# Assignment 4: Collaborating Together
# Introduction to Applied Data Science
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## Assignment 4: Collaborating Together

### Part 1: Contributing to another student's Github repository

In this assignment, you will create a Github repository, containing this document and the .pdf output, which analyzes a dataset individually using some of the tools we have developed.

This time, make sure to not only put your name and student e-mail in your Rmarkdown header, but also your Github account, as I have done myself.

However, you will also pair up with a class mate and contribute to each others' Github repository. Each student is supposed to contribute to another student's work by writing a short interpretation of 1 or 2 sentences at the designated place (this place is marked with **designated place**) in the other student's assignment.

This interpretation will not be graded, but a Github shows the contributors to a certain repository. This way, we can see whether you have contributed to a repository of a class mate.

**Question 1.1**: Fill in the **github username** of the class mate to whose repository you have contributed.

DataLover911

### Part 2: Analyzing various linear models

In this part, we will summarize a dataset and create a couple of customized tables. Then, we will compare a couple of linear models to each other, and see which linear model fits the data the best, and yields the most interesting results.

We will use a dataset called `GrowthSW` from the `AER` package. This is a dataset containing 65 observations on 6 variables and investigates the determinants of economic growth. First, we will try to summarize the data using the `modelsummary` package.

```
library(AER)
data(GrowthSW)
```

One of the variables in the dataset is `revolutions`, the number of revolutions, insurrections and coup d'etats in country $i$ from 1965 to 1995.

| | More than 0 revolutions | | | | | Revolutions equal to 0 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | SD | Min | Max | Mean | Median | SD | Min | Max |
| growth | 1.68 | 1.92 | 2.11 | −2.81 | 7.16 | 2.46 | 2.29 | 1.28 | 0.42 | 6.65 |
| rgdp60 | 1988.67 | 1259.00 | 1698.18 | 367.00 | 6823.00 | 5283.32 | 5393.00 | 2439.39 | 1374.00 | 9895.00 |

**Question 2.1**: Using the function `datasummary`, summarize the mean, median, sd, min, and max of the variables `growth`, and `rgdp60` between two groups: countries with `revolutions` equal to 0, and countries with more than 0 revolutions. Call this variable `treat`. Make sure to also write the resulting data set to memory. Hint: you can check some examples here.

```
library(modelsummary); library(tidyverse)

GrowthSW$treat <- ifelse(GrowthSW$revolutions == 0,
                         "Revolutions equal to 0", "More than 0 revolutions")

datasummary(growth + rgdp60 ~ treat*(Mean + Median + SD + Min + Max), data = GrowthSW)
```

**Designated place**: type one or two sentences describing this table of a fellow student below. For example, comment on the mean and median growth of both groups. Then stage, commit and push it to their github repository.

### Part 3: Make a table summarizing reressions using modelsummary and kable

In question 2, we have seen that growth rates differ markedly between countries that experienced at least one revolution/episode of political stability and countries that did not.

**Question 3.1**: Try to make this more precise this by performing a t-test on the variable growth according to the group variable you have created in the previous question.

```
# write t test here
t.test(growth ~ treat, data = GrowthSW)
```

```
##
##  Welch Two Sample t-test
##
## data:  growth by treat
## t = -1.8531, df = 61.015, p-value = 0.06871
## alternative hypothesis: true difference in means between group More than 0 revolutions and group Revo
## 95 percent confidence interval:
##  -1.62566475  0.06182741
## sample estimates:
## mean in group More than 0 revolutions  mean in group Revolutions equal to 0
##                              1.678066                              2.459985
```

**Question 3.2**: What is the $p$-value of the test, and what does that mean? Write down your answer below.

The p-value of the test is 0.06871, indicating that we do not have strong evidence to reject the null hypothesis on 95 percent confidence interval. This suggests that there may not be a significant difference in the mean growth rates between the two groups of countries (with and without revolutions), although further analysis may be applied.

We can also control for other factors by including them in a linear model, for example:

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| (Intercept) | 1.678*** | 1.826*** | 0.425 | −0.119 |
| | (0.286) | (0.374) | (0.638) | (0.590) |
| treatRevolutions equal to 0 | 0.782 | 1.028 | 0.415 | 0.069 |
| | (0.491) | (0.633) | (0.647) | (0.589) |
| rgdp60 | | 0.000 | 0.000 | 0.000* |
| | | (0.000) | (0.000) | (0.000) |
| tradeshare | | | 2.233* | 1.813* |
| | | | (0.842) | (0.765) |
| education | | | | 0.564*** |
| | | | | (0.144) |
| Num.Obs. | 65 | 65 | 65 | 65 |
| R2 | 0.039 | 0.045 | 0.143 | 0.318 |

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

$$\text{growth}_i = \beta_0 + \beta_1 \cdot \text{treat}_i + \beta_2 \cdot \text{rgdp60}_i + \beta_3 \cdot \text{tradeshare}_i + \beta_4 \cdot \text{education}_i + \epsilon_i$$

**Question 3.3**: What do you think the purpose of including the variable `rgdp60` is? Look at `?GrowthSW` to find out what the variables mean.

RGDP60 is the value of GDP per capita in 1960, converted to 1960 U.S. dollars. We must consider it too, since the increase in GDP for a country with a smaller absolute value per capita is expected to be simpler than for a country with a larger one.

We now want to estimate a stepwise model. Stepwise means that we first estimate a univariate regression $\text{growth}_i = \beta_0 + \beta_1 \cdot \text{treat}_i + \epsilon_i$, and in each subsequent model, we add one control variable.

**Question 3.4**: Write four models, titled `model1`, `model2`, `model3`, `model4` (using the `lm` function) to memory. Hint: you can also use the `update` function to add variables to an already existing specification.

```
model1 <- lm(growth ~ treat, data = GrowthSW)
model2 <- update(model1, . ~ . + rgdp60)
model3 <- update(model2, . ~ . + tradeshare)
model4 <- update(model3, . ~ . + education)
```

Now, we put the models in a list, and see what `modelsummary` gives us:

```
list(model1, model2, model3, model4) |>
  modelsummary(stars=T,
               gof_map = c("nobs", "r.squared")
)
```

**Question 3.5**: Edit the code chunk above to remove many statistics from the table, but keep only the number of observations $N$, and the $R^2$ statistic.

**Question 3.6**: According to this analysis, what is the main driver of economic growth? Why?

In our models main driver of economic growth is an education. As we can see R2 in a model with this variable is the highest, up to 32%, so variables explain our model here in the best way. Also p-value associated with "education" is less than 0.001, so this variable is most statistically significant (compared to other).

**Question 3.7**: In the code chunk below, edit the table such that the cells (including standard errors) corresponding to the variable `treat` have a red background and white text. Make sure to load the `kableExtra` library beforehand.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| (Intercept) | 1.678*** | 1.826*** | 0.425 | −0.119 |
| | (0.286) | (0.374) | (0.638) | (0.590) |
| treatRevolutions equal to 0 | 0.782 | 1.028 | 0.415 | 0.069 |
| | (0.491) | (0.633) | (0.647) | (0.589) |
| rgdp60 | | 0.000 | 0.000 | 0.000* |
| | | (0.000) | (0.000) | (0.000) |
| tradeshare | | | 2.233* | 1.813* |
| | | | (0.842) | (0.765) |
| education | | | | 0.564*** |
| | | | | (0.144) |
| Num.Obs. | 65 | 65 | 65 | 65 |
| R2 | 0.039 | 0.045 | 0.143 | 0.318 |

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

```
library(kableExtra)
list(model1, model2, model3, model4) |>
  modelsummary(stars=T, gof_map = c("nobs", "r.squared")) |>
  kable_styling() |>
  row_spec(row = 3, background = "red", color = "white") |>
  row_spec(row = 4, background = "red", color = "white")
```

**Question 3.8**: Write a piece of code that exports this table (without the formatting) to a Word document.

```
list(model1, model2, model3, model4) |>
  modelsummary(stars=T, title = "Regression table",
  gof_map=c("nobs", "adj.r.squared"),
  output = 'regression_table.docx')
```

## The End