In [1]:
```
df <- read.csv(".\\master.csv")
head(df)
```

A data.frame: 6 × 12

	ď.žcountry	year	sex	age	suicides_no	population	suicides.100k.pop	country.year	HDI.for.year	gdp_for_year....	gdp_per_capita....	generation
	<chr>	<int>	<chr>	<chr>	<int>	<int>	<dbl>	<chr>	<dbl>	<chr>	<int>	<chr>
1	Albania	1987	male	15-24 years	21	312900	6.71	Albania1987	NA	2,156,624,900	796	Generation X
2	Albania	1987	male	35-54 years	16	308000	5.19	Albania1987	NA	2,156,624,900	796	Silent
3	Albania	1987	female	15-24 years	14	289700	4.83	Albania1987	NA	2,156,624,900	796	Generation X
4	Albania	1987	male	75+ years	1	21800	4.59	Albania1987	NA	2,156,624,900	796	G.I. Generation
5	Albania	1987	male	25-34 years	9	274300	3.28	Albania1987	NA	2,156,624,900	796	Boomers
6	Albania	1987	female	75+ years	1	35600	2.81	Albania1987	NA	2,156,624,900	796	G.I. Generation

In [2]:
```
#Napraviću nov dataframe koji će predstavljati sređen prethodni dataframe
reworked.df <- df

#Potrebno je preimenovati kolone
names(reworked.df)[1] <- "country"

#Prvo obrisati suvišne tačke na krajevima naziva kolona
dots.delete <- function (name){
    return(sub("\\.{2,}","", name))
}

names(reworked.df) <- sapply(names(reworked.df), dots.delete)

#Sad je potrebno promeniti "_" u "." da bi imali iste notacije u kolonama
column.notation <- function (column){
    return(gsub("_", ".", column))
}

names(reworked.df) <- sapply(names(reworked.df), column.notation)

#Menjamo"HDI" u malo "hdi"
names(reworked.df) <- sapply(names(reworked.df), tolower)

#gdp.for.year iz string u numeric
reworked.df$gdp.for.year <- sapply(reworked.df$gdp.for.year, function(x) {gsub(",", "", x)})
reworked.df$gdp.for.year <- sapply(reworked.df$gdp.for.year, as.numeric)

#Potrebno napraviti faktore
reworked.df$sex <- as.factor(reworked.df$sex)
reworked.df$age <- factor(reworked.df$age, level=c(
"5-14 years", "15-24 years","25-34 years", "35-54 years", "55-74 years", "75+ years"), ordered = TRUE)

#unique(reworked.df$generation)

reworked.df$generation <- factor(reworked.df$generation, level=c(
"G.I. Generation", "Silent", "Boomers", "Generation X", "Millenials", "Generation Z"))

head(reworked.df)
```

A data.frame: 6 × 12

	country	year	sex	age	suicides.no	population	suicides.100k.pop	country.year	hdi.for.year	gdp.for.year	gdp.per.capita	generation
	<chr>	<int>	<fct>	<ord>	<int>	<int>	<dbl>	<chr>	<dbl>	<dbl>	<int>	<fct>
1	Albania	1987	male	15-24 years	21	312900	6.71	Albania1987	NA	2156624900	796	Generation X
2	Albania	1987	male	35-54 years	16	308000	5.19	Albania1987	NA	2156624900	796	Silent
3	Albania	1987	female	15-24 years	14	289700	4.83	Albania1987	NA	2156624900	796	Generation X
4	Albania	1987	male	75+ years	1	21800	4.59	Albania1987	NA	2156624900	796	G.I. Generation
5	Albania	1987	male	25-34 years	9	274300	3.28	Albania1987	NA	2156624900	796	Boomers
6	Albania	1987	female	75+ years	1	35600	2.81	Albania1987	NA	2156624900	796	G.I. Generation

In [3]:
```
apply(reworked.df, 2, function(x) sum(is.na(x)))
```

country: 0 **year:** 0 **sex:** 0 **age:** 0 **suicides.no:** 0 **population:** 0 **suicides.100k.pop:** 0 **country.year:** 0 **hdi.for.year:** 19456 **gdp.for.year:** 0 **gdp.per.capita:** 0 **generation:** 0

In [26]:
```
#Proverimo da li su za svaku državu obezbeđeni podaci za iste godine
country.year <- aggregate(reworked.df["year"], list(country = reworked.df$country), unique)

head(country.year)
```

A data.frame: 6 × 2

	country	year
	<chr>	<list>
1	Albania	1987, 1988, 1989, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010
2	Antigua and Barbuda	1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2012, 2013, 2014, 2015
3	Argentina	1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015
4	Armenia	1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016
5	Aruba	1995, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011
6	Australia	1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015

Bitno je istaći da ovaj dataset ima dosta nedostajućih vrednosti za varijablu hdi.for.year. Nema svaka država merenja za svaku godinu već npr. Argentina ima merenja za 1985. dok Albanija ima merenja tek od 1987. Takođe postoji ponavljanje podataka kao što su hdi.for.year, gdp.for.year i gdp.per.capita koji se ponavljaju čak 12 puta (6 starosnih grupa za muški pol i 6 starosnih grupa za ženski pol za datu godinu).

*Varijabla suicides.100k.pop predstavlja količnik varijabli suicides.no i population

**Istraživačka pitanja:

1. Koje države imaju najveću stopu samoubistava?
2. Koje starosne grupe su nasklonije suicidu?
3. Da li postoji značajno veća stopa kod određenog pola?
4. Da li je u nekoj generaciji suicid zastupljeniji?
5. Od čega zavisi ta stopa?

In [5]:
```
#1. Koje države imaju najveću stopu suicida
#Za odgovor na ovo pitanje koristiću godinu sa najviše opservacija
which.max(table(reworked.df$year))
```

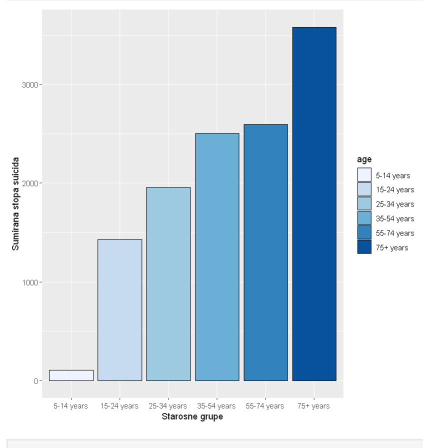
2009: 25

In [6]:
```
year2009 <- as.data.frame(reworked.df[reworked.df$year == 2009, ])

year2009.suicides.agg <- aggregate(year2009[c(
    "suicides.no", "population")], list(country = year2009$country), sum)

year2009.suicides.agg$suicides.100k.pop <- year2009.suicides.agg$suicides.no / year2009.suicides.agg$population

year2009.suicides.agg <- year2009.suicides.agg[
    order(year2009.suicides.agg$suicides.100k.pop, decreasing = TRUE), ]

head(year2009.suicides.agg)
```

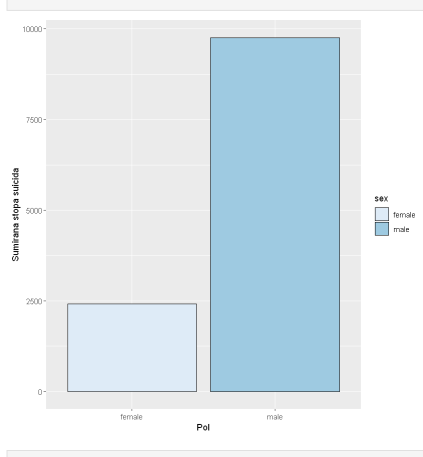
A data.frame: 6 × 4

	country	suicides.no	population	suicides.100k.pop
	<chr>	<int>	<int>	<dbl>
48	Lithuania	1138	3016497	0.0003772588
65	Republic of Korea	15402	47380017	0.0003250738
11	Belarus	2743	9169969	0.0002991286
67	Russian Federation	37408	134085433	0.0002789863
77	Suriname	131	470448	0.0002784580
44	Kazakhstan	3838	14370635	0.0002670724

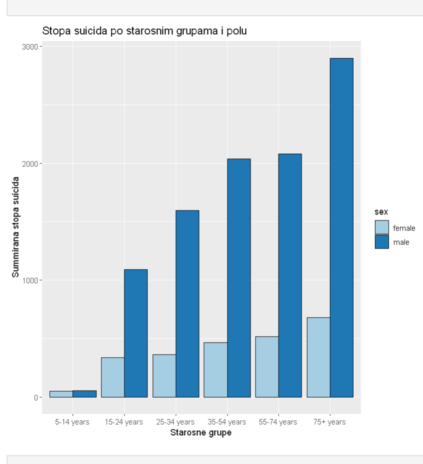
In [7]:
```
#2. Koje starosne grupe su sklonije suicidu?
#Računaće se za sve države. Za razliku od prošlog primera neću računati nove vrednosti suicides.100k.pop,
#već ću sabrati postojeće. Takva sumirana vrednost nije ista kao i ona
#koja se dobija suicides.no/population ali smatram da oslikava istu pojavu

year2009.age.agg <- aggregate(year2009["suicides.100k.pop"], list(age=year2009$age), sum)

#install.packages("RColorBrewer")

library(ggplot2)
library(RColorBrewer)

ggplot(year2009.age.agg, aes(x=age, y=suicides.100k.pop, fill=age)) +
geom_bar(stat="identity", color="black") +
labs(x="Starosne grupe", y="Sumirana stopa suicida") +
scale_fill_brewer(palette="Blues")
```



In [8]:
```
#3. Koji pol je skloniji suicidu?

year2009.sex.agg <- aggregate(year2009["suicides.100k.pop"], list(sex = year2009$sex), sum)

ggplot(year2009.sex.agg, aes(x=sex, y=suicides.100k.pop, fill=sex)) +
geom_bar(stat="identity", color="black") +
labs(x="Pol", y="Sumirana stopa suicida") +
scale_fill_brewer(palette="Blues")
```



In [9]:
```
sex.age.agg <- aggregate(year2009["suicides.100k.pop"], list(sex = year2009$sex, age = year2009$age), sum)

ggplot(sex.age.agg, aes(x = age, y = suicides.100k.pop, fill = sex)) +
geom_bar(stat="identity", color="black", position = "dodge") +
scale_fill_brewer(palette="Paired") +
labs(x = "Starosne grupe", y= "Summirana stopa suicida", title="Stopa suicida po starosnim grupama i polu")
```



In [10]:
```
#4. U kojoj generaciji je suicid zastupljeniji?
generation <- aggregate(year2009["suicides.100k.pop"], list(generation=year2009$generation), sum)
generation
```

A data.frame: 5 × 2

generation	suicides.100k.pop
<fct>	<dbl>
Silent	6177.07
Boomers	2506.18
Generation X	1957.17
Millenials	1429.18
Generation Z	106.44

In [11]:
```
#5. Od čega zavisi stopa suicida?
#Za odgovor na ovo pitanje moram koristiti i vairjablu sa HDI vrednostim.
#Početna hipoteza je da stopa zavisi od HDI-ja i GDP-ja

hdi.df <- as.data.frame(reworked.df[is.na(reworked.df$hdi.for.year) == FALSE, ])
which.max(table(hdi.df$year))
```

2010: 6

In [12]:
```
#Uzeta je gdoina 2010. zbog najvećeg broja HDI vrednosti

year2010 <- as.data.frame(hdi.df[hdi.df$year == 2010, ])
head(year2010)
```

A data.frame: 6 × 12

	country	year	sex	age	suicides.no	population	suicides.100k.pop	country.year	hdi.for.year	gdp.for.year	gdp.per.capita	generation
	<chr>	<int>	<fct>	<ord>	<int>	<int>	<dbl>	<chr>	<dbl>	<dbl>	<int>	<fct>
253	Albania	2010	male	55-74 years	20	241852	8.27	Albania2010	0.722	11926953259	4359	Silent
254	Albania	2010	male	35-54 years	20	371611	5.38	Albania2010	0.722	11926953259	4359	Generation X
255	Albania	2010	male	25-34 years	9	179720	5.01	Albania2010	0.722	11926953259	4359	Generation X
256	Albania	2010	male	75+ years	2	50767	3.94	Albania2010	0.722	11926953259	4359	Silent
257	Albania	2010	male	15-24 years	10	279508	3.58	Albania2010	0.722	11926953259	4359	Millenials
258	Albania	2010	female	25-34 years	6	183579	3.27	Albania2010	0.722	11926953259	4359	Generation X

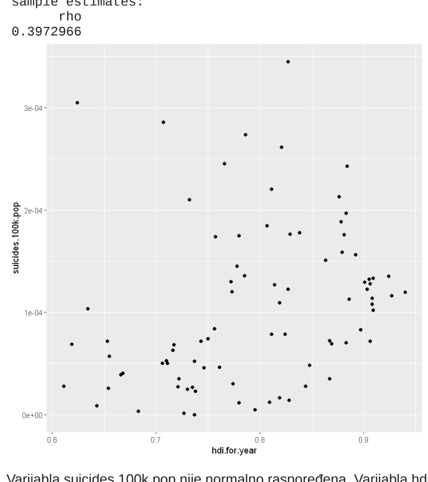
In [13]:
```
year2010.agg <- aggregate(
    year2010[ , c("hdi.for.year", "gdp.for.year", "gdp.per.capita")], list(country = year2010$country), unique)

year2010.agg2 <- aggregate(year2010[, c("suicides.no", "population")], list(country = year2010$country), sum)
year2010.agg2$suicides.100k.pop <- year2010.agg2$suicides.no / year2010.agg2$population
year2010.agg[c("suicides.no", "population", "suicides.100k.pop")] <- year2010.agg2[
    , c("suicides.no", "population", "suicides.100k.pop")]

head(year2010.agg)
```

A data.frame: 6 × 7

	country	hdi.for.year	gdp.for.year	gdp.per.capita	suicides.no	population	suicides.100k.pop
	<chr>	<dbl>	<dbl>	<int>	<int>	<int>	<dbl>
1	Albania	0.722	1.192695e+10	4359	96	2736025	3.508740e-05
2	Argentina	0.811	4.236274e+11	11273	2943	37578454	7.831615e-05
3	Armenia	0.721	9.260285e+09	3460	73	2676225	2.727723e-05
4	Australia	0.927	1.144261e+12	54887	2420	20847547	1.160808e-04
5	Austria	0.879	3.918927e+11	49181	1264	7968421	1.586262e-04
6	Bahamas	0.774	1.009576e+10	30239	10	333869	2.995187e-05

In [14]:
```
shapiro.test(year2010.agg$suicides.100k.pop)
shapiro.test(year2010.agg$hdi.for.year)

ggplot(year2010.agg, aes(hdi.for.year, suicides.100k.pop)) + geom_point()

cor.test(year2010.agg$hdi.for.year, year2010.agg$suicides.100k.pop, method="spearman")
```

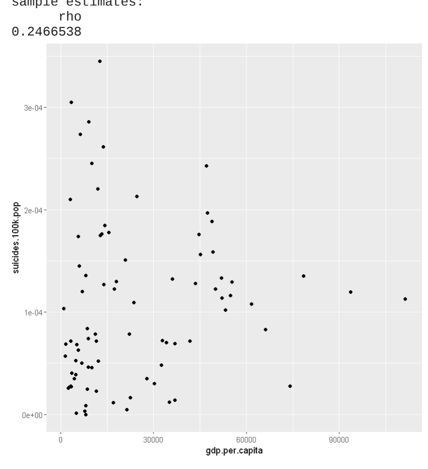
```
        Shapiro-Wilk normality test

data:  year2010.agg$suicides.100k.pop
W = 0.93155, p-value = 0.0002438
        Shapiro-Wilk normality test

data:  year2010.agg$hdi.for.year
W = 0.96029, p-value = 0.01097
Warning message in cor.test.default(year2010.agg$hdi.for.year, year2010.agg$suicides.100k.pop, :
"Cannot compute exact p-value with ties"
        Spearman's rank correlation rho

data:  year2010.agg$hdi.for.year and year2010.agg$suicides.100k.pop
S = 59529, p-value = 0.0001826
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.3972966
```



Varijabla suicides.100k.pop nije normalno raspoređena. Varijabla hdi.for.year nije normalno raspoređena. Korelacija između ove dve varijable statistički značajna ali je slaba.

In [15]:
```
shapiro.test(year2010.agg$gdp.per.capita)
cor.test(year2010.agg$gdp.per.capita, year2010.agg$suicides.100k.pop, method="spearman")

ggplot(year2010.agg, aes(gdp.per.capita, suicides.100k.pop)) + geom_point()
```

```
        Shapiro-Wilk normality test

data:  year2010.agg$gdp.per.capita
W = 0.83498, p-value = 2.966e-08
        Spearman's rank correlation rho

data:  year2010.agg$gdp.per.capita and year2010.agg$suicides.100k.pop
S = 74408, p-value = 0.02394
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.2466538
```



Korelacija između ove dve varijable ne postoji ili nije značajna.

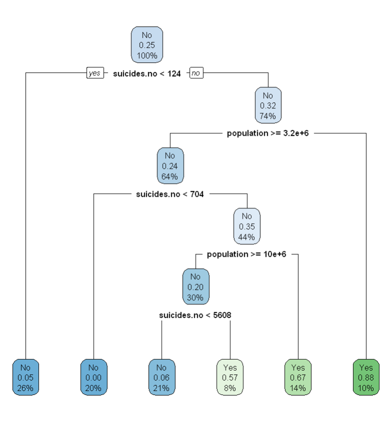
In [16]:
```
#Za desicion tree ću uzezi isti ovaj df jer sadrži najviše hdi vrednosti
#install.packages(c("rpart", "rpart.plot"))

library(rpart)
library(rpart.plot)

train.data <- as.data.frame(year2010.agg)
third.q <- quantile(train.data$suicides.100k.pop, 0.75)

train.data$high.rate <- ifelse(train.data$suicides.100k.pop > third.q, "Yes", "No")
train.data$high.rate <- as.factor(train.data$high.rate)
train.data[c("country", "suicides.100k.pop")] <- NULL

head(train.data)
```

A data.frame: 6 × 6

	hdi.for.year	gdp.for.year	gdp.per.capita	suicides.no	population	high.rate
	<dbl>	<dbl>	<int>	<int>	<int>	<fct>
1	0.722	1.192695e+10	4359	96	2736025	No
2	0.811	4.236274e+11	11273	2943	37578454	No
3	0.721	9.260285e+09	3460	73	2676225	No
4	0.927	1.144261e+12	54887	2420	20847547	No
5	0.879	3.918927e+11	49181	1264	7968421	Yes
6	0.774	1.009576e+10	30239	10	333869	No

In [17]:
```
tree1 <- rpart(high.rate ~. , train.data, method = "class")
print(tree1)
rpart.plot(tree1)
```

```
n= 84

node), split, n, loss, yval, (yprob)
      * denotes terminal node

 1) root 84 21 No (0.75000000 0.25000000)
   2) suicides.no< 124 22  1 No (0.95454545 0.04545455) *
   3) suicides.no>=124 62 20 No (0.67741935 0.32258065)
     6) population>=3200861 54 13 No (0.75925926 0.24074074)
      12) suicides.no< 703.5 17  0 No (1.00000000 0.00000000) *
      13) suicides.no>=703.5 37 13 No (0.64864865 0.35135135)
        26) population>=1.046851e+07 25  5 No (0.80000000 0.20000000)
          52) suicides.no< 5607.5 18  1 No (0.94444444 0.05555556) *
          53) suicides.no>=5607.5 7  3 Yes (0.42857143 0.57142857) *
        27) population< 1.046851e+07 12  4 Yes (0.33333333 0.66666667) *
     7) population< 3200861 8  1 Yes (0.12500000 0.87500000) *
```



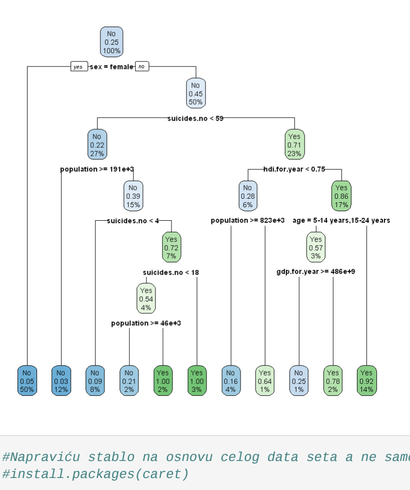
In [18]:
```
#Probaću još jedan model kojem ću proslediti ceo dataset
train.data2 <- as.data.frame(year2010)
q3 <- quantile(train.data2$suicides.100k.pop, 0.75)

train.data2$high.rate <- ifelse(train.data2$suicides.100k.pop > q3, "Yes", "No")
train.data2$high.rate <- as.factor(train.data2$high.rate)
train.data2[c("country", "year", "suicides.100k.pop", "country.year")] <- NULL

head(train.data2)
```

A data.frame: 6 × 9

	sex	age	suicides.no	population	hdi.for.year	gdp.for.year	gdp.per.capita	generation	high.rate
	<fct>	<ord>	<int>	<int>	<dbl>	<dbl>	<int>	<fct>	<fct>
253	male	55-74 years	20	241852	0.722	11926953259	4359	Silent	No
254	male	35-54 years	20	371611	0.722	11926953259	4359	Generation X	No
255	male	25-34 years	9	179720	0.722	11926953259	4359	Generation X	No
256	male	75+ years	2	50767	0.722	11926953259	4359	Silent	No
257	male	15-24 years	10	279508	0.722	11926953259	4359	Millenials	No
258	female	25-34 years	6	183579	0.722	11926953259	4359	Generation X	No

In [19]:
```
tree2 <- rpart(high.rate ~. , train.data2, method = "class")
print(tree2)
rpart.plot(tree2)
```

```
n= 1008

node), split, n, loss, yval, (yprob)
      * denotes terminal node

  1) root 1008 252 No (0.75000000 0.25000000)
    2) sex=female 504  26 No (0.94841270 0.05158730) *
    3) sex=male 504 226 No (0.55158730 0.44841270)
      6) suicides.no< 58.5 272  61 No (0.77573529 0.22426471)
       12) population>=190637.5 124   4 No (0.96774194 0.03225806) *
       13) population< 190637.5 148  57 No (0.61486486 0.38513514)
         26) suicides.no< 3.5 79   7 No (0.91139241 0.08860759) *
         27) suicides.no>=3.5 69  19 Yes (0.27536232 0.72463768)
           54) suicides.no< 17.5 41  19 Yes (0.46341463 0.53658537)
            108) population>=45716 24   5 No (0.79166667 0.20833333) *
            109) population< 45716 17   0 Yes (0.00000000 1.00000000) *
           55) suicides.no>=17.5 28   0 Yes (0.00000000 1.00000000) *
      7) suicides.no>=58.5 232  67 Yes (0.28879310 0.71120690)
       14) hdi.for.year< 0.748 58  16 No (0.72413793 0.27586207)
         28) population>=822889 44   7 No (0.84090909 0.15909091) *
         29) population< 822889 14   5 Yes (0.35714286 0.64285714) *
       15) hdi.for.year>=0.748 174  25 Yes (0.14367816 0.85632184)
         30) age=5-14 years,15-24 years 30  13 Yes (0.43333333 0.56666667)
           60) gdp.for.year>=4.859629e+11 12   3 No (0.75000000 0.25000000) *
           61) gdp.for.year< 4.859629e+11 18   4 Yes (0.22222222 0.77777778) *
         31) age=25-34 years,35-54 years,55-74 years,75+ years 144  12 Yes (0.08333333 0.91666667) *
```



In [20]:
```
#Napraviću stablo na osnovu celog data seta a ne samo jedne godine
#install.packages(caret)

library(caret)

quant3 <- quantile(hdi.df$suicides.100k.pop, 0.75)
hdi.df$high.rate <- ifelse(hdi.df$suicides.100k.pop > quant3, "Yes", "No")
hdi.df$high.rate <- factor(hdi.df$high.rate)
hdi.df[c("country", "year", "suicides.100k.pop", "country.year")] <- NULL

head(hdi.df)
```

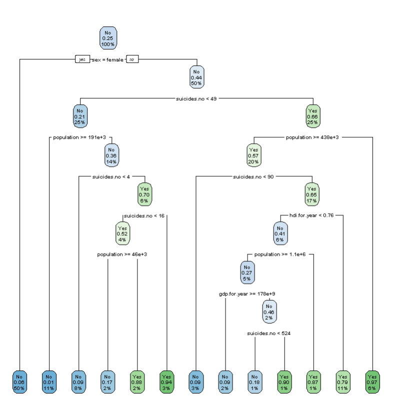
```
Loading required package: lattice
```

A data.frame: 6 × 9

	sex	age	suicides.no	population	hdi.for.year	gdp.for.year	gdp.per.capita	generation	high.rate
	<fct>	<ord>	<int>	<int>	<dbl>	<dbl>	<int>	<fct>	<fct>
73	male	25-34 years	13	232900	0.619	2424499009	835	Generation X	No
74	male	55-74 years	9	178000	0.619	2424499009	835	Silent	No
75	female	75+ years	2	40800	0.619	2424499009	835	G.I. Generation	No
76	female	15-24 years	13	283500	0.619	2424499009	835	Generation X	No
77	male	15-24 years	11	241200	0.619	2424499009	835	Generation X	No
78	male	75+ years	1	25100	0.619	2424499009	835	G.I. Generation	No

In [21]:
```
train.indices <- createDataPartition(hdi.df$high.rate, p=0.8, list=FALSE)
train.data3 <- hdi.df[train.indices, ]
test.data <- hdi.df[-train.indices, ]

tree3 <-rpart(high.rate ~. , train.data3, method = "class")
print(tree3)
rpart.plot(tree3)
```

```
n= 6692

node), split, n, loss, yval, (yprob)
      * denotes terminal node

  1) root 6692 1673 No (0.75000000 0.25000000)
    2) sex=female 3341  204 No (0.93894044 0.06105956) *
    3) sex=male 3351 1469 No (0.56162340 0.43837660)
      6) suicides.no< 48.5 1649  347 No (0.78956944 0.21043056)
       12) population>=190676.5 725   10 No (0.98620690 0.01379310) *
       13) population< 190676.5 924  337 No (0.63528139 0.36471861)
         26) suicides.no< 3.5 508   47 No (0.90748031 0.09251969) *
         27) suicides.no>=3.5 416  126 Yes (0.30288462 0.69711538)
           54) suicides.no< 15.5 240  115 Yes (0.47916667 0.52083333)
            108) population>=45716 122   21 No (0.82786885 0.17213115) *
            109) population< 45716 118   14 Yes (0.11864407 0.88135593) *
           55) suicides.no>=15.5 176   11 Yes (0.06250000 0.93750000) *
      7) suicides.no>=48.5 1702  580 Yes (0.34077556 0.65922444)
       14) population>=438249 1332  570 Yes (0.42792793 0.57207207)
         28) suicides.no< 89.5 187   16 No (0.91443850 0.08556150) *
         29) suicides.no>=89.5 1145  399 Yes (0.34847162 0.65152838)
           58) hdi.for.year< 0.7625 411  169 No (0.58880779 0.41119221)
            116) population>=1136953 317   87 No (0.72555205 0.27444795)
              232) gdp.for.year>=1.780419e+11 162   15 No (0.90740741 0.09259259) *
              233) gdp.for.year< 1.780419e+11 155   72 No (0.53548387 0.46451613)
                466) suicides.no< 523.5 94   17 No (0.81914894 0.18085106) *
                467) suicides.no>=523.5 61    6 Yes (0.09836066 0.90163934) *
            117) population< 1136953 94   12 Yes (0.12765957 0.87234043) *
           59) hdi.for.year>=0.7625 734  157 Yes (0.21389646 0.78610354) *
       15) population< 438249 370   10 Yes (0.02702703 0.97297297) *
```



In [22]:
```
#S obzirom da je stablo veliko te se plot ne vidi dobro, kod ispod pravi čitljivu sliku.
#png("FinalClassTree1.png", width=1280, height=960)
#rpart.plot(tree3)
#dev.off()
```

In [23]:
```
tree3.pred <- predict(tree3, test.data, type = "class")
tree3.cm <- table(true = test.data$high.rate, predicted = tree3.pred)
tree3.cm
```

```
     predicted
true    No  Yes
  No  1191   63
  Yes   87  331
```

In [24]:
```
compute.eval.metrics <- function(cmatrix) {
TP <- cmatrix[2,2]
TN <- cmatrix[1,1]
FP <- cmatrix[1,2]
FN <- cmatrix[2,1]
acc <- sum(diag(cmatrix)) / sum(cmatrix)
precision <- TP / (TP + FP)
recall <- TP / (TP + FN)
F1 <- 2*precision*recall / (precision + recall)
c(accuracy = acc, precision = precision, recall = recall, F1 = F1)}

tree3.eval <- compute.eval.metrics(tree3.cm)
tree3.eval
```

accuracy: 0.910287081339713 **precision:** 0.84010152284264 **recall:** 0.791866028708134 **F1:** 0.815270935960591

Zaključak

Na osnovu ovih mera možemo zaključiti da ovaj model nije dovoljno precizan. Na osnovu Recall mere (339/339+79) vidimo da je model čak 79 pozitivnih vrednosti prediktovao kao negativne ili približno 19%. Druga mera, Precision (339/339+33) nam govori da je model 33 negativne vrednosti prediktovao kao pozitivne ili približno 9%. Zaključak je da je model sklon da realizovane pozitivne vrednosti lošije predviđa. U kontekstu ovih podataka u približno 19% slučajeva model je realizovanu visoku stopu suicida evaluirao kao nisku.

Razlog bi bili sami podaci. Naime varijable preko kojih želimo da prediktujemo neku drugu varijablu moraju da dele zajednički varijabilitet, odnosno da preko njih možemo da objasnimo varijablu čije vrednosti želimo da predviđamo.

U ovom slučaju, kao odgovor na 5. pitanje (od čega zavisi stopa suicida?) smo pokazali da stopa suicida ne zavisi od GDP-a, dok sa HDI-em postoji značajna korelacija iako je ona ipak slaba. Ukoliko pogledamo grafik stabla možemo videti da ono koristi za odlučivanje HDI i GDP (iako korelacije nema). Ipak, koristi ih za odlučivanje samo po jednom. Razlog zašto najviše koristi varijable "suicides.no" i "population" je logičan s obzirom da smo "sucides.100k.pop" izračunali preko prethodne dve varijable.

Upravo ova činjenica se i odražava na preciznost našeg modela. Da bi povećali preciznost modela (pri tom i odgovorili na 5. pitanje) morali bi da imamo neke dodatne varijable koje će bliže i bolje objašnjavati stopu suicida u državama.

Zanimljivo je primetiti da možemo intuitivno razumeti kako stablo odlučuje (koje varijable koristi) preko prethodnih pet pitanja tj. odgovora na njih (pokazano je da je stopa suicida daleko viša kod muškaraca, s toga stablo i kreće sa pitanjem o polu, gde slučajeve stope sucida za ženski pol uopšte i ne razmatra).