Practical session - Modèles de régression linéaire

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IV. Application: GAFAM or BATX dataset

The data set below shows the number of monthly active users (MAU) on Facebook from 2008 to 2021 in millions (*source: https://www.statista.com/statistics/264810/number-of-monthly-active-facebook-users-worldwide/*). The numbers were taken from Q4 of each year except for the year 2008, whose data is only available in Q3.

```
tab <- read.table("fb_mau.txt", header=TRUE, sep=",")
tab
```

```
##    year  mau
## 1  2008  100
## 2  2009  360
## 3  2010  608
## 4  2011  845
## 5  2012 1056
## 6  2013 1228
## 7  2014 1393
## 8  2015 1591
## 9  2016 1860
## 10 2017 2129
## 11 2018 2320
## 12 2019 2498
## 13 2020 2797
## 14 2021 2912
```

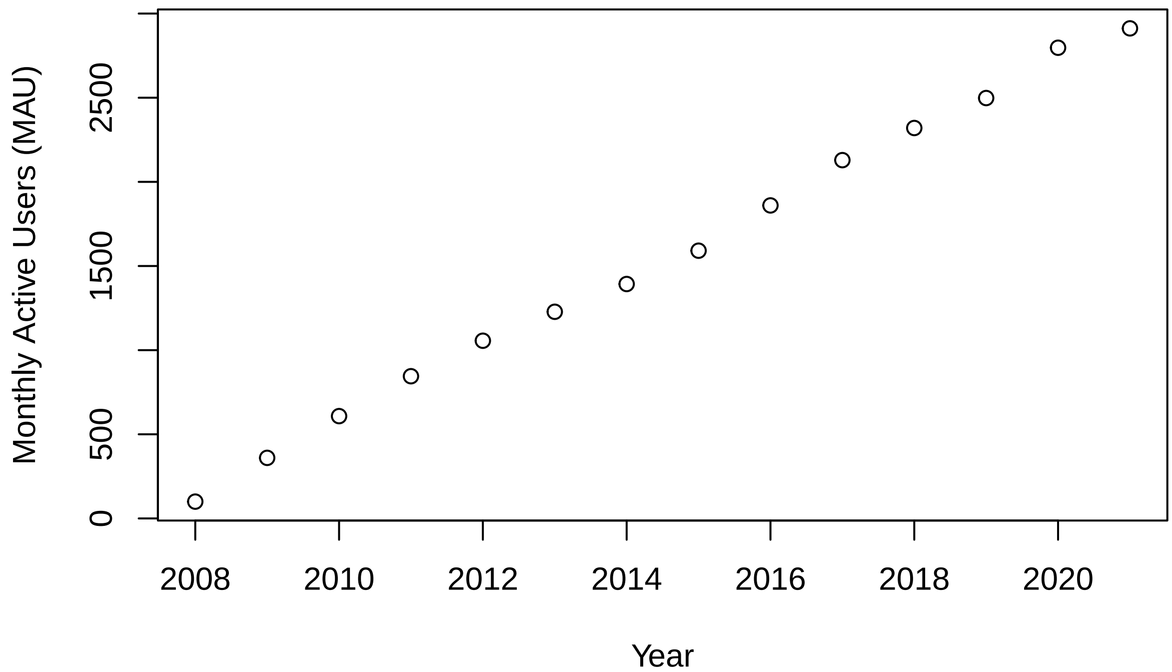
The dimension of the data set:

```
dim(tab)
```

```
## [1] 14  2
```

We then try visualizing the data in order to see if there is an apparent linear relationship between the year and the number of users.

```
plot(tab, xlab="Year", ylab="Monthly Active Users (MAU)")
```



Based on the plotted graph above, we can see that the relationship is fairly linear. Therefore, we can use a linear model to represent the relationship.

```
modreg = lm(mau ~ year, data=tab)
summary(modreg)
```

```
##
## Call:
## lm(formula = mau ~ year, data = tab)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -66.651 -35.664  -0.732  37.167  60.701
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -4.330e+05  5.764e+03  -75.13   <2e-16 ***
## year         2.157e+02  2.861e+00   75.40   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 43.15 on 12 degrees of freedom
## Multiple R-squared:  0.9979, Adjusted R-squared:  0.9977
## F-statistic:  5685 on 1 and 12 DF,  p-value: < 2.2e-16
```

According to the summary of the model, the estimated intercept equals -4.330×10^5 and the estimated coefficient of the year variable equals 2.157×10^2. The model can be written in the form:

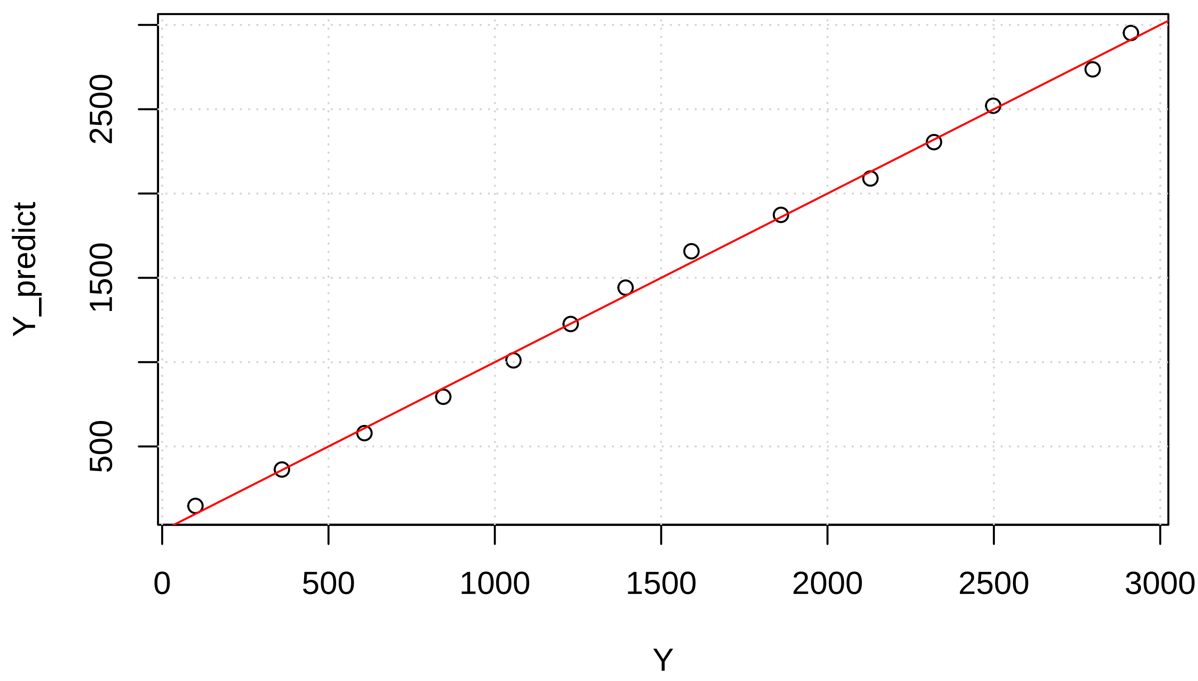
$$\hat{y} = (-4.330 \times 10^5) + (2.157 \times 10^2)x(??? + \hat{\epsilon})$$

where x is the year variable and $\hat{y}$ is the prediction of the MAU.

As for the R^2, we can see that $R^2 = 0.9979 \approx 1$. It is a great result since the value corresponds to the cosinus of the angle between the vector of predictions and the vector of the target values, and the closer to 0 the angle gets, the better the model becomes.

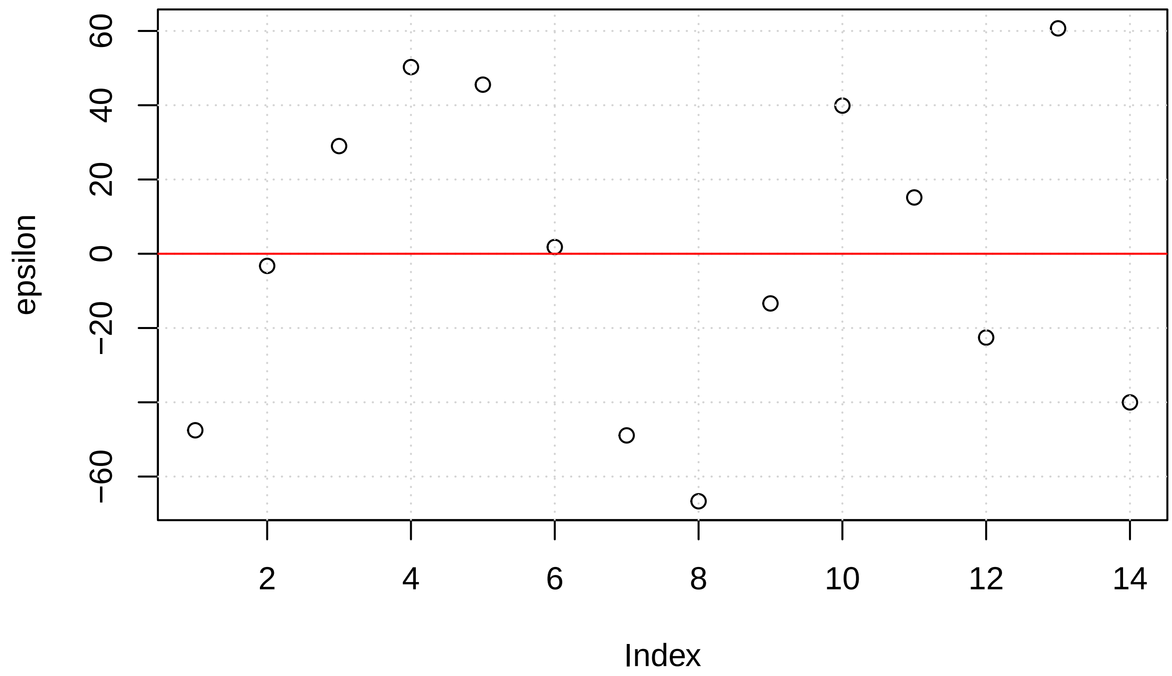
```
Y <- tab$mau
Y_predict <- predict(modreg, tab)

plot(Y, Y_predict)
grid()
abline(a=0, b=1, col="red")
```



In the graph $(y, \hat{y})$ above, we can see that the plotted points are fairly close to the bisector, which indicates that the model is acceptable.

```
epsilon <- Y - Y_predict
plot(epsilon)
grid()
abline(a=0, b=0, col="red")
```



V. Medical data

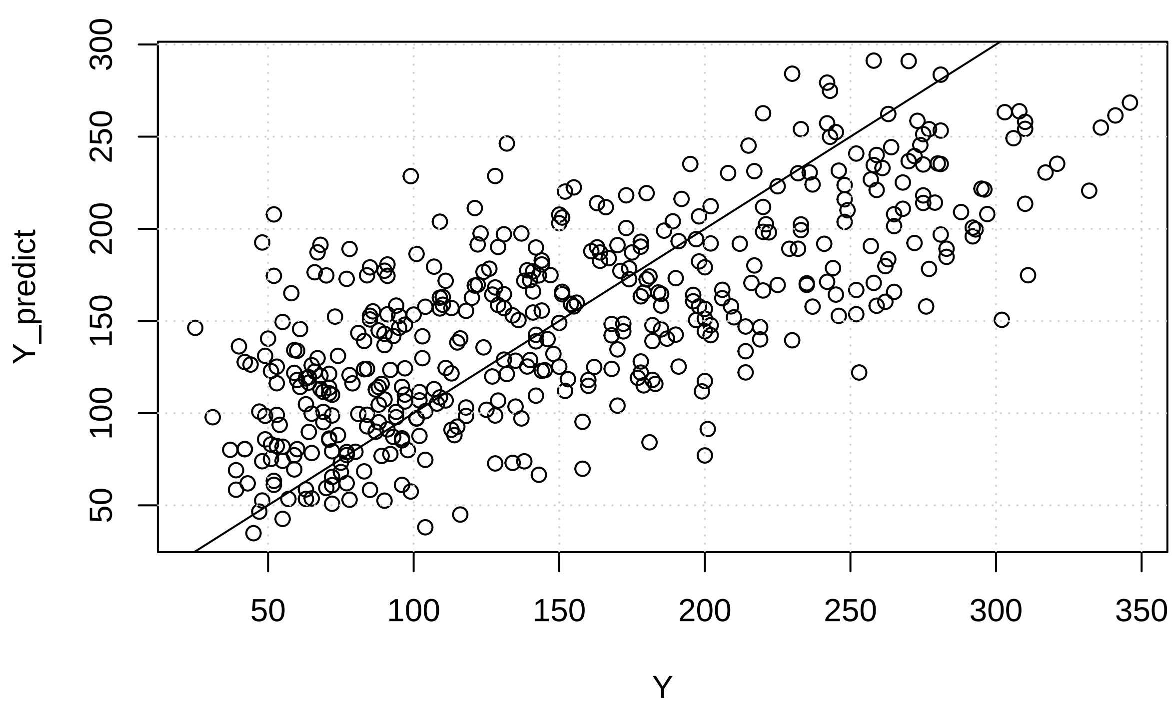
```
tab <- read.table("diabetes.txt", header=TRUE, sep="\t")

modreg = lm(Y~., data=tab)
summary(modreg)
```

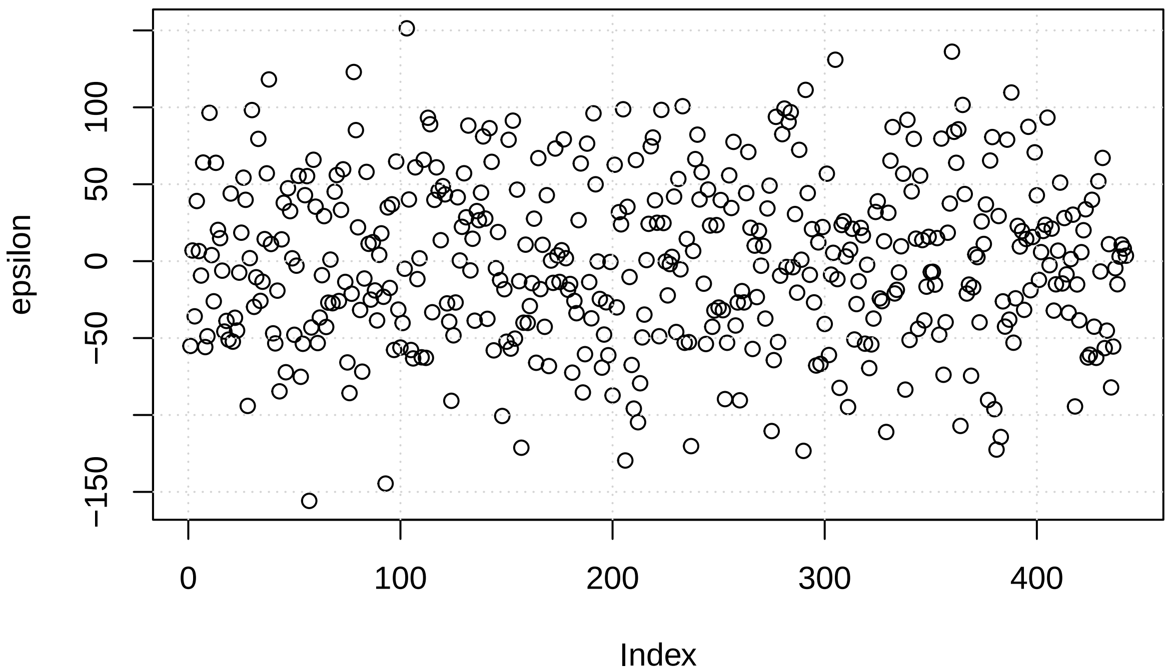
```
##
## Call:
## lm(formula = Y ~ ., data = tab)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -155.827  -38.536   -0.228   37.806  151.353
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -334.56714   67.45462  -4.960 1.02e-06 ***
## AGE           -0.03636    0.21704  -0.168 0.867031
## SEX          -22.85965    5.83582  -3.917 0.000104 ***
## BMI            5.60296    0.71711   7.813 4.30e-14 ***
## BP             1.11681    0.22524   4.958 1.02e-06 ***
## S1            -1.09000    0.57333  -1.901 0.057948 .
```

```
## S2              0.74645    0.53083   1.406 0.160390
## S3              0.37200    0.78246   0.475 0.634723
## S4              6.53383    5.95864   1.097 0.273459
## S5             68.48312   15.66972   4.370 1.56e-05 ***
## S6              0.28012    0.27331   1.025 0.305990
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 54.15 on 431 degrees of freedom
## Multiple R-squared:  0.5177, Adjusted R-squared:  0.5066
## F-statistic: 46.27 on 10 and 431 DF,  p-value: < 2.2e-16
```

```r
Y <- tab$Y
Y_predict <- predict(modreg, tab)
plot(Y, Y_predict)
grid()
abline(a=0, b=1)
```




```r
epsilon <- Y - Y_predict
plot(epsilon)
grid()
```



epsilon
100
50
0
−50
−150
0
100
200
300
400
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