Lab Session 2 (Week 10)

1.30 Learning Objectives

In this week's lab session we will start working on some basic concepts of statistical exploration of data. One of the first steps we take as Psychologists when we want to analyse our data, is first to get a "feel", or gist if you want, of how are data are **distributed**. Moreover, we will start using **functions** and not just rely on simple mathematical operations. **Functions** are useful collections of commands that can carry out specific tasks without us having to worry about manually calculating figures.

By the end of this Lab session you should have a clear understanding of the following concepts:

- **Vectors**
- **Functions and Arguments**
- **Creating Random Data for Practice Purposes**
- **Grouping Data using R**
- **Creating Frequency Tables using R**
- **Creating a basic Histograms using R**

Before we begin, do make sure you start a new project. Make sure to save it into a folder named Week 10, inside your PSYC3000 folder. Name this week's project Week 10. If you are running RStudio Cloud do not start a new project, continue working on the same one from last week.

Also, make sure that you are always writing your code into a script. So, once your project is created, click **File**, **New File**, **New Script**. Now you should have 4 panes open on RStudio. Make sure to type your code into the script. Make sure to save your R Script, and name it something useful. For this session, we can call it "Week 10".

Finally, before we get started: this week you will be running some lines of code from your script. To **run** a specific line of code while working from a script, you need to make sure your cursor is on the right line, then click the **Run** button on the top banner of you script.

Alternatively, for windows users, hold the 'Ctrl' button and click enter (Mac users: hold the 'command' key, and click enter). When we ask you to type and run some code, we will present it as follows:

```
100+100
```

Sometimes, we will also show you the **output** from the line of code. This will be clear as the line will begin with [1]. See below:

```
100+100
```

```
[1] 200
```

Note that you **do not** need to type the 'output' text - this is simply what RStudio will show you after you run your code.

1.31 Vectors

Let us assume that we asked 15 participants to report their age. One way to record this in R would be to use one variable per participant. It would look something like the following (DO NOT TYPE THE FOLLOWING IN RSTUDIO!!)

```
age1 <- 18
age2 <- 20
age3 <- 35
# and so on all the way down until we reach
age15 <- 32
```

As you can see this would take 15 variables. Not only it would look horrible but also it would be a very wasteful way to store our information.

(note the line of code that begins with a # symbol. This tells R to not consider this line as code - it will simply ignore them. So, we use these (#) to write text to help us remember what we're doing - it also helps when looking back on our old saved scripts).

For cases where we want to store multiple observations single value variables are not the best way forward. Actually they are the worst way forward. Instead we can use a variable that can store many different values at once, a **vector**. The following is an example of a vector that

stores our participants' 15 ages. Please type the following in your R script and **run** each line to see the output.

```
# We are creating a vector c and we are populating it with 15 values
# Then we assign it to a variable called Age

Age <- c(18, 18, 20, 32, 45, 33, 19, 19, 20, 58, 63, 21, 19, 19, 18)

# If we call the variable Age we will get all 15 values
Age
```

```
[1] 18 18 20 32 45 33 19 19 20 58 63 21 19 19 18
```

```
# But we can also access any of the 15 entries we want by calling its "location"
Age[7]
```

```
[1] 19
```

Note we always use **c()** to define a vector.

The same way we did calculations with simple value variables we can also do with vectors. For example, we may have a vector or prices for products and we may want to double the price of all of the products at once:

```
# We are creating a vector c and we are populating it with 5 prices.
# The prices could be in £ or any other currency (we only type the value in).
# Then we assign our vector to a variable called Prices.

Prices <- c(115, 120, 200, 300, 500)

# call Price to see the values in the console

Prices
```

```
[1] 115 120 200 300 500
```

```
# We now want a new variable that will include the old prices doubled.
# We can call the new variable anything we want, let us call it Newprices

Newprices <- 2*Prices
# call Price to see the values in the console
Newprices
```

[1] 230 240 400 600 1000

```
# But we can also access any of the new 5 entries we want by calling its "location"
Newprices[2]
```

[1] 240

You see how powerful and handy vectors can be as they allow us to work with many values as once. We will be using vectors a lot in our work, as well as an extension of vectors called dataframes. (More about dataframes in the future)

1.32 Exercise 1: Creating vectors with random numbers

As we do not have any real data yet, we might want to practice our learning with some made up data sets. That is absolutely fine but it poses a problem. If we want to create a vector with 200 made up values it will take us quite a while to actually type 200 values. Luckily, there is a solution to that. We can use an R **function** to create these numbers automatically. Let us see this in practice with a small example. Below we will use a function called **sample.int()**, that can generate random integers for us. Write the following code and run each line, we will explain what you have done in a moment.

```
# I am using a R function called sample.int()
# This function creates random integer numbers
numbers <- sample.int(10, 5, replace = TRUE)

numbers
```

[1] 4 3 5 2 7

As mentioned above, I used a function called **sample.int()**. A **function** in R, is a mechanism that can perform a task. In this case our function can select an integer number randomly. A function also includes two brackets (). Within these brackets we can specify our own arguments in order to be clear what we want R to do for us when this function is used.

Notice the number 10, this **argument** instructs our function that we want to pick randomly a number between 1 and 10.

Notice the second number 5, this **argument** instructs our function to give 5 such numbers from 1 to 10.

Notice the **replace = TRUE** part, this is another argument instructing R that numbers could be repeated. In other words, we can see the same number appearing more than once.

1.33 Exercise 2: Frequency tables in R and Histograms

Let us now proceed to a larger data set comprised of 200 random integers between 1 and 50. We will organise that data in 5 groups and produce a **grouped frequency table**. Then lastly, we will create a histogram with the same 5 groups. Write and run the following lines of code (*again, don't write the **output** lines). Try to work out what each function and argument has done - we will explain this straight after.

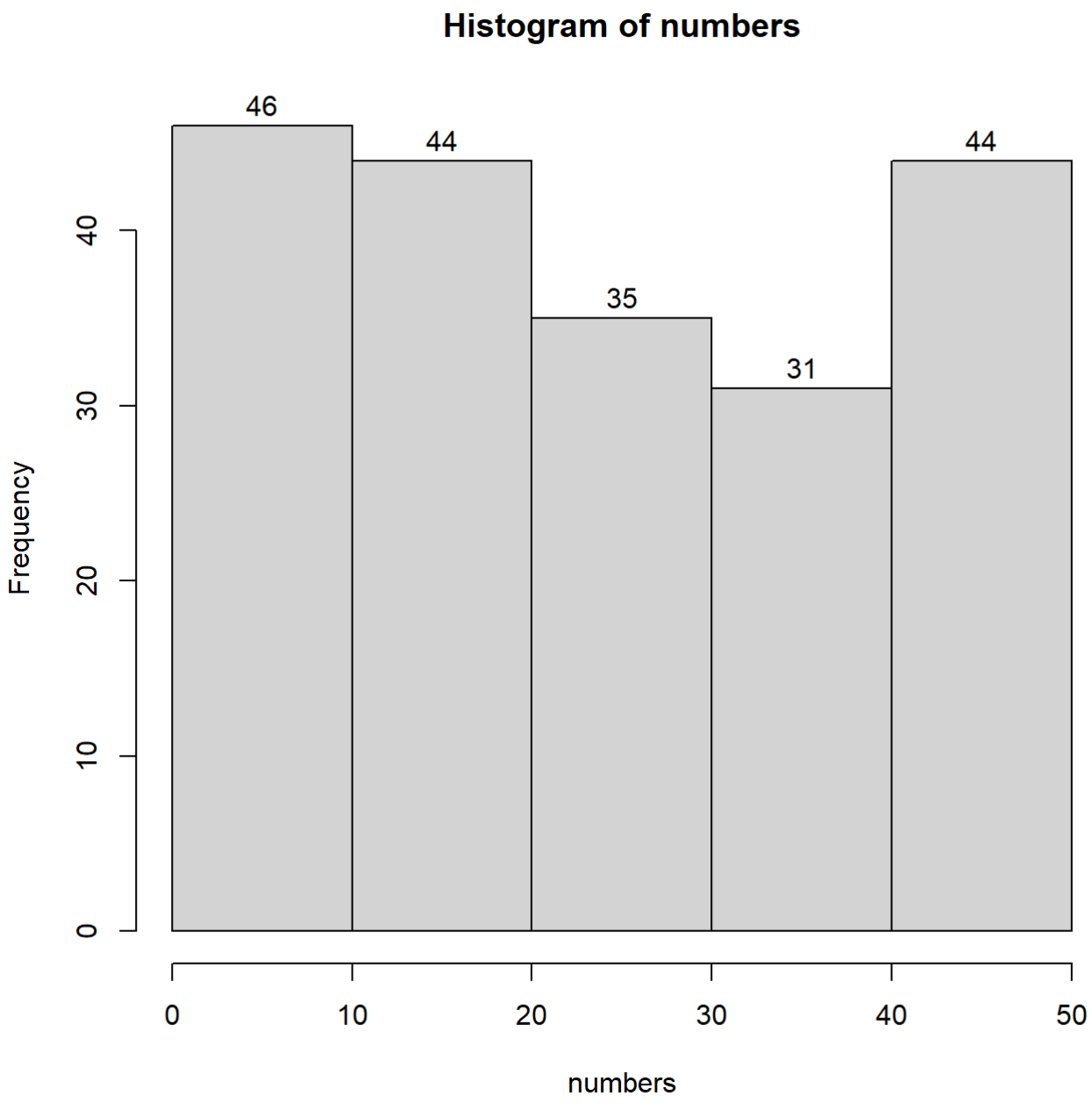
```
# Similarly as above, I will call sample.int()
# But this time I need 200 numbers between 1 and 50.
# See how my arguments have now changed.
numbers <- sample.int(50, 200, replace = TRUE)
numbers
```

[1] 39 32 48 5 49 30 11 17 43 27 32 43 30 30 40 14 30 38 10 9 34 11 1 21 10 [26] 4 7 41 25 45 17 47 32 3 31 3 38 40 6 42 14 1 10 8 29 37 37 19 9 1 [51] 28 28 36 14 41 41 23 49 21 4 1 11 1 7 15 16 34 43 13 33 3 10 35 42 38 [76] 46 16 10 27 22 16 8 18 41 24 19 44 27 12 12 13 8 7 43 14 15 20 24 11 20 [101] 43 16 39 9 31 48 9 48 32 33 30 11 50 5 44 13 13 49 35 48 8 25 15 20 21 [126] 24 6 42 48 1 41 49 17 10 4 11 3 49 18 15 44 6 25 28 46 26 44 28 50 20 [151] 22 5 8 34 26 5 21 15 46 42 34 10 23 18 24 12 47 48 15 34 22 45 45 23 5 [176] 49 10 12 44 7 31 9 7 16 19 18 50 43 40 33 20 46 34 28 30 35 36 23 5 6

```r
# Now we will call a new function to help us group our data.
# First put them in 5 groups. The numbers in c() declare the numbers # that define each
# I chose to split them in groups of 0-10, 10-20, 20-30, 30-40, # # 40-50

groups <- cut(numbers, breaks = c(0,10,20,30,40,50), right = TRUE)

# Now I can produce my frequency table using another function
# This function is called summary () and uses an object as argument
# we will use the object groups that we created just above.
summary(groups)
```

```
(0,10] (10,20] (20,30] (30,40] (40,50] 46 44 35 31 44
```

```r
# We will now use a new function called hist that creates
# histograms.
# Note that this function has to work with the original numbers
# and not with the groups.


hist(numbers, breaks = 5, labels = TRUE)
```



Let's discuss the **functions** we used:

sample.init() creates a sample of integer numbers

cut() cuts our sample in smaller pieces. For arguments we had to provide our original sample (**numbers**). We then specified at what numbers we wanted the breaks to be (**c(0,10,20,30,40,50)**). Finally, we wanted the numbers on the right end of each group to be included in the count.

summary() prints out the group frequency table, we only need one argument here, the variable that contains the grouped data (**groups**).

hist() creates a histogram from our original sample (**not the grouped one!!!**). The arguments here were our sample (**numbers**), how many breaks we wanted (**breaks = 5**), and we wanted each bar to have its frequency at the top (**labels = TRUE**). As you can see we can define how many groups we want when we ask for our histogram. So when all we want is a histogram, then the **cut()** and **summary()** steps can be omitted. The histogram will do that behind the scenes and show us the frequencies in the graph. Try it out on your own by changing the number of breaks in the histogram.

Notice each time your run your code you will get a different frequency distribution and a different histogram. This is because we create these 200 numbers randomly and each time we are getting a new set.

Learning opportunity from using random numbers. Run the above code many times, and each time observe the new histogram. Then discuss its **skewness** with your group mates. Does it look as **positively** or **negatively skewed**? Keep in mind your friends will have different graphs, so it is best to share your screen and show your histogram.

1.34 Exercise 3

Create a random set of 200 integers between 1 and 40. Group that data in 8 groups and produce the grouped frequency table. Then produce a histogram using these 8 groups. Spend some time to experiments with the number of bars in the histogram as well as generating new random numbers. This will allow you to become good at judging the **skewness** of a **frequency distribution**.

1.35 Exercise 4

For this exercise you will have to upload your answers on the Moodle Module Participation section.Start a new script and save it as exercise4, in your new script type in the following two lines exactly as you see them, then select both of them with your mouse and run them. Please run them together and not one by one

```
set.seed(1234)
observations <- sample.int(100, 500, replace = TRUE)
```

This should now have created a vector called observations that includes 500 integers from 1 to 200. Using [**set.seed()**]{style = “color: Orange;”} allowed us to have the exact same numbers for all the students in the class. We will talk more about **set.seed()** in next week’s drop-in session. Now create a histogram that will include 10 groups. By observing your histogram go to moodle and answer the relevant questions in the **Moodle Module Participation** section.