UNIVERSITY OF MARYLAND
ROBERT H. SMITH SCHOOL OF BUSINESS

ASSIGNMENT 1

The goal of this assignment is to familiarize you with the fundamentals of R, data visualization, basic data wrangling, and exploration. The first part of this assignment is quite easy to complete because you will have a chance to check the solution at each step, interactively. However, I strongly recommend you do **not** check a solution before you attempt to answer a question. Otherwise, you will not learn, and you will struggle with the rest of the course. So, please!

If you don't cut corners by checking solutions even before you attempt, this assignment will take quite some time depending on how familiar you are with R. Please plan ahead and start early.

Assignment Instructions (Part I)

Please complete the following RStudio Cloud Primers and take the screenshots showing both the completion of each Primer and your username together. You can take screenshots on a PC using the Snipping Tool (Mac users, see this). A sample submission for Part I is on the last page.

Before you click on the following links and start working on the assignment, please visit rstudio.cloud and log in first. If you don't log in, your name will not come up in the screenshots.

This assignment has five mandatory parts:

1. Data Visualization Basics
2. Programming Basics
3. Working with Tibbles
4. Isolating Data with dplyr
5. Deriving Information with dplyr

and two highly recommended sections[1]:

1. Visualize Data
2. Tidy Your Data

and two more recommended sections:

1. Iterate
2. Write Functions

[1] In the past, students who completed the recommended sections increased the probability of getting an A by 39%, on average. Don't attempt to finish them all at once. You will **not** submit the optional sections in your assignment.

Assignment Instructions (Part II)

In this part of the assignment, you will apply what you learned in the first part. You will work on the Gapminder dataset, which is available as a library in R (how convenient!). You can read more about the source of the dataset here, and enjoy this talk from 2007 if you have not yet done so. See How to submit labs/assignments to learn how to submit the second part of the assignment.

Use the following R libraries in this assignment: tidyverse, tidymodels, plotly, skimr, gapminder

Data Overview

1. country: Name of the country
2. continent: Name of the continent a country belongs in
3. year: Year for which the data is collected
4. lifeExp: Average life expectancy of the people in a country in a year
5. pop: Total population of a country in a year
6. gdpPercap: GDP per capita of a country in a year

Questions

1. **Create an R Notebook**
    a. Start with the assignment template and set your working directory using `setwd`
    b. From here on, use a new chunk for each question to make your code readable
2. **Load the data**
    a. In a new chunk, load the `gapminder` library, and use this line to create dfGap: **`dfGap <- gapminder`**
3. **Explore the data**
    a. Use the `skim` function on the `dfGap` dataframe to get summary statistics in a nice format. I suggest you use the widest screen possible for the best reading.
    b. Filter `dfGap` for the year 2007 and sort it in descending order of life expectancy. Don't forget to use pipes!
        i. What are the names of the countries with a life expectancy over 81?
    c. Add a calculated column `totalGDP` to `dfGap` showing the total GDP per country, filter the dataframe for 2007, and sort in descending order for `totalGDP`. If you like, save the new dataframe as a new one for repeated use.
        i. What are some names of the countries with the top levels of total GDP?
        ii. Which ones of these countries overlap with the countries from **3-b**?
        iii. What if you selected only the two columns country and gdpPercap and sorted the dataframe in descending order for `gdpPercap`? Do you observe more of an overlap now? What do you infer from this difference?
    d. Filter `dfGap` for 2007, group it by continent, and then calculate the median life expectancy and *median* total GDP (so you need to have totalGDP already). Remember, you will pipe the filtered and grouped dataframe into `summarize()`

to get the medians. Then, sort it in descending order for the median life expectancy. Before you sort it, don't forget to use `ungroup()` to ungroup.

i. What continent has the highest median of life expectancy?
ii. Does it seem to be correlated with the median total GDP?

4. Visualize the data

a. Now that you have explored the relationship between life expectancy and totalGDP in a table format, let's also visualize it to see a bigger picture.
   i. Create a scatter plot to understand the relationship between life expectancy (y-axis) and totalGDP (x-axis) in 2007. Does this plot help?
   ii. Copy the same code, but this time also filter for countries with a totalGDP of over a billion (use the scientific notation 1e+12). What about now?
   iii. Copy the same code, and add labels this time. Do you see a cluster now? What are the names of the countries that are outside of the cluster?
   iv. Here is a pro tip. The labels you used in (iii) overlap and hide the points. This causes poor visibility. Install and load the `ggrepel` library. After that, copy the same code and use `geom_label_repel()` function instead of `geom_label()`. Does it look better now? Describe what has changed.
   v. Copy the same code. This time, add a color for the continent. What are the continents that are missing from your visual? Why do you think so?

b. You have an idea about the relationship between life expectancy and totalGDP even though you have not tested it statistically. Now, let's examine a more realistic relationship between life expectancy and gdpPercap (GDP per capita). Plot life expectancy (y-axis) against gdpPercap (x-axis) for 2007, add a smoothed line (no need to define any parameters, use the defaults). What do you observe about the overall relationship? Don't use any labels, just focus on the aggregate.

c. Now let's find out the variations in life expectancy across different continents. Create box plots for each continent (in the same plot) and add a title this time. What do you observe? Describe your observations and answer the questions:
   i. Which continent has the highest median life expectancy?
   ii. Which continent has the largest range of life expectancy?
   iii. Save your plot as `boxPlotsForAll` and put it into the `ggplotly()` function. More useful, right? Report the actual medians per continent by reading from the new interactive plot `ggplotly()` has created for you.

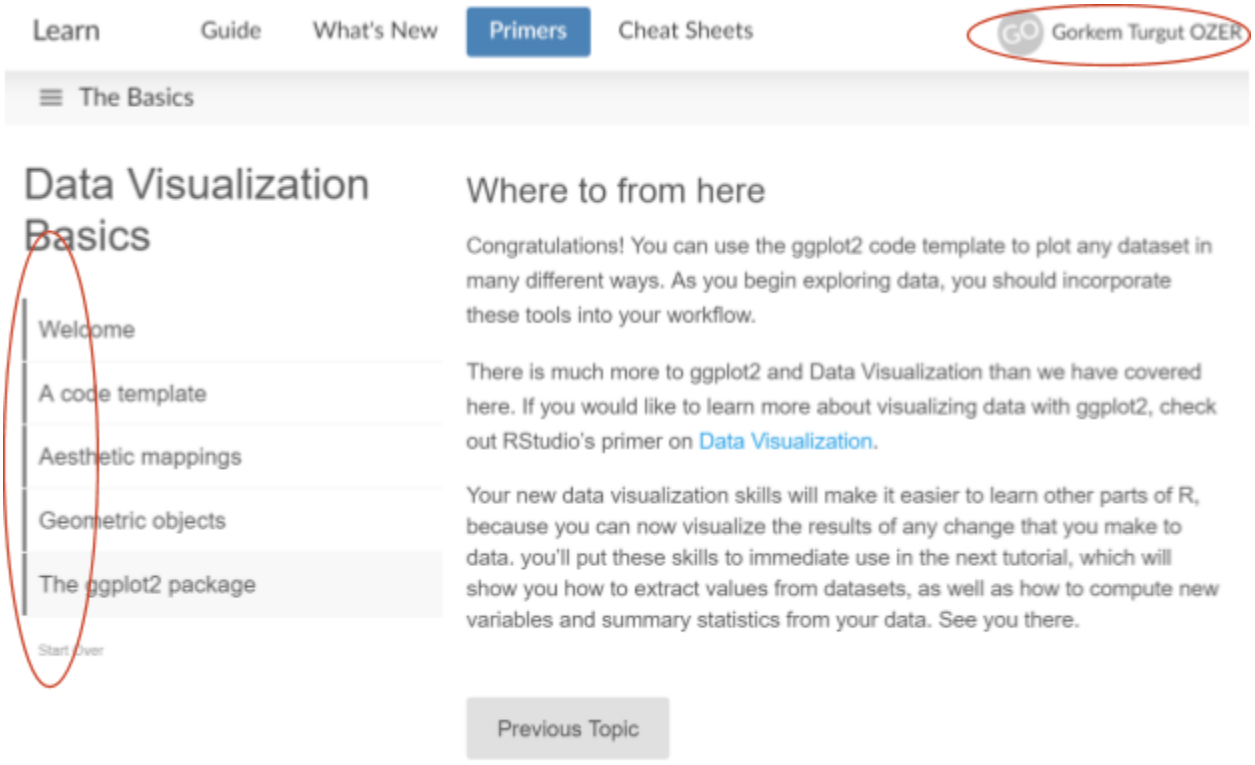
d. Finally, it is time to create a more advanced (and likely more helpful) plot. Create a line plot to show how **median GDP per capita** by continent changes **over time**. [Hint: For the continents, use the color parameter]. Describe what you observe.
   i. What continents have a clearer trend than others? Why do you think so?
   ii. Change the summary metric from median to mean. What has changed? Why do you think so?
   iii. Finally, don't you think these plots would be much more useful in plotly? Pick one and save it as `gdpOverTime` and call `ggplotly()` on it. You

can now read the actual GDP values per year. What are some of the breakthrough years (steep changes) for GDP in different continents?

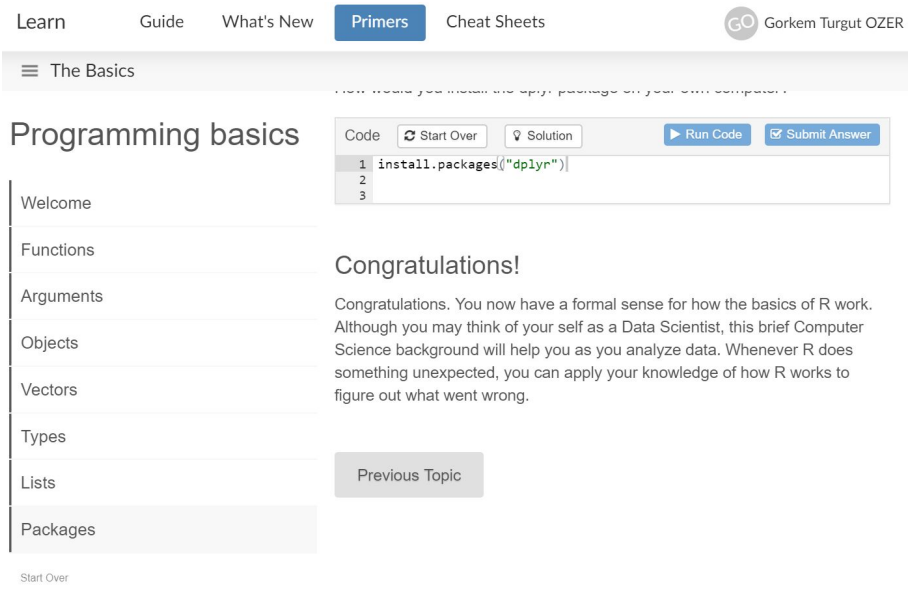
Sample Submission for Part I (For Part II, refer to the assignment instructions above)

Your name and UID: Jane Doe (13474382)

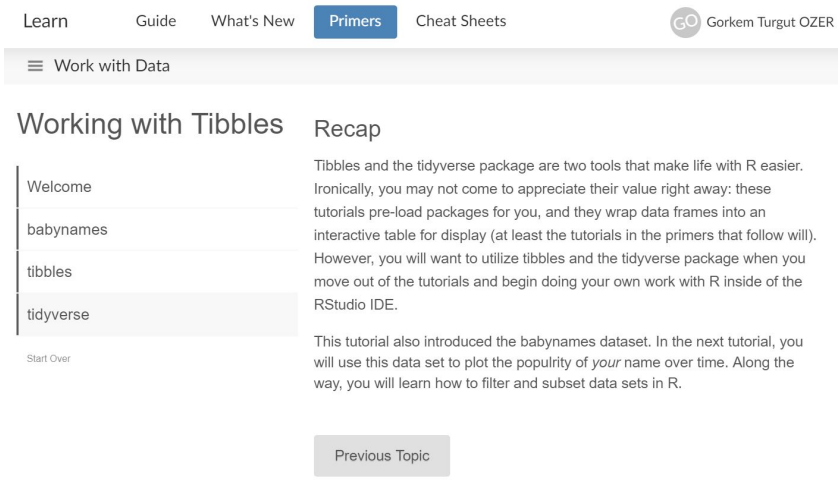
1. Data Visualization Basics



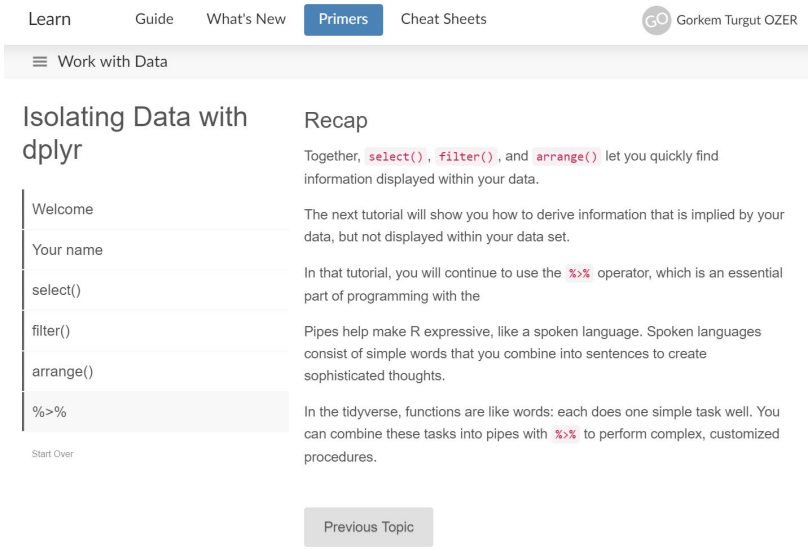
2. Programming Basics



3. Working with Tibbles



4. Isolating Data with dplyr



5. Deriving Information with dplyr