produce a range of numbers from -5 to 10 in 0.1 increments. Store it in a variable `x_range`.
- Create a vector `sin_wave` by calling the `sin()` function on each element in `x_range`.
- Plot your sine wave using `ggplot2`.
 - Hint: To pass the data to `ggplot`, combine it into a data frame that contains `x_range` as the first column and `sin_wave` as the second column.
- Create a vector `cos_wave` by calling the `cos()` function on each element in `x_range`. Plot your sine wave using `ggplot2`.
- Create a vector `wave` by multiplying `sin_wave` and `cos_wave` together, then adding `sin_wave` to the product. Plot the result using `ggplot2`.

```
x_range <- seq(-5,10,0.1)
print(x_range)
```

```
[1] -5.0 -4.9 -4.8 -4.7 -4.6 -4.5 -4.4 -4.3 -4.2 -4.1 -4.0 -3.9 -3.8 -3.7 -3.6
[16] -3.5 -3.4 -3.3 -3.2 -3.1 -3.0 -2.9 -2.8 -2.7 -2.6 -2.5 -2.4 -2.3 -2.2 -2.1
[31] -2.0 -1.9 -1.8 -1.7 -1.6 -1.5 -1.4 -1.3 -1.2 -1.1 -1.0 -0.9 -0.8 -0.7 -0.6
[46] -0.5 -0.4 -0.3 -0.2 -0.1  0.0  0.1  0.2  0.3  0.4  0.5  0.6  0.7  0.8  0.9
[61]  1.0  1.1  1.2  1.3  1.4  1.5  1.6  1.7  1.8  1.9  2.0  2.1  2.2  2.3  2.4
[76]  2.5  2.6  2.7  2.8  2.9  3.0  3.1  3.2  3.3  3.4  3.5  3.6  3.7  3.8  3.9
[91]  4.0  4.1  4.2  4.3  4.4  4.5  4.6  4.7  4.8  4.9  5.0  5.1  5.2  5.3  5.4
[106] 5.5 5.6 5.7 5.8 5.9 6.0 6.1 6.2 6.3 6.4 6.5 6.6 6.7 6.8 6.9
[121] 7.0 7.1 7.2 7.3 7.4 7.5 7.6 7.7 7.8 7.9 8.0 8.1 8.2 8.3 8.4
[136] 8.5 8.6 8.7 8.8 8.9 9.0 9.1 9.2 9.3 9.4 9.5 9.6 9.7 9.8 9.9
[151] 10.0
```

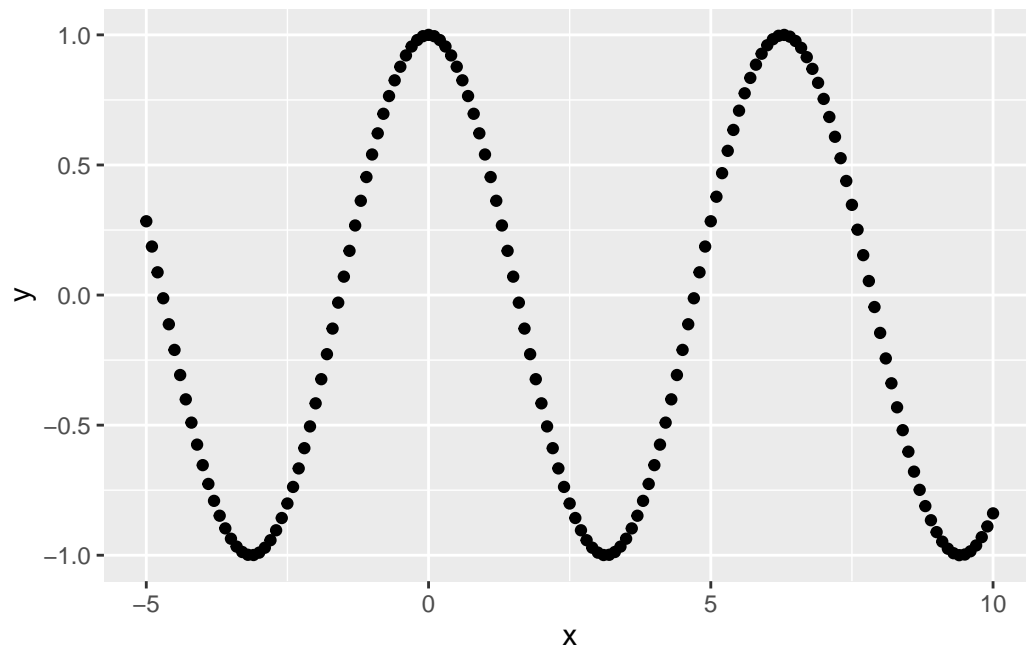
```
sin_wave <- sin(x_range)

library("ggplot2")
df_sin_wave <- data.frame(x = x_range, y = sin_wave)
ggplot(df_sin_wave, aes(x = x, y = y)) +
  geom_point()
```



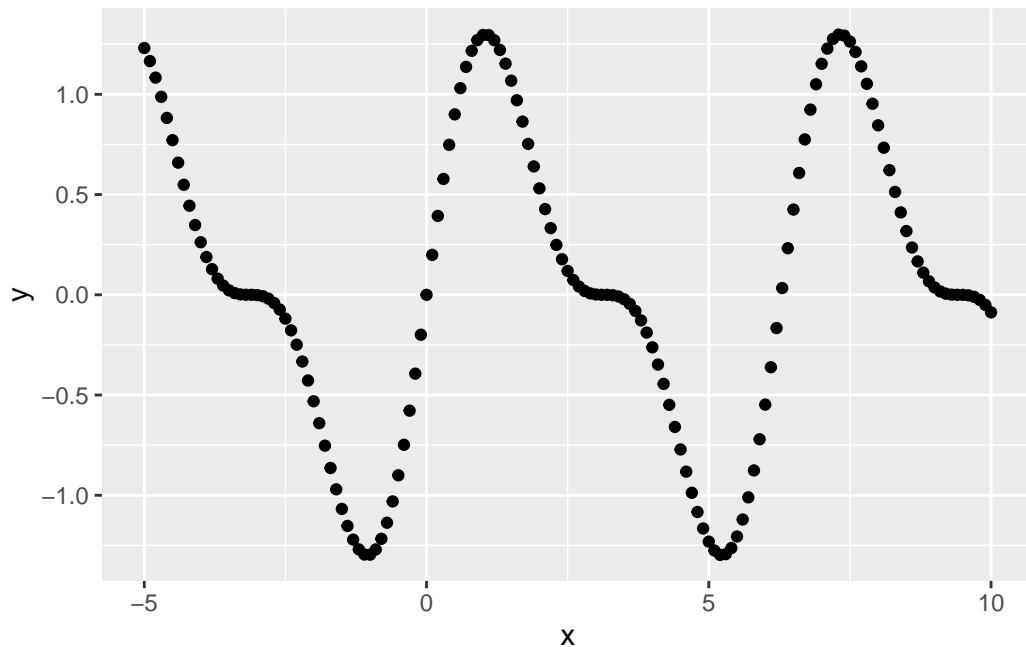
```
cos_wave <- cos(x_range)

df_cos_wave <- data.frame(x = x_range, y = cos_wave)
ggplot(df_cos_wave, aes(x = x, y = y)) +
  geom_point()
```



```
wave <- (sin_wave * cos_wave) + sin_wave

df_wave <- data.frame(x = x_range, y = wave)
ggplot(df_wave, aes(x = x, y = y)) +
  geom_point()
```



Self-Study 2.2 - Task 2: Indexing and Filtering Vectors

- Create a vector `phone_numbers` that contains the numbers 8, 6, 7, 5, 3, 0, 9.
- Create a vector `prefix` that has the first three elements of `phone_numbers`.
- Create a vector `small` that has the values of `phone_numbers` that are less than or equal to 5.
- Create a vector `large` that has the values of `phone_numbers` that are strictly greater than 5.
- Replace the values in `phone_numbers` that are larger than 5 with the number 5.
- Replace every odd-numbered value in `phone_numbers` with the number 0.

```
phone_numbers <- c(8, 6, 7, 5, 3, 0, 9)
print(phone_numbers)
```

```
[1] 8 6 7 5 3 0 9
```

```
prefix <- phone_numbers[1:3]
print(prefix)
```

```
[1] 8 6 7
```

```
small <- phone_numbers[phone_numbers <= 5]  
print(small)
```

```
[1] 5 3 0
```

```
large <- phone_numbers[phone_numbers > 5]  
print(large)
```

```
[1] 8 6 7 9
```

```
phone_numbers[phone_numbers > 5] <- 5  
print(phone_numbers)
```

```
[1] 5 5 5 5 3 0 5
```

```
phone_numbers[phone_numbers %% 2 == 1] <- 0  
print(phone_numbers)
```

```
[1] 0 0 0 0 0 0 0
```

Self-Study 2.2 - Task 3: Vector Practice

a) Create a vector `words` of 6 (or more) words. You can Google for a “random word generator” if you wish!

b) Create a vector `words_of_the_day` that is your words vector with the string “is the word of the day!” pasted on to the end.

- BONUS: Surround the word in quotes (e.g., `'data' is the word of the day!`).
- Remark: Note that the results are more obviously correct with single quotes.

c) Create a vector `a_f_words` which are the elements in `words` that start with “a” through “f”.

- Hint: Use a comparison operator to see if the word comes before “f” alphabetically!

- Hint: Make sure all the words are lower-case, and only consider the first letter of the word!

d) Create a vector `g_m_words` which are the elements in words that start with “g” through “m”.

e) Define a function `word_bin` that takes in three arguments: a vector of words, and two letters. The function should return a vector of words that go between those letters alphabetically.

f) Use your `word_bin` function to determine which of your words start with “e” through “q”.

```
words <- c("flower", "Ralunkel", "viola", "dog", "Good", "Light", "perfume", "Cookie")

words_of_the_day <- paste0("", words, "' is the word of the day!") # no space between ' a
words_of_the_day
```

```
[1] "'flower' is the word of the day!"    "'Ralunkel' is the word of the day!"
[3] "'viola' is the word of the day!"      "'dog' is the word of the day!"
[5] "'Good' is the word of the day!"       "'Light' is the word of the day!"
[7] "'perfume' is the word of the day!"    "'Cookie' is the word of the day!"
```

```
words_lower <- tolower(words) # make sure all words are lowercase
a_f_words <- words_lower[substring(words_lower, 1, 1) <= "f"] # make a substring of first
a_f_words
```

```
[1] "flower" "dog"    "cookie"
```

```
g_m_words <- words_lower[words_lower >= "g" & substring(words_lower, 1, 1) <= "m"]
g_m_words
```

```
[1] "good" "light"
```

```
word_bin <- function(vector_of_words, letter_1, letter_2){
  # all input to lower
  vector_of_words <- tolower(vector_of_words)
  letter_1 <- tolower(letter_1)
  letter_2 <- tolower(letter_2)

  words_result <- vector_of_words[substring(vector_of_words, 1, 1) >= letter_1 & substring
```

```
    return(words_result)
}

word_bin(words, "e", "q")
```

```
[1] "flower" "good"    "light"   "perfume"
```