Proyecto Estadística

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Introducción

Este documento es una extensión de la investidación *Promoting Engagement in Computing Research for Non-CS Majors* sobre el evento ExploreCSR primera edición 2023 elaborado en la universidad ESPOL.

Experimento

Según la Teoría del Comportamiento Planificado (TPB), la intención de una persona en realizar una acción o un comportamiento se encuentra relacionado a diferentes variables. En este proyecto se busca medir la intención de los participantes en participar en una investigación (**INT**) y los factores que influyen en ella. La variable INT se refiere directamente a la intención del participante de realizar una determinada conducta. En este caso, los comportamientos están relacionados con habilidades de ML e investigación. Además, TPB identifica tres antecedentes en INT que pueden influir en comportamientos particulares:

- **Control conductual percibido (PBC):** a menudo denominado autoeficacia, se refiere a las percepciones de los individuos sobre la facilidad o dificultad asociada con un comportamiento específico. Según Bandura (2006), la autoeficacia es la creencia de un individuo en sus habilidades.
- **Creencias conductuales (BB):** se refiere a las creencias u opiniones de un individuo con respecto a un comportamiento específico asociado con un resultado particular.
- **Norma Subjetiva (SN):** Involucra las expectativas de otros dentro de un contexto o comportamiento.

Análisis Exploratorio de datos

el CSV *filtered_data.csv* presenta un resumen de los resultados obtenidos en ambas encuestas realizadas. Este documento presenta las siguientes columnas:

- **matricula**: identificador único del estudiante
- **variable**: Tipo de variable: INT, SN, BB, PBC.
- **modo**: modo de agrupación: inv (investigación), ia (inteligencia artificial) y general (inv & ia)
- **periodo**: tipo de encuesta realizada: start (encuesta inicio evento) y end (encuesta final evento)
- **valor**: moda obtenida de la agrupación (depende del modo y la variable)

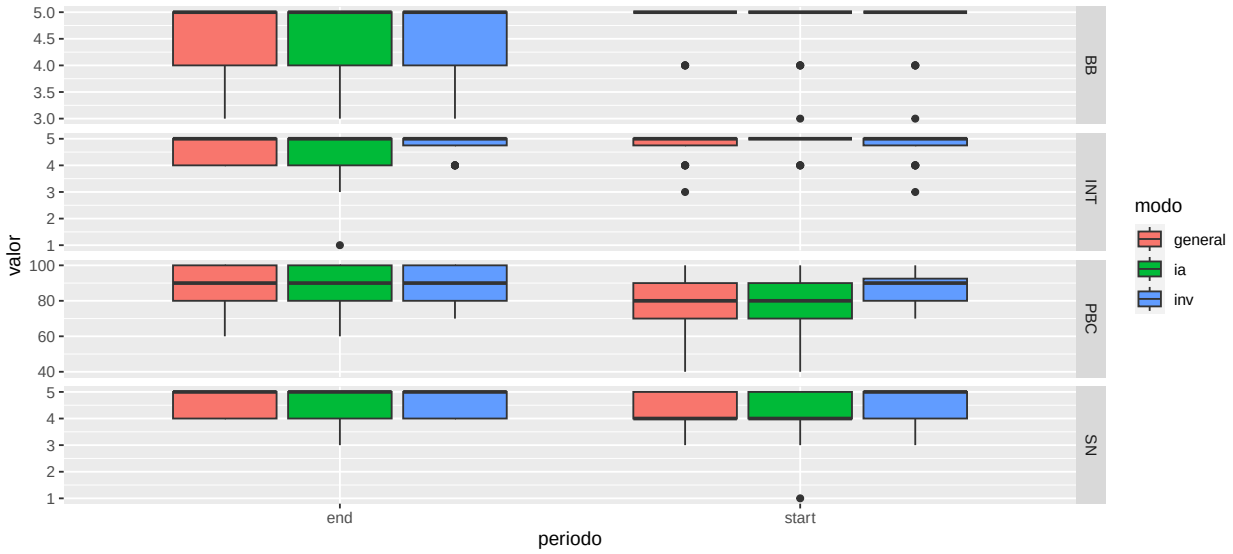
```
data <- read.csv("datos/filtered_data.csv", col.names = c("matricula","variable","modo","periodo","valo

# Muestra el resumen de un data frame
summary(data)
```

```
##    matricula           variable             modo             periodo
##  Min.   :201404282   Length:576         Length:576         Length:576
##  1st Qu.:201779668   Class :character   Class :character   Class :character
##  Median :201857022   Mode  :character   Mode  :character   Mode  :character
##  Mean   :201865877
##  3rd Qu.:202005715
##  Max.   :202208351
##      valor
##  Min.   :  1.00
##  1st Qu.:  5.00
##  Median :  5.00
##  Mean   : 24.89
##  3rd Qu.: 13.75
##  Max.   :100.00
```

Se agruparon los resultados de las variables INT, BB, PCB y SN. La columna periodo contiene dos etiquetas, donde *start* se refiere a la encuesta realizada antes del evento y *end* a la encuesta realizada después.

A primera vista se observa como los promedios del diagrama de cajas se elevan en ciertas variables en la encuesta realizada luego del evento. No obstante, se ven diferencias al momento de comparar los datos agrupados (general) y desglozados en las variables investigación (inv) y preguntas relacionadas a inteligencia artificial (ia).

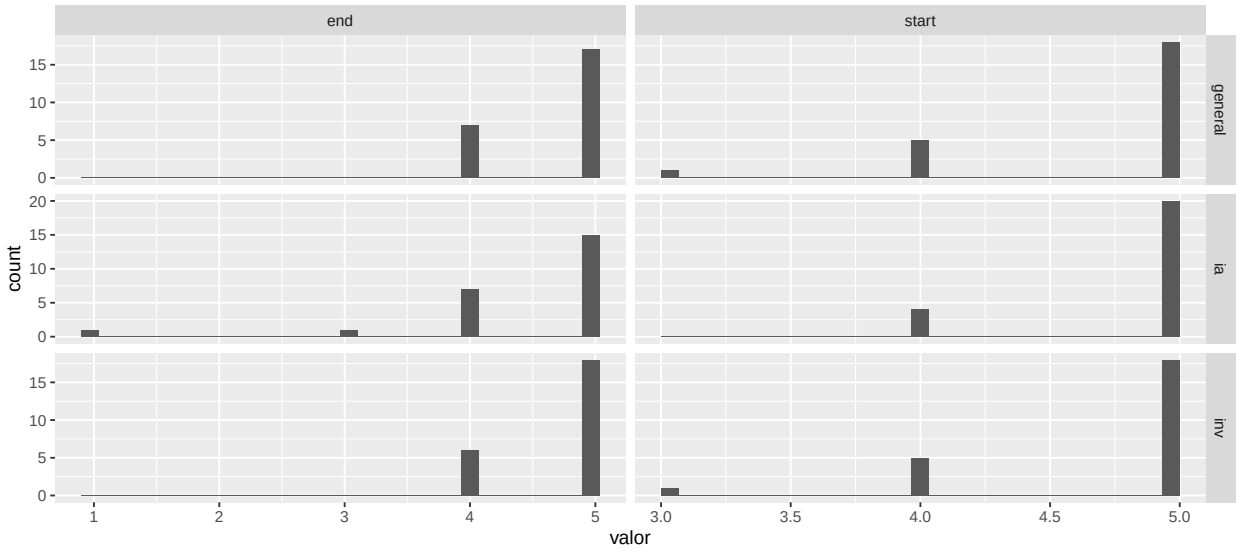
```
ggplot(data, aes(x = periodo, y = valor, fill = modo)) +
  geom_boxplot() +
  facet_grid(variable ~ ., scales = "free_y")
```



Las variables INT, SN Y BB tratan de valores en la escala 5 de Linket, por lo que un histograma de cada una permite obsevar mejor la tendencia de esta.

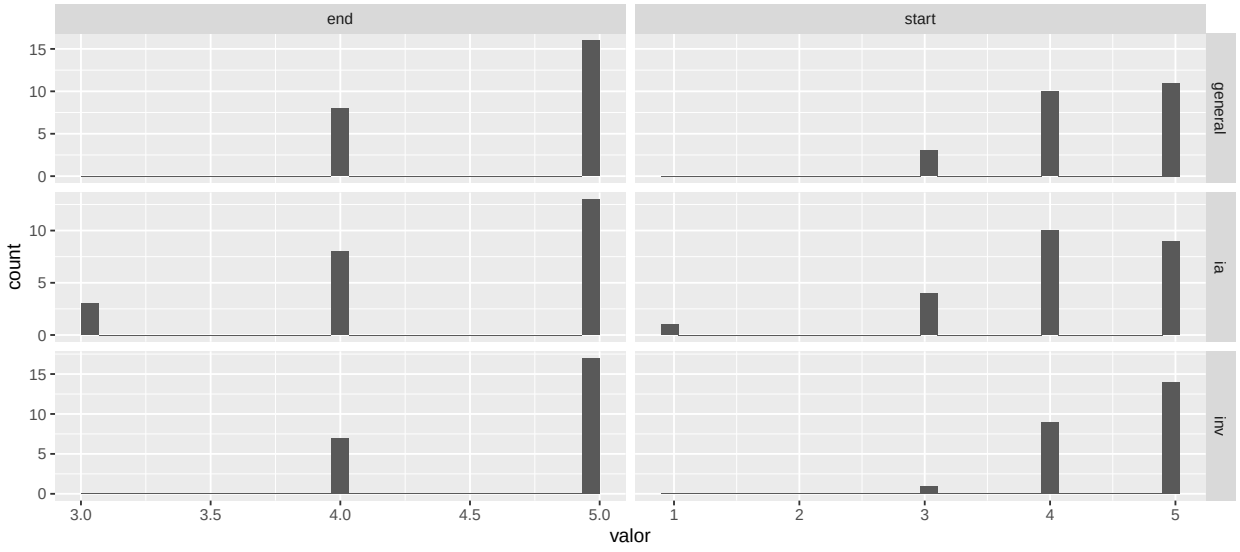
```
ggplot(data[(data$variable == "INT"),], aes(x = valor)) +
  geom_histogram() +
  facet_grid(modo ~ periodo, scales = "free")
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



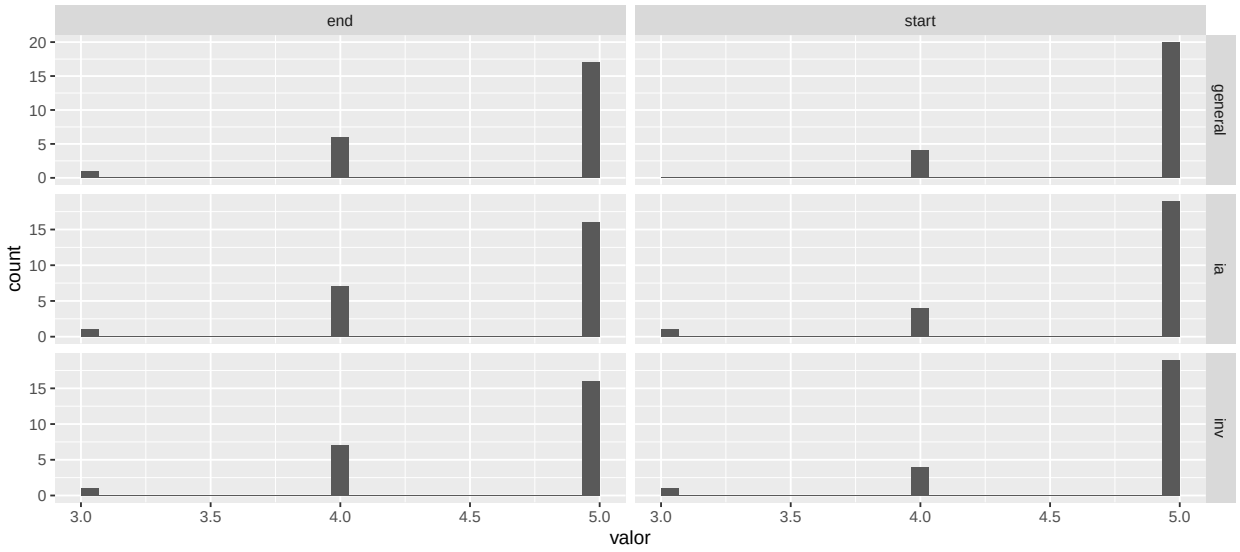

```
ggplot(data[(data$variable == "SN"),], aes(x = valor)) +
  geom_histogram() +
  facet_grid(modo ~ periodo, scales = "free")
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
ggplot(data[(data$variable == "BB"),], aes(x = valor)) +
  geom_histogram() +
  facet_grid(modo ~ periodo, scales = "free")
```

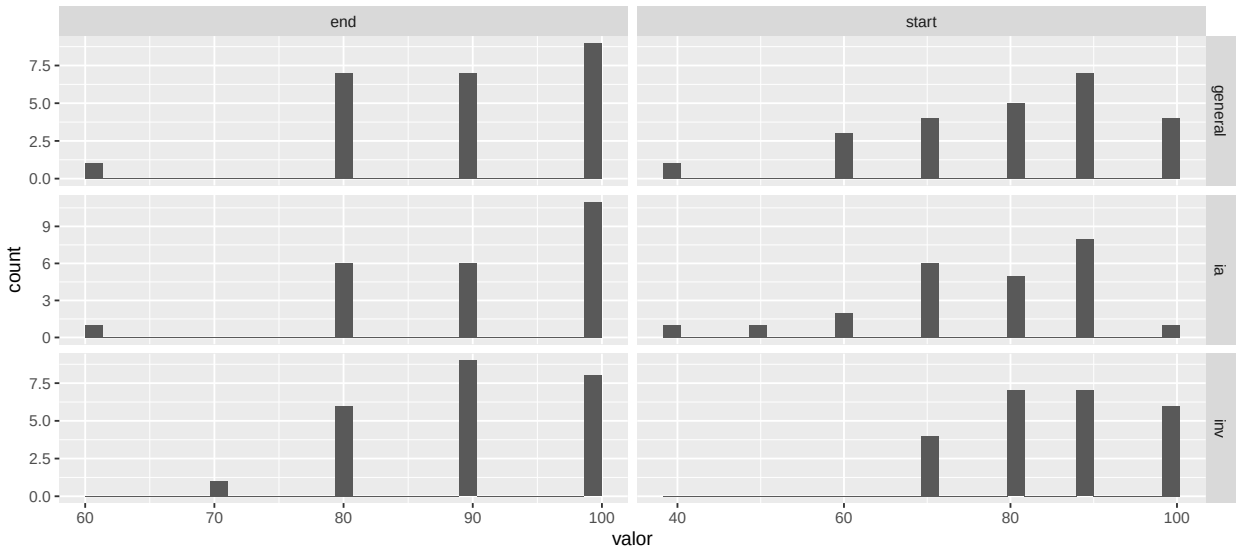
```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



A diferencia de las demás variables, PBC se trata de una escala de 0 a 100, donde el participante puede colocar una medición subjetivo de su autoeficacia en relación a habilidades de investigación e IA. Para poder ser comparada con las demás variables no paramétricas, los valores de PBC se agruparon de 10 en 10, por lo que tenemos la cantidad de los valores según esos rangos.

```
ggplot(data[(data$variable == "PBC"),], aes(x = valor)) +
  geom_histogram() +
  facet_grid(modo ~ periodo, scales = "free")
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



Análisis de Independencia

La Teoría del Comportamiento Planificado establece que las variables SN, BB y PBC son dependientes de INT. En este caso, queremos comprobar si, con la cantidad de participantes encuestados, se muestra dicha

dependencia. Por eso se propone utilizar la prueba Chi cuadrado para comprobar la independencia de estas variables.

##Independencia (INT & SN)

Wilcoxon paired test

Variable Intention (INT)

```
data_general = data[(data$variable == "INT" & data$modo == "general"),]

group_by(data_general, periodo) %>%
  summarise(
    count = n(),
    median = median(valor, na.rm = TRUE),
    IQR = IQR(valor, na.rm = TRUE)
  )
```

```
## # A tibble: 2 x 4
##   periodo count median   IQR
##   <chr>   <int>  <dbl> <dbl>
## 1 end        24      5  1
## 2 start      24      5  0.25
```

```
res <- wilcox.test(valor ~ periodo, data = data_general, paired = TRUE)
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with ties
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with zeroes
```

```
print(res)
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  valor by periodo
## V = 18, p-value = 1
## alternative hypothesis: true location shift is not equal to 0
```

```
data_inv = data[(data$variable == "INT" & data$modo == "inv"),]

group_by(data_inv, periodo) %>%
  summarise(
    count = n(),
    median = median(valor, na.rm = TRUE),
    IQR = IQR(valor, na.rm = TRUE)
  )
```

```
## # A tibble: 2 x 4
##   periodo count median   IQR
##   <chr>   <int>  <dbl> <dbl>
## 1 end        24      5  0.25
## 2 start      24      5  0.25
```

```
res <- wilcox.test(valor ~ periodo, data = data_inv, paired = TRUE)
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with ties
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with zeroes
```

```
print(res)
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  valor by periodo
## V = 25, p-value = 0.7897
## alternative hypothesis: true location shift is not equal to 0
```

```
data_ia = data[(data$variable == "INT" & data$modo == "ia"),]

group_by(data_ia, periodo) %>%
  summarise(
    count = n(),
    median = median(valor, na.rm = TRUE),
    IQR = IQR(valor, na.rm = TRUE)
  )
```

```
## # A tibble: 2 x 4
##   periodo count median   IQR
##   <chr>   <int>  <dbl> <dbl>
## 1 end        24      5     1
## 2 start      24      5     0
```

```
res <- wilcox.test(valor ~ periodo, data = data_ia, paired = TRUE)
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with ties
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with zeroes
```

```
print(res)
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  valor by periodo
## V = 3.5, p-value = 0.04033
## alternative hypothesis: true location shift is not equal to 0
```

Perceived Behavioral Control (PBC)

```
data_general = data[(data$variable == "PBC" & data$modo == "general"),]

group_by(data_general, periodo) %>%
  summarise(
    count = n(),
    median = median(valor, na.rm = TRUE),
    IQR = IQR(valor, na.rm = TRUE)
  )
```

```
## # A tibble: 2 x 4
##   periodo count median   IQR
##   <chr>   <int>  <dbl> <dbl>
## 1 end        24     90    20
## 2 start      24     80    20
```

```
res <- wilcox.test(valor ~ periodo, data = data_general, paired = TRUE)
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with ties
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with zeroes
```

```
print(res)
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  valor by periodo
## V = 101, p-value = 0.02001
## alternative hypothesis: true location shift is not equal to 0
```

```
data_inv = data[(data$variable == "PBC" & data$modo == "inv"),]

group_by(data_inv, periodo) %>%
  summarise(
    count = n(),
    median = median(valor, na.rm = TRUE),
    IQR = IQR(valor, na.rm = TRUE)
  )
```

```
## # A tibble: 2 x 4
##   periodo count median   IQR
##   <chr>   <int>  <dbl> <dbl>
## 1 end        24     90  20
## 2 start      24     90  12.5
```

```r
res <- wilcox.test(valor ~ periodo, data = data_inv, paired = TRUE)
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with zeroes
```

```r
print(res)
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  valor by periodo
## V = 43, p-value = 0.1188
## alternative hypothesis: true location shift is not equal to 0
```

```r
data_ia = data[(data$variable == "PBC" & data$modo == "ia"),]

group_by(data_ia, periodo) %>%
  summarise(
    count = n(),
    median = median(valor, na.rm = TRUE),
    IQR = IQR(valor, na.rm = TRUE)
  )
```

```
## # A tibble: 2 x 4
##   periodo count median   IQR
##   <chr>   <int>  <dbl> <dbl>
## 1 end        24     90    20
## 2 start      24     80    20
```

```r
res <- wilcox.test(valor ~ periodo, data = data_ia, paired = TRUE)
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with zeroes
```

```r
print(res)
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  valor by periodo
## V = 146, p-value = 0.0009628
## alternative hypothesis: true location shift is not equal to 0
```

Behavioral Beliefs (BB)

```r
data_general = data[(data$variable == "BB" & data$modo == "general"),]

group_by(data_general, periodo) %>%
  summarise(
    count = n(),
    median = median(valor, na.rm = TRUE),
    IQR = IQR(valor, na.rm = TRUE)
  )
```

```
## # A tibble: 2 x 4
##   periodo count median   IQR
##   <chr>   <int>  <dbl> <dbl>
## 1 end        24      5     1
## 2 start      24      5     0
```

```r
res <- wilcox.test(valor ~ periodo, data = data_general, paired = TRUE)
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with ties
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with zeroes
```

```r
print(res)
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  valor by periodo
## V = 7, p-value = 0.2402
## alternative hypothesis: true location shift is not equal to 0
```

```r
data_inv = data[(data$variable == "BB" & data$modo == "inv"),]

group_by(data_inv, periodo) %>%
  summarise(
    count = n(),
    median = median(valor, na.rm = TRUE),
    IQR = IQR(valor, na.rm = TRUE)
  )
```

```
## # A tibble: 2 x 4
##   periodo count median   IQR
##   <chr>   <int>  <dbl> <dbl>
## 1 end        24      5     1
## 2 start      24      5     0
```

```r
res <- wilcox.test(valor ~ periodo, data = data_inv, paired = TRUE)
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with zeroes
```

```
print(res)
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  valor by periodo
## V = 20, p-value = 0.4374
## alternative hypothesis: true location shift is not equal to 0
```

```
data_ia = data[(data$variable == "BB" & data$modo == "ia"),]

group_by(data_ia, periodo) %>%
  summarise(
    count = n(),
    median = median(valor, na.rm = TRUE),
    IQR = IQR(valor, na.rm = TRUE)
  )
```

```
## # A tibble: 2 x 4
##   periodo count median   IQR
##   <chr>   <int>  <dbl> <dbl>
## 1 end        24      5     1
## 2 start      24      5     0
```

```
res <- wilcox.test(valor ~ periodo, data = data_ia, paired = TRUE)
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with zeroes
```

```
print(res)
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  valor by periodo
## V = 15, p-value = 0.3506
## alternative hypothesis: true location shift is not equal to 0
```

Subjective Norm (SN)

```r
data_general = data[(data$variable == "SN" & data$modo == "general"),]

group_by(data_general, periodo) %>%
  summarise(
    count = n(),
    median = median(valor, na.rm = TRUE),
    IQR = IQR(valor, na.rm = TRUE)
  )
```

```
## # A tibble: 2 x 4
##   periodo count median   IQR
##   <chr>   <int>  <dbl> <dbl>
## 1 end        24      5     1
## 2 start      24      4     1
```

```r
res <- wilcox.test(valor ~ periodo, data = data_general, paired = TRUE)
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with ties
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with zeroes
```

```r
print(res)
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  valor by periodo
## V = 82.5, p-value = 0.03551
## alternative hypothesis: true location shift is not equal to 0
```

```r
data_inv = data[(data$variable == "SN" & data$modo == "inv"),]

group_by(data_inv, periodo) %>%
  summarise(
    count = n(),
    median = median(valor, na.rm = TRUE),
    IQR = IQR(valor, na.rm = TRUE)
  )
```

```
## # A tibble: 2 x 4
##   periodo count median   IQR
##   <chr>   <int>  <dbl> <dbl>
## 1 end        24      5     1
## 2 start      24      5     1
```

```r
res <- wilcox.test(valor ~ periodo, data = data_inv, paired = TRUE)
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with zeroes
```

```
print(res)
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  valor by periodo
## V = 52, p-value = 0.2669
## alternative hypothesis: true location shift is not equal to 0
```

```
data_ia = data[(data$variable == "SN" & data$modo == "ia"),]

group_by(data_ia, periodo) %>%
  summarise(
    count = n(),
    median = median(valor, na.rm = TRUE),
    IQR = IQR(valor, na.rm = TRUE)
  )
```

```
## # A tibble: 2 x 4
##   periodo count median   IQR
##   <chr>   <int>  <dbl> <dbl>
## 1 end        24      5     1
## 2 start      24      4     1
```

```
res <- wilcox.test(valor ~ periodo, data = data_ia, paired = TRUE)
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with ties

## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with zeroes
```

```
print(res)
```

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  valor by periodo
## V = 91, p-value = 0.2064
## alternative hypothesis: true location shift is not equal to 0
```