Splitting the dataset

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Preface

To develop a classification model, the original data must be divided into train data set and test data set. You should do the following:

- Cleansing the dataset
- **Split the data into a train set and a test set**
  - **Split the data.frame or tbl_df into a train set and a test set**
  - **Compare dataset**
    - **Comparison of categorical variables**
    - **Comparison of numeric variables**
    - **Diagnosis of train set and test set**
  - **Extract train/test dataset**
    - **Extract train set or test set**
    - **Extract the data to fit the model**
- Modeling and Evaluate, Predict

The alookr package makes these steps fast and easy:

Data: Credit Card Default Data

`Default` of `ISLR package` is a simulated data set containing information on ten thousand customers. The aim here is to predict which customers will default on their credit card debt.

A data frame with 10000 observations on the following 4 variables.:

- `default` : factor. A factor with levels No and Yes indicating whether the customer defaulted on their debt
- `student`: factor. A factor with levels No and Yes indicating whether the customer is a student
- `balance`: numeric. The average balance that the customer has remaining on their credit card after making their monthly payment
- `income` : numeric. Income of customer

```
# Credit Card Default Data
head(ISLR::Default)
  default student   balance    income
1      No      No  729.5265 44361.625
2      No     Yes  817.1804 12106.135
3      No      No 1073.5492 31767.139
4      No      No  529.2506 35704.494
5      No      No  785.6559 38463.496
6      No     Yes  919.5885  7491.559

# structure of dataset
str(ISLR::Default)
'data.frame':   10000 obs. of  4 variables:
 $ default: Factor w/ 2 levels "No","Yes": 1 1 1 1 1 1 1 1 1 1 ...
 $ student: Factor w/ 2 levels "No","Yes": 1 2 1 1 1 2 1 2 1 1 ...
 $ balance: num  730 817 1074 529 786 ...
 $ income : num  44362 12106 31767 35704 38463 ...
```

```
# summary of dataset
summary(ISLR::Default)
 default    student       balance           income     
 No :9667   No :7056   Min.   :   0.0   Min.   :  772  
 Yes: 333   Yes:2944   1st Qu.: 481.7   1st Qu.:21340  
                       Median : 823.6   Median :34553  
                       Mean   : 835.4   Mean   :33517  
                       3rd Qu.:1166.3   3rd Qu.:43808  
                       Max.   :2654.3   Max.   :73554  
```

Split dataset

split_by() splits the data.frame or tbl_df into a training set and a test set.

Split dataset with split_by()

The split_df class is created, which contains the split information and criteria to separate the training and the test set.

```
library(alookr)
library(dplyr)

# Generate data for the example
sb <- ISLR::Default %>%
  split_by(default, seed = 6534)

sb
# A tibble: 10,000 x 5
# Groups:   split_flag [2]
  default student balance income split_flag
  <fct>   <fct>     <dbl>  <dbl> <chr>     
1 No      No         730. 44362. train     
2 No      Yes        817. 12106. train     
3 No      No        1074. 31767. train     
4 No      No         529. 35704. train     
5 No      No         786. 38463. test      
6 No      Yes        920.  7492. train     
# ... with 9,994 more rows
```

The attributes of the split_df class are as follows.:

- split_seed : integer. random seed used for splitting
- target : character. the name of the target variable
- binary : logical. whether the target variable is binary class
- minority : character. the name of the minority class
- majority : character. the name of the majority class
- minority_rate : numeric. the rate of the minority class
- majority_rate : numeric. the rate of the majority class

```
sb_attr <- attributes(sb)

# The third attribute, row.names, is a vector that is very long and excluded from the output.
sb_attr[-3]
$names
[1] "default"    "student"    "balance"    "income"     "split_flag"
```

```
$class
[1] "split_df"   "grouped_df" "tbl_df"     "tbl"        "data.frame"

$groups
# A tibble: 2 x 2
  split_flag .rows
  <chr>      <list>
1 test       <int [3,000]>
2 train      <int [7,000]>

$split_seed
[1] 6534

$target
  default
"default"

$binary
[1] TRUE

$minority
[1] "Yes"

$majority
[1] "No"

$minority_rate
   Yes
0.0333

$majority_rate
    No
0.9667
```

`summary()` summarizes the information of two datasets splitted by `split_by()`.

```
summary(sb)
** Split train/test set information **
 + random seed        :  6534
 + split data
    - train set count :  7000
    - test set count  :  3000
 + target variable    :  default
    - minority class  :  Yes (0.033300)
    - majority class  :  No (0.966700)
```

Compare dataset

Train data and test data should be similar. If the two datasets are not similar, the performance of the predictive model may be reduced.

`alookr` provides a function to compare the similarity between train dataset and test dataset.

If the two data sets are not similar, the train dataset and test dataset should be splitted again from the original data.

Comparison of categorical variables with `compare_category()`

Compare the statistics of the categorical variables of the train set and test set included in the "split_df" class.

```
sb %>%
  compare_category()
# A tibble: 4 x 5
  variable level train  test abs_diff
  <chr>    <fct> <dbl> <dbl>    <dbl>
1 default  No    96.7  96.7   0.00476
2 default  Yes    3.33  3.33  0.00476
3 student  No    70.0  71.8   1.77
4 student  Yes   30.0  28.2   1.77

# compare variables that are character data types.
sb %>%
  compare_category(add_character = TRUE)
# A tibble: 4 x 5
  variable level train  test abs_diff
  <chr>    <fct> <dbl> <dbl>    <dbl>
1 default  No    96.7  96.7   0.00476
2 default  Yes    3.33  3.33  0.00476
3 student  No    70.0  71.8   1.77
4 student  Yes   30.0  28.2   1.77

# display marginal
sb %>%
  compare_category(margin = TRUE)
# A tibble: 6 x 5
  variable level    train   test abs_diff
  <chr>    <fct>    <dbl>  <dbl>    <dbl>
1 default  No       96.7   96.7   0.00476
2 default  Yes       3.33   3.33  0.00476
3 default  <Total> 100    100     0.00952
4 student  No       70.0   71.8   1.77
5 student  Yes      30.0   28.2   1.77
6 student  <Total> 100    100     3.54

# student variable only
sb %>%
  compare_category(student)
# A tibble: 2 x 5
  variable level train  test abs_diff
  <chr>    <fct> <dbl> <dbl>    <dbl>
1 student  No     70.0  71.8     1.77
2 student  Yes    30.0  28.2     1.77

sb %>%
  compare_category(student, margin = TRUE)
# A tibble: 3 x 5
  variable level   train  test abs_diff
  <chr>    <fct>   <dbl> <dbl>    <dbl>
1 student  No       70.0  71.8     1.77
2 student  Yes      30.0  28.2     1.77
3 student  <Total> 100   100       3.54
```

compare_category() returns tbl_df, where the variables have the following.:

- variable : character. categorical variable name
- level : factor. level of categorical variables
- train : numeric. the relative frequency of the level in the train set
- test : numeric. the relative frequency of the level in the test set
- abs_diff : numeric. the absolute value of the difference between two relative frequencies

Comparison of numeric variables with `compare_numeric()`

Compare the statistics of the numerical variables of the train set and test set included in the "split_df" class.

```
sb %>%
  compare_numeric()
# A tibble: 2 x 7
  variable train_mean test_mean train_sd test_sd train_z test_z
  <chr>         <dbl>     <dbl>    <dbl>   <dbl>   <dbl>  <dbl>
1 balance        836.      834.     487.    477.    1.72   1.75
2 income       33446.    33684.   13437.  13101.    2.49   2.57

# balance variable only
sb %>%
  compare_numeric(balance)
# A tibble: 1 x 7
  variable train_mean test_mean train_sd test_sd train_z test_z
  <chr>         <dbl>     <dbl>    <dbl>   <dbl>   <dbl>  <dbl>
1 balance        836.      834.     487.    477.    1.72   1.75
```

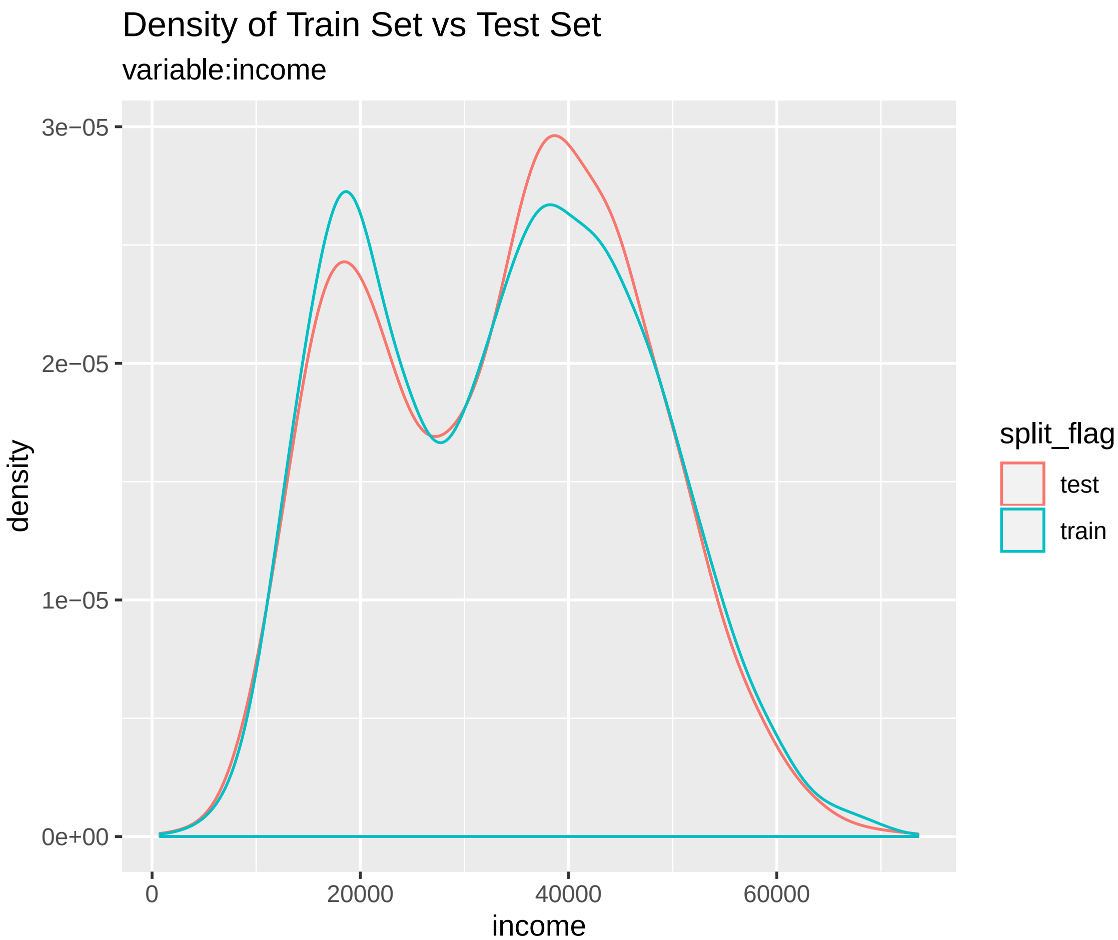
compare_numeric() returns tbl_df, where the variables have the following.:

- variable : character. numeric variable name
- train_mean : numeric. arithmetic mean of train set
- test_mean : numeric. arithmetic mean of test set
- train_sd : numeric. standard deviation of train set
- test_sd : numeric. standard deviation of test set
- train_z : numeric. the arithmetic mean of the train set divided by the standard deviation
- test_z : numeric. the arithmetic mean of the test set divided by the standard deviation

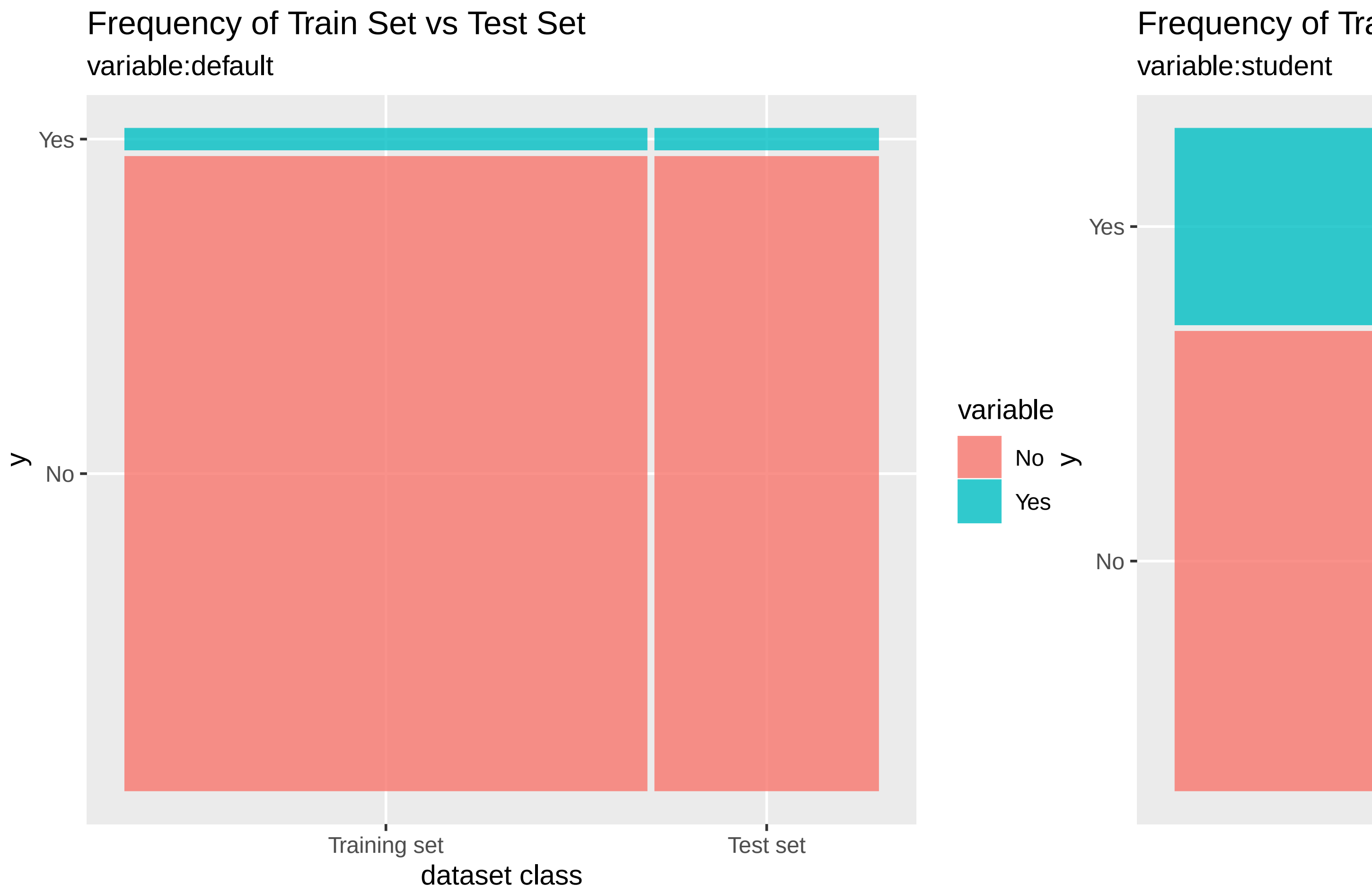
Comparison plot with `compare_plot()`

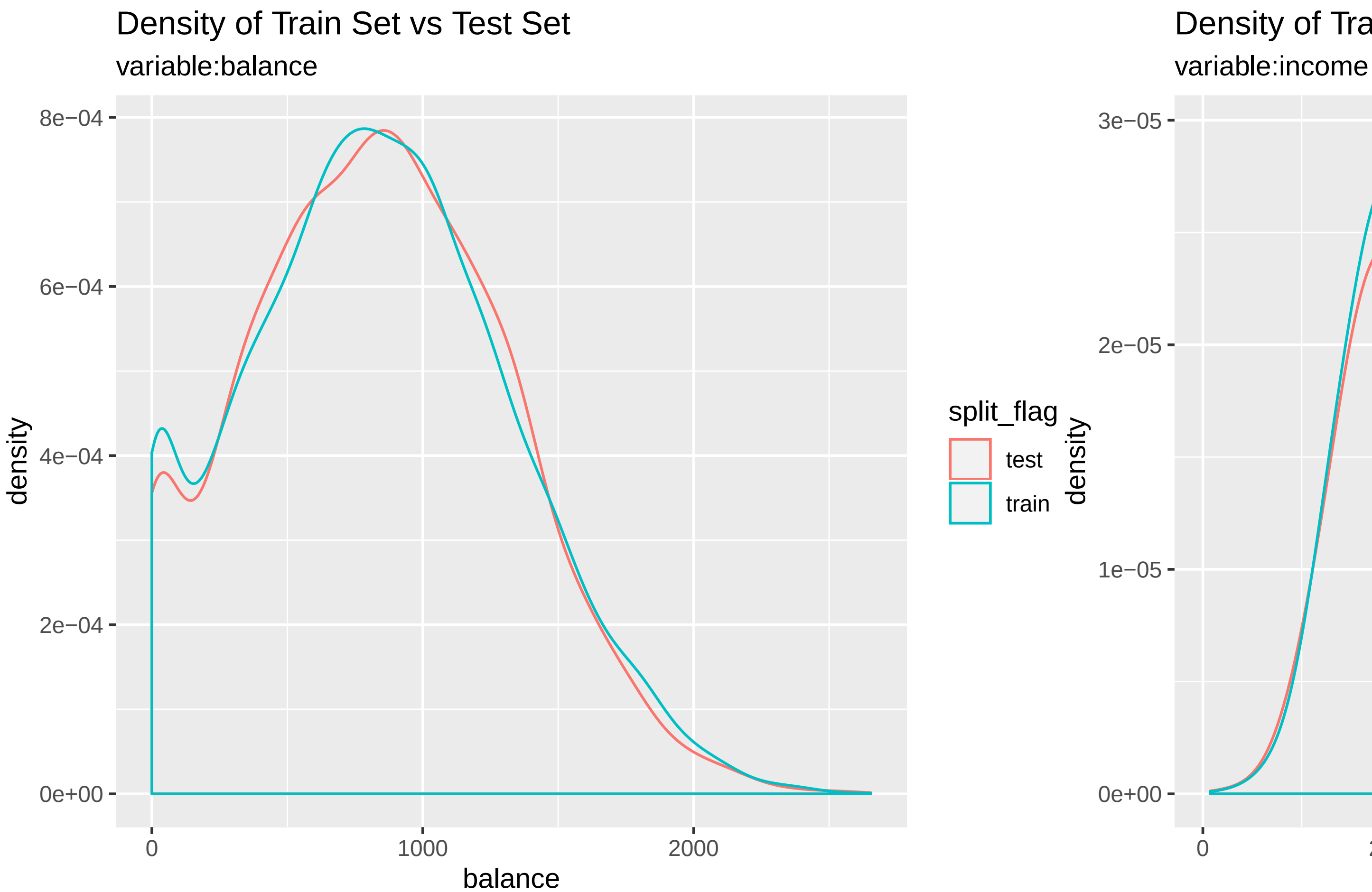
Plot compare information of the train set and test set included in the "split_df" class.

```
# income variable only
sb %>%
  compare_plot("income")
```




```r
# all varibales
sb %>%
  compare_plot()
```


Frequency of Train Set vs Test Set
variable:default
Yes
No
y
Training set
Test set
dataset class
variable
No
Yes
Frequency of Tra
variable:student
Yes
No
y



Diagnosis of train set and test set with `compare_diag()`

Diagnosis of similarity between datasets splitted by train set and set included in the "split_df" class.

```
defaults <- ISLR::Default
defaults$id <- seq(NROW(defaults))

set.seed(1)
defaults[sample(seq(NROW(defaults)), 3), "student"] <- NA
set.seed(2)
defaults[sample(seq(NROW(defaults)), 10), "balance"] <- NA

sb_2 <- defaults %>%
  split_by(default)

sb_2 %>%
  compare_diag()
* Detected diagnose missing value
 - student
 - balance

* Detected diagnose missing levels
 - student
$missing_value
```

```
# A tibble: 2 x 4
  variables train_misscount train_missrate test_missrate
  <chr>               <int>          <dbl>         <dbl>
1 student                 3         0.0429        NA
2 balance                 5         0.0714         0.167

$single_value
# A tibble: 0 x 3
# ... with 3 variables: variables <chr>, train_uniq <lgl>, test_uniq <lgl>

$uniq_rate
# A tibble: 0 x 5
# ... with 5 variables: variables <chr>, train_uniqcount <int>,
#   train_uniqrate <dbl>, test_uniqcount <int>, test_uniqrate <dbl>

$missing_level
# A tibble: 1 x 4
  variables n_levels train_missing_nlevel test_missing_nlevel
  <chr>        <int>                <int>               <int>
1 student          3                    0                   1

sb_2 %>%
  compare_diag(add_character = TRUE)
* Detected diagnose missing value
 - student
 - balance

* Detected diagnose missing levels
 - student
$missing_value
# A tibble: 2 x 4
  variables train_misscount train_missrate test_missrate
  <chr>               <int>          <dbl>         <dbl>
1 student                 3         0.0429        NA
2 balance                 5         0.0714         0.167

$single_value
# A tibble: 0 x 3
# ... with 3 variables: variables <chr>, train_uniq <lgl>, test_uniq <lgl>

$uniq_rate
# A tibble: 0 x 5
# ... with 5 variables: variables <chr>, train_uniqcount <int>,
#   train_uniqrate <dbl>, test_uniqcount <int>, test_uniqrate <dbl>

$missing_level
# A tibble: 1 x 4
  variables n_levels train_missing_nlevel test_missing_nlevel
  <chr>        <int>                <int>               <int>
1 student          3                    0                   1

sb_2 %>%
  compare_diag(uniq_thres = 0.0005)
```

```
* Detected diagnose missing value
 - student
 - balance

* Detected diagnose many unique value
 - default
 - student

* Detected diagnose missing levels
 - student
$missing_value
# A tibble: 2 x 4
  variables train_misscount train_missrate test_missrate
  <chr>                <int>          <dbl>         <dbl>
1 student                  3         0.0429        NA
2 balance                  5         0.0714         0.167

$single_value
# A tibble: 0 x 3
# ... with 3 variables: variables <chr>, train_uniq <lgl>, test_uniq <lgl>

$uniq_rate
# A tibble: 2 x 5
  variables train_uniqcount train_uniqrate test_uniqcount test_uniqrate
  <chr>                <int>          <dbl>          <int>         <dbl>
1 default                 NA             NA              2      0.000667
2 student                 NA             NA              2      0.000667

$missing_level
# A tibble: 1 x 4
  variables n_levels train_missing_nlevel test_missing_nlevel
  <chr>        <int>                <int>               <int>
1 student          3                    0                   1
```

Extract train/test dataset

If you compare the train set with the test set and find that the two datasets are similar, extract the data from the split_df object.

Extract train set or test set with `extract_set()`

Extract train set or test set from split_df class object.

```
train <- sb %>%
  extract_set(set = "train")

test <- sb %>%
  extract_set(set = "test")

dim(train)
[1] 7000    4

dim(test)
[1] 3000    4
```

Extract the data to fit the model with `sampling_target()`

In a target class, the ratio of the majority class to the minority class is not similar and the ratio of the minority class is very small, which is called the `imbalanced class`.

If target variable is an imbalanced class, the characteristics of the majority class are actively reflected in the model. This model implies an error in predicting the minority class as the majority class. So we have to make the train dataset a balanced class.

`sampling_target()` performs sampling on the train set of split_df to resolve the imbalanced class.

```
# under-sampling with random seed
under <- sb %>%
  sampling_target(seed = 1234L)

under %>%
  count(default)
# A tibble: 2 x 2
  default     n
  <fct>   <int>
1 No        233
2 Yes       233

# under-sampling with random seed, and minority class frequency is 40%
under40 <- sb %>%
  sampling_target(seed = 1234L, perc = 40)

under40 %>%
  count(default)
# A tibble: 2 x 2
  default     n
  <fct>   <int>
1 No        349
2 Yes       233

# over-sampling with random seed
over <- sb %>%
  sampling_target(method = "ubOver", seed = 1234L)

over %>%
  count(default)
# A tibble: 2 x 2
  default     n
  <fct>   <int>
1 No       6767
2 Yes      6767

# over-sampling with random seed, and k = 10
over10 <- sb %>%
  sampling_target(method = "ubOver", seed = 1234L, k = 10)

over10 %>%
  count(default)
# A tibble: 2 x 2
  default     n
  <fct>   <int>
```

```
1 No        6767
2 Yes       2330

# SMOTE with random seed
smote <- sb %>%
  sampling_target(method = "ubSMOTE", seed = 1234L)

smote %>%
  count(default)
# A tibble: 2 x 2
  default     n
  <fct>   <int>
1 No        932
2 Yes       699

# SMOTE with random seed, and perc.under = 250
smote250 <- sb %>%
  sampling_target(method = "ubSMOTE", seed = 1234L, perc.under = 250)

smote250 %>%
  count(default)
# A tibble: 2 x 2
  default     n
  <fct>   <int>
1 No       1165
2 Yes       699
```

The argument that specifies the sampling method in sampling_target () is method. "ubUnder" is under-sampling, and "ubOver" is over-sampling, "ubSMOTE" is SMOTE(Synthetic Minority Over-sampling TEchnique).