08_IYCF

#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

```
icy_df <- read_csv(here("data", "raw", "iycf_national_zaf.csv"))

## Rows: 23 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(icy_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    795971 Children… 87.4  1         ZA              South Afri… 1998
## 3 ZAF    795973 Children… 38.9  1         ZA              South Afri… 1998
## 4 ZAF    621666 Children… 6.9   1         ZA              South Afri… 1998
## 5 ZAF    621667 Children… 6.3   1         ZA              South Afri… 1998
## 6 ZAF    621670 Children… 40.9  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)

```
icy_df <- icy_df[-1, ]
```

#dimensions

```
dim(icy_df)

## [1] 22 29
```

Inspect Duplicated rows

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

dup_check

## # A tibble: 0 × 29
## # Groups:   Indicator, SurveyYear, CharacteristicId, Value [0]
## # ℹ 29 variables: ISO3 <chr>, DataId <chr>, Indicator <chr>, Value <chr>,
## #   Precision <chr>, DHS_CountryCode <chr>, CountryName <chr>,
## #   SurveyYear <chr>, 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>,
…

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

Missing Values

```
# 1. Remove completely empty columns
icy_df <- icy_df %>% select(where(~!all(is.na(.))))

# 2. Impute numeric columns with median
num_cols <- icy_df %>% select(where(is.numeric)) %>% names()
icy_df <- icy_df %>%
  mutate(across(all_of(num_cols), ~ ifelse(is.na(.), median(., na.rm = TRUE),
.)))

# 3. Impute character/categorical columns with mode
cat_cols <- icy_df %>% select(where(is.character)) %>% names()
get_mode <- function(x) {
  ux <- na.omit(x)
  if(length(ux) == 0) return(NA_character_)
  names(sort(table(ux), decreasing = TRUE))[1]
}
icy_df <- icy_df %>%
  mutate(across(all_of(cat_cols), ~ ifelse(is.na(.), get_mode(.), .)))

# 4. Summary after handling missing values
missing_summary <- data.frame(
  Column = names(icy_df),
  Missing_Percentage = paste0(round(colMeans(is.na(icy_df)) * 100, 2), "%"),
  Missing_Count = colSums(is.na(icy_df))
)

cat("Total remaining NAs:", sum(is.na(icy_df)), "\n")

## Total remaining NAs: 0

cat("Missing value summary per column:\n")

## Missing value summary per column:

print(missing_summary)

##                                         Column Missing_Percentage
Missing_Count
## ISO3                                     ISO3                 0%
0
## DataId                                 DataId                 0%
0
```

```
## Indicator                           Indicator                 0%
0
## Value                                   Value                 0%
0
## Precision                           Precision                 0%
0
## DHS_CountryCode               DHS_CountryCode                 0%
0
## CountryName                       CountryName                 0%
0
## SurveyYear                         SurveyYear                 0%
0
## SurveyId                             SurveyId                 0%
0
## IndicatorId                       IndicatorId                 0%
0
## IndicatorOrder                 IndicatorOrder                 0%
0
## IndicatorType                   IndicatorType                 0%
0
## CharacteristicId             CharacteristicId                 0%
0
## CharacteristicOrder       CharacteristicOrder                 0%
0
## CharacteristicCategory CharacteristicCategory                 0%
0
## CharacteristicLabel       CharacteristicLabel                 0%
0
## ByVariableId                     ByVariableId                 0%
0
## IsTotal                               IsTotal                 0%
0
## IsPreferred                       IsPreferred                 0%
0
## SDRID                                   SDRID                 0%
0
## SurveyYearLabel               SurveyYearLabel                 0%
0
## SurveyType                         SurveyType                 0%
0
## DenominatorWeighted       DenominatorWeighted                 0%
0
## DenominatorUnweighted   DenominatorUnweighted                 0%
0

data.frame(
  Column = names(icy_df),
  Missing_Data = paste0(colSums(is.na(icy_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                IsTotal            0
## 19            IsPreferred            0
## 20                  SDRID            0
## 21        SurveyYearLabel            0
## 22             SurveyType            0
## 23    DenominatorWeighted            0
## 24  DenominatorUnweighted            0
```

#check data types

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

```
##                        Column paste0.sapply.icy_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                IsTotal                         double
## 19            IsPreferred                         double
## 20                  SDRID                      character
## 21        SurveyYearLabel                         double
## 22             SurveyType                      character
## 23    DenominatorWeighted                         double
## 24  DenominatorUnweighted                         double
```

#Check The structure of the dataset

```
str(icy_df)
```

```
## tibble [22 × 24] (S3: tbl_df/tbl/data.frame)
##  $ ISO3                   : chr [1:22] "ZAF" "ZAF" "ZAF" "ZAF" ...
##  $ DataId                 : chr [1:22] "795971" "795973" "621666" "621667"
...
##  $ Indicator              : chr [1:22] "Children ever breastfed" "Children
who started breastfeeding within 1 hour of birth" "Children exclusively
breastfed" "Children breastfeeding and consuming plain water only" ...
##  $ Value                  : chr [1:22] "87.4" "38.9" "6.9" "6.3" ...
##  $ Precision              : chr [1:22] "1" "1" "1" "1" ...
##  $ DHS_CountryCode        : chr [1:22] "ZA" "ZA" "ZA" "ZA" ...
##  $ CountryName            : chr [1:22] "South Africa" "South Africa" "South
Africa" "South Africa" ...
##  $ SurveyYear             : chr [1:22] "1998" "1998" "1998" "1998" ...
##  $ SurveyId               : chr [1:22] "ZA1998DHS" "ZA1998DHS" "ZA1998DHS"
"ZA1998DHS" ...
##  $ IndicatorId            : chr [1:22] "CN_BRFI_C_EVR" "CN_BRFI_C_1HR"
"CN_BRFS_C_EXB" "CN_BRFS_C_WAT" ...
##  $ IndicatorOrder         : num [1:22] 1.04e+08 1.04e+08 1.04e+08 1.04e+08
1.04e+08 ...
##  $ IndicatorType          : chr [1:22] "I" "I" "I" "I" ...
##  $ CharacteristicId       : num [1:22] 1000 1000 295001 295001 295001 ...
##  $ CharacteristicOrder    : num [1:22] 0 0 21001 21001 21001 ...
##  $ CharacteristicCategory: chr [1:22] "Total" "Total" "Age in months
(other groupings)" "Age in months (other groupings)" ...
##  $ CharacteristicLabel    : chr [1:22] "Total" "Total" "0-5" "0-5" ...
##  $ ByVariableId           : chr [1:22] "0" "0" "0" "0" ...
##  $ IsTotal                : num [1:22] 1 1 1 1 1 1 1 1 1 1 ...
##  $ IsPreferred            : num [1:22] 1 1 1 1 1 1 1 1 1 1 ...
##  $ SDRID                  : chr [1:22] "CNBRFICEVR" "CNBRFIC1HR"
"CNBRFSCEXB" "CNBRFSCWAT" ...
##  $ SurveyYearLabel        : num [1:22] 1998 1998 1998 1998 1998 ...
##  $ SurveyType             : chr [1:22] "DHS" "DHS" "DHS" "DHS" ...
##  $ DenominatorWeighted    : num [1:22] 2010 2010 499 499 499 ...
##  $ DenominatorUnweighted : num [1:22] 2041 2041 505 505 505 ...
```

#Convert Data Types

```
icy_df <- icy_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),
  )
```

#check for unique values

```
library(dplyr)
library(purrr)

# Summary table: column name, number of unique values, sample of unique
values
n_sample <- 3

summary_tbl <- icy_df %>%
  map_df(~ tibble(
    n_unique = n_distinct(.),
    sample_values = paste(head(unique(.), n_sample), collapse = ", ")
  ), .id = "column")


summary_tbl

## # A tibble: 24 × 3
##    column          n_unique sample_values
##    <chr>              <int> <chr>
##  1 ISO3                   1 ZAF
##  2 DataId                22 795971, 795973, 621666
##  3 Indicator             14 Children ever breastfed, Children who started
breas…
##  4 Value                 22 87.4, 38.9, 6.9
##  5 Precision              1 1
##  6 DHS_CountryCode        1 ZA
##  7 CountryName            1 South Africa
##  8 SurveyYear             2 1998, 2016
##  9 SurveyId               2 ZA1998DHS, ZA2016DHS
## 10 IndicatorId           14 CN_BRFI_C_EVR, CN_BRFI_C_1HR, CN_BRFS_C_EXB
## # ℹ 14 more rows
```

Drop the Redundant Columns

```
icy_df <- icy_df %>%
  select(
    -ISO3,
    -DHS_CountryCode,
    -CountryName,
    -SurveyId,
    -ByVariableId,

    -IsTotal,

    -SurveyYearLabel,
    -SurveyType,
    -CharacteristicOrder

  )
```

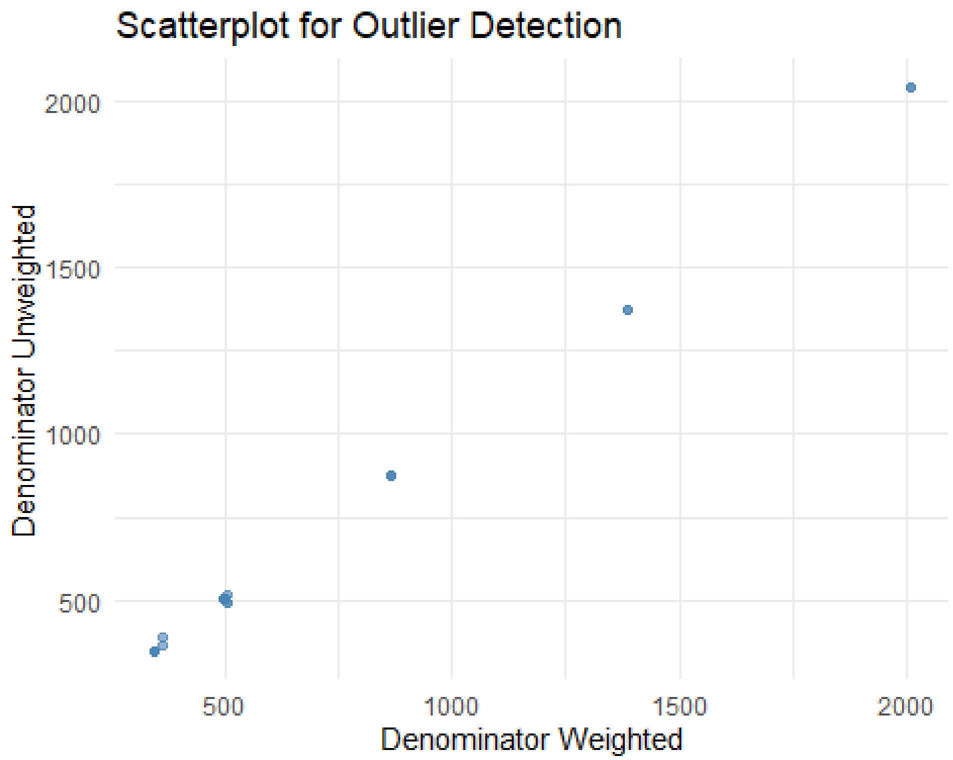
- Columns removed because they were constant, redundant, or not analytically useful:

- ISO3, DHS_CountryCode, CountryName, SurveyId, ByVariableId, IsTotal, SurveyYearLabel, SurveyType, CharacteristicOrder

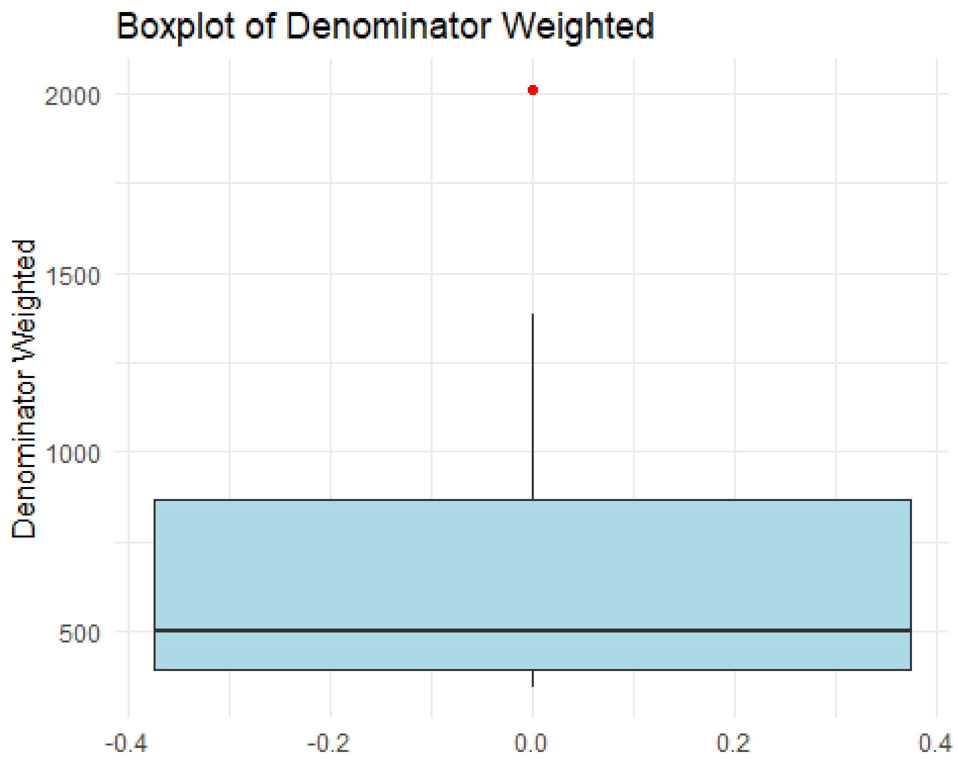
- These columns either contained a single value, duplicated information, or survey metadata that does not impact analysis. # Assumed pattern, the missing values can be filled with the previous non missing value in the opposite attribute

```
library(dplyr)
library(tidyr)

icy_df <- icy_df %>%
  fill(DenominatorWeighted, DenominatorUnweighted, .direction = "up")

icy_df[
       c("DataId","DenominatorWeighted", "DenominatorUnweighted")]

## # A tibble: 22 × 3
##    DataId DenominatorWeighted DenominatorUnweighted
##    <chr>                <dbl>                 <dbl>
##  1 795971               2010                   2041
##  2 795973               2010                   2041
##  3 621666                499                    505
##  4 621667                499                    505
##  5 621670                499                    505
##  6 621664                499                    505
##  7 621143                505                    514
##  8 796663                502.                   505
##  9 719834               1386                   1376
## 10 719833               1386                   1376
## # ℹ 12 more rows
```

```r
ggplot(icy_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()
```



```r
ggplot(icy_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()
```



```
dim(icy_df)

## [1] 22 15
```

#Outlier Handling

```
# Calculate IQR boundaries
Q1_w <- quantile(icy_df$DenominatorWeighted, 0.25, na.rm = TRUE)
Q3_w <- quantile(icy_df$DenominatorWeighted, 0.75, na.rm = TRUE)
IQR_w <- Q3_w - Q1_w
lower_w <- Q1_w - 1.5 * IQR_w
upper_w <- Q3_w + 1.5 * IQR_w

Q1_uw <- quantile(icy_df$DenominatorUnweighted, 0.25, na.rm = TRUE)
Q3_uw <- quantile(icy_df$DenominatorUnweighted, 0.75, na.rm = TRUE)
IQR_uw <- Q3_uw - Q1_uw
lower_uw <- Q1_uw - 1.5 * IQR_uw
upper_uw <- Q3_uw + 1.5 * IQR_uw

# Cap values to the IQR limits
icy_df <- icy_df %>%
  mutate(
    DenominatorWeighted = pmin(pmax(DenominatorWeighted, lower_w), upper_w),
    DenominatorUnweighted = pmin(pmax(DenominatorUnweighted, lower_uw),
upper_uw)
  )
```

Problem: DenominatorWeighted and DenominatorUnweighted contained extreme values that could skew analyses.

Solution: IQR-based capping:

Calculate bounds:

- Lower bound = Q1 – 1.5 × IQR
- Upper bound = Q3 + 1.5 × IQR
- Cap extreme values:
- Values below lower bound → set to lower bound
- Values above upper bound → set to upper bound
- Visualize: Scatterplots and boxplots were used to confirm the effect of outlier capping.
- Outcome: Extreme values were mitigated while retaining all rows, improving robustness for analysis. #save cleaned data

```r
write_csv(icy_df, here("data","processed", "iycf_cleaned.csv"))
```