# HW3_1S457_8

## Main topic: Using the â??applyâ?? family function.

## Part 1: let's start with "apply". (2 pts each)

## create a 10-by-10 matrix for manipulation.

```
set.seed(1120)
some_matrix = matrix(rnorm(100), ncol = 10)  # standard normal dist

some_matrix[1, 3]= some_matrix[5,5]=some_matrix[10, 2]= some_matrix[6,8] = NA
```

## think about how to deal with NA.

#NA values become a hinderance when using certain functions, so they can be removed by specifying values of arguments #in your R code that remove them before making calculations eg na.rm = TRUE

## 1a, what's the variance of the observations in each row of the matrix?

```
 row_var = apply(some_matrix, 1, var,na.rm=TRUE)
      row_var

##  [1] 0.5789088 0.1880476 1.2409336 0.5984562 0.7451429 1.2965789 0.6087033
##  [8] 1.6622512 0.4732179 1.0681420
```

## 1b, sort (all) the columns of the above matrix

```
some_matrix[,1]= sort(some_matrix[,1])
      some_matrix[,2]=sort(some_matrix[,2], na.last  = TRUE)
      some_matrix[,3]=sort(some_matrix[,3], na.last = TRUE)
      some_matrix[,4]=sort(some_matrix[,4])
      some_matrix[,5]=sort(some_matrix[,5],na.last = TRUE)
      some_matrix[,6]=sort(some_matrix[,6])
      some_matrix[,7]=sort(some_matrix[,7])
      some_matrix[,8]=sort(some_matrix[,8],na.last=TRUE)
      some_matrix[,9]=sort(some_matrix[,9])
      some_matrix[,10]=sort(some_matrix[,10])
```

## 1c, find the total number of negative values by column in some_matrix.

## your answer should be a vector of integer of length 10.

```
      new_vec = c(sum(some_matrix[,1] < 0),sum(some_matrix[,2] < 0, na.rm=
TRUE),
      sum(some_matrix[,3] < 0, na.rm= TRUE ),sum(some_matrix[,4] < 0),
      sum(some_matrix[,5] < 0, na.rm= TRUE),sum(some_matrix[,6] < 0),
      sum(some_matrix[,7] < 0),sum(some_matrix[,8] < 0, na.rm= TRUE),
      sum(some_matrix[,9] < 0),sum(some_matrix[,10] < 0))
      new_vec

##  [1] 5 6 5 6 6 7 5 2 8 4
```

## Part 2: let's play with "sapply". (2 pts each)

## 2a, find the square root, the square and the cube of the numbers 1 to 10.

## (hint: think about how to define the function first; your answer should be a 3-by-10 matrix.)

```
numbers = c(1,2,3,4,5,6,7,8,9,10)
squareroot_vector= sapply(numbers, sqrt)
      square_vector =sapply(numbers, function (x) x^2)
      cube_vector = sapply(numbers, function (x) x^3)
      solution_matrix = rbind(squareroot_vector,square_vector,cube_vector)
      solution_matrix

##                   [,1]     [,2]      [,3] [,4]       [,5]      [,6]
## squareroot_vector    1 1.414214  1.732051    2   2.236068   2.44949
## square_vector        1 4.000000  9.000000   16  25.000000  36.00000
## cube_vector          1 8.000000 27.000000   64 125.000000 216.00000
##                         [,7]       [,8] [,9]       [,10]
## squareroot_vector   2.645751   2.828427    3    3.162278
## square_vector      49.000000  64.000000   81  100.000000
## cube_vector       343.000000 512.000000  729 1000.000000
```

## 2b, we played with the data set mtcars previously.

## now find the class of each variable(column)

```
 data(mtcars)
sapply(mtcars, class)
```

```
##       mpg       cyl      disp        hp      drat        wt      qsec
## "numeric" "numeric" "numeric" "numeric" "numeric" "numeric" "numeric"
##        vs        am      gear      carb
## "numeric" "numeric" "numeric" "numeric"
```

## Part 3: the next is “lapply”! (2 pts each)

## 3a, same as 2b), but using “lapply”, and get your function output as a vector as well.

## (hint: what does “lapply” return? how to convert it to a vector?)

```
 unlist(lapply(mtcars, class))
```

```
##       mpg       cyl      disp        hp      drat        wt      qsec
## "numeric" "numeric" "numeric" "numeric" "numeric" "numeric" "numeric"
##        vs        am      gear      carb
## "numeric" "numeric" "numeric" "numeric"
```

## 3b, from 3a), what do you observe about the relationship, the difference

## between “sapply” and “lapply”? (hint: think about their inputs and outputs)

# sapply tries to simplify output by returning it in a vector form, while lapply returns output as a list

## 3c, here I create some random data

```
set.seed(1120)
rndm <- replicate(15, runif(sample(1:10, 1)), simplify = FALSE)
```

## first, what did the above code generate? name the data structure, the length,

## and the content as well as giving a description.

#the above code generated a random distribution of samples in a list format #it is a list

```
 length(rndm)
```

```
## [1] 15
```

```
 str(rndm)
```

```
## List of 15
##  $ : num [1:7] 0.1359 0.1727 0.5719 0.0383 0.628 ...
##  $ : num [1:3] 0.0997 0.1031 0.4102
##  $ : num [1:2] 0.711 0.996
##  $ : num [1:2] 0.839 0.344
##  $ : num [1:8] 0.727 0.784 0.414 0.597 0.489 ...
##  $ : num [1:9] 0.094 0.649 0.442 0.583 0.912 ...
##  $ : num [1:5] 0.0547 0.3792 0.6228 0.2838 0.141
##  $ : num [1:8] 0.5109 0.112 0.6394 0.0277 0.9371 ...
##  $ : num [1:5] 0.7878 0.7276 0.122 0.1758 0.0278
##  $ : num [1:3] 0.183 0.664 0.427
##  $ : num [1:3] 0.997 0.663 0.582
##  $ : num [1:3] 0.582 0.463 0.996
##  $ : num [1:7] 0.966 0.296 0.622 0.119 0.587 ...
##  $ : num 0.657
##  $ : num [1:8] 0.0685 0.4317 0.0478 0.258 0.4222 ...
```

## 3d, using “lapply”, return the lengths of each component in rndm.

```
lapply(rndm, length)
```

```
## [[1]]
## [1] 7
##
## [[2]]
## [1] 3
##
## [[3]]
## [1] 2
##
## [[4]]
## [1] 2
##
## [[5]]
## [1] 8
```

```
##
## [[6]]
## [1] 9
##
## [[7]]
## [1] 5
##
## [[8]]
## [1] 8
##
## [[9]]
## [1] 5
##
## [[10]]
## [1] 3
##
## [[11]]
## [1] 3
##
## [[12]]
## [1] 3
##
## [[13]]
## [1] 7
##
## [[14]]
## [1] 1
##
## [[15]]
## [1] 8
```

## 3e, now create the following list:

```
list_a <- list(c=c(11:20), d=c(31:40))
```

## take the (natural) log of EACH element in list_a

```
  log(list_a$c)
```

```
##  [1] 2.397895 2.484907 2.564949 2.639057 2.708050 2.772589 2.833213
##  [8] 2.890372 2.944439 2.995732
```

```
  log(list_a$d)
```

```
##  [1] 3.433987 3.465736 3.496508 3.526361 3.555348 3.583519 3.610918
##  [8] 3.637586 3.663562 3.688879
```

## explain why log2(list_a) doesn't work. (hint: help manual, look at the function input format)

#log2(x) works on numeric arguments, it does not view list_a as a numeric argument because list_a is a list

## Part 4: the "tapply" and its equivalent. (2 pts each)

## we will use the data set "iris"; familiarize yourself with it first:

```
data(iris)
```

## 4a, find the mean petal length by species.

```
tapply(iris$Petal.Length, iris$Species, mean )
```

```
##     setosa versicolor  virginica
##      1.462      4.260      5.552
```

## 4b, look up the function "by"

## obtain the mean of the 4 features, by species, but using only one function call.

```
 for( i in 1:4){


        print(by(iris[,i], iris$Species, mean))

        }
```

```
## iris$Species: setosa
## [1] 5.006
## ------------------------------------------------------------
## iris$Species: versicolor
## [1] 5.936
## ------------------------------------------------------------
## iris$Species: virginica
## [1] 6.588
## iris$Species: setosa
## [1] 3.428
## ------------------------------------------------------------
## iris$Species: versicolor
## [1] 2.77
## ------------------------------------------------------------
```

```
## iris$Species: virginica
## [1] 2.974
## iris$Species: setosa
## [1] 1.462
## ------------------------------------------------------------
## iris$Species: versicolor
## [1] 4.26
## ------------------------------------------------------------
## iris$Species: virginica
## [1] 5.552
## iris$Species: setosa
## [1] 0.246
## ------------------------------------------------------------
## iris$Species: versicolor
## [1] 1.326
## ------------------------------------------------------------
## iris$Species: virginica
## [1] 2.026
```

## 4c, same as 4b), but using “aggregate” function.

```
 aggregate(iris[,1:4], list(iris$Species), mean)
```

```
##      Group.1 Sepal.Length Sepal.Width Petal.Length Petal.Width
## 1     setosa        5.006       3.428        1.462       0.246
## 2 versicolor        5.936       2.770        4.260       1.326
## 3  virginica        6.588       2.974        5.552       2.026
```

## 4d, same as 4b), but using the combination of “apply” and “tapply”.

## (hint: nested function)

## Part 5: other apply functions. (2 pts each)

## 5a, look up the function “mapply”

## we create list_a in 3e).

```
list_b <- list(a=1:10, b=21:30)
```

## What is the sum of the corresponding elements of list_a and list_b,in one function call?

## Your result should be a vector of length 10.

```
 mapply(sum, list_a$c,list_a$d,list_b$a, list_b$b)
```

```
##  [1]  64  68  72  76  80  84  88  92  96 100
```

## 5b, look up the function “rapply”

## same as 3e), but using rapply function, get your function output as a list as well.

## (hint: take a look at the function parameters)

```
 log_function_output= as.list(rapply(list_a, log))
  log_function_output
```

```
## $c1
## [1] 2.397895
##
## $c2
## [1] 2.484907
##
## $c3
## [1] 2.564949
##
## $c4
## [1] 2.639057
##
## $c5
## [1] 2.70805
##
## $c6
## [1] 2.772589
##
## $c7
## [1] 2.833213
##
## $c8
## [1] 2.890372
##
## $c9
## [1] 2.944439
```

```
##
## $c10
## [1] 2.995732
##
## $d1
## [1] 3.433987
##
## $d2
## [1] 3.465736
##
## $d3
## [1] 3.496508
##
## $d4
## [1] 3.526361
##
## $d5
## [1] 3.555348
##
## $d6
## [1] 3.583519
##
## $d7
## [1] 3.610918
##
## $d8
## [1] 3.637586
##
## $d9
## [1] 3.663562
##
## $d10
## [1] 3.688879
```

## Part 6: to sum up… (2 pts each)

## 6a,

## give an example or detailed explanation of and example of when the "apply" family function

## doesn't work, we have to use for loop(s).

#some members of the apply family functions only work on arguments of the same length as its index per time, #in such cases a loop has to be introduced. # For example a for loop is necessary when using the tapply function to find the mean of all the columns of the iris dataset with index "Species"

**6b, to make sure you really know how to apply "apply",**

**give an example of, two nested "apply" family functions, explain what you did.**

**e.g., apply(apply(some_matrix,2,is.na), 2, sum), this gives you the number**

**of NA's in each column. It's just for illustration, you can do this with one "apply" too.**

**anything similar to the example above doesn't count.**

## Part 7: linear regression. (5pts)

**Using the family data, fit a linear regression model to predict weight from height.**

**comment on the output; how do you interpret this model? (hint: lm() function)**

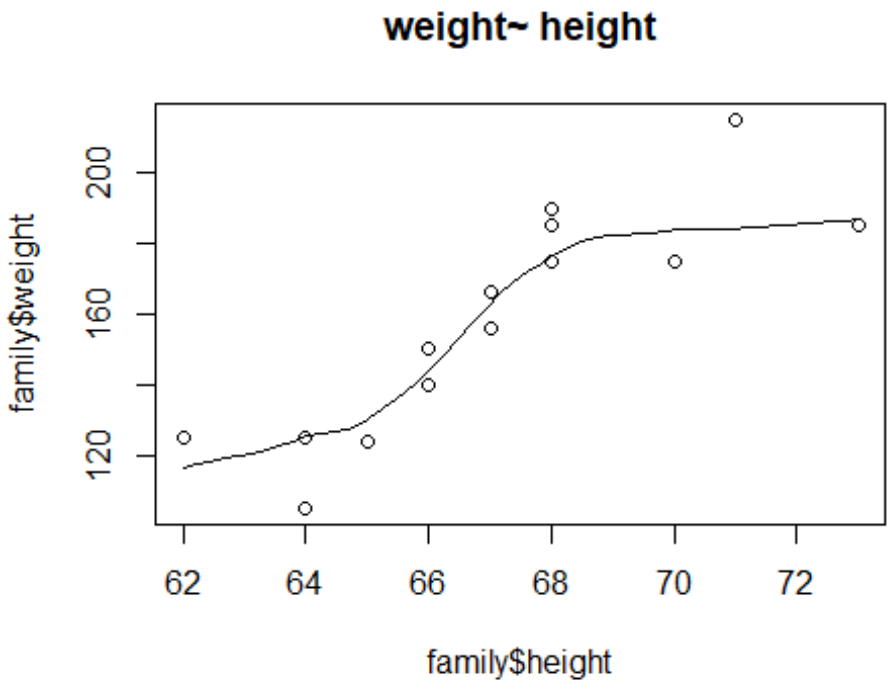
```
load("C:/Users/Kosi/Downloads/family.rda")

   lm(weight ~ height, data = family)

##
## Call:
## lm(formula = weight ~ height, data = family)
##
## Coefficients:
## (Intercept)       height
##    -455.666        9.154
```

#-455.666 andd 9.154 are the beta coefficients. #we can therefore say weight = -455.666 + 9.154height

## Create a scatterplot of height vs weight. Add the linear regression line you found above.

## Provide an interpretation for your plot.

```
scatter.smooth (x = family$height, y = family$weight, main= "weight~ height")
```




# weight and height have a positive linear relationship meaning that as height increases , weight tends to incease too.