Group_project_5014

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11/21/2020

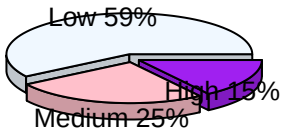
Social Disparity - Income

```
# 2019 region
library(plotrix)
library(treemap)
library(reshape2)
library(ggplot2)
Allraces<- read.csv("~/Desktop/VTCourse/STAT 5014/Group Project/Total work experience-both sexes/2019/Al
Allraces = as.data.frame(Allraces[-1,])
colnames(Allraces) = c('Region','Total', 'Total with Income', '$2499', '$2500-$4999', '$5000-$7499', '$7
                       '$10000-$12499', '$12500-$14999', '$15000-$17499', '$17500-$19999', '$20000-$2249
                       '$22500-$24999', '$25000-$27499', '$27500-$29999', '$30000-$32499', '$32500-$3749
                       '$42500-$44999', '$45000-$47499', '$47500-$49999', '$50000-$52499','$52500-$5499
                       '$100000-'
                      )
all_race_income_range = Allraces[,4:44]
colnames(all_race_income_range) = c('$2499', '$2500-$4999', '$5000-$7499', '$7500-$9999',
                       '$10000-$12499', '$12500-$14999', '$15000-$17499', '$17500-$19999', '$20000-$2249
                       '$22500-$24999', '$25000-$27499', '$27500-$29999', '$30000-$32499', '$32500-$3749
                       '$42500-$44999', '$45000-$47499', '$47999-$49999', '$50000-$52499','$52500-$5499
                       '$100000-')
# Change the range to $10000
range_combine_allr = matrix(0, 4, 9)
for (i in 1:dim(all_race_income_range)[1]){
  for (j in 1:dim(all_race_income_range)[2]){
all_race_income_range[i,j] = as.numeric(gsub(",","", all_race_income_range[i,j]))
  }
}
for (i in 1:dim(all_race_income_range)[1]){
  range_combine_allr[i,1] = sum(as.numeric(all_race_income_range[i,1:5])) # 0 - 12499
  range_combine_allr[i,2] = sum(as.numeric(all_race_income_range[i,6:10])) #12500 - 24999
   range_combine_allr[i,3] = sum(as.numeric(all_race_income_range[i,11:15])) # 25000 - 37499
   range_combine_allr[i,4] = sum(as.numeric(all_race_income_range[i,16:20])) # 37500 - 49999
   range_combine_allr[i,5] = sum(as.numeric(all_race_income_range[i,21:25])) # 50000 - 62499
   range_combine_allr[i,6] = sum(as.numeric(all_race_income_range[i,26:30])) # 62500 - 74999
   range_combine_allr[i,7] = sum(as.numeric(all_race_income_range[i,31:35])) # 75000- 87499
   range_combine_allr[i,8] = sum(as.numeric(all_race_income_range[i,36:40])) # 87500 - 99999
   range_combine_allr[i,9] = sum(as.numeric(all_race_income_range[i,41])) # >= 100000
}
range_combine_allr = as.data.frame(range_combine_allr)
rownames(range_combine_allr) = c('Northeast', 'Midwest', 'South', 'West')
```

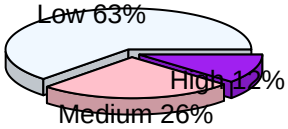
```r
#colnames(range_combine_allr) = c('0to12499', '12500to24999', '25000to37499', '37500to49999','50000to62
colnames(range_combine_allr) = seq(0,100000, 12500)
# After divide the total income range data, I tried to divide it into low, medium and high level
income_level_all = matrix(0, 4, 3)
for (i in 1:4){
  income_level_all[i,1] = sum(range_combine_allr[i,1:4]) # 0 - 49999 Low Level
  income_level_all[i,2] = sum(range_combine_allr[i,5:8]) # 49999- 99999 Medium Level
   income_level_all[i,3] = sum(range_combine_allr[i,9]) # >= 199999 High Level
}
income_level_all = as.data.frame(income_level_all)
colnames(income_level_all) = c('Low', 'Medium', 'High')
rownames(income_level_all) = c('Northeast', 'Midwest', 'South', 'West')
```

```r
# Pie plot
###
par(mfrow=c(2,2))
x <- as.vector(unlist(income_level_all[1,]))
lbls <- c('Low', 'Medium', 'High')
pct <- round(x/sum(x)*100)
lbls <- paste(lbls, pct) # add percents to labels
lbls <- paste(lbls,"%",sep="") # ad % to labels
pie3D(x,labels=lbls,explode=0.1,labelcex =0.8, radius = 1.5,
   main="Income Level of Northeast in 2019", col = c('aliceblue', 'pink', 'purple'))
x <- as.vector(unlist(income_level_all[2,]))
lbls <- c('Low', 'Medium', 'High')
pct <- round(x/sum(x)*100)
lbls <- paste(lbls, pct) # add percents to labels
lbls <- paste(lbls,"%",sep="") # ad % to labels
pie3D(x,labels=lbls,explode=0.1, labelcex = 0.8, radius = 1.5,
   main="Income Level of Midwest in 2019", cex= 0.5, col = c('aliceblue', 'pink', 'purple'))
x <- as.vector(unlist(income_level_all[3,]))
lbls <- c('Low', 'Medium', 'High')
pct <- round(x/sum(x)*100)
lbls <- paste(lbls, pct) # add percents to labels
lbls <- paste(lbls,"%",sep="") # ad % to labels
pie3D(x,labels=lbls,explode=0.05,labelcex = 0.8, radius = 1.5,
   main="Income Level of South in 2019", col = c('aliceblue', 'pink', 'purple'))
x <- as.vector(unlist(income_level_all[4,]))
lbls <- c('Low', 'Medium', 'High')
pct <- round(x/sum(x)*100)
lbls <- paste(lbls, pct) # add percents to labels
lbls <- paste(lbls,"%",sep="") # ad % to labels
pie3D(x,labels=lbls,explode=0.05, labelcex = 0.8, radius = 1.5,
   main="Income Level of West in 2019", col = c('aliceblue', 'pink', 'purple'))
```

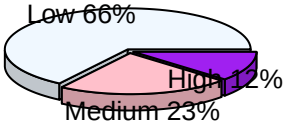
Income Level of Northeast in 2019



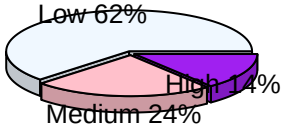
Income Level of Midwest in 2019



Income Level of South in 2019



Income Level of West in 2019

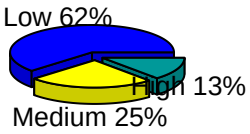



```
# 2018 region
allraces_2018 <-read.csv("~/Desktop/VTCourse/STAT 5014/Group Project/Total work experience-both sexes/20
allraces_2018 = as.data.frame(allraces_2018 [-1,])
colnames(allraces_2018) = c('Region','Total', 'Total with Income', '$2499', '$2500-$4999', '$5000-$7499
                        '$10000-$12499', '$12500-$14999', '$15000-$17499', '$17500-$19999', '$20000-$224
                        '$22500-$24999', '$25000-$27499', '$27500-$29999', '$30000-$32499', '$32500-$374
                        '$42500-$44999', '$45000-$47499', '$47500-$49999', '$50000-$52499','$52500-$5499
                        '$100000-'
                        )
all_race_income_range_2018 = allraces_2018[,4:44]
colnames(all_race_income_range_2018) = c('$2499', '$2500-$4999', '$5000-$7499', '$7500-$9999',
                        '$10000-$12499', '$12500-$14999', '$15000-$17499', '$17500-$19999', '$20000-$224
                        '$22500-$24999', '$25000-$27499', '$27500-$29999', '$30000-$32499', '$32500-$374
                        '$42500-$44999', '$45000-$47499', '$47999-$49999', '$50000-$52499','$52500-$5499
                        '$100000-')
range_combine_allr_2018 = matrix(0, 4, 9)
for (i in 1:dim(all_race_income_range_2018)[1]){
  for (j in 1:dim(all_race_income_range_2018)[2]){
all_race_income_range_2018[i,j] = as.numeric(gsub(",","", all_race_income_range_2018[i,j]))
  }
}
for (i in 1:dim(all_race_income_range_2018)[1]){
  range_combine_allr_2018[i,1] = sum(as.numeric(all_race_income_range_2018[i,1:5])) # 0 - 12499
  range_combine_allr_2018[i,2] = sum(as.numeric(all_race_income_range_2018[i,6:10])) #12500 - 24999
   range_combine_allr_2018[i,3] = sum(as.numeric(all_race_income_range_2018[i,11:15])) # 25000 - 37499
   range_combine_allr_2018[i,4] = sum(as.numeric(all_race_income_range_2018[i,16:20])) # 37500 - 49999
   range_combine_allr_2018[i,5] = sum(as.numeric(all_race_income_range_2018[i,21:25])) # 50000 - 62499
   range_combine_allr_2018[i,6] = sum(as.numeric(all_race_income_range_2018[i,26:30])) # 62500 - 74999
   range_combine_allr_2018[i,7] = sum(as.numeric(all_race_income_range_2018[i,31:35])) # 75000- 87499
   range_combine_allr_2018[i,8] = sum(as.numeric(all_race_income_range_2018[i,36:40])) # 87500 - 99999
   range_combine_allr_2018[i,9] = sum(as.numeric(all_race_income_range_2018[i,41])) # >= 100000
}
```

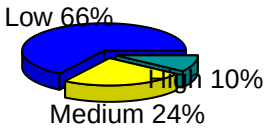
```r
range_combine_allr_2018 = as.data.frame(range_combine_allr_2018)
rownames(range_combine_allr_2018) = c('Northeast', 'Midwest', 'South', 'West')
#colnames(range_combine_allr) = c('0to12499', '12500to24999', '25000to37499', '37500to49999','50000to62
colnames(range_combine_allr_2018) = seq(0,100000, 12500)
# After divide the total income range data, I tried to divide it into low, medium and high level
income_level_all_2018 = matrix(0, 4, 3)
for (i in 1:4){
  income_level_all_2018[i,1] = sum(range_combine_allr_2018[i,1:4]) # 0 - 49999 Low Level
  income_level_all_2018[i,2] = sum(range_combine_allr_2018[i,5:8]) # 49999- 99999 Medium Level
   income_level_all_2018[i,3] = sum(range_combine_allr_2018[i,9]) # >= 199999 High Level
}
income_level_all_2018 = as.data.frame(income_level_all_2018)
colnames(income_level_all_2018) = c('Low', 'Medium', 'High')
rownames(income_level_all_2018) = c('Northeast', 'Midwest', 'South', 'West')
```

```r
# Pie plot
###
par(mfrow=c(2,2))
x <- as.vector(unlist(income_level_all_2018[1,]))
lbls <- c('Low', 'Medium', 'High')
pct <- round(x/sum(x)*100)
lbls <- paste(lbls, pct) # add percents to labels
lbls <- paste(lbls,"%",sep="") # ad % to labels
pie3D(x,labels=lbls,explode=0.1,labelcex = 0.8,
   main="Income Level Percent of Northeast of 2018", col = c('blue', 'yellow', '#009999'))
x <- as.vector(unlist(income_level_all_2018[2,]))
lbls <- c('Low', 'Medium', 'High')
pct <- round(x/sum(x)*100)
lbls <- paste(lbls, pct) # add percents to labels
lbls <- paste(lbls,"%",sep="") # ad % to labels
pie3D(x,labels=lbls,explode=0.1, labelcex = 0.8,col = c('blue', 'yellow', '#009999'),
   main="Income Level Percent of Midwest of 2018")
x <- as.vector(unlist(income_level_all_2018[3,]))
lbls <- c('Low', 'Medium', 'High')
pct <- round(x/sum(x)*100)
lbls <- paste(lbls, pct) # add percents to labels
lbls <- paste(lbls,"%",sep="") # ad % to labels
pie3D(x,labels=lbls,explode=0.05, labelcex = 0.8,col = c('blue', 'yellow', '#009999'),
   main="Income Level Percent of South of 2018")
x <- as.vector(unlist(income_level_all_2018[4,]))
lbls <- c('Low', 'Medium', 'High')
pct <- round(x/sum(x)*100)
lbls <- paste(lbls, pct) # add percents to labels
lbls <- paste(lbls,"%",sep="") # ad % to labels
pie3D(x,labels=lbls,explode=0.05, labelcex = 0.8,col = c('blue', 'yellow', '#009999'),
   main="Income Level Percent of West of 2018")
```

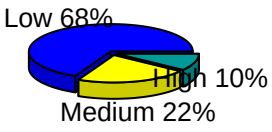
ncome Level Percent of Northeast of 201



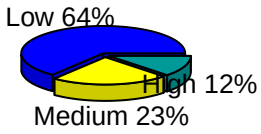
Income Level Percent of Midwest of 2018



Income Level Percent of South of 2018



Income Level Percent of West of 2018

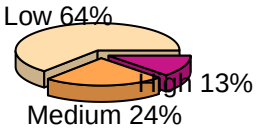



```
# 2017 region
allraces_2017 <- read.csv("~/Desktop/VTCourse/STAT 5014/Group Project/Total work experience-both sexes/1
allraces_2017 = as.data.frame(allraces_2017[-1,])
colnames(allraces_2017) = c('Region','Total', 'Total with Income', '$2499', '$2500-$4999', '$5000-$7499
                        '$10000-$12499', '$12500-$14999', '$15000-$17499', '$17500-$19999', '$20000-$224
                        '$22500-$24999', '$25000-$27499', '$27500-$29999', '$30000-$32499', '$32500-$374
                        '$42500-$44999', '$45000-$47499', '$47500-$49999', '$50000-$52499','$52500-$5499
                        '$100000-'
                        )
all_race_income_range_2017 = allraces_2017[,4:44]
colnames(all_race_income_range_2017) = c('$2499', '$2500-$4999', '$5000-$7499', '$7500-$9999',
                        '$10000-$12499', '$12500-$14999', '$15000-$17499', '$17500-$19999', '$20000-$224
                        '$22500-$24999', '$25000-$27499', '$27500-$29999', '$30000-$32499', '$32500-$374
                        '$42500-$44999', '$45000-$47499', '$47999-$49999', '$50000-$52499','$52500-$5499
                        '$100000-')
# Change the range to $10000
range_combine_allr_2017 = matrix(0, 4, 9)
for (i in 1:dim(all_race_income_range_2017)[1]){
  for (j in 1:dim(all_race_income_range_2017)[2]){
all_race_income_range_2017[i,j] = as.numeric(gsub(",","", all_race_income_range_2017[i,j]))
  }
}
for (i in 1:dim(all_race_income_range_2017)[1]){
  range_combine_allr_2017[i,1] = sum(as.numeric(all_race_income_range_2017[i,1:5])) # 0 - 12499
  range_combine_allr_2017[i,2] = sum(as.numeric(all_race_income_range_2017[i,6:10])) #12500 - 24999
   range_combine_allr_2017[i,3] = sum(as.numeric(all_race_income_range_2017[i,11:15])) # 25000 - 37499
   range_combine_allr_2017[i,4] = sum(as.numeric(all_race_income_range_2017[i,16:20])) # 37500 - 49999
   range_combine_allr_2017[i,5] = sum(as.numeric(all_race_income_range_2017[i,21:25])) # 50000 - 62499
   range_combine_allr_2017[i,6] = sum(as.numeric(all_race_income_range_2017[i,26:30])) # 62500 - 74999
   range_combine_allr_2017[i,7] = sum(as.numeric(all_race_income_range_2017[i,31:35])) # 75000- 87499
   range_combine_allr_2017[i,8] = sum(as.numeric(all_race_income_range_2017[i,36:40])) # 87500 - 99999
   range_combine_allr_2017[i,9] = sum(as.numeric(all_race_income_range_2017[i,41])) # >= 100000
```

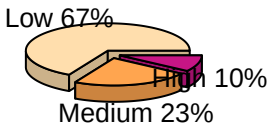
```
}
range_combine_allr_2017 = as.data.frame(range_combine_allr_2017)
rownames(range_combine_allr_2017) = c('Northeast', 'Midwest', 'South', 'West')
#colnames(range_combine_allr) = c('0to12499', '12500to24999', '25000to37499', '37500to49999','50000to62
colnames(range_combine_allr_2017) = seq(0,100000, 12500)
# After divide the total income range data, I tried to divide it into low, medium and high level
income_level_all_2017 = matrix(0, 4, 3)
for (i in 1:4){
  income_level_all_2017[i,1] = sum(range_combine_allr_2017[i,1:4]) # 0 - 49999 Low Level
  income_level_all_2017[i,2] = sum(range_combine_allr_2017[i,5:8]) # 49999- 99999 Medium Level
   income_level_all_2017[i,3] = sum(range_combine_allr_2017[i,9]) # >= 199999 High Level
}
income_level_all_2017 = as.data.frame(income_level_all_2017)
colnames(income_level_all_2017) = c('Low', 'Medium', 'High')
rownames(income_level_all_2017) = c('Northeast', 'Midwest', 'South', 'West')
```

```
par(mfrow=c(2,2))
x <- as.vector(unlist(income_level_all_2017[1,]))
lbls <- c('Low', 'Medium', 'High')
pct <- round(x/sum(x)*100)
lbls <- paste(lbls, pct) # add percents to labels
lbls <- paste(lbls,"%",sep="") # ad % to labels
pie3D(x,labels=lbls,explode=0.1,labelcex = 0.8,
   main="Income Level Percent of Northeast of 2017", col = c('navajowhite1', 'tan1', 'mediumvioletred'))
x <- as.vector(unlist(income_level_all_2017[2,]))
lbls <- c('Low', 'Medium', 'High')
pct <- round(x/sum(x)*100)
lbls <- paste(lbls, pct) # add percents to labels
lbls <- paste(lbls,"%",sep="") # ad % to labels
pie3D(x,labels=lbls,explode=0.1, labelcex = 0.8,col = c('navajowhite1', 'tan1', 'mediumvioletred'),
   main="Income Level Percent of Midwest of 2017")
x <- as.vector(unlist(income_level_all_2017[3,]))
lbls <- c('Low', 'Medium', 'High')
pct <- round(x/sum(x)*100)
lbls <- paste(lbls, pct) # add percents to labels
lbls <- paste(lbls,"%",sep="") # ad % to labels
pie3D(x,labels=lbls,explode=0.05, labelcex = 0.8,col = c('navajowhite1', 'tan1', 'mediumvioletred'),
   main="Income Level Percent of South of 2017")
x <- as.vector(unlist(income_level_all_2017[4,]))
lbls <- c('Low', 'Medium', 'High')
pct <- round(x/sum(x)*100)
lbls <- paste(lbls, pct) # add percents to labels
lbls <- paste(lbls,"%",sep="") # ad % to labels
pie3D(x,labels=lbls,explode=0.05, labelcex = 0.8,col = c('navajowhite1', 'tan1', 'mediumvioletred'),
   main="Income Level Percent of West of 2017")
```

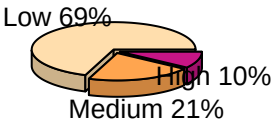
ncome Level Percent of Northeast of 201



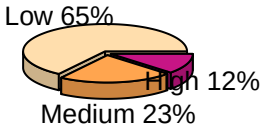
Income Level Percent of Midwest of 2017



Income Level Percent of South of 2017



Income Level Percent of West of 2017




```r
# Social disparity about Education level
Education_2017 <- read.csv("~/Desktop/VTCourse/STAT 5014/Group Project/Total work experience-both sexes,
Education_2017 <- Education_2017[-c(1,2,8),]
Education_2017[,1] <- c('9th_Grade', '12th_Grade', 'High_School', 'College', 'Associate','Bachelor', 'Ma
rowname_edu = Education_2017[,1]
Education_2017 <- as.data.frame(Education_2017[,-(1:3)])
rownames(Education_2017) <- rowname_edu
colnames(Education_2017) = c('$2499', '$2500-$4999', '$5000-$7499', '$7500-$9999',
                        '$10000-$12499', '$12500-$14999', '$15000-$17499', '$17500-$19999', '$20000-$224
                        '$22500-$24999', '$25000-$27499', '$27500-$29999', '$30000-$32499', '$32500-$374
                        '$42500-$44999', '$45000-$47499', '$47999-$49999', '$50000-$52499','$52500-$5499
                        '$100000-')
edu_income_range_2017 = matrix(0, 9, 9)
for (i in 1:dim(Education_2017)[1]){
  for (j in 1:dim(Education_2017)[2]){
Education_2017[i,j] = as.numeric(gsub(",","", Education_2017[i,j]))
  }
}
for (i in 1:dim(edu_income_range_2017)[1]){
  edu_income_range_2017[i,1] = sum(as.numeric(Education_2017[i,1:5])) # 0 - 12499
  edu_income_range_2017[i,2] = sum(as.numeric(Education_2017[i,6:10])) #12500 - 24999
   edu_income_range_2017[i,3] = sum(as.numeric(Education_2017[i,11:15])) # 25000 - 37499
   edu_income_range_2017[i,4] = sum(as.numeric(Education_2017[i,16:20])) # 37500 - 49999
   edu_income_range_2017[i,5] = sum(as.numeric(Education_2017[i,21:25])) # 50000 - 62499
   edu_income_range_2017[i,6] = sum(as.numeric(Education_2017[i,26:30])) # 62500 - 74999
   edu_income_range_2017[i,7] = sum(as.numeric(Education_2017[i,31:35])) # 75000- 87499
   edu_income_range_2017[i,8] = sum(as.numeric(Education_2017[i,36:40])) # 87500 - 99999
   edu_income_range_2017[i,9] = sum(as.numeric(Education_2017[i,41])) # >= 100000
}
edu_income_range_2017 = as.data.frame(edu_income_range_2017)
rownames(edu_income_range_2017) = c('9th_Grade', '12th_Grade', 'High_School', 'College', 'Associate','Ba
#colnames(range_combine_allr) = c('0to12499', '12500to24999', '25000to37499', '37500to49999','50000to62
```

```r
colnames(edu_income_range_2017) = seq(0,100000, 12500)
# After divide the total income range data, I tried to divide it into low, medium and high level
income_edu_2017 = matrix(0, 9, 3)
for (i in 1:9){
  income_edu_2017[i,1] = sum(edu_income_range_2017[i,1:4]) # 0 - 49999 Low Level
  income_edu_2017[i,2] = sum(edu_income_range_2017[i,5:8]) # 49999- 99999 Medium Level
   income_edu_2017[i,3] = sum(edu_income_range_2017[i,9]) # >= 199999 High Level
}
income_edu_2017= as.data.frame(income_edu_2017)
colnames(income_edu_2017) = c('Low', 'Medium', 'High')
rownames(income_edu_2017) =c('9th_Grade', '12th_Grade', 'High_School', 'College', 'Associate','Bachelor
income_edu_2017_mod = matrix(0, 3, 3)
for (i in 1:dim(income_edu_2017_mod)[2]){
income_edu_2017_mod[1,i] = sum(income_edu_2017[1:3,i])
income_edu_2017_mod[2,i] = sum(income_edu_2017[4:5,i])
income_edu_2017_mod[3,i] = sum(income_edu_2017[6:9,i])
}
income_edu_2017_mod = as.data.frame(income_edu_2017_mod)
colnames(income_edu_2017_mod) = c('Low', 'Medium', "High")
rownames(income_edu_2017_mod) = c('HighSchool', 'College', 'Bachelor Above')
```

```r
# Education 2018
Education_2018 <- read.csv("~/Desktop/VTCourse/STAT 5014/Group Project/Total work experience-both sexes,
Education_2018 <- Education_2018[-c(1,2,8),]
Education_2018[,1] <- c('9th_Grade', '12th_Grade', 'High_School', 'College', 'Associate','Bachelor', 'Ma
rowname_edu = Education_2018[,1]
Education_2018 <- as.data.frame(Education_2018[,-(1:3)])
rownames(Education_2018) <- rowname_edu
colnames(Education_2018) = c('$2499', '$2500-$4999', '$5000-$7499', '$7500-$9999',
                        '$10000-$12499', '$12500-$14999', '$15000-$17499', '$17500-$19999', '$20000-$224
                        '$22500-$24999', '$25000-$27499', '$27500-$29999', '$30000-$32499', '$32500-$374
                        '$42500-$44999', '$45000-$47499', '$47999-$49999', '$50000-$52499','$52500-$5499
                        '$100000-')
edu_income_range_2018 = matrix(0, 9, 9)
for (i in 1:dim(Education_2018)[1]){
  for (j in 1:dim(Education_2018)[2]){
Education_2018[i,j] = as.numeric(gsub(",","", Education_2018[i,j]))
  }
}
for (i in 1:dim(edu_income_range_2018)[1]){
  edu_income_range_2018[i,1] = sum(as.numeric(Education_2018[i,1:5])) # 0 - 12499
  edu_income_range_2018[i,2] = sum(as.numeric(Education_2018[i,6:10])) #12500 - 24999
   edu_income_range_2018[i,3] = sum(as.numeric(Education_2018[i,11:15])) # 25000 - 37499
   edu_income_range_2018[i,4] = sum(as.numeric(Education_2018[i,16:20])) # 37500 - 49999
   edu_income_range_2018[i,5] = sum(as.numeric(Education_2018[i,21:25])) # 50000 - 62499
   edu_income_range_2018[i,6] = sum(as.numeric(Education_2018[i,26:30])) # 62500 - 74999
   edu_income_range_2018[i,7] = sum(as.numeric(Education_2018[i,31:35])) # 75000- 87499
   edu_income_range_2018[i,8] = sum(as.numeric(Education_2018[i,36:40])) # 87500 - 99999
   edu_income_range_2018[i,9] = sum(as.numeric(Education_2018[i,41])) # >= 100000
}
edu_income_range_2018 = as.data.frame(edu_income_range_2018)
rownames(edu_income_range_2018) = c('9th_Grade', '12th_Grade', 'High_School', 'College', 'Associate','Ba
#colnames(range_combine_allr) = c('0to12499', '12500to24999', '25000to37499', '37500to49999','50000to62
colnames(edu_income_range_2018) = seq(0,100000, 12500)
```

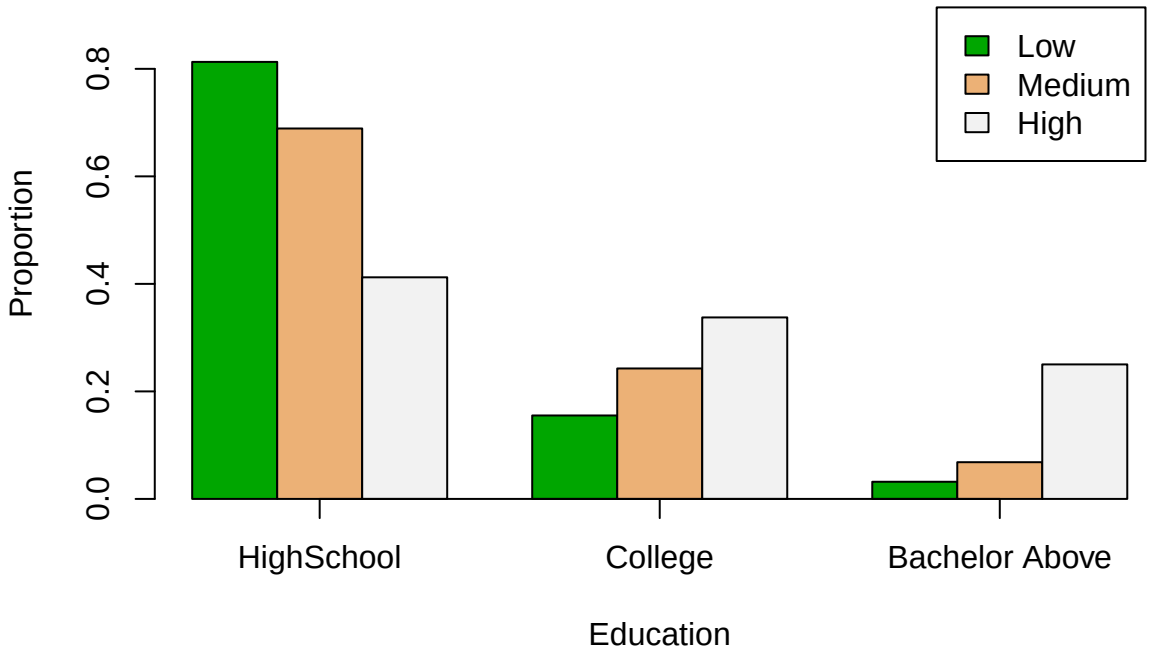
```r
# After divide the total income range data, I tried to divide it into low, medium and high level
income_edu_2018 = matrix(0, 9, 3)
for (i in 1:9){
  income_edu_2018[i,1] = sum(edu_income_range_2018[i,1:4]) # 0 - 49999 Low Level
  income_edu_2018[i,2] = sum(edu_income_range_2018[i,5:8]) # 49999- 99999 Medium Level
   income_edu_2018[i,3] = sum(edu_income_range_2018[i,9]) # >= 199999 High Level
}
income_edu_2018= as.data.frame(income_edu_2018)
colnames(income_edu_2018) = c('Low', 'Medium', 'High')
rownames(income_edu_2018) =c('9th_Grade', '12th_Grade', 'High_School', 'College', 'Associate','Bachelor
income_edu_2018_mod = matrix(0, 3, 3)
for (i in 1:dim(income_edu_2018_mod)[2]){
income_edu_2018_mod[1,i] = sum(income_edu_2018[1:3,i])
income_edu_2018_mod[2,i] = sum(income_edu_2018[4:5,i])
income_edu_2018_mod[3,i] = sum(income_edu_2018[6:9,i])
}
income_edu_2018_mod = as.data.frame(income_edu_2018_mod)
colnames(income_edu_2018_mod) = c('Low', 'Medium', "High")
rownames(income_edu_2018_mod) = c('HighSchool', 'College', 'Bachelor Above')
```

```r
# Education 2019
Education_2019 <- read.csv("~/Desktop/VTCourse/STAT 5014/Group Project/Total work experience-both sexes,
Education_2019 <- Education_2019[-c(1,2,8),]
Education_2019[,1] <- c('9th_Grade', '12th_Grade', 'High_School', 'College', 'Associate','Bachelor', 'Ma
rowname_edu = Education_2019[,1]
Education_2019 <- as.data.frame(Education_2019[,-(1:3)])
rownames(Education_2019) <- rowname_edu
colnames(Education_2019) = c('$2499', '$2500-$4999', '$5000-$7499', '$7500-$9999',
                        '$10000-$12499', '$12500-$14999', '$15000-$17499', '$17500-$19999', '$20000-$224
                        '$22500-$24999', '$25000-$27499', '$27500-$29999', '$30000-$32499', '$32500-$374
                        '$42500-$44999', '$45000-$47499', '$47999-$49999', '$50000-$52499','$52500-$5499
                        '$100000-')
edu_income_range_2019 = matrix(0, 9, 9)
for (i in 1:dim(Education_2019)[1]){
  for (j in 1:dim(Education_2019)[2]){
Education_2019[i,j] = as.numeric(gsub(",","", Education_2019[i,j]))
  }
}
for (i in 1:dim(edu_income_range_2019)[1]){
  edu_income_range_2019[i,1] = sum(as.numeric(Education_2019[i,1:5])) # 0 - 12499
  edu_income_range_2019[i,2] = sum(as.numeric(Education_2019[i,6:10])) #12500 - 24999
   edu_income_range_2019[i,3] = sum(as.numeric(Education_2019[i,11:15])) # 25000 - 37499
   edu_income_range_2019[i,4] = sum(as.numeric(Education_2019[i,16:20])) # 37500 - 49999
   edu_income_range_2019[i,5] = sum(as.numeric(Education_2019[i,21:25])) # 50000 - 62499
   edu_income_range_2019[i,6] = sum(as.numeric(Education_2019[i,26:30])) # 62500 - 74999
   edu_income_range_2019[i,7] = sum(as.numeric(Education_2019[i,31:35])) # 75000- 87499
   edu_income_range_2019[i,8] = sum(as.numeric(Education_2019[i,36:40])) # 87500 - 99999
   edu_income_range_2019[i,9] = sum(as.numeric(Education_2019[i,41])) # >= 100000
}
edu_income_range_2019 = as.data.frame(edu_income_range_2019)
rownames(edu_income_range_2019) = c('9th_Grade', '12th_Grade', 'High_School', 'College', 'Associate','Ba
#colnames(range_combine_allr) = c('0to12499', '12500to24999', '25000to37499', '37500to49999','50000to62
colnames(edu_income_range_2019) = seq(0,100000, 12500)
# After divide the total income range data, I tried to divide it into low, medium and high level
```

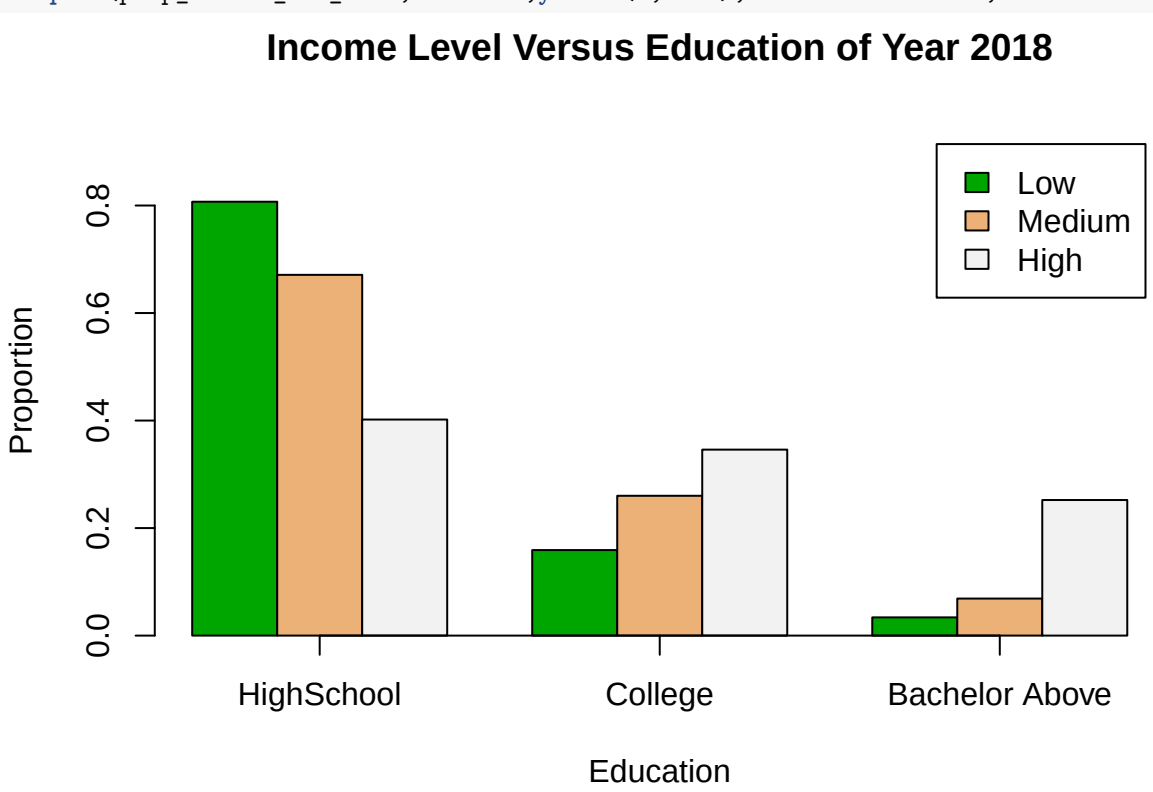
```r
income_edu_2019 = matrix(0, 9, 3)
for (i in 1:9){
  income_edu_2019[i,1] = sum(edu_income_range_2019[i,1:4]) # 0 - 49999 Low Level
  income_edu_2019[i,2] = sum(edu_income_range_2019[i,5:8]) # 49999- 99999 Medium Level
   income_edu_2019[i,3] = sum(edu_income_range_2019[i,9]) # >= 199999 High Level
}
income_edu_2019 = as.data.frame(income_edu_2019)
colnames(income_edu_2019) = c('Low', 'Medium', 'High')
rownames(income_edu_2019) =c('9th_Grade', '12th_Grade', 'High_School', 'College', 'Associate','Bachelor
income_edu_2019_mod = matrix(0, 3, 3)
for (i in 1:dim(income_edu_2019_mod)[2]){
income_edu_2019_mod[1,i] = sum(income_edu_2019[1:3,i])
income_edu_2019_mod[2,i] = sum(income_edu_2019[4:5,i])
income_edu_2019_mod[3,i] = sum(income_edu_2019[6:9,i])}
income_edu_2019_mod = as.data.frame(income_edu_2019_mod)
colnames(income_edu_2019_mod) = c('Low', 'Medium', "High")
rownames(income_edu_2019_mod) = c('HighSchool', 'College', 'Bachelor Above')
```

```r
income_edu_2017_mod = as.matrix(income_edu_2017_mod)
prop_income_edu_2017 = matrix(0, 3, 3)
for (i in 1:dim(income_edu_2017_mod)[1]){
  prop_income_edu_2017[i,1] = income_edu_2017_mod[i,1]/sum(income_edu_2017_mod[i,])
  prop_income_edu_2017[i,2] = income_edu_2017_mod[i,2]/sum(income_edu_2017_mod[i,])
  prop_income_edu_2017[i,3] = income_edu_2017_mod[i,3]/sum(income_edu_2017_mod[i,])
}
labels = rownames(income_edu_2017_mod)
color.names = terrain.colors(3)
barplot(prop_income_edu_2017,beside=T,ylim=c(0,0.95), col= color.names,xlab='Education',ylab="Proportio
```

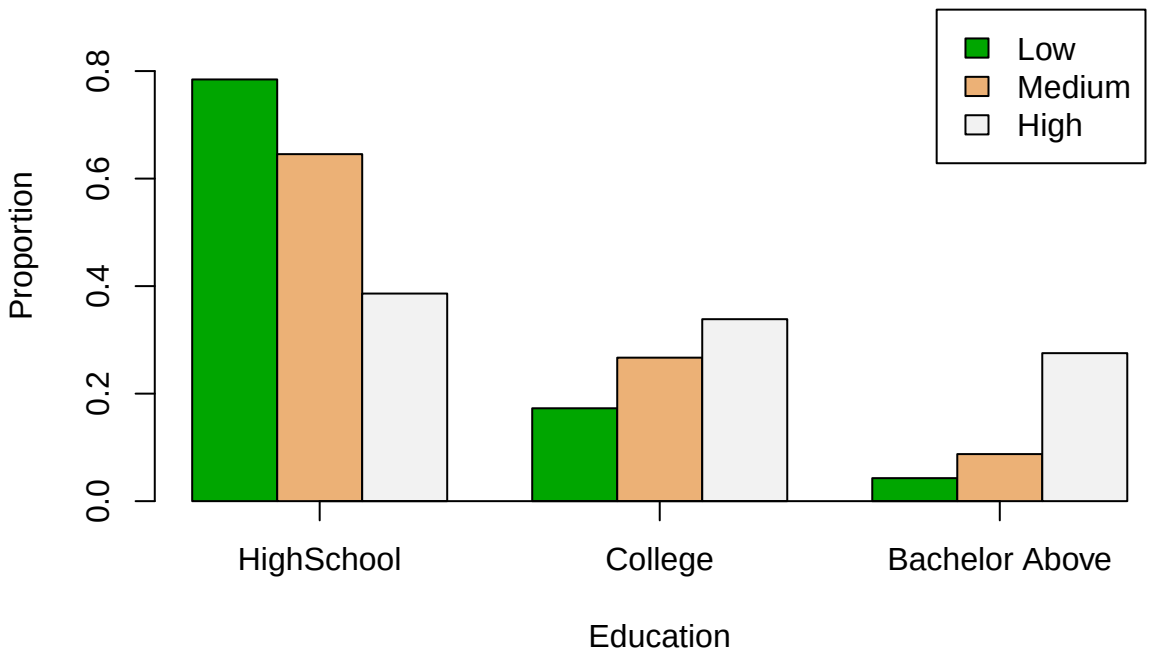
Income Level Versus Education of Year 2017



```r
income_edu_2018_mod = as.matrix(income_edu_2018_mod)
prop_income_edu_2018 = matrix(0, 3, 3)
for (i in 1:dim(income_edu_2018_mod)[1]){
  prop_income_edu_2018[i,1] = income_edu_2018_mod[i,1]/sum(income_edu_2018_mod[i,])
  prop_income_edu_2018[i,2] = income_edu_2018_mod[i,2]/sum(income_edu_2018_mod[i,])
  prop_income_edu_2018[i,3] = income_edu_2018_mod[i,3]/sum(income_edu_2018_mod[i,])
}
labels = rownames(income_edu_2018_mod)
color.names = terrain.colors(3)
barplot(prop_income_edu_2018,beside=T,ylim=c(0,0.95), col= color.names,xlab='Education',ylab="Proportion
```




```r
income_edu_2019_mod = as.matrix(income_edu_2019_mod)
prop_income_edu_2019 = matrix(0, 3, 3)
for (i in 1:dim(income_edu_2019_mod)[1]){
  prop_income_edu_2019[i,1] = income_edu_2019_mod[i,1]/sum(income_edu_2019_mod[i,])
  prop_income_edu_2019[i,2] = income_edu_2019_mod[i,2]/sum(income_edu_2019_mod[i,])
  prop_income_edu_2019[i,3] = income_edu_2019_mod[i,3]/sum(income_edu_2019_mod[i,])
}
labels = rownames(income_edu_2019_mod)
color.names = terrain.colors(3)
barplot(prop_income_edu_2019,beside=T,ylim=c(0,0.95), col= color.names,xlab='Education',ylab="Proportion
```




```
Age_2019 <- read.csv("~/Desktop/VTCourse/STAT 5014/Group Project/Total work experience-both sexes/2019/
ind = c(1, 2, 3, 6,7, 9, 10, 12, 13, 15, 16,18, 19, 20 ,21)
Age_2019 = Age_2019[-ind,]
Age_2019_mod = as.data.frame(Age_2019[,-c(1,2,3)])
rownames(Age_2019_mod) = c('15 to 24', '25 to 35', '35 to 44', '45 to 54', '55 to 64', 'above 65')
colnames(Age_2019_mod) = c('$2499', '$2500-$4999', '$5000-$7499', '$7500-$9999',
                           '$10000-$12499', '$12500-$14999', '$15000-$17499', '$17500-$19999', '$20000-$224
                           '$22500-$24999', '$25000-$27499', '$27500-$29999', '$30000-$32499', '$32500-$374
                           '$42500-$44999', '$45000-$47499', '$47999-$49999', '$50000-$52499','$52500-$5499
                           '$100000-')
age_2019 = matrix(0, 6, 9)
for (i in 1:dim(Age_2019_mod)[1]){
  for (j in 1:dim(Age_2019_mod)[2]){
Age_2019_mod[i,j] = as.numeric(gsub(",","", Age_2019_mod[i,j]))
  }
}
for (i in 1:dim(age_2019)[1]){
  age_2019[i,1] = sum(as.numeric(Age_2019_mod[i,1:5])) # 0 - 12499
  age_2019[i,2] = sum(as.numeric(Age_2019_mod[i,6:10])) #12500 - 24999
  age_2019[i,3] = sum(as.numeric(Age_2019_mod[i,11:15])) # 25000 - 37499
  age_2019[i,4] = sum(as.numeric(Age_2019_mod[i,16:20])) # 37500 - 49999
   age_2019[i,5] = sum(as.numeric(Age_2019_mod[i,21:25])) # 50000 - 62499
  age_2019[i,6] = sum(as.numeric(Age_2019_mod[i,26:30])) # 62500 - 74999
   age_2019[i,7] = sum(as.numeric(Age_2019_mod[i,31:35])) # 75000- 87499
  age_2019[i,8] = sum(as.numeric(Age_2019_mod[i,36:40])) # 87500 - 99999
   age_2019[i,9] = sum(as.numeric(Age_2019_mod[i,41])) # >= 100000
}
age_2019 = as.data.frame(age_2019)
rownames(age_2019) =c('15 to 24', '25 to 35', '35 to 44', '45 to 54', '55 to 64', 'above 65')
Age_2019 = matrix(0, 6, 3)
```

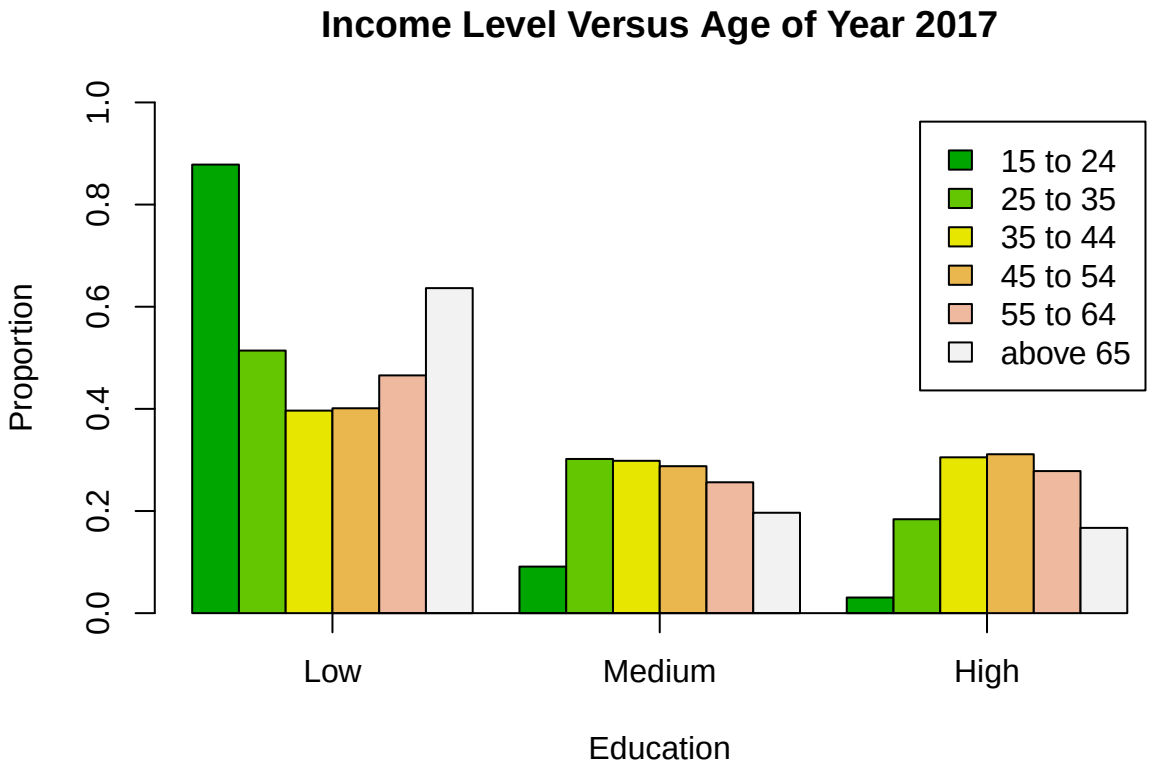
```
for (i in 1:dim(Age_2019)[1]){
Age_2019[i,1] = sum(age_2019[i,1:3])
Age_2019[i,2] = sum(age_2019[i,4:6])
Age_2019[i,3] = sum(age_2019[i,6:9])
}
Age_2019 = as.data.frame(Age_2019)
colnames(Age_2019) = c('Low', 'Medium', "High")
rownames(Age_2019) =c('15 to 24', '25 to 35', '35 to 44', '45 to 54', '55 to 64', 'above 65')
```

```
# Age 2018
Age_2018 <- read.csv("~/Desktop/VTCourse/STAT 5014/Group Project/Total work experience-both sexes/2018/a
ind = c(1, 2, 3, 6,7, 9, 10, 12, 13, 15, 16,18, 19, 20 ,21)
Age_2018 = Age_2018[-ind,]
Age_2018_mod = as.data.frame(Age_2018[,-c(1,2,3)])
rownames(Age_2018_mod) = c('15 to 24', '25 to 35', '35 to 44', '45 to 54', '55 to 64', 'above 65')
colnames(Age_2018_mod) = c('$2499', '$2500-$4999', '$5000-$7499', '$7500-$9999',
                        '$10000-$12499', '$12500-$14999', '$15000-$17499', '$17500-$19999', '$20000-$224
                        '$22500-$24999', '$25000-$27499', '$27500-$29999', '$30000-$32499', '$32500-$374
                        '$42500-$44999', '$45000-$47499', '$47999-$49999', '$50000-$52499','$52500-$5499
                        '$100000-')
age_2018 = matrix(0, 6, 9)
for (i in 1:dim(Age_2018_mod)[1]){
  for (j in 1:dim(Age_2018_mod)[2]){
Age_2018_mod[i,j] = as.numeric(gsub(",","", Age_2018_mod[i,j]))
  }
}
for (i in 1:dim(age_2018)[1]){
  age_2018[i,1] = sum(as.numeric(Age_2018_mod[i,1:5])) # 0 - 12499
  age_2018[i,2] = sum(as.numeric(Age_2018_mod[i,6:10])) #12500 - 24999
  age_2018[i,3] = sum(as.numeric(Age_2018_mod[i,11:15])) # 25000 - 37499
  age_2018[i,4] = sum(as.numeric(Age_2018_mod[i,16:20])) # 37500 - 49999
   age_2018[i,5] = sum(as.numeric(Age_2018_mod[i,21:25])) # 50000 - 62499
  age_2018[i,6] = sum(as.numeric(Age_2018_mod[i,26:30])) # 62500 - 74999
   age_2018[i,7] = sum(as.numeric(Age_2018_mod[i,31:35])) # 75000- 87499
  age_2018[i,8] = sum(as.numeric(Age_2018_mod[i,36:40])) # 87500 - 99999
   age_2018[i,9] = sum(as.numeric(Age_2018_mod[i,41])) # >= 100000
}
age_2018 = as.data.frame(age_2018)
rownames(age_2018) =c('15 to 24', '25 to 35', '35 to 44', '45 to 54', '55 to 64', 'above 65')
Age_2018 = matrix(0, 6, 3)
for (i in 1:dim(Age_2018)[1]){
Age_2018[i,1] = sum(age_2018[i,1:3])
Age_2018[i,2] = sum(age_2018[i,4:6])
Age_2018[i,3] = sum(age_2018[i,6:9])
}
Age_2018 = as.data.frame(Age_2018)
colnames(Age_2018) = c('Low', 'Medium', "High")
rownames(Age_2018) =c('15 to 24', '25 to 35', '35 to 44', '45 to 54', '55 to 64', 'above 65')
```

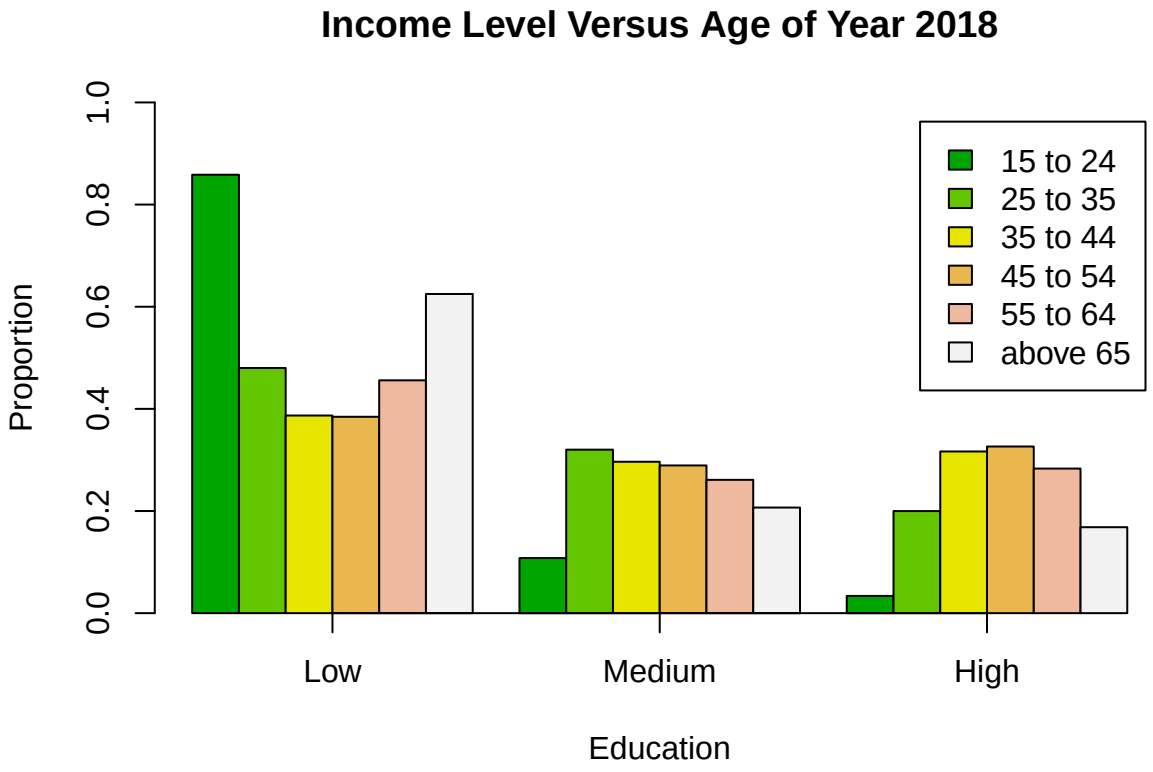
```
# Age 2017
Age_2017 <- read.csv("~/Desktop/VTCourse/STAT 5014/Group Project/Total work experience-both sexes/2017/A
ind = c(1, 2, 3, 6,7, 9, 10, 12, 13, 15, 16,18, 19, 20 ,21)
Age_2017 = Age_2017[-ind,]
Age_2017_mod = as.data.frame(Age_2017[,-c(1,2,3)])
```

```
rownames(Age_2017_mod) = c('15 to 24', '25 to 35', '35 to 44', '45 to 54', '55 to 64', 'above 65')
colnames(Age_2017_mod) = c('$2499', '$2500-$4999', '$5000-$7499', '$7500-$9999',
                        '$10000-$12499', '$12500-$14999', '$15000-$17499', '$17500-$19999', '$20000-$224
                        '$22500-$24999', '$25000-$27499', '$27500-$29999', '$30000-$32499', '$32500-$374
                        '$42500-$44999', '$45000-$47499', '$47999-$49999', '$50000-$52499','$52500-$5499
                        '$100000-')
age_2017 = matrix(0, 6, 9)
for (i in 1:dim(Age_2017_mod)[1]){
  for (j in 1:dim(Age_2017_mod)[2]){
Age_2017_mod[i,j] = as.numeric(gsub(",","", Age_2017_mod[i,j]))
  }
}
for (i in 1:dim(age_2017)[1]){
  age_2017[i,1] = sum(as.numeric(Age_2017_mod[i,1:5])) # 0 - 12499
  age_2017[i,2] = sum(as.numeric(Age_2017_mod[i,6:10])) #12500 - 24999
  age_2017[i,3] = sum(as.numeric(Age_2017_mod[i,11:15])) # 25000 - 37499
  age_2017[i,4] = sum(as.numeric(Age_2017_mod[i,16:20])) # 37500 - 49999
   age_2017[i,5] = sum(as.numeric(Age_2017_mod[i,21:25])) # 50000 - 62499
  age_2017[i,6] = sum(as.numeric(Age_2017_mod[i,26:30])) # 62500 - 74999
   age_2017[i,7] = sum(as.numeric(Age_2017_mod[i,31:35])) # 75000- 87499
  age_2017[i,8] = sum(as.numeric(Age_2017_mod[i,36:40])) # 87500 - 99999
   age_2017[i,9] = sum(as.numeric(Age_2017_mod[i,41])) # >= 100000
}
age_2017 = as.data.frame(age_2017)
rownames(age_2017) =c('15 to 24', '25 to 35', '35 to 44', '45 to 54', '55 to 64', 'above 65')
Age_2017 = matrix(0, 6, 3)
for (i in 1:dim(Age_2017)[1]){
Age_2017[i,1] = sum(age_2017[i,1:3])
Age_2017[i,2] = sum(age_2017[i,4:6])
Age_2017[i,3] = sum(age_2017[i,6:9])
}
Age_2017 = as.data.frame(Age_2017)
colnames(Age_2017) = c('Low', 'Medium', "High")
rownames(Age_2017) =c('15 to 24', '25 to 35', '35 to 44', '45 to 54', '55 to 64', 'above 65')
```

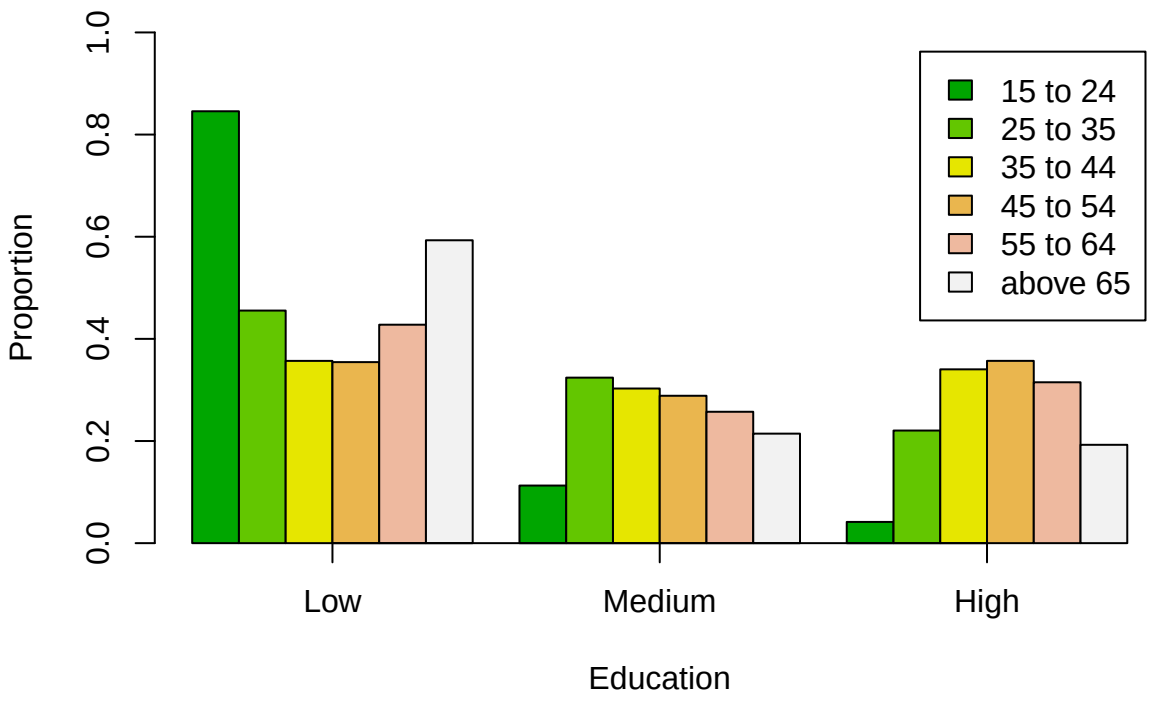
```
Age_2017 = as.matrix(Age_2017)
prop_age_2017 = matrix(0, 6, 3)
for (i in 1:dim(prop_age_2017)[1]){
  prop_age_2017[i,1] = Age_2017[i,1]/sum(Age_2017[i,])
  prop_age_2017[i,2] = Age_2017[i,2]/sum(Age_2017[i,])
  prop_age_2017[i,3] = Age_2017[i,3]/sum(Age_2017[i,])
}
labels = colnames(Age_2017)
color.names = terrain.colors(6)
barplot(prop_age_2017, beside=T,ylim=c(0,1), col= color.names,
        xlab='Education',ylab="Proportion",axis.lty="solid", legend = rownames(Age_2017), names.arg=labe
```




```
Age_2018 = as.matrix(Age_2018)
prop_age_2018 = matrix(0, 6, 3)
for (i in 1:dim(prop_age_2018)[1]){
  prop_age_2018[i,1] = Age_2018[i,1]/sum(Age_2018[i,])
  prop_age_2018[i,2] = Age_2018[i,2]/sum(Age_2018[i,])
  prop_age_2018[i,3] = Age_2018[i,3]/sum(Age_2018[i,])
}
labels = colnames(Age_2018)
color.names = terrain.colors(6)
barplot(prop_age_2018, beside=T,ylim=c(0,1), col= color.names,
        xlab='Education',ylab="Proportion",axis.lty="solid", legend = rownames(Age_2018), names.arg=lab
```




```
Age_2019 = as.matrix(Age_2019)
prop_age_2019 = matrix(0, 6, 3)
for (i in 1:dim(prop_age_2019)[1]){
  prop_age_2019[i,1] = Age_2019[i,1]/sum(Age_2019[i,])
  prop_age_2019[i,2] = Age_2019[i,2]/sum(Age_2019[i,])
  prop_age_2019[i,3] = Age_2019[i,3]/sum(Age_2019[i,])
}
labels = colnames(Age_2019)
color.names = terrain.colors(6)
barplot(prop_age_2019, beside=T,ylim=c(0,1), col= color.names,
        xlab='Education',ylab="Proportion",axis.lty="solid", legend = rownames(Age_2019), names.arg=labe
```




```
# 2016 region
allraces_2016 <- read.csv("~/Desktop/VTCourse/STAT 5014/Group Project/Total work experience-both sexes/1
allraces_2016 = as.data.frame(allraces_2016[-1,])
colnames(allraces_2016) = c('Region','Total', 'Total with Income', '$2499', '$2500-$4999', '$5000-$7499
                        '$10000-$12499', '$12500-$14999', '$15000-$17499', '$17500-$19999', '$20000-$224
                        '$22500-$24999', '$25000-$27499', '$27500-$29999', '$30000-$32499', '$32500-$374
                        '$42500-$44999', '$45000-$47499', '$47500-$49999', '$50000-$52499','$52500-$5499
                        '$100000-'
                        )
all_race_income_range_2016 = allraces_2016[,4:44]
colnames(all_race_income_range_2016) = c('$2499', '$2500-$4999', '$5000-$7499', '$7500-$9999',
                        '$10000-$12499', '$12500-$14999', '$15000-$17499', '$17500-$19999', '$20000-$224
                        '$22500-$24999', '$25000-$27499', '$27500-$29999', '$30000-$32499', '$32500-$374
                        '$42500-$44999', '$45000-$47499', '$47999-$49999', '$50000-$52499','$52500-$5499
                        '$100000-')
range_combine_allr_2016 = matrix(0, 4, 9)
for (i in 1:dim(all_race_income_range_2016)[1]){
  for (j in 1:dim(all_race_income_range_2016)[2]){
all_race_income_range_2016[i,j] = as.numeric(gsub(",","", all_race_income_range_2016[i,j]))
  }
}
for (i in 1:dim(all_race_income_range_2016)[1]){
  range_combine_allr_2016[i,1] = sum(as.numeric(all_race_income_range_2016[i,1:5])) # 0 - 12499
  range_combine_allr_2016[i,2] = sum(as.numeric(all_race_income_range_2016[i,6:10])) #12500 - 24999
   range_combine_allr_2016[i,3] = sum(as.numeric(all_race_income_range_2016[i,11:15])) # 25000 - 37499
   range_combine_allr_2016[i,4] = sum(as.numeric(all_race_income_range_2016[i,16:20])) # 37500 - 49999
   range_combine_allr_2016[i,5] = sum(as.numeric(all_race_income_range_2016[i,21:25])) # 50000 - 62499
   range_combine_allr_2016[i,6] = sum(as.numeric(all_race_income_range_2016[i,26:30])) # 62500 - 74999
   range_combine_allr_2016[i,7] = sum(as.numeric(all_race_income_range_2016[i,31:35])) # 75000- 87499
   range_combine_allr_2016[i,8] = sum(as.numeric(all_race_income_range_2016[i,36:40])) # 87500 - 99999
```

```
   range_combine_allr_2016[i,9] = sum(as.numeric(all_race_income_range_2016[i,41])) # >= 100000
}
range_combine_allr_2016 = as.data.frame(range_combine_allr_2016)
rownames(range_combine_allr_2016) = c('Northeast', 'Midwest', 'South', 'West')
#colnames(range_combine_allr) = c('0to12499', '12500to24999', '25000to37499', '37500to49999','50000to62
colnames(range_combine_allr_2016) = seq(0,100000, 12500)
# After divide the total income range data, I tried to divide it into low, medium and high level
income_level_all_2016 = matrix(0, 4, 3)
for (i in 1:4){
  income_level_all_2016[i,1] = sum(range_combine_allr_2016[i,1:4]) # 0 - 49999 Low Level
  income_level_all_2016[i,2] = sum(range_combine_allr_2016[i,5:8]) # 49999- 99999 Medium Level
   income_level_all_2016[i,3] = sum(range_combine_allr_2016[i,9]) # >= 199999 High Level
}
income_level_all_2016= as.data.frame(income_level_all_2016)
colnames(income_level_all_2016) = c('Low', 'Medium', 'High')
rownames(income_level_all_2016) = c('Northeast', 'Midwest', 'South', 'West')
```

```
# 2015 region
allraces_2015 <- read.csv("~/Desktop/VTCourse/STAT 5014/Group Project/Total work experience-both sexes/1
allraces_2015 = as.data.frame(allraces_2015[-1,])
colnames(allraces_2015) = c('Region','Total', 'Total with Income', '$2499', '$2500-$4999', '$5000-$7499
                        '$10000-$12499', '$12500-$14999', '$15000-$17499', '$17500-$19999', '$20000-$224
                        '$22500-$24999', '$25000-$27499', '$27500-$29999', '$30000-$32499', '$32500-$374
                        '$42500-$44999', '$45000-$47499', '$47500-$49999', '$50000-$52499','$52500-$5499
                        '$100000-'
                        )
all_race_income_range_2015 = allraces_2015[,4:44]
colnames(all_race_income_range_2015) = c('$2499', '$2500-$4999', '$5000-$7499', '$7500-$9999',
                        '$10000-$12499', '$12500-$14999', '$15000-$17499', '$17500-$19999', '$20000-$224
                        '$22500-$24999', '$25000-$27499', '$27500-$29999', '$30000-$32499', '$32500-$374
                        '$42500-$44999', '$45000-$47499', '$47999-$49999', '$50000-$52499','$52500-$5499
                        '$100000-')
range_combine_allr_2015 = matrix(0, 4, 9)
for (i in 1:dim(all_race_income_range_2015)[1]){
  for (j in 1:dim(all_race_income_range_2015)[2]){
all_race_income_range_2015[i,j] = as.numeric(gsub(",","", all_race_income_range_2015[i,j]))
  }
}
for (i in 1:dim(all_race_income_range_2015)[1]){
  range_combine_allr_2015[i,1] = sum(as.numeric(all_race_income_range_2015[i,1:5])) # 0 - 12499
  range_combine_allr_2015[i,2] = sum(as.numeric(all_race_income_range_2015[i,6:10])) #12500 - 24999
   range_combine_allr_2015[i,3] = sum(as.numeric(all_race_income_range_2015[i,11:15])) # 25000 - 37499
   range_combine_allr_2015[i,4] = sum(as.numeric(all_race_income_range_2015[i,16:20])) # 37500 - 49999
   range_combine_allr_2015[i,5] = sum(as.numeric(all_race_income_range_2015[i,21:25])) # 50000 - 62499
   range_combine_allr_2015[i,6] = sum(as.numeric(all_race_income_range_2015[i,26:30])) # 62500 - 74999
   range_combine_allr_2015[i,7] = sum(as.numeric(all_race_income_range_2015[i,31:35])) # 75000- 87499
   range_combine_allr_2015[i,8] = sum(as.numeric(all_race_income_range_2015[i,36:40])) # 87500 - 99999
   range_combine_allr_2015[i,9] = sum(as.numeric(all_race_income_range_2015[i,41])) # >= 100000
}
range_combine_allr_2015 = as.data.frame(range_combine_allr_2015)
rownames(range_combine_allr_2015) = c('Northeast', 'Midwest', 'South', 'West')
#colnames(range_combine_allr) = c('0to12499', '12500to24999', '25000to37499', '37500to49999','50000to62
colnames(range_combine_allr_2015) = seq(0,100000, 12500)
# After divide the total income range data, I tried to divide it into low, medium and high level
```

```
income_level_all_2015 = matrix(0, 4, 3)
for (i in 1:4){
  income_level_all_2015[i,1] = sum(range_combine_allr_2015[i,1:4]) # 0 - 49999 Low Level
  income_level_all_2015[i,2] = sum(range_combine_allr_2015[i,5:8]) # 49999- 99999 Medium Level
   income_level_all_2015[i,3] = sum(range_combine_allr_2015[i,9]) # >= 199999 High Level
}
income_level_all_2015= as.data.frame(income_level_all_2015)
colnames(income_level_all_2015) = c('Low', 'Medium', 'High')
rownames(income_level_all_2015) = c('Northeast', 'Midwest', 'South', 'West')
```

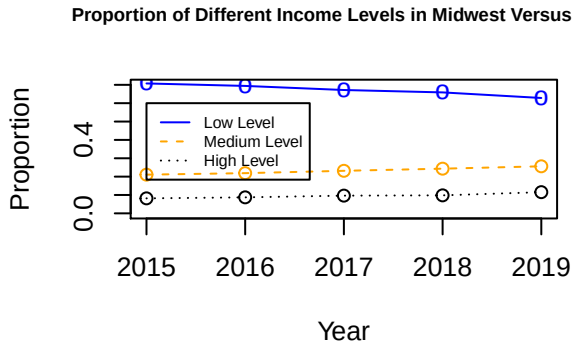
For one region, time series data analysis:

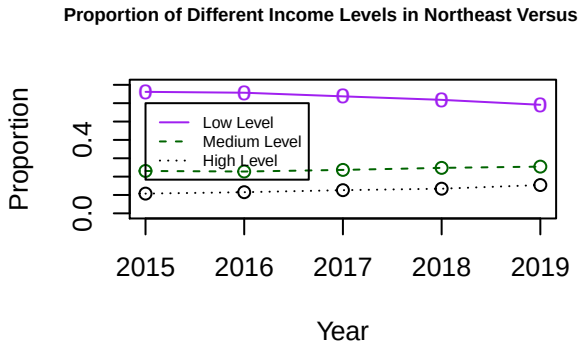
```
# Northeast Region Past five years
Northeast = rbind(income_level_all_2015[1,],income_level_all_2016[1,],income_level_all_2017[1,],income_l
rownames(Northeast) = c('2015', '2016', '2017', '2018', '2019')
# Midwest Region Past five years
Midwest = rbind(income_level_all_2015[2,],income_level_all_2016[2,],income_level_all_2017[2,],income_lev
rownames(Midwest) = c('2015', '2016', '2017', '2018', '2019')
# South Region Past five years
South = rbind(income_level_all_2015[3,],income_level_all_2016[3,],income_level_all_2017[3,],income_level
rownames(South) = c('2015', '2016', '2017', '2018', '2019')
# West Region Past Five years
West = rbind(income_level_all_2015[4,],income_level_all_2016[4,],income_level_all_2017[4,],income_level_
rownames(West) = c('2015', '2016', '2017', '2018', '2019')
prop <- function(data){
  dat_prop = matrix(0, 5, 3)
  for (i in 1:dim(data)[1]){
    dat_prop[i,1] = data[i,1]/sum(data[i,])
    dat_prop[i,2] = data[i,2]/sum(data[i,])
    dat_prop[i,3] = data[i,3]/sum(data[i,])
  }
  return(dat_prop)
}
# West
west_prop = as.data.frame(prop(West))
rownames(west_prop) = c('2015', '2016', '2017', '2018', '2019')
colnames(west_prop) = c('Low', 'Medium', 'High')
# Northeast
northeast_prop = as.data.frame(prop(Northeast))
rownames(northeast_prop) = c('2015', '2016', '2017', '2018', '2019')
colnames(northeast_prop) = c('Low', 'Medium', 'High')
# South
south_prop = as.data.frame(prop(South))
rownames(south_prop) = c('2015', '2016', '2017', '2018', '2019')
colnames(south_prop) = c('Low', 'Medium', 'High')
# Midwest
midwest_prop = as.data.frame(prop(Midwest))
rownames(midwest_prop) = c('2015', '2016', '2017', '2018', '2019')
colnames(midwest_prop) = c('Low', 'Medium', 'High')
```

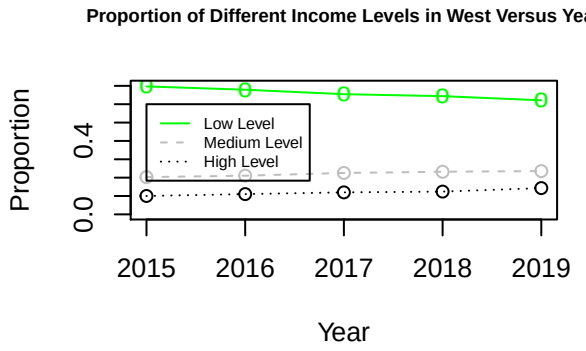
```
par(mfrow=c(2,2))
# Midwest
Year = seq(2015,2019,1)
# plot the first curve by calling plot() function
```

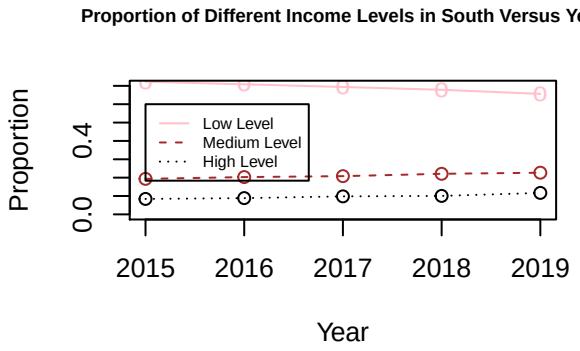
```r
# First curve is plotted
plot(Year, midwest_prop[,1], type="o", col="blue", pch="o", lty=1, ylim=c(0,0.7), main = 'Proportion of
# Add second curve to the same plot by calling points() and lines()
# Use symbol '*' for points.
points(Year,midwest_prop[,2], col="orange")
lines(Year,midwest_prop[,2], col="orange",lty=2)
# Add Third curve to the same plot by calling points() and lines()
# Use symbol '+' for points.
points(Year, midwest_prop[,3], col="black")
 lines(Year, midwest_prop[,3], col="black", lty=3)
legend(2015, 0.6, legend=c("Low Level", "Medium Level",'High Level'),
       col=c("blue", "orange", 'black'),lty= 1:3, cex=0.6)
# Northeast
Year = seq(2015,2019,1)
# plot the first curve by calling plot() function
# First curve is plotted
plot(Year, northeast_prop[,1], type="o", col="purple", pch="o", lty=1, ylim=c(0,0.7), main = 'Proportio
# Add second curve to the same plot by calling points() and lines()
# Use symbol '*' for points.
points(Year,northeast_prop[,2], col="darkgreen")
lines(Year,northeast_prop[,2], col="darkgreen",lty=2)
# Add Third curve to the same plot by calling points() and lines()
# Use symbol '+' for points.
points(Year, northeast_prop[,3], col="black")
 lines(Year, northeast_prop[,3], col='black', lty=3)
legend(2015, 0.6, legend=c("Low Level", "Medium Level",'High Level'),
       col=c("purple", "darkgreen", 'black'),lty= 1:3, cex=0.6)

# West
Year = seq(2015,2019,1)
# plot the first curve by calling plot() function
# First curve is plotted
plot(Year, west_prop[,1], type="o", col="green", pch="o", lty=1, ylim=c(0,0.7), main = 'Proportion of D
# Add second curve to the same plot by calling points() and lines()
# Use symbol '*' for points.
points(Year,west_prop[,2], col="gray")
lines(Year,west_prop[,2], col="gray",lty=2)
# Add Third curve to the same plot by calling points() and lines()
# Use symbol '+' for points.
points(Year, west_prop[,3], col="black")
 lines(Year, west_prop[,3], col="black", lty=3)
legend(2015, 0.6, legend=c("Low Level", "Medium Level",'High Level'),
       col=c("green", "gray", 'black'),lty= 1:3, cex=0.6)
# South
Year = seq(2015,2019,1)
# plot the first curve by calling plot() function
# First curve is plotted
plot(Year, south_prop[,1], type="o", col="pink", pch="o", lty=1, ylim=c(0,0.7), main = 'Proportion of D
# Add second curve to the same plot by calling points() and lines()
# Use symbol '*' for points.
points(Year,south_prop[,2], col="brown")
lines(Year,south_prop[,2], col="brown",lty=2)
# Add Third curve to the same plot by calling points() and lines()
```

```
# Use symbol '+' for points.
points(Year, south_prop[,3], col="black")
 lines(Year, south_prop[,3], col="black", lty=3)
legend(2015, 0.6, legend=c("Low Level", "Medium Level",'High Level'),
       col=c("pink", "brown", 'black'),lty= 1:3, cex=0.6)
```










```
# part regression versus time
# Northeast eg.
dat_noreast_low =as.data.frame(cbind(Year, northeast_prop[,1]))
colnames(dat_noreast_low) = c('Year', 'Prop_low')
fit_low = lm(Prop_low ~ Year, data = dat_noreast_low)
summary(fit_low)
```

```
##
## Call:
## lm(formula = Prop_low ~ Year, data = dat_noreast_low)
##
## Residuals:
##         1         2         3         4         5
## -0.007286  0.005938  0.004114  0.003102 -0.005868
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 36.861015   4.500148   8.191  0.00381 **
## Year        -0.017961   0.002231  -8.050  0.00400 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.007055 on 3 degrees of freedom
```

```
## Multiple R-squared:  0.9558, Adjusted R-squared:  0.941
## F-statistic: 64.81 on 1 and 3 DF,  p-value: 0.004003
```

```
dat_noreast_medium =as.data.frame(cbind(Year, northeast_prop[,2]))
colnames(dat_noreast_medium) = c('Year', 'Prop_medium')
fit_medium = lm(Prop_medium ~ Year, data = dat_noreast_medium)
summary(fit_medium)
```

```
##
## Call:
## lm(formula = Prop_medium ~ Year, data = dat_noreast_medium)
##
## Residuals:
##         1         2         3         4         5
##  0.004764 -0.004946 -0.002829  0.001441  0.001571
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -13.330106   2.845577  -4.685   0.0184 *
## Year          0.006728   0.001411   4.769   0.0175 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.004461 on 3 degrees of freedom
## Multiple R-squared:  0.8834, Adjusted R-squared:  0.8446
## F-statistic: 22.74 on 1 and 3 DF,  p-value: 0.01752
```

```
dat_noreast_high =as.data.frame(cbind(Year, northeast_prop[,3]))
colnames(dat_noreast_high) = c('Year', 'Prop_high')
fit_high = lm(Prop_high ~ Year, data = dat_noreast_high)
summary(fit_high)
```

```
##
## Call:
## lm(formula = Prop_high ~ Year, data = dat_noreast_high)
##
## Residuals:
##          1          2          3          4          5
##  0.0025221 -0.0009919 -0.0012851 -0.0045427  0.0042976
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -22.530909   2.554028  -8.822  0.00307 **
## Year          0.011234   0.001266   8.872  0.00302 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.004004 on 3 degrees of freedom
## Multiple R-squared:  0.9633, Adjusted R-squared:  0.951
## F-statistic: 78.71 on 1 and 3 DF,  p-value: 0.00302
```

```
Low =as.data.frame( cbind(northeast_prop[,1], south_prop[,1], west_prop[,1], midwest_prop[,1]))
colnames(Low) = c('Northeast', 'South', 'West','Midwest')
rownames(Low) = c('2015', '2016', '2017', '2018', '2019')
t = as.data.frame(melt(Low))
```

```
## No id variables; using all as measure variables
```

```
fit_low  = lm(value~variable, data=t)
summary(fit_low)
```

```
##
## Call:
## lm(formula = value ~ variable, data = t)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.043739 -0.014959  0.000823  0.022421  0.037841
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      0.63311    0.01293  48.959  < 2e-16 ***
## variableSouth    0.05886    0.01829   3.218  0.00537 **
## variableWest     0.02603    0.01829   1.423  0.17390
## variableMidwest  0.03900    0.01829   2.133  0.04878 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.02892 on 16 degrees of freedom
## Multiple R-squared:  0.4056, Adjusted R-squared:  0.2942
## F-statistic: 3.639 on 3 and 16 DF,  p-value: 0.03566
```

```
# Medium
Medium =as.data.frame( cbind(northeast_prop[,2], south_prop[,2], west_prop[,2], midwest_prop[,2]))
colnames(Medium) = c('Northeast', 'South', 'West','Midwest')
rownames(Medium) = c('2015', '2016', '2017', '2018', '2019')
m = as.data.frame(melt(Medium))
```

```
## No id variables; using all as measure variables
```

```
fit_medium  = lm(value~variable, data=m)
summary(fit_medium)
```

```
##
## Call:
## lm(formula = value ~ variable, data = m)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.021369 -0.010960 -0.001403  0.010777  0.024083
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)      0.239449   0.006494  36.873  < 2e-16 ***
## variableSouth   -0.028985   0.009184  -3.156  0.00612 **
## variableWest    -0.018078   0.009184  -1.968  0.06659 .
## variableMidwest -0.007283   0.009184  -0.793  0.43938
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.01452 on 16 degrees of freedom
## Multiple R-squared:  0.4165, Adjusted R-squared:  0.3071
```

```
## F-statistic: 3.807 on 3 and 16 DF,  p-value: 0.03107
```

```
# High
High =as.data.frame( cbind(northeast_prop[,3], south_prop[,3], west_prop[,3], midwest_prop[,3]))
colnames(High) = c('Northeast', 'South', 'West','Midwest')
rownames(High) = c('2015', '2016', '2017', '2018', '2019')
h = as.data.frame(melt(High))
```

```
## No id variables; using all as measure variables
```

```
fit_high  = lm(value~variable, data=h)
summary(fit_high)
```

```
##
## Call:
## lm(formula = value ~ variable, data = h)
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -0.0199453 -0.0098606  0.0003246  0.0051092  0.0267649
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)      0.127442   0.006756  18.862 2.36e-12 ***
## variableSouth   -0.029870   0.009555  -3.126  0.00651 **
## variableWest    -0.007948   0.009555  -0.832  0.41773
## variableMidwest -0.031721   0.009555  -3.320  0.00433 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.01511 on 16 degrees of freedom
## Multiple R-squared:  0.5075, Adjusted R-squared:  0.4152
## F-statistic: 5.496 on 3 and 16 DF,  p-value: 0.008654
```