

# Lab 3 - Muestreo en varias etapas

Matias Bajac

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## UNIVERSO

```
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ----- tidyverse 2.0.0 --
## v dplyr      1.1.4      v readr      2.1.5
## v forcats    1.0.0      v stringr   1.5.1
## v ggplot2    3.5.0      v tibble    3.2.1
## v lubridate  1.9.3      v tidyr     1.3.1
## v purrr      1.0.2
```

```
## -- Conflicts ----- tidyverse_conflicts() --
```

```
## x dplyr::filter() masks stats::filter()
```

```
## x dplyr::lag()     masks stats::lag()
```

```
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(data.table)
```

```
##
```

```
## Attaching package: 'data.table'
```

```
##
```

```
## The following objects are masked from 'package:lubridate':
```

```
##
```

```
##      hour, isoweek, mday, minute, month, quarter, second, wday, week,
```

```
##      yday, year
```

```
##
```

```
## The following objects are masked from 'package:dplyr':
```

```
##
```

```
##      between, first, last
```

```
##
```

```
## The following object is masked from 'package:purrr':
```

```
##
```

```
##      transpose
```

```
library(sampling) ##Muestra
```

```
library(srvyr) ##Estimación
```

```
##
```

```
## Attaching package: 'srvyr'
```

```
##
```

```
## The following object is masked from 'package:stats':
```

```
##
```

```
##      filter
```

```
library(here)
```

```
## here() starts at /Users/matiasbajac/Desktop/Muestreo 2
```

```
Universo <- read_csv(here("Labs ", "ECH_2022.csv"))%>%
  filter(
    dpto == 1, #Montevideo
    e27 >= 14 #Edad
  )%>%
  transmute(
    ID_HOGAR = ID,
    ID_PERSONA = paste(ID,nper,sep = "-"),
    secc,
    segm,
    UPM = paste(secc,segm,sep = "-"), #Identificamos los segmentos censales a apartir del identificador
    Estrato_Socioeconomico = factor(
      case_when(
        estred13 == 1 ~ "Montevideo Bajo",
        estred13 == 2 ~ "Montevideo Medio Bajo",
        estred13 == 3 ~ "Motevideo Medio",
        estred13 == 4 ~ "Montevideo Medio Alto",
        estred13 == 5 ~ "Montevideo Alto"
      ),
      ordered = TRUE,
      levels = c("Montevideo Bajo","Montevideo Medio Bajo","Motevideo Medio","Montevideo Medio Alto","Mon
    ),
    Sexo = case_when(
      e26 == 1 ~ "Hombre",
      e26 == 2 ~ "Mujer",
      TRUE ~ "Sin dato"
    ),
    Condicion_Actividad = POBPCOAC,
    pobre = pobre,
    Ingreso_Persona = PT1,
    Edad = e27
  )
```

```
## Rows: 55056 Columns: 528
```

```
## -- Column specification -----
```

```
## Delimiter: ","
```

```
## chr (8): secc, segm, e29_5_1, e246_1, f108_1, nom_dpto, Loc_agr_13, Nom_lo...
```

```
## dbl (520): ID, nper, anio, mes, GR, region, region_4, dpto, ccz, barrio, c1,...
```

```
##
```

```
## i Use `spec()` to retrieve the full column specification for this data.
```

```
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

## CALCULO PARÁMETROS DE INTERÉS

```
Universo%>%
  summarise(
    N = n(),
    Tasa_pobreza = mean(pobre),
    Cantidad_personas_pobres = sum(pobre),
```

```

    Ingreso_Promedio = mean(Ingreso_Persona)
  )

## # A tibble: 1 x 4
##       N Tasa_pobreza Cantidad_personas_pobres Ingreso_Promedio
##   <int>      <dbl>                <dbl>          <dbl>
## 1 17384      0.0862                1499          42958.

Universo%>%
  group_by(
    Estrato_Socioeconomico
  )%>%
  summarise(
    Tasa_pobreza = mean(pobre),
    Cantidad_personas_pobres = sum(pobre),
    Ingreso_Promedio = mean(Ingreso_Persona)
  )

## # A tibble: 5 x 4
##   Estrato_Socioeconomico Tasa_pobreza Cantidad_personas_pobres Ingreso_Promedio
##   <ord>                <dbl>                <dbl>          <dbl>
## 1 Montevideo Bajo      0.249                735          22860.
## 2 Montevideo Medio Bajo 0.126                448          30309.
## 3 Montevideo Medio     0.0525               239          39380.
## 4 Montevideo Medio Alto 0.0172                71          53749.
## 5 Montevideo Alto      0.00271               6          77362.

Universo%>%
  group_by(
    Sexo
  )%>%
  summarise(
    Tasa_pobreza = mean(pobre),
    Cantidad_personas_pobres = sum(pobre),
    Ingreso_Promedio = mean(Ingreso_Persona)
  )

## # A tibble: 2 x 4
##   Sexo Tasa_pobreza Cantidad_personas_pobres Ingreso_Promedio
##   <chr>      <dbl>                <dbl>          <dbl>
## 1 Hombre    0.0843                650          49746.
## 2 Mujer     0.0878                849          37549.

#BUSCAREMOS ESTIMAR ESOS PARAMETROS.

```

Se llevará a cabo una estrategia de muestreo indirecto.

1) Se estratifican las UPM (segmentos censales) con base en el estrato socioeconómico al que pertenecen.

2) Dentro de cada estrato, se realizará un diseño proporcional al tamaño de UPM's

- el tamaño de muestra por estrato se asigna de manera proporcional a la cantidad de hogares x estrato. (Se asigna mayor

tamaño de muestra en aquellos estratos en donde hay mayor cantidad de hogares).

3) Dentro de cada UPM muestreada en la primera etapa, se seleccionan hogares siguiendo un MAS.

4) Dentro de cada hogar, selecciono a una persona al azar.

Se desea tener una muestra de aproximadamente 1500 individuos - En cada segmento se encuestará a 5 hogares - Se muestrea a  $1500/5 = 300$  segmentos

```
#MARCO DE UPM'S # #####
```

```
Marco_UPMS <- Universo%>%
  group_by(
    UPM,
    Estrato_Socioeconomico
  )%>%
  summarise(
    Cantidad_Hogares = n_distinct(ID_HOGAR) #MOS: Medida de tamaño de los segmentos.
  )
```

```
## `summarise()` has grouped output by 'UPM'. You can override using the `.groups`
## argument.
```

```
Marco_UPMS_Muestra <- Marco_UPMS%>%
  filter(
    Cantidad_Hogares >= 5 #nos aseguramos de que todos los segmentos tengan al menos 5 hogares, son muy
  )
```

## CÁLCULO TAMAÑO DE MUESTRA

```
Tam_muestra_x_estrato <- Marco_UPMS_Muestra%>%
  group_by(
    Estrato_Socioeconomico
  )%>%
```

```

summarise(
  N_segmentos = n(),
  N_hogares_en_segmento = sum(Cantidad_Hogares),
  Tam_muestra = round(300*N_hogares_en_segmento/sum(Marco_UPMS_Muestra$Cantidad_Hogares))
) #La muestra queda de 301 por redondeo

```

## PRIMERA ETAPA: MUESTRA DE UPM'S

```

set.seed(2023)

Marco_UPMS_Muestra <- Marco_UPMS_Muestra%>%
  arrange(
    Estrato_Socioeconomico
  )

Muestra_de_UPMS <- sampling::strata(
  Marco_UPMS_Muestra,
  stratanames = "Estrato_Socioeconomico",
  size = Tam_muestra_x_estrato$Tam_muestra,
  method = "systematic",
  pik = Marco_UPMS_Muestra$Cantidad_Hogares, #Necesariamente hay que poner Tabla$MOS
  description = TRUE
)

```

```

## Stratum 1
##
## Population total and number of selected units: 68 45
## Stratum 2
##
## Population total and number of selected units: 69 58
## Stratum 3
##
## Population total and number of selected units: 92 81
## Stratum 4
##
## Population total and number of selected units: 88 77
## Stratum 5
##
## Population total and number of selected units: 56 40
## Number of strata 5
## Total number of selected units 301

```

```

Muestra_UPMS_con_Info <- sampling::getdata(
  Marco_UPMS_Muestra,
  Muestra_de_UPMS
)%>%
  rename(
    P_INC_UPM = Prob
  )

```

## Verifico que el tamaño de muestra sea el indicado

```
Muestra_UPMS_con_Info%>%
  group_by(
    Estrato_Socioeconomico
  )%>%
  count()

## # A tibble: 5 x 2
## # Groups:   Estrato_Socioeconomico [5]
##   Estrato_Socioeconomico     n
##   <ord>                  <int>
## 1 Montevideo Bajo           45
## 2 Montevideo Medio Bajo     58
## 3 Montevideo Medio          81
## 4 Montevideo Medio Alto     77
## 5 Montevideo Alto          40
```

## SEGUNDA ETAPA: MUESTRA DE USM: HOGARES

```
Marco_Segunda_etapa <- Muestra_UPMS_con_Info%>%
  left_join(
    Universo%>%
      select(
        ID_HOGAR,
        UPM
      )%>%
      group_by(
        ID_HOGAR
      )%>%
      slice(1),
    by = "UPM"
  )%>%
  arrange(
    UPM
  )

Muestra_Segunda_etapa <- sampling::strata(
  Marco_Segunda_etapa,
  stratanames = "UPM",
  size = rep(5, nrow(Muestra_UPMS_con_Info)),
  method = "srswor"
)

Muestra_USM_con_Info <- sampling::getdata(
  Marco_Segunda_etapa,
  Muestra_Segunda_etapa
)%>%
  rename(
    P_INC_USM = Prob
  )
```

## TERCERA ETAPA: MUESTRA DE UUM: PERSONAS

```
Marco_ultima_etapa <- Muestra_USM_con_Info %>%
  left_join(
    Universo%>%
      transmute(
        ID_HOGAR,
        ID_PERSONA
      ),
    by = "ID_HOGAR"
  )

Muestra_Final <- sampling::strata(
  Marco_ultima_etapa,
  strata = "ID_HOGAR",
  size = rep(1,nrow(Muestra_USM_con_Info)),
  method = "srswor"
)

MUESTRA <- sampling::getdata(
  Marco_ultima_etapa,
  Muestra_Final
)%>%
  transmute(
    ID_PERSONA,
    ID_HOGAR,
    UPM,
    Estrato_Socioeconomico,
    PI = P_INC_UPM*P_INC_USM*Prob,
    WI = 1/PI
  )%>%
  left_join(
    Universo%>%
      select(
        -ID_HOGAR,
        -UPM,
        -Estrato_Socioeconomico
      ),
    by = "ID_PERSONA"
  )
```

## ESTIMACIONES

```
Design <- MUESTRA %>%
  as_survey_design(
    id = UPM, #Acá se asignará la variable de identificación de la UPM y luego la variable de estratifi
    strata = Estrato_Socioeconomico,
    weights = WI
  )

Design%>%
  summarise(
```

```

Tasa_de_pobreza = survey_mean(pobre, vartype = c("se", "cv"), deff=TRUE)
)

## # A tibble: 1 x 4
##   Tasa_de_pobreza Tasa_de_pobreza_se Tasa_de_pobreza_cv Tasa_de_pobreza_deff
##         <dbl>         <dbl>         <dbl>         <dbl>
## 1         0.0865         0.0104         0.120         2.24

Design%>%
  group_by(Estrato_Socioeconomico)%>%
  summarise(
    Tasa_de_pobreza = survey_mean(pobre, vartype = c("se", "cv"), deff=TRUE)
  )

## # A tibble: 5 x 5
##   Estrato_Socioeconomico Tasa_de_pobreza Tasa_de_pobreza_se Tasa_de_pobreza_cv
##   <ord>                 <dbl>         <dbl>         <dbl>
## 1 Montevideo Bajo      0.278         0.0291         0.105
## 2 Montevideo Medio Bajo 0.134         0.0261         0.195
## 3 Montevideo Medio      0.0391        0.0183         0.467
## 4 Montevideo Medio Alto 0.00973       0.00558        0.574
## 5 Montevideo Alto       0             0             NaN
## # i 1 more variable: Tasa_de_pobreza_deff <dbl>

Design%>%
  summarise(
    Cantidad_de_personas = survey_total(1, vartype = c("se", "cv"), deff=TRUE)
  )

## # A tibble: 1 x 4
##   Cantidad_de_personas Cantidad_de_personas_se Cantidad_de_personas_cv
##         <dbl>         <dbl>         <dbl>
## 1        17094.         793.         0.0464
## # i 1 more variable: Cantidad_de_personas_deff <dbl>

Design%>%
  summarise(
    Ingreso_Promedio = survey_mean(Ingreso_Persona, vartype = c("se", "cv"), deff=TRUE)
  ) #EL DESIGN NO CALIBRA AL TOTAL POBLACIONAL

## # A tibble: 1 x 4
##   Ingreso_Promedio Ingreso_Promedio_se Ingreso_Promedio_cv Ingreso_Promedio_deff
##         <dbl>         <dbl>         <dbl>         <dbl>
## 1        41475.         1760.         0.0424         1.86

Design%>%
  group_by(Estrato_Socioeconomico)%>%
  summarise(
    Ingreso_Promedio = survey_mean(Ingreso_Persona, vartype = c("se", "cv"), deff=TRUE)
  )

## # A tibble: 5 x 5
##   Estrato_Socioeconomico Ingreso_Promedio Ingreso_Promedio_se
##   <ord>                 <dbl>         <dbl>
## 1 Montevideo Bajo      21156.         2225.
## 2 Montevideo Medio Bajo 28829.         2448.
## 3 Montevideo Medio      36050.         2959.

```

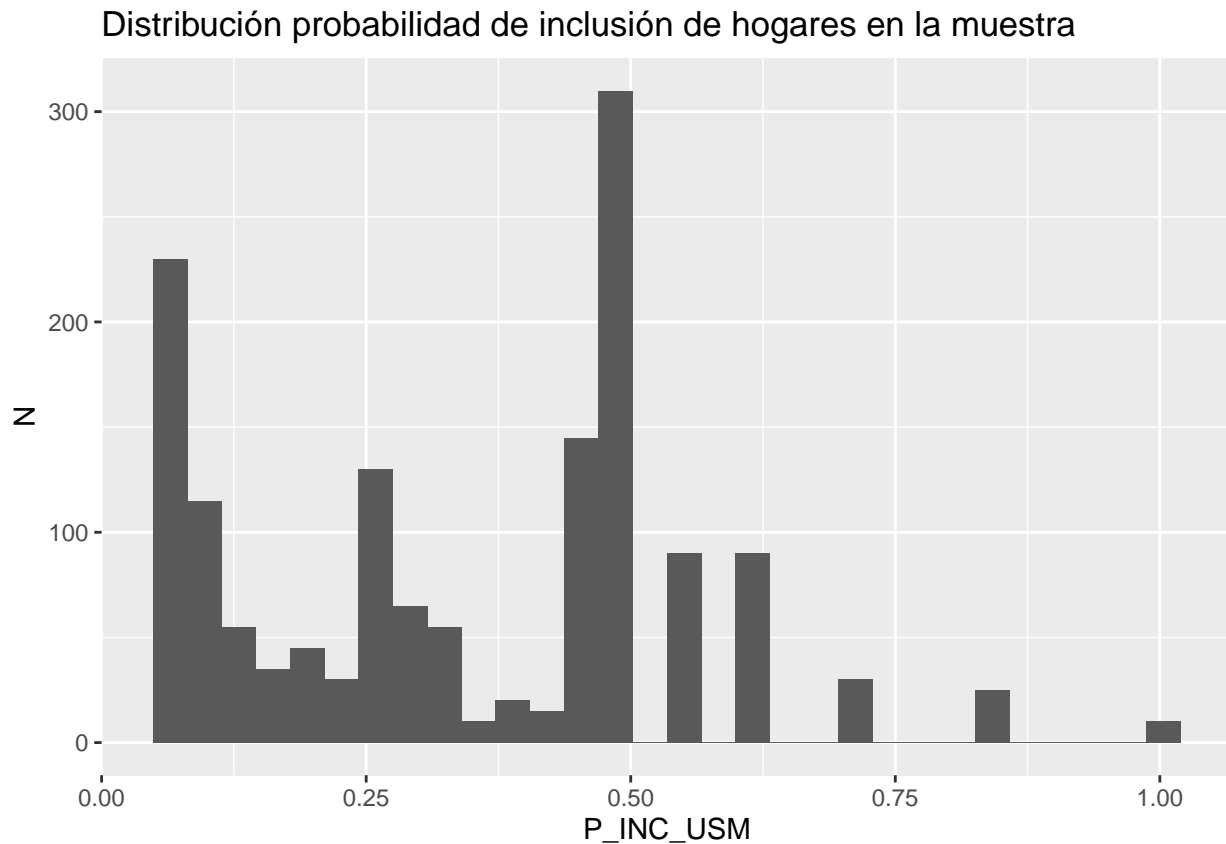


```
## 4 Montevideo Medio Alto          56310.          3918.
## 5 Montevideo Alto                 74232.          7643.
## # i 2 more variables: Ingreso_Promedio_cv <dbl>, Ingreso_Promedio_deff <dbl>
```

## PONDERADORES

```
Muestra_USM_con_Info%>%
  ggplot(
    aes(
      x = P_INC_USM
    )
  )+
  geom_histogram()+
  labs(
    title = "Distribución probabilidad de inclusión de hogares en la muestra", y = "N"
  )
```

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

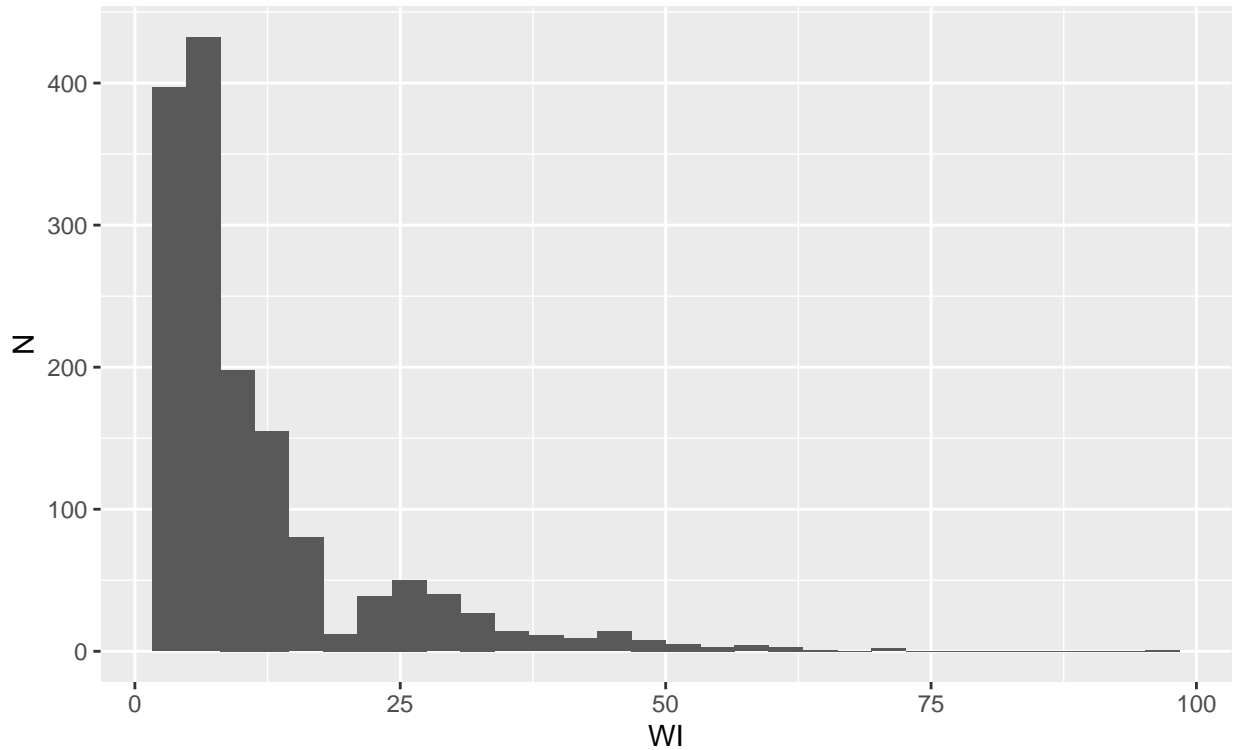


```
MUESTRA %>%
  ggplot(
    aes(
      x = WI
    )
  )+
  geom_histogram()+
```

```
labs(
  title = "Distribución de los ponderadores",
  subtitle = "Individuos pertenecientes a la muestra",
  y = "N"
)
```

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

Distribución de los ponderadores  
Individuos pertenecientes a la muestra



```
#####
# QUE PASABA SI TOMABA UN SI? #
#####

Muestra_SI <- sampling::strata(
  Universo%>%
    transmute(
      Estrato = 1
    ),
  strata = "Estrato",
  size = 1500,
  method = "srswor"
)

Muestra_SI_INFO <- Universo%>%
  sampling::getdata(
    Muestra_SI
  )
```

```

Design_SI <- Muestra_SI_INFO%>%
  as_survey_design(
    id = ID_PERSONA,
    strata = Estrato,
    weights = 1/Prob
  )

Design_SI%>%
  summarise(
    Tasa_de_pobreza = survey_mean(pobre, vartype = c("se", "cv"), deff=TRUE)
  )

## # A tibble: 1 x 4
##   Tasa_de_pobreza Tasa_de_pobreza_se Tasa_de_pobreza_cv Tasa_de_pobreza_deff
##   <dbl>          <dbl>          <dbl>          <dbl>
## 1          0.0736          0.00697          0.0946          1.07

#####
# SI TOMO MUCHAS MUESTRAS ??? #
#####

SE_3E <- numeric()
SE_2E <- numeric()
SE_CON <- numeric()
SE_SI <- numeric()

for (i in seq(1,100,1)) {

  Marco_UPMS_Muestra <- Marco_UPMS_Muestra%>%
    arrange(
      Estrato_Socioeconomico
    )

  Muestra_de_UPMS <- sampling::strata(
    Marco_UPMS_Muestra,
    stratanames = "Estrato_Socioeconomico",
    size = Tam_muestra_x_estrato$Tam_muestra,
    method = "systematic",
    pik = Marco_UPMS_Muestra$Cantidad_Hogares, #Necesariamente hay que poner Tabla$MOS
    description = TRUE
  )

  Muestra_UPMS_con_Info <- sampling::getdata(
    Marco_UPMS_Muestra,
    Muestra_de_UPMS
  )%>%
    rename(
      P_INC_UPM = Prob
    )

  # Verifico que el tamaño de muestra sea el indicado

```

```

Muestra_UPMS_con_Info%>%
  group_by(
    Estrato_Socioeconomico
  )%>%
  count()
#####
# SEGUNDA ETAPA: MUESTRA DE USM: HOGARES #
#####

Marco_Segunda_etapa <- Muestra_UPMS_con_Info%>%
  left_join(
    Universo%>%
      select(
        ID_HOGAR,
        UPM
      )%>%
      group_by(
        ID_HOGAR
      )%>%
      slice(1),
    by = "UPM"
  )%>%
  arrange(
    UPM
  )

Muestra_Segunda_etapa <- sampling::strata(
  Marco_Segunda_etapa,
  stratanames = "UPM",
  size = rep(5,nrow(Muestra_UPMS_con_Info)),
  method = "srswor"
)

Muestra_USM_con_Info <- sampling::getdata(
  Marco_Segunda_etapa,
  Muestra_Segunda_etapa
)%>%
  rename(
    P_INC_USM = Prob
  )

#####
# TERCERA ETAPA: MUESTRA DE UUM: PERSONAS #
#####

Marco_ultima_etapa <- Muestra_USM_con_Info %>%
  left_join(
    Universo%>%
      transmute(
        ID_HOGAR,
        ID_PERSONA
      ),
    by = "ID_HOGAR"
  )

```

```

)

Muestra_Final <- sampling::strata(
  Marco_ultima_etapa,
  strata = "ID_HOGAR",
  size = rep(1,nrow(Muestra_USM_con_Info)),
  method = "srswor"
)

MUESTRA <- sampling::getdata(
  Marco_ultima_etapa,
  Muestra_Final
)%>%
  transmute(
    ID_PERSONA,
    ID_HOGAR,
    UPM,
    Estrato_Socioeconomico,
    PI = P_INC_UPM*P_INC_USM*Prob,
    WI = 1/PI
  )%>%
  left_join(
    Universo%>%
      select(
        -ID_HOGAR,
        -UPM,
        -Estrato_Socioeconomico
      ),
    by = "ID_PERSONA"
  )

#####
# ESTIMACIONES #
#####

Design <- MUESTRA %>%
  as_survey_design(
    id = UPM, #Acá se asignará la variable de identificación de la UPM y luego la variable de estrati.
    strata = Estrato_Socioeconomico,
    weights = WI
  )

POBRES_3E <- Design%>%
  summarise(
    Tasa_de_pobreza = survey_mean(pobre, vartype = c("se", "cv"), deff=TRUE)
  )

SE_3E[i] <- POBRES_3E[[2]]

Muestra_SI <- sampling::strata(
  Universo%>%
    transmute(
      Estrato = 1

```

```

    ),
    strata = "Estrato",
    size = 1500,
    method = "srswor"
  )

Muestra_SI_INFO <- Universo%>%
  sampling::getdata(
    Muestra_SI
  )

Design_SI <- Muestra_SI_INFO%>%
  as_survey_design(
    id = ID_PERSONA,
    strata = Estrato,
    weights = 1/Prob
  )

POBRES_SI <- Design_SI%>%
  summarise(
    Tasa_de_pobreza = survey_mean(pobre, vartype = c("se", "cv"), deff=TRUE)
  )

SE_SI[i] <- POBRES_SI[[2]]
}

```

```

## Stratum 1
##
## Population total and number of selected units: 68 45
## Stratum 2
##
## Population total and number of selected units: 69 58
## Stratum 3
##
## Population total and number of selected units: 92 81
## Stratum 4
##
## Population total and number of selected units: 88 77
## Stratum 5
##
## Population total and number of selected units: 56 40
## Number of strata 5
## Total number of selected units 301
## Stratum 1
##
## Population total and number of selected units: 68 45
## Stratum 2
##
## Population total and number of selected units: 69 58
## Stratum 3
##
## Population total and number of selected units: 92 81
## Stratum 4
##

```

```

## Population total and number of selected units: 88 77
## Stratum 5
##
## Population total and number of selected units: 56 40
## Number of strata 5
## Total number of selected units 301
## Stratum 1
##
## Population total and number of selected units: 68 45
## Stratum 2
##
## Population total and number of selected units: 69 58
## Stratum 3
##
## Population total and number of selected units: 92 81
## Stratum 4
##
## Population total and number of selected units: 88 77
## Stratum 5
##
## Population total and number of selected units: 56 40
## Number of strata 5
## Total number of selected units 301
## Stratum 1
##
## Population total and number of selected units: 68 45
## Stratum 2
##
## Population total and number of selected units: 69 58
## Stratum 3
##
## Population total and number of selected units: 92 81
## Stratum 4
##
## Population total and number of selected units: 88 77
## Stratum 5
##
## Population total and number of selected units: 56 40
## Number of strata 5
## Total number of selected units 301
## Stratum 1
##
## Population total and number of selected units: 68 45
## Stratum 2
##
## Population total and number of selected units: 69 58
## Stratum 3
##
## Population total and number of selected units: 92 81
## Stratum 4
##
## Population total and number of selected units: 88 77
## Stratum 5
##

```

```

## Population total and number of selected units: 56 40
## Number of strata 5
## Total number of selected units 301
## Stratum 1
##
## Population total and number of selected units: 68 45
## Stratum 2
##
## Population total and number of selected units: 69 58
## Stratum 3
##
## Population total and number of selected units: 92 81
## Stratum 4
##
## Population total and number of selected units: 88 77
## Stratum 5
##
## Population total and number of selected units: 56 40
## Number of strata 5
## Total number of selected units 301
## Stratum 1
##
## Population total and number of selected units: 68 45
## Stratum 2
##
## Population total and number of selected units: 69 58
## Stratum 3
##
## Population total and number of selected units: 92 81
## Stratum 4
##
## Population total and number of selected units: 88 77
## Stratum 5
##
## Population total and number of selected units: 56 40
## Number of strata 5
## Total number of selected units 301
## Stratum 1
##
## Population total and number of selected units: 68 45
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## Population total and number of selected units: 68 45
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## Stratum 3
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## Population total and number of selected units: 92 81

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## Stratum 4
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```

data.frame(
  SE = SE_SI
)%>%
  ggplot(
    aes(
      x = SE_SI
    )
  )+
  geom_histogram(
    fill = "red",
    alpha = 0.5
  )+
  geom_vline(
    xintercept = mean(SE_SI),
    linetype = "dashed",
    size = 1,
    colour = "red"
  )+
  geom_histogram(
    inherit.aes = FALSE,
    aes(
      x = SE_3E
    ),
    data = data.frame(SE_3E),
    fill = "blue",
    alpha = 0.5
  )+
  geom_vline(
    xintercept = mean(SE_3E),
    linetype = "dashed",
    size = 1,
    colour = "blue"
  )+
  labs(
    x = "SD",
    y = "N",
    title = "Distribución del SD de las estimaciones de tasa de pobreza",
    subtitle = "En rojo diseño SI, en azul 3 etapas."
  )
)

```

```

## Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
## i Please use `linewidth` instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.

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

Distribución del SD de las estimaciones de tasa de pobreza  
En rojo diseño SI, en azul 3 etapas.

