Cooperation in innovation

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```
#Carga de datos
library(readxl)
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
df <- read_excel("/Users/unimooc/Dropbox/2021/Directorio R/Research/Cooperation/DATOS 2004-2014.xlsx", s
head(df)
```

```
## # A tibble: 6 x 41
##   IDENT ACTIVIDAD PERIODO INTEC INTECMAN  CIFRA  GTINN  INTINN TAMANO MDOLOCAL
##   <dbl>     <dbl> <chr>   <dbl> <chr>     <dbl>  <dbl>   <dbl>  <dbl>    <dbl>
## 1     1        15 2004-2~     2 2.4      7.81e6  14232 0.00182     49        1
## 2     2        17 2004-2~     2 2.4      3.19e7 291379 0.00913    212        1
## 3     3        19 2004-2~     2 2.4      4.52e6 177232 0.0392      49        1
## 4     4        18 2004-2~     2 2.4      1.33e7 172760 0.0130      96        1
## 5     5        33 2004-2~     2 2.1      2.82e8 320506 0.00114   1129        1
## 6     6        34 2004-2~     2 2.2      1.42e8 713878 0.00504    319        1
## # ... with 31 more variables: MDONAC <dbl>, MDOUE <dbl>, INNPROD <dbl>,
## #   INNOBIEN <dbl>, INNOSERV <dbl>, INNPROC <dbl>, INNFABRI <dbl>,
## #   INNLOGIS <dbl>, INNAPOYO <dbl>, COOP <dbl>, GIO1 <dbl>, GIO2 <dbl>,
## #   GIO3 <dbl>, GIO4 <dbl>, GIO5 <dbl>, GIO6 <dbl>, GIO7 <dbl>, GIO8 <dbl>,
## #   GIO9 <dbl>, F1 <dbl>, F2 <dbl>, F3 <dbl>, F4 <dbl>, F5 <dbl>, F6 <dbl>,
## #   F7 <dbl>, F8 <dbl>, F9 <dbl>, F10 <dbl>, F11 <dbl>, TIEMPO <dbl>
```

```
df <- na.omit(df)
anyNA(df)
```

```
## [1] FALSE
```

```
df.gr <- filter(df, TIEMPO <= 2007)
df.cr <- filter(df, TIEMPO %in% c(2008, 2009, 2010))
df.re <- filter(df, TIEMPO >= 2011)
```

Chi Cuadrado

Creamos un dataframe con las variables COOP y Tiempo.

```
df.or <- df[,c("COOP","TIEMPO")]
```

Creamos variables categóricas con la inormación de "TIEMPO" y "COOP"

```
facTiemp <- factor(df$TIEMPO,
                   levels = c(2004,2005,2006,2007,
                              2008,2009,2010
                              ,2011, 2012, 2013, 2014),
                   labels = c("Growth", "Growth", "Growth", "Growth",
                              "Crisis", "Crisis", "Crisis",
                              "Recovery", "Recovery", "Recovery", "Recovery"))
df$facTiemp <- facTiemp

facCoop <- factor(df$COOP,
                  levels = c(0, 1),
                  labels = c("NoCoop", "Coop"))

df$facCoop <- facCoop
```

Creamos variables dicotómicas en función de los distintos momentos del periodo económico

```
#Etapa de crecimiento
df$facTiempG <- factor(df$TIEMPO,
                     levels = c(2004,2005,2006,2007,
                                2008,2009,2010
                                ,2011, 2012, 2013, 2014),
                     labels = c("1", "1", "1", "1",
                                "0", "0", "0",
                                "0", "0", "0", "0"))

#Etapa de crisis
df$facTiempC <- factor(df$TIEMPO,
                      levels = c(2004,2005,2006,2007,
                                 2008,2009,2010
                                 ,2011, 2012, 2013, 2014),
                      labels = c("0", "0", "0", "0",
                                 "1", "1", "1",
                                 "0", "0", "0", "0"))

#Etapa de recuperación
df$facTiempR <- factor(df$TIEMPO,
                      levels = c(2004,2005,2006,2007,
```

```
                                2008,2009,2010
                                ,2011, 2012, 2013, 2014),
                    labels = c("0", "0", "0", "0",
                               "0", "0", "0",
                               "1", "1", "1", "1"))
```

Chi cuadrado - Pearson para la primera hipótesis

H1: Companies change their perspective on cooperation to develop innovation according to the economic cycle.

```
tablaCoop <-table(df$facCoop, df$facTiemp)
chisq.test(tablaCoop,correct=FALSE)
```

```
##
##  Pearson's Chi-squared test
##
## data:  tablaCoop
## X-squared = 620.47, df = 2, p-value < 2.2e-16
```

```
tablaCoopG <-table(df$facCoop, df$facTiempG)
chisq.test(tablaCoopG, correct=FALSE)
```

```
##
##  Pearson's Chi-squared test
##
## data:  tablaCoopG
## X-squared = 339.69, df = 1, p-value < 2.2e-16
```

```
tablaCoopC <-table(df$facCoop, df$facTiempC)
chisq.test(tablaCoopC, correct=FALSE)
```

```
##
##  Pearson's Chi-squared test
##
## data:  tablaCoopC
## X-squared = 13.291, df = 1, p-value = 0.0002667
```

```
tablaCoopR <-table(df$facCoop, df$facTiempR)
chisq.test(tablaCoopR, correct=FALSE)
```

```
##
##  Pearson's Chi-squared test
##
## data:  tablaCoopR
## X-squared = 577.95, df = 1, p-value < 2.2e-16
```

Cálculo de medias

```r
  mean(df$COOP)
```

```
## [1] 0.1508814
```

```r
  mean(df.gr$COOP)
```

```
## [1] 0.1242933
```

```r
  mean(df.cr$COOP)
```

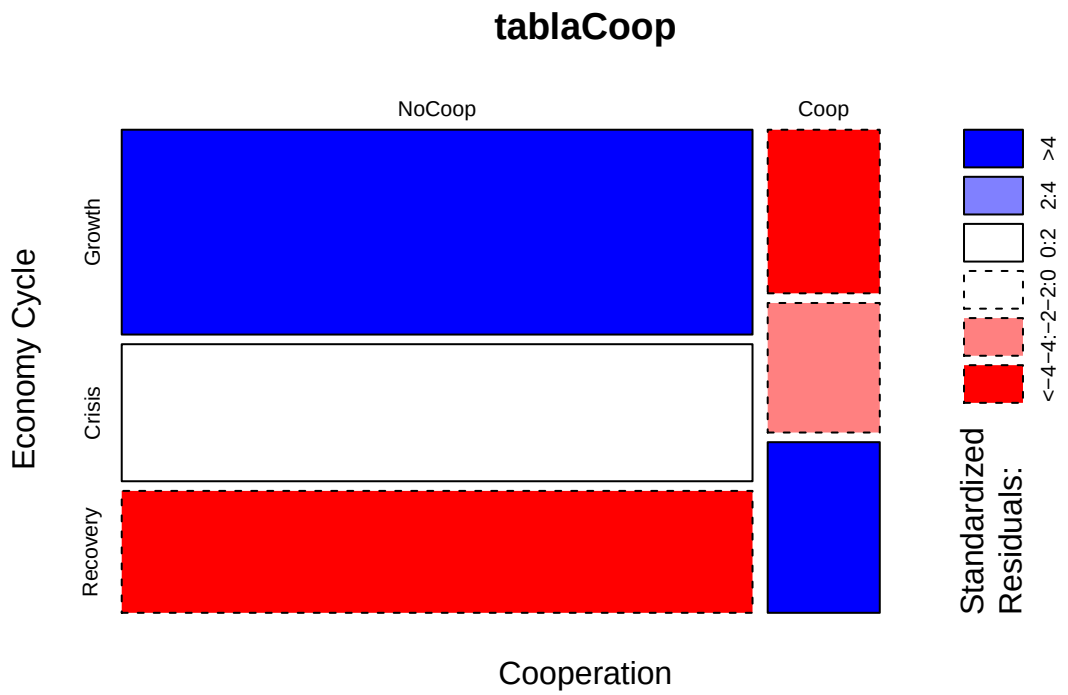
```
## [1] 0.143812
```

```r
  mean(df.re$COOP)
```

```
## [1] 0.199162
```

Representación gráfica

```r
mosaicplot(tablaCoop, ylab="Economy Cycle", xlab = "Cooperation",
           shade = T)
```



Chi cuadrado - Pearson para la segunda hipótesis

H2: Companies change their views on the competitive need for innovation depending on the economic cycle.

```
    DOI_1 <-table(df$GIO1, df$facTiemp)
    chisq.test(DOI_1,correct=FALSE)
```

```
##
##  Pearson's Chi-squared test
##
## data:  DOI_1
## X-squared = 723.59, df = 6, p-value < 2.2e-16
```

```
    DOI_2 <-table(df$GIO2, df$facTiemp)
    chisq.test(DOI_2,correct=FALSE)
```

```
##
##  Pearson's Chi-squared test
##
## data:  DOI_2
## X-squared = 1281.2, df = 6, p-value < 2.2e-16
```

```
    DOI_3 <-table(df$GIO3, df$facTiemp)
    chisq.test(DOI_3,correct=FALSE)
```

```
##
##  Pearson's Chi-squared test
##
## data:  DOI_3
## X-squared = 905.93, df = 6, p-value < 2.2e-16
```

```
    DOI_4 <-table(df$GIO4, df$facTiemp)
    chisq.test(DOI_4,correct=FALSE)
```

```
##
##  Pearson's Chi-squared test
##
## data:  DOI_4
## X-squared = 645.66, df = 6, p-value < 2.2e-16
```

```
    DOI_5 <-table(df$GIO5, df$facTiemp)
    chisq.test(DOI_5,correct=FALSE)
```

```
##
##  Pearson's Chi-squared test
##
## data:  DOI_5
## X-squared = 371.83, df = 6, p-value < 2.2e-16
```

```
    DOI_6 <-table(df$GIO6, df$facTiemp)
    chisq.test(DOI_6,correct=FALSE)
```

```
##
##  Pearson's Chi-squared test
##
## data:  DOI_6
## X-squared = 1607.7, df = 6, p-value < 2.2e-16
```

```
    DOI_7 <-table(df$GIO7, df$facTiemp)
    chisq.test(DOI_7,correct=FALSE)
```

```
##
##  Pearson's Chi-squared test
##
## data:  DOI_7
## X-squared = 7763.1, df = 6, p-value < 2.2e-16
```

```
    DOI_8 <-table(df$GIO8, df$facTiemp)
    chisq.test(DOI_8,correct=FALSE)
```

```
##
##  Pearson's Chi-squared test
##
## data:  DOI_8
## X-squared = 748.2, df = 6, p-value < 2.2e-16
```

```
    DOI_9 <-table(df$GIO9, df$facTiemp)
    chisq.test(DOI_9,correct=FALSE)
```

```
##
##  Pearson's Chi-squared test
##
## data:  DOI_9
## X-squared = 201.83, df = 6, p-value < 2.2e-16
```

```
    #Replicar para facTiempG, facTiempC, facTiempR
```

Cálculo de medias

```
  mean(df$GIO1)
```

```
## [1] 2.090599
```

```
  mean(df$GIO2)
```

```
## [1] 2.287346
```

```r
  mean(df$GIO3)
```

```
## [1] 1.968636
```

```r
  mean(df.gr$GIO1)
```

```
## [1] 2.160374
```

```r
  mean(df.cr$GIO1)
```

```
## [1] 2.108191
```

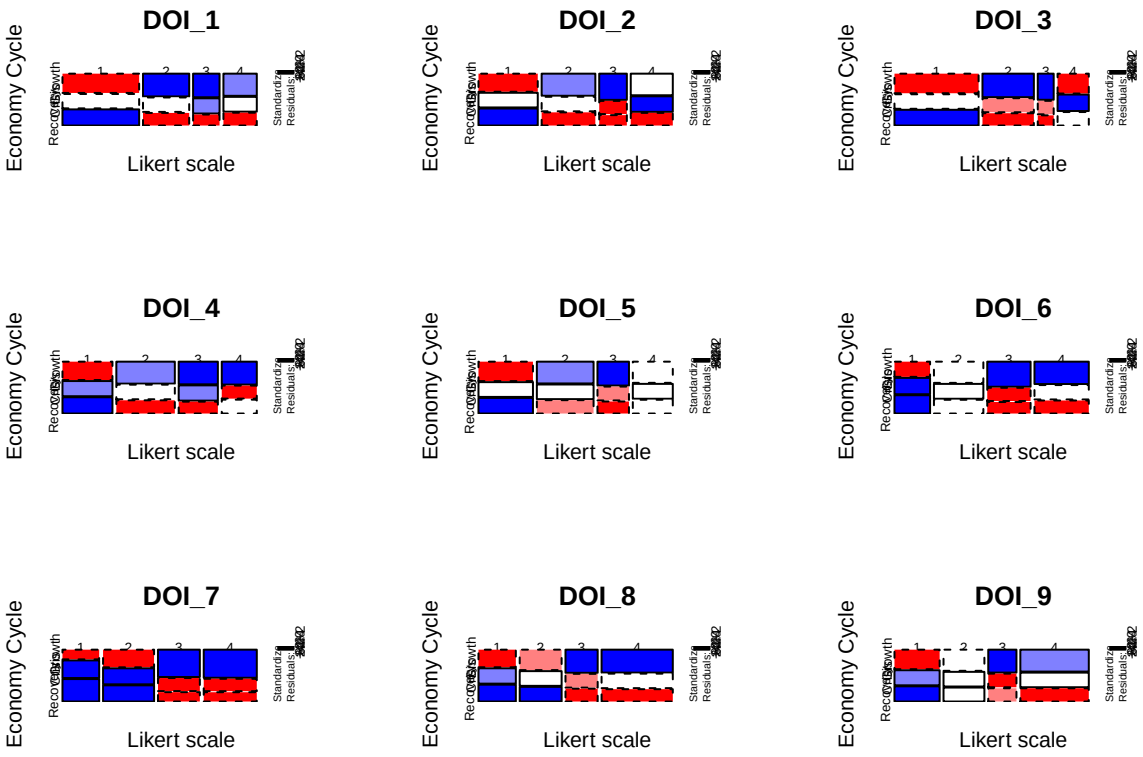
```r
  mean(df.re$GIO1)
```

```
## [1] 1.964908
```

```r
  #Replicar para todos los casos restantes
```

Representación gráfica

```r
par(mfrow = c(3,3))
   mosaicplot(DOI_1, ylab="Economy Cycle", xlab = "Likert scale",
              shade = T)

    mosaicplot(DOI_2, ylab="Economy Cycle", xlab = "Likert scale",
              shade = T)

    mosaicplot(DOI_3, ylab="Economy Cycle", xlab = "Likert scale",
              shade = T)

    mosaicplot(DOI_4, ylab="Economy Cycle", xlab = "Likert scale",
              shade = T)

    mosaicplot(DOI_5, ylab="Economy Cycle", xlab = "Likert scale",
              shade = T)

    mosaicplot(DOI_6, ylab="Economy Cycle", xlab = "Likert scale",
              shade = T)

    mosaicplot(DOI_7, ylab="Economy Cycle", xlab = "Likert scale",
              shade = T)

    mosaicplot(DOI_8, ylab="Economy Cycle", xlab = "Likert scale",
              shade = T)

    mosaicplot(DOI_9, ylab="Economy Cycle", xlab = "Likert scale",
              shade = T)
```



Chi cuadrado - Pearson para la tercera hipótesis

H3: Companies change their views on the problems and barriers to entry for developing innovation according to the economic cycle.

Mismo proceso que anterior.

U de Mann-Whitney

Mann-Whitney para la cuarta hipótesis

H4: The firms' perspective on the competitive importance of innovation and the possible problems for the development of innovation conditions their response on whether or not to cooperate with technology centres.

```
library(survival)
library(coin)
```

P-valores de ManW

```
wilcox.test(GIO1~COOP,data=df, Paired = TRUE, exact = FALSE)
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
```

```
## data:  GIO1 by COOP
## W = 522146456, p-value < 2.2e-16
## alternative hypothesis: true location shift is not equal to 0
```

```
wilcox.test(GIO2~COOP,data=df, Paired = TRUE, exact = FALSE)
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  GIO2 by COOP
## W = 522807048, p-value < 2.2e-16
## alternative hypothesis: true location shift is not equal to 0
```

```
wilcox.test(GIO3~COOP,data=df, Paired = TRUE, exact = FALSE)
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  GIO3 by COOP
## W = 513178808, p-value < 2.2e-16
## alternative hypothesis: true location shift is not equal to 0
```

```
#Replicar para todas las posiblidades
```

Valores Z de ManW

```
df$COOP <- as.factor(df$COOP)
df.gr$COOP <- as.factor(df.gr$COOP)
df.cr$COOP <- as.factor(df.cr$COOP)
df.re$COOP <- as.factor(df.re$COOP)

wilcox_test(df$GIO1 ~ df$COOP)
```

```
##
##  Asymptotic Wilcoxon-Mann-Whitney Test
##
## data:  df$GIO1 by df$COOP (0, 1)
## Z = 38.661, p-value < 2.2e-16
## alternative hypothesis: true mu is not equal to 0
```

```
wilcox_test(df$GIO2 ~ df$COOP)
```

```
##
##  Asymptotic Wilcoxon-Mann-Whitney Test
##
## data:  df$GIO2 by df$COOP (0, 1)
## Z = 38.439, p-value < 2.2e-16
## alternative hypothesis: true mu is not equal to 0
```

```r
wilcox_test(df$GIO2 ~ df$COOP)
```

```
##
##  Asymptotic Wilcoxon-Mann-Whitney Test
##
## data:  df$GIO2 by df$COOP (0, 1)
## Z = 38.439, p-value < 2.2e-16
## alternative hypothesis: true mu is not equal to 0
```

```r
#La función wilcox_test necesita que se le indique una variable como factor.
#Repetir para todas las posibilidades
```

Cálculo de medias (para las que cooperan y para las que no)

```r
df.0 <- filter(df, COOP == "0")
df.1 <- filter(df, COOP == "1")

mean(df.0$GIO1)
```

```
## [1] 2.155942
```

```r
mean(df.1$GIO1)
```

```
## [1] 1.722867
```

```r
df.gr.0 <- filter(df.gr, COOP == "0")
df.gr.1 <- filter(df.gr, COOP == "1")

mean(df.gr.0$GIO1)
```

```
## [1] 2.204159
```

```r
mean(df.gr.1$GIO1)
```

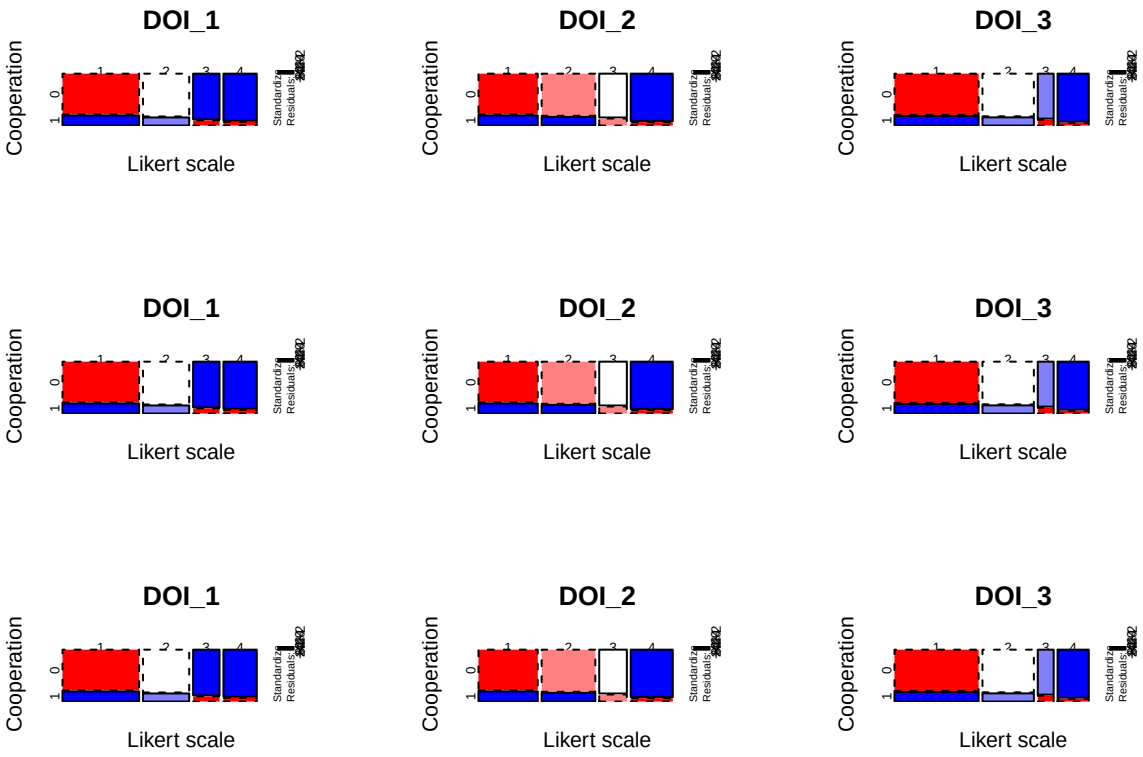
```
## [1] 1.851886
```

```r
#Replicar para todos los valores necesarios
```

Representación gráfica

```r
par(mfrow = c(3,3))

DOI_1 <-table(df$GIO1, df$COOP)
mosaicplot(DOI_1, ylab="Cooperation", xlab = "Likert scale",
           shade = T)

DOI_2 <-table(df$GIO2, df$COOP)
mosaicplot(DOI_2, ylab="Cooperation", xlab = "Likert scale",
           shade = T)
```

```r
DOI_3 <-table(df$GIO3, df$COOP)
mosaicplot(DOI_3, ylab="Cooperation", xlab = "Likert scale",
           shade = T)

DOI_4 <-table(df$GIO1, df$COOP)
mosaicplot(DOI_1, ylab="Cooperation", xlab = "Likert scale",
           shade = T)

DOI_5 <-table(df$GIO2, df$COOP)
mosaicplot(DOI_2, ylab="Cooperation", xlab = "Likert scale",
           shade = T)

DOI_6 <-table(df$GIO3, df$COOP)
mosaicplot(DOI_3, ylab="Cooperation", xlab = "Likert scale",
           shade = T)

DOI_7 <-table(df$GIO1, df$COOP)
mosaicplot(DOI_1, ylab="Cooperation", xlab = "Likert scale",
           shade = T)

DOI_8 <-table(df$GIO2, df$COOP)
mosaicplot(DOI_2, ylab="Cooperation", xlab = "Likert scale",
           shade = T)

DOI_9 <-table(df$GIO3, df$COOP)
mosaicplot(DOI_3, ylab="Cooperation", xlab = "Likert scale",
           shade = T)
```


DOI_1
DOI_2
DOI_3
Cooperation
Likert scale
Standardized Residuals