13_Water

#Loading Libraries

```
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
```

```
library(tidyr)
library(stringr)
library(readr)
library(here)
```

```
## here() starts at C:/Users/morul/School/3rd
Year/BIN381/BIN381_PROJECT/BIN381_PROJECT
```

```
library(ggplot2)
```

#Load Dataset

```
wtr_df <- read_csv(here("data","raw", "water_national_zaf.csv"))
```

```
## Rows: 101 Columns: 29
## ── Column specification
────────────────────────────────────────────────────────
## Delimiter: ","
## chr (17): ISO3, DataId, Indicator, Value, Precision, DHS_CountryCode,
Countr...
## dbl  (8): IndicatorOrder, CharacteristicId, CharacteristicOrder, IsTotal,
Is...
## lgl  (4): RegionId, CILow, CIHigh, LevelRank
##
## 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.
```

#Display Dataset content

```
head(wtr_df)
```

```
## # A tibble: 6 × 29
##   ISO3   DataId Indicator Value Precision DHS_CountryCode CountryName
```

```
SurveyYear
##   <chr>  <chr>  <chr>     <chr> <chr>     <chr>           <chr>
<chr>
## 1 #coun… #meta… #indicat… #ind… #indicat… <NA>            #country+n…
#date+year
## 2 ZAF    795195 Househol… 86.3  1         ZA              South Afri… 1998
## 3 ZAF    795196 Househol… 38.9  1         ZA              South Afri… 1998
## 4 ZAF    795198 Househol… 19.5  1         ZA              South Afri… 1998
## 5 ZAF    795199 Househol… 3     1         ZA              South Afri… 1998
## 6 ZAF    795212 Househol… 0.7   1         ZA              South Afri… 1998
## # ℹ 21 more variables: SurveyId <chr>, IndicatorId <chr>, IndicatorOrder
<dbl>,
## #   IndicatorType <chr>, CharacteristicId <dbl>, CharacteristicOrder
<dbl>,
## #   CharacteristicCategory <chr>, CharacteristicLabel <chr>,
## #   ByVariableId <chr>, ByVariableLabel <chr>, IsTotal <dbl>,
## #   IsPreferred <dbl>, SDRID <chr>, RegionId <lgl>, SurveyYearLabel <dbl>,
## #   SurveyType <chr>, DenominatorWeighted <dbl>, DenominatorUnweighted
<dbl>,
## #   CILow <lgl>, CIHigh <lgl>, LevelRank <lgl>
```

#Remove the first row(meta data)

```
wtr_df <- wtr_df[-1, ]
```

#dimensions

```
dim(wtr_df)

## [1] 100  29
```

#Inspect Duplicated rows

```
dup_check <- wtr_df %>%
  group_by(Indicator, SurveyYear, CharacteristicId, Value,
DenominatorWeighted) %>%
  filter(n() > 1)

dup_check

## # A tibble: 8 × 29
## # Groups:   Indicator, SurveyYear, CharacteristicId, Value,
DenominatorWeighted
## #   [4]
##   ISO3  DataId Indicator  Value Precision DHS_CountryCode CountryName
SurveyYear
##   <chr> <chr>  <chr>      <chr> <chr>     <chr>           <chr>
<chr>
## 1 ZAF   795213 Household… 100   1         ZA              South Afri… 1998
## 2 ZAF   795752 Populatio… 100   1         ZA              South Afri… 1998
## 3 ZAF   795205 Household… 100   1         ZA              South Afri… 1998
```

```
## 4 ZAF   795759 Populatio… 100   1         ZA              South Afri… 1998
## 5 ZAF   295330 Household… 100   1         ZA              South Afri… 2016
## 6 ZAF   414154 Populatio… 100   1         ZA              South Afri… 2016
## 7 ZAF   295325 Household… 100   1         ZA              South Afri… 2016
## 8 ZAF   414167 Populatio… 100   1         ZA              South Afri… 2016
## # ℹ 21 more variables: SurveyId <chr>, IndicatorId <chr>, IndicatorOrder
<dbl>,
## #   IndicatorType <chr>, CharacteristicId <dbl>, CharacteristicOrder
<dbl>,
## #   CharacteristicCategory <chr>, CharacteristicLabel <chr>,
## #   ByVariableId <chr>, ByVariableLabel <chr>, IsTotal <dbl>,
## #   IsPreferred <dbl>, SDRID <chr>, RegionId <lgl>, SurveyYearLabel <dbl>,
## #   SurveyType <chr>, DenominatorWeighted <dbl>, DenominatorUnweighted
<dbl>,
## #   CILow <lgl>, CIHigh <lgl>, LevelRank <lgl>
```

```
wtr_df <- wtr_df %>%
  distinct(Indicator, SurveyYear, CharacteristicId, Value,
DenominatorWeighted, .keep_all = TRUE)
```

#Percentage Missing Values

```
data.frame(
  Column = names(wtr_df),
  Missing_Percentage = paste0(round(colMeans(is.na(wtr_df)) * 100, 2), "%")
  )
```

```
##                    Column Missing_Percentage
## 1                    ISO3                 0%
## 2                  DataId                 0%
## 3               Indicator                 0%
## 4                   Value                 0%
## 5               Precision                 0%
## 6         DHS_CountryCode                 0%
## 7             CountryName                 0%
## 8              SurveyYear                 0%
## 9                SurveyId                 0%
## 10            IndicatorId                 0%
## 11         IndicatorOrder                 0%
## 12          IndicatorType                 0%
## 13       CharacteristicId                 0%
## 14    CharacteristicOrder                 0%
## 15 CharacteristicCategory                 0%
## 16    CharacteristicLabel                 0%
## 17           ByVariableId                 0%
## 18        ByVariableLabel               100%
## 19                IsTotal                 0%
## 20            IsPreferred                 0%
## 21                  SDRID                 0%
## 22               RegionId               100%
## 23        SurveyYearLabel                 0%
```

```
## 24             SurveyType                 0%
## 25    DenominatorWeighted              4.17%
## 26  DenominatorUnweighted              4.17%
## 27                  CILow               100%
## 28                 CIHigh               100%
## 29              LevelRank               100%
```

```
data.frame(
  Column = names(wtr_df),
  Missing_Data = paste0(colSums(is.na(wtr_df)))
  )
```

```
##                    Column Missing_Data
## 1                    ISO3            0
## 2                  DataId            0
## 3               Indicator            0
## 4                   Value            0
## 5               Precision            0
## 6         DHS_CountryCode            0
## 7             CountryName            0
## 8              SurveyYear            0
## 9                SurveyId            0
## 10            IndicatorId            0
## 11         IndicatorOrder            0
## 12          IndicatorType            0
## 13       CharacteristicId            0
## 14    CharacteristicOrder            0
## 15 CharacteristicCategory            0
## 16    CharacteristicLabel            0
## 17           ByVariableId            0
## 18        ByVariableLabel           96
## 19                 IsTotal            0
## 20            IsPreferred            0
## 21                  SDRID            0
## 22               RegionId           96
## 23        SurveyYearLabel            0
## 24             SurveyType            0
## 25    DenominatorWeighted            4
## 26  DenominatorUnweighted            4
## 27                  CILow           96
## 28                 CIHigh           96
## 29              LevelRank           96
```

#check data types

```
data.frame(
  Column = names(wtr_df),
  paste0(sapply(wtr_df, typeof))
)
```

```
##                    Column paste0.sapply.wtr_df..typeof..
## 1                    ISO3                      character
## 2                  DataId                      character
## 3               Indicator                      character
## 4                   Value                      character
## 5               Precision                      character
## 6         DHS_CountryCode                      character
## 7             CountryName                      character
## 8              SurveyYear                      character
## 9                SurveyId                      character
## 10            IndicatorId                      character
## 11         IndicatorOrder                         double
## 12          IndicatorType                      character
## 13       CharacteristicId                         double
## 14    CharacteristicOrder                         double
## 15 CharacteristicCategory                      character
## 16    CharacteristicLabel                      character
## 17           ByVariableId                      character
## 18        ByVariableLabel                      character
## 19                IsTotal                         double
## 20            IsPreferred                         double
## 21                  SDRID                      character
## 22               RegionId                        logical
## 23        SurveyYearLabel                         double
## 24             SurveyType                      character
## 25    DenominatorWeighted                         double
## 26  DenominatorUnweighted                         double
## 27                  CILow                        logical
## 28                 CIHigh                        logical
## 29              LevelRank                        logical
```

#Check The structure of the dataset

```
str(wtr_df)
```

```
## tibble [96 × 29] (S3: tbl_df/tbl/data.frame)
##  $ ISO3                  : chr [1:96] "ZAF" "ZAF" "ZAF" "ZAF" ...
##  $ DataId                : chr [1:96] "795195" "795196" "795198" "795199"
...
##  $ Indicator             : chr [1:96] "Households using an improved water
source" "Households using water piped into dwelling" "Households using a
public tap/standpipe" "Households using a tubewell/borehole" ...
##  $ Value                 : chr [1:96] "86.3" "38.9" "19.5" "3" ...
##  $ Precision             : chr [1:96] "1" "1" "1" "1" ...
##  $ DHS_CountryCode       : chr [1:96] "ZA" "ZA" "ZA" "ZA" ...
##  $ CountryName           : chr [1:96] "South Africa" "South Africa" "South
Africa" "South Africa" ...
##  $ SurveyYear            : chr [1:96] "1998" "1998" "1998" "1998" ...
##  $ SurveyId              : chr [1:96] "ZA1998DHS" "ZA1998DHS" "ZA1998DHS"
"ZA1998DHS" ...
```

```
##  $ IndicatorId           : chr [1:96] "WS_SRCE_H_IMP" "WS_SRCE_H_PIP"
"WS_SRCE_H_TAP" "WS_SRCE_H_TUB" ...
##  $ IndicatorOrder        : num [1:96] 2.5e+08 2.5e+08 2.5e+08 2.5e+08
2.5e+08 ...
##  $ IndicatorType         : chr [1:96] "I" "I" "I" "I" ...
##  $ CharacteristicId      : num [1:96] 1000 1000 1000 1000 1000 1000 1000
1000 1000 1000 ...
##  $ CharacteristicOrder   : num [1:96] 0 0 0 0 0 0 0 0 0 0 ...
##  $ CharacteristicCategory: chr [1:96] "Total" "Total" "Total" "Total" ...
##  $ CharacteristicLabel   : chr [1:96] "Total" "Total" "Total" "Total" ...
##  $ ByVariableId          : chr [1:96] "0" "0" "0" "0" ...
##  $ ByVariableLabel       : chr [1:96] NA NA NA NA ...
##  $ IsTotal               : num [1:96] 1 1 1 1 1 1 1 1 1 1 ...
##  $ IsPreferred           : num [1:96] 1 1 1 1 1 1 1 1 1 1 ...
##  $ SDRID                 : chr [1:96] "WSSRCEHIMP" "WSSRCEHPIP"
"WSSRCEHTAP" "WSSRCEHTUB" ...
##  $ RegionId              : logi [1:96] NA NA NA NA NA NA ...
##  $ SurveyYearLabel       : num [1:96] 1998 1998 1998 1998 1998 ...
##  $ SurveyType            : chr [1:96] "DHS" "DHS" "DHS" "DHS" ...
##  $ DenominatorWeighted   : num [1:96] 12247 12247 12247 12247 12247 ...
##  $ DenominatorUnweighted : num [1:96] 12247 12247 12247 12247 12247 ...
##  $ CILow                 : logi [1:96] NA NA NA NA NA NA ...
##  $ CIHigh                : logi [1:96] NA NA NA NA NA NA ...
##  $ LevelRank             : logi [1:96] NA NA NA NA NA NA ...
```

#Convert Data Types

```
wtr_df <- wtr_df %>%
  mutate(
        Value = as.numeric(Value),
    Precision = as.numeric(Precision),
    SurveyYear = as.integer(SurveyYear),
    IndicatorOrder = as.integer(IndicatorOrder),
    CharacteristicId = as.integer(CharacteristicId),
    CharacteristicOrder = as.integer(CharacteristicOrder),
    IsTotal = as.logical(as.integer(IsTotal)),
    IsPreferred = as.logical(as.integer(IsPreferred)),
    SurveyYearLabel = as.integer(SurveyYearLabel),
    DenominatorWeighted = as.numeric(DenominatorWeighted),
    DenominatorUnweighted = as.numeric(DenominatorUnweighted),
  )
```

#Drop the countries only onw unqiue value: reason, there is no useful information - county is also always za

```
wtr_df <- wtr_df %>%
  select(
    -ISO3,
    -DHS_CountryCode,
    -CountryName,
```

```
    -SurveyId,
    -ByVariableId,
    -ByVariableLabel,
    -IsTotal,
    -RegionId,
    -SurveyYearLabel,
    -SurveyType,
    -CharacteristicOrder
  )
```

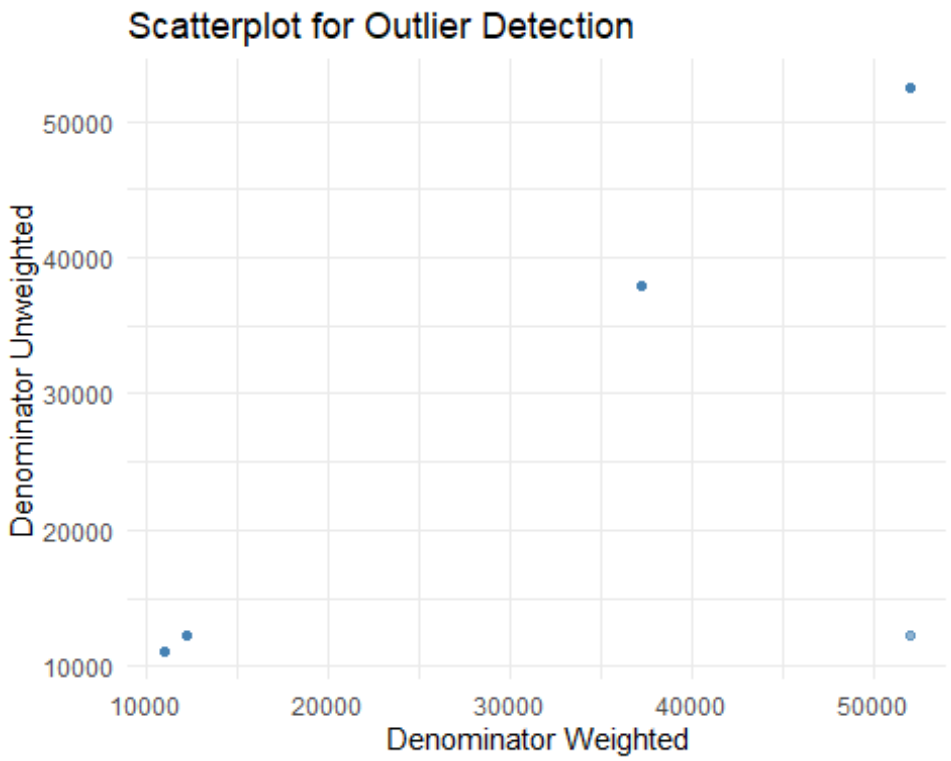
#Assumed pattern, the missing values can be filled with the previous non missing value in the opposite attribute

```
wtr_df <- wtr_df %>%
  fill(DenominatorWeighted, DenominatorUnweighted, .direction = "down")

wtr_df[
       c("DataId","DenominatorWeighted", "DenominatorUnweighted")]
```

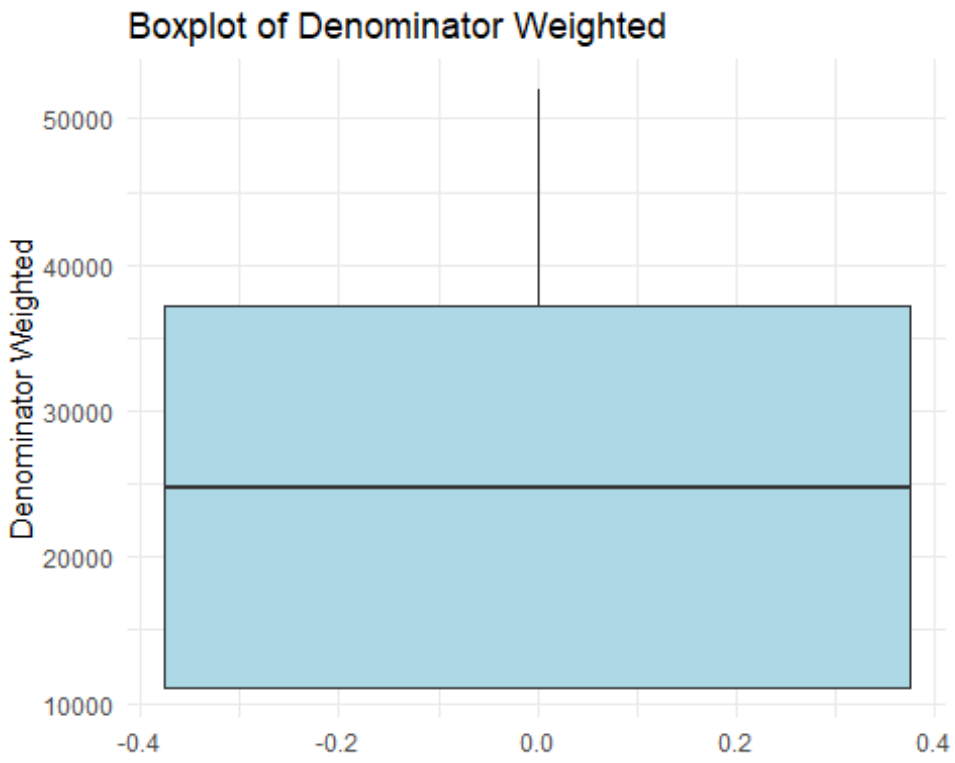
```
## # A tibble: 96 × 3
##    DataId DenominatorWeighted DenominatorUnweighted
##    <chr>                <dbl>                 <dbl>
##  1 795195               12247                 12247
##  2 795196               12247                 12247
##  3 795198               12247                 12247
##  4 795199               12247                 12247
##  5 795212               12247                 12247
##  6 795201               12247                 12247
##  7 795207               12247                 12247
##  8 795211               12247                 12247
##  9 795200               12247                 12247
## 10 795202               12247                 12247
## # ℹ 86 more rows
```

Replace DenominatorUnweighted for a specific dataid

```
wtr_df$DenominatorUnweighted[wtr_df$DataId == "795270"] <- 12247

ggplot(wtr_df, aes(x = DenominatorWeighted, y = DenominatorUnweighted)) +
  geom_point(alpha = 0.6, color = "steelblue") +
  labs(title = "Scatterplot for Outlier Detection",
       x = "Denominator Weighted",
       y = "Denominator Unweighted") +
  theme_minimal()
```




```
ggplot(wtr_df, aes(y = DenominatorWeighted)) +
  geom_boxplot(fill = "lightblue", outlier.color = "red", outlier.shape = 16)
+
  labs(title = "Boxplot of Denominator Weighted",
       y = "Denominator Weighted") +
  theme_minimal()
```




```
unique(wtr_df$Indicator)
```

```
##  [1] "Households using an improved water source"
##  [2] "Households using water piped into dwelling"
##  [3] "Households using a public tap/standpipe"
##  [4] "Households using a tubewell/borehole"
##  [5] "Households using rainwater"
##  [6] "Households using tanker truck"
##  [7] "Households using bottled water"
##  [8] "Households using an unimproved water source"
##  [9] "Households using surface water"
## [10] "Households using other water source"
## [11] "Households with don't know or missing information on water source"
## [12] "Households: Total"
## [13] "Population using an improved water source"
## [14] "Population using water piped into dwelling"
## [15] "Population using a public tap/standpipe"
## [16] "Population using a tubewell/borehole"
## [17] "Population using rainwater"
## [18] "Population using tanker truck"
## [19] "Population using bottled water/demi john"
## [20] "Population using an unimproved water source"
## [21] "Population using surface water"
## [22] "Population using other water source"
## [23] "Population with don't know or missing information on water source"
## [24] "Population: Total"
## [25] "Households with water on the premises"
```

```
## [26] "Households with water 30 minutes or less away round trip"
## [27] "Households with water more than 30 minutes away round trip"
## [28] "Household with unknown or missing information on round trip time to
water"
## [29] "Population with water on the premises"
## [30] "Population with water 30 minutes or less away round trip"
## [31] "Population with water more than 30 minutes away round trip"
## [32] "Population with unknown or missing information on round trip time to
water"
## [33] "Number of households"
## [34] "Number of households (unweighted)"
## [35] "Number of persons"
## [36] "Number of persons (unweighted)"
## [37] "Households using a protected well"
## [38] "Households using a protected spring"
## [39] "Households using an unprotected well water"
## [40] "Households using an unprotected spring"
## [41] "Population using a protected well"
## [42] "Population using a protected spring"
## [43] "Population using an unprotected well water"
## [44] "Population using an unprotected spring"
## [45] "Households treating water by boiling"
## [46] "Households treating water by adding bleach/chlorine"
## [47] "Households treating water by straining through a cloth"
## [48] "Households treating water using a ceramic, sand or other filter"
## [49] "Households treating water using solar disinfection"
## [50] "Households treating water using other methods"
## [51] "Households not treating water"
## [52] "Households with missing information on treatment of water"
## [53] "Households using an appropriate treatment method"
## [54] "Population treating water by boiling"
## [55] "Population treating water by adding bleach/chlorine"
## [56] "Population treating water by straining through a cloth"
## [57] "Population treating water using a ceramic, sand or other filter"
## [58] "Population treating water using solar disinfection"
## [59] "Population treating water using other methods"
## [60] "Population not treating water"
## [61] "Population with missing information on treatment of water"
## [62] "Population using an appropriate treatment method"
```

#save cleaned data

```
write_csv(wtr_df, here("data","processed", "water_cleaned.csv"))
```