Statistics and R short course

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Session 1 - Practical (Solutions)

From https://github.com/mlw-stats/R_And_Statistics_Training_2020/Session1 download the following files:

`btTBreg.csv`
`btTBregHospitals.csv`
`btTBreg_info.txt`

1. Load the `btTBreg.csv` data table into R.

```
btDat<-read.csv("btTBreg.csv")

head(btDat) # have a look at the data
##   id age sex hiv   bmi ses cd41 cd42   cd41.sk  cd42.sk hosp
## 1  1  44   2   0 26.32   4  346  519 313.11656 572.8906    1
## 2  2  32   2   0 20.79   5  237  337  43.12752 406.1971    5
## 3  3  32   1   0 19.21   1  198  328 338.32172 408.2427    2
## 4  4  20   1   0 21.34   4  246  525  77.08697 312.7572    3
## 5  5  30   1   0 23.98   4  270  444 169.02539 335.3739    3
## 6  6  32   1   0 17.97   4  283  372 255.45773 323.4773    4
dim(btDat) # check dimesnions of data table
## [1] 3000   11
```

2. The variables `cd41`, `cd42` and `cd41.sk`, `cd42.sk` measure the same variables (`cd4` and `cd4.sk` respectively) in the same individuals at two different time point. This means the data are in wide format. Reformat to long format.

```
btDatLong.cd4<-btDat %>%
  pivot_longer(names_to="time", values_to="cd4", cols=c(cd41, cd42)) %>%
  select(id,age,sex,hiv,bmi,ses,time,cd4)

btDatLong.cd4sk<-btDat%>%
  pivot_longer(names_to="time", values_to="cd4.sk", cols=c(cd41.sk, cd42.sk)) %>%
  select(id,age,sex,hiv,bmi,ses,time,cd4.sk)

btDatLong<-data.frame(btDatLong.cd4,cd4.sk=btDatLong.cd4sk$cd4.sk)

rm(btDatLong.cd4,btDatLong.cd4sk)

levels(btDatLong$time)<-c("entry","exit") # rename the levels of the time variable

head(btDatLong) # have a look at the data
##   id age sex hiv   bmi ses time cd4    cd4.sk
```

```
## 1  1  44   2   0 26.32   4 cd41 346 313.11656
## 2  1  44   2   0 26.32   4 cd42 519 572.89062
## 3  2  32   2   0 20.79   5 cd41 237  43.12752
## 4  2  32   2   0 20.79   5 cd42 337 406.19707
## 5  3  32   1   0 19.21   1 cd41 198 338.32172
## 6  3  32   1   0 19.21   1 cd42 328 408.24267
dim(btDatLong) # check dimensions
## [1] 6000    9
```

An alternative function that can be used is `reshape()`. To get more information on this function, type `?reshape` at the console.

```
btDatLong<-reshape(btDat,
                   direction="long",
                   varying=list(c("cd41","cd42"),c("cd41.sk","cd42.sk")),
                   ids="id",
                   v.names=c("cd4","cd4.sk"))

head(btDatLong) # have a look at the data
##     id age sex hiv   bmi ses hosp time cd4    cd4.sk
## 1.1  1  44   2   0 26.32   4    1    1 346 313.11656
## 2.1  2  32   2   0 20.79   5    5    1 237  43.12752
## 3.1  3  32   1   0 19.21   1    2    1 198 338.32172
## 4.1  4  20   1   0 21.34   4    3    1 246  77.08697
## 5.1  5  30   1   0 23.98   4    3    1 270 169.02539
## 6.1  6  32   1   0 17.97   4    4    1 283 255.45773
dim(btDatLong) # check dimensions
## [1] 6000   10
```

3. Save the reformatted data into a file called `btTBregLong.tab` in such a way that
   i. Columns are tab-separated.
   ii. Column names are saved.
   iii. No row number is saved in the resulting file.

```
write.table(btDatLong,sep="\t",col.names=T,row.names=F,file="Session1_output/btTBregLong.tab")
```

4. Load the `btTBregHospitals.csv` data table. Join the data frames storing `btTBreg.csv` and `btTBregHospitals.csv`.

```
btDatHosp<-read.csv("btTBregHospitals.csv")

head(btDatHosp) # have a look at the data
##   HID ShortName                          FullName beds     city
## 1   1      QECH Queen Elizabeth Central Hospital 1000 Blantyre
## 2   2       KCH          Kamuzu Central Hospital 1000 Lilongwe
## 3   3       ZCH           Zomba Central Hospital  400    Zomba
## 4   4       MCH           Mzuzu Central Hospital  350    Mzuzu
## 5   5    Mlambe          Mlambe Mission Hospital  254    Lunzu
dim(btDatHosp) # check dimensions of the data table
## [1] 5 5

btDatJoined<-btDat %>%
  inner_join(btDatHosp,by=c("hosp"="HID"))

head(btDatJoined) # have a look
##   id age sex hiv   bmi ses cd41 cd42   cd41.sk  cd42.sk hosp ShortName
```

```
## 1  1  44   2   0 26.32   4  346  519 313.11656 572.8906    1      QECH
## 2  2  32   2   0 20.79   5  237  337  43.12752 406.1971    5    Mlambe
## 3  3  32   1   0 19.21   1  198  328 338.32172 408.2427    2       KCH
## 4  4  20   1   0 21.34   4  246  525  77.08697 312.7572    3       ZCH
## 5  5  30   1   0 23.98   4  270  444 169.02539 335.3739    3       ZCH
## 6  6  32   1   0 17.97   4  283  372 255.45773 323.4773    4       MCH
##                            FullName beds     city
## 1 Queen Elizabeth Central Hospital 1000 Blantyre
## 2          Mlambe Mission Hospital  254    Lunzu
## 3          Kamuzu Central Hospital 1000 Lilongwe
## 4           Zomba Central Hospital  400    Zomba
## 5           Zomba Central Hospital  400    Zomba
## 6           Mzuzu Central Hospital  350    Mzuzu
dim(btDatJoined) # check dimensions
## [1] 3000   15
```

5. Compute the average patient age and the proportion of male patients for each hospital.

Useful functions for this are `aggregate()` and `group_by()`. You can however also do it manually.

- Manually:

```
# initialise new variables
btDatHosp$avgAge<-NA
btDatHosp$propMale<-NA

# iterate over hospitals
for(i in 1:nrow(btDatHosp)){
  btDatHosp$avgAge[i]<-mean(btDatJoined$age[btDatJoined$ShortName==btDatHosp$ShortName[i]],na.rm=T)
  btDatHosp$propMale[i]<-sum(btDatJoined$sex==1 &
                         btDatJoined$ShortName==btDatHosp$ShortName[i]) /
                       sum(btDatJoined$ShortName==btDatHosp$ShortName[i])
}

print(btDatHosp)
##   HID ShortName                          FullName beds     city   avgAge
## 1   1      QECH Queen Elizabeth Central Hospital 1000 Blantyre 33.14020
## 2   2       KCH          Kamuzu Central Hospital 1000 Lilongwe 32.80067
## 3   3       ZCH           Zomba Central Hospital  400    Zomba 32.99310
## 4   4       MCH           Mzuzu Central Hospital  350    Mzuzu 32.87382
## 5   5    Mlambe          Mlambe Mission Hospital  254    Lunzu 32.89950
##    propMale
## 1 0.4763514
## 2 0.4757119
## 3 0.4948276
## 4 0.4731861
## 5 0.5242881
```

- Using `aggregate()`

```
btDat$hosp<-factor(btDat$hosp)
btDatHosp$avgAge<-aggregate(btDatJoined$age,FUN=mean,by=list(btDat$hosp))$x
btDatHosp$propMale<-aggregate(ifelse(btDatJoined$sex==1,1,0),FUN=mean,by=list(btDat$hosp))$x

print(btDatHosp)
##   HID ShortName                          FullName beds     city   avgAge
```

```
## 1   1      QECH Queen Elizabeth Central Hospital 1000 Blantyre 33.14020
## 2   2       KCH          Kamuzu Central Hospital 1000 Lilongwe 32.80067
## 3   3       ZCH           Zomba Central Hospital  400    Zomba 32.99310
## 4   4       MCH           Mzuzu Central Hospital  350    Mzuzu 32.87382
## 5   5    Mlambe          Mlambe Mission Hospital  254    Lunzu 32.89950
##    propMale
## 1 0.4763514
## 2 0.4757119
## 3 0.4948276
## 4 0.4731861
## 5 0.5242881
```

- Using `group_by()`

```
tmp<-btDat %>%
  group_by(hosp) %>%
  summarise(avgAge=mean(age,na.rm=T))
## `summarise()` ungrouping output (override with `.groups` argument)
btDatHosp$avgAge<-tmp$avgAge

tmp<-btDat %>%
  group_by(hosp) %>%
  summarise(propMale=mean(ifelse(sex==1,1,0),na.rm=T))
## `summarise()` ungrouping output (override with `.groups` argument)
btDatHosp$propMale<-tmp$propMale

print(btDatHosp)
##   HID ShortName                          FullName beds     city   avgAge
## 1   1      QECH Queen Elizabeth Central Hospital 1000 Blantyre 33.14020
## 2   2       KCH          Kamuzu Central Hospital 1000 Lilongwe 32.80067
## 3   3       ZCH           Zomba Central Hospital  400    Zomba 32.99310
## 4   4       MCH           Mzuzu Central Hospital  350    Mzuzu 32.87382
## 5   5    Mlambe          Mlambe Mission Hospital  254    Lunzu 32.89950
##    propMale
## 1 0.4763514
## 2 0.4757119
## 3 0.4948276
## 4 0.4731861
## 5 0.5242881
```

6. Write an R function that computes the following summary statistics, then, using your custom function, compute these for the `bmi`, `cd41`, `cd42` columns:
   i. mean
   ii. median
   iii. interquartile range
   iv. minimum
   v. maximum
   vi. number of missing values

```
summaryFun<-function(x){
  return(c(
    mean(x,na.rm=T),
    median(x),
    paste(sep="","(",paste(collapse=",",quantile(x,probs=c(0.25,0.75))),")"),
    min(x,na.rm=T),
```

```
    max(x,na.rm=T),
    sum(is.na(x))
  ))
}

res<-apply(btDat[,c("bmi","cd41","cd42")],MARGIN=2,FUN=summaryFun)
rownames(res)<-c("mean","median","IQR","min","max","num_MV")
print(res)
##         bmi                 cd41                cd42
## mean    "23.0574333333333" "248.794333333333" "448.003"
## median "23.05"             "249"               "447"
## IQR     "(21.34,24.74)"    "(216,281)"         "(381,515)"
## min     "12.64"            "57"                "81"
## max     "31.14"            "447"               "843"
## num_MV "0"                 "0"                 "0"
```

7. Do the same now, but only for female patients. Repeat for only male patients.

```
resF<-apply(btDat[btDat$sex==2,c("bmi","cd41","cd42")],MARGIN=2,FUN=summaryFun)
rownames(resF)<-c("mean","median","IQR","min","max","num_MV")
print(resF)
##         bmi                 cd41                cd42
## mean    "23.1218644067797" "248.473924380704" "446.675358539765"
## median "23.14"             "250"               "447.5"
## IQR     "(21.365,24.82)"   "(215,281)"         "(379,512)"
## min     "12.64"            "57"                "138"
## max     "31.14"            "447"               "820"
## num_MV "0"                 "0"                 "0"

resM<-apply(btDat[btDat$sex==1,c("bmi","cd41","cd42")],MARGIN=2,FUN=summaryFun)
rownames(resM)<-c("mean","median","IQR","min","max","num_MV")
print(resM)
##         bmi                 cd41                cd42
## mean    "22.9900136425648" "249.129604365621" "449.392223738063"
## median "22.98"             "248"               "447"
## IQR     "(21.3,24.66)"     "(216,282)"         "(383,519.75)"
## min     "14.44"            "71"                "81"
## max     "30.9"             "414"               "843"
## num_MV "0"                 "0"                 "0"
```