Homework Project 1

HW ______1___________________
Winter 2018, DSPA (HS650)
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I certify that the following paper represents my own independent work and conforms with the guidelines of academic honesty described in the UMich student handbook.

Problem 1.1 (Long-to-Wide Data format translation):

We demonstrated the wide-to-long conversion in lecture. Now, let's explore long-to-wide. Load in the long-format SOCR Parkinson's Disease dataLinks to an external site. and export it as wide format. For simplicity, just choose only 3 variables (avoiding case and time variables). Please note that there are several time observations for each subject. You need to transform the features according to the time variable. Try to use reshape function.

```
library(rvest)
#Load the data from website
site <- "http://wiki.socr.umich.edu/index.php/SOCR_Data_PD_BiomedBigMetadata"
wiki_url <- read_html(site)
html_nodes(wiki_url, "#content")
pd_data <- html_table(html_nodes(wiki_url,"table")[[1]])
head(pd_data); summary(pd_data)

#Choose three variables Sex, Weight and Age other than Cases and Time
pd_data_sub <- pd_data[,c("Cases", "Time", "Sex", "Weight", "Age")]

#Transform the data from long to wide
wide_data <- reshape(pd_data_sub, timevar = "Time", idvar = "Cases",
                     direction = "wide")
str(pd_data_sub)
```

```
> str(pd_data_sub)
'data.frame':  1128 obs. of   5 variables:
 $ Cases : int   2 2 2 2 3 3 3 3 6 6 ...
 $ Time   : int   0 6 12 18 0 6 12 18 0 6 ...
 $ Sex    : int   1 1 1 1 0 0 0 0 0 0 ...
 $ Weight: int   84 84 84 84 97 97 97 97 96 96 ...
 $ Age    : int   67 67 67 67 39 39 39 39 54 54 ...
```

Problem 1.2 (Data stratification):

Use the same SOCR Parkinson's Disease dataLinks to an external site. and extract rows satisfying Time=0. Complete the following protocol in R:

Extract the first 10 subjects
Find the cases for which L_caudate_ComputeArea<600.
Sort the subjects based on L_caudate_Volume in descending and ascending order.
Generate frequency and probability tables for Age and Sex.
Compute the mean Age and the correlation between Age and Weight.
Plot Histogram and density of R_fusiform_gyrus_Volume and scatterplot L_fusiform_gyrus_Volume and R_fusiform_gyrus_Volume.

```
#Extract rows satisfying Time=0
pd_data_timezero <- subset(pd_data, Time == 0)
pd_data_timezero

#Extract the first 10 subjects
pd_data_timezero_10 <- pd_data_timezero[1:10,]
str(pd_data_timezero_10)
```

```
> str(pd_data_timezero_10)
'data.frame':	10 obs. of  33 variables:
 $ Cases                      : int  2 3 6 7 8 10 11 12 13 14
 $ L_caudate_ComputeArea      : int  597 604 580 575 578 574 604 590 549 639
 $ L_caudate_Volume           : int  767 873 797 798 837 808 829 792 798 774
 $ R_caudate_ComputeArea      : int  855 935 919 919 904 907 857 886 901 931
 $ R_caudate_Volume           : int  968 1043 1023 1044 1012 1025 981 965
975 1032
 $ L_putamen_ComputeArea      : int  842 892 908 925 860 888 866 952 913
918
 $ L_putamen_Volume           : int  1357 1366 1415 1383 1364 1379 1370
1347 1382 1426
 $ R_putamen_ComputeArea      : int  1285 1305 1264 1331 1250 1268 1322
1300 1242 1317
 $ R_putamen_Volume           : int  3052 2920 2995 2944 2958 2965 2930
3021 3048 2927
 $ L_hippocampus_ComputeArea  : int  1306 1292 1313 1317 1293 1305 1291
1303 1261 1320
 $ L_hippocampus_Volume       : int  3238 3079 3227 3208 3223 3276 3155
3182 3127 3293
 $ R_hippocampus_ComputeArea  : int  1513 1516 1541 1526 1474 1520 1506
1494 1524 1585
 $ R_hippocampus_Volume       : int  3759 3827 3791 3736 3867 3836 3752
```

```
3792 3677 3894
 $ cerebellum_ComputeArea          : int  16845 16698 16480 16732 16509 16663
16727 16758 16880 16793
 $ cerebellum_Volume               : int  13949 14076 13992 13807 14103 13875
14072 13947 13922 14086
 $ L_lingual_gyrus_ComputeArea : int  3268 3243 3331 3259 3281 3186 3333 3333
3366 3442
 $ L_lingual_gyrus_Volume          : int  11130 11033 11093 11015 11195 10990
10952 10920 11170 11069
 $ R_lingual_gyrus_ComputeArea : int  3294 3190 3407 3266 3279 3220 3307 3320
3234 3459
 $ R_lingual_gyrus_Volume          : int  12221 12187 12062 11932 11983 11989
12080 11972 11859 12037
 $ L_fusiform_gyrus_ComputeArea: int  3625 3631 3520 3665 3527 3460 3543 3554
3681 3624
 $ L_fusiform_gyrus_Volume         : int  11087 11116 10890 10989 11101 11093
10830 11134 10936 10913
 $ R_fusiform_gyrus_ComputeArea: int  3232 3302 3328 3311 3257 3291 3265 3313
3234 3283
 $ R_fusiform_gyrus_Volume        : int  10122 10162 9884 9996 10050 9916 10188
9869 10028 9945
 $ Sex                             : int  1 0 0 1 1 0 0 1 1 1
 $ Weight                          : int  84 97 96 79 79 71 82 93 67 72
 $ Age                             : int  67 39 54 53 46 56 69 66 61 58
 $ Dx                              : chr  "PD" "PD" "PD" "PD" ...
 $ chr12_rs34637584_GT             : int  1 1 0 0 1 1 0 1 1 1
 $ chr17_rs11868035_GT             : int  0 1 0 0 1 0 0 0 0 1
 $ UPDRS_part_I                    : int  1 0 1 1 1 0 1 0 0 1
 $ UPDRS_part_II                   : int  12 19 15 17 13 2 18 3 18 18
 $ UPDRS_part_III                  : int  1 22 19 29 11 16 28 26 3 6
 $ Time                            : int  0 0 0 0 0 0 0 0 0 0
```

```
#Find the cases for which L_caudate_ComputeArea<600.
Cauareabelow600 <- subset(pd_data_timezero_10, L_caudate_ComputeArea < 600)
str(Cauareabelow600)
```

```
> str(Cauareabelow600)
'data.frame':  7 obs. of   33 variables:
 $ Cases                           : int  2 6 7 8 10 12 13
 $ L_caudate_ComputeArea           : int  597 580 575 578 574 590 549
 $ L_caudate_Volume                : int  767 797 798 837 808 792 798
 $ R_caudate_ComputeArea           : int  855 919 919 904 907 886 901
 $ R_caudate_Volume                : int  968 1023 1044 1012 1025 965 975
 $ L_putamen_ComputeArea           : int  842 908 925 860 888 952 913
```

```
 $ L_putamen_Volume              : int  1357 1415 1383 1364 1379 1347 1382
 $ R_putamen_ComputeArea         : int  1285 1264 1331 1250 1268 1300 1242
 $ R_putamen_Volume              : int  3052 2995 2944 2958 2965 3021 3048
 $ L_hippocampus_ComputeArea     : int  1306 1313 1317 1293 1305 1303 1261
 $ L_hippocampus_Volume          : int  3238 3227 3208 3223 3276 3182 3127
 $ R_hippocampus_ComputeArea     : int  1513 1541 1526 1474 1520 1494 1524
 $ R_hippocampus_Volume          : int  3759 3791 3736 3867 3836 3792 3677
 $ cerebellum_ComputeArea        : int  16845 16480 16732 16509 16663 16758
16880
 $ cerebellum_Volume             : int  13949 13992 13807 14103 13875 13947
13922
 $ L_lingual_gyrus_ComputeArea : int  3268 3331 3259 3281 3186 3333 3366
 $ L_lingual_gyrus_Volume        : int  11130 11093 11015 11195 10990 10920
11170
 $ R_lingual_gyrus_ComputeArea : int  3294 3407 3266 3279 3220 3320 3234
 $ R_lingual_gyrus_Volume        : int  12221 12062 11932 11983 11989 11972
11859
 $ L_fusiform_gyrus_ComputeArea: int  3625 3520 3665 3527 3460 3554 3681
 $ L_fusiform_gyrus_Volume       : int  11087 10890 10989 11101 11093 11134
10936
 $ R_fusiform_gyrus_ComputeArea: int  3232 3328 3311 3257 3291 3313 3234
 $ R_fusiform_gyrus_Volume       : int  10122 9884 9996 10050 9916 9869 10028
 $ Sex                           : int  1 0 1 1 0 1 1
 $ Weight                        : int  84 96 79 79 71 93 67
 $ Age                           : int  67 54 53 46 56 66 61
 $ Dx                            : chr  "PD" "PD" "PD" "PD" ...
 $ chr12_rs34637584_GT           : int  1 0 0 1 1 1 1
 $ chr17_rs11868035_GT           : int  0 0 0 1 0 0 0
 $ UPDRS_part_I                  : int  1 1 1 1 0 0 0
 $ UPDRS_part_II                 : int  12 15 17 13 2 3 18
 $ UPDRS_part_III                : int  1 19 29 11 16 26 3
 $ Time                          : int  0 0 0 0 0 0 0
```

```
#Generate frequency and probability tables for Age and Sex.
 table(pd_data$Sex)
```

```
  0   1
468 660
```

```
 table(pd_data$Age)
```

```
31 38 39 40 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
 4  4 12  8  4 12 32 12 32  4 20 24 16 36 12 28 36 56 48 28 72 28 32
61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 82 83 85
32 32 44 40 44 36 44 40 56 28  8 24 16 28  4 20 12 12 20  8  8  4  4
87 4
```

```
prop.table(pd_data$Sex)
```

```
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```
#Sort the subjects based on L_caudate_Volume in ascending order.
SortAscend <- Cauareabelow600[order(Cauareabelow600$L_caudate_Volume), ]
head(SortAscend$L_caudate_Volume)
```

```
[1] 767 792 797 798 798 808
```

```
#Sort the subjects based on L_caudate_Volume in descending order.
SortDescend <- Cauareabelow600[order(Cauareabelow600$L_caudate_Volume, decreasing = T),]
head(SortDescend$L_caudate_Volume)
```

```
[1] 837 808 798 798 797 792
```

```
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                    pd_data_timezero$Age

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                      1  1  1  1  1  0  3  3  3  6  1  4  3  3  6  2  4  6  8  7  4 11
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pd_data_timezero$Sex 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79
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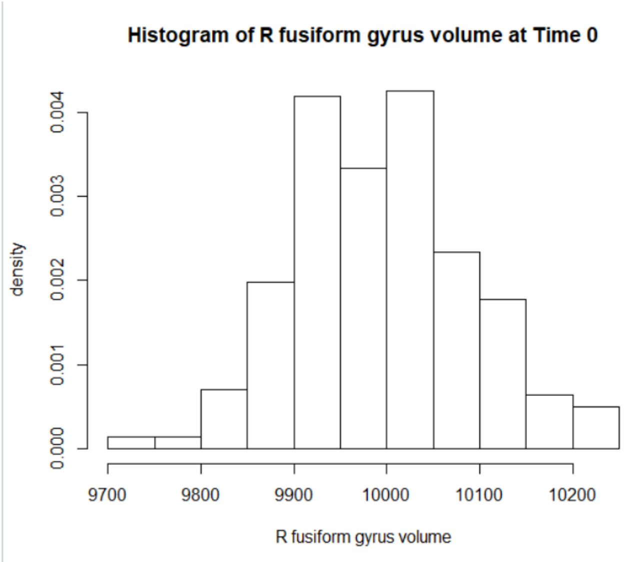
```

```
                     1  3  2  6  2  5  9  5  6  7  7  6  6  1  4  2  2
1  3  1  1  3
                      pd_data_timezero$Age
pd_data_timezero$Sex 80 82 83 85 87
                     0  0  1  0  0  1
                     1  2  1  1  1  0
```

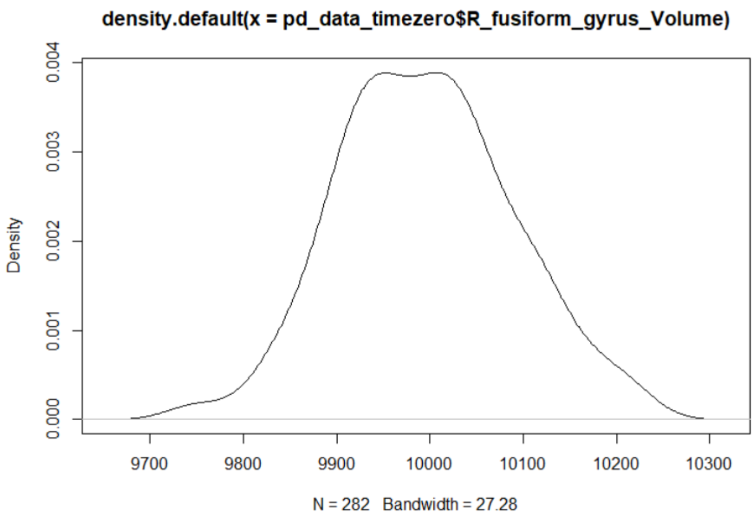
```
#Compute the mean Age.
mean(pd_data_timezero$Age)
```
[1] 60.6383

```
#Compute the correlation between Age and Weight.
cor(pd_data_timezero$Age, pd_data_timezero$Weight)
```
[1] 0.1390514

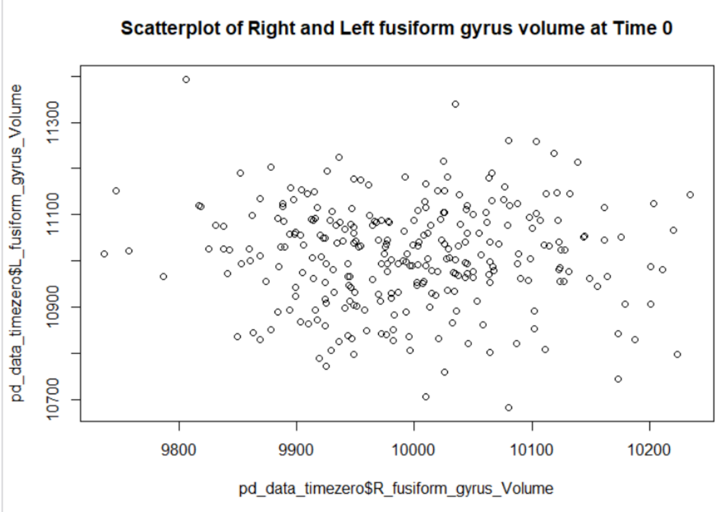
```
#Plot Histogram and density of R_fusiform_gyrus_Volume.
hist(pd_data_timezero$R_fusiform_gyrus_Volume, freq = F, main = "Histogram of R fusiform gyrus volume at Time 0", xlab = "R fusiform gyrus volume", ylab = "density")
```




```
#Plot density of R_fusiform_gyrus_Volume
plot(density(pd_data_timezero$R_fusiform_gyrus_Volume))
```




```
#Plot the scatterplot L_fusiform_gyrus_Volume and R_fusiform_gyrus_Volume.
plot(pd_data_timezero$R_fusiform_gyrus_Volume,
pd_data_timezero$L_fusiform_gyrus_Volume, main = "Scatterplot of Right and Left fusiform gyrus volume at Time 0", xlabs = "Right fusiform gyrus volume", ylabs = "Left fusiform gyrus volume")
```



Problem 1.3 (Simulation)

Generate 1,000 standard normal variables and 1,200 student t distributed random variables with df=20. Generate a quantile-quantile (Q-Q) probability plot of the two samples. Then, compare it with qqnorm of student t simulation.

```
#Generate 1,000 standard normal variables
stuvar <- rnorm(1000)

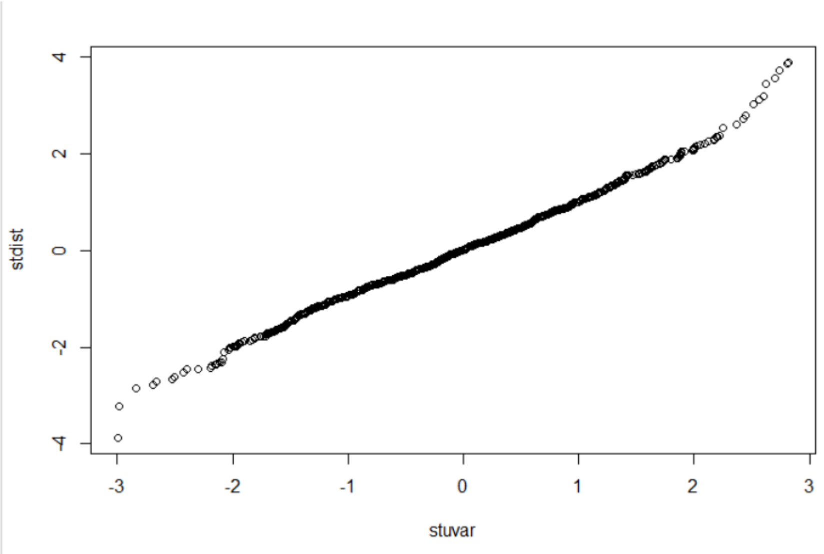
# Generate 1,200 student t distributed random variables with df=20
```

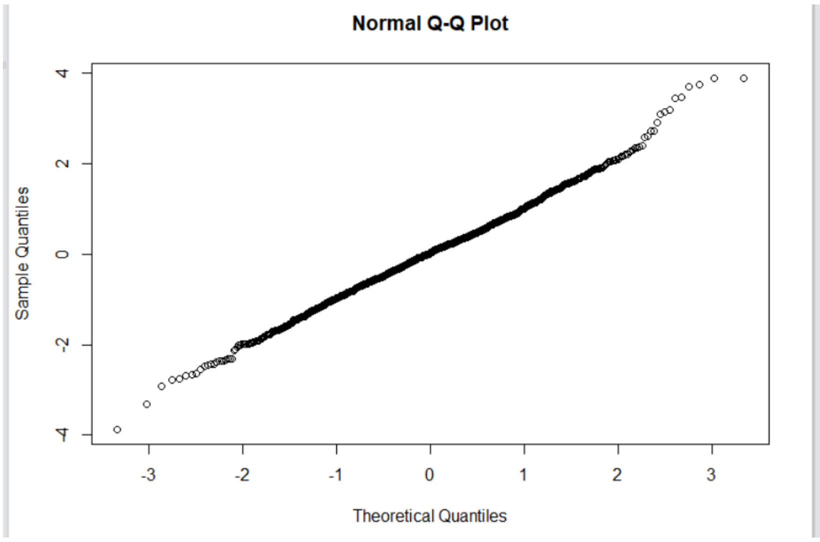
```
stdist <- rt(1200, df = 20)

#Generate a quantile-quantile (Q-Q) probability plot of the two samples.
qqplot(stuvar, stdist)

#Generate qqnorm of student t simulation
qqnorm(stdist)

#Compare these two plots: they look similar with a bit of difference at the beginning
#and end of the lines
```





Problem 1.4 (Define an R SD function)

Generate a function that computes a sample standard deviation function and compare it against the sd function using the simulation data you generate in the last question. Did you cover all possible situations for the input data?

```
stuvar <- rnorm(1000)
a <- c(stuvar)
b <- sqrt(sum((a-mean(a))**2/(length(a)-1)))
b
```

[1] 1.026676

```
c<- sd(a)
c
```

[1] 1.026676

```
stdist <- rt(1200, df = 20)
d <- c(stdist)
e <- sqrt(sum((d-mean(d))**2/(length(d)-1)))
e
```

[1] 1.044765

```
f <- sd(stdist)
f
```

[1] 1.044765

Yes, it looks like I covered all the possible situations for this input data. And the function I defined for standard deviation generates the same output as the one from the inserted function sd().