Final Project - Team7(ParkBokKyu)

2018년 12월20일

**\*Purpose of our project**

* 1. We analyzed this data set to help beginner investors who tries to start overseas investment.
  2. Because there are so many risks in overseas investment, investors need to reference all the possible information of each country.
  3. We focused on and tried to figure out coloration of “MPI”, “previous funded amount”, “How long does it take to pay back the amount invested” and “investment section” to understand worldwide investment trend and predict the investment model.

loan <- read.csv("C:/Users/Han Jung Kyu/Desktop/PBK/kivaloans.csv", header = TRUE)  
MPI <- read.csv("C:/Users/Han Jung Kyu/Desktop/PBK/kiva\_mpi\_region\_locations.csv", header = TRUE)

library(dplyr)

##   
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':  
##   
## filter, lag

## The following objects are masked from 'package:base':  
##   
## intersect, setdiff, setequal, union

library(tidyr)  
library(arules)

## Loading required package: Matrix

##   
## Attaching package: 'Matrix'

## The following object is masked from 'package:tidyr':  
##   
## expand

##   
## Attaching package: 'arules'

## The following object is masked from 'package:dplyr':  
##   
## recode

## The following objects are masked from 'package:base':  
##   
## abbreviate, write

library(arulesViz)

## Loading required package: grid

library(cluster)  
library(factoextra)

## Loading required package: ggplot2

## Welcome! Related Books: `Practical Guide To Cluster Analysis in R` at https://goo.gl/13EFCZ

library(bindrcpp)  
library(ggplot2)  
library(stats)  
library(datasets)  
library(sm)

## Package 'sm', version 2.2-5.6: type help(sm) for summary information

library(lubridate)

##   
## Attaching package: 'lubridate'

## The following object is masked from 'package:base':  
##   
## date

library(rpart)  
library(data.table)

##   
## Attaching package: 'data.table'

## The following objects are masked from 'package:lubridate':  
##   
## hour, isoweek, mday, minute, month, quarter, second, wday,  
## week, yday, year

## The following objects are masked from 'package:dplyr':  
##   
## between, first, last

library(ggridges)

##   
## Attaching package: 'ggridges'

## The following object is masked from 'package:ggplot2':  
##   
## scale\_discrete\_manual

library(grid)  
library(NbClust)

MA <- merge(loan, MPI)  
  
#대륙-나라-funded  
a <- aggregate(funded\_amount ~ world\_region+country, MA, mean)  
a %>% group\_by(world\_region)

## # A tibble: 26 x 3  
## # Groups: world\_region [5]  
## world\_region country funded\_amount  
## <fct> <fct> <dbl>  
## 1 South Asia Bhutan 10000   
## 2 Latin America and Caribbean Brazil 1042.  
## 3 East Asia and the Pacific Cambodia 311.  
## 4 Sub-Saharan Africa Cameroon 356.  
## 5 Latin America and Caribbean El Salvador 615.  
## 6 Latin America and Caribbean Guatemala 1257.  
## 7 Latin America and Caribbean Haiti 723.  
## 8 Latin America and Caribbean Honduras 732.  
## 9 East Asia and the Pacific Indonesia 3070.  
## 10 Sub-Saharan Africa Kenya 1915.  
## # ... with 16 more rows

a %>% arrange(-funded\_amount) %>% mutate(Rank=1:nrow(a)) %>% head(5)

## world\_region country funded\_amount Rank  
## 1 South Asia Bhutan 10000.000 1  
## 2 East Asia and the Pacific Indonesia 3069.556 2  
## 3 Latin America and Caribbean Suriname 2422.260 3  
## 4 Sub-Saharan Africa Kenya 1914.614 4  
## 5 Sub-Saharan Africa Zambia 1866.304 5

#나라-sector-funded  
b <- aggregate(funded\_amount ~ sector+country, MA, mean)  
b %>% group\_by(sector)

## # A tibble: 234 x 3  
## # Groups: sector [15]  
## sector country funded\_amount  
## <fct> <fct> <dbl>  
## 1 Arts Bhutan 10000   
## 2 Arts Brazil 996.  
## 3 Health Brazil 1600   
## 4 Agriculture Cambodia 717.  
## 5 Arts Cambodia 527.  
## 6 Clothing Cambodia 812.  
## 7 Construction Cambodia 732.  
## 8 Education Cambodia 570.  
## 9 Entertainment Cambodia 1125   
## 10 Food Cambodia 697.  
## # ... with 224 more rows

b %>% arrange(-funded\_amount) %>% mutate(Rank=1:nrow(b)) %>% head(5)

## sector country funded\_amount Rank  
## 1 Wholesale Mali 49250.00 1  
## 2 Manufacturing Kenya 17416.67 2  
## 3 Retail Nigeria 11725.00 3  
## 4 Agriculture Kenya 11011.67 4  
## 5 Retail Indonesia 10308.33 5

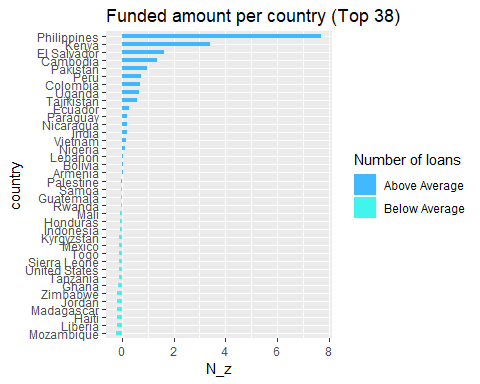
#대륙-나라-sector-funded  
ab <- aggregate(funded\_amount ~ world\_region+country+sector, MA, mean)  
ab %>% group\_by(world\_region)

## # A tibble: 234 x 4  
## # Groups: world\_region [5]  
## world\_region country sector funded\_amount  
## <fct> <fct> <fct> <dbl>  
## 1 East Asia and the Pacific Cambodia Agriculture 717.  
## 2 Sub-Saharan Africa Cameroon Agriculture 450   
## 3 Latin America and Caribbean El Salvador Agriculture 591.  
## 4 Latin America and Caribbean Guatemala Agriculture 1308.  
## 5 Latin America and Caribbean Haiti Agriculture 762.  
## 6 Latin America and Caribbean Honduras Agriculture 684.  
## 7 East Asia and the Pacific Indonesia Agriculture 2746.  
## 8 Sub-Saharan Africa Kenya Agriculture 11012.  
## 9 Sub-Saharan Africa Malawi Agriculture 188.  
## 10 Sub-Saharan Africa Mali Agriculture 616.  
## # ... with 224 more rows

ab %>% arrange(-funded\_amount) %>% mutate(Rank=1:nrow(ab)) %>% head(10)

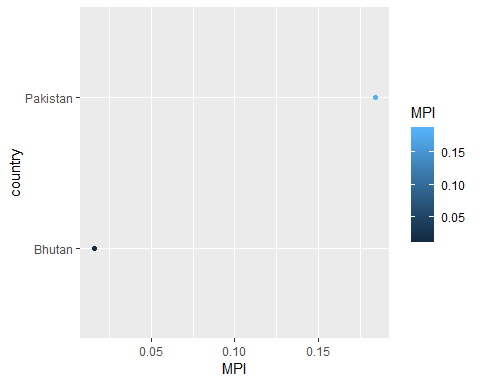
## world\_region country sector funded\_amount Rank  
## 1 Sub-Saharan Africa Mali Wholesale 49250.000 1  
## 2 Sub-Saharan Africa Kenya Manufacturing 17416.667 2  
## 3 Sub-Saharan Africa Nigeria Retail 11725.000 3  
## 4 Sub-Saharan Africa Kenya Agriculture 11011.667 4  
## 5 East Asia and the Pacific Indonesia Retail 10308.333 5  
## 6 Sub-Saharan Africa Zambia Agriculture 10000.000 6  
## 7 South Asia Bhutan Arts 10000.000 7  
## 8 Sub-Saharan Africa Zambia Retail 9308.333 8  
## 9 Sub-Saharan Africa Kenya Arts 8000.000 9  
## 10 Sub-Saharan Africa Zambia Manufacturing 5500.000 10

#Funded amount per country  
loans\_dt <- as.data.table(loan)  
nloans <- loans\_dt[, .N, by=country]  
nloans$N\_z <- round((nloans$N - mean(nloans$N))/sd(nloans$N), 2)  
nloans$type <- ifelse(nloans$N\_z < 0, "below", "above")  
nloans <- nloans[order(N\_z),]  
nloans$country <- factor(nloans$country, levels = nloans$country)  
nloans <- tail(nloans, 38)  
  
ggplot(nloans, aes(x=country, y=N\_z, label=N\_z)) +  
 geom\_bar(stat='identity', aes(fill=type), width=.5) +  
 scale\_fill\_manual(name="Number of loans",  
 labels = c("Above Average", "Below Average"),  
 values = c("above"="#42b9ff", "below"="#42f4ee")) +  
 labs(title= "Funded amount per country (Top 38)") +   
coord\_flip()

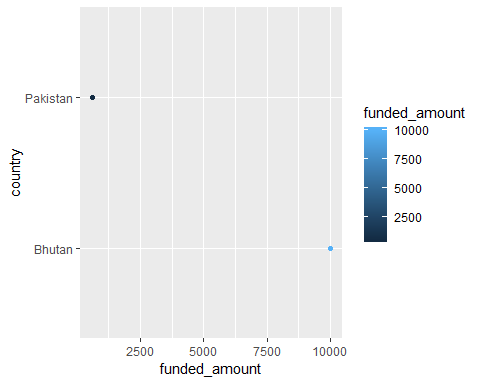


-We analyzed Top ranked countries by sector and funded\_amouunt. As a result we figured out sub-saharan africa countries are positioned on top of the rank. And also made graph that shows which countries are above average(funded\_amount) or below average. -You can see which countries have more popularity(analyzed by funded\_amount).

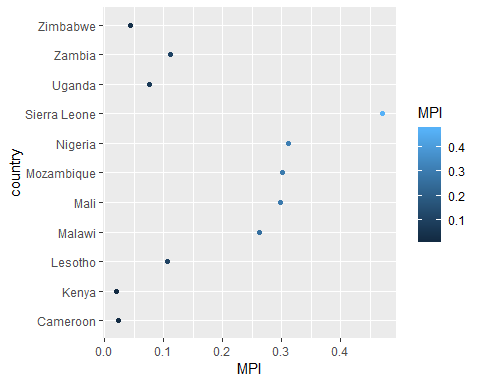
mpi\_nomiss <- MA %>% filter(!is.na(MPI)) %>% select(country, MPI, world\_region, MPI)  
funded\_nomiss <- MA %>% filter(!is.na(funded\_amount)) %>% select(country, funded\_amount, world\_region, funded\_amount)  
  
##World\_region's MPI  
  
#Asia mpi  
Asia <- filter(mpi\_nomiss, world\_region == "South Asia") %>% select(country, MPI)  
aggregate(MPI~country, Asia,mean) %>%   
 ggplot(aes(x = MPI, y = country, color = MPI)) + geom\_point()



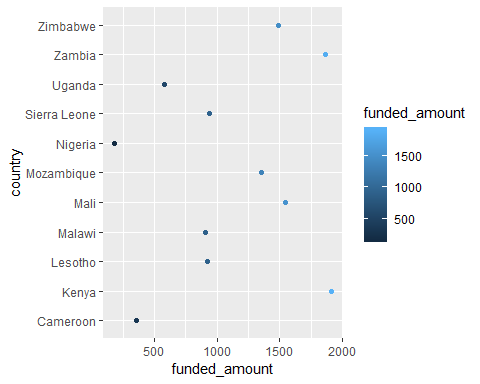
#Asia funded\_amount  
Asia <- filter(funded\_nomiss, world\_region == "South Asia") %>% select(country, funded\_amount)  
aggregate(funded\_amount~country, Asia,mean) %>%   
 ggplot(aes(x = funded\_amount, y = country, color = funded\_amount)) + geom\_point()



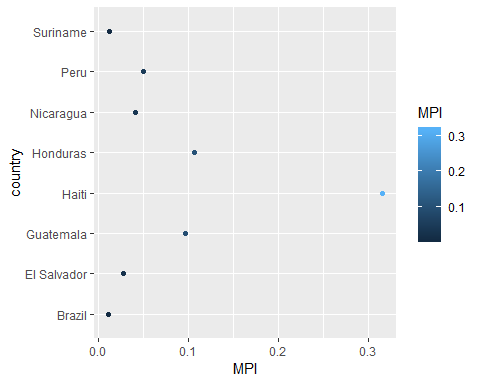
#Sub-Saharan Africa MPI  
Sub\_Saharan\_Africa <- filter(mpi\_nomiss, world\_region == "Sub-Saharan Africa")  
aggregate(MPI~country, Sub\_Saharan\_Africa,mean) %>%   
 ggplot(aes(x = MPI, y = country, color = MPI)) + geom\_point()



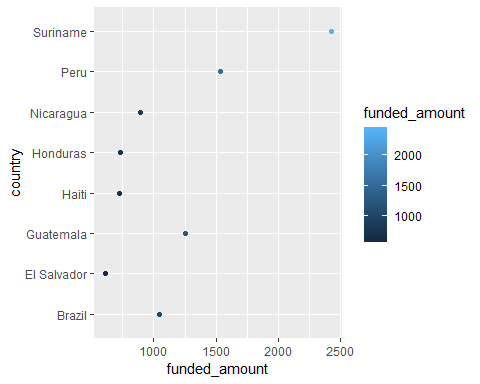
#Sub-Saharan Africa funded\_amount  
Sub\_Saharan\_Africa <- filter(funded\_nomiss, world\_region == "Sub-Saharan Africa")  
aggregate(funded\_amount~country, Sub\_Saharan\_Africa,mean) %>%   
 ggplot(aes(x = funded\_amount, y = country, color = funded\_amount)) + geom\_point()



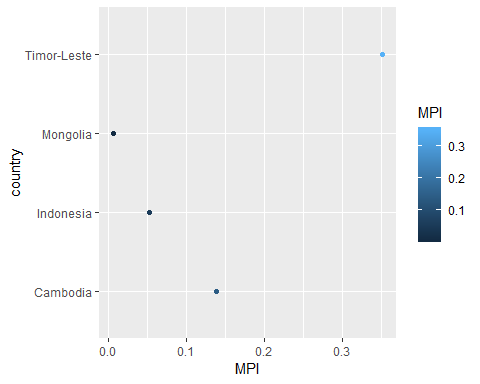
#Latin America and Caribbean MPI  
Latin\_America\_and\_Caribbean <- filter(mpi\_nomiss, world\_region == "Latin America and Caribbean")  
aggregate(MPI~country, Latin\_America\_and\_Caribbean, mean) %>%   
 ggplot(aes(x = MPI, y = country, color = MPI)) + geom\_point()



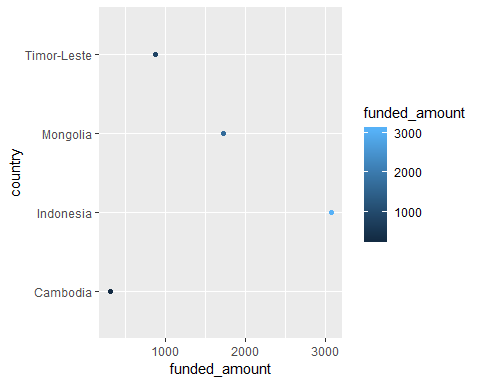
#Latin America and Caribbean funded\_amount  
Latin\_America\_and\_Caribbean <- filter(funded\_nomiss, world\_region == "Latin America and Caribbean")  
aggregate(funded\_amount~country, Latin\_America\_and\_Caribbean, mean) %>%   
 ggplot(aes(x = funded\_amount, y = country, color = funded\_amount)) + geom\_point()



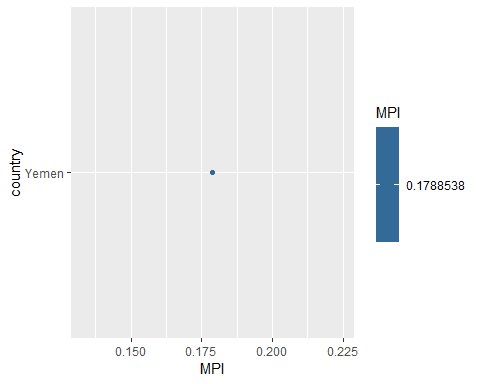
#East Asia and the Pacific MPI  
East\_Asia\_and\_the\_Pacific <- filter(mpi\_nomiss, world\_region == "East Asia and the Pacific")  
aggregate(MPI~country, East\_Asia\_and\_the\_Pacific, mean) %>%   
 ggplot(aes(x = MPI, y = country, color = MPI)) + geom\_point()



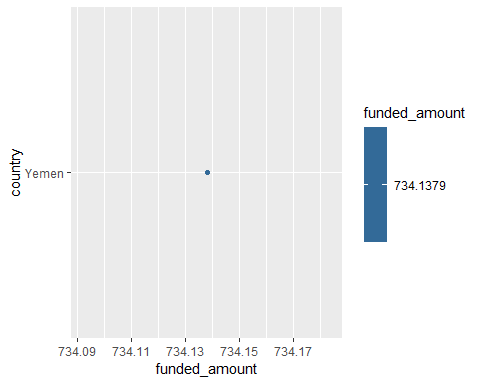
#East Asia and the Pacific funded\_amount  
East\_Asia\_and\_the\_Pacific <- filter(funded\_nomiss, world\_region == "East Asia and the Pacific")  
aggregate(funded\_amount~country, East\_Asia\_and\_the\_Pacific, mean) %>%   
 ggplot(aes(x = funded\_amount, y = country, color = funded\_amount)) + geom\_point()



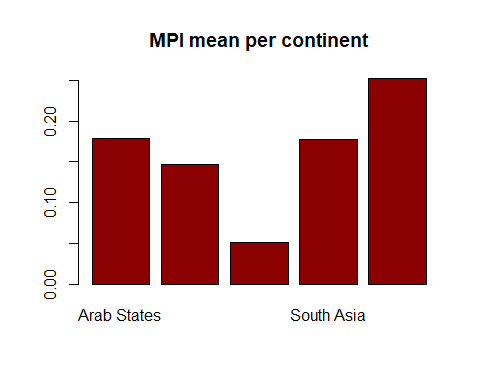
#Arab States MPI  
Arab\_States <- filter(mpi\_nomiss, world\_region == "Arab States")  
aggregate(MPI~country, Arab\_States, mean) %>%   
 ggplot( aes(x = MPI, y = country, color = MPI)) + geom\_point()



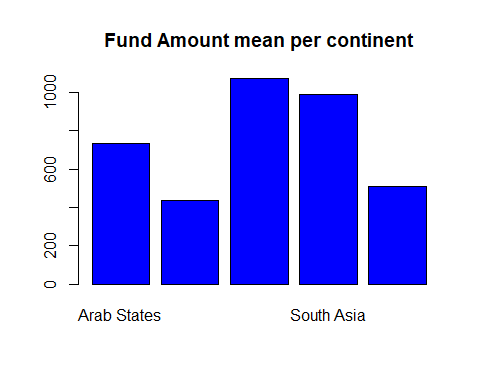
#Arab States funded\_amount  
Arab\_States <- filter(funded\_nomiss, world\_region == "Arab States")  
aggregate(funded\_amount~country, Arab\_States, mean) %>%   
 ggplot( aes(x = funded\_amount, y = country, color = funded\_amount)) + geom\_point()



#Barchart MPI-Funded\_amount  
MA1 <- select(MA, MPI, world\_region) %>% filter(!is.na(MPI))  
MA2 <- select(MA, funded\_amount, world\_region) %>% filter(!is.na(funded\_amount))  
MPI\_mean <- tapply(MA1$MPI, MA1$world\_region, mean)  
funded\_amount\_mean <- tapply(MA2$funded\_amount, MA2$world\_region, mean)  
barplot(MPI\_mean,  
 main = "MPI mean per continent",  
 col = "darkred")



barplot(funded\_amount\_mean,  
 main = "Fund Amount mean per continent", col = "blue")

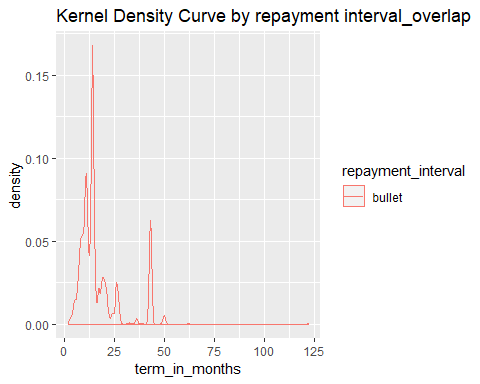


-There are not enough correlation. So we recommend to find other information rather than “MPI” before make decision where to invest. -About code, we used function “filter” and “aggregate” to divide our data into continent. After that, we made barplot depend on our data about MPI depend on continent

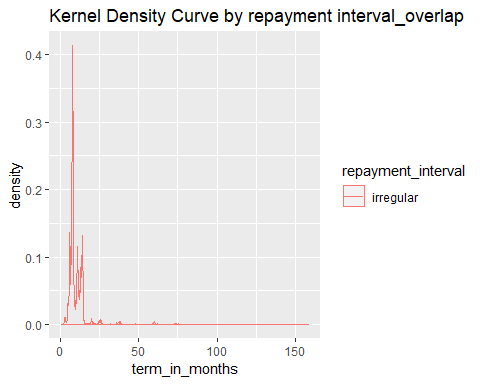
m<-subset(loan, select=c(term\_in\_months,repayment\_interval))  
aggregate(term\_in\_months~repayment\_interval,m,mean)

## repayment\_interval term\_in\_months  
## 1 bullet 17.08115  
## 2 irregular 10.63920  
## 3 monthly 15.36635  
## 4 weekly 4.32392

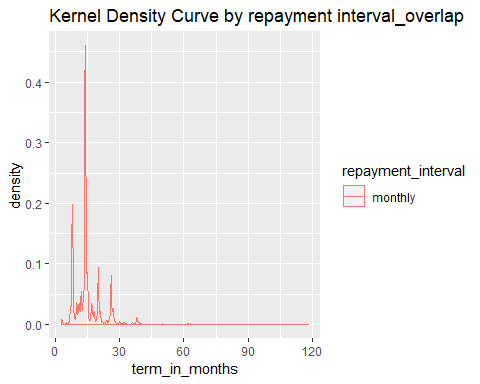
b<-subset(m, repayment\_interval == "bullet")  
i<-subset(m, repayment\_interval == "irregular")  
n<-subset(m, repayment\_interval == "monthly")  
w<-subset(m, repayment\_interval == "weekly")  
  
ggplot(b, aes(x=term\_in\_months, colour = repayment\_interval)) +   
geom\_density(fill = NA) +   
geom\_line(stat = "density") +   
expand\_limits(y = 0) +   
ggtitle("Kernel Density Curve by repayment interval\_overlap")



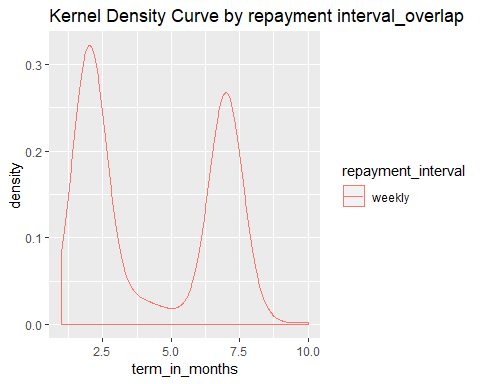
ggplot(i, aes(x=term\_in\_months, colour = repayment\_interval)) +   
geom\_density(fill = NA) +   
geom\_line(stat = "density") +   
expand\_limits(y = 0) +   
ggtitle("Kernel Density Curve by repayment interval\_overlap")



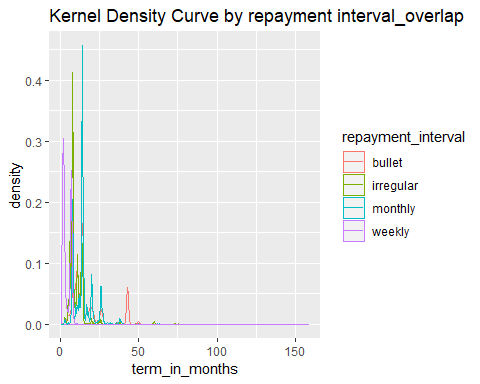
ggplot(n, aes(x=term\_in\_months, colour = repayment\_interval)) +   
geom\_density(fill = NA) +   
geom\_line(stat = "density") +   
expand\_limits(y = 0) +   
ggtitle("Kernel Density Curve by repayment interval\_overlap")



ggplot(w, aes(x=term\_in\_months, colour = repayment\_interval)) +   
geom\_density(fill = NA) +   
geom\_line(stat = "density") +   
expand\_limits(y = 0) +   
ggtitle("Kernel Density Curve by repayment interval\_overlap")



ggplot(loan, aes(x=term\_in\_months, colour = repayment\_interval)) +   
geom\_density(fill = NA) +   
geom\_line(stat = "density") +   
expand\_limits(y = 0) +   
ggtitle("Kernel Density Curve by repayment interval\_overlap")



-There are four ways in which the investment can be repaid. Depending on how the repayment is made, it is expressed as a function of the density within which the investment is repaid within a few months. -The first method, the bullet-paying method, is that most of the people pay the investment in about 14 months. -Most of the people who pay the investment irregularly pay off all of their investments in about seven months. -Most of the people who make monthly payments pay off their investments in about 14 months. -Most of the people who pay off the investment in a weekly manner pay off the investment in about 2.5 months and 7.5 months. -In conclusion, it can be seen that the people who pay the weekly pay the fastest, and those who pay the monthly pay back the earliest. I analyzed this to see how long it took depending on the repayment method and to help investors make investments.

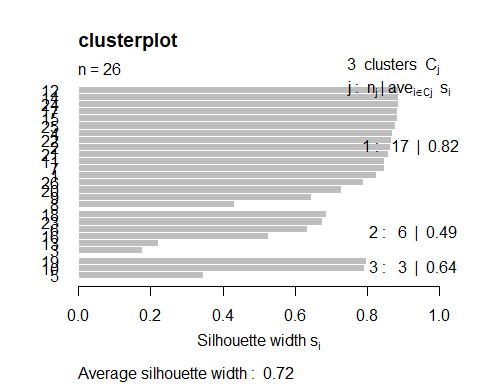
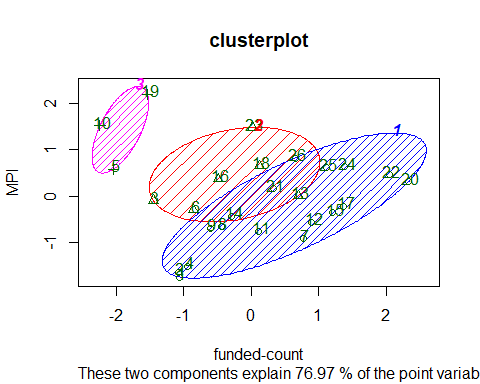
loan <- na.omit(loan)   
loan2 <- select(loan, funded\_amount, lender\_count, country)  
a <- aggregate(funded\_amount~country, loan2, sum)  
b <- aggregate(MPI~country, MA, mean)  
data.frame(a)

## country funded\_amount  
## 1 Afghanistan 14000  
## 2 Albania 2490000  
## 3 Armenia 11186675  
## 4 Azerbaijan 2699575  
## 5 Belize 114025  
## 6 Benin 516825  
## 7 Bhutan 15625  
## 8 Bolivia 18276200  
## 9 Brazil 661025  
## 10 Burkina Faso 2909975  
## 11 Burundi 2558550  
## 12 Cambodia 18815825  
## 13 Cameroon 875500  
## 14 Chile 76250  
## 15 China 373475  
## 16 Colombia 12473775  
## 17 Congo 786250  
## 18 Costa Rica 2015525  
## 19 Cote D'Ivoire 50000  
## 20 Dominican Republic 2083500  
## 21 Ecuador 14597850  
## 22 Egypt 1084925  
## 23 El Salvador 23357325  
## 24 Georgia 3369500  
## 25 Ghana 4792275  
## 26 Guatemala 10930825  
## 27 Haiti 2645650  
## 28 Honduras 5667925  
## 29 India 6466850  
## 30 Indonesia 4547025  
## 31 Iraq 2611225  
## 32 Israel 561650  
## 33 Jordan 4362675  
## 34 Kenya 30650850  
## 35 Kosovo 1778600  
## 36 Kyrgyzstan 6728550  
## 37 Lao People's Democratic Republic 1153975  
## 38 Lebanon 11555800  
## 39 Lesotho 359525  
## 40 Liberia 1168225  
## 41 Madagascar 1223575  
## 42 Malawi 1612500  
## 43 Mali 8340850  
## 44 Mauritania 15000  
## 45 Mexico 9391225  
## 46 Moldova 686850  
## 47 Mongolia 1591400  
## 48 Mozambique 1918825  
## 49 Myanmar (Burma) 3035850  
## 50 Namibia 32375  
## 51 Nepal 307625  
## 52 Nicaragua 9853875  
## 53 Nigeria 1905325  
## 54 Pakistan 12467100  
## 55 Palestine 12032025  
## 56 Panama 273275  
## 57 Paraguay 29412700  
## 58 Peru 30392350  
## 59 Philippines 54473925  
## 60 Rwanda 15505600  
## 61 Saint Vincent and the Grenadines 49225  
## 62 Samoa 5638475  
## 63 Senegal 6819675  
## 64 Sierra Leone 3961050  
## 65 Solomon Islands 493875  
## 66 Somalia 225875  
## 67 South Africa 574025  
## 68 South Sudan 120900  
## 69 Suriname 540475  
## 70 Tajikistan 13780775  
## 71 Tanzania 6518075  
## 72 Thailand 423350  
## 73 The Democratic Republic of the Congo 11020275  
## 74 Timor-Leste 2326900  
## 75 Togo 1486725  
## 76 Turkey 743625  
## 77 Uganda 14142450  
## 78 Ukraine 1561350  
## 79 United States 4430575  
## 80 Vanuatu 9250  
## 81 Vietnam 13616775  
## 82 Yemen 1784075  
## 83 Zambia 1147950  
## 84 Zimbabwe 3372725

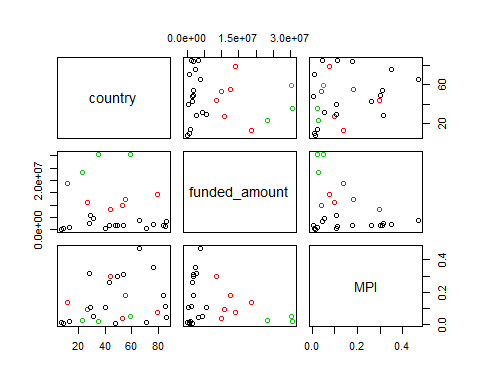
data.frame(b)

## country MPI  
## 1 Bhutan 0.01600000  
## 2 Brazil 0.01100000  
## 3 Cambodia 0.13928893  
## 4 Cameroon 0.02400000  
## 5 El Salvador 0.02800733  
## 6 Guatemala 0.09740437  
## 7 Haiti 0.31600000  
## 8 Honduras 0.10689404  
## 9 Indonesia 0.05275806  
## 10 Kenya 0.02092271  
## 11 Lesotho 0.10600000  
## 12 Malawi 0.26224638  
## 13 Mali 0.29831420  
## 14 Mongolia 0.00600000  
## 15 Mozambique 0.30100000  
## 16 Nicaragua 0.04084149  
## 17 Nigeria 0.31100000  
## 18 Pakistan 0.18400000  
## 19 Peru 0.05069809  
## 20 Sierra Leone 0.47106927  
## 21 Suriname 0.01190868  
## 22 Timor-Leste 0.35173919  
## 23 Uganda 0.07600000  
## 24 Yemen 0.17885379  
## 25 Zambia 0.11200000  
## 26 Zimbabwe 0.04339821

c <- merge(a,b)   
pc <- pam(c, 3)  
plot(pc, main = 'clusterplot', color=TRUE, shade=TRUE,  
 label=2, lines=0, xlab='funded-count', ylab='MPI')



plot(c, col=pc$clustering)



c

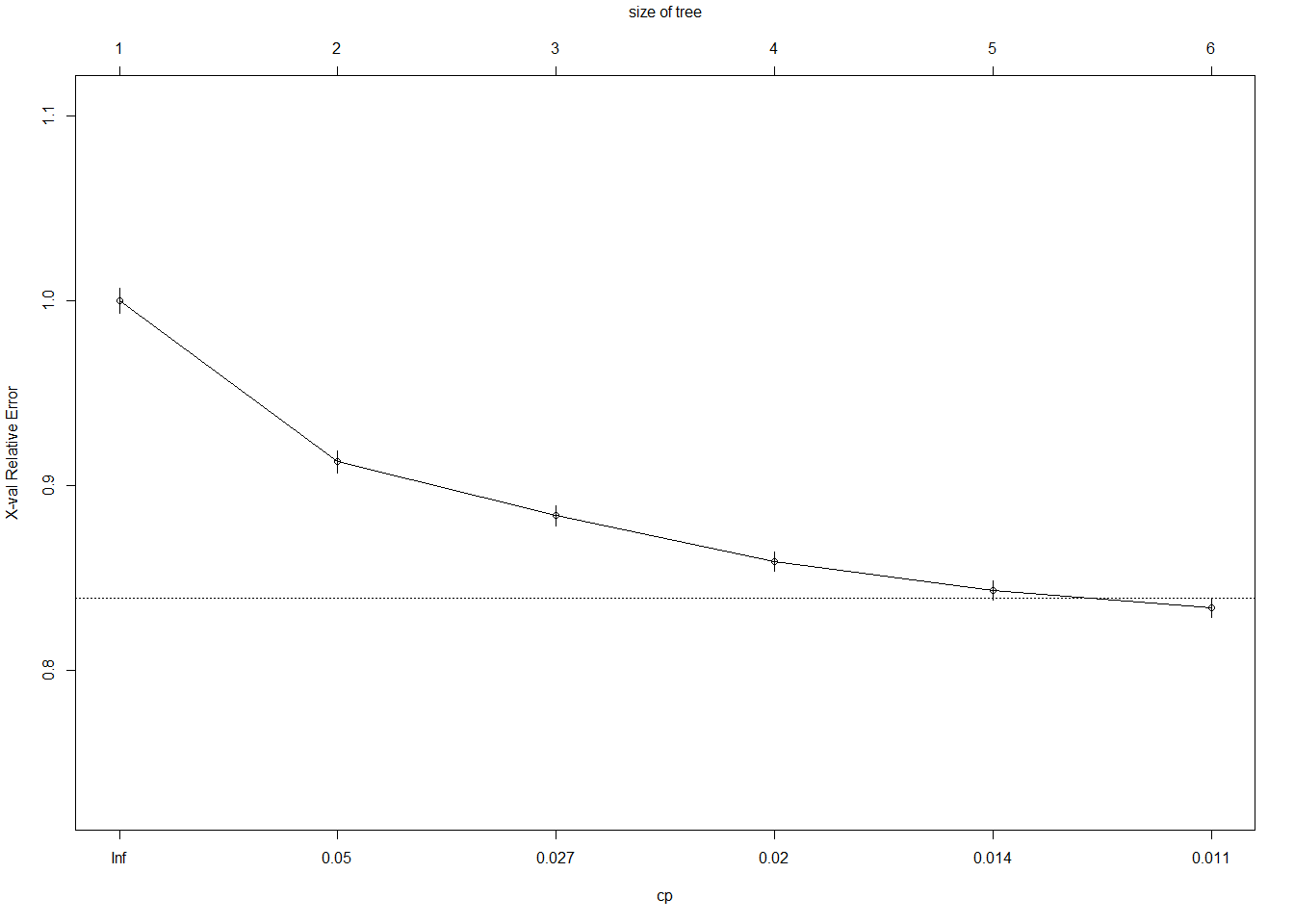
## country funded\_amount MPI  
## 1 Bhutan 15625 0.01600000  
## 2 Brazil 661025 0.01100000  
## 3 Cambodia 18815825 0.13928893  
## 4 Cameroon 875500 0.02400000  
## 5 El Salvador 23357325 0.02800733  
## 6 Guatemala 10930825 0.09740437  
## 7 Haiti 2645650 0.31600000  
## 8 Honduras 5667925 0.10689404  
## 9 Indonesia 4547025 0.05275806  
## 10 Kenya 30650850 0.02092271  
## 11 Lesotho 359525 0.10600000  
## 12 Malawi 1612500 0.26224638  
## 13 Mali 8340850 0.29831420  
## 14 Mongolia 1591400 0.00600000  
## 15 Mozambique 1918825 0.30100000  
## 16 Nicaragua 9853875 0.04084149  
## 17 Nigeria 1905325 0.31100000  
## 18 Pakistan 12467100 0.18400000  
## 19 Peru 30392350 0.05069809  
## 20 Sierra Leone 3961050 0.47106927  
## 21 Suriname 540475 0.01190868  
## 22 Timor-Leste 2326900 0.35173919  
## 23 Uganda 14142450 0.07600000  
## 24 Yemen 1784075 0.17885379  
## 25 Zambia 1147950 0.11200000  
## 26 Zimbabwe 3372725 0.04339821

-We used clustering to know which countries have similar MPI average and funded\_amount average. You can see the each cluster has number and that number mean country(If you want to know each number’s country you can find it by searching ‘c’). -Assume that you have some money and you are going to invest with that money then you could choose where to invest your money, also consider with MPI.

m <- rpart(term\_in\_months~funded\_amount+sector ,method = "anova",data = loan)  
  
printcp(m)

##   
## Regression tree:  
## rpart(formula = term\_in\_months ~ funded\_amount + sector, data = loan,   
## method = "anova")  
##   
## Variables actually used in tree construction:  
## [1] funded\_amount sector   
##   
## Root node error: 47622453/655016 = 72.704  
##   
## n= 655016   
##   
## CP nsplit rel error xerror xstd  
## 1 0.087156 0 1.00000 1.00000 0.0066860  
## 2 0.029042 1 0.91284 0.91286 0.0059543  
## 3 0.024843 2 0.88380 0.88384 0.0054237  
## 4 0.015517 3 0.85896 0.85900 0.0053329  
## 5 0.012042 4 0.84344 0.84349 0.0053192  
## 6 0.010000 5 0.83140 0.83407 0.0050525

plotcp(m)

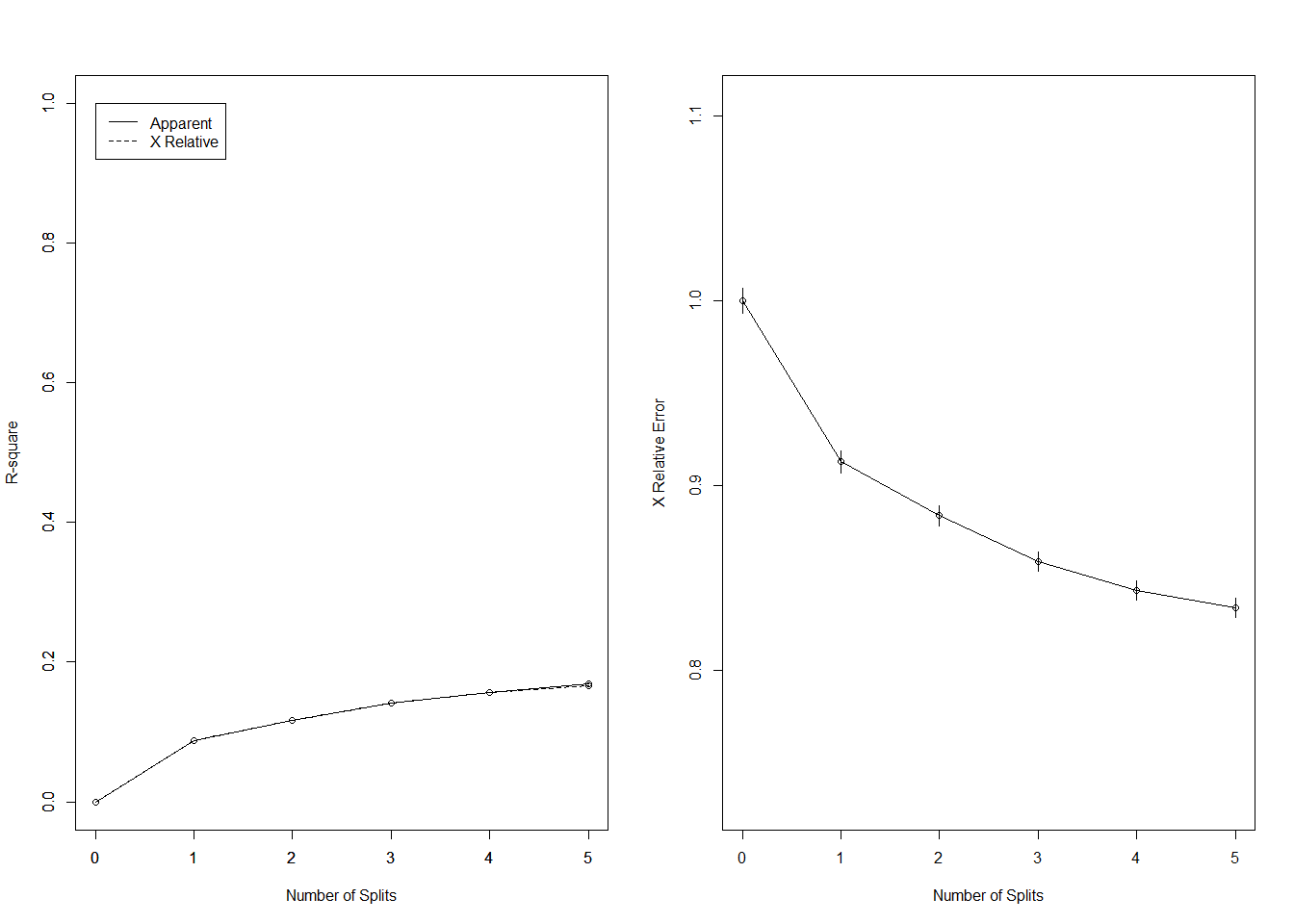


summary(m)

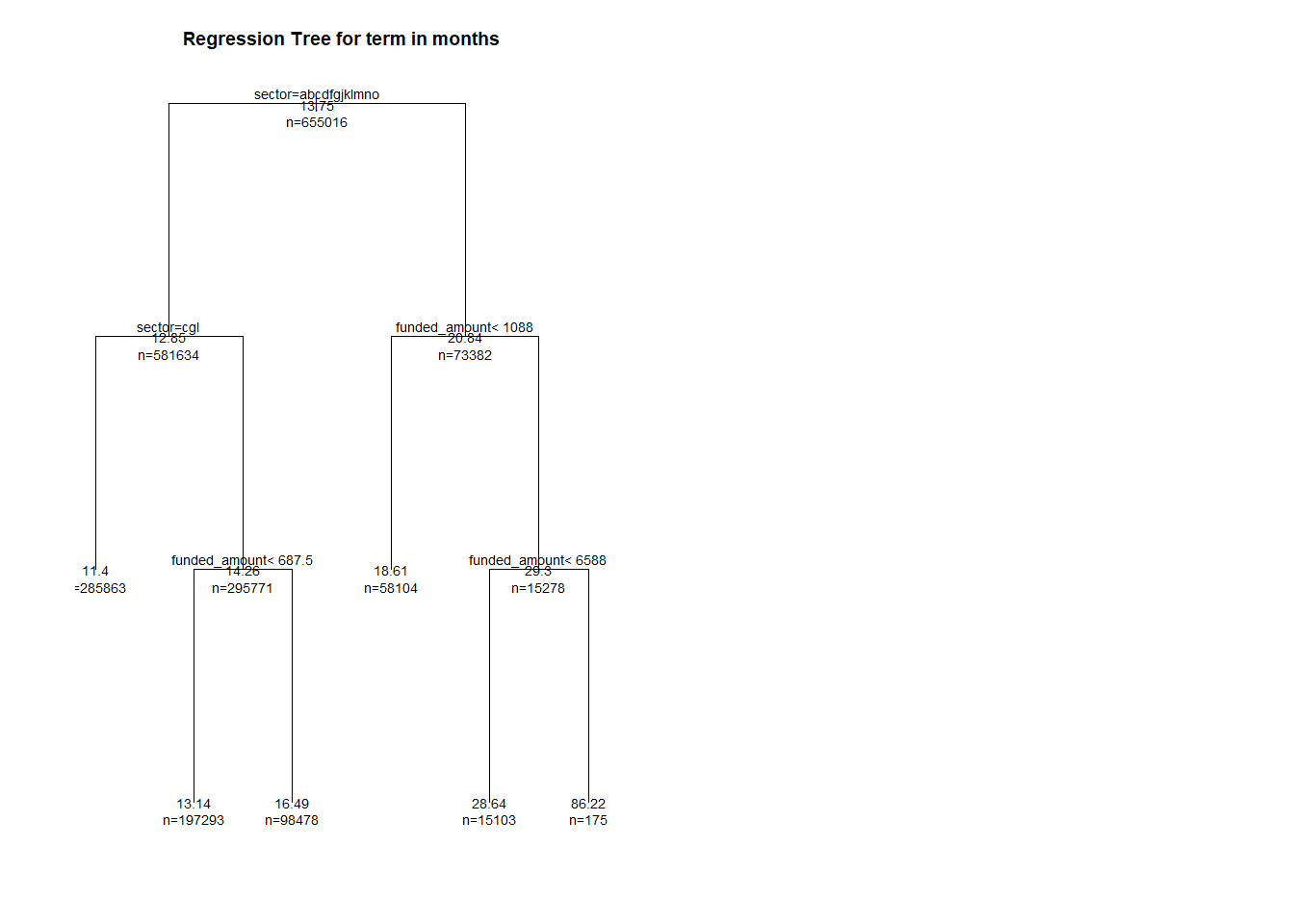
## Call:  
## rpart(formula = term\_in\_months ~ funded\_amount + sector, data = loan,   
## method = "anova")  
## n= 655016   
##   
## CP nsplit rel error xerror xstd  
## 1 0.08715576 0 1.0000000 1.0000044 0.006686049  
## 2 0.02904187 1 0.9128442 0.9128568 0.005954265  
## 3 0.02484258 2 0.8838024 0.8838404 0.005423726  
## 4 0.01551653 3 0.8589598 0.8590004 0.005332863  
## 5 0.01204188 4 0.8434433 0.8434863 0.005319190  
## 6 0.01000000 5 0.8314014 0.8340714 0.005052494  
##   
## Variable importance  
## sector funded\_amount   
## 66 34   
##   
## Node number 1: 655016 observations, complexity param=0.08715576  
## mean=13.74819, MSE=72.70426   
## left son=2 (581634 obs) right son=3 (73382 obs)  
## Primary splits:  
## sector splits as LLLLRLLRRLLLLLL, improve=0.08715576, (0 missing)  
## funded\_amount < 687.5 to the left, improve=0.03647227, (0 missing)  
##   
## Node number 2: 581634 observations, complexity param=0.02484258  
## mean=12.85407, MSE=48.29394   
## left son=4 (285863 obs) right son=5 (295771 obs)  
## Primary splits:  
## sector splits as RRLR-RL--RRLRRR, improve=0.04211783, (0 missing)  
## funded\_amount < 462.5 to the left, improve=0.03215883, (0 missing)  
## Surrogate splits:  
## funded\_amount < 2512.5 to the right, agree=0.521, adj=0.025, (0 split)  
##   
## Node number 3: 73382 observations, complexity param=0.02904187  
## mean=20.83512, MSE=209.622   
## left son=6 (58104 obs) right son=7 (15278 obs)  
## Primary splits:  
## funded\_amount < 1087.5 to the left, improve=0.089910390, (0 missing)  
## sector splits as ----R--LL------, improve=0.002101291, (0 missing)  
##   
## Node number 4: 285863 observations  
## mean=11.40337, MSE=28.99643   
##   
## Node number 5: 295771 observations, complexity param=0.01551653  
## mean=14.25617, MSE=62.94507   
## left son=10 (197293 obs) right son=11 (98478 obs)  
## Primary splits:  
## funded\_amount < 687.5 to the left, improve=0.039690730, (0 missing)  
## sector splits as RL-R-R---RL-RLR, improve=0.003351211, (0 missing)  
## Surrogate splits:  
## sector splits as LL-L-L---LL-LLR, agree=0.667, adj=0.001, (0 split)  
##   
## Node number 6: 58104 observations  
## mean=18.60898, MSE=110.7139   
##   
## Node number 7: 15278 observations, complexity param=0.01204188  
## mean=29.30141, MSE=495.256   
## left son=14 (15103 obs) right son=15 (175 obs)  
## Primary splits:  
## funded\_amount < 6587.5 to the left, improve=0.07578961, (0 missing)  
## sector splits as ----R--LL------, improve=0.03342963, (0 missing)  
##   
## Node number 10: 197293 observations  
## mean=13.13947, MSE=52.10376   
##   
## Node number 11: 98478 observations  
## mean=16.49341, MSE=77.16125   
##   
## Node number 14: 15103 observations  
## mean=28.64193, MSE=432.6237   
##   
## Node number 15: 175 observations  
## mean=86.21714, MSE=2623.667

par(mfrow=c(1,2))  
rsq.rpart(m)

##   
## Regression tree:  
## rpart(formula = term\_in\_months ~ funded\_amount + sector, data = loan,   
## method = "anova")  
##   
## Variables actually used in tree construction:  
## [1] funded\_amount sector   
##   
## Root node error: 47622453/655016 = 72.704  
##   
## n= 655016   
##   
## CP nsplit rel error xerror xstd  
## 1 0.087156 0 1.00000 1.00000 0.0066860  
## 2 0.029042 1 0.91284 0.91286 0.0059543  
## 3 0.024843 2 0.88380 0.88384 0.0054237  
## 4 0.015517 3 0.85896 0.85900 0.0053329  
## 5 0.012042 4 0.84344 0.84349 0.0053192  
## 6 0.010000 5 0.83140 0.83407 0.0050525



plot(m,uniform=TRUE,main="Regression Tree for term in months")  
text(m,use.n=TRUE,all=TRUE,cex=0.9)

 -We wanted to predict term in months using funded amount and sector. -Investors can see how long it takes to be repaid their money through how much they invest in which sector.

##Association Rules = country <-> sector  
  
country\_sector <- select(loan, sector, country)  
country\_sector1 <- sample\_n(country\_sector, 10000)  
country\_sector\_list <- split(country\_sector1$sector, country\_sector1$country)  
country\_sector\_list\_trans <- as(country\_sector\_list, "transactions")

## Warning in asMethod(object): removing duplicated items in transactions

country\_sector\_list\_rules <- apriori(country\_sector\_list\_trans, parameter = list(supp=0.2,conf=0.9))

## Apriori  
##   
## Parameter specification:  
## confidence minval smax arem aval originalSupport maxtime support minlen  
## 0.9 0.1 1 none FALSE TRUE 5 0.2 1  
## maxlen target ext  
## 10 rules FALSE  
##   
## Algorithmic control:  
## filter tree heap memopt load sort verbose  
## 0.1 TRUE TRUE FALSE TRUE 2 TRUE  
##   
## Absolute minimum support count: 17   
##   
## set item appearances ...[0 item(s)] done [0.00s].  
## set transactions ...[15 item(s), 86 transaction(s)] done [0.00s].  
## sorting and recoding items ... [13 item(s)] done [0.00s].  
## creating transaction tree ... done [0.00s].  
## checking subsets of size 1 2 3 4 5 6 7 done [0.00s].  
## writing ... [1372 rule(s)] done [0.00s].  
## creating S4 object ... done [0.00s].

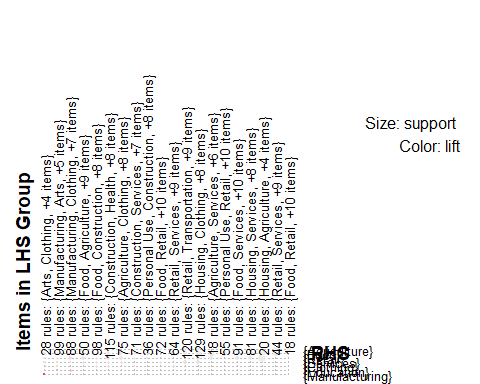
##Association Rules = country <-> Sector 시각화   
inspect(country\_sector\_list\_rules, head=T)

## lhs rhs support confidence lift count  
## [1] {Health} => {Retail} 0.3023256 0.9629630 1.357620 26  
## [2] {Health} => {Food} 0.2906977 0.9259259 1.263962 25  
## [3] {Transportation} => {Services} 0.3139535 0.9642857 1.454887 27  
## [4] {Transportation} => {Agriculture} 0.3023256 0.9285714 1.288018 26  
## [5] {Transportation} => {Food} 0.3139535 0.9642857 1.316327 27  
## [6] {Housing} => {Agriculture} 0.3372093 0.9666667 1.340860 29  
## [7] {Housing} => {Retail} 0.3255814 0.9333333 1.315847 28  
## [8] {Housing} => {Food} 0.3255814 0.9333333 1.274074 28  
## [9] {Construction} => {Clothing} 0.3023256 0.9285714 1.506739 26  
## [10] {Construction} => {Services} 0.3023256 0.9285714 1.401003 26  
## [11] {Construction} => {Agriculture} 0.3023256 0.9285714 1.288018 26  
## [12] {Construction} => {Retail} 0.3139535 0.9642857 1.359485 27  
## [13] {Construction} => {Food} 0.3255814 1.0000000 1.365079 28  
## [14] {Manufacturing} => {Services} 0.3139535 0.9642857 1.454887 27  
## [15] {Manufacturing} => {Retail} 0.3255814 1.0000000 1.409836 28  
## [16] {Manufacturing} => {Food} 0.3255814 1.0000000 1.365079 28  
## [17] {Arts} => {Services} 0.3488372 0.9375000 1.414474 30  
## [18] {Arts} => {Agriculture} 0.3488372 0.9375000 1.300403 30  
## [19] {Arts} => {Retail} 0.3372093 0.9062500 1.277664 29  
## [20] {Arts} => {Food} 0.3604651 0.9687500 1.322421 31  
## [21] {Education} => {Services} 0.4418605 0.9500000 1.433333 38  
## [22] {Education} => {Agriculture} 0.4186047 0.9000000 1.248387 36  
## [23] {Education} => {Retail} 0.4418605 0.9500000 1.339344 38  
## [24] {Education} => {Food} 0.4418605 0.9500000 1.296825 38  
## [25] {Clothing} => {Retail} 0.5697674 0.9245283 1.303433 49  
## [26] {Clothing} => {Food} 0.5813953 0.9433962 1.287811 50  
## [27] {Services} => {Food} 0.6046512 0.9122807 1.245336 52  
## [28] {Agriculture} => {Food} 0.6511628 0.9032258 1.232975 56  
## [29] {Retail} => {Food} 0.6511628 0.9180328 1.253188 56  
## [30] {Construction,   
## Health} => {Retail} 0.2093023 1.0000000 1.409836 18  
## [31] {Construction,   
## Health} => {Food} 0.2093023 1.0000000 1.365079 18  
## [32] {Education,   
## Health} => {Clothing} 0.2325581 0.9090909 1.475129 20  
## [33] {Education,   
## Health} => {Services} 0.2441860 0.9545455 1.440191 21  
## [34] {Education,   
## Health} => {Agriculture} 0.2441860 0.9545455 1.324047 21  
## [35] {Education,   
## Health} => {Retail} 0.2558140 1.0000000 1.409836 22  
## [36] {Education,   
## Health} => {Food} 0.2441860 0.9545455 1.303030 21  
## [37] {Clothing,   
## Health} => {Agriculture} 0.2558140 0.9166667 1.271505 22  
## [38] {Agriculture,   
## Health} => {Clothing} 0.2558140 0.9166667 1.487421 22  
## [39] {Clothing,   
## Health} => {Retail} 0.2790698 1.0000000 1.409836 24  
## [40] {Health,   
## Retail} => {Clothing} 0.2790698 0.9230769 1.497823 24  
## [41] {Clothing,   
## Health} => {Food} 0.2674419 0.9583333 1.308201 23  
## [42] {Food,   
## Health} => {Clothing} 0.2674419 0.9200000 1.492830 23  
## [43] {Health,   
## Services} => {Agriculture} 0.2558140 0.9166667 1.271505 22  
## [44] {Agriculture,   
## Health} => {Services} 0.2558140 0.9166667 1.383041 22  
## [45] {Health,   
## Services} => {Retail} 0.2674419 0.9583333 1.351093 23  
## [46] {Health,   
## Services} => {Food} 0.2558140 0.9166667 1.251323 22  
## [47] {Agriculture,   
## Health} => {Retail} 0.2790698 1.0000000 1.409836 24  
## [48] {Health,   
## Retail} => {Agriculture} 0.2790698 0.9230769 1.280397 24  
## [49] {Agriculture,   
## Health} => {Food} 0.2674419 0.9583333 1.308201 23  
## [50] {Food,   
## Health} => {Agriculture} 0.2674419 0.9200000 1.276129 23  
## [51] {Health,   
## Retail} => {Food} 0.2906977 0.9615385 1.312576 25  
## [52] {Food,   
## Health} => {Retail} 0.2906977 1.0000000 1.409836 25  
## [53] {Construction,   
## Transportation} => {Clothing} 0.2093023 0.9473684 1.537239 18  
## [54] {Construction,   
## Transportation} => {Services} 0.2209302 1.0000000 1.508772 19  
## [55] {Construction,   
## Transportation} => {Agriculture} 0.2093023 0.9473684 1.314092 18  
## [56] {Construction,   
## Transportation} => {Retail} 0.2093023 0.9473684 1.335634 18  
## [57] {Construction,   
## Transportation} => {Food} 0.2209302 1.0000000 1.365079 19  
## [58] {Personal Use,   
## Transportation} => {Services} 0.2209302 1.0000000 1.508772 19  
## [59] {Personal Use,   
## Transportation} => {Agriculture} 0.2093023 0.9473684 1.314092 18  
## [60] {Personal Use,   
## Transportation} => {Retail} 0.2093023 0.9473684 1.335634 18  
## [61] {Personal Use,   
## Transportation} => {Food} 0.2209302 1.0000000 1.365079 19  
## [62] {Arts,   
## Transportation} => {Clothing} 0.2093023 0.9000000 1.460377 18  
## [63] {Arts,   
## Transportation} => {Services} 0.2325581 1.0000000 1.508772 20  
## [64] {Arts,   
## Transportation} => {Agriculture} 0.2209302 0.9500000 1.317742 19  
## [65] {Arts,   
## Transportation} => {Retail} 0.2209302 0.9500000 1.339344 19  
## [66] {Arts,   
## Transportation} => {Food} 0.2325581 1.0000000 1.365079 20  
## [67] {Education,   
## Transportation} => {Services} 0.2558140 1.0000000 1.508772 22  
## [68] {Education,   
## Transportation} => {Agriculture} 0.2325581 0.9090909 1.260997 20  
## [69] {Education,   
## Transportation} => {Retail} 0.2558140 1.0000000 1.409836 22  
## [70] {Education,   
## Transportation} => {Food} 0.2441860 0.9545455 1.303030 21  
## [71] {Clothing,   
## Transportation} => {Services} 0.2674419 1.0000000 1.508772 23  
## [72] {Clothing,   
## Transportation} => {Agriculture} 0.2558140 0.9565217 1.326788 22  
## [73] {Clothing,   
## Transportation} => {Retail} 0.2558140 0.9565217 1.348539 22  
## [74] {Clothing,   
## Transportation} => {Food} 0.2674419 1.0000000 1.365079 23  
## [75] {Services,   
## Transportation} => {Agriculture} 0.2906977 0.9259259 1.284349 25  
## [76] {Agriculture,   
## Transportation} => {Services} 0.2906977 0.9615385 1.450742 25  
## [77] {Services,   
## Transportation} => {Retail} 0.2906977 0.9259259 1.305404 25  
## [78] {Retail,   
## Transportation} => {Services} 0.2906977 1.0000000 1.508772 25  
## [79] {Services,   
## Transportation} => {Food} 0.3023256 0.9629630 1.314521 26  
## [80] {Food,   
## Transportation} => {Services} 0.3023256 0.9629630 1.452891 26  
## [81] {Retail,   
## Transportation} => {Agriculture} 0.2674419 0.9200000 1.276129 23  
## [82] {Agriculture,   
## Transportation} => {Food} 0.3023256 1.0000000 1.365079 26  
## [83] {Food,   
## Transportation} => {Agriculture} 0.3023256 0.9629630 1.335723 26  
## [84] {Retail,   
## Transportation} => {Food} 0.2790698 0.9600000 1.310476 24  
## [85] {Construction,   
## Housing} => {Food} 0.2093023 1.0000000 1.365079 18  
## [86] {Housing,   
## Personal Use} => {Services} 0.2209302 0.9047619 1.365079 19  
## [87] {Housing,   
## Personal Use} => {Agriculture} 0.2325581 0.9523810 1.321045 20  
## [88] {Housing,   
## Personal Use} => {Retail} 0.2325581 0.9523810 1.342701 20  
## [89] {Housing,   
## Personal Use} => {Food} 0.2325581 0.9523810 1.300076 20  
## [90] {Arts,   
## Housing} => {Services} 0.2093023 0.9473684 1.429363 18  
## [91] {Arts,   
## Housing} => {Agriculture} 0.2093023 0.9473684 1.314092 18  
## [92] {Arts,   
## Housing} => {Food} 0.2209302 1.0000000 1.365079 19  
## [93] {Education,   
## Housing} => {Services} 0.2674419 0.9583333 1.445906 23  
## [94] {Education,   
## Housing} => {Agriculture} 0.2674419 0.9583333 1.329301 23  
## [95] {Education,   
## Housing} => {Retail} 0.2674419 0.9583333 1.351093 23  
## [96] {Education,   
## Housing} => {Food} 0.2674419 0.9583333 1.308201 23  
## [97] {Clothing,   
## Housing} => {Agriculture} 0.2790698 0.9600000 1.331613 24  
## [98] {Clothing,   
## Housing} => {Retail} 0.2790698 0.9600000 1.353443 24  
## [99] {Clothing,   
## Housing} => {Food} 0.2674419 0.9200000 1.255873 23  
## [100] {Housing,   
## Services} => {Agriculture} 0.2906977 0.9615385 1.333747 25  
## [101] {Housing,   
## Services} => {Retail} 0.2790698 0.9230769 1.301387 24  
## [102] {Housing,   
## Services} => {Food} 0.2906977 0.9615385 1.312576 25  
## [103] {Agriculture,   
## Housing} => {Retail} 0.3139535 0.9310345 1.312606 27  
## [104] {Housing,   
## Retail} => {Agriculture} 0.3139535 0.9642857 1.337558 27  
## [105] {Agriculture,   
## Housing} => {Food} 0.3139535 0.9310345 1.270936 27  
## [106] {Food,   
## Housing} => {Agriculture} 0.3139535 0.9642857 1.337558 27  
## [107] {Housing,   
## Retail} => {Food} 0.3023256 0.9285714 1.267574 26  
## [108] {Food,   
## Housing} => {Retail} 0.3023256 0.9285714 1.309133 26  
## [109] {Construction,   
## Manufacturing} => {Retail} 0.2093023 1.0000000 1.409836 18  
## [110] {Construction,   
## Manufacturing} => {Food} 0.2093023 1.0000000 1.365079 18  
## [111] {Construction,   
## Personal Use} => {Clothing} 0.2093023 0.9473684 1.537239 18  
## [112] {Construction,   
## Personal Use} => {Services} 0.2093023 0.9473684 1.429363 18  
## [113] {Construction,   
## Personal Use} => {Agriculture} 0.2093023 0.9473684 1.314092 18  
## [114] {Construction,   
## Personal Use} => {Retail} 0.2209302 1.0000000 1.409836 19  
## [115] {Construction,   
## Personal Use} => {Food} 0.2209302 1.0000000 1.365079 19  
## [116] {Arts,   
## Construction} => {Food} 0.2093023 1.0000000 1.365079 18  
## [117] {Construction,   
## Education} => {Clothing} 0.2325581 0.9523810 1.545373 20  
## [118] {Construction,   
## Education} => {Services} 0.2325581 0.9523810 1.436926 20  
## [119] {Construction,   
## Education} => {Agriculture} 0.2325581 0.9523810 1.321045 20  
## [120] {Construction,   
## Education} => {Retail} 0.2441860 1.0000000 1.409836 21  
## [121] {Construction,   
## Education} => {Food} 0.2441860 1.0000000 1.365079 21  
## [122] {Clothing,   
## Construction} => {Services} 0.2790698 0.9230769 1.392713 24  
## [123] {Construction,   
## Services} => {Clothing} 0.2790698 0.9230769 1.497823 24  
## [124] {Clothing,   
## Construction} => {Agriculture} 0.2906977 0.9615385 1.333747 25  
## [125] {Agriculture,   
## Construction} => {Clothing} 0.2906977 0.9615385 1.560232 25  
## [126] {Clothing,   
## Construction} => {Retail} 0.2906977 0.9615385 1.355612 25  
## [127] {Construction,   
## Retail} => {Clothing} 0.2906977 0.9259259 1.502446 25  
## [128] {Clothing,   
## Construction} => {Food} 0.3023256 1.0000000 1.365079 26  
## [129] {Construction,   
## Food} => {Clothing} 0.3023256 0.9285714 1.506739 26  
## [130] {Construction,   
## Services} => {Agriculture} 0.2790698 0.9230769 1.280397 24  
## [131] {Agriculture,   
## Construction} => {Services} 0.2790698 0.9230769 1.392713 24  
## [132] {Construction,   
## Services} => {Retail} 0.2906977 0.9615385 1.355612 25  
## [133] {Construction,   
## Retail} => {Services} 0.2906977 0.9259259 1.397011 25  
## [134] {Construction,   
## Services} => {Food} 0.3023256 1.0000000 1.365079 26  
## [135] {Construction,   
## Food} => {Services} 0.3023256 0.9285714 1.401003 26  
## [136] {Agriculture,   
## Construction} => {Retail} 0.2906977 0.9615385 1.355612 25  
## [137] {Construction,   
## Retail} => {Agriculture} 0.2906977 0.9259259 1.284349 25  
## [138] {Agriculture,   
## Construction} => {Food} 0.3023256 1.0000000 1.365079 26  
## [139] {Construction,   
## Food} => {Agriculture} 0.3023256 0.9285714 1.288018 26  
## [140] {Construction,   
## Retail} => {Food} 0.3139535 1.0000000 1.365079 27  
## [141] {Construction,   
## Food} => {Retail} 0.3139535 0.9642857 1.359485 27  
## [142] {Manufacturing,   
## Personal Use} => {Retail} 0.2093023 1.0000000 1.409836 18  
## [143] {Manufacturing,   
## Personal Use} => {Food} 0.2093023 1.0000000 1.365079 18  
## [144] {Arts,   
## Manufacturing} => {Education} 0.2209302 0.9500000 2.042500 19  
## [145] {Arts,   
## Manufacturing} => {Clothing} 0.2209302 0.9500000 1.541509 19  
## [146] {Arts,   
## Manufacturing} => {Services} 0.2325581 1.0000000 1.508772 20  
## [147] {Arts,   
## Manufacturing} => {Agriculture} 0.2209302 0.9500000 1.317742 19  
## [148] {Arts,   
## Manufacturing} => {Retail} 0.2325581 1.0000000 1.409836 20  
## [149] {Arts,   
## Manufacturing} => {Food} 0.2325581 1.0000000 1.365079 20  
## [150] {Education,   
## Manufacturing} => {Services} 0.2906977 1.0000000 1.508772 25  
## [151] {Manufacturing,   
## Services} => {Education} 0.2906977 0.9259259 1.990741 25  
## [152] {Education,   
## Manufacturing} => {Retail} 0.2906977 1.0000000 1.409836 25  
## [153] {Education,   
## Manufacturing} => {Food} 0.2906977 1.0000000 1.365079 25  
## [154] {Clothing,   
## Manufacturing} => {Services} 0.2790698 0.9600000 1.448421 24  
## [155] {Clothing,   
## Manufacturing} => {Agriculture} 0.2674419 0.9200000 1.276129 23  
## [156] {Agriculture,   
## Manufacturing} => {Clothing} 0.2674419 0.9200000 1.492830 23  
## [157] {Clothing,   
## Manufacturing} => {Retail} 0.2906977 1.0000000 1.409836 25  
## [158] {Clothing,   
## Manufacturing} => {Food} 0.2906977 1.0000000 1.365079 25  
## [159] {Agriculture,   
## Manufacturing} => {Services} 0.2790698 0.9600000 1.448421 24  
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## Food,   
## Retail,   
## Services} => {Manufacturing} 0.2093023 0.9473684 2.909774 18  
## [1353] {Agriculture,   
## Arts,   
## Education,   
## Manufacturing,   
## Retail,   
## Services} => {Food} 0.2093023 1.0000000 1.365079 18  
## [1354] {Agriculture,   
## Arts,   
## Education,   
## Food,   
## Manufacturing,   
## Services} => {Retail} 0.2093023 1.0000000 1.409836 18  
## [1355] {Arts,   
## Education,   
## Food,   
## Manufacturing,   
## Retail,   
## Services} => {Agriculture} 0.2093023 0.9473684 1.314092 18  
## [1356] {Agriculture,   
## Arts,   
## Education,   
## Food,   
## Manufacturing,   
## Retail} => {Services} 0.2093023 1.0000000 1.508772 18  
## [1357] {Agriculture,   
## Arts,   
## Food,   
## Manufacturing,   
## Retail,   
## Services} => {Education} 0.2093023 0.9473684 2.036842 18  
## [1358] {Agriculture,   
## Arts,   
## Clothing,   
## Manufacturing,   
## Retail,   
## Services} => {Food} 0.2093023 1.0000000 1.365079 18  
## [1359] {Agriculture,   
## Arts,   
## Clothing,   
## Food,   
## Manufacturing,   
## Services} => {Retail} 0.2093023 1.0000000 1.409836 18  
## [1360] {Arts,   
## Clothing,   
## Food,   
## Manufacturing,   
## Retail,   
## Services} => {Agriculture} 0.2093023 0.9473684 1.314092 18  
## [1361] {Agriculture,   
## Arts,   
## Clothing,   
## Food,   
## Manufacturing,   
## Retail} => {Services} 0.2093023 1.0000000 1.508772 18  
## [1362] {Agriculture,   
## Arts,   
## Food,   
## Manufacturing,   
## Retail,   
## Services} => {Clothing} 0.2093023 0.9473684 1.537239 18  
## [1363] {Agriculture,   
## Clothing,   
## Education,   
## Manufacturing,   
## Retail,   
## Services} => {Food} 0.2325581 1.0000000 1.365079 20  
## [1364] {Agriculture,   
## Clothing,   
## Education,   
## Food,   
## Manufacturing,   
## Services} => {Retail} 0.2325581 1.0000000 1.409836 20  
## [1365] {Clothing,   
## Education,   
## Food,   
## Manufacturing,   
## Retail,   
## Services} => {Agriculture} 0.2325581 0.9090909 1.260997 20  
## [1366] {Agriculture,   
## Clothing,   
## Education,   
## Food,   
## Manufacturing,   
## Retail} => {Services} 0.2325581 1.0000000 1.508772 20  
## [1367] {Agriculture,   
## Education,   
## Food,   
## Manufacturing,   
## Retail,   
## Services} => {Clothing} 0.2325581 0.9090909 1.475129 20  
## [1368] {Agriculture,   
## Clothing,   
## Food,   
## Manufacturing,   
## Retail,   
## Services} => {Education} 0.2325581 0.9090909 1.954545 20  
## [1369] {Agriculture,   
## Arts,   
## Clothing,   
## Education,   
## Retail,   
## Services} => {Food} 0.2093023 1.0000000 1.365079 18  
## [1370] {Agriculture,   
## Arts,   
## Clothing,   
## Education,   
## Food,   
## Services} => {Retail} 0.2093023 1.0000000 1.409836 18  
## [1371] {Arts,   
## Clothing,   
## Education,   
## Food,   
## Retail,   
## Services} => {Agriculture} 0.2093023 0.9473684 1.314092 18  
## [1372] {Agriculture,   
## Arts,   
## Clothing,   
## Education,   
## Food,   
## Retail} => {Services} 0.2093023 0.9473684 1.429363 18

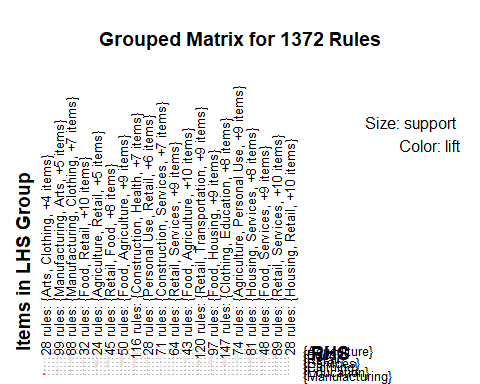
plot(country\_sector\_list\_rules, method = "grouped", control=list(type="item", main =""))

## Warning: Unknown control parameters: type

## Available control parameters (with default values):  
## main = Grouped Matrix for 1372 Rules  
## k = 20  
## rhs\_max = 10  
## lhs\_items = 2  
## aggr.fun = function (x, ...) UseMethod("mean")  
## col = c("#EE0000FF", "#EE0303FF", "#EE0606FF", "#EE0909FF", "#EE0C0CFF", "#EE0F0FFF", "#EE1212FF", "#EE1515FF", "#EE1818FF", "#EE1B1BFF", "#EE1E1EFF", "#EE2222FF", "#EE2525FF", "#EE2828FF", "#EE2B2BFF", "#EE2E2EFF", "#EE3131FF", "#EE3434FF", "#EE3737FF", "#EE3A3AFF", "#EE3D3DFF", "#EE4040FF", "#EE4444FF", "#EE4747FF", "#EE4A4AFF", "#EE4D4DFF", "#EE5050FF", "#EE5353FF", "#EE5656FF", "#EE5959FF", "#EE5C5CFF", "#EE5F5FFF", "#EE6262FF", "#EE6666FF", "#EE6969FF", "#EE6C6CFF", "#EE6F6FFF", "#EE7272FF", "#EE7575FF", "#EE7878FF", "#EE7B7BFF", "#EE7E7EFF", "#EE8181FF", "#EE8484FF", "#EE8888FF", "#EE8B8BFF", "#EE8E8EFF", "#EE9191FF", "#EE9494FF", "#EE9797FF", "#EE9999FF", "#EE9B9BFF", "#EE9D9DFF", "#EE9F9FFF", "#EEA0A0FF", "#EEA2A2FF", "#EEA4A4FF", "#EEA5A5FF", "#EEA7A7FF", "#EEA9A9FF", "#EEABABFF", "#EEACACFF", "#EEAEAEFF", "#EEB0B0FF", "#EEB1B1FF", "#EEB3B3FF", "#EEB5B5FF", "#EEB7B7FF", "#EEB8B8FF", "#EEBABAFF", "#EEBCBCFF", "#EEBDBDFF", "#EEBFBFFF", "#EEC1C1FF", "#EEC3C3FF", "#EEC4C4FF", "#EEC6C6FF", "#EEC8C8FF", "#EEC9C9FF", "#EECBCBFF", "#EECDCDFF", "#EECFCFFF", "#EED0D0FF", "#EED2D2FF", "#EED4D4FF", "#EED5D5FF", "#EED7D7FF", "#EED9D9FF", "#EEDBDBFF", "#EEDCDCFF", "#EEDEDEFF", "#EEE0E0FF", "#EEE1E1FF", "#EEE3E3FF", "#EEE5E5FF", "#EEE7E7FF", "#EEE8E8FF", "#EEEAEAFF", "#EEECECFF", "#EEEEEEFF")  
## reverse = TRUE  
## xlab = NULL  
## ylab = NULL  
## legend = Size: support Color: lift  
## spacing = -1  
## panel.function = function (row, size, shading, spacing) { size[size == 0] <- NA shading[is.na(shading)] <- 1 grid.circle(x = c(1:length(size)), y = row, r = size/2 \* (1 - spacing), default.units = "native", gp = gpar(fill = shading, col = shading, alpha = 0.9)) }  
## gp\_main = list(cex = 1.2, fontface = "bold", font = c(bold = 2))  
## gp\_labels = list(cex = 0.8)  
## gp\_labs = list(cex = 1.2, fontface = "bold", font = c(bold = 2))  
## gp\_lines = list(col = "gray", lty = 3)  
## newpage = TRUE  
## max.shading = NA  
## engine = default  
## verbose = FALSE

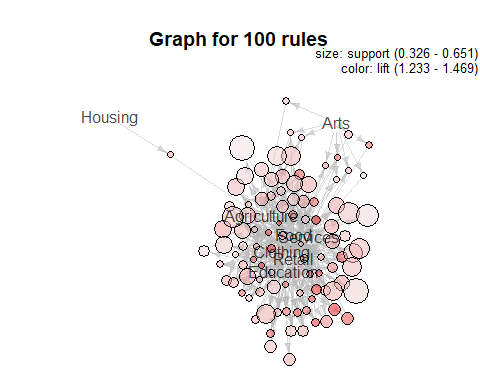


plot(country\_sector\_list\_rules, method = "grouped")



plot(country\_sector\_list\_rules, method = "graph")

## Warning: plot: Too many rules supplied. Only plotting the best 100 rules  
## using 'support' (change control parameter max if needed)



-Figuring out relationship of invested items to help make decision which item to invest depend on previous items -As our result you can find out that “Heath and Manufacturing” and “Transportation”, “Education and Health” and “Transportation” sector has high relationship depend on lift. -So, it is better to invest “Transportation” sector, if the previous investment item is “Heath and Manufacturing” or “Education and Health” sector.