Solutions

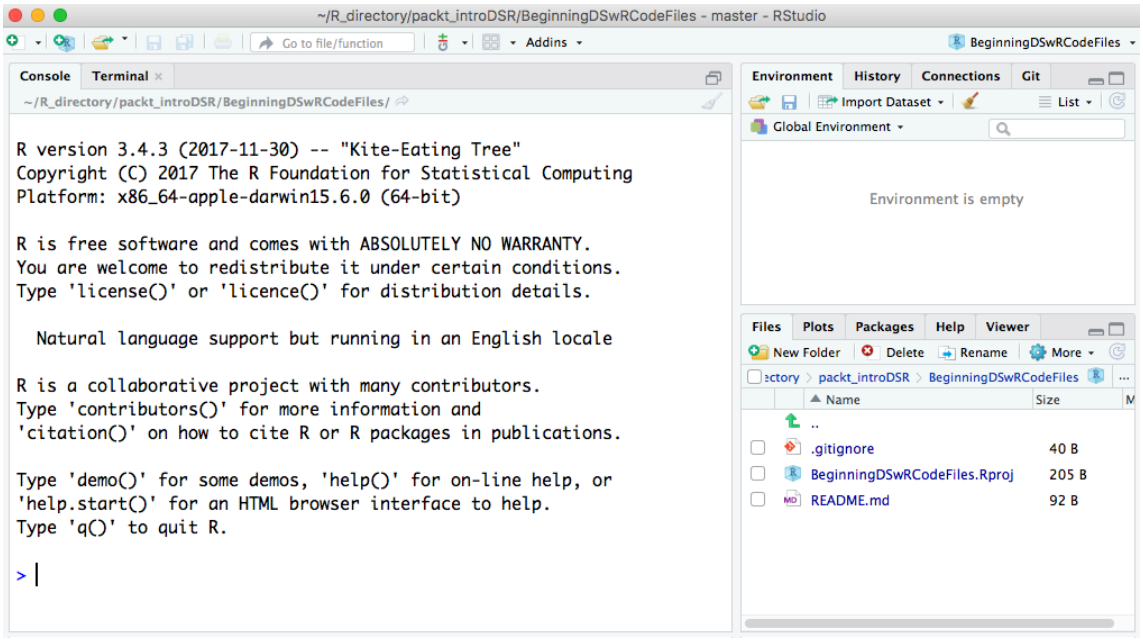
This section contains the worked-out answers for the activities present in each lesson. Note that in case of descriptive questions, your answers might not match the ones provided in this section completely. As long as the essence of the answers remain the same, you can consider them correct.

Lab 1: Introduction to R

The following are the activity solutions for this lab.

Activity: Installing the Tidyverse Packages

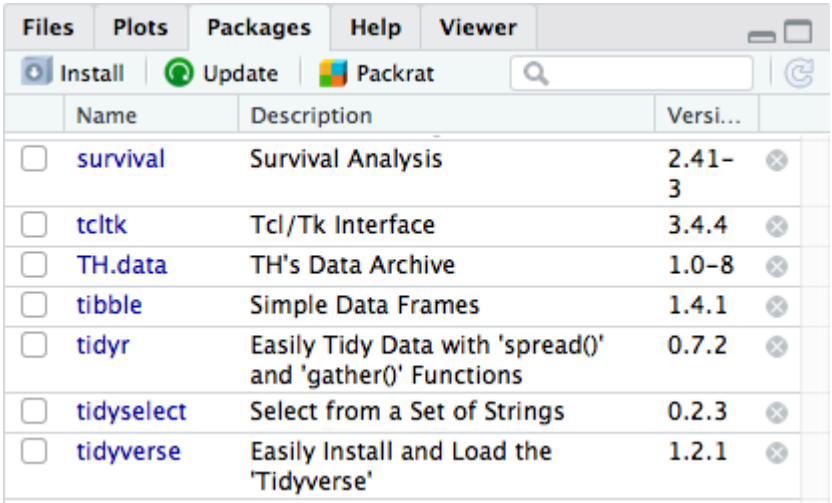
1. Open the project we created in the subtopic [*Using R and RStudio*] called `IntroToDSwRCourse`. You will see the following screen:



2. Create another new R script, using either **`File`** | **`New File`** | **`R Script`**, or by clicking the top - left button that looks like a piece of white paper with a green arrow over it, and selecting **`R Script`**.
3. In the new script, type `install.packages("tidyverse")` and click **`Run`**, or use [*Ctrl*] + [*Enter*]. You should now see something along the lines of the following screenshot in the console. Also, if you scroll through the packages in the lower right corner, Tidyverse will now be listed among them:

```
> install.packages("tidyverse")
also installing the dependency ‘haven’

trying URL 'https://cran.rstudio.com/bin/macosx/el-capitan/contrib/3.4/haven_1.1.1
.tgz'
Content type 'application/x-gzip' length 839173 bytes (819 KB)
==================================================
downloaded 819 KB

trying URL 'https://cran.rstudio.com/bin/macosx/el-capitan/contrib/3.4/tidyverse_1
.2.1.tgz'
Content type 'application/x-gzip' length 77756 bytes (75 KB)
==================================================
downloaded 75 KB


The downloaded binary packages are in

/var/folders/pn/bbp_y4nd58l5rjtnqj9yj0_40000gn/T//RtmpSUrCXn/downloaded_packages
>
```

4. The graphical user interface lists the packages that are installed on your machine in the **`Packages`** tab, as follows:



5. Save this R script with the name `install_packages`. You can save R scripts by either navigating to **`File`** | **`Save As`** or by hitting *[Ctrl] + [S] (or [cmd] + [S]*, on a macOS). It is now saved in your working directory as `install_packages.R`.
6. Load the `ggplot2` package with the code `library(ggplot2)`. `ggplot2` is a package contained in the `tidyverse` set of packages.
7. Load the `msleep` dataset by using `data("msleep")`. Examine the variables in this dataset by using `str(msleep)`.
8. Save a copy of the global environment to the working directory.

Note:

When you install a package, installation-related text will print to your console in red. This doesn't mean that something has gone wrong! Watch out for the words error or warning. If neither appear, the installation is fine, despite the red text.

Activity: Identifying Variable Classes and Types

Code:

```
class("John Smith")
typeof("John Smith")
...
class(as.Date("02-03-28"))
typeof(as.Date("02-03-28"))
```

Note: Solution is available in `R-Programming/lesson1` folder.

Output:

The preceding code provides the following output:

```
[1] "character"
[1] "character"
[1] "numeric"
[1] "double"
[1] "integer"
[1] "integer"
[1] "numeric"
[1] "double"
[1] "numeric"
[1] "double"
[1] "character"
[1] "character"
[1] "Date"
[1] "double"
```

Thus, the table provided in this scenario can be filed in as follows:

Variable	Class	Type
`"John Smith"`	`character`	`character`
`16`	`numeric`	`double`
`10L`	`integer`	`integer`
92	`numeric`	`double`
`-10`	`numeric`	`double`
`"03-28-02"`	`character`	`character`
`as.Date("02-03-28")`	`Date`	`double`

Activity: Creating Vectors, Lists, Matrices, and Dataframes

1. Create vectors using the following code:

```
vec1 <- c(1:10)
vec2 <- c(LETTERS)
vec3 <- c(1, "A", 2, "B", 3, "C", 4, "D")
```

2. Create lists using the following code:

```
list1 <- list(1:10)
list2 <- list(LETTERS)
list3 <- list(list("popcorn", "kale"), list("the Blacklist", "This is Us", "The X-Files"), list("run", "listen to podcasts", "paint my nails", "learn data science"))
```

3. When you've created the lists, go and look in the environment and hit **`View`** to see the third list. Expand each list in the list of lists to see your answers and the types, as shown in the following screenshot:

4. Create matrices using the following code:

   a. Use `cbind()` to combine the vector 1:10 and the

   ```
   vector A:Z:
   ```

```
matrix1 <- cbind(vec1, vec2)
```

1. b. Use the following code to combine these two into a matrix,

```
albeit one that will be coerced to character type:
```

```
matrix_solution <-cbind(vec1, vec2[1:10])
```

3. Create dataframes using the following code:

```
df1 <- as.data.frame(matrix_solution)
df2 <- rbind.data.frame(c(1:5), c(6:10), c(11:15), c(16:20), c(21:25))
names(df2) <- c("one", "two", "three", "four", "five")
```

Activity: Building Basic Loops

The code we have developed thus far is as follows:

```
#load datasets
data("iris")
data("ChickWeight")

# if
var <- 100

  if((var/5) >= 25){
    print("Big number")
  }
...
  }else{
    Diet4 <- rbind(Diet4, ChickWeight[chick,])
  }
}
```

Note: Solution is available in `R-Programming/lesson1` folder.

Activity: Exporting and Importing the mtcars Dataset

1. Open a new R Script and save it as a file called `lesson1_activityD.R`.
2. Load the `datasets` library, and then the `mtcars` dataset with the following code:

```
library(datasets)
data("mtcars")
```

3. View `mtcars` with the `str()` function to see the data names, types, and how many observations and variables there are. The code will be as follows:

```
str(mtcars)
```

4. Create a variable called `hpcyl`, which is equal to the horsepower per cylinders of each car as follows:

```
mtcars$hpcyl <- mtcars$hp/mtcars$cyl
```

5. Write `mtcars` into a `.csv` file called `mtcars_out.csv`. If you have a program installed that will allow it, open it on your computer and verify that the `hpcyl` variable is inside. The code will be as follows:

```
write.csv(mtcars, "mtcars_out.csv")
```

6. Read the dataset back in and call it `mtcars_in` by using `read.csv()`. The code will be as follows:

```
mtcars_in <- read.csv("mtcars_out.csv")
```

Activity: Exploring the Introduction to dplyr Vignette

Code:

```
...
filter(flights, month == 1, day == 1)
flights[flights$month == 1 & flights$day == 1, ]
#arrange
arrange(flights, year, month, day)
arrange(flights, desc(arr_delay))
#select
select(flights, year, month, day)
select(flights, year:day)
select(flights, -(year:day))
...
```

Note: Solution is available in `R-Programming/lesson1` folder.

Lab 2: Data Visualization and Graphics

The following are the activity solutions for this lab.

Activity: Recreating Plots with Base Plot Methods

The following code can be used to load the `datasets` library:

```
library(datasets)
install.packages("ggplot2")
library(ggplot2)
```

The following code can be used to load the data:

```
data("iris")
data("mpg")
```

The following code can be used to create a scatterplot to plot petal width without an axis label:

```
plot(iris$Petal.Width)
```

The following code can be used to create a scatterplot to plot petal width without axis labels:

```
plot(iris$Petal.Width, iris$Petal.Length,
     main = "Petal Length vs. Petal Width",
```

```
     xlab = "Petal Width",
     ylab = "Petal Length")
```

The following code can be used to create scatterplots in [*1x2*] grids to plot petal length and width with axis labels:

```
par(mfrow = c(1,2))
plot(iris$Petal.Width, iris$Petal.Length,
     xlab = "Petal Width",
     ylab = "Petal Length")
plot(iris$Sepal.Width, iris$Sepal.Length,
     xlab = "Sepal Width",
     ylab = "Sepal Length")
dev.off()
```

The following code can be used to create a histogram using `mtcars` data to plot the number of cylinders in the color blue:

```
plot(as.factor(mpg$cyl),
     col = "blue",
     xlab = "# of cylinders")
```

Activity: Recreating Plots Using ggplot2

The following code can be used to load the `datasets` library:

```
library(ggplot2)
```

The following code can be used to create a histogram to plot petal width:

```
ggplot(iris, aes(Petal.Width)) + geom_histogram(binwidth = 0.5)
```

The following code can be used to create a scatterplot to plot petal length and width:

```
ggplot(iris, aes(Petal.Width, Petal.Length)) + geom_point()
```

The following code can be used to create a boxplot to plot petal length and the `Species` factor variable:

```
ggplot(iris, aes(as.factor(Species), Petal.Width)) + geom_boxplot()
```

The following code can be used to create a bar chart using the `gear` variable of the `mtcars` dataset:

```
ggplot(mtcars, aes(gear)) + geom_bar()
```

Activity: Utilizing ggplot2 Aesthetics

The following code is used to recreate the various plots using the mpg and diamonds datasets:

```
ggplot(mpg, aes(class)) + geom_bar(fill = "purple")

ggplot(mpg, aes(class, fill = as.factor(drv))) + geom_bar(position = "fill")

#scatter plot
ggplot(diamonds, aes(carat, price, col = cut)) + geom_point(alpha = 0.4)
```

```
ggplot(diamonds, aes(carat, price)) + geom_point(shape = 6, alpha = 0.3)
```

Lab 3: Data Management

The following are the activity solutions for this lab.

Activity: Creating and Manipulating Factor Variables

Use the following code to load the `datasets` library:

```
library(datasets)
```

Use the following code to load the `diamonds` dataset:

```
data("diamonds")
```

The function `str()` can be used to examine the `diamonds` dataset as follows:

```
str(diamonds)
```

We understand that there are three factors of ordered type as we examine the `diamonds` dataset. To identify the class of those factors, we can use the function `class()` as follows:

```
class(diamonds$cut)
class(diamonds$color)
class(diamonds$clarity)
```

The following code can be used to load the `midwest` dataset:

```
data("midwest")
```

The `str()` function can be used to examine the `midwest` dataset as follows:

```
str(midwest)
```

The following code can be used to convert the character variables into factor variables using the `apply()` method for changing many variables at once:

```
to.factor <- c("county", "state", "category")
midwest[,to.factor] <- data.frame(apply(midwest[,to.factor], 2, as.factor))
```

We can confirm if the character variables have been converted into the factor variable using the `str()` method, as follows:

```
str(midwest)
```

Activity: Creating Data Summarization Tables

The following is the code we need to execute to accomplish the activity:

```
library(dplyr)
library(datasets)
```

```
#below:
table(diamonds$clarity)
table(diamonds$clarity, diamonds$color)
diamonds %>% group_by(clarity) %>% summarise(median(depth))
```

Activity: Implementing Data Summary

The following code can be used to load the `mtcars` dataset and examine it:

```
data("mtcars")
str(mtcars)
```

Use the following code to summarize all the variables in the `mtcars` dataset that are not categorical, and find the mean and variance of each:

```
apply(mtcars[,-c(2,10,11)], 2, function(x) c(mean(x), var(x)))

diamonds %>% group_by(color, clarity) %>% summarise(median(price))
diamonds %>% filter(color != "D" & color != "H") %>% group_
by(color) %>% summarise(median(depth))
```

Activity: Demonstrating Splitting and Combining Data

1. Load the `mtcars` dataset using the following code:

```
install.packages("datasets")
library(datasets)
data("mtcars")
```

Split the data by the `cyl` variable as follows:

```
mtcars_split <- split(mtcars, mtcars$cyl)
```

Create one dataset for each level of `cyl` using the following code:

```
mtcars_4 <- mtcars_split[[1]]
mtcars_6 <- mtcars_split[[2]]
mtcars_8 <- mtcars_split[[3]]
```

Recreate `mtcars` by unsplitting the split version of the data as follows:

```
mtcars_unsplit <- unsplit(mtcars_split, mtcars$cyl)
```

2. Combine the data using the following code:

```
l1 <- letters[1:4]
l2 <- letters[5:8]
l3 <- letters[9:12]
l4 <- letters[13:16]
l5 <- letters[17:20]
```

Create the following datasets `letters1` and `letters2` as follows:

```
letters1 <- rbind.data.frame(l1, l2, l3, l4, l5)
letters2 <- cbind.data.frame(l1, l2, l3, l4, l5)
```

Activity: Merging and Joining Data

The following is the code we need to execute to accomplish the activity:

```
library(readr)
students <- read_csv("https://github.com/fenago/R-
Programming/blob/master/lesson1/students.csv")
students$StudentID <- seq(1:nrow(students))

students2 <- data.frame("ID" = seq(1:25),
                        "Gender" = sample(c("M","F"), size = 25, replace = TRUE),
                        "Grade" = sample(c(9,10,11,12), size = 25, replace = TRUE),
                        "Sport" = sample(c("Basketball", "Tennis", "Track", "None"),
size = 25, replace = TRUE))

str(students2)
```

Note: Solution is available in `R-Programming/lesson3` folder.