# Sentiment Analysis

Analysis performed using Italian_LIWC2007 Dictionary

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## Contents



```
# Data
load("data/dfm.Rda")

# Dictionary LWIC Complete
LWIC_ITA <- dictionary(file = "data/large_files/Italian_LIWC2007_Dictionary.dic",
                       format = "LIWC")
```

```
## note: removing empty key: Formale

## note: removing empty key: Passivo
```

```
emotions <- c("Emo_Pos", "Emo_Neg", "Ansia", "Rabbia", "Tristez", "Ottimis" )

# Inspect the words
n.words <- c(
length(LWIC_ITA[["Emo_Pos"]]),
length(LWIC_ITA[["Emo_Neg"]]),
length(LWIC_ITA[["Ansia"]]),
length(LWIC_ITA[["Rabbia"]]),
length(LWIC_ITA[["Tristez"]]),
length(LWIC_ITA[["Ottimis"]])
)

num_words <-  data.frame(emotions,n.words)
kable(num_words)
```

| emotions | n.words |
|---|---|
| Emo_Pos | 200 |
| Emo_Neg | 663 |
| Ansia | 65 |
| Rabbia | 227 |
| Tristez | 226 |
| Ottimis | 93 |

```
# Extracting only the keys we need
myLWIC_ITA <- dictionary(list(positive = LWIC_ITA[["Emo_Pos"]],
                              negative = LWIC_ITA[["Emo_Neg"]],
                              anxiety = LWIC_ITA[["Ansia"]],
                              anger = LWIC_ITA[["Rabbia"]],
                              sadness = LWIC_ITA[["Tristez"]],
                              optimism = LWIC_ITA[["Ottimis"]]))

myLWIC_ITA_sent <- dictionary(list(positive = LWIC_ITA[["Emo_Pos"]],
                              negative = LWIC_ITA[["Emo_Neg"]]))
```

**Group and weight the dfm**

```
# By party & quarter
dfm_weigh_p_quart <- dfm_group(DFM, groups = interaction(party_id, quarter))%>%
  dfm_weight(scheme = "prop")
```

## Apply the dictionary

```
# Apply Dictionary to DFM
DFM_emotions <- dfm_lookup(dfm_weigh_p_quart,
                           dictionary = myLWIC_ITA)
DFM_emotions
```

```
## Document-feature matrix of: 110 documents, 6 features (0.76% sparse) and 3 docvars.
##                 features
## docs                positive   negative     anxiety       anger     sadness
##   CI.1           0.008060854 0.02236603 0.003405995 0.006471390 0.004541326
##   FDI.1          0.006416312 0.02893245 0.002834199 0.011061250 0.006140765
##   FI.1           0.006498830 0.02547256 0.003243474 0.007675035 0.006974064
##   INDIPENDENTE.1 0.005129667 0.01567398 0.001994870 0.005984611 0.003989741
##   IV.1           0.008545455 0.02309091 0.003272727 0.009272727 0.006000000
##   LEGA.1         0.006352373 0.02593448 0.003005565 0.008426081 0.006194876
##                 features
## docs               optimism
##   CI.1           0.01089918
##   FDI.1          0.01487955
##   FI.1           0.01447089
##   INDIPENDENTE.1 0.01025933
##   IV.1           0.01600000
##   LEGA.1         0.01257350
## [ reached max_ndoc ... 104 more documents ]
```

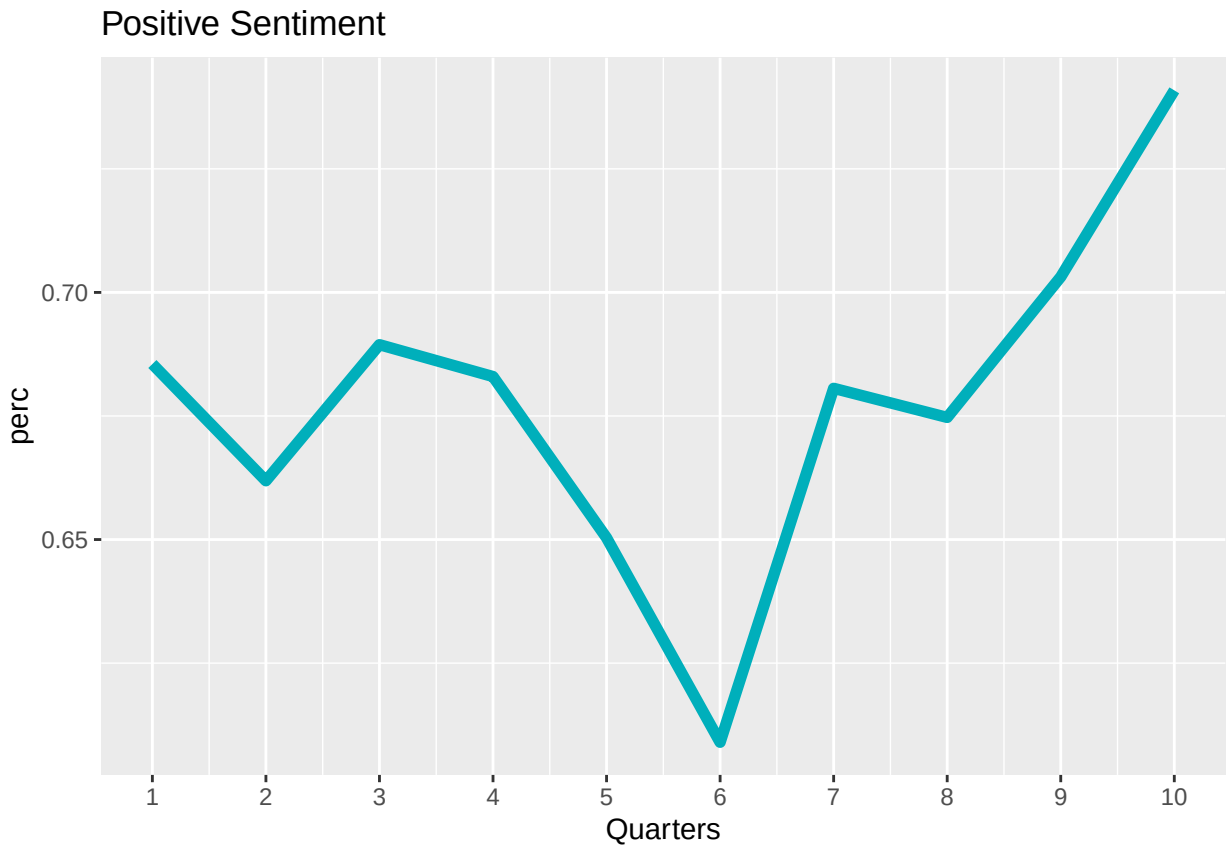
**Transform the DFM into an ordinary dataframe**

```
data_dict_emo <- DFM_emotions %>%
  quanteda::convert(to = "data.frame") %>%
```

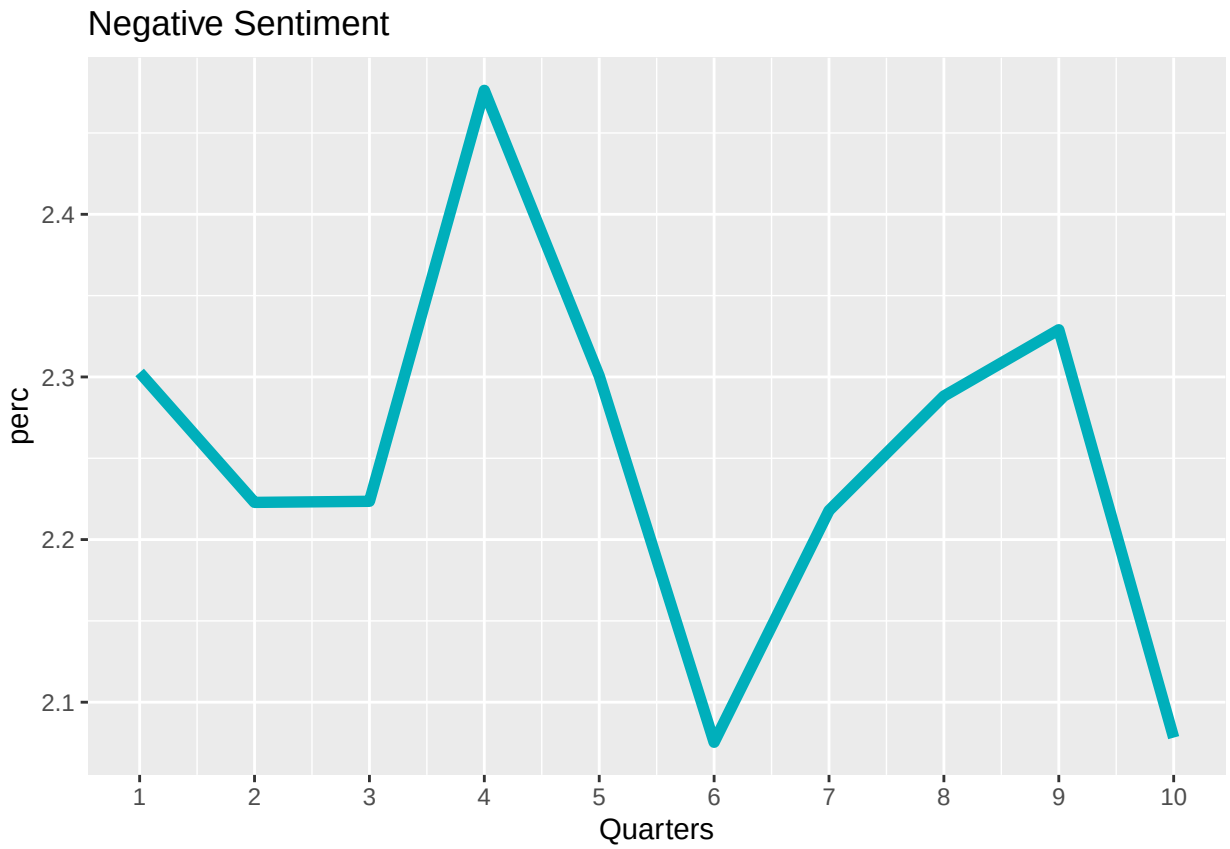
```
  cbind(docvars(DFM_emotions))

# Transform the proportion into percentage
data_dict_emo <- data_dict_emo %>% mutate(positive =  positive * 100,
                                          negative = negative * 100,
                                          anxiety = anxiety * 100,
                                          anger = anger *100,
                                          sadness = sadness * 100,
                                          optimism = optimism *100)
```

### Percentage of the emotions in time

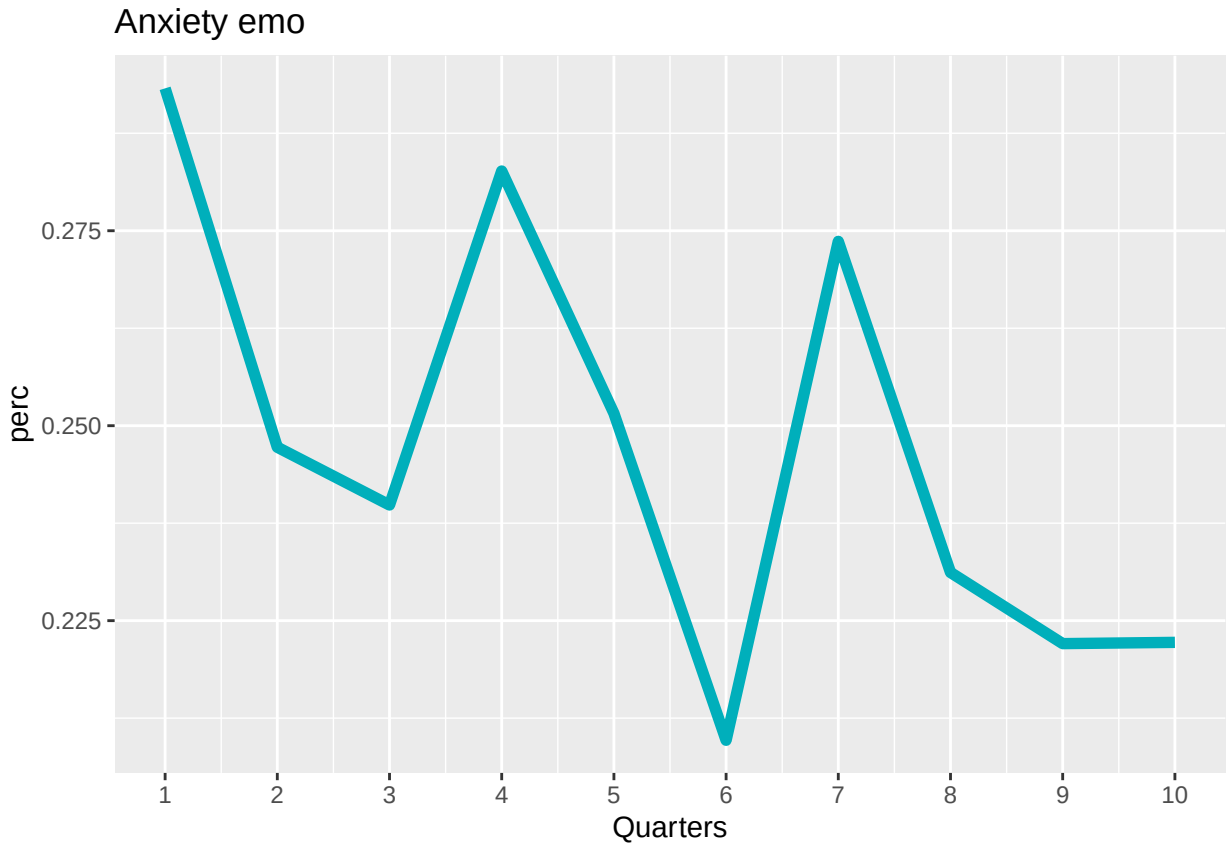
```
#Over time POSITIVE (quarters)
data_quarter_positive <- aggregate(x = data_dict_emo$positive,  # Specify data column
          by = list(data_dict_emo$quarter),  # Specify group indicator
          FUN = mean) # Specify function (i.e. mean)
data_quarter_positive$perc <- data_quarter_positive$x

# plot
plot_positive <- ggplot(data = data_quarter_positive, aes(x = Group.1, y = perc))+
  geom_line(color = "#00AFBB", size = 2)+
  scale_x_continuous("Quarters", labels = as.character(data_quarter_positive$Group.1), breaks = data_qua
  labs(title = "Positive Sentiment")
plot_positive
```



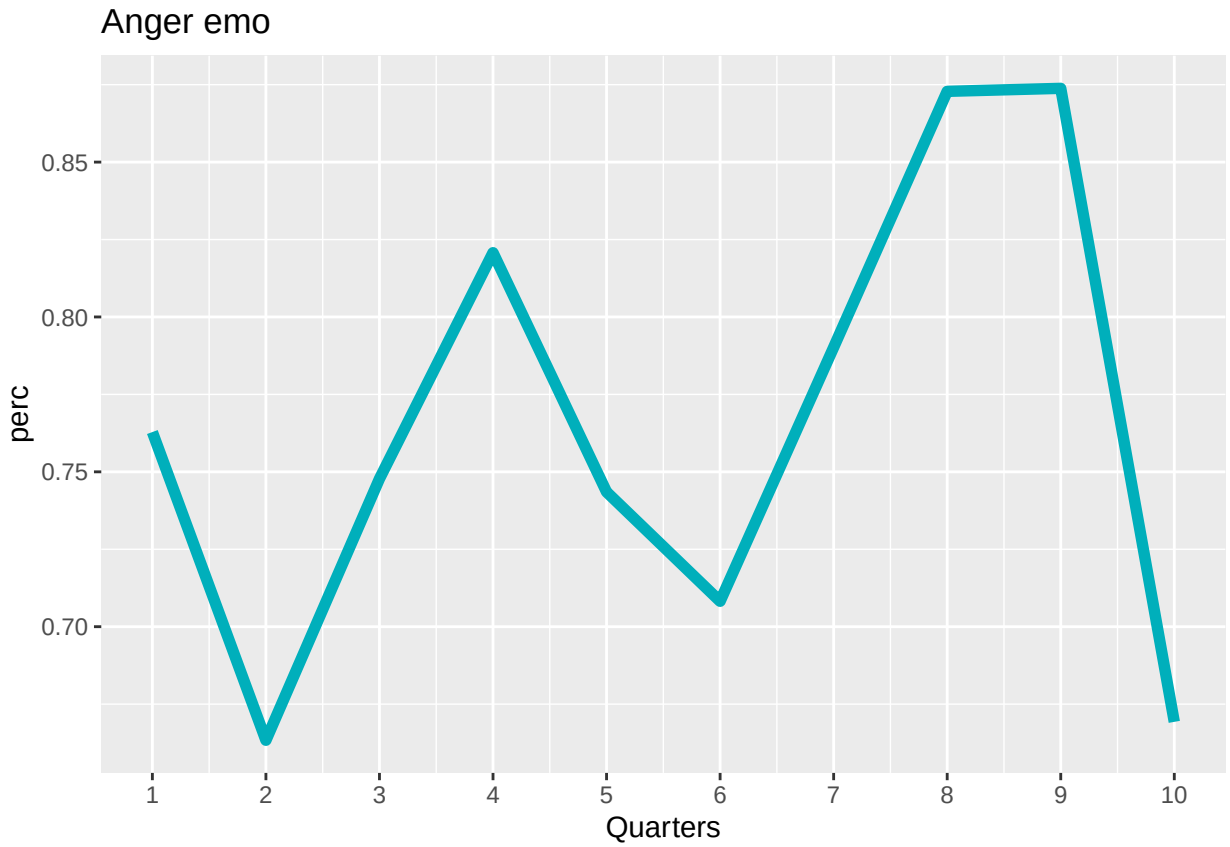

```
#############
#Over time NEGATIVE (quarters)
data_quarter_negative <- aggregate(x = data_dict_emo$negative,  # Specify data column
          by = list(data_dict_emo$quarter),  # Specify group indicator
          FUN = mean) # Specify function (i.e. mean)
data_quarter_negative$perc <- data_quarter_negative$x

# plot
plot_negative <- ggplot(data = data_quarter_negative, aes(x = Group.1, y = perc))+
  geom_line(color = "#00AFBB", size = 2)+
  scale_x_continuous("Quarters", labels = as.character(data_quarter_negative$Group.1), breaks = data_qua
  labs(title = "Negative Sentiment")
plot_negative
```



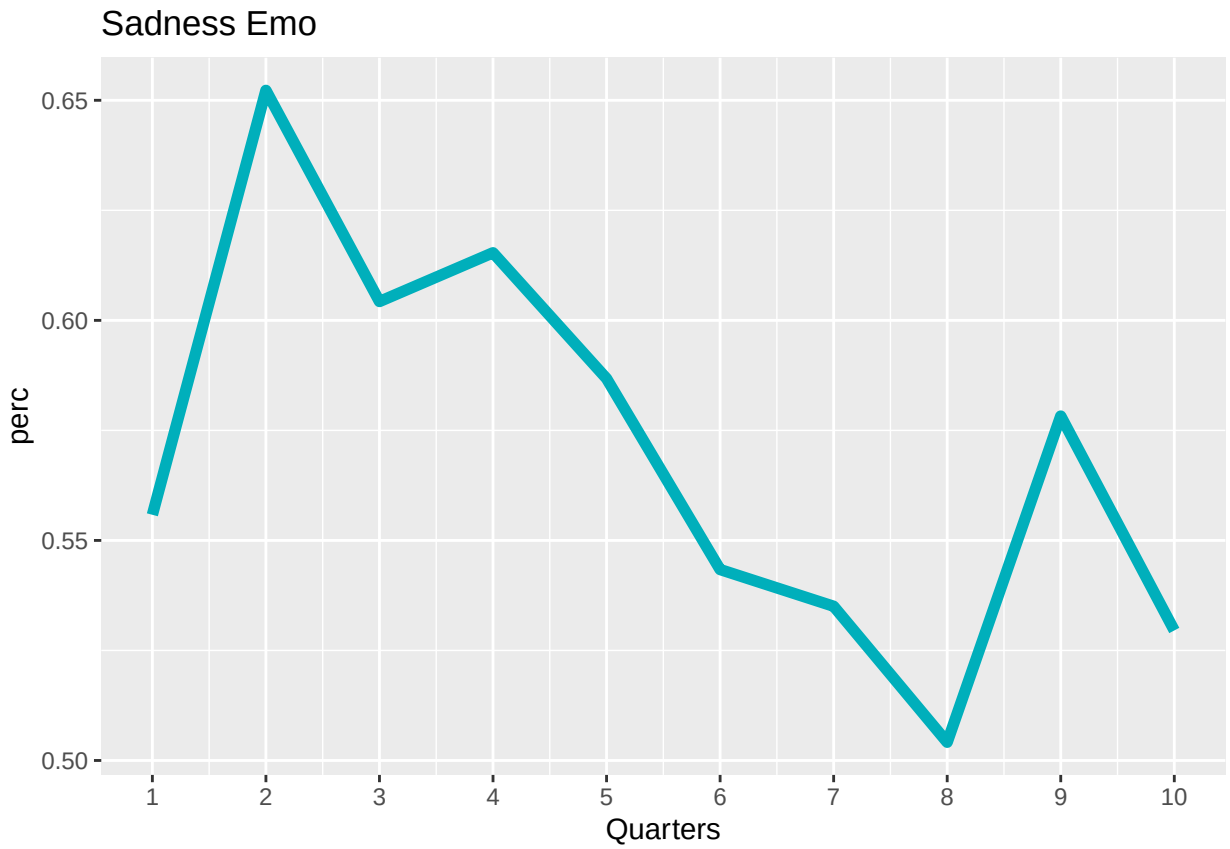

```
############
#Over time ANXIETY (quarters)
data_quarter_anxiety <- aggregate(x = data_dict_emo$anxiety,  # Specify data column
          by = list(data_dict_emo$quarter),  # Specify group indicator
          FUN = mean) # Specify function (i.e. mean)
data_quarter_anxiety$perc <- data_quarter_anxiety$x

# plot the level of the "ELITE" component in time
plot_anxiety <- ggplot(data = data_quarter_anxiety, aes(x = Group.1, y = perc))+
  geom_line(color = "#00AFBB", size = 2)+
  scale_x_continuous("Quarters", labels = as.character(data_quarter_anxiety$Group.1), breaks = data_quar
  labs(title = "Anxiety emo")
plot_anxiety
```



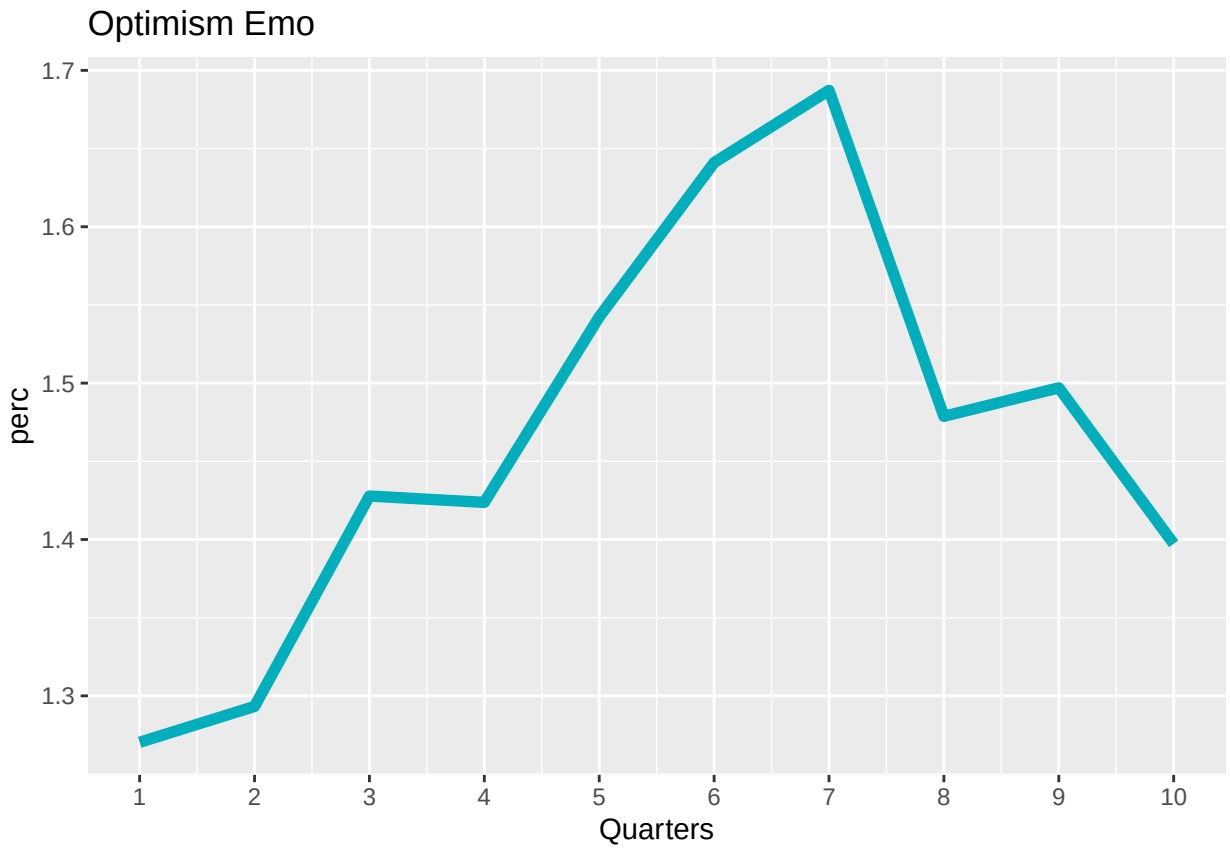

```
############
#Over time ANGER (quarters)
data_quarter_anger <- aggregate(x = data_dict_emo$anger,  # Specify data column
          by = list(data_dict_emo$quarter),  # Specify group indicator
          FUN = mean) # Specify function (i.e. mean)
data_quarter_anger$perc <- data_quarter_anger$x

# plot the level of the "ELITE" component in time
plot_anger <- ggplot(data = data_quarter_anger, aes(x = Group.1, y = perc))+
  geom_line(color = "#00AFBB", size = 2)+
  scale_x_continuous("Quarters", labels = as.character(data_quarter_anger$Group.1), breaks = data_quarte
  labs(title = "Anger emo")
plot_anger
```




```
############
#Over time SADNESS (quarters)
data_quarter_sadness <- aggregate(x = data_dict_emo$sadness,  # Specify data column
          by = list(data_dict_emo$quarter),  # Specify group indicator
          FUN = mean) # Specify function (i.e. mean)
data_quarter_sadness$perc <- data_quarter_sadness$x

# plot
plot_sadness <- ggplot(data = data_quarter_sadness, aes(x = Group.1, y = perc))+
  geom_line(color = "#00AFBB", size = 2)+
  scale_x_continuous("Quarters", labels = as.character(data_quarter_sadness$Group.1), breaks = data_quar
  labs(title = "Sadness Emo")
plot_sadness
```

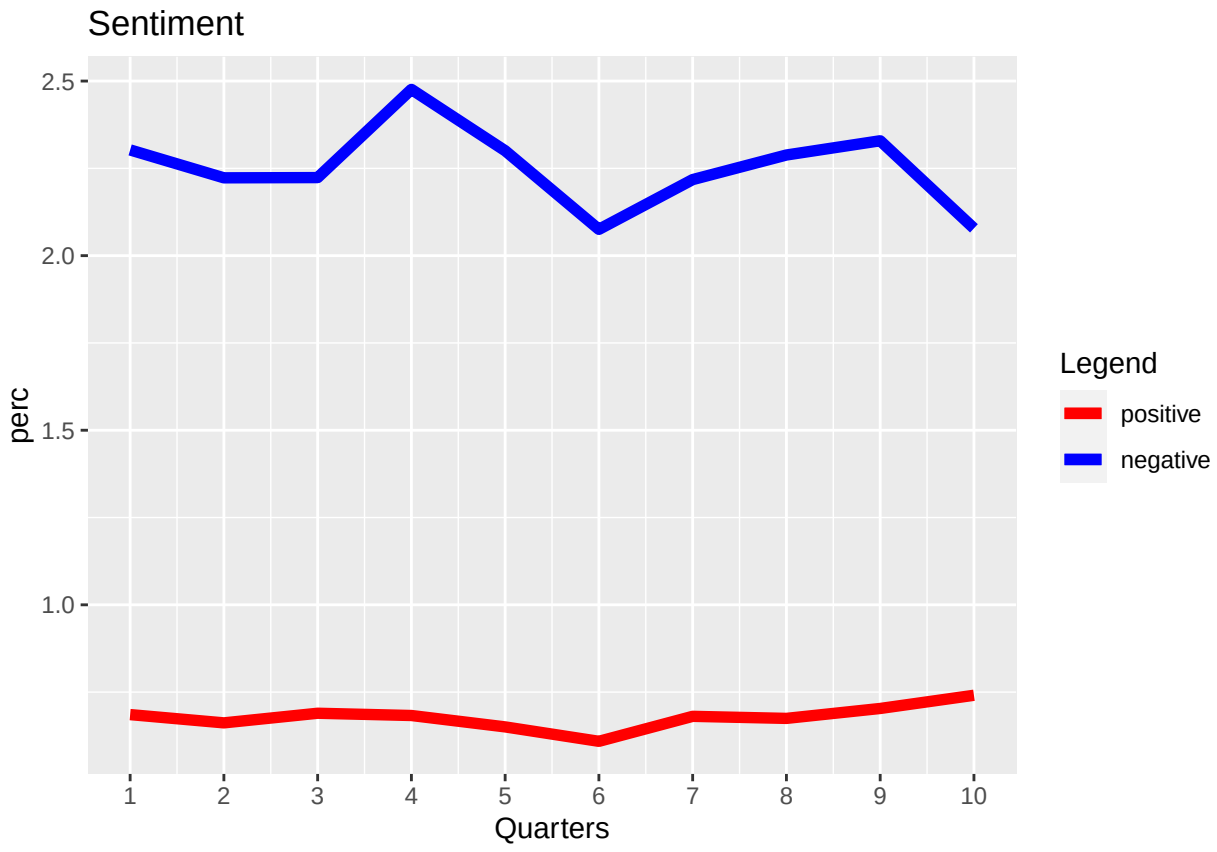



```
############
#Over time OPTIMISM (quarters)
data_quarter_optimism <- aggregate(x = data_dict_emo$optimism,  # Specify data column
          by = list(data_dict_emo$quarter),  # Specify group indicator
          FUN = mean) # Specify function (i.e. mean)
data_quarter_optimism$perc <- data_quarter_optimism$x

# plot
plot_optimism<- ggplot(data = data_quarter_optimism, aes(x = Group.1, y = perc))+
  geom_line(color = "#00AFBB", size = 2)+
  scale_x_continuous("Quarters", labels = as.character(data_quarter_optimism$Group.1), breaks = data_qua
  labs(title = "Optimism Emo")
plot_optimism
```

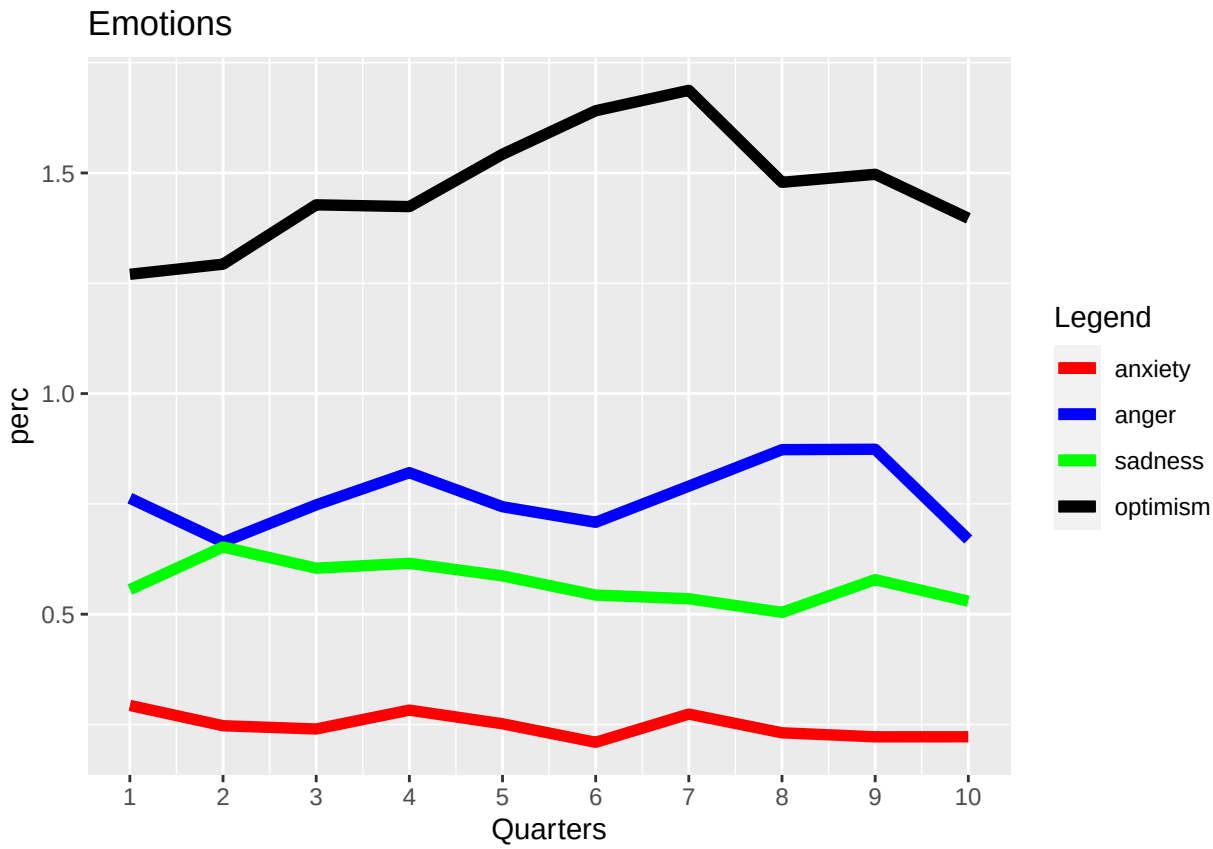



```
#########
# compare the levels
p1 <- ggplot() +
  # plot positive
  geom_line(data = data_quarter_positive, aes(x = Group.1, y = perc, color = "positive"), size = 2) +
  # plot negative
  geom_line(data = data_quarter_negative, aes(x = Group.1, y = perc, color = "negative"), size = 2) +
  scale_color_manual(name='Legend',
                     breaks=c('positive', 'negative'),
                     values=c('positive'='red', 'negative'='blue'))+
  scale_x_continuous("Quarters",
                     labels = as.character(data_quarter_positive$Group.1),
                     breaks = data_quarter_positive$Group.1)+
  labs(title = "Sentiment")

p2 <- ggplot() +
  # plot anxiety
  geom_line(data = data_quarter_anxiety, aes(x = Group.1, y = perc, color = "anxiety"), size = 2) +
  # plot anger
  geom_line(data = data_quarter_anger, aes(x = Group.1, y = perc, color = "anger"), size = 2) +
  # plot sadness
  geom_line(data = data_quarter_sadness, aes(x = Group.1, y = perc, color = "sadness"), size = 2) +
  # plot optimism
  geom_line(data = data_quarter_optimism, aes(x = Group.1, y = perc, color = "optimism"), size = 2) +
  scale_color_manual(name='Legend',
                     breaks=c('anxiety', 'anger', 'sadness',"optimism"),
```

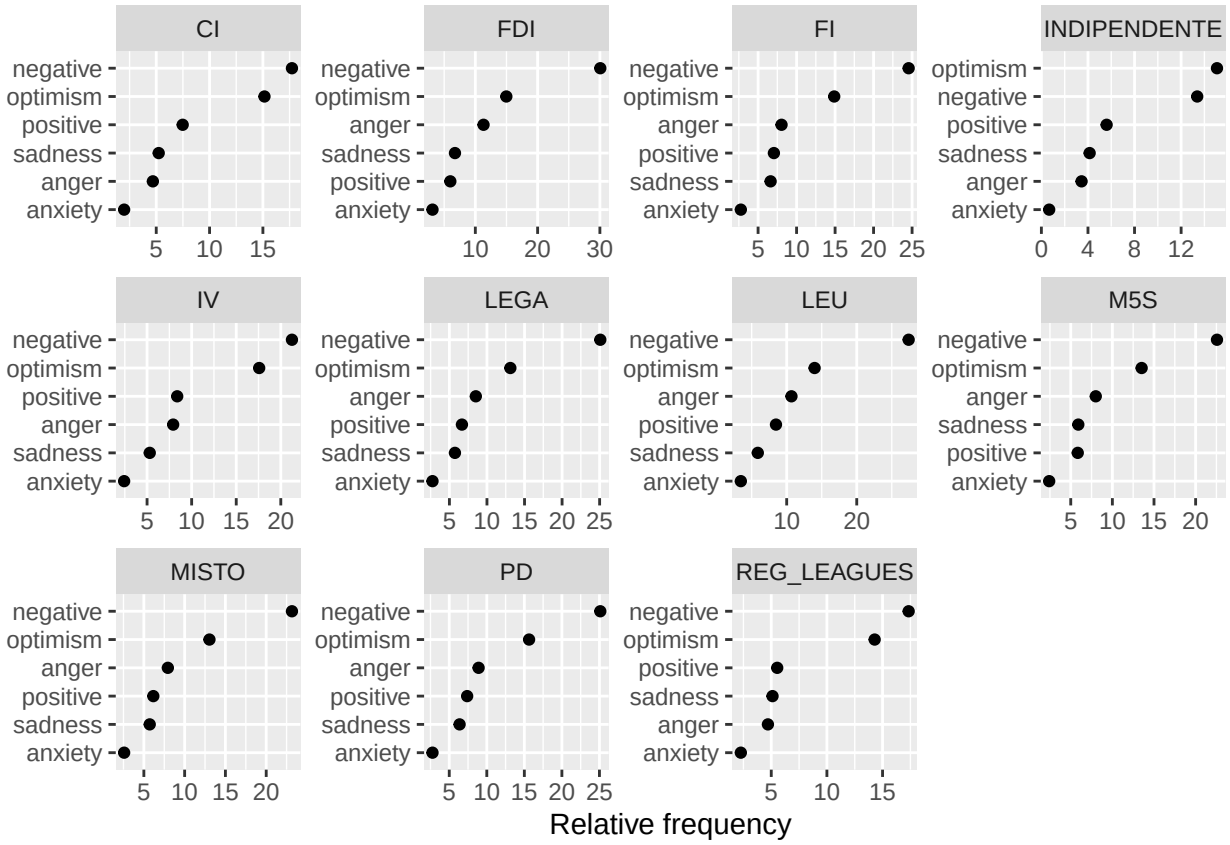
```
                    values=c('anxiety'='red', 'anger'='blue',
                             'sadness'='green', "optimism" = "black"))+

  scale_x_continuous("Quarters", labels = as.character(data_quarter_positive$Group.1), breaks = data_qua
  labs(title = "Emotions")

p1
```




```
p2
```


Emotions
perc
1.5
1.0
0.5
1
2
3
4
5
6
7
8
9
10
Quarters
Legend
anxiety
anger
sadness
optimism

### Main emotion for each parliamentary group

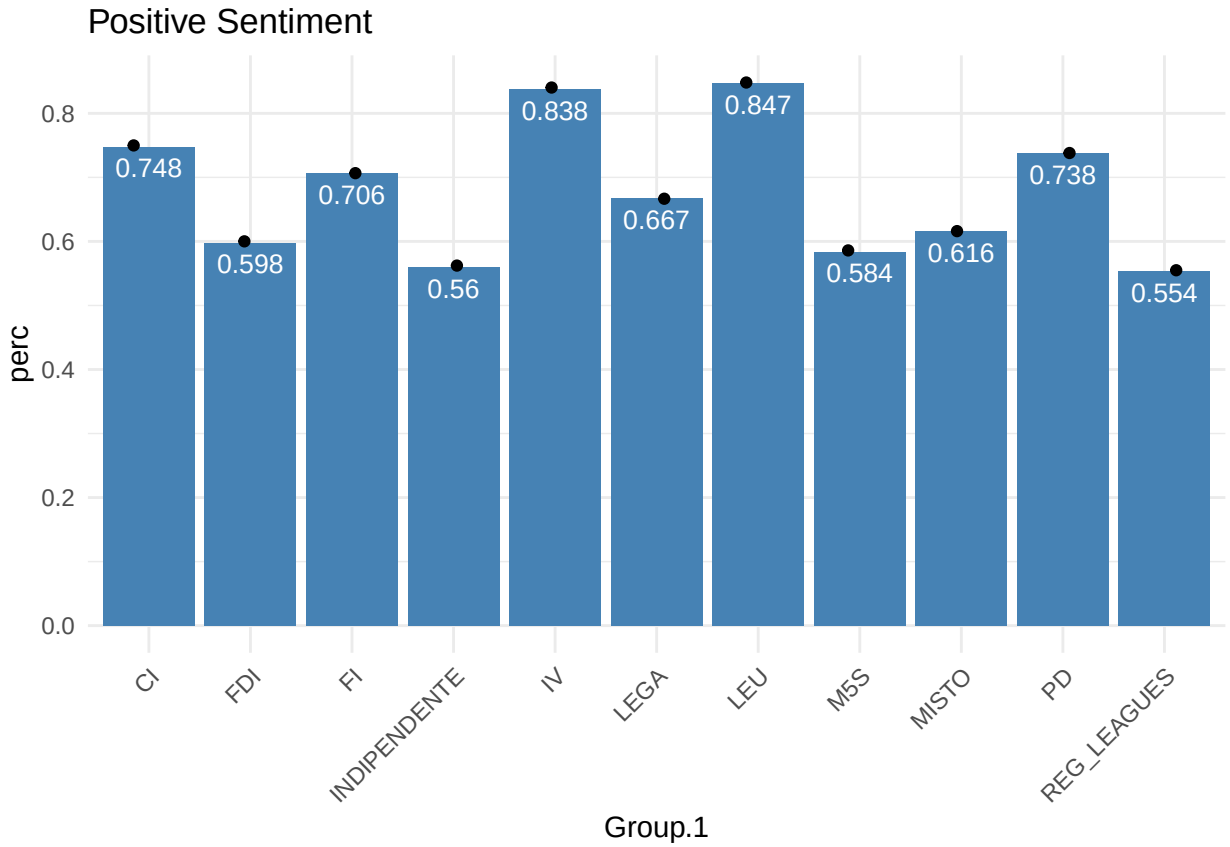



```
#By party no time (quarters)

# POSITIVE
data_party_positive <- aggregate(x = data_dict_emo$positive,  # Specify data column
          by = list(data_dict_emo$party_id),  # Specify group indicator
          FUN = mean) # Specify function (i.e. mean)
data_party_positive$perc <- round(data_party_positive$x,3)
kable(data_party_positive %>% select(Group.1, perc) %>%  arrange(desc(perc)), caption = "POSITIVE")
```

```
ggplot(data=data_party_positive, aes(x=Group.1, y=perc)) +
  geom_bar(stat="identity", fill="steelblue")+
  geom_text(aes(label=perc), vjust=1.6, color="white", size=3.5)+
  theme_minimal()+
  geom_jitter(width=0.15)+
  theme(axis.text.x = element_text(angle = 45, hjust=1))+
  labs(title = "Positive Sentiment")
```

Table 1: POSITIVE

| Group.1 | perc |
|---|---|
| LEU | 0.847 |
| IV | 0.838 |
| CI | 0.748 |
| PD | 0.738 |
| FI | 0.706 |
| LEGA | 0.667 |
| MISTO | 0.616 |
| FDI | 0.598 |
| M5S | 0.584 |
| INDIPENDENTE | 0.560 |
| REG_LEAGUES | 0.554 |




```
######################

# NEGATIVE
data_party_negative <- aggregate(x = data_dict_emo$negative,  # Specify data column
          by = list(data_dict_emo$party_id),  # Specify group indicator
          FUN = mean) # Specify function (i.e. mean)
data_party_negative$perc <- round(data_party_negative$x,3)
kable(data_party_negative %>% select(Group.1, perc) %>%  arrange(desc(perc)), caption = "NEGATIVE")
```

Table 2: NEGATIVE

| Group.1 | perc |
|---|---|
| FDI | 3.006 |
| LEU | 2.741 |
| PD | 2.512 |
| LEGA | 2.509 |
| FI | 2.455 |
| MISTO | 2.316 |
| M5S | 2.257 |
| IV | 2.125 |
| CI | 1.772 |
| REG_LEAGUES | 1.734 |
| INDIPENDENTE | 1.338 |

```
ggplot(data=data_party_negative, aes(x=Group.1, y=perc)) +
  geom_bar(stat="identity", fill="steelblue")+
  geom_text(aes(label=perc), vjust=1.6, color="white", size=3.5)+
  theme_minimal()+
  geom_jitter(width=0.15)+
  theme(axis.text.x = element_text(angle = 45, hjust=1))+
  labs(title = "Negative Sentiment")
```

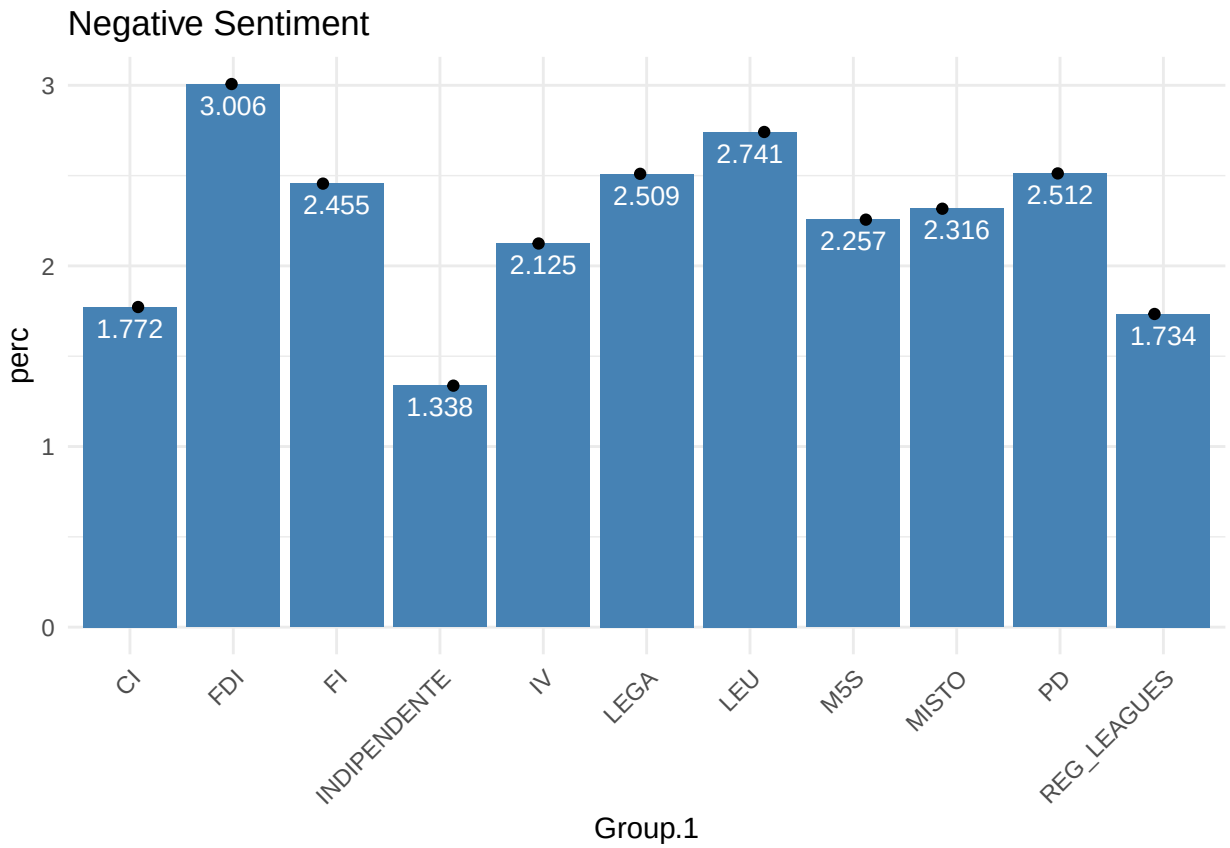


Table 3: ANXIETY

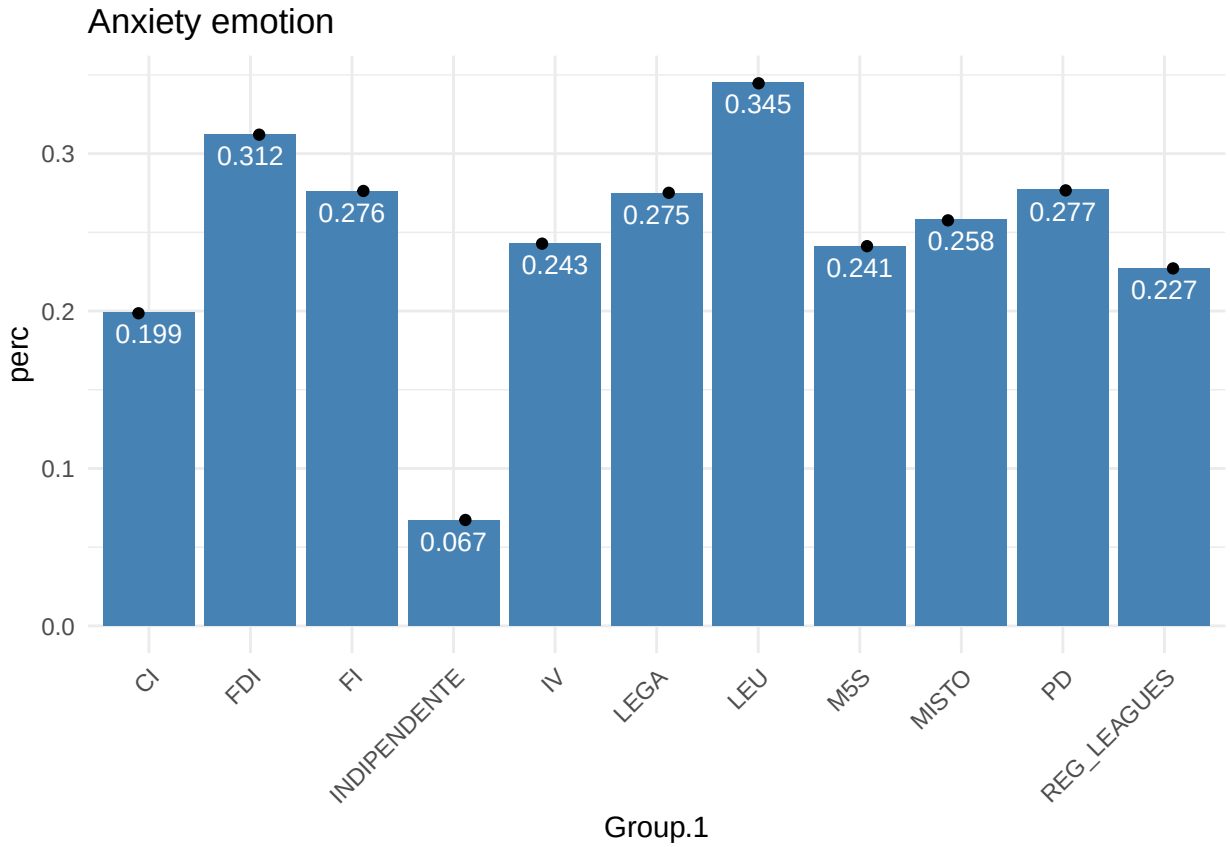
| Group.1 | perc |
|---|---|
| LEU | 0.345 |
| FDI | 0.312 |
| PD | 0.277 |
| FI | 0.276 |
| LEGA | 0.275 |
| MISTO | 0.258 |
| IV | 0.243 |
| M5S | 0.241 |
| REG_LEAGUES | 0.227 |
| CI | 0.199 |
| INDIPENDENTE | 0.067 |

```
############################

# ANXIETY
data_party_anxiety <- aggregate(x = data_dict_emo$anxiety,  # Specify data column
          by = list(data_dict_emo$party_id),  # Specify group indicator
          FUN = mean) # Specify function (i.e. mean)
data_party_anxiety$perc <- round(data_party_anxiety$x,3)
kable(data_party_anxiety %>% select(Group.1, perc) %>%  arrange(desc(perc)), caption = "ANXIETY")
```

```
ggplot(data=data_party_anxiety, aes(x=Group.1, y=perc)) +
  geom_bar(stat="identity", fill="steelblue")+
  geom_text(aes(label=perc), vjust=1.6, color="white", size=3.5)+
  theme_minimal()+
  geom_jitter(width=0.15)+
  theme(axis.text.x = element_text(angle = 45, hjust=1))+
  labs(title = "Anxiety emotion")
```

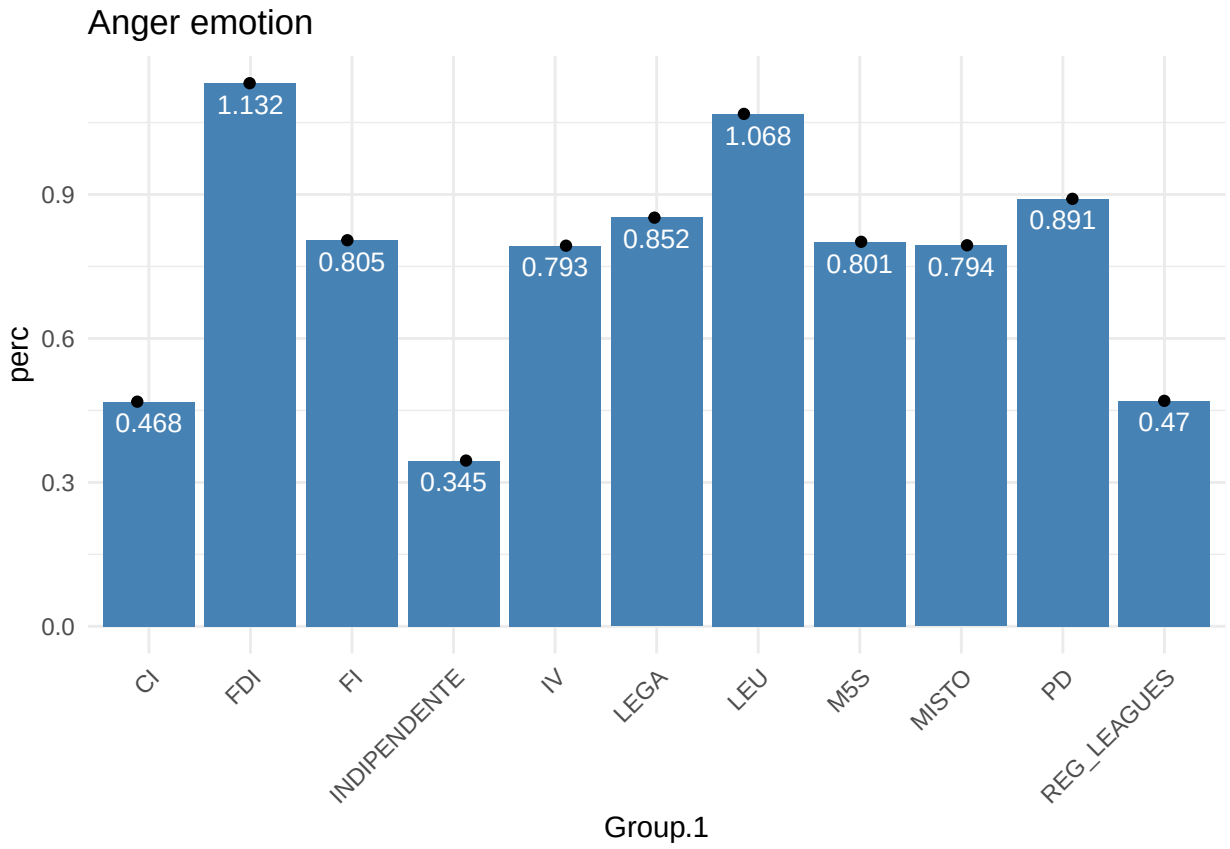
Table 4: ANGER

| Group.1 | perc |
|---|---|
| FDI | 1.132 |
| LEU | 1.068 |
| PD | 0.891 |
| LEGA | 0.852 |
| FI | 0.805 |
| M5S | 0.801 |
| MISTO | 0.794 |
| IV | 0.793 |
| REG_LEAGUES | 0.470 |
| CI | 0.468 |
| INDIPENDENTE | 0.345 |




```
##################

# ANGER
data_party_anger <- aggregate(x = data_dict_emo$anger,  # Specify data column
          by = list(data_dict_emo$party_id),  # Specify group indicator
          FUN = mean) # Specify function (i.e. mean)
data_party_anger$perc <- round(data_party_anger$x,3)
kable(data_party_anger %>% select(Group.1, perc) %>%  arrange(desc(perc)), caption = "ANGER")
```

```
ggplot(data=data_party_anger, aes(x=Group.1, y=perc)) +
  geom_bar(stat="identity", fill="steelblue")+
  geom_text(aes(label=perc), vjust=1.6, color="white", size=3.5)+
  theme_minimal()+
  geom_jitter(width=0.15)+
  theme(axis.text.x = element_text(angle = 45, hjust=1))+
  labs(title = "Anger emotion")
```

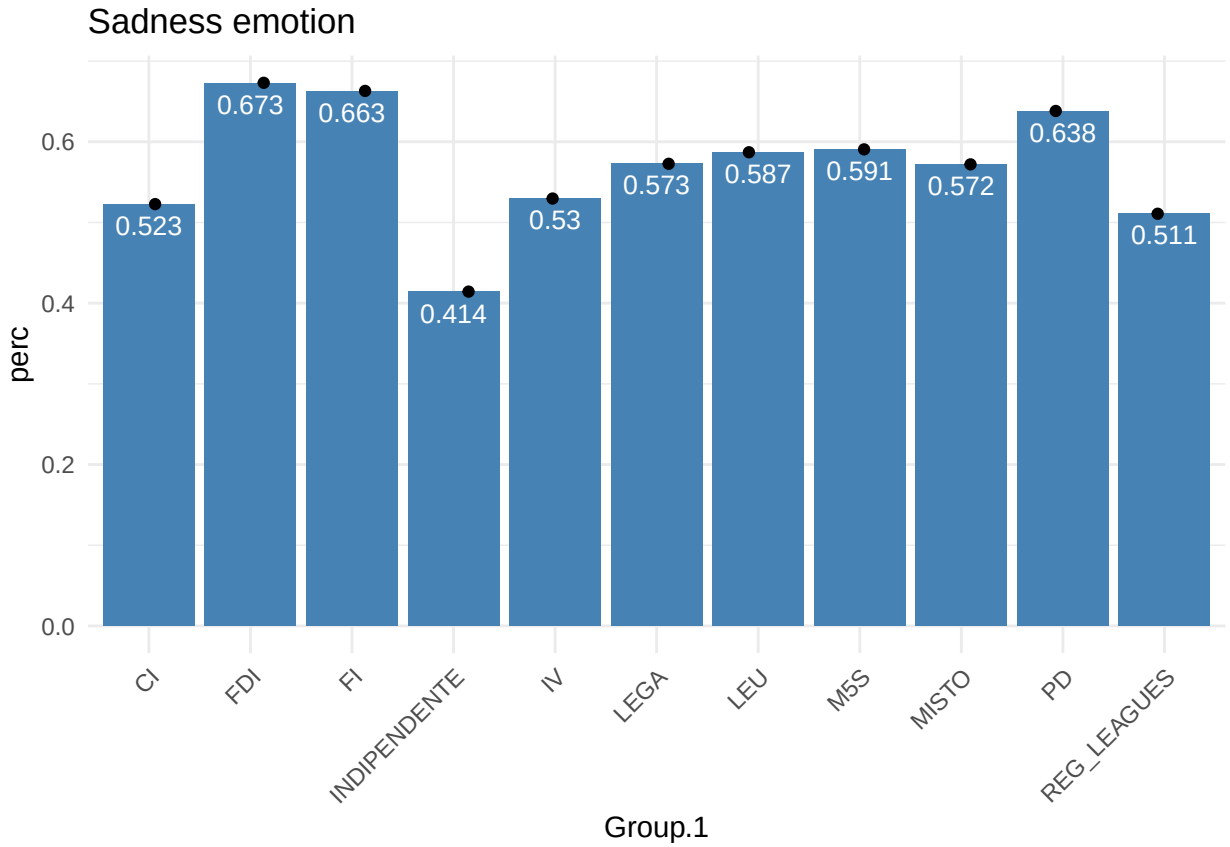



```
###################

# SADNESS
data_party_sadness <- aggregate(x = data_dict_emo$sadness,  # Specify data column
          by = list(data_dict_emo$party_id),  # Specify group indicator
          FUN = mean) # Specify function (i.e. mean)
data_party_sadness$perc <- round(data_party_sadness$x,3)
kable(data_party_sadness %>% select(Group.1, perc) %>%  arrange(desc(perc)), caption = "SADNESS")
```

```
ggplot(data=data_party_sadness, aes(x=Group.1, y=perc)) +
  geom_bar(stat="identity", fill="steelblue")+
  geom_text(aes(label=perc), vjust=1.6, color="white", size=3.5)+
  theme_minimal()+
  geom_jitter(width=0.15)+
  theme(axis.text.x = element_text(angle = 45, hjust=1))+
  labs(title = "Sadness emotion")
```

Table 5: SADNESS

| Group.1 | perc |
|---|---|
| FDI | 0.673 |
| FI | 0.663 |
| PD | 0.638 |
| M5S | 0.591 |
| LEU | 0.587 |
| LEGA | 0.573 |
| MISTO | 0.572 |
| IV | 0.530 |
| CI | 0.523 |
| REG_LEAGUES | 0.511 |
| INDIPENDENTE | 0.414 |

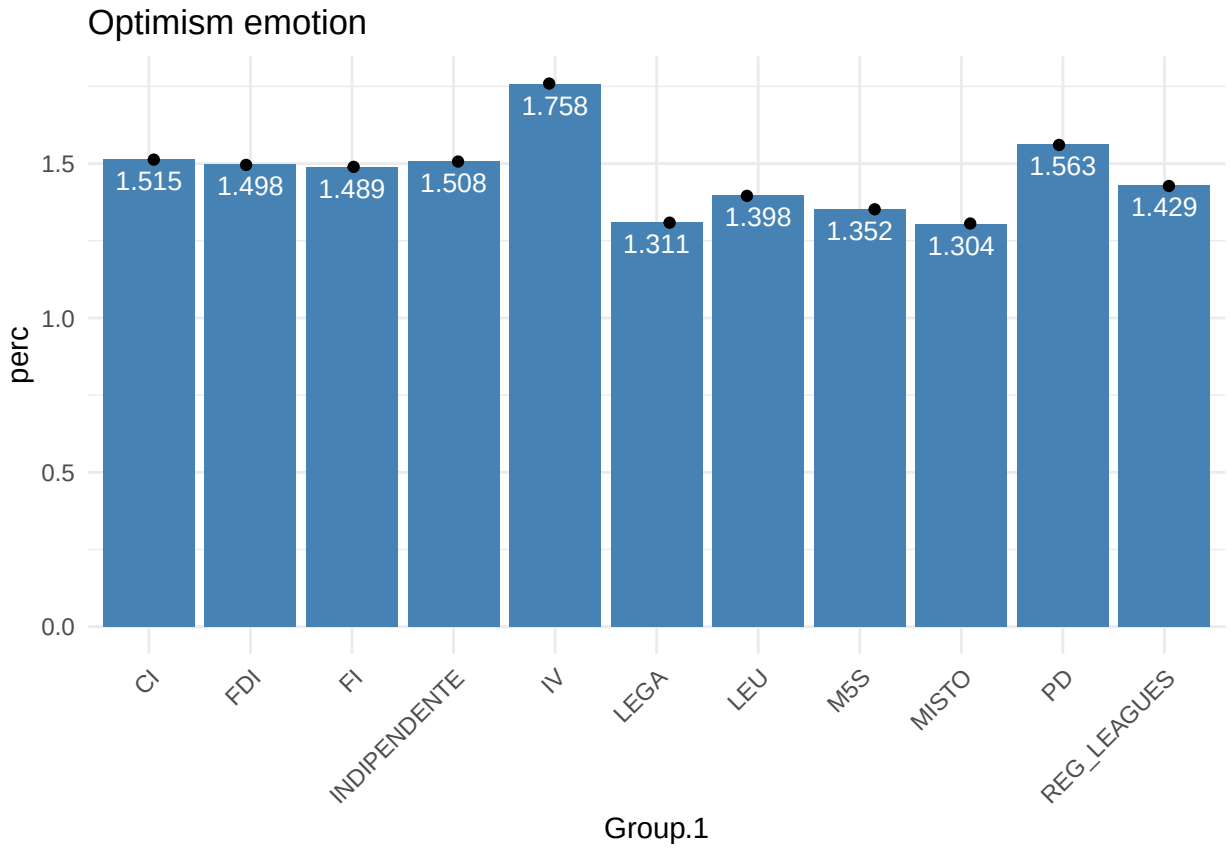



```
##################

# OPTIMISM
data_party_optimism <- aggregate(x = data_dict_emo$optimism,  # Specify data column
          by = list(data_dict_emo$party_id),  # Specify group indicator
          FUN = mean) # Specify function (i.e. mean)
data_party_optimism$perc <- round(data_party_optimism$x,3)
kable(data_party_optimism %>% select(Group.1, perc) %>%  arrange(desc(perc)), caption = "OPTIMISM")
```

Table 6: OPTIMISM

| Group.1 | perc |
|---|---|
| IV | 1.758 |
| PD | 1.563 |
| CI | 1.515 |
| INDIPENDENTE | 1.508 |
| FDI | 1.498 |
| FI | 1.489 |
| REG_LEAGUES | 1.429 |
| LEU | 1.398 |
| M5S | 1.352 |
| LEGA | 1.311 |
| MISTO | 1.304 |

```
ggplot(data=data_party_optimism, aes(x=Group.1, y=perc)) +
  geom_bar(stat="identity", fill="steelblue")+
  geom_text(aes(label=perc), vjust=1.6, color="white", size=3.5)+
  theme_minimal()+
  geom_jitter(width=0.15)+
  theme(axis.text.x = element_text(angle = 45, hjust=1))+
  labs(title = "Optimism emotion")
```



```
##################
```

Are the average values of [...] for each party statistically different from each other? The reference category is PD

```
# POSITIVE
summary(data_dict_emo$positive)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.3281  0.5863  0.6542  0.6778  0.7546  1.1593
```

```
# bivariate regression for check t-test
data_dict_emo$factor_party <- as.factor(data_dict_emo$party_id)
data_dict_emo$factor_party <- relevel(data_dict_emo$factor_party, ref = "PD")

data_dict_emo$factor_quarter <- as.factor(data_dict_emo$quarter)
data_dict_emo$factor_quarter <- relevel(data_dict_emo$factor_quarter, ref = "5")

positive_model <- lm(positive ~  factor_quarter + factor_party, data_dict_emo )

summary(positive_model)
```

```
##
## Call:
## lm(formula = positive ~ factor_quarter + factor_party, data = data_dict_emo)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.26194 -0.06684  0.00093  0.04680  0.33861
##
## Coefficients:
##                             Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 0.710990   0.052210  13.618  < 2e-16 ***
## factor_quarter1             0.035165   0.052210   0.674  0.50234
## factor_quarter2             0.011541   0.052210   0.221  0.82556
## factor_quarter3             0.039079   0.052210   0.748  0.45611
## factor_quarter4             0.032630   0.052210   0.625  0.53358
## factor_quarter6            -0.041367   0.052210  -0.792  0.43026
## factor_quarter7             0.030252   0.052210   0.579  0.56376
## factor_quarter8             0.024362   0.052210   0.467  0.64191
## factor_quarter9             0.052797   0.052210   1.011  0.31462
## factor_quarter10            0.090541   0.052210   1.734  0.08632 .
## factor_partyCI              0.009462   0.054759   0.173  0.86321
## factor_partyFDI            -0.140003   0.054759  -2.557  0.01224 *
## factor_partyFI             -0.032835   0.054759  -0.600  0.55026
## factor_partyINDIPENDENTE -0.178239   0.054759  -3.255  0.00160 **
## factor_partyIV              0.099436   0.054759   1.816  0.07272 .
## factor_partyLEGA           -0.071907   0.054759  -1.313  0.19247
## factor_partyLEU             0.108649   0.054759   1.984  0.05029 .
## factor_partyM5S            -0.154273   0.054759  -2.817  0.00595 **
## factor_partyMISTO          -0.122489   0.054759  -2.237  0.02776 *
## factor_partyREG_LEAGUES  -0.184902   0.054759  -3.377  0.00109 **
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1224 on 90 degrees of freedom
## Multiple R-squared:  0.4781, Adjusted R-squared:  0.3679
## F-statistic: 4.339 on 19 and 90 DF,  p-value: 1.009e-06
```

```
#NEGATIVE
summary(data_dict_emo$negative)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.9522  1.9364  2.3318  2.2515  2.5867  3.2025
```

```
# bivariate regression for check t-test
data_dict_emo$factor_party <- as.factor(data_dict_emo$party_id)
data_dict_emo$factor_party <- relevel(data_dict_emo$factor_party, ref = "PD")

data_dict_emo$factor_quarter <- as.factor(data_dict_emo$quarter)
data_dict_emo$factor_quarter <- relevel(data_dict_emo$factor_quarter, ref = "5")

negative_model <- lm(negative ~  factor_quarter + factor_party, data_dict_emo )

summary(negative_model)
```

```
##
## Call:
## lm(formula = negative ~ factor_quarter + factor_party, data = data_dict_emo)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.79357 -0.14849  0.00431  0.15790  0.46872
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                2.560662   0.108714  23.554  < 2e-16 ***
## factor_quarter1            0.002167   0.108714   0.020  0.98414
## factor_quarter2           -0.077716   0.108714  -0.715  0.47654
## factor_quarter3           -0.077039   0.108714  -0.709  0.48038
## factor_quarter4            0.175647   0.108714   1.616  0.10966
## factor_quarter6           -0.225225   0.108714  -2.072  0.04115 *
## factor_quarter7           -0.082757   0.108714  -0.761  0.44851
## factor_quarter8           -0.012345   0.108714  -0.114  0.90984
## factor_quarter9            0.028457   0.108714   0.262  0.79410
## factor_quarter10          -0.222362   0.108714  -2.045  0.04374 *
## factor_partyCI            -0.739253   0.114020  -6.484 4.70e-09 ***
## factor_partyFDI            0.494954   0.114020   4.341 3.71e-05 ***
## factor_partyFI            -0.056139   0.114020  -0.492  0.62366
## factor_partyINDIPENDENTE -1.173282   0.114020 -10.290  < 2e-16 ***
## factor_partyIV            -0.386425   0.114020  -3.389  0.00104 **
## factor_partyLEGA          -0.002478   0.114020  -0.022  0.98271
## factor_partyLEU            0.229343   0.114020   2.011  0.04727 *
## factor_partyM5S           -0.254663   0.114020  -2.233  0.02800 *
## factor_partyMISTO         -0.195756   0.114020  -1.717  0.08944 .
```

```
## factor_partyREG_LEAGUES  -0.777217   0.114020  -6.817 1.03e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.255 on 90 degrees of freedom
## Multiple R-squared:  0.8089, Adjusted R-squared:  0.7685
## F-statistic: 20.05 on 19 and 90 DF,  p-value: < 2.2e-16
```