assignment

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Step1: Data Preparation

In step1, we aim to read in the original datasets and the synthetic dataset while aligning the variables especially set in the syn dataset. Attempting to compare the two datasets, we should also concatenate the original datasets vertically with variables all set as the same. Also, we are filtering out all the non-GPDR countries.

```
# set the working directory
wd <- getwd()
setwd(wd)
# read in the synthetic dataset
syn_data <- read.csv(file = "./syn_2020-08-02_2020-08-08.csv")
# and on macos
head(syn_data)
```

```
##   sample_weight B1_1 B1_2 B1_3 B1_4 B1_5 B1_6 B1_7 B1_8 B1_9 B1_10 B1_11 B1_12
## 1      20424.14    2    2    2    2    2    2    2    2    2     2     2     2
## 2      20424.14    2    2    2    1    2    2    2    2    2     2     2     2
## 3      20424.14    2    1    1    2    2    1    2    2    2     2     2     2
## 4      20424.14    2    2    2    2    2    2    2    2    2     2     2     2
## 5      20424.14    2    1    2    1    1    1    1    1    1     2     2     1
## 6      20424.14    2    2    2    1    2    2    2    2    2     2     2     2
##   B1_13 B1b_x1 B1b_x2 B1b_x3 B1b_x4 B1b_x5 B1b_x6 B1b_x7 B1b_x8 B1b_x9 B1b_x10
## 1     2    -99    -99    -99    -99    -99    -99    -99    -99    -99     -99
## 2     2    -99    -99    -99      1    -99    -99    -99    -99    -99     -99
## 3     2    -99      2      1    -99    -99      2    -99    -99    -99     -99
## 4     2    -99    -99    -99    -99    -99    -99    -99    -99    -99     -99
## 5     2    -99      2    -99      2      2      2      2      2      2     -99
## 6     2    -99    -99    -99      2    -99    -99    -99    -99    -99     -99
##   B1b_x11 B1b_x12 B1b_x13 B3  B5 B6  B7  B8  B9 B10 B11 B12_1 B12_2 B12_3 B12_4
## 1     -99     -99     -99  2 -99  2 -99 -99 -99 -99 -99   -99   -99   -99   -99
## 2     -99     -99     -99  2 -99  1   1   2   2 -99 -99   -99   -99   -99   -99
## 3     -99     -99     -99  2 -99  2 -99 -99 -99 -99 -99   -99   -99   -99   -99
## 4     -99     -99     -99  2 -99  2 -99 -99 -99 -99 -99   -99   -99   -99   -99
## 5     -99       2     -99  2 -99  2 -99 -99 -99 -99 -99   -99   -99   -99   -99
## 6     -99     -99     -99  2 -99  2 -99 -99 -99 -99 -99   -99   -99   -99   -99
##   B12_5 B12_6 B13_1 B13_2 B13_3 B13_4 B13_5 B13_6 B13_7 B14_1 B14_2 B14_3 B14_4
## 1   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99
## 2   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99
## 3   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99
## 4   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99
## 5   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99
## 6   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99   -99
##   B14_5 C0_1 C0_2 C0_3 C0_4 C0_5 C0_6 C1_m  C2 C3 C5 C6 C7 C8 D1 D2 D3 D4 D5
## 1   -99    2    1    2    1    2    2    2 -99  2  5  3  4  1  5  5  3  4  3
## 2   -99    2    2    2    2    2    2    1   1  2  1  1  3  1  5  5  3  4  4
## 3   -99    2    1    2    2    2    2    1   2  2  1  1  4  1  5  4  3  3  3
## 4   -99    2    1    1    1    2    2    1   1  2  1  3  4  1  5  4  2  3  2
## 5   -99    2    1    2    2    2    1    2 -99  2  2  3  4  1  4  2  2  3  1
## 6   -99    2    1    2    1    2    1    1   2  2  2  3  4  1  5  4  3  4  4
##   D6_1 D6_2 D6_3 D7  D8  D9 D10 E2  E3 E4 E7 F1 F2_1 F2_2 F3_de GID_0    GID_1
## 1  -99  -99  -99  2   2 -99 -99  3   1  6  1  1    2    2   -99   NLD  NLD.8_1
## 2  -99  -99  -99  2   2 -99 -99  2   1  6  1  1    2    2   -99   FRA  FRA.7_1
## 3  -99  -99  -99  2   2 -99 -99  1   1  6  2  1    2    2   -99   ITA ITA.11_1
## 4  -99  -99  -99  1 -99 -99  13  2   1  5  3  1    2    2   -99   HUN HUN.14_1
## 5  -99  -99  -99  2   1   7   2  1   2  2  2  1    2    2   -99   FIN  FIN.5_1
## 6  -99  -99  -99  2   2 -99 -99  1 -99  1  5  1    2    2   -99   SVK  SVK.3_1
##           B2  B4        E5      E6
## 1         -99 -99    [2, 4)      -99
## 2   [28, 90) -99    [1, 2)  [0, 9)
## 3 [180, 366) -99    [2, 4) [9, 26)
## 4         -99 -99    [2, 4) [9, 26)
## 5     [1, 3) -99    [1, 2) [9, 26)
## 6         -99 -99 [6, 1000) [9, 26)
```

```
# syn_data <- read_csv("./syn_2020-08-02_2020-08-08.csv", show_col_types = FALSE)
# rename "sample weight" to "weight" to avoid conflicts
colnames(syn_data)[colnames(syn_data) == "sample_weight"] <- "weight"

# columns to be included from the original dataset
cols_list <- colnames(syn_data)

# initialize an empty dataset list
ori_dataset <- list()

for (i in 1:7){
ori_dataset[[i]] <- vroom(list.files(pattern = "*_full.csv$")[i],
                    show_col_types = FALSE) %>%
                    select(all_of(cols_list))
}

dim(ori_dataset[[2]])[2] == dim(syn_data)[2]
```

```
## [1] TRUE
```

```
# check whether 2 dimensions coincide with each other

# bind the original datasets from 0802 to 0808 vertically
bindori_dataset <- bind_rows(ori_dataset)
bindori_dataset <- as.data.frame(bindori_dataset)
dim(bindori_dataset)
```

```
## [1] 996174     92
```

```
dim(syn_data)
```

```
## [1] 100000     92
```

Now we need to check all the `gpdr` countries and only do the alignment.

```
gpdr_countries_data <- NA
gpdr_countries_data <- read.csv(file = "./gpdr.csv", sep = ",")
head(gpdr_countries_data$Country_GID, n = 10L)
```

```
##  [1] "AUT" "AUT" "AUT" "AUT" "AUT" "AUT" "AUT" "AUT" "AUT" "BEL"
```

We then filter the binded original datasets and syn dataset with Region_GID specified

```
country_name <- unique(as.character(gpdr_countries_data$Country_GID))
length(country_name)
```

```
## [1] 27
```

```
length(unique(bindori_dataset$GID_0))
```

```
## [1] 218
```

```
bindori_dataset_filtered <- bindori_dataset %>%
                                        filter(GID_0 %in% country_name)


syn_data_filtered <- syn_data %>%
                          filter(GID_0 %in% country_name)
length(unique(bindori_dataset_filtered$GID_0)) == length(unique(syn_data_filtered$GID_0))  # check whet
```

```
## [1] TRUE
```

Step2: Evaluating the utility of the syn data

In step2, we try to evaluate the utility of the synthetic dataset with one-way marginal and two-way marginal measures.

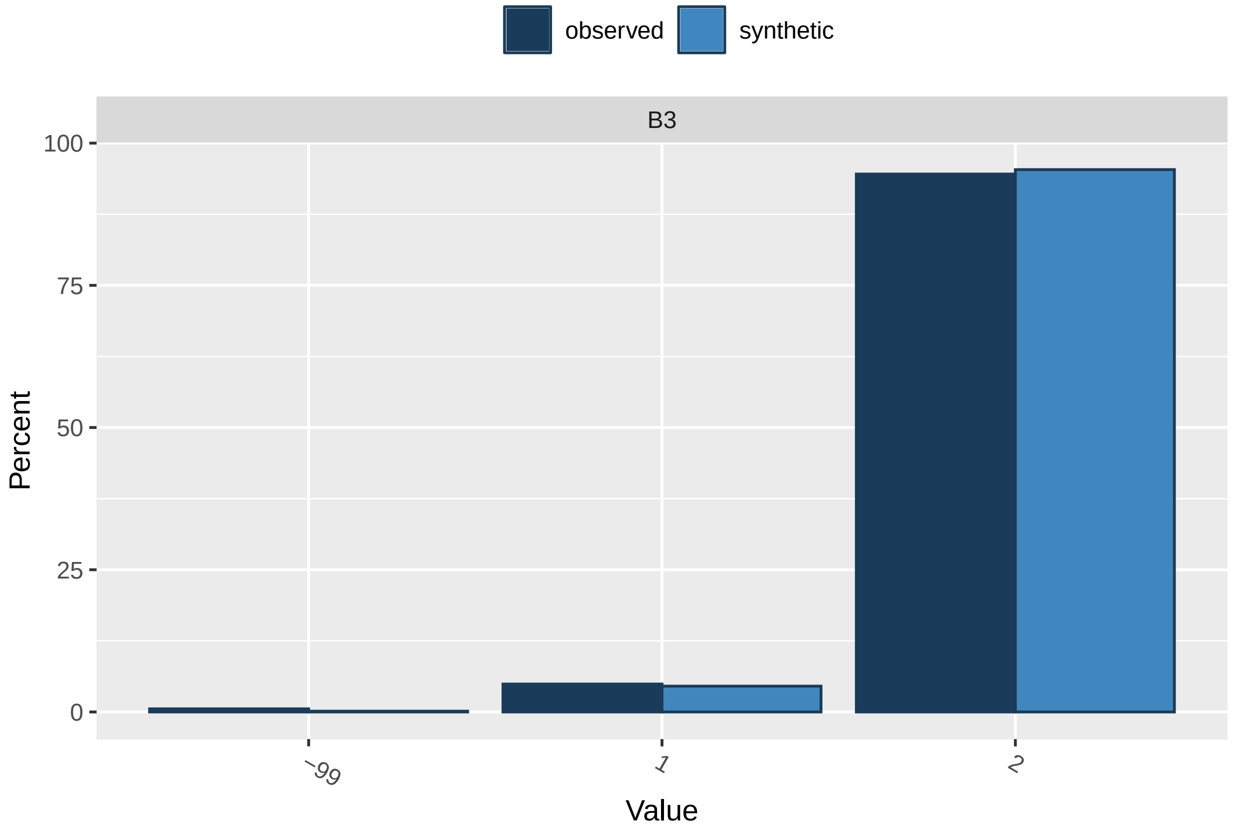
- As for the one-way utility, the syn dataset is measured with the compare plots and pMSE/S_pMSE.
- And for the two-way utility, the synthetic dataset is evaluated with the utility tables which takes up a heatmap fashion/manner.

```
# subset some example columns and try plotting the compare histograms
# these are symptoms variables
symptoms <- c("B3","B4","B1_1","B1_2","B1_3","B1_4","B1_5","B1_6","B1_7",
              "B1_8","B1_9","B1_10","B1_12","B1_13",
              "B1b_x1","B1b_x2","B1b_x3","B1b_x4","B1b_x5","B1b_x6","B1b_x7",
              "B1b_x8","B1b_x9","B1b_x10","B1b_x12","B1b_x13","B2")

# these are testing variables
testing <- c("B7")

# Columns `B0`, `B8a`, `B15_1`, `B15_2`, `B15_3`, etc. don't exist

ori_dataset_symptoms <- as.data.frame(bindori_dataset_filtered[, symptoms])
syn_dataset_symptoms <- as.data.frame(syn_data_filtered[, symptoms])

ori_dataset_testing <- as.data.frame(bindori_dataset_filtered$B7)
syn_dataset_testing <- as.data.frame(syn_data_filtered$B7)
```

(1). one-way marginals using compare()

```
## for var B3 -> symptoms
compare(object = data.frame(B3 = syn_dataset_symptoms$B3),
        data = data.frame(B3 = ori_dataset_symptoms$B3),
        vars = c("B3"), cont.na = NULL,
        msel = NULL, stat = "percents", breaks = 20,
        nrow = 2, ncol = 2, rel.size.x = 1,
        utility.stats = c("pMSE", "S_pMSE"),
        cols = c("#1A3C5A","#4187BF"),
        plot = TRUE, table = TRUE)
```

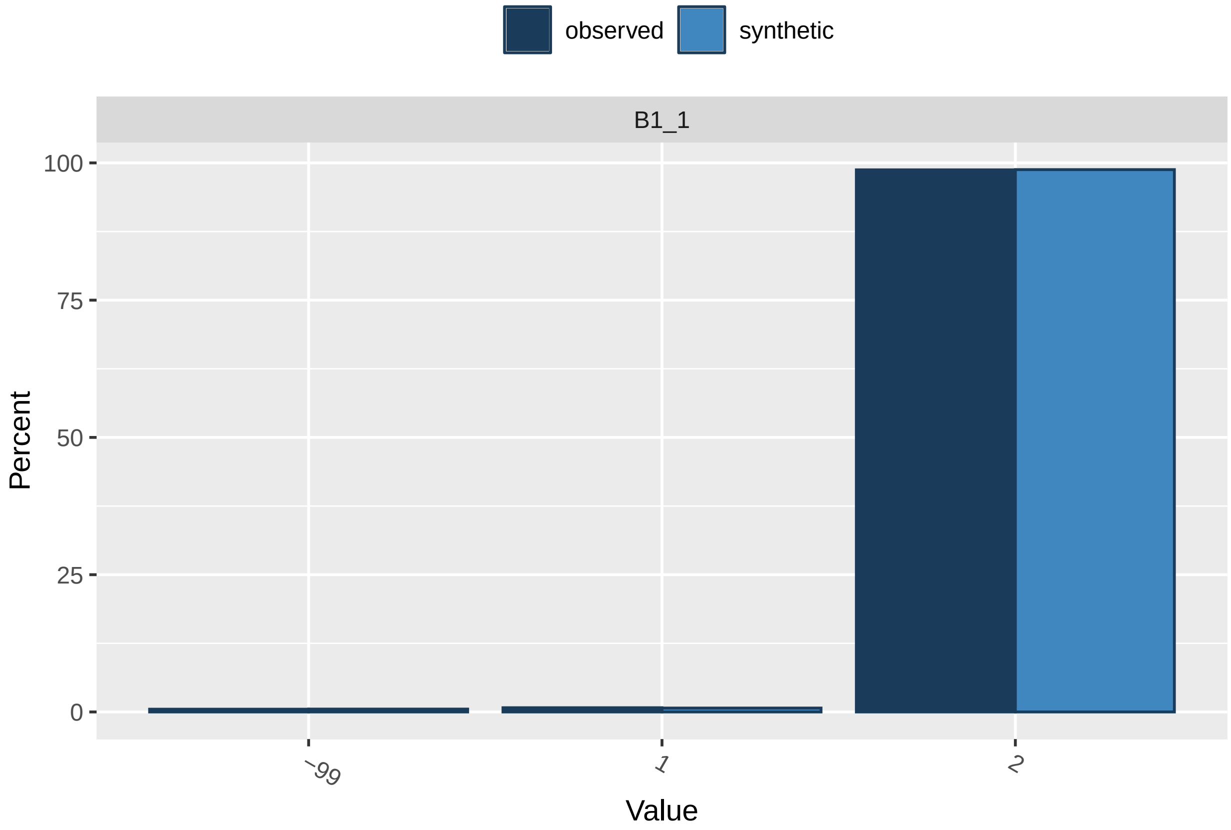
```
##
## Comparing percentages observed with synthetic
##
## $B3
##                 -99        1        2
## observed  0.5424531 4.903592 94.55396
## synthetic 0.1320000 4.531000 95.33700
```



```
##
## Selected utility measures:
##        pMSE   S_pMSE
## B3 0.000172 214.2633
```

```
## for var B1_1 -> symptoms
compare(object = data.frame(B1_1 = syn_dataset_symptoms$B1_1),
        data = data.frame(B1_1 = ori_dataset_symptoms$B1_1),
        vars = "B1_1", cont.na = NULL,
        msel = NULL, stat = "percents", breaks = 20,
        nrow = 2, ncol = 2, rel.size.x = 1,
        utility.stats = c("pMSE", "S_pMSE"),
        cols = c("#1A3C5A","#4187BF"),
        plot = TRUE, table = FALSE)
```

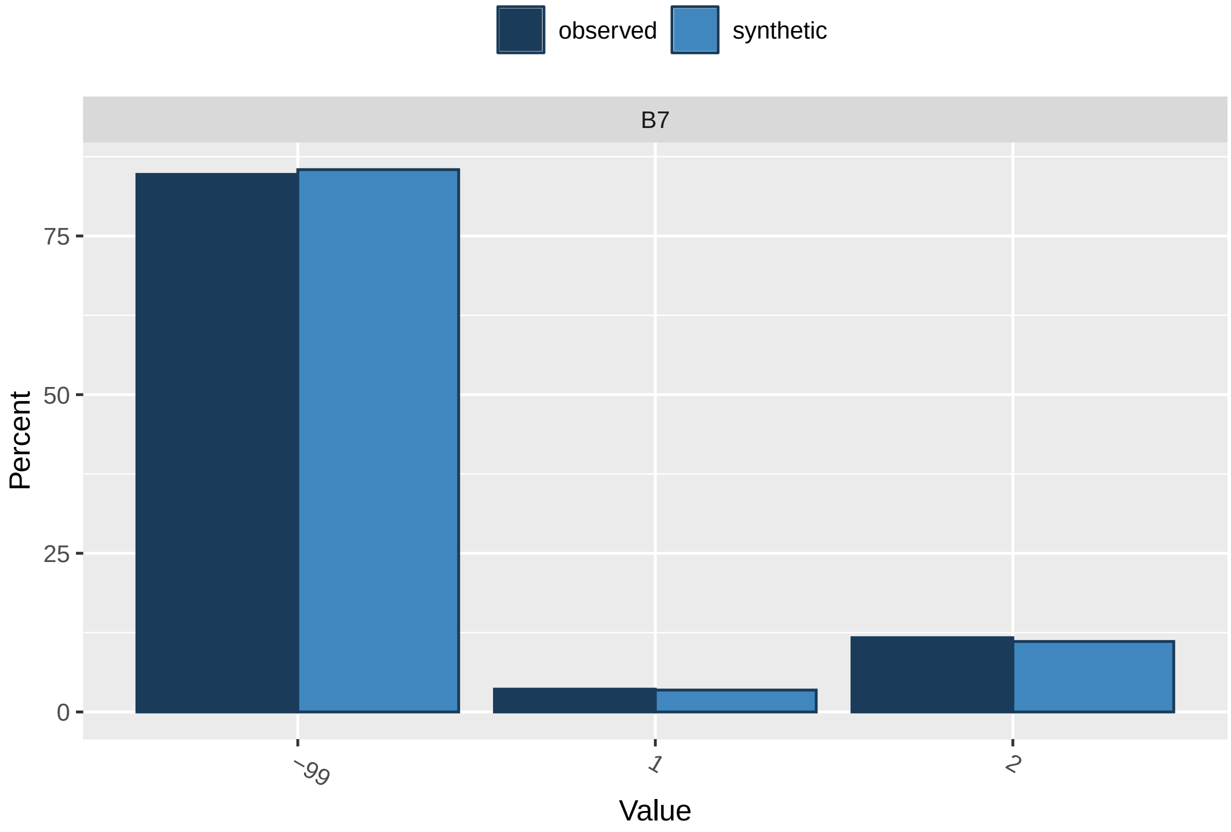
```
##
## Comparing percentages observed with synthetic
```



```
##
## Selected utility measures:
##       pMSE   S_pMSE
## B1_1 2e-06 2.429377
```

```
## for var B7 -> testing
compare(object = data.frame(B7 = syn_data_filtered$B7),
        data = data.frame(B7 = bindori_dataset_filtered$B7),
        vars = "B7", cont.na = NULL,
        msel = NULL, stat = "percents", breaks = 20,
        nrow = 2, ncol = 2, rel.size.x = 1,
        utility.stats = c("pMSE", "S_pMSE"),
        cols = c("#1A3C5A","#4187BF"),
        plot = TRUE, table = FALSE)
```

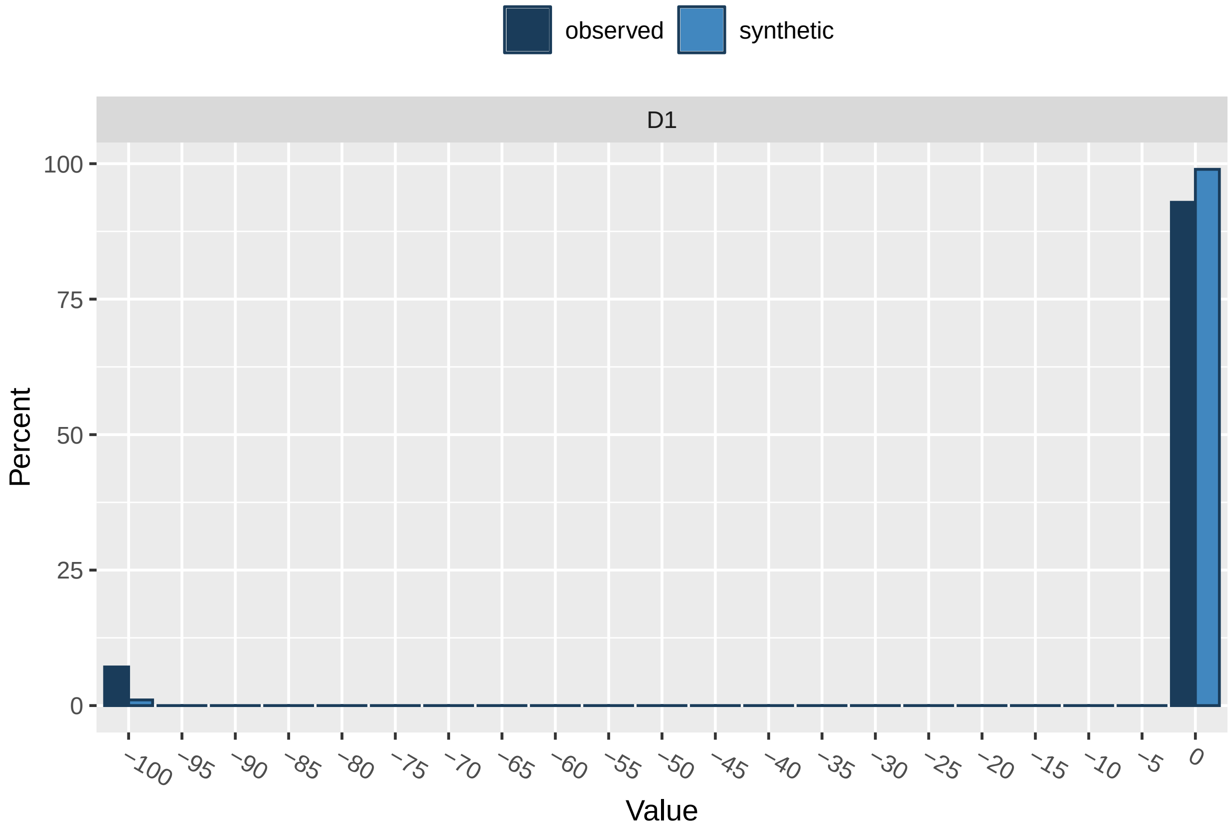
```
##
## Comparing percentages observed with synthetic
```



```
##
## Selected utility measures:
##       pMSE   S_pMSE
## B7 1.8e-05 22.01889
```

```
## for var D1 -> module B
compare(object = data.frame(D1 = syn_data_filtered$D1),
        data = data.frame(D1 = bindori_dataset_filtered$D1),
        vars = "D1", cont.na = NULL,
        msel = NULL, stat = "percents", breaks = 20,
        nrow = 2, ncol = 2, rel.size.x = 1,
        utility.stats = c("pMSE", "S_pMSE"),
        cols = c("#1A3C5A","#4187BF"),
        plot = TRUE, table = FALSE)
```

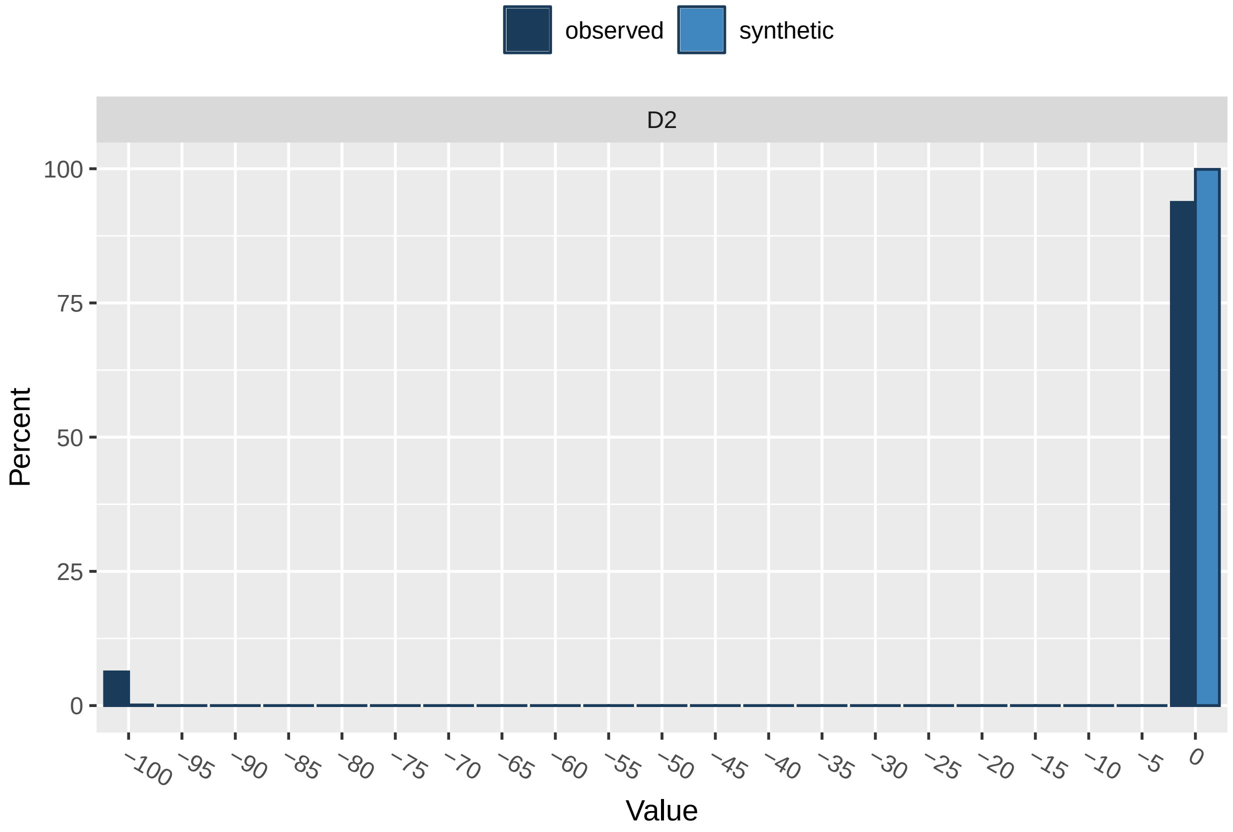
```
##
## Comparing percentages observed with synthetic
```



```
##
## Selected utility measures:
##         pMSE   S_pMSE
## D1 0.000835 2076.806
```

```
## for var D2 -> module B
compare(object = data.frame(D2 = syn_data_filtered$D2),
        data = data.frame(D2 = bindori_dataset_filtered$D2),
        vars = "D2", cont.na = NULL,
        msel = NULL, stat = "percents", breaks = 20,
        nrow = 2, ncol = 2, rel.size.x = 1,
        utility.stats = c("pMSE", "S_pMSE"),
        cols = c("#1A3C5A","#4187BF"),
        plot = TRUE, table = FALSE)
```

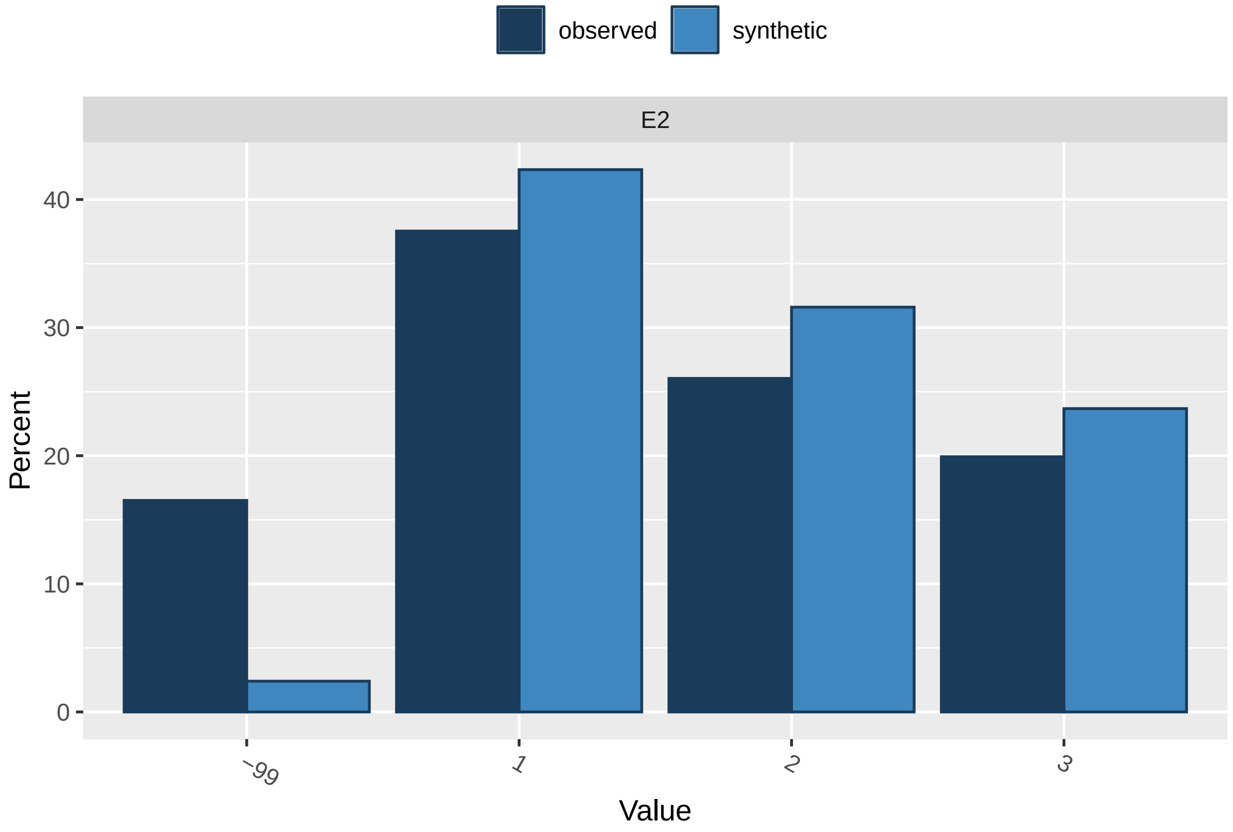
```
##
## Comparing percentages observed with synthetic
```



```
##
## Selected utility measures:
##        pMSE   S_pMSE
## D2 0.000665 1654.444
```

```
## for var E2 -> demographics
compare(object = data.frame(E2 = syn_data_filtered$E2),
        data = data.frame(E2 = bindori_dataset_filtered$E2),
        vars = "E2", cont.na = NULL,
        msel = NULL, stat = "percents", breaks = 20,
        nrow = 2, ncol = 2, rel.size.x = 1,
        utility.stats = c("pMSE", "S_pMSE"),
        cols = c("#1A3C5A","#4187BF"),
        plot = TRUE, table = FALSE)
```

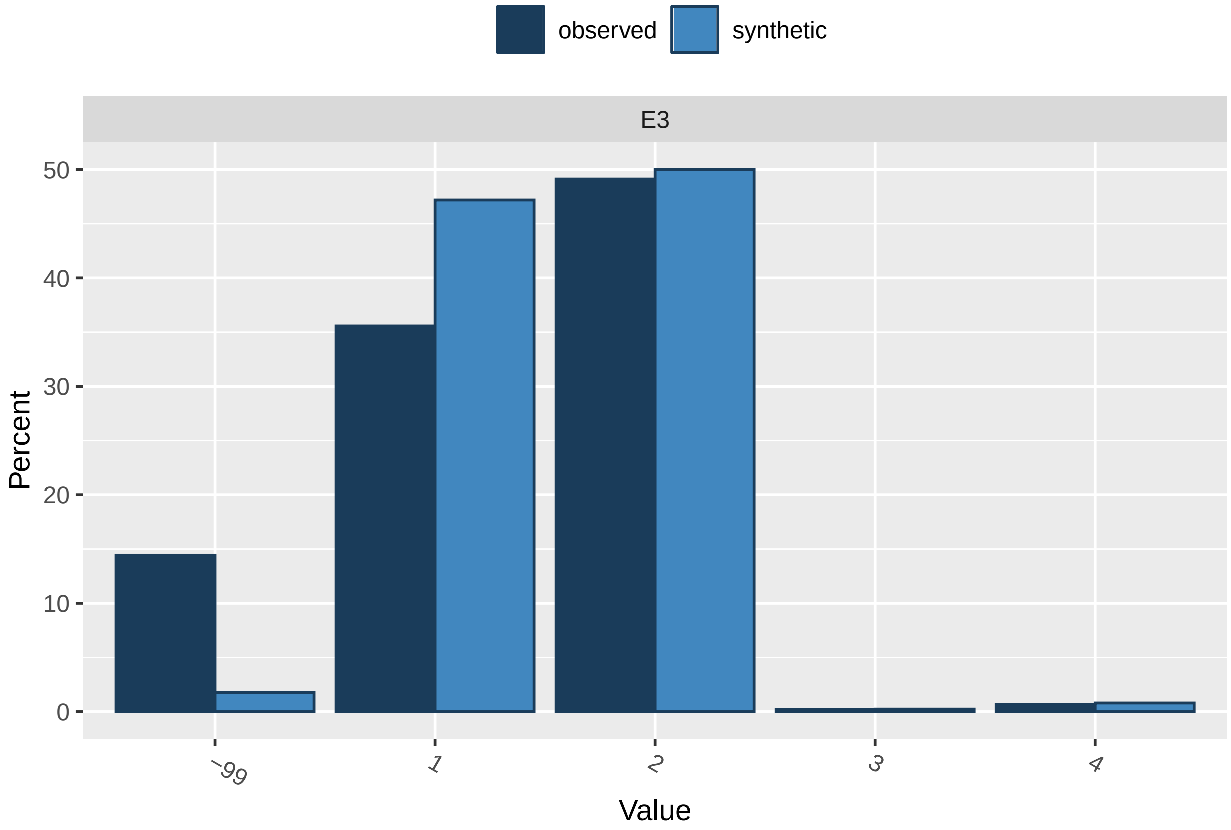
```
##
## Comparing percentages observed with synthetic
```



```
##
## Selected utility measures:
##         pMSE   S_pMSE
## E2 0.007316 6065.024
```

```
## for var E3 -> demographics
compare(object = data.frame(E3 = syn_data_filtered$E3),
        data = data.frame(E3 = bindori_dataset_filtered$E3),
        vars = "E3", cont.na = NULL,
        msel = NULL, stat = "percents", breaks = 20,
        nrow = 2, ncol = 2, rel.size.x = 1,
        utility.stats = c("pMSE", "S_pMSE"),
        cols = c("#1A3C5A","#4187BF"),
        plot = TRUE, table = FALSE)
```

```
##
## Comparing percentages observed with synthetic
```



```
##
## Selected utility measures:
##        pMSE   S_pMSE
## E3 0.007331 4558.638
```

(2). two-way marginals with utility.tables()

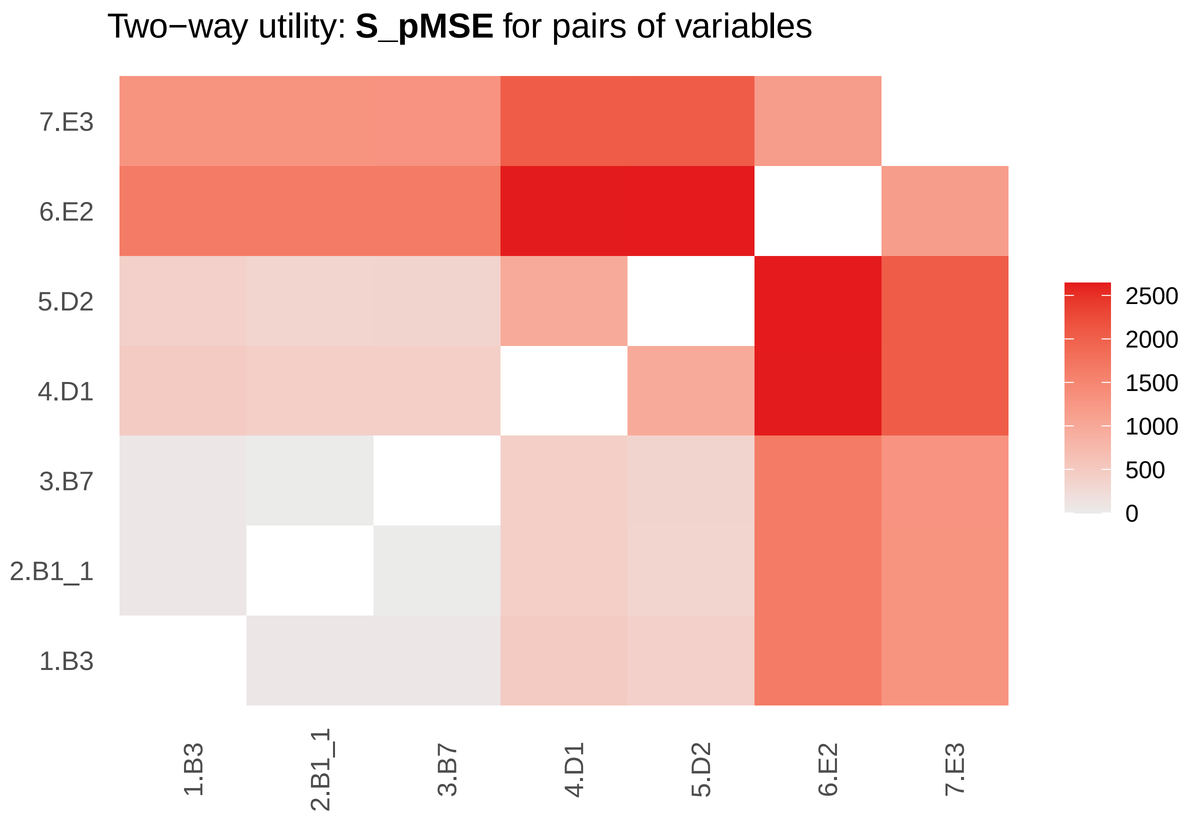
In this part, we focus on the utility in the two-way manner/fashion. However, with a large number of vars to be included, we need to select a few variables to have a first glance of what does the `utility.tables` look like.

```
## filter out a few variables to run the evaluation
## pls make sure that the vars selected are in alignment
## with the one-way maginal ones
selected_cols <- c("B3", "B1_1", "B7", "D1", "D2", "E2", "E3")
syn_select_vars <- syn_data_filtered[, selected_cols]
bindori_select_vars <- bindori_dataset_filtered[, selected_cols]
```

```
## S3 method for class 'data.frame'
utility.twoway <- utility.tables(object = data.frame(syn_select_vars),
                                 data = data.frame(bindori_select_vars),
                                 tables = "twoway",
                                 tab.stats = c("pMSE", "S_pMSE"),
                                 plot.stat = "S_pMSE", plot = TRUE,
                                 print.tabs = TRUE)
```

Now, we print the results out with the heatmap-like output plot.

```
utility.twoway$utility.plot
```


Two−way utility: **S_pMSE** for pairs of variables
7.E3
6.E2
5.D2
4.D1
3.B7
2.B1_1
1.B3
1.B3
2.B1_1
3.B7
4.D1
5.D2
6.E2
7.E3