Bioinformatics III

Seventh Assignment

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Exercise 7.1: Missing Data Imputation

All the listings are at the end of the exercise.

(a) **The script**

Listing 1: Missing data imputation script

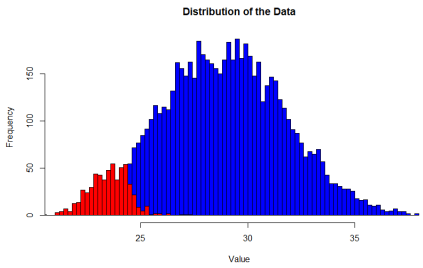
```
print("Assignment 7 - Schmitt Schowing")

#setwd("C:/Users/thsch/Desktop/Bioinformatics3/Assignments/Assignment7/Scripts")


data = read.table("ms_toy.txt", header=TRUE)
summary(data)
# class(data) -> data.frame


# Takes a dataframe and the col name and calculate the values for the missing data
# as if they were data "under the detection threshold"
impute_missing_data <- function(data, colname, QUANTILE_VALUE, FRACTION, replace = FALSE){

  current_sd <- apply(data[colname], 2, sd, na.rm = TRUE)
  current_mean <- apply(data[colname], 2, mean, na.rm = TRUE)

  str = sprintf("Current sd: %f", current_sd)
  print(str)
  str = sprintf("Current mean: %f", current_mean)
  print(str)


  # Chosing the mean of the new distribution -> the 5% quantile for instance ?!?!?!
  #QUANTILE_VALUE <- 5

  quant <- quantile(data[colname], QUANTILE_VALUE/100, na.rm = TRUE)
  str = sprintf("Current %d percent quantile: %f", QUANTILE_VALUE, quant)
  print(str)

  # New mean equals the above quantile
  new_mean = quant

  # New sd -> fraction of the current sd
  #FRACTION <- 1/3
  new_sd <- FRACTION * current_sd

  print(paste0("New mean: ", new_mean))
```

```
    print(paste0("New sd: ", new_sd))

40
    # Display the distribution with the chosen mean
    hist(as.matrix(data[colname]), main = "Distribution of the Data", xlab = "
        Value")
    abline(v=quant,col="red")

45  # We have sd and mean -> rnorm(nb, sd, mean) will generage numbers in the
        distribution

    # Numbers of NA in the column (nb of data to generate):
    nb_na <- sum(is.na(data[colname]))

50  generated_data = rnorm(nb_na, mean = new_mean, sd = new_sd)



    # Trying to make the plots nice but will work for ONE distribution
55  p1 <- hist(generated_data, breaks = 30, freq = TRUE)
    p2 <- hist(as.matrix(data[colname]), breaks = 60, freq = TRUE)

    # Acceptable graphs for any distribution
    #p1 <- hist(generated_data, freq = TRUE)
60  #p2 <- hist(as.matrix(data[colname]), freq = TRUE)

    plot(p2, main = "Distribution of the Data", xlab = "Value", col = "blue")
    plot(p1, main = "Distribution of the Data", xlab = "Value", col = "red", add
        =T)

65

    # Replace the data a copy of the original dataframe if the parameter "
        replace" is set to TRUE.
    # Also print the information of the data (copy) before and after the
        replacement
    # By default it's FALSE.

70

    if (replace){
      data.replace <- data
      print(summary(data.replace))
      data.replace[[colname]][which(is.na(data[colname]))] <- generated_data
75
      #data[[colname]][which(is.na(data[colname]))] <- generated_data
      p <- hist(as.matrix(data.replace[colname]),breaks = 60, freq = TRUE)
      plot(p, main = "Distribution of the data after replacement", xlab = "Value
          ", col = "blue")
      print(summary(data.replace))
80  }


  }

85

  # Playing with the new mean and sd values
  impute_missing_data(data = data, 'ctrl.1', 1, 1/3)
  impute_missing_data(data = data, 'ctrl.1', 5, 1/3)
  impute_missing_data(data = data, 'ctrl.1', 10, 1/3)
90 impute_missing_data(data = data, 'ctrl.1', 15, 1/3)
  impute_missing_data(data = data, 'ctrl.1', 20, 1/3)

  # 5 looks like the best new mean
  impute_missing_data(data = data, 'ctrl.1', 5, 1)
95 impute_missing_data(data = data, 'ctrl.1', 5, 1/2)
  impute_missing_data(data = data, 'ctrl.1', 5, 1/3)
  impute_missing_data(data = data, 'ctrl.1', 5, 1/4)
  impute_missing_data(data = data, 'ctrl.1', 5, 1/5)
```

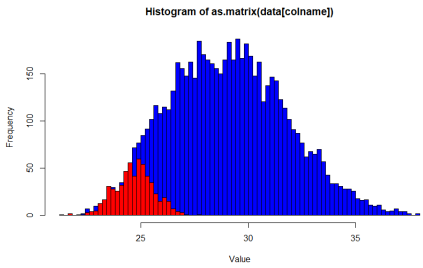
```
100

# We chose the 5% quartile for the mean and 1 third of the standard deviation
    for the new sd.
impute_missing_data(data = data, 'ctrl.1', 5, 1/3)

105 # Plot and information of the distribution after data replacement.
impute_missing_data(data = data, 'ctrl.1', 5, 1/3, TRUE)

# As we have to chose one of the 6, the plot are adapted especially for the
    first column of data.
# If you want to have good looking plots for any data, switch the two
    commented lines
110 # in the impute_missing_data function.

# impute_missing_data(data = data, 'ctrl.2')
# impute_missing_data(data = data, 'ctrl.3')
# impute_missing_data(data = data, 'kout.1')
115 # impute_missing_data(data = data, 'kout.2')
# impute_missing_data(data = data, 'kout.3')
```

(b) **Playing with the new mean and new standard deviation**

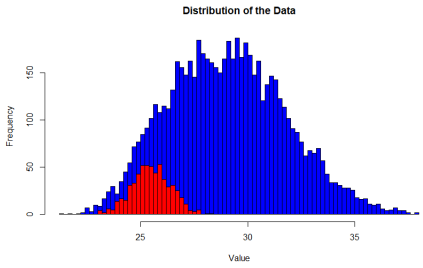
In figure 1 we vary the mean and and standard deviation of the imputed data distribution. We can see the imputed data distribution sliding to the right when we change the new mean to a higher quartile and getting thinner when we take a smaller fraction of the original SD. The nicest fit is with one third of the original standard deviation and the 5% quartile as the new mean (figure 1b). In figure 2 we show the distribution of the data after having replaced the NAs with the values generated with the same parameters as in figure 1b.



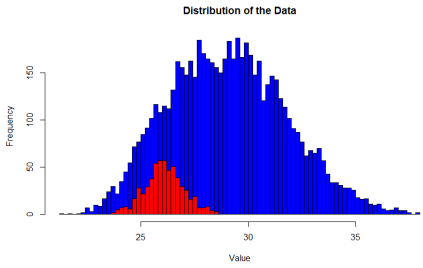
(a) New mean is the 1% quartile of the data distribution and SD is 1/3 of the original SD



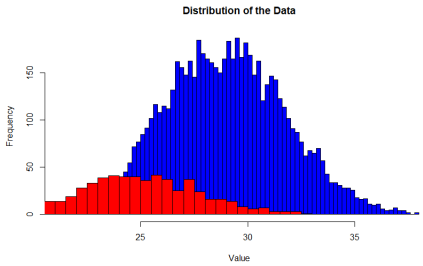
(b) New mean is the 5% quartile of the data distribution and SD is 1/3 of the original SD



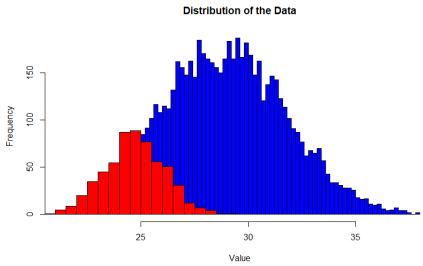
(c) New mean is the 10% quartile of the data distribution and SD is 1/3 of the original SD



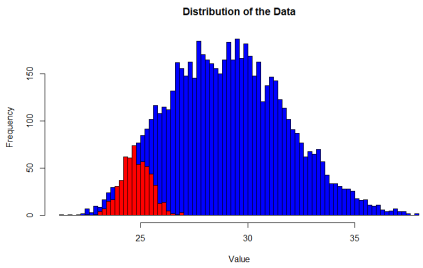
(d) New mean is the 15% quartile of the data distribution and SD is 1/3 of the original SD



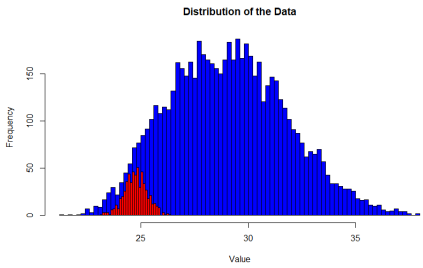
(e) New mean is the 5% quartile of the data distribution and SD is the original SD



(f) New mean is the 5% quartile of the data distribution and SD is 1/2 of the original SD



(g) New mean is the 5% quartile of the data distribution and SD is 1/4 of the original SD



(h) New mean is the 5% quartile of the data distribution and SD is 1/5 of the original SD

Figure 1: Variations of the new mean and the new standard deviation according to the one of the original distribution.

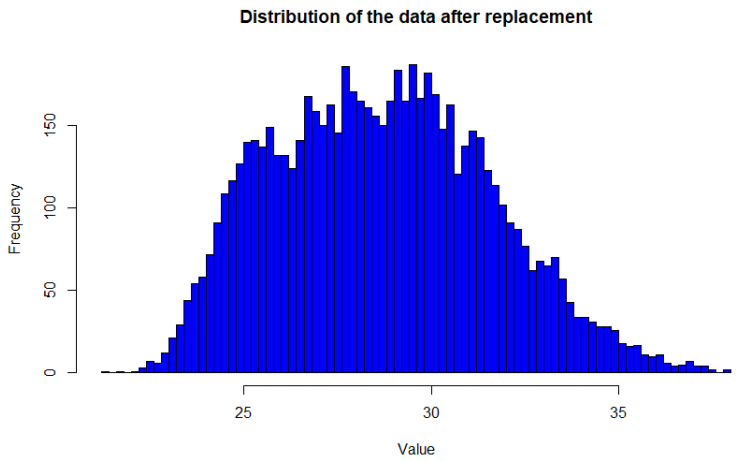


Figure 2: Data distribution after replacement of the NAs with the generated values.

Exercise 7.2: DREAM challenge

(a) **NOT IMPLEMENTED**