Final Version of Assignment One

Amahle Nzimande

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Assignment One

Welcome

Dear fellow survivor of this course

If you are reading this, we have both made it this far, congratulations to us! I hope this assignment makes sense, runs without errors, and causes minimal emotional damage.

May your marking be fair, your coffee strong, and your rubric generous.

1 Project One

QUESTION ONE

```
down <- nrow(airquality)
across <- ncol(airquality)
sum <- 0

print('The following rows have missing information: ')
```

```
[1] "The following rows have missing information: "
```

```
for(i in 1:down){
  for(j in 1:across){
    if(is.na(airquality[i,j])){
      sum <- sum + 1
      print(i)
      break}
  }
}
```

```
[1] 5
[1] 6
[1] 10
[1] 11
[1] 25
[1] 26
[1] 27
[1] 32
[1] 33
[1] 34
[1] 35
[1] 36
[1] 37
[1] 39
```

```
[1] 42
[1] 43
[1] 45
[1] 46
[1] 52
[1] 53
[1] 54
[1] 55
[1] 56
[1] 57
[1] 58
[1] 59
[1] 60
[1] 61
[1] 65
[1] 72
[1] 75
[1] 83
[1] 84
[1] 96
[1] 97
[1] 98
[1] 102
[1] 103
[1] 107
[1] 115
[1] 119
[1] 150
```

```r
print(paste0('In total there are ', sum, ' rows with missing information.' ))
```

```
[1] "In total there are 42 rows with missing information."
```

QUESTION TWO

```r
my_table <- data.frame(
  Column = c('Temperature', 'Ozone'),
  Mean = c(mean(airquality[,4]), mean(airquality[,1], na.rm=TRUE)),
  SD = c(sd(airquality[,4]), sd(airquality[,1], na.rm=TRUE)),
  Min = c(min(airquality[,4]), min(airquality[,1], na.rm=TRUE)),
  Max = c(max(airquality[,4]), max(airquality[,1], na.rm=TRUE))
```

```
)

print(my_table)
```

```
       Column     Mean       SD Min Max
1 Temperature 77.88235  9.46527  56  97
2       Ozone 42.12931 32.98788   1 168
```

QUESTION THREE

```
data(cars)

Y <- cars$dist
X <- cbind(1, cars$speed)

my_funct <- function(design, response) {

  a <- t(design)%*%design
  b <- solve(a)
  c <- t(design)%*%response
  d <- b%*%c

  return(d)
}

print(my_funct(X, Y))
```

```
           [,1]
[1,] -17.579095
[2,]   3.932409
```

QUESTION FOUR

```
model <- lm(cars$dist~cars$speed, data=cars )
summary(model)
```

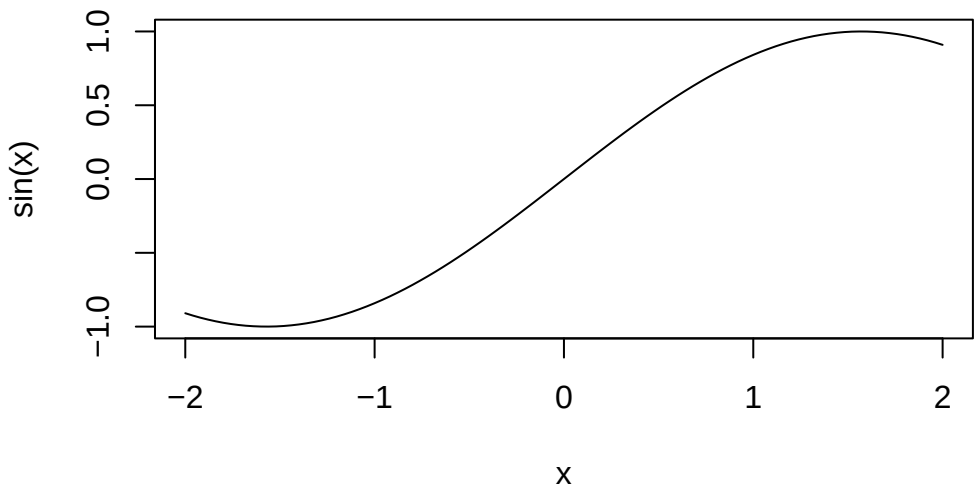
```
Call:
lm(formula = cars$dist ~ cars$speed, data = cars)
```

```
Residuals:
    Min      1Q  Median      3Q     Max
-29.069  -9.525  -2.272   9.215  43.201

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -17.5791     6.7584  -2.601   0.0123 *
cars$speed    3.9324     0.4155   9.464 1.49e-12 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 15.38 on 48 degrees of freedom
Multiple R-squared:  0.6511,    Adjusted R-squared:  0.6438
F-statistic: 89.57 on 1 and 48 DF,  p-value: 1.49e-12
```

2 Day Three Practical Q3 & Q4

QUESTION FOUR

```
curve(sin(x), from = -2, to = 2)
```



QUESTION FIVE

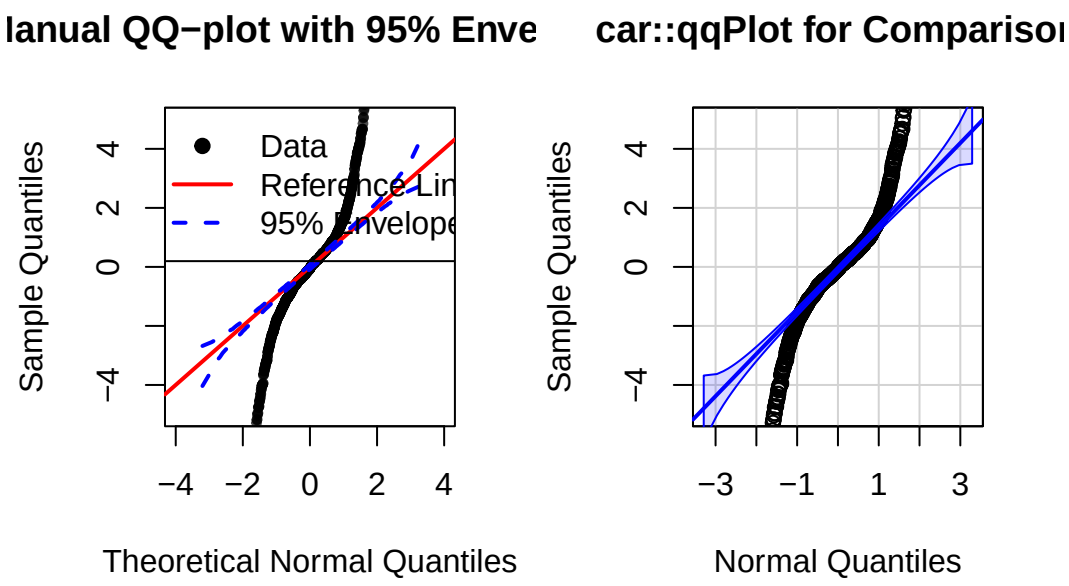
```
randoms <- rt(1000, 1)

#Creating a manual QQ-plot with 95% confidence interval

sorted_randoms <- sort(randoms)

n <- length(randoms)
i <- 1:n
```

```r
# Calculate plotting positions (probabilities)
p <- (i - 3/8) / (n + 1/4)

# Generate normal quantiles by simulation (since we can't use qnorm)
large_normal_sample <- rnorm(1000000)  # Large normal reference
theoretical_quantiles <- quantile(large_normal_sample, probs = p)

# Calculate 95% probability envelopes by simulation
n_sim <- 1000  # Number of simulations
envelope_matrix <- matrix(NA, nrow = n_sim, ncol = n)

# Simulate many normal samples of size n
for (j in 1:n_sim) {
    sim_sample <- rnorm(n)
    sim_sorted <- sort(sim_sample)
    envelope_matrix[j, ] <- sim_sorted
}

# Calculate 2.5% and 97.5% percentiles at each position
lower_envelope <- apply(envelope_matrix, 2, quantile, probs = 0.025)
upper_envelope <- apply(envelope_matrix, 2, quantile, probs = 0.975)

# Create the QQ-plot
par(mfrow = c(1, 2))  # Split plot window

# Manual QQ-plot
plot(theoretical_quantiles, sorted_randoms,
     xlab = "Theoretical Normal Quantiles",
     ylab = "Sample Quantiles",
     main = "Manual QQ-plot with 95% Envelopes",
     pch = 19, cex = 0.6,
     ylim = c(-5, 5), xlim = c(-4, 4),
     col = rgb(0, 0, 0, 0.7))

# Add reference line (y = x)
abline(a = 0, b = 1, col = "red", lwd = 2)

# Add 95% probability bands
lines(theoretical_quantiles, lower_envelope,
      col = "blue", lty = 2, lwd = 2)
lines(theoretical_quantiles, upper_envelope,
      col = "blue", lty = 2, lwd = 2)
```

```r
# Add legend
legend("topleft",
       legend = c("Data", "Reference Line", "95% Envelope"),
       col = c("black", "red", "blue"),
       pch = c(19, NA, NA),
       lty = c(NA, 1, 2),
       lwd = c(NA, 2, 2))

# Check with car::qqPlot for comparison
library(car)
```

```
Loading required package: carData
```

```r
qqPlot(randoms, envelope = 0.95, ylim = c(-5, 5),
       main = "car::qqPlot for Comparison",
       xlab = "Normal Quantiles",
       ylab = "Sample Quantiles")
```




```
[1]  35 275
```

3 Day Four Practical

QUESTION ONE

```
library(tidyverse)
```

```
Warning: package 'tidyverse' was built under R version 4.3.3
```

```
Warning: package 'tidyr' was built under R version 4.3.3
```

```
Warning: package 'purrr' was built under R version 4.3.3
```

```
Warning: package 'dplyr' was built under R version 4.3.3
```

```
Warning: package 'forcats' was built under R version 4.3.3
```

```
Warning: package 'lubridate' was built under R version 4.3.3
```

```
-- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
v dplyr     1.1.4     v readr     2.1.5
v forcats   1.0.0     v stringr   1.6.0
v ggplot2   4.0.2     v tibble    3.2.1
v lubridate 1.9.4     v tidyr     1.3.1
v purrr     1.0.4
-- Conflicts ------------------------------------------ tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to becor
```

```
library(nycflights13)
```

```
Warning: package 'nycflights13' was built under R version 4.3.3
```

```r
#The line below renames the first 10 columns of flights and prints the flights data set
#with the arrival times arranged in ascending order

flights |> rename(Year = year, Month = month, Day = day, Dep_Time = dep_time,
                  Sched_Dep_Time = sched_dep_time, Dep_Delay = dep_delay,
                  Arr_Time = arr_time, Sched_Arr_Time = sched_arr_time,
                  Arr_Delay = arr_delay, Carrier = carrier) |> arrange(Arr_Time)
```

```
# A tibble: 336,776 x 19
    Year Month   Day Dep_Time Sched_Dep_Time Dep_Delay Arr_Time Sched_Arr_Time
   <int> <int> <int>    <int>          <int>     <dbl>    <int>          <int>
 1  2013     1     2     2130           2130         0        1             18
 2  2013     1    11     2157           2000       117        1           2208
 3  2013     1    11     2253           2249         4        1           2357
 4  2013     1    14     2122           2130        -8        1              2
 5  2013     1    14     2246           2250        -4        1              7
 6  2013     1    15     2304           2245        19        1           2357
 7  2013     1    16     2018           2025        -7        1           2329
 8  2013     1    16     2303           2245        18        1           2357
 9  2013     1    19     2107           2110        -3        1           2355
10  2013     1    22     2246           2249        -3        1           2357
# i 336,766 more rows
# i 11 more variables: Arr_Delay <dbl>, Carrier <chr>, flight <int>,
#   tailnum <chr>, origin <chr>, dest <chr>, air_time <dbl>, distance <dbl>,
#   hour <dbl>, minute <dbl>, time_hour <dttm>
```

QUESTION TWO

```r
#Creates flight1 tibble that contains flights that occured in month 1 ONLY
flight1 <- flights |> filter(month == 1)

#Gets the average distance of each carrier
carrier_dist_vec_mean <- flight1 |> group_by(carrier) |>
  summarise(MEAN = mean(distance, na.rm = TRUE ))

#Gets the standard deviation of the distance for each carrier
carrier_dist_vec_sd <- flight1 |> group_by(carrier) |>
  summarise(SD = sd(distance, na.rm = TRUE))

#Creates one tibble with both the mean and sd distance for each carrier
dist_tbl <- carrier_dist_vec_mean |> left_join(carrier_dist_vec_sd)
```

```
Joining with `by = join_by(carrier)`
```

```
#Arranges the carrier rows from that with the least to the highest mean distance
dist_tbl |> arrange(MEAN)
```

```
# A tibble: 16 x 3
   carrier  MEAN    SD
   <chr>   <dbl> <dbl>
 1 YV        229    0
 2 9E        476. 334.
 3 EV        522. 294.
 4 US        536. 553.
 5 MQ        566. 223.
 6 FL        691. 142.
 7 OO        733   NA
 8 WN        942. 496.
 9 B6       1062. 681.
10 DL       1220. 644.
11 AA       1350. 626.
12 UA       1462. 778.
13 F9       1620    0
14 AS       2402    0
15 VX       2495.  98.2
16 HA       4983    0
```

QUESTION THREE

```
########## NA ##############

carrierOO <- flight1 |> filter(carrier == 'OO') |> select(carrier, distance)

carrierOO
```

```
# A tibble: 1 x 2
  carrier distance
  <chr>      <dbl>
1 OO           733
```

```
print('Explanation of NA: Carrier OO has NA as the standard deviation of the distance,
      that is because as shown by the code above, there is only one entry thus the
      standard deviation can\'t be calculated since sd is a measure of how spread
```

```
      apart data points are from each other, with only one distance entry there is
      no spread.')
```

```
[1] "Explanation of NA: Carrier OO has NA as the standard deviation of the distance,\n
```

```
########## ZERO ###############

carrierYV <- flight1 |> filter(carrier == 'YV') |> select(carrier, distance)

carrierYV
```

```
# A tibble: 46 x 2
   carrier distance
   <chr>      <dbl>
 1 YV           229
 2 YV           229
 3 YV           229
 4 YV           229
 5 YV           229
 6 YV           229
 7 YV           229
 8 YV           229
 9 YV           229
10 YV           229
# i 36 more rows
```

```
print('Explanaition of ZERO: The standard deviation of the distance for the YV carrier
      is zero because as displayed by the code above, all the distance entries are 229,
      sd is a measure of how spread apart entries are from each other, in this case
      they are all the same thus resulting in no spread or a spread of zero.')
```

```
[1] "Explanaition of ZERO: The standard deviation of the distance for the YV carrier\n
```

QUESTION FOUR

```
#Getting the Average Departure delay for each carrier in each month in the long format
switched <- flights |> group_by(carrier, month) |>
  summarise(Av_Dep_Delay = mean(dep_delay, na.rm = TRUE))
```

```
`summarise()` has grouped output by 'carrier'. You can override using the
`.groups` argument.
```

```
#Converting into wide data
switched2 <- switched |> pivot_wider(names_from = carrier, values_from = Av_Dep_Delay)

switched2
```

```
# A tibble: 12 x 17
   month  `9E`    AA     AS    B6    DL    EV    F9    FL    HA    MQ    OO
   <int> <dbl> <dbl>  <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
 1     1 16.9   6.93  7.35   9.49  3.85 24.2  10     1.97 54.4   6.49 67
 2     2 16.5   8.28  0.722 13.8   5.54 21.5  29.8   5.18 17.4   8.09 NA
 3     3 13.4   8.70  8.42  14.2   9.93 26.2  16.8  17.3   1.16  7.19 NA
 4     4 13.6  11.7  11.3   15.2   8.17 22.8  24.6  13.1  -2.1  13.7  NA
 5     5 22.7   9.66  6.77   9.78  9.74 20.2  35.9  19.2  -1.45 13.9  NA
 6     6 29.0  14.6  13.1   20.4  18.7  25.5  29.4  38.8   1.47 20.8  61
 7     7 31.4  12.1   2.42  24.9  20.6  26.5  31.8  41.2  -1.71 20.7  NA
 8     8 17.3   7.17  2.87  15.7   9.85 16.3  22.2  23.4   1.68 10.1  64
 9     9  7.75  5.69 -4.52   6.63  5.53  8.24  8.26 16.9  -5.44  5.35 -4.94
10    10  9.33  3.00  0.677  2.96  3.42 13.4   9.70 13.7  -5.10  4.48 NA
11    11  7.56  3.10  3.08   3.52  2.85  9.83 13.5  16.9  -5.44  3.28  0.8
12    12 19.8  11.7  18.0   17.0  10.8  27.9  13.1  26.1  -3.14 12.7  NA
# i 5 more variables: UA <dbl>, US <dbl>, VX <dbl>, WN <dbl>, YV <dbl>
```

QUESTION FIVE

```
#Getting number of all flights with a delayed departure time and arrived with NO delay
meet_Condition <- flights |> filter(dep_delay > 0) |> filter(arr_delay <= 0) |> count()

#Getting number of total flights
total_Flights <- flights |> count()

#Calculating the proportion
prop_Delayed <- meet_Condition/total_Flights

#Renaming the column
prop_Delayed <- prop_Delayed |> rename(Prop_Delayed = n)

prop_Delayed
```

```
  Prop_Delayed
1    0.1052391
```

QUESTION SIX

```
routes <- flights |> group_by(origin, dest) |>
  summarize(n_airlines = n_distinct(carrier)) |> filter(n_airlines > 1)
```

```
`summarise()` has grouped output by 'origin'. You can override using the
`.groups` argument.
```

```
routes
```

```
# A tibble: 128 x 3
# Groups:   origin [3]
   origin dest  n_airlines
   <chr>  <chr>      <int>
 1 EWR    ATL            4
 2 EWR    AUS            2
 3 EWR    BDL            2
 4 EWR    BNA            2
 5 EWR    BOS            3
 6 EWR    BWI            2
 7 EWR    CHS            2
 8 EWR    CLE            2
 9 EWR    CLT            3
10 EWR    CVG            2
# i 118 more rows
```

```
#Joining the routes with at least two airlines with rest of the flights data
joint <- routes |> left_join(flights, by = join_by(origin, dest))

#Grouping to get each route+carrier combo then calc it's average arrival delay
joint2 <- joint |> group_by(origin, dest, carrier) |>
  summarise(Av_Arr_Delay = mean(arr_delay, na.rm = TRUE))
```

```
`summarise()` has grouped output by 'origin', 'dest'. You can override using
the `.groups` argument.
```

```
joint2
```

```
# A tibble: 343 x 4
# Groups:   origin, dest [128]
   origin dest  carrier Av_Arr_Delay
   <chr>  <chr> <chr>          <dbl>
 1 EWR    ATL   9E             -6.25
 2 EWR    ATL   DL             10.00
 3 EWR    ATL   EV             19.5
 4 EWR    ATL   UA             10.5
 5 EWR    AUS   UA              4.28
 6 EWR    AUS   WN            -11.2
 7 EWR    BDL   EV              6.78
 8 EWR    BDL   UA             22.6
 9 EWR    BNA   EV             17.7
10 EWR    BNA   WN             -2.13
# i 333 more rows
```

```
# Airline with the best average arrival delay

best <- joint2 |> group_by(origin, dest) |>
  summarise(best_av_arr_delay = min(Av_Arr_Delay))
```

```
`summarise()` has grouped output by 'origin'. You can override using the
`.groups` argument.
```

```
best2 <- best |> left_join(joint2, join_by(best_av_arr_delay == Av_Arr_Delay)) |>
  select(!origin.y) |> select(!dest.y)
```

```
Warning in left_join(best, joint2, join_by(best_av_arr_delay == Av_Arr_Delay)): Detected an u
to-many relationship between `x` and `y`.
i Row 17 of `x` matches multiple rows in `y`.
i Row 41 of `y` matches multiple rows in `x`.
i If a many-to-many relationship is expected, set `relationship =
  "many-to-many"` to silence this warning.
```

```
best2
```

```
# A tibble: 134 x 4
   origin.x dest.x best_av_arr_delay carrier
   <chr>    <chr>              <dbl> <chr>
 1 EWR      ATL                -6.25  9E
 2 EWR      AUS               -11.2   WN
 3 EWR      BDL                 6.78  EV
 4 EWR      BNA                -2.13  WN
 5 EWR      BOS                -4.01  EV
 6 EWR      BWI                 5.95  WN
 7 EWR      CHS               -14     UA
 8 EWR      CLE                -3.71  EV
 9 EWR      CLT                 0.920 US
10 EWR      CVG                 1.40  9E
# i 124 more rows
```

```
#Airline with the worst arrival delay

worst <- joint2 |> group_by(origin, dest) |>
  summarise(worst_av_arr_delay = max(Av_Arr_Delay))
```

```
`summarise()` has grouped output by 'origin'. You can override using the
`.groups` argument.
```

```
worst2 <- worst |> left_join(joint2, join_by(worst_av_arr_delay == Av_Arr_Delay)) |>
  select(!origin.y) |> select(!dest.y)
```

```
Warning in left_join(worst, joint2, join_by(worst_av_arr_delay == Av_Arr_Delay)): Detected a
to-many relationship between `x` and `y`.
i Row 75 of `x` matches multiple rows in `y`.
i Row 194 of `y` matches multiple rows in `x`.
i If a many-to-many relationship is expected, set `relationship =
  "many-to-many"` to silence this warning.
```

```
worst2
```

```
# A tibble: 130 x 4
   origin.x dest.x worst_av_arr_delay carrier
   <chr>    <chr>                <dbl> <chr>
 1 EWR      ATL                  19.5  EV
 2 EWR      AUS                   4.28 UA
```

```
 3 EWR      BDL                 22.6  UA
 4 EWR      BNA                 17.7  EV
 5 EWR      BOS                  6.87 B6
 6 EWR      BWI                 20.1  EV
 7 EWR      CHS                 16.2  EV
 8 EWR      CLE                  5.97 UA
 9 EWR      CLT                 20.5  EV
10 EWR      CVG                 21.2  EV
# i 120 more rows
```

```
#Combining

results <- best2 |> left_join(worst2, join_by(origin.x, dest.x))
```

```
Warning in left_join(best2, worst2, join_by(origin.x, dest.x)): Detected an unexpected many-
to-many relationship between `x` and `y`.
i Row 77 of `x` matches multiple rows in `y`.
i Row 17 of `y` matches multiple rows in `x`.
i If a many-to-many relationship is expected, set `relationship =
  "many-to-many"` to silence this warning.
```

```
results
```

```
# A tibble: 136 x 6
   origin.x dest.x best_av_arr_delay carrier.x worst_av_arr_delay carrier.y
   <chr>    <chr>              <dbl> <chr>                  <dbl> <chr>
 1 EWR      ATL                -6.25 9E                     19.5  EV
 2 EWR      AUS               -11.2  WN                      4.28 UA
 3 EWR      BDL                 6.78 EV                     22.6  UA
 4 EWR      BNA                -2.13 WN                     17.7  EV
 5 EWR      BOS                -4.01 EV                      6.87 B6
 6 EWR      BWI                 5.95 WN                     20.1  EV
 7 EWR      CHS               -14    UA                     16.2  EV
 8 EWR      CLE                -3.71 EV                      5.97 UA
 9 EWR      CLT                 0.920 US                    20.5  EV
10 EWR      CVG                 1.40 9E                     21.2  EV
# i 126 more rows
```

```
results2 <- results |> mutate(diff = sqrt((best_av_arr_delay - worst_av_arr_delay)**2))

results3 <- results2 |> summarise(greatest_diff = max(diff, na.rm = TRUE)) |>
```

```
  left_join(results2, join_by(greatest_diff == diff ))

results3
```

```
# A tibble: 1 x 7
  greatest_diff origin.x dest.x best_av_arr_delay carrier.x worst_av_arr_delay
          <dbl> <chr>    <chr>              <dbl> <chr>                   <dbl>
1          127. JFK      ATL                 1.40 9E                        128
# i 1 more variable: carrier.y <chr>
```

```
#Trying to find the reason

reason <- results |> mutate(diff = sqrt((best_av_arr_delay - worst_av_arr_delay)**2))

reason2 <- reason |> summarise(terrible = max(worst_av_arr_delay, na.rm = TRUE))

reason2
```

```
# A tibble: 1 x 1
  terrible
     <dbl>
1      128
```

```
print('The above code shows that the worst average arrival delay was 128,
      it so happens that this corresponds with the route with the greatest
      diff (it\'s an outlier), their average arrival delay was too much thus
      creating the large difference between their best and worst av. arr delay.')
```

```
[1] "The above code shows that the worst average arrival delay was 128, \n      it so happens
```

QUESTION SEVEN

```
given_data <- structure(list(id = c("id_1", "id_2", "id_3", "id_4", "id_5",
"id_6", "id_7", "id_8", "id_9", "id_10", "id_11", "id_12", "id_13",
"id_14", "id_15", "id_16", "id_17", "id_18", "id_19", "id_20",
"id_21", "id_22", "id_23", "id_24", "id_25", "id_26", "id_27",
"id_28", "id_29", "id_30", "id_31", "id_32", "id_33", "id_34",
"id_35", "id_36", "id_37", "id_38", "id_39", "id_40", "id_41",
"id_42", "id_43", "id_44", "id_45", "id_46", "id_47", "id_48",
"id_49", "id_50"), age = c(50L, 34L, 70L, 33L, 22L, 61L, 69L,
```

```
73L, 62L, 56L, 71L, 33L, 73L, 44L, 45L, 46L, 24L, 70L, 46L, 76L,
47L, 76L, 28L, 48L, 54L, 27L, 45L, 26L, 61L, 28L, 38L, 55L, 33L,
36L, 62L, 58L, 72L, 31L, 34L, 51L, 61L, 64L, 26L, 28L, 60L, 29L,
42L, 46L, 79L, 72L), gender = c("male", "male", "male", "female",
"female", "male", "female", "male", "male", "female", "female",
"male", "male", "female", "male", "male", "male", "male", "female",
"male", "male", "male", "male", "female", "femal", "male", "female",
"female", "female", "female", "male", "female", "female", "female",
"male", "male", "female", "male", "female", "female", "male",
"female", "female", "male", "male", "female", "male", "male",
"male", "female"), height = c(174.4, 197.7, 174.1, 194.5, NA,
180.4, 170.5, 157.4, 196.8, 165.1, 153, 197.4, 186, 157.1, 177.5,
197.7, 179.3, 170.2, 182.4, NA, 165.4, 161, 168.5, 199.2, 157.7,
154.6, 157.1, 184.5, 181, 194.6, 183.6, 186.9, 176.1, 183, 191.1,
189.3, 199, 172, 165.6, 170.5, 150.5, 159.2, 192.1, 161.6, 162,
153.8, 162.3, 186.6, 192.4, 174.9), weight = c(69.4, 62.3, 55.6,
69.5, 78.6, 60.8, 72.2, 60.9, 75.1, 67.7, 82.5, 68.7, 67.8, 76.7,
87, 61.1, 70.6, 63.3, 81.5, 59.2, 93.2, 87.3, 83.4, 80.9, 68.6,
76.5, 93.7, 79.1, 92, 65.6, 85.4, 63.3, 79.7, 74.1, 63.3, 78.2,
95.7, 95.1, 63.7, 66.1, 99.3, 81, 96.9, 73.3, 70.3, 83, 57.6,
78.6, 61.9, 98.1), blood_type = c("O", "A", "O", "O", "B", "AB",
"O", "O", "O", "AB", "A", "O", "O", "O", "B", "A", "B", "AB",
"O", "AB", "A", "AB", "O", "B", "A", "A", "B", "AB", "A", "B",
"B", "A", "O", "O", "O", "B", "O", "A", "A", "B", "A", "O", "AB",
"A", "A", "O", "O", "B", "A", "O"), disease_status = c("diseased",
"healthy", "healthy", "healthy", "healthy", "healthy", "diseased",
"healthy", "diseased", "Healthy", "diseased", "healthy", "diseased",
"healthy", "diseased", "healthy", "healthy", "healthy", "healthy",
"healthy", "healthy", "diseased", "healthy", "diseased", "healthy",
"healthy", "healthy", "healthy", "diseased", "diseased", "healthy",
"healthy", "healthy", "diseased", "diseased", "diseased", "healthy",
"diseased", "healthy", "healthy", "healthy", "healthy", "healthy",
"diseased", "diseased", "diseased", "healthy", "healthy", "diseased",
"diseased"), cholesterol = c(228, 223, 213, 198, 166, 151, 195,
199, 189, 196, 221, 156, 185, 230, 234, 174, 185, 236, 235, 180,
165, 220, 160, 153, 250, 153, 184, 242, 212, 179, 224, 233, 181,
199, 220, 214, 214, 248, 191, 162, 203, 173, 199, 187, 248, 189,
173, 212, 164, 247), glucose = c(96, 78, 101, 119, 103, 91, 86,
NA, 77, 80, 115, 85, 88, 109, NA, 71, 90, 94, 91, 87, 113, 93,
97, 118, 109, 80, 85, 119, 99, 108, 89, 108, 97, 116, 79, 84,
75, 81, 119, NA, 106, 109, 75, 82, 84, 75, 76, 120, 119, 77),
    smoker = c("yes", "yes", "yes", "yes", "no", "yes", "no",
```

```
    "yes", "no", "no", "no", "no", "no", "yes", "no", "yes",
    "yes", "yes", "yes", "yes", "yes", "yes", "yes", "yes", "no",
    "no", "yes", "yes", "yes", "no", "no", "yes", "no", "yes",
    "no", "yes", "no", "yes", "yes", "yes", "no", "no", "yes",
    "no", "no", "no", "no", "no", "no", "yes"), exercise = c("occasional",
    "regular", "occasional", "regular", "none", "occasional",
    "regular", "none", "occasional", "none", "occasional", "none",
    "none", "regular", "occasional", "none", "regular", "regular",
    "none", "occasional", "none", "occasional", "occasional",
    "occasional", "regular", "occasional", "regular", "regular",
    "regular", "occasional", "occasional", "none", "none", "regular",
    "occasional", "occasional", "none", "none", "none", "none",
    "occasional", "regular", "regular", "none", "regular", "occasional",
    "occasional", "none", "occasional", "regular"), income = c(84820L,
    81547L, 22588L, 72490L, 74533L, 25338L, 41469L, 57315L, 63629L,
    88662L, 62615L, 56261L, 58499L, 82232L, 77584L, 77275L, 38468L,
    54510L, 91326L, 78611L, 31402L, 29586L, 21441L, 58269L, 84173L,
    88295L, 37940L, 43750L, 69750L, 92356L, 82518L, 91455L, 68866L,
    51178L, 68275L, 27689L, 35418L, 81318L, 62405L, 86851L, 25654L,
    47553L, 74474L, 51409L, 22607L, 55360L, 96351L, 21516L, 41927L,
    55810L), education = c("master", "bachelor", "PhD", "master",
    "bachelor", "highschool", "PhD", "highschool", "PhD", "PhD",
    "bachelor", "highschool", "master", "bachelor", "PhD", "PhD",
    "PhD", "bachelor", "master", "highschool", "PhD", "highschool",
    "bachelor", "master", "highschool", "highschool", "master",
    "master", "bachelor", "PhD", "highschool", "PhD", "master",
    "master", "master", "PhD", "highschool", "master", "master",
    "highschool", "bachelor", "highschool", "bachelor", "PhD",
    "bachelor", "highschool", "master", "highschool", "bachelor",
    "bachelor"), region = c("North", "South", "North", "West",
    "North", "West", "South", "South", "West", "South", "West",
    "South", "West", "East", "North", "West", "North", "North",
    "West", "North", "East", "West", "South", "North", "North",
    "East", "East", "North", "North", "West", "South", "West",
    "West", "East", "West", "North", "West", "North", "East",
    "North", "West", "South", "South", "East", "North", "West",
    "West", "East", "North", "East"), marital_status = c("divorced",
    "single", "divorced", "divorced", "divorced", "divorced",
    "divorced", "married", "divorced", "married", "divorced",
    "widowed", "married", "single", "widowed", "widowed", "single",
    "divorced", "widowed", "widowed", "single", "married", "single",
    "married", "widowed", "married", "single", "single", "widowed",
```

```
    "married", "widowed", "divorced", "single", "married", "single",
    "widowed", "widowed", "married", "widowed", "divorced", "married",
    "married", "divorced", "single", "married", "widowed", "divorced",
    "divorced", "single", "divorced")), row.names = c(NA, -50L
), class = c("tbl_df", "tbl", "data.frame"))

library(UtilsDataRSV)
see <- given_data |> view_cols()
```

```
[1] "id"
 [1] "id_10" "id_13" "id_46" "id_41" "id_48" "id_8"  "id_27" "id_45" "id_31"
[10] "id_9"  "id_19" "id_34" "id_32" "id_21" "id_43" "id_23" "id_29" "id_4"
[19] "id_38" "id_20"
[1] "30 unique entries not displayed"
[1] "----------------------"
[1] "age"
[1] 48 56 36 47 42
[1] "----------------------"
[1] "gender"
[1] "female" "femal"  "male"
[1] "----------------------"
[1] "height"
[1] 189.3 165.6 174.9 194.6    NA
[1] "----------------------"
[1] "weight"
[1] 83.4 78.2 93.7 74.1 63.7
[1] "----------------------"
[1] "blood_type"
[1] "O"  "B"  "A"  "AB"
[1] "----------------------"
[1] "disease_status"
[1] "diseased" "Healthy"  "healthy"
[1] "----------------------"
[1] "cholesterol"
[1] 156 220 185 184 160
[1] "----------------------"
[1] "glucose"
[1]  96  87 103  97  NA
[1] "----------------------"
[1] "smoker"
[1] "no"  "yes"
[1] "----------------------"
```

```
[1] "exercise"
[1] "none"       "regular"    "occasional"
[1] "_____________________"
[1] "income"
[1] 91326 57315 84820 58499 78611
[1] "_____________________"
[1] "education"
[1] "highschool" "master"     "bachelor"   "PhD"
[1] "_____________________"
[1] "region"
[1] "East"  "West"  "South" "North"
[1] "_____________________"
[1] "marital_status"
[1] "widowed"  "divorced" "married"  "single"
[1] "_____________________"

Warning: Not all unique entries displayed for these non-numeric cols: id
```

```
print('LIST OF ERRORS: ')
```

```
[1] "LIST OF ERRORS: "
```

```
print(' From the above we can see that the gender column has a typo: \'femal\'
      instead of \'female\'. ')
```

```
[1] " From the above we can see that the gender column has a typo: 'femal'\n      instead of
```

```
print(' The height column has some missing entries.')
```

```
[1] " The height column has some missing entries."
```

```
print(' The disease_status column has a typo, \'Healthy\' and \'healthy\'.')
```

```
[1] " The disease_status column has a typo, 'Healthy' and 'healthy'."
```

```
print(' The glucose column has some missing entries.')
```

```
[1] " The glucose column has some missing entries."
```