Project: ANALYZE THE HEALTHCARE COST

Tool Used-R studio.

//Read the given csv hospital file and mount the table:-

```
hosp<-read.csv("HospitalCosts.csv")
hosp
```

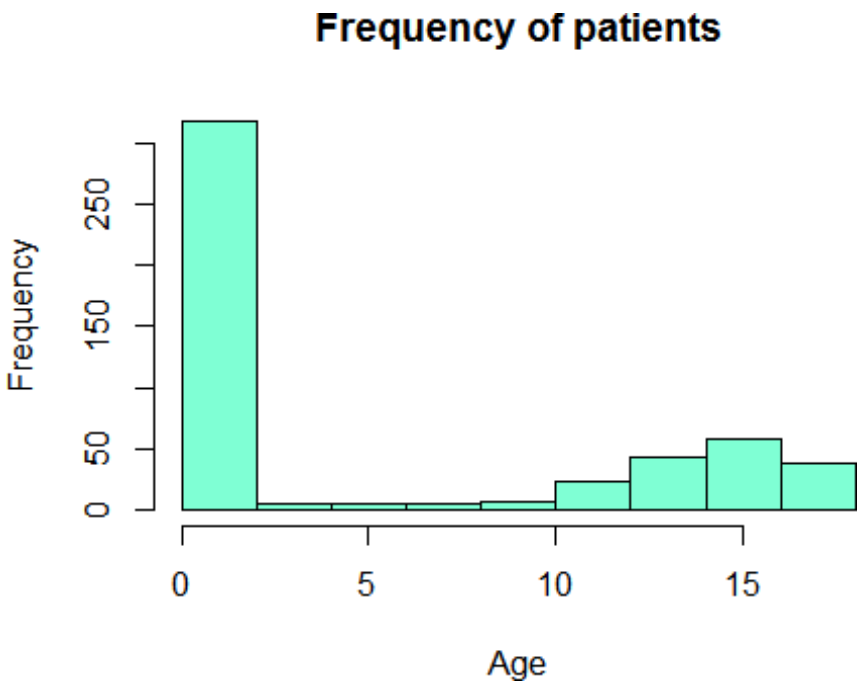
I. To record the patient statistics, the agency wants to find the age category of people who frequents the hospital and has the maximum expenditure.

Note-The following question has two conclusions

Now to find the category with the max frequency of hospital vists we us data visualization to get an overview of the all the categories, in this case we will use a histogram for frequency analysis.

Code-

```
hist(hosp$AGE,main = "Frequency of patients",col = "aquamarine",xlab = "Age")
```



After that we will factor function the make the "AGE" column numerical which will be later used in summary function

```
attach(hosp)
AGE<-as.factor(AGE)
summary(AGE)
```

```
##   0   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16
17
## 307  10   1   3   2   2   2   3   2   2   4   8  15  18  25  29  29
38
```

Conclusion 1: From the above results we conclude that infant category has the max hospital visits (above 300). The summary of Age gives us the exact numerical output showing that Age 0 patients have the max visits followed by Ages 15-17.

Aggregate function is used to add the expenditure from each age and then max function used to find highest costs.

Code-

```
aggregate(TOTCHG~AGE,FUN=sum,data = hosp)
```

```
##     AGE  TOTCHG
## 1     0  678118
## 2     1   37744
## 3     2    7298
## 4     3   30550
## 5     4   15992
## 6     5   18507
## 7     6   17928
## 8     7   10087
## 9     8    4741
## 10    9   21147
## 11   10   24469
## 12   11   14250
## 13   12   54912
## 14   13   31135
## 15   14   64643
## 16   15  111747
## 17   16   69149
## 18   17  174777
```

```
max(aggregate(TOTCHG~AGE,FUN=sum,data=hosp))
```

```
## [1] 678118
```

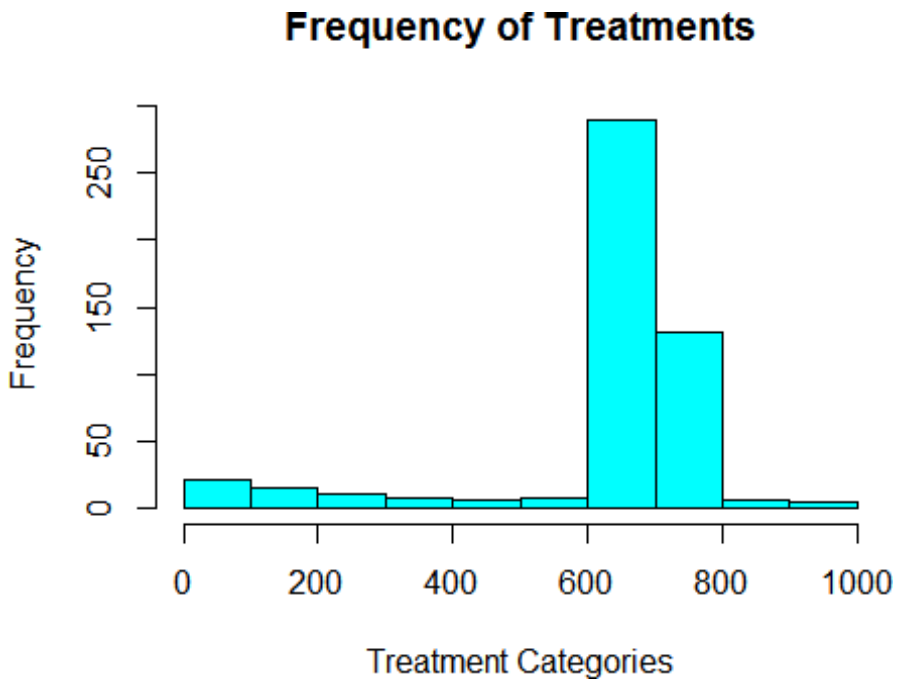
Conclusion 2: Thus, we can conclude that the infants also have the maximum hospital costs followed by Age groups 15 to 17, additionally we can say confidently that number of hospital visits are proportional to hospital costs.

II. In order of severity of the diagnosis and treatments and to find out the expen sive treatments, the agency wants to find the diagnosis related group that has maximum hospitalization and expenditure.

Here first we visualize the categories based on their frequency using histograms

Code-

```
hist(APRDRG,col = "cyan1",main = "Frequency of Treatments",xlab = "Trea
tment Categories")
```



Now we will make sure that category column("APRDRG") is numerical and then generate a summary along with the which.max to generate the max index of the category data frame, this will be followed by aggregate function used in a similar way as above.

Code-

```
APRDRG_fact<-as.factor(hosp$APRDRG)
summary(APRDRG_fact)
```

```
##  21  23  49  50  51  53  54  57  58  92  97 114 115 137 138 139 141
143
##   1   1   1   1   1  10   1   2   1   1   1   1   2   1   4   5   1
1
## 204 206 225 249 254 308 313 317 344 347 420 421 422 560 561 566 580
581
```

```
##   1   1   2   6   1   1   1   1   2   3   2   1   3   2   1   1   1
3
## 602 614 626 633 634 636 639 640 710 720 723 740 750 751 753 754 755
756
##   1   3   6   4   2   3   4 267   1   1   2   1   1  14  36  37  13
2
## 758 760 776 811 812 863 911 930 952
##  20   2   1   2   3   1   1   2   1
```

```
which.max(summary(APRDRG_fact))
```

```
## 640
##  44
```

```
df<-aggregate(TOTCHG~APRDRG,FUN  = sum,data=hosp)
df
```

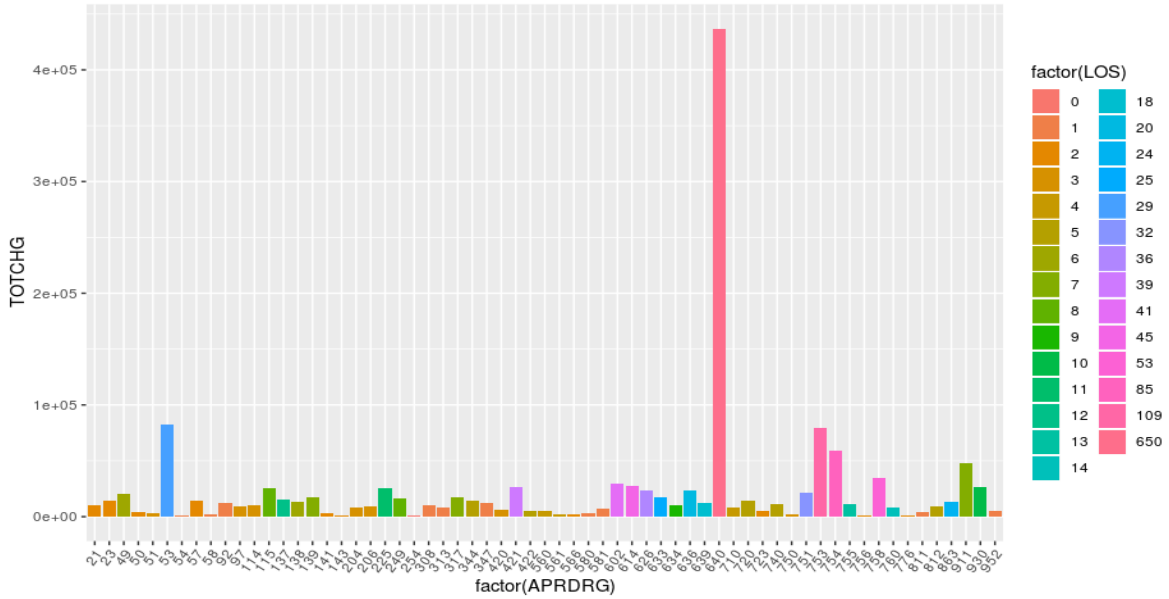
```
##      APRDRG  TOTCHG
## 1        21   10002
## 2        23   14174
## 3        49   20195
## 4        50    3908
## 5        51    3023
## 6        53   82271
## 7        54     851
## 8        57   14509
## 9        58    2117
## 10       92   12024
## 11       97    9530
## 12      114   10562
## 13      115   25832
## 14      137   15129
## 15      138   13622
## 16      139   17766
## 17      141    2860
## 18      143    1393
## 19      204    8439
## 20      206    9230
## 21      225   25649
## 22      249   16642
## 23      254     615
## 24      308   10585
## 25      313    8159
## 26      317   17524
## 27      344   14802
## 28      347   12597
## 29      420    6357
## 30      421   26356
## 31      422    5177
## 32      560    4877
## 33      561    2296
```

```
## 34      566    2129
## 35      580    2825
## 36      581    7453
## 37      602   29188
## 38      614   27531
## 39      626   23289
## 40      633   17591
## 41      634    9952
## 42      636   23224
## 43      639   12612
## 44      640  437978
## 45      710    8223
## 46      720   14243
## 47      723    5289
## 48      740   11125
## 49      750    1753
## 50      751   21666
## 51      753   79542
## 52      754   59150
## 53      755   11168
## 54      756    1494
## 55      758   34953
## 56      760    8273
## 57      776    1193
## 58      811    3838
## 59      812    9524
## 60      863   13040
## 61      911   48388
## 62      930   26654
## 63      952    4833
```

```
df[which.max(df$TOTCHG),]
```

```
##     APRDRG  TOTCHG
## 44     640 437978
```

Graphically –



```
ggplot (hosp, aes(x=factor(APRDRG), y= TOTCHG, fill=factor(LOS)))+
  geom_bar(stat = 'identity')+
  theme(axis.text.x = element_text(angle = 55, hjust = 1))
```

Conclusion: Hence can conclude that category 640 has the maximum hospitalizations by a huge number (267 out of 500), along with this it also has the highest hospitalization cost.

III. To make sure that there is no malpractice, the agency needs to analyze if the race of the patient is related to the hospitalization costs.

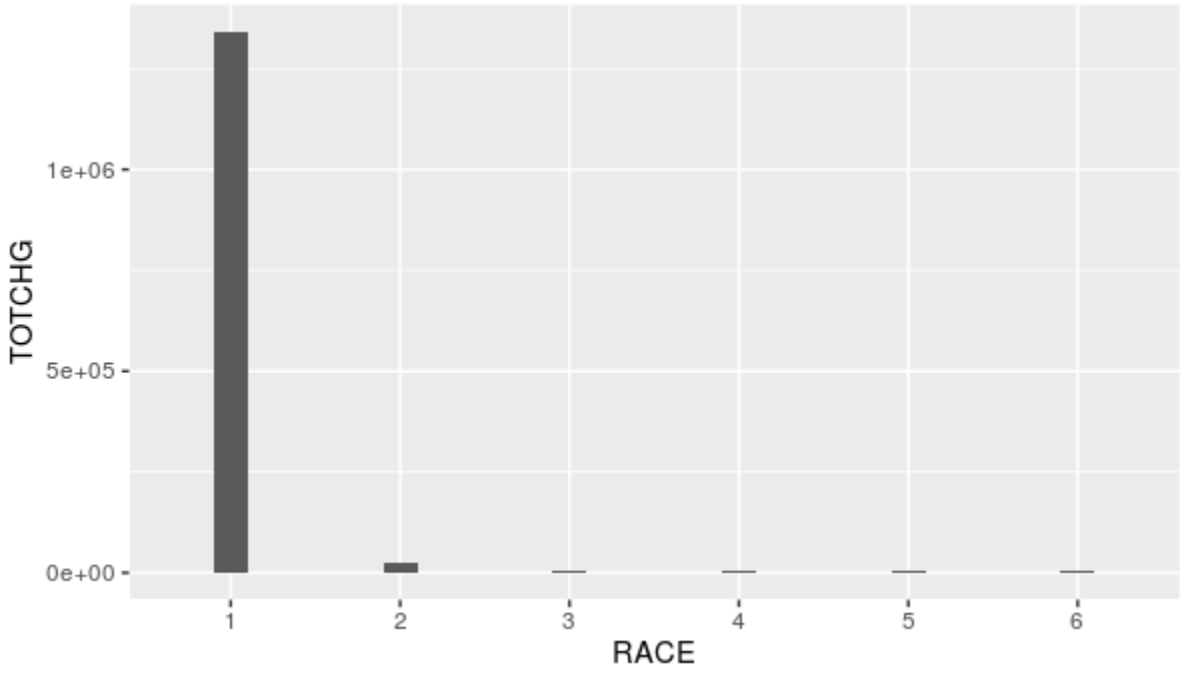
Here we will first remove the "NA" values from our records, then factorize the Race variable to generate a summary, additionally to verify whether race made an impact on the hospital costs we will use ANOVA function with TOTCHG as dependent variable and RACE as grouping variable.

Code-

```
hosp<-na.omit(hosp)#first we remove "NA"values
hosp$RACE<-as.factor(hosp$RACE)
model_aov<-aov(TOTCHG~RACE,data = hosp)
model_aov#ANOVA RESULTS
```

Graphically-

```
ggplot(hosp, aes(x=RACE, y= TOTCHG))+
  geom_bar(stat = 'identity', width = 0.2)
```



```
## Call:
##    aov(formula = TOTCHG ~ RACE, data = hosp)
##
## Terms:
##                        RACE   Residuals
## Sum of Squares     18593279  7523518505
## Deg. of Freedom           5         493
##
## Residual standard error: 3906.493
## Estimated effects may be unbalanced
```

```
summary(model_aov)
```

```
##               Df    Sum Sq   Mean Sq  F value  Pr(>F)
## RACE           5 1.859e+07   3718656    0.244   0.943
## Residuals    493 7.524e+09  15260687
```

```
summary(hosp$RACE)#getting max hospital cost per race
```

```
##   1   2   3   4   5   6
## 484   6   1   3   3   2
```

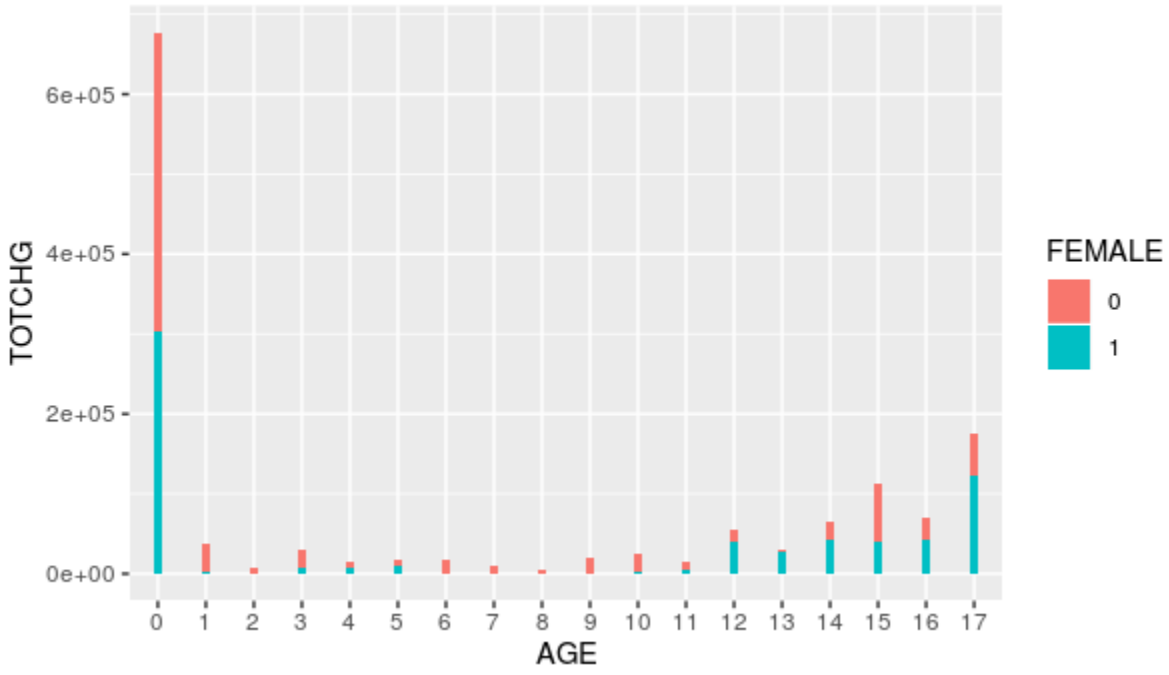
Conclusion: F value is quite low, which means that variation between hospital costs among different races is much smaller than the variation of hospital costs within each race, and P value being quite high shows that there is no relationship between race and hospital costs, thereby accepting the Null hypothesis. Additionally, we have more data for Race 1 in comparison to other races (484 out of 500 patients = 97% of all patients belong to Race 1) which make the observations skewed and thus all we can say is that there isn't enough data to verify whether race of a patient affects hospital costs.

IV. To properly utilize the costs, the agency has to analyze the severity of the hospital costs by age and gender for proper allocation of resources.

Now to analyze the severity of costs we will use linear regression with TOTCHG(Cost) and independent variable along with AGE and Female as dependent variables

Graphically –

```
ggplot (hosp, aes(x=factor(AGE), y= TOTCHG, fill=FEMALE))+
  geom_bar(stat = 'identity', width = 0.2)
```



Code-

```
hosp$FEMALE<-as.factor(hosp$FEMALE)
model_lm4<-lm(TOTCHG~AGE+FEMALE,data = hosp)#calling Regression funtion
summary(model_lm4)
##
## Call:
## lm(formula = TOTCHG ~ AGE + FEMALE, data = hosp)
##
## Residuals:
##    Min      1Q  Median      3Q     Max
##  -3403   -1444    -873    -156   44950
##
## Coefficients:
##             Estimate  Std. Error t value  Pr(>|t|)
## (Intercept)  2719.45      261.42   10.403   < 2e-16 ***
## AGE            86.04       25.53    3.371  0.000808  ***
## FEMALE1      -744.21      354.67   -2.098  0.036382  *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3849 on 496 degrees of freedom
## Multiple R-squared:  0.02585,    Adjusted R-squared:  0.02192
## F-statistic: 6.581 on 2 and 496 DF,  p-value: 0.001511

summary(hosp$FEMALE)#comapring genders

##   0   1
## 244 255
```

Conclusion-Age has more impact than gender according to the P-values and significant levels, also there are equal number of Females and Males and on an average (based on the negative coefficient values) females incur lesser hospital costs than males.

V. Since the length of stay is the crucial factor for inpatients, the agency wants to find if the length of stay can be predicted from age, gender, and race.

Using linear Regression, we can show whether length of stay is dependent on age, gender or race. Here we LOS is the dependent variable and age, gender and race are independent variables

Code-

```
hosp$RACE<-as.factor(hosp$RACE)
model_lm5<-lm(LOS~AGE+FEMALE+RACE,data = hosp)
summary(model_lm5)
```

```
##
## Call:
## lm(formula = LOS ~ AGE + FEMALE + RACE, data = hosp)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.211 -1.211 -0.857   0.143  37.789
##
## Coefficients:
##             Estimate  Std. Error t value  Pr(>|t|)
## (Intercept)  2.85687     0.23160   12.335   <2e-16 ***
## AGE         -0.03938     0.02258   -1.744   0.0818 .
## FEMALE1      0.35391     0.31292    1.131   0.2586
## RACE2       -0.37501     1.39568   -0.269   0.7883
## RACE3        0.78922     3.38581    0.233   0.8158
## RACE4        0.59493     1.95716    0.304   0.7613
## RACE5       -0.85687     1.96273   -0.437   0.6626
## RACE6       -0.71879     2.39295   -0.300   0.7640
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.376 on 491 degrees of freedom
## Multiple R-squared:  0.008699,   Adjusted R-squared:  -0.005433
## F-statistic: 0.6156 on 7 and 491 DF,  p-value: 0.7432
```

Conclusion-p-values for all independent variables are quite high thus signifying that there is no linear relationship between the given variables, finally concluding the fact that we can't predict length of stay of a patient based on age, gender and race.

VI. To perform a complete analysis, the agency wants to find the variable that mainly affects the hospital costs.

Using linear Regression, we can show which variable affects the hospital costs the most, thus TOTCHG becomes dependent variable and rest all variables are taken as independent.

Code-

```
model_lm6<-lm(TOTCHG~AGE+FEMALE+RACE+LOS+APRDRG,data = hosp)
summary(model_lm6)

##
## Call:
## lm(formula = TOTCHG ~ AGE + FEMALE + RACE + LOS + APRDRG, data = hos
p)
##
## Residuals:
##    Min     1Q Median     3Q    Max
##  -6367   -691   -186    121  43412
##
## Coefficients:
##               Estimate  Std. Error t value  Pr(>|t|)
## (Intercept)  5024.9610    440.1366  11.417   < 2e-16 ***
## AGE           133.2207     17.6662   7.541  2.29e-13  ***
## FEMALE1      -392.5778    249.2981  -1.575     0.116
## RACE2         458.2427   1085.2320   0.422     0.673
## RACE3         330.5184   2629.5121   0.126     0.900
## RACE4        -499.3818   1520.9293  -0.328     0.743
## RACE5       -1784.5776   1532.0048  -1.165     0.245
## RACE6        -594.2921   1859.1271  -0.320     0.749
## LOS           742.9637     35.0464  21.199   < 2e-16 ***
## APRDRG         -7.8175      0.6881 -11.361   < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2622 on 489 degrees of freedom
## Multiple R-squared:  0.5544, Adjusted R-squared:  0.5462
## F-statistic:  67.6 on 9 and 489 DF,  p-value: < 2.2e-16

```

Conclusion-Age and length of stay affect the total hospital costs. Additionally, there is positive relationship between length of stay to the cost, so with an increase of 1 day there is an addition of a value of 742 to the cost.