Data Mining Project 1

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Business Understanding

1.1 What is the purpose of stop and frisk program?

The purpose of the program is to eliminate weapons that are carried illegally and eventually reduce the number of crime rates.

1.2 How do you define and measure effectiveness for such a program?

I would measure the effectiveness of the program by averaging the numbers of crimes occur in a certain period of time during the program and when the program is on hold. The reason is to try and estimate the number of crime that are prevented by the program.

1.3 What data would be needed to judge its effectiveness?

The number of crimes occur in New York when the program is running and when the program is on hold.

Data Understanding

Type of attributes:

Variable	Label	Data Type
year	YEAR OF STOP (CCYY)	Interval
pct	PRECINCT OF STOP (FROM 1 TO 123)	Nominal
ser_num	UF250 SERIAL NUMBER	Nominal
datestop	DATE OF STOP (MM-DD-YYYY)	Interval
timestop	TIME OF STOP (HH:MM)	Interval
recstat	RECORD STATUS	Nominal
inout	WAS STOP INSIDE OR OUTSIDE ?	Nominal
trhsloc	WAS LOCATION HOUSING OR TRANSIT AUTHORITY ?	Nominal
perobs	PERIOD OF OBSERVATION (MINUTES)	ratio
crimsusp	CRIME SUSPECTED	Nominal
perstop	PERIOD OF STOP (MINUTES)	ratio
typeofid	STOPPED PERSON'S IDENTIFICATION TYPE	Nominal
explnstp	DID OFFICER EXPLAIN REASON FOR STOP ?	Nominal
othpers	WERE OTHER PERSONS STOPPED, QUESTIONED OR FRISKED ?	Nominal
arstmade	WAS AN ARREST MADE ?	Nominal
arstoffn	OFFENSE SUSPECT ARRESTED FOR	Nominal
sumissue	WAS A SUMMONS ISSUED ?	Nominal
sumoffen	OFFENSE SUSPECT WAS SUMMONSED FOR	Nominal
compyear	COMPLAINT YEAR (IF COMPLAINT REPORT PREPARED)	Interval
comppct	COMPLAINT PRECINCT (IF COMPLAINT REPORT PREPARED)	Nominal
offunif	WAS OFFICER IN UNIFORM ?	Nominal
officrid	ID CARD PROVIDED BY OFFICER (IF NOT IN UNIFORM)	Nominal
frisked	WAS SUSPECT FRISKED ?	Nominal
searched	WAS SUSPECT SEARCHED ?	Nominal
contrabn	WAS CONTRABAND FOUND ON SUSPECT ?	Nominal
adtlrept	WERE ADDITIONAL REPORTS PREPARED ?	Nominal
pistol	WAS A PISTOL FOUND ON SUSPECT ?	Nominal
riflshot	WAS A RIFLE FOUND ON SUSPECT ?	Nominal
asltweap	WAS AN ASSAULT WEAPON FOUND ON SUSPECT ?	Nominal
knifcuti	WAS A KNIFE OR CUTTING INSTRUMENT FOUND ON SUSPECT ?	Nominal
machgun	WAS A MACHINE GUN FOUND ON SUSPECT ?	Nominal
othrweap	WAS ANOTHER TYPE OF WEAPON FOUND ON SUSPECT	Nominal
pf_hands	PHYSICAL FORCE USED BY OFFICER - HANDS	Nominal
pf_wall	PHYSICAL FORCE USED BY OFFICER - SUSPECT AGAINST WALL	Nominal
pf_grnd	PHYSICAL FORCE USED BY OFFICER - SUSPECT ON GROUND	Nominal
pf_drwep	PHYSICAL FORCE USED BY OFFICER - WEAPON DRAWN	Nominal
pf_ptwep	PHYSICAL FORCE USED BY OFFICER - WEAPON POINTED	Nominal

pf_baton	PHYSICAL FORCE USED BY OFFICER - BATON	**Nominal**
pf_hcuff	PHYSICAL FORCE USED BY OFFICER - HANDCUFFS	**Nominal**
pf_pepsp	PHYSICAL FORCE USED BY OFFICER - PEPPER SPRAY	**Nominal**
pf_other	PHYSICAL FORCE USED BY OFFICER - OTHER	**Nominal**
radio	RADIO RUN	**Nominal**
ac_rept	ADDITIONAL CIRCUMSTANCES - REPORT BY VICTIM/WITNESS/OFFICER	**Nominal**
ac_inves	ADDITIONAL CIRCUMSTANCES - ONGOING INVESTIGATION	**Nominal**
rf_vcrim	REASON FOR FRISK - VIOLENT CRIME SUSPECTED	**Nominal**
rf_othsw	REASON FOR FRISK - OTHER SUSPICION OF WEAPONS	**Nominal**
ac_proxm	ADDITIONAL CIRCUMSTANCES - PROXIMITY TO SCENE OF OFFENSE	**Nominal**
rf_attir	REASON FOR FRISK - INAPPROPRIATE ATTIRE FOR SEASON	**Nominal**
cs_objcs	REASON FOR STOP - CARRYING SUSPICIOUS OBJECT	**Nominal**
cs_descr	REASON FOR STOP - FITS A RELEVANT DESCRIPTION	**Nominal**
cs_casng	REASON FOR STOP - CASING A VICTIM OR LOCATION	**Nominal**
cs_lkout	REASON FOR STOP - SUSPECT ACTING AS A LOOKOUT	**Nominal**
rf_vcact	REASON FOR FRISK- ACTIONS OF ENGAGING IN A VIOLENT CRIME	**Nominal**
cs_cloth	REASON FOR STOP - WEARING CLOTHES COMMONLY USED IN A CRIME	**Nominal**
cs_drgtr	REASON FOR STOP - ACTIONS INDICATIVE OF A DRUG TRANSACTION	**Nominal**
ac_evasv	ADDITIONAL CIRCUMSTANCES - EVASIVE RESPONSE TO QUESTIONING	**Nominal**
ac_assoc	ADDITIONAL CIRCUMSTANCES - ASSOCIATING WITH KNOWN CRIMINALS	**Nominal**
cs_furtv	REASON FOR STOP - FURTIVE MOVEMENTS	**Nominal**
rf_rfcmp	REASON FOR FRISK - REFUSE TO COMPLY W OFFICER'S DIRECTIONS	**Nominal**
ac_cgdir	ADDITIONAL CIRCUMSTANCES - CHANGE DIRECTION AT SIGHT OF OFFICER	**Nominal**
rf_verbl	REASON FOR FRISK - VERBAL THREATS BY SUSPECT	**Nominal**
cs_vcrim	REASON FOR STOP - ACTIONS OF ENGAGING IN A VIOLENT CRIME	**Nominal**
cs_bulge	REASON FOR STOP - SUSPICIOUS BULGE	**Nominal**
cs_other	REASON FOR STOP - OTHER	**Nominal**
ac_incid	ADDITIONAL CIRCUMSTANCES - AREA HAS HIGH CRIME INCIDENCE	**Nominal**
ac_time	ADDITIONAL CIRCUMSTANCES - TIME OF DAY FITS CRIME INCIDENCE	**Nominal**
rf_knowl	REASON FOR FRISK - KNOWLEDGE OF SUSPECT'S PRIOR CRIM BEHAV	**Nominal**
ac_stsnd	ADDITIONAL CIRCUMSTANCES - SIGHTS OR SOUNDS OF CRIMINAL ACTIVITY	**Nominal**
ac_other	ADDITIONAL CIRCUMSTANCES - OTHER	**Nominal**
sb_hdobj	BASIS OF SEARCH - HARD OBJECT	**Nominal**
sb_outln	BASIS OF SEARCH - OUTLINE OF WEAPON	**Nominal**
sb_admis	BASIS OF SEARCH - ADMISSION BY SUSPECT	**Nominal**
sb_other	BASIS OF SEARCH - OTHER	**Nominal**

repcmd	REPORTING OFFICER'S COMMAND (1 TO 999)	**Nominal**
revcmd	REVIEWING OFFICER'S COMMAND (1 TO 999)	**Nominal**
rf_furt	REASON FOR FRISK - FURTIVE MOVEMENTS	**Nominal**
rf_bulg	REASON FOR FRISK - SUSPICIOUS BULGE	**Nominal**
offverb	VERBAL STATEMENT PROVIDED BY OFFICER (IF NOT IN UNIFORM)	**Nominal**
offshld	SHIELD PROVIDED BY OFFICER (IF NOT IN UNIFORM)	**Nominal**
forceuse	REASON FORCE USED	**Nominal**
sex	SUSPECT'S SEX	**Nominal**
race	SUSPECT'S RACE	**Nominal**
dob	SUSPECT'S DATE OF BIRTH (CCYY-MM-DD)	**Interval**
age	SUSPECT'S AGE	**Ratio**
ht_feet	SUSPECT'S HEIGHT (FEET)	**Ratio**
ht_inch	SUSPECT'S HEIGHT (INCHES)	**Ratio**
weight	SUSPECT'S WEIGHT	**Ratio**
haircolr	SUSPECT'S HAIRCOLOR	**Nominal**
eyecolor	SUSPECT'S EYE COLOR	**Nominal**
build	SUSPECT'S BUILD	**Ordinal**
addrtyp	LOCATION OF STOP ADDRESS TYPE	**Nominal**
rescode	LOCATION OF STOP RESIDENT CODE	**Nominal**
premtype	LOCATION OF STOP PREMISE TYPE	**Nominal**
premname	LOCATION OF STOP PREMISE NAME	**Nominal**
addrnum	LOCATION OF STOP ADDRESS NUMBER	**Ordinal**
stname	LOCATION OF STOP STREET NAME	**Nominal**
stinter	LOCATION OF STOP INTERSECTION	**Nominal**
crossst	LOCATION OF STOP CROSS STREET	**Nominal**
aptnum	LOCATION OF STOP APT NUMBER	**Ordinal**
city	LOCATION OF STOP CITY	**Nominal**
state	LOCATION OF STOP STATE	**Nominal**
zip	LOCATION OF STOP ZIP CODE	**Nominal**
addrpct	LOCATION OF STOP ADDRESS PRECINCT	**Nominal**
sector	LOCATION OF STOP SECTOR	**Nominal**
xcoord	LOCATION OF STOP X COORD	**Interval**
ycoord	LOCATION OF STOP Y COORD	**Interval**
detailCM	CRIME CODE DESCRIPTION	**Nominal**

R Mark Down

The Data is first loaded into RStudio:

```
SQF = read.csv("/Users/boom/Desktop/Data mining/SQF_2016.csv",na.strings=" ",
stringsAsFactors = TRUE)
```

Remove last row which is all NA values by

```
df = SQF[0:(nrow(SQF)-1),]
```

Verify data quality

Locate missing values

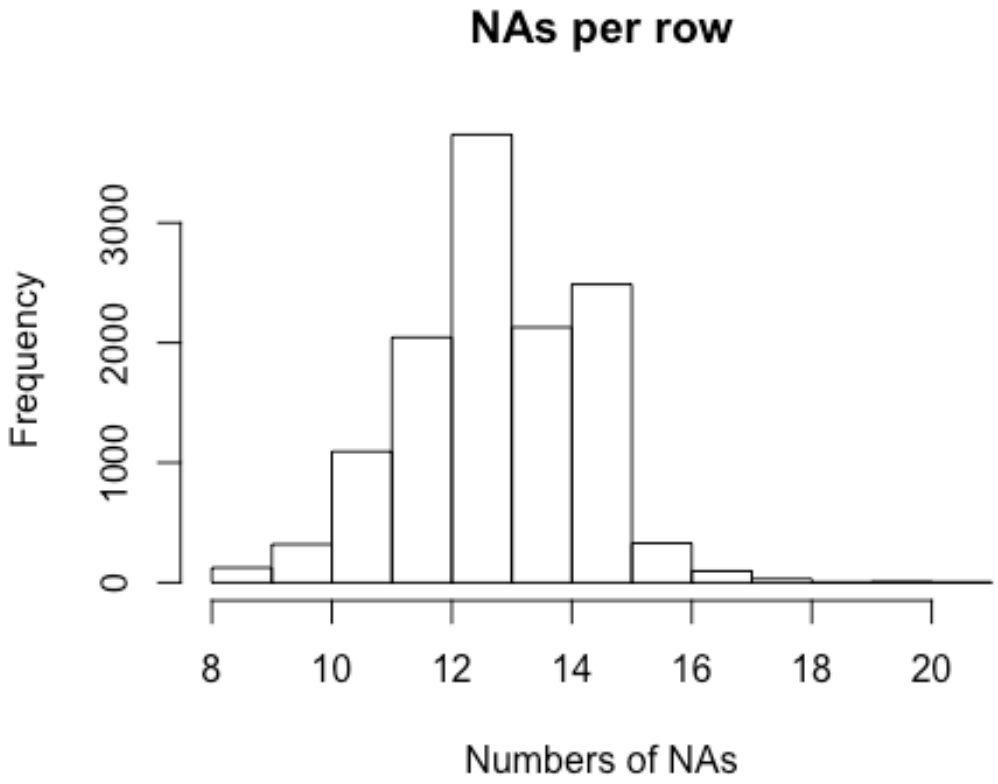
Columns with over 1 missing value can be seen by running

```
colNA = colSums(is.na(df))
colNA[colNA>0]

## arstoffn sumoffen officrid  offverb  offshld forceuse      dob  addrtyp
##     9762    12037    12236     9376     8401     9464    12404    12404
##  rescode premtype premname  addrnum   stname  stinter  crossst   aptnum
##    12404    12404     1295     7004     6989       43       43    12404
##    state      zip   sector   xcoord   ycoord
##    12404    12404      120      351      351
```

There are too many rows that contains NA values so i have decided to plot a historgram show the number of NA values in each row

```
rowNA = rowSums(is.na(df))
hist(rowNA,main = "NAs per row", xlab = "Numbers of NAs")
```



Removing missing values

arstoffn

The arstoffn columns indicates why a suspect get arrested, and if the suspect didn't get arrested the values will be NA. Any row where no arrest is made (arst=='N'), arstoffn will be filled with 'NOARREST'

```
levels(df$arstoffn) <- c(levels(df$arstoffn),"NOARREST")
df$arstoffn[df$arstmade=='N'] = 'NOARREST'
summary(is.na(df$arstoffn))
```

```
##    Mode   FALSE    TRUE
## logical   12403       1
```

There is still 1 NA value when the arrested was made but no reason was given, the mode(except NOARREST) of the reason for arrest will use to fill in 1 NA.

```
df$arstoffn[is.na(df$arstoffn)] = "CPW"
```

sumoffen

The sumoffen column indicates why a suspect is summoned, and if no summoned is issued the values will be NA. Any row where the summon is not made(sumissue=='N'), sumoffen will be filled with 'NOSUMMON'

```
levels(df$sumoffen) <- c(levels(df$sumoffen),"NOSUMMON")
df$sumoffen[df$sumissue=='N'] = 'NOSUMMON'
summary(is.na(df$sumissue))
```

```
##    Mode   FALSE
## logical   12404
```

offcrid

The offcrid column indicates whether an ID card is provided by the officer when not in uniform, and if the officer is in uniform the value will be null. Any row where officer is in uniform(offunif=='Y'), offcrid will be filled with 'INUNIFORM'

```
levels(df$officrid) <- c(levels(df$officrid),"INUNIFORM")
df$officrid[df$offunif=='Y'] = 'INUNIFORM'
summary(is.na(df$officrid))
```

```
##    Mode   FALSE    TRUE
## logical    8418    3986
```

There is still 3986 NA values after 'INUNIFORM' is filled. The NA values will be assume that officer didn't provide ID card even not in uniform. So NA values will be filled with 'N'

```
levels(df$officrid) <- c(levels(df$offunif),'N')
df$officrid[df$offunif=='N' & is.na(df$officrid)] = 'N'
```

offverb

The offverb column indicates whether verbal statement is provided by the officer when not in uniform, and if the officer is in uniform the value will be null. Any row where officer is in uniform(offunif=='Y'), offverb will be filled with 'INUNIFORM'

```
levels(df$offverb) <- c(levels(df$offverb),"INUNIFORM")
df$offverb[df$offunif=='Y'] = 'INUNIFORM'
summary(df$offverb)
```

```
##         V INUNIFORM      NA's
##      3028      8250      1126
```

There is still 1126 NA values after 'INUNIFORM' is filled. The NA values will be assume that officer didn't provide verbal statement even not in uniform. So NA values will be filled with 'N'

```
levels(df$offverb) <- c(levels(df$offverb),"N")
df$offverb[df$offunif=='N' & is.na(df$offverb)] = 'N'
```

offshld

The offshld column indicates whether shield is provided by the officer when not in uniform, and if the officer is in uniform the value will be null. Any row where officer is in uniform(offunif=='Y'), offshld will be filled with 'INUNIFORM'

```
levels(df$offshld) <- c(levels(df$offshld),"INUNIFORM")
df$offshld[df$offunif=='Y'] = 'INUNIFORM'
summary(df$offshld)

##         S INUNIFORM      NA's
##      4003      8250       151
```

There is still 151 NA values after 'INUNIFORM' is filled. The NA values will be assume that officer didn't show the shield even not in uniform. So NA values will be filled with 'N'

```
levels(df$offshld) <- c(levels(df$offshld),"N")
df$offshld[df$offunif=='N' & is.na(df$offshld)] = 'N'
```

stinter

NA value in intersection will be assume that the frisk doesn't occur in the intersection and will be fill with NOTINTERSECTION.

```
levels(df$stinter) <- c(levels(df$stinter),"NOTINTERSECTION")
df$stinter[is.na(df$stinter)] = "NOTINTERSECTION"
```

crossst

NA value in cross street will be assume that the frisk doesn't occur in the cross street and will be fill with NOTCROSSSTREET

```
levels(df$crossst) <- c(levels(df$crossst),"NOTCROSSSTREET")
df$crossst[is.na(df$crossst)] = "NOTCROSSSTREET"
```

xcoord and ycoord

The xcoord and ycoord is the coordinates of the stop. This will be filled in based on the coordinate of each city. The average cooridinate of each city is found by

```
noCoorNull= df[!is.na(df$xcoord),c('xcoord','ycoord','city')]
meanQUEENSx = mean(noCoorNull[noCoorNull$city=='QUEENS',1])
meanQUEENSy =  mean(noCoorNull[noCoorNull$city=='QUEENS',2])
meanSTATENx =  mean(noCoorNull[noCoorNull$city=='STATEN IS',1])
meanSTATENy =  mean(noCoorNull[noCoorNull$city=='STATEN IS',2])
meanBROOKLYNx =  mean(noCoorNull[noCoorNull$city=='BROOKLYN',1])
meanBROOKLYNy =  mean(noCoorNull[noCoorNull$city=='BROOKLYN',2])
meanBRONXx =  mean(noCoorNull[noCoorNull$city=='BRONX',1])
meanBRONXy =  mean(noCoorNull[noCoorNull$city=='BRONX',2])
meanMANHATTANx =  mean(noCoorNull[noCoorNull$city=='MANHATTAN',1])
meanMANHATTANy =  mean(noCoorNull[noCoorNull$city=='MANHATTAN',2])
```

The missing coordinate of each city is filled in with the average coordinate of each city

```
df$xcoord[is.na(df$xcoord) & df$city=='QUEENS'] = meanQUEENSx
df$ycoord[is.na(df$ycoord) & df$city=='QUEENS'] = meanQUEENSy
df$xcoord[is.na(df$xcoord) & df$city=='STATEN IS'] = meanSTATENx
df$ycoord[is.na(df$ycoord) & df$city=='STATEN IS'] = meanSTATENy
df$xcoord[is.na(df$xcoord) & df$city=='BROOKLYN'] = meanBROOKLYNx
df$ycoord[is.na(df$ycoord) & df$city=='BROOKLYN'] = meanBROOKLYNy
df$xcoord[is.na(df$xcoord) & df$city=='BRONX'] = meanBRONXx
df$ycoord[is.na(df$ycoord) & df$city=='BRONX'] = meanBRONXy
df$xcoord[is.na(df$xcoord) & df$city=='MANHATTAN'] = meanMANHATTANx
df$ycoord[is.na(df$ycoord) & df$city=='MANHATTAN'] = meanMANHATTANy
```

isforceuse (new variable)

There are many types of physical force used by officer in the dataset, which are pf_baton, pf_drwep, pf_grnd, pf_hands, pf_hcuff, pf_other, pf_pepsp, pf_ptwep and pf_wall. A column will be added to indicate whether force is used.

```
tempForce = (df$pf_baton=='Y' | df$pf_drwep == 'Y' | df$pf_grnd =='Y' | df$pf
_hands =='Y' | df$pf_hcuff=='Y' | df$pf_other=='Y'| df$pf_pepsp=='Y' | df$pf_
ptwep == 'Y' | df$pf_wall=='Y')
df$isforceuse[tempForce] ='Y'
df$isforceuse[!tempForce] = 'N'
df$isforceuse = factor(df$isforceuse)
summary(df$isforceuse)

##    N    Y
## 8531 3873
```

forceuse

The forceuse column indicates the reason why force is used by the officer , and if the no force is used the value will be null. Any row where no force is used(isforceuse=='N'), forceuse will be filled with 'NOFORCE'

```
levels(df$forceuse) <- c(levels(df$forceuse),"NOFORCE")
df$forceuse[df$isforceuse=='N'] = 'NOFORCE'
summary(is.na(df$forceuse))
```

```
##    Mode   FALSE    TRUE
## logical   11471     933
```

There is still 933 null values after 'NOFORCE' is filled. This will be dealth with later.

Further NA removal

recalulate NAs in each column

```
colNA = colSums(is.na(df))
colNA[colNA>0]
```

```
## forceuse      dob  addrtyp  rescode premtype premname  addrnum   stname
##      933    12404    12404    12404    12404     1295     7004     6989
##   aptnum    state      zip   sector
##    12404    12404    12404      120
```

Columns that all its value is NA will be remove. stname and addrnum will also be remove because there is too much NAs and no promising way to fill in the values

```
df = df[,colNA!=nrow(df)]
df = subset(df, select = -c(stname,addrnum))
```

Remove rows

Check how many rows contain more than 1 NA values

```
rowNA = rowSums(is.na(df))
nrow(df[rowNA>1,])
```

```
## [1] 121
```

Only 121 rows so these will be removed by invoking

```
df = df[rowNA<=1,]
```

Filling in remaing column with mode

Recalulate NAs in each column

```
colNA = colSums(is.na(df))
colNA[colNA>0]
```

```
## forceuse premname   sector
##      833     1182       88
```

There is only 3 columns with relatively low number of NA values and will be filled which the mode of each column

premname

```
modePremname = names(summary(df$premname)[(summary(df$premname)==max(summary(
df$premname)))])
df$premname[is.na(df$premname)] = modePremname
modePremname

## [1] "STREET"
```

sector

```
modeSector = names(summary(df$sector)[(summary(df$sector)==max(summary(df$sec
tor)))])
df$sector[is.na(df$sector)] = modeSector
modeSector

## [1] "B"
```

forceuse

```
modeForceuse = names(summary(df$forceuse[df$isforceuse=='Y'])[(summary(df$for
ceuse[df$isforceuse=='Y'])==max(summary(df$forceuse[df$isforceuse=='Y'])))])
df$forceuse[is.na(df$forceuse)] = modeForceuse
modeForceuse

## [1] "OT"
```

Check whether NA still exist in the dataset

```
colNA = colSums(is.na(df))
colNA[colNA>0]

## named numeric(0)
```

Adding new variable

weaponFound

In the dataset the weapons is categorize into many types. It will be simpified by creating a column to indicate whether any type of weapon is found. If weapon is found, weaponFound will be set as 'Y' otherwise 'N'

```
df$weaponfound = df$weaponfound = (df$pistol=='Y' | df$riflshot == 'Y' | df$a
sltweap =='Y' | df$knifcuti =='Y' | df$machgun=='Y' | df$othrweap=='Y')
df$weaponfound[df$weaponfound] = 'Y'
df$weaponfound[df$weaponfound=='FALSE'] = 'N'
df$weaponfound = factor(df$weaponfound)
```

day

Add days of the week, Monday to Sunday.

```
df$datestop = as.Date(as.character(df$datestop),format="%m/%d/%Y")
df$day = factor(weekdays(df$datestop),levels = c('Monday','Tuesday','Wednesda
y','Thursday','Friday','Saturday','Sunday'))
```

height

Add height in cm using the ht_feet and ht_inch column

```
df$height = ((df$ht_feet*12) + df$ht_inch) * 2.54
```

bmi

bmi column will store the body mass index of the suspect. First the weight needs to be converted to kilograms. The the formula for finding bmi can be applied.

```
df$weight = df$weight/2.2046
df$bmi = df$weight/((df$height/100)**2)
```

hours

Indicate time in hours with fractions. Hours + Minute/60

```
library(stringr)
minutes = as.numeric(str_sub(as.character(df$timestop),-2,-1))/60
hours = as.numeric(substr(df$timestop,1,nchar(df$timestop)-2))
hours[is.na(hours)] = 0
df$hours = round(hours+minutes,2)
```

Find duplicates

The condition of duplicate is flagged if age, height, datestop, weight and race are the same, and is likely to be the same person.

```
dupes = duplicated(df[c('age','height','datestop','weight','race')])
df = df[!dupes,]
summary(dupes)

##    Mode   FALSE    TRUE
## logical   12166     117
```

117 rows are found to be duplicate and only the duplicated row is remove from the dataset.

Outliers

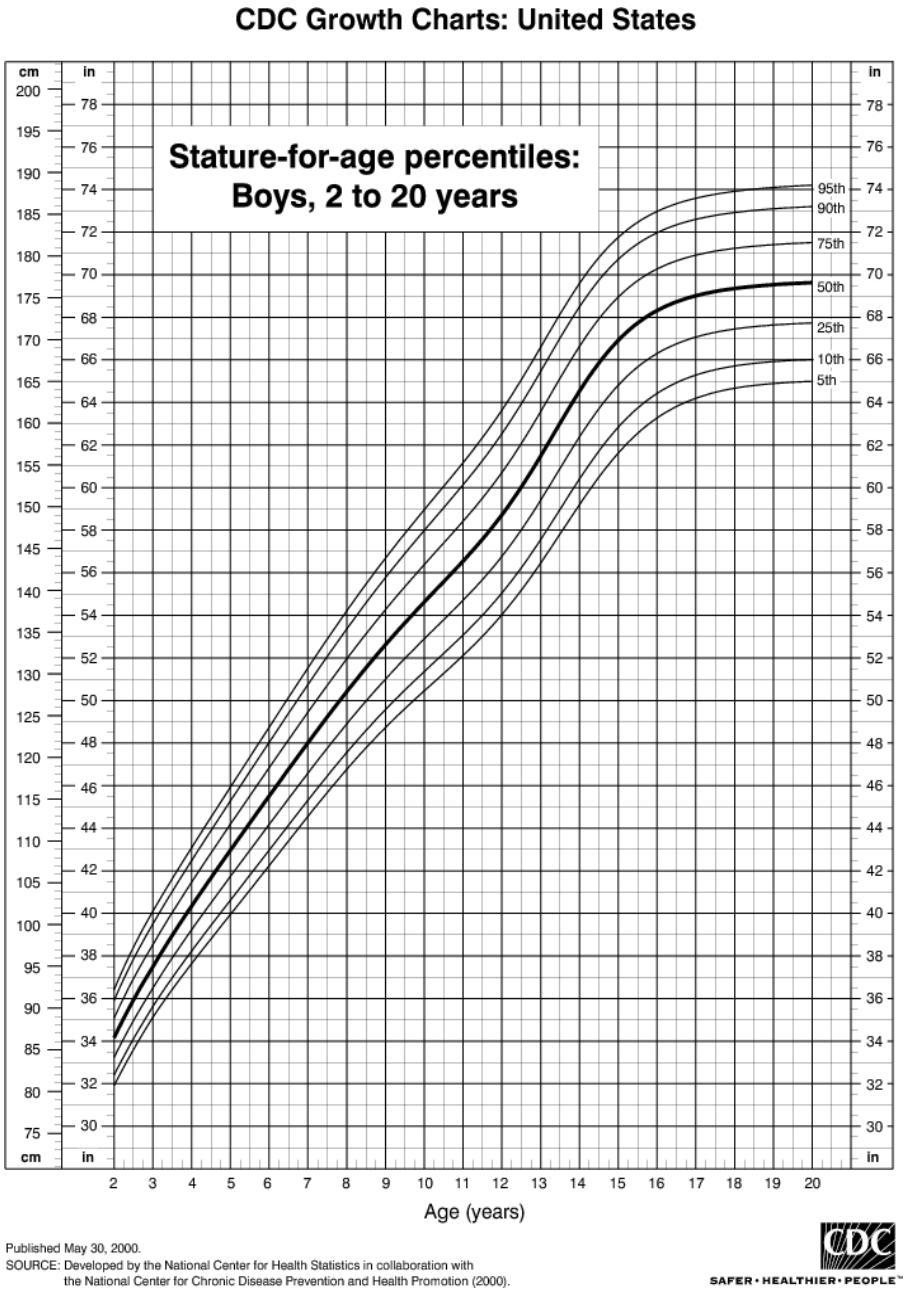
Age

Convert age and height in to numeric

```
df$age = as.numeric(df$age)
df$height = as.numeric(df$height)
```

The height vs age chart is provided by CDC National Center for Health and will be use to help indicating outliers.

image:



It seems unreasonble to stop and frisk a 5 years old child and the age will be replace with the average age

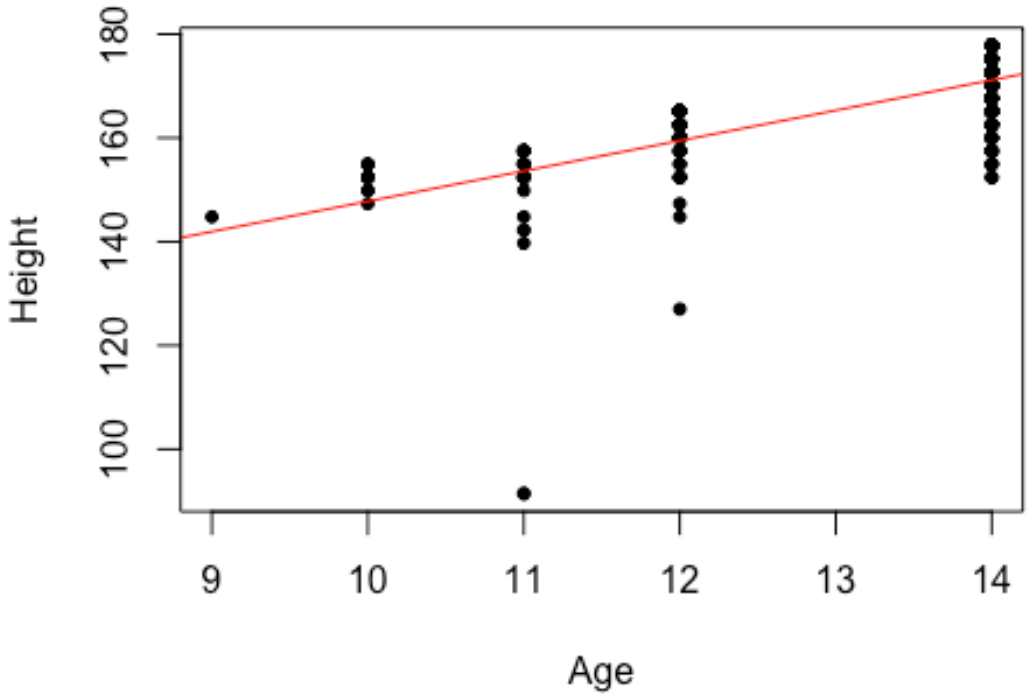
```
df$age[df$age<=5]  = mean(df$age)
```

By looking at the height vs age chart suspect that is alot higher than usual is replaced with the mean age

```
df$age[df$age==6 & df$height >110] = mean(df$age)
df$age[df$age==7 & df$height >135] = mean(df$age)
df$age[df$age==8 & df$height >145] = mean(df$age)
df$age[df$age==9 & df$height >150] = mean(df$age)
df$age[df$age==10 & df$height >155] = mean(df$age)
df$age[df$age==11 & df$height >160] = mean(df$age)
df$age[df$age==12 & df$height >167] = mean(df$age)
df$age[df$age==13 & df$height >175] = mean(df$age)
df$age[df$age==14 & df$height >180] = mean(df$age)
df$age[df$age==15 & df$height >185] = mean(df$age)
df$age = round(df$age)
```

Plot age vs height to compare with the CDC data

```
plot(df$age[df$age<15],df$height[df$age<15],pch=20,xlab = "Age",ylab="Height"
)
abline(lm(df$height[df$age<15]~ df$age[df$age<15]), col="red") # regression l
ine (y~x)
```



Statistics of the age

```
summary(df$age)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     9.0    19.0    24.0    26.2    30.0    82.0
```

The statistics of age seems possible and nothing else will be done to age.

Weight and Height

Looking at some statistics the invalid data can be seen

```
summary(df$weight)
```

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
##   0.4536  68.0396  74.8435  76.8966  83.9154 453.1434
```

```
summary(df$height)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   91.44  170.18  175.26  174.55  180.34  210.82
```

Weight below 30 and above 200 will be consider as incorrect data and will be replace with average weight

```
df$weight[df$weight<30] = mean(df$weight)
df$weight[df$weight>200] = mean(df$weight)
```

Height below 100 and above 250 will be consider as incorrect data and will be replace with the average height

```
df$height[df$height<30] = mean(df$height)
df$height[df$height>200] = mean(df$height)
```

BMI will be help to use to indicate abnormal ratios between weight and height. patient.info stated that doctors consider BMI below 17.5 as 'Anorexia Nervosa'. BMI below 15 will be replaced with average weight and height. On the otherhand BMI above 60 will also be replaced with average weight and height.

```
#Recalculate BMI
df$bmi = df$weight/((df$height/100)**2)
df$weight[df$bmi>50|df$bmi<15] = mean(df$weight)
df$height[df$bmi>50|df$bmi<15] = mean(df$height)
#Recalculate bmi
df$bmi = df$weight/((df$height/100)**2)
```

Statistic of BMI and Weight

```
summary(df$bmi)

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   15.12   22.60   24.41   25.19   27.12   50.00

summary(df$weight)

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   34.02   68.04   74.84   76.88   83.92  181.44
```

The statistic of bmi and weight looks to be possible and can't be consider as an invalid data.

Appropriate Statistics of 10 attributes

1.Age

Statistical analysis of age can be shown by

```
summary(df$age)

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     9.0    19.0    24.0    26.2    30.0    82.0
```

```
paste("SD = ",round(sd(df$age),2)," ,IQR = ",round(IQR(df$age),2))
```

```
## [1] "SD =  10.06  ,IQR =  11"
```

The distribution of age looks right-skewed this could be because police believe younger pedestrians are likely to be have illegal weapons. Or it might be that most pedesdrians are on the younger side.

2.Height(cm)

Statistical analysis of height can be shown by

```
summary(df$height)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   121.9   170.2   175.3   174.6   180.3   198.1
```

```
paste("SD = ",round(sd(df$height),2)," ,IQR = ",round(IQR(df$height),2))
```

```
## [1] "SD =  8.29  ,IQR =  10.16"
```

The distribution of height of pedestrians that are stopped is almost symetric because the mean and median is very close. The SD and IQR is low and it appear to be the the distribution of the height doesn't spread out much.

3.Body Mass Index

Statistical analysis of BMI can be shown by

```
summary(df$bmi)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   15.12   22.60   24.41   25.19   27.12   50.00
```

```
paste("SD = ",round(sd(df$bmi),2)," ,IQR = ",round(IQR(df$bmi),2))
```

```
## [1] "SD =  4.13  ,IQR =  4.53"
```

BMI of the suspect looks almost symetric because the mean and median is close together. The standard deviation and IQR is quite low and shows that the BMI doesn't spread out much.

4.Day of the Week

The percentage of day of the week can be found by

```
round(summary(df$day)*100/nrow(df),2)
```

```
##    Monday   Tuesday Wednesday  Thursday    Friday  Saturday    Sunday
##      9.62     16.08     17.13     15.03     16.26     14.94     10.95
```

At first I thought that Friday and Saturday will have the most frequency because those are the days when people go out at night. But in fact the numbers of occurances on Tuesday to Saturday are similiar. While Sunday and Monday are relatively lower.

5.Arrest made

The percentage of each attributes in arstmade can be found by

```
round(summary(df$arstmade)*100/nrow(df),2)
```

```
##     N     Y
## 78.71 21.29
```

This shows that most of the people that are stopped doesn't not get arrested.

6.Is force used

The percentage of each attributes in forceused can be found by

```
round(summary(df$isforceuse)*100/nrow(df),2)
```

```
##     N     Y
## 69.33 30.67
```

This is interesting the percentage of force used is more than percentage of arrest made. Which means that officers uses force to stop pedestrians which some are innocent.

7.Race

The percentage of each attributes in race can be found by

```
round(summary(df$race)*100/nrow(df),2)
```

```
##     A     B     I     P     Q     U     W     Z
##  6.02 52.15  0.31  7.10 22.23  0.77 10.30  1.12
```

Source from Wikipedia White: 44.6%, Black:25.1%, Hispanic:27.5% and Asian: 11.8% is the percentage of race in New York City. This clearly shows that police are bias into suspecting Blacks and flavour the Whites.

8.Weapon Found

The percentage of each attributes in weaponfound can be found by

```
round(summary(df$weaponfound)*100/nrow(df),2)
```

```
##     N     Y
## 94.25  5.75
```

It is surprising that the percentage of weapons way lower than that of the percentage of arrested. This means than many pedestrians get arrested while not having any weapon in hand.

9.City

The percentage of each attributes in city can be found by

```
round(summary(df$city)*100/nrow(df),2)
```

```
##     BRONX  BROOKLYN MANHATTAN    QUEENS STATEN IS
##     19.77     28.74     20.14     26.08      5.27
```

Source from Wikipedia Manhattan:19.25%, Bronx:17.06% ,Brooklyn:30.79% ,Queens:27.33% ,Staten Island:5.58%. The distribution of seems to be similiar. This tells that the police didn't specifically choose one city over the other.

10.Sex

The percentage of each attributes in sex can be found by

```
round(summary(df$sex)*100/nrow(df),2)
```

```
##     F     M     Z
##  7.26 92.29  0.45
```

This is suprising that over 90% of the suspect are males. It clearly shows that polices are bias towards stopping males over female

Visualize 10 attributes

```
library(ggplot2)
```

1.Age

Normal plot of height can be shown by

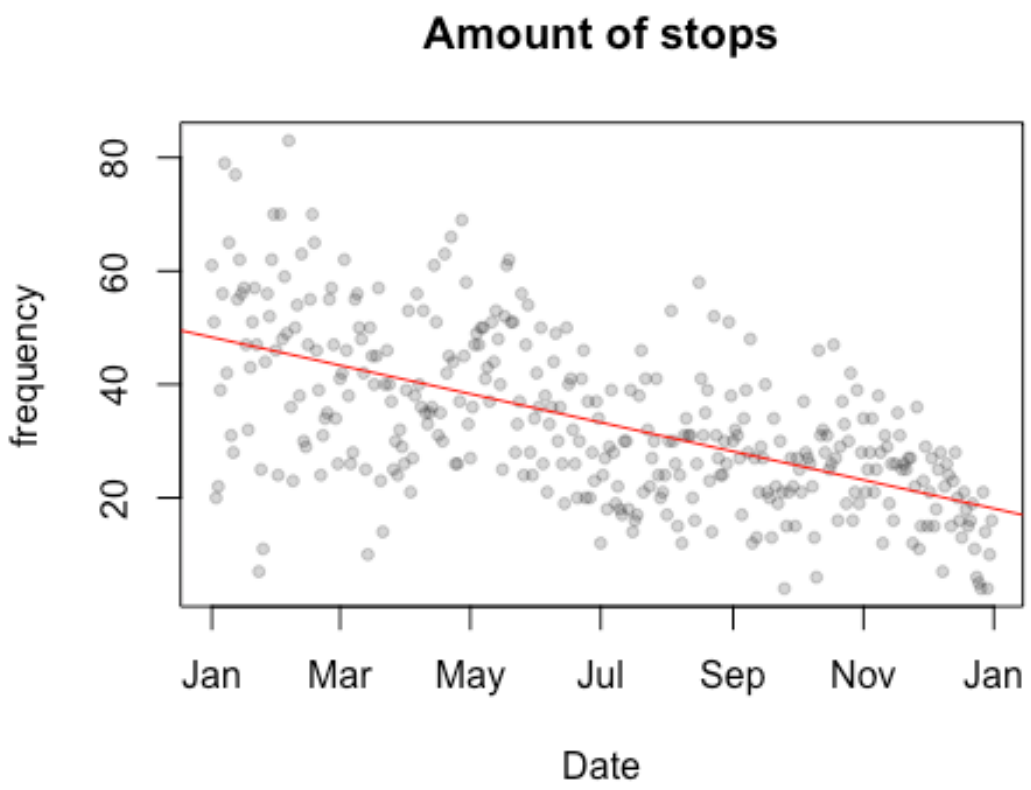
```
qqnorm(df$age,pch=20,main ="Normal Plot of Age",col = rgb(0, 0, 0, 0.2))
qqline(df$age)
```

The plot is not in a straight line and shows that it is doesn't follow the normal distribution. The age distribution is skewed to the right.

2.Amount of stops

The number of stops per day can be plot by

```
a = aggregate(df$datestop, by=list(df$datestop),FUN =length)
plot(a$Group.1,a$x,pch=20,main = "Amount of stops",xlab="Date",ylab="frequenc
y",col = rgb(0, 0, 0, 0.2))
abline(lm(a$x~ a$Group.1), col="red")
```

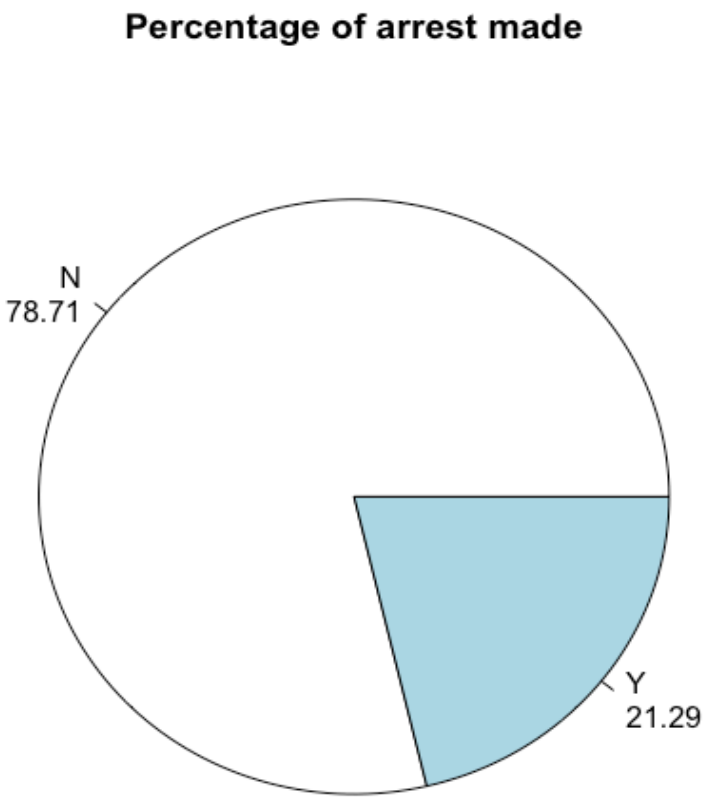


The fitted line shows that the number of stop decreases qucikly as time pass by. This could be because the officers are less active in the job? Or that they are more experience which leads to less random stops?

3.Arrest made

The piechart of whether the arrest is made is shown by

```
tb <- round(table(df$arstmade)/nrow(df),4)*100
lbls <- paste(names(tb), "\n", tb, sep="")
pie(tb, labels = lbls, main="Percentage of arrest made")
```

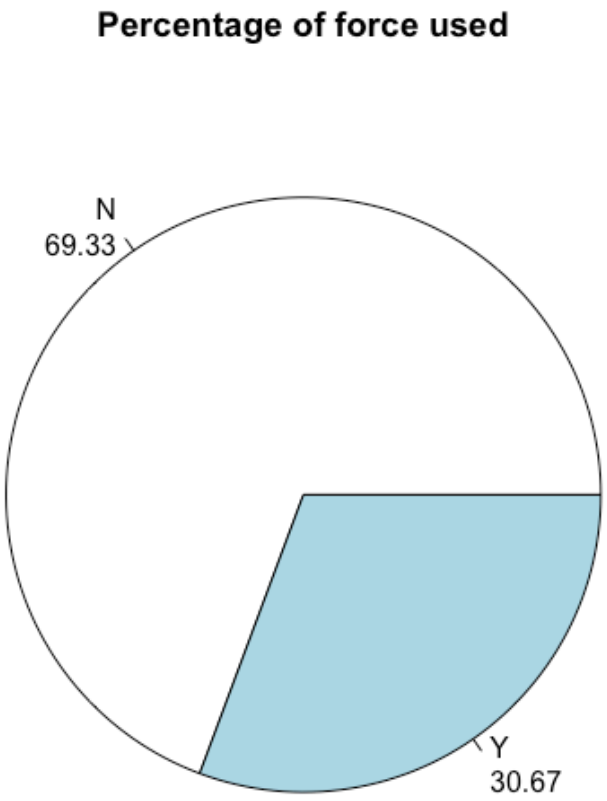


The piechart shows that most of the pedestrians that get stopped is innocent.

4.Is force used

The piechart of whether the force is used is shown by

```
tb <- round(table(df$isforceuse)/nrow(df),4)*100
lbls <- paste(names(tb), "\n", tb, sep="")
pie(tb, labels = lbls, main="Percentage of force used")
```

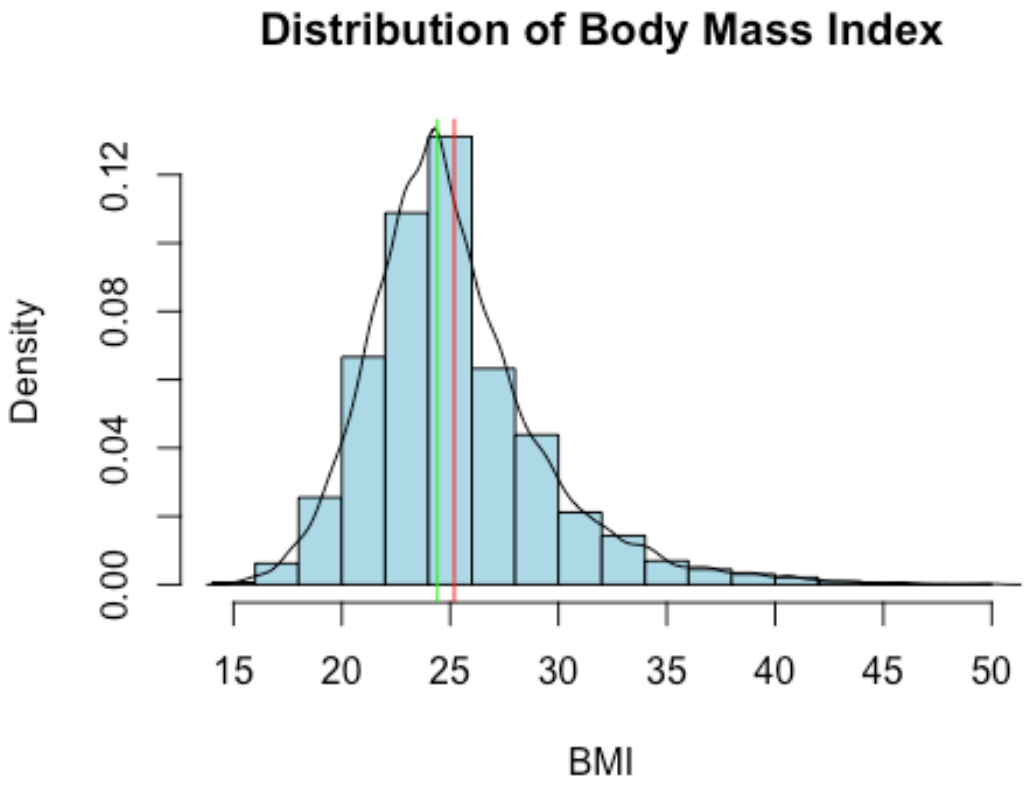


The piechart shows that most of the pedestrians that get stopped is innocent.

5.Body Mass Index

The distribution of Body Mass Index can be shown by

```
hist(df$bmi, main = "Distribution of Body Mass Index",xlab ="BMI",col = "ligh
tblue", prob = TRUE)
lines(density(df$bmi))
abline(v = mean(df$bmi), col = "red")
abline(v = median(df$bmi), col = "green")
```

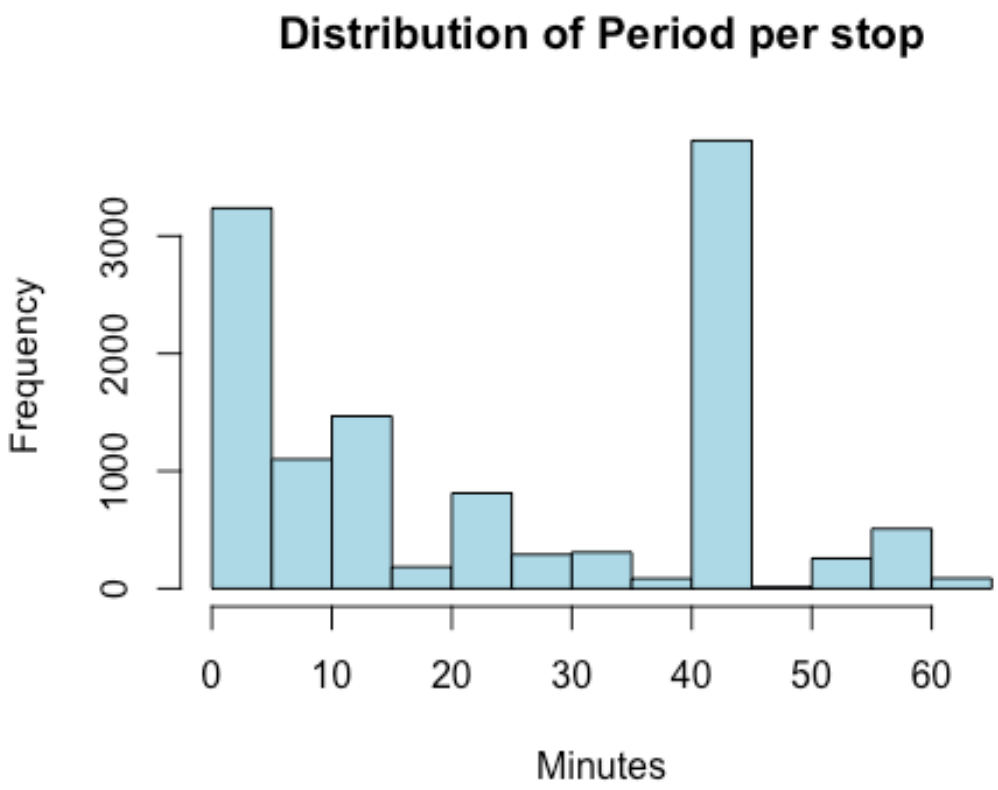


The read line shows the mean of BMI and the green line shows the median of BMI. The distribution of BMI is slightly right-skewed which means that there are more younger populations that are caught.

6.Period of stop

The histogram of the period of stop distribution can be shown by

```
df$perstop =as.numeric(df$perstop)
hist(df$perstop, main = "Distribution of Period per stop",xlab ="Minutes",col
= "lightblue",breaks = 20)
```



By looking at the histogram of the period stop, the distribution doesn't follows the normal distribution. Most stop takes around 45-50 minutes and 0-5 minutes. The 40-45 minutes peak seems abnormal unless there is a reason for this.

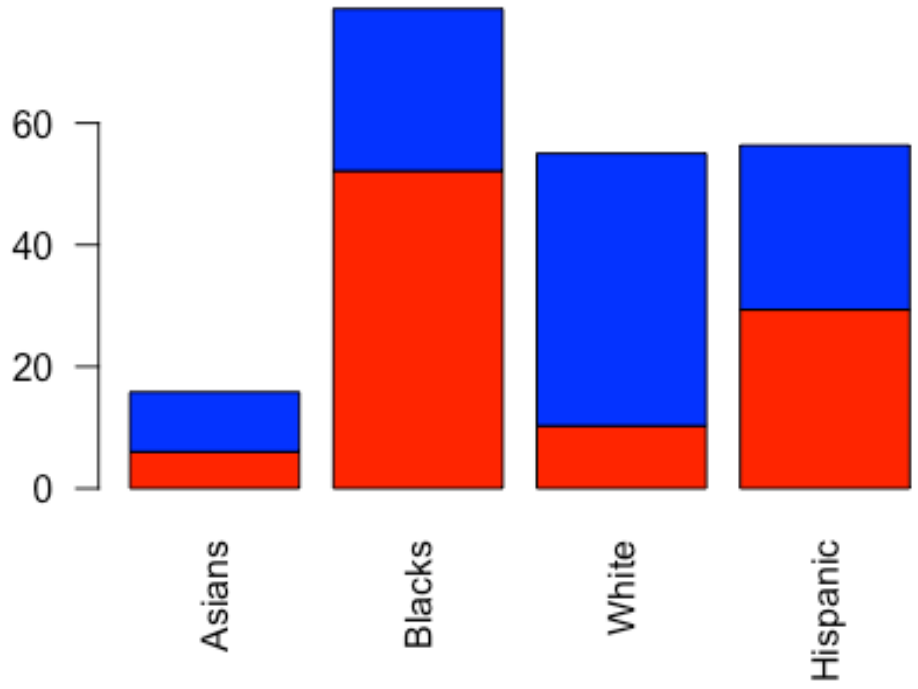
7.Races

The barchartshows the population of race distribution in New York City and the distribution of the race that are stopped. The red area shows in percentage of the race that are stopped. The blue area shows the percentage of race in New York City. Only 4 the main race are choosen.

```
temp = df$race
levels(temp) <- c(levels(temp),"H")
#combine black and white hispanics
temp[temp =="P"|temp=="Q"] = "H"
tb <- round(table(temp)/length(temp),4)*100
tb = tb[tb>2]
tb

## temp
##     A     B     W     H
##  6.02 52.15 10.30 29.34
```

```
names(tb) = c("Asians","Blacks","White","Hispanic")
tb = cbind(tb,c(9.8,26.6,44.7,27))
tb = t(tb)
barplot(tb,las=2,col = c("red","blue"))
```

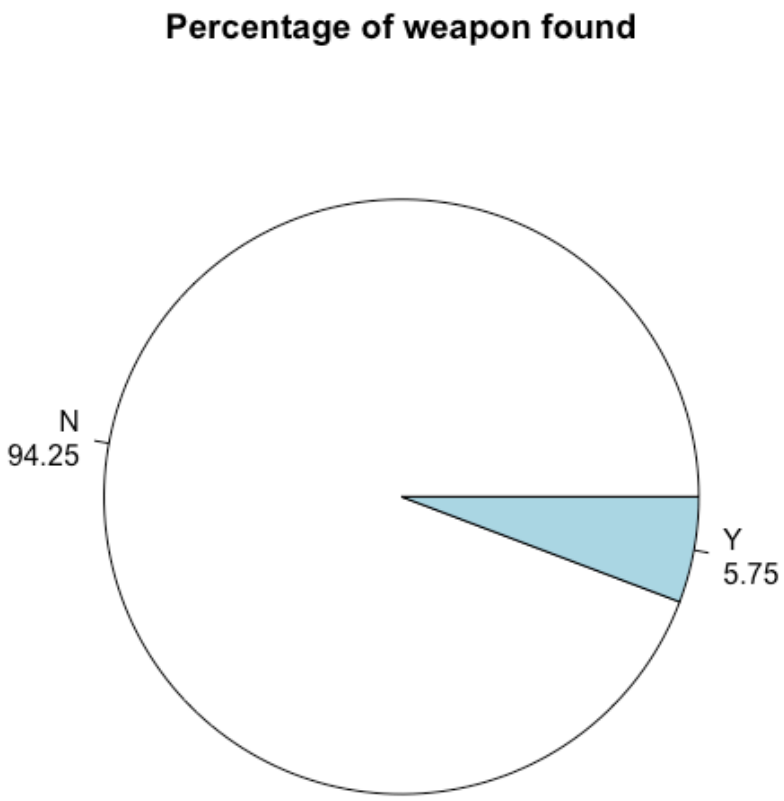


If the person stopped didn't depend on the race the area of each barchart should be the same. However, the percentage of whites that are stopped is far less than the percentage of whites in NYC. Moreover, The percentage the blacks are stopped is far more than the percentage of blacks in NYC. This shows that officers are bias in stopping blacks and not stopping whites. Source for population in NYC

8.Weapon Found

Piechart of percentage to shows whether the weapons are found can be shown by

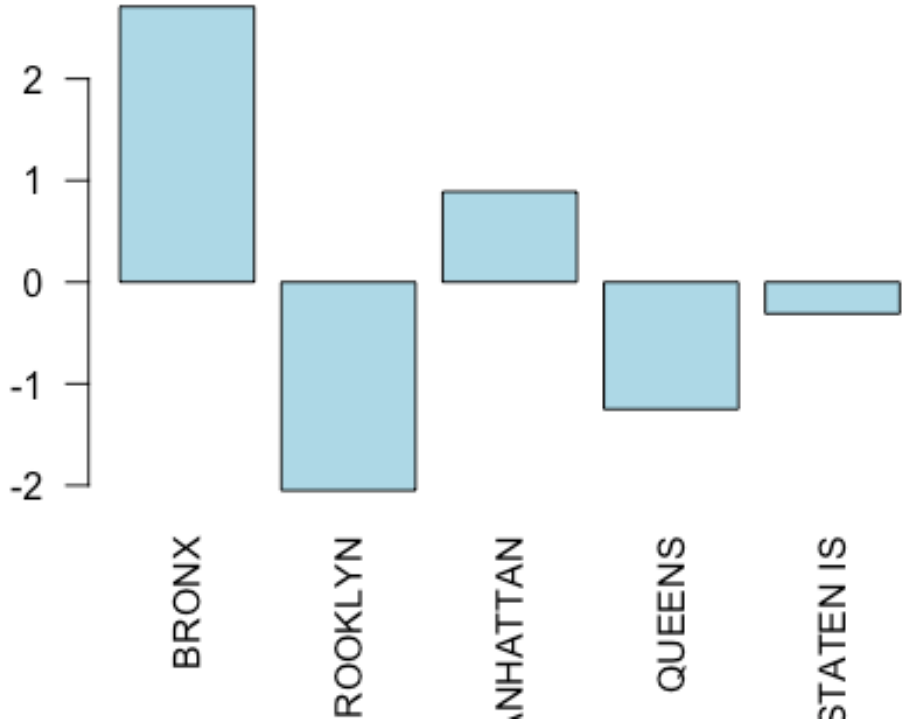
```
tb <- round(table(df$weaponfound)/nrow(df),4)*100
lbls <- paste(names(tb), "\n", tb, sep="")
pie(tb, labels = lbls, main="Percentage of weapon found")
```



9.City

The barplot shows the difference between the percentage of the city that pedestrians were stop and the percentage population of each city.

```
tb <- round(table(df$city)/nrow(df),4)*100
tb = tb - c(17.06,30.79,19.25,27.33,5.58)
barplot(tb,las=2,col = c("lightblue"))
```

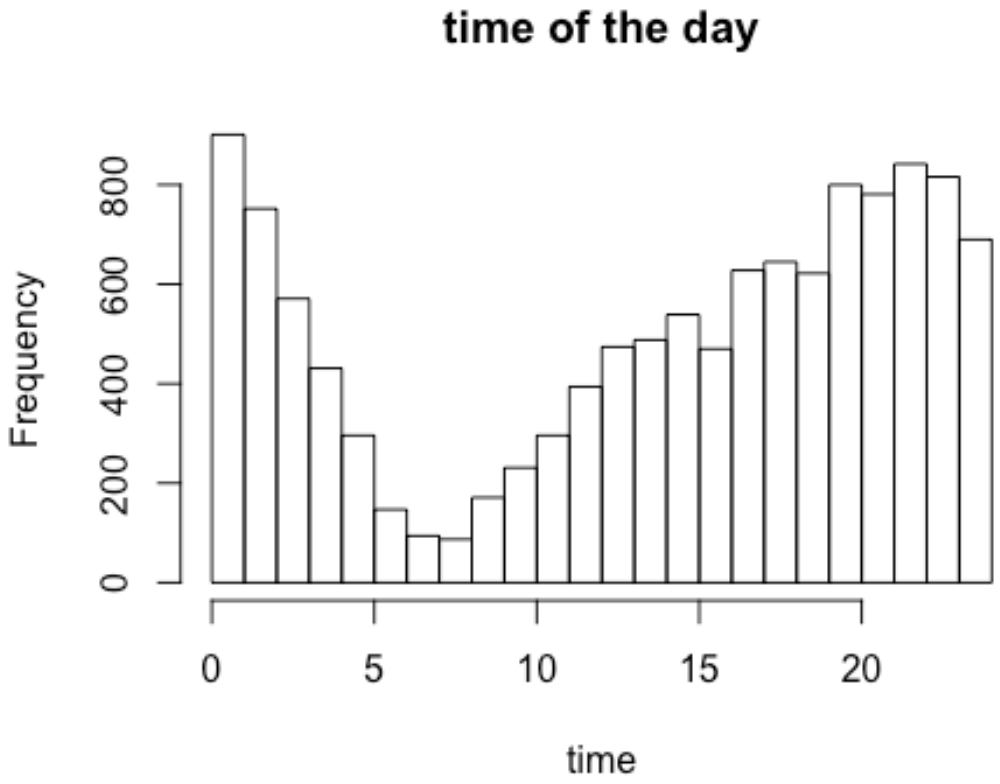


Source The positive barchart shows that officers stop more pedestrian in this city. However, the values is so little that no conclusion can be made in whether pedestrian in which city is more likely to be stopped.

10.Hours

The histogram that shows what time of the day pedestrians are likely to get stopped are plotted by

```
hist(df$hours,breaks = 24,main = "time of the day",xlab = 'time')
```

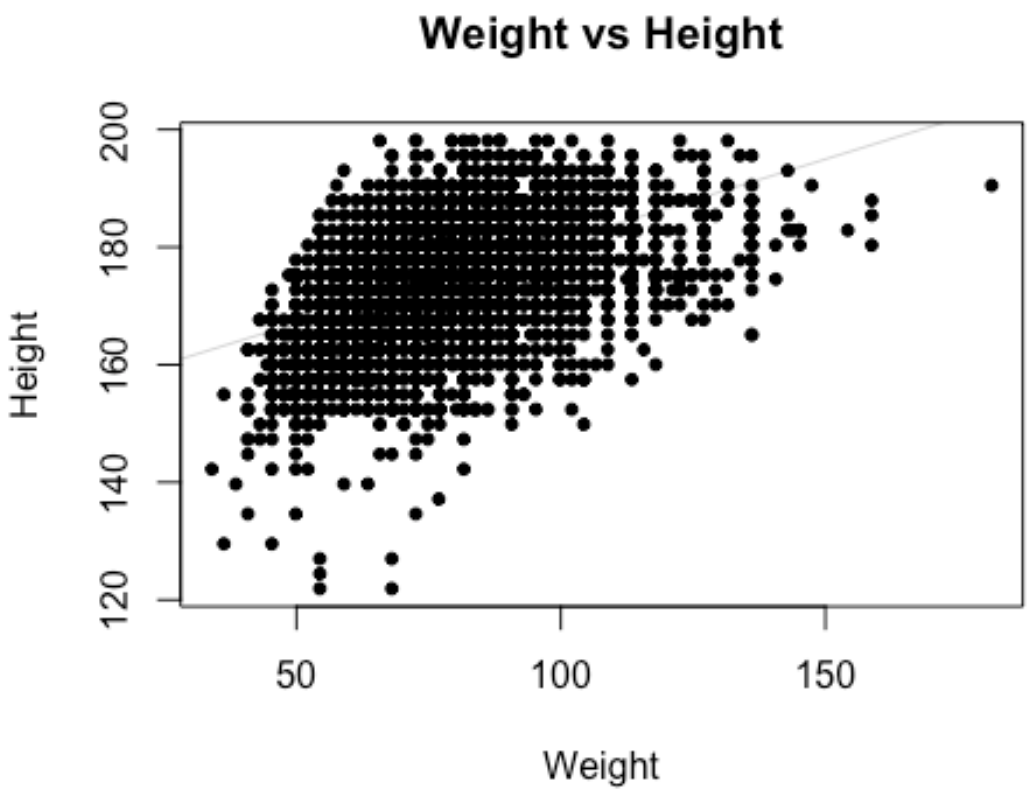


The stop mostly occur at night from 19:00 to 02:00 and least in the morning from 05:00 to 10:00. The explanation for this could be that people are hurry to work in the morning and officers doesn't want to interfere. While at night, crimes rate usually rise.

10 Relationship Between Attributes

1.Weight and height

```
plot(df$weight,df$height,pch=20,main="Weight vs Height",xlab = "Weight",ylab
= "Height")
abline(lm(df$height~ df$weight),col = rgb(0, 0, 0, 0.2))
```

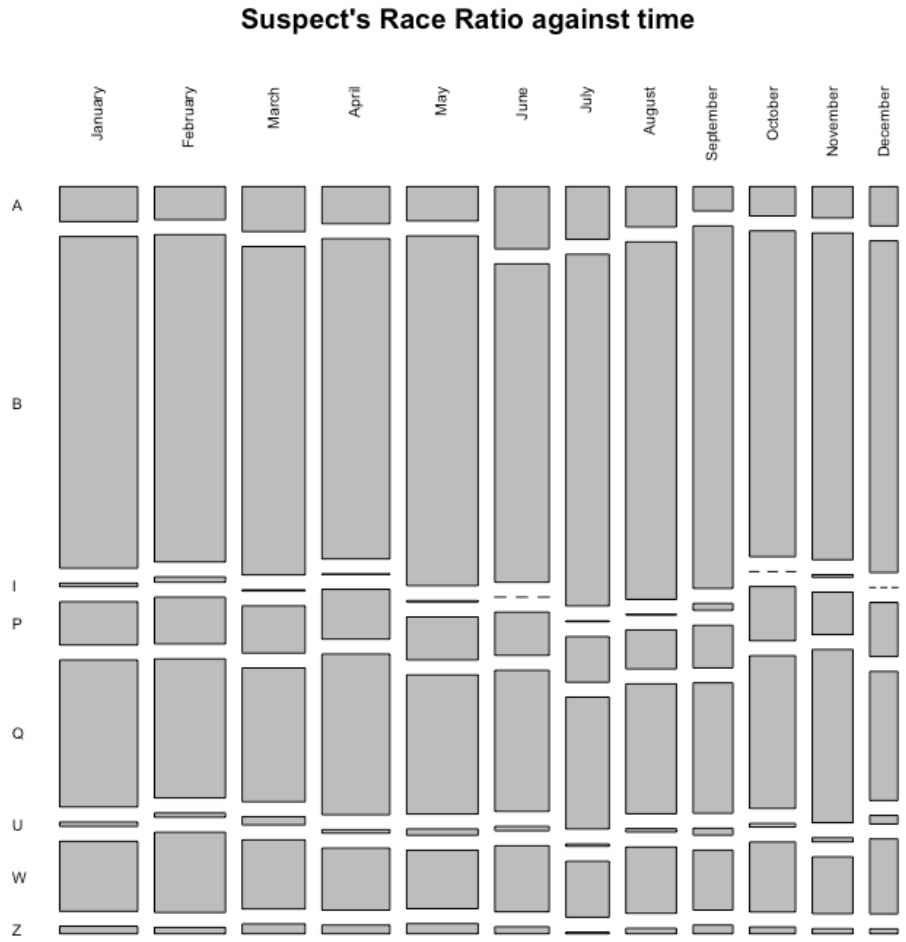


2.Date and Race

Plot to show how officer stop pedestrian base on race changes over time.

```
df$month = months(as.Date(df$datestop))
df$month = factor(df$month,levels = c("January","February","March","April","M
ay","June","July","August","September","October","November","December"))

plot(table(df$month,df$race),las = 2,main = "Suspect's Race Ratio against tim
e ")
```

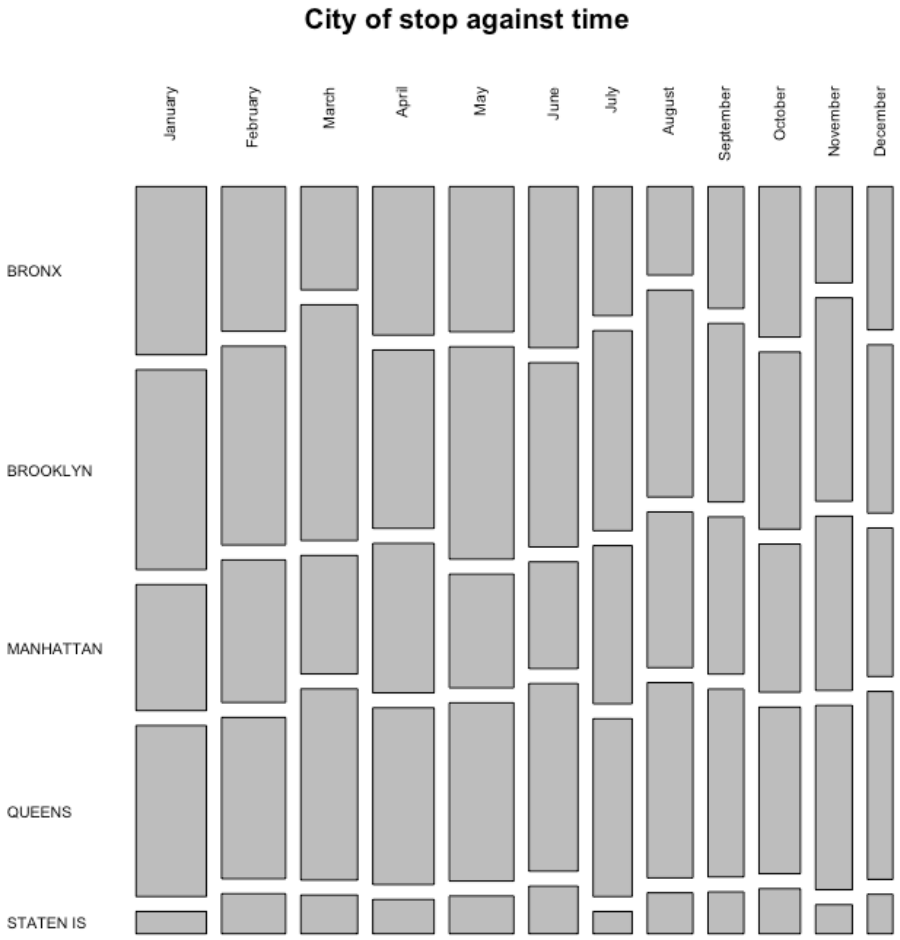


From the plot the chance of each race getting stop stay relatively constant. Which means that police still suspect the blacks more than the white throughout the year 2016.

3.Date and city

Plot to show how the amount of pedestrian stops change over time.

```
plot(table(df$month,df$city),las = 2 ,main = "City of stop against time")
```



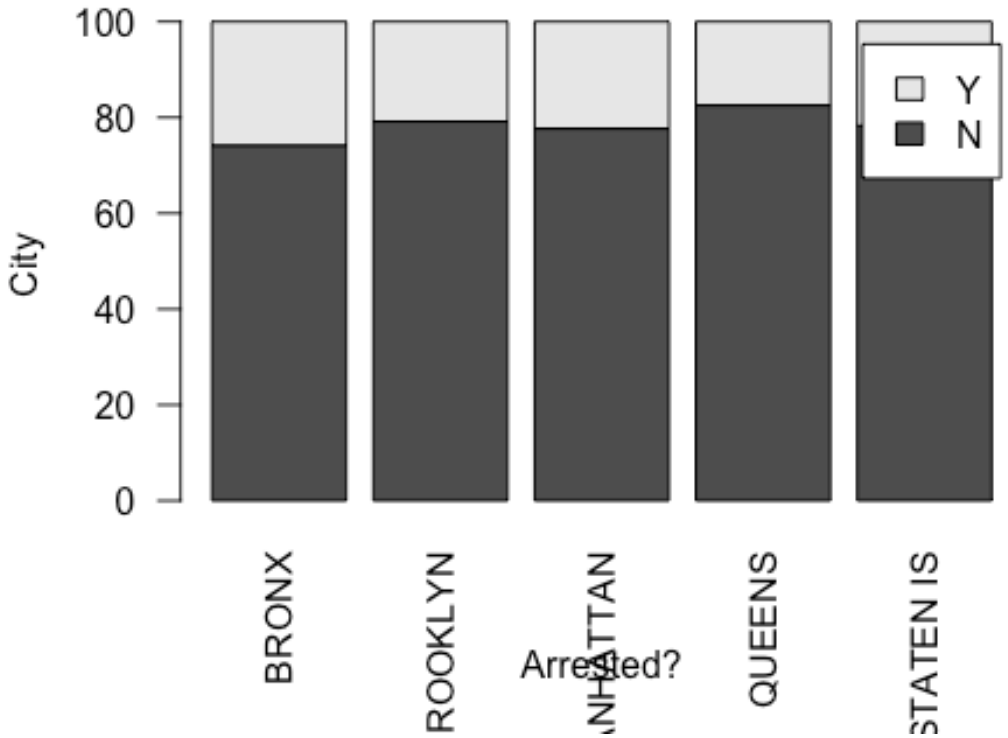
From the plot the width of the plot gets smaller which means that less stops occur. However, the amount of stops in each city stays about the same.

4.Arrest made and City

To show the ratio whether which city is likely to get arrested the graph can be plot as follows

```
tb = table(df$arstmade,df$city)
for (x in 1:ncol(tb)){
  tb[,x] = tb[,x]*100/sum(tb[,x])
}

barplot(tb,las = 2,xlab = "Arrested?",ylab="City",legend = rownames(tb))
```

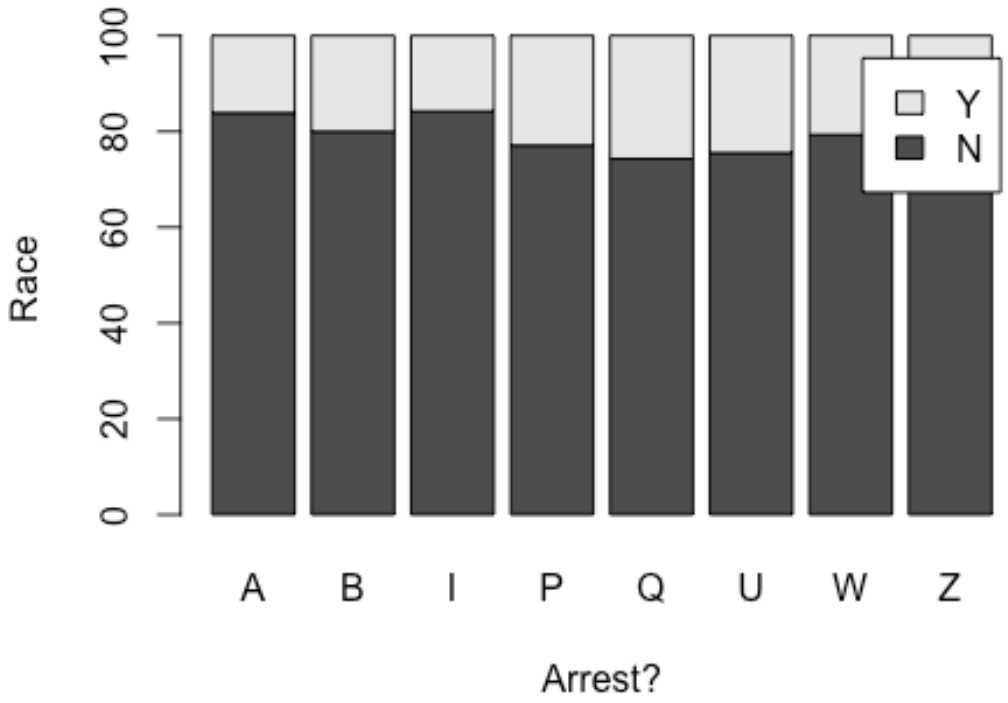


The height of the barchart is 100% and the darker area represents no arrest have been made. From the chart chances of getting arrest in different cities is very similiar.

5.Arrest made and Race

To show which race is likely to be arrested can be shown as follows

```
tb = table(df$arstmade,df$race)
for (x in 1:ncol(tb)){
  tb[,x] = tb[,x]*100/sum(tb[,x])
}
barplot(tb,xlab = "Arrest?",ylab = "Race",legend = rownames(tb))
```

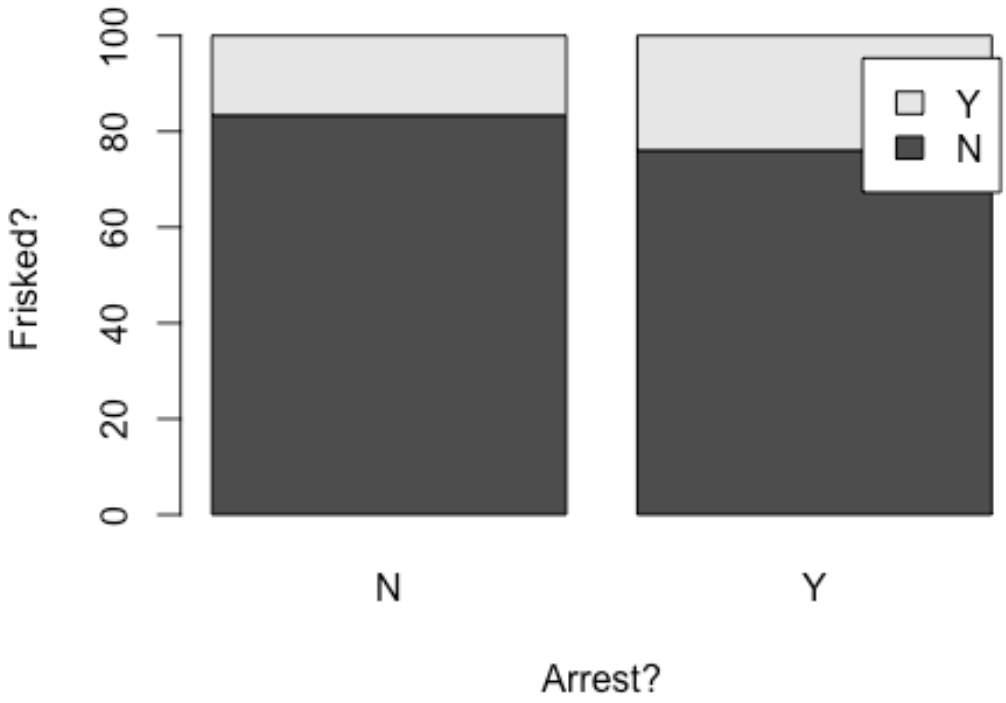


This doesn't not support the reason why blacks are getting stop more often and whites getting stop less. There doesn't not seem to be any relationship between getting arrested and race.

6.Arrest made and Frisked

To show the relationships between arrest made and frisked a chart can be plot by

```
tb = table(df$arstmade,df$frisked)
for (x in 1:ncol(tb)){
  tb[,x] = tb[,x]*100/sum(tb[,x])
}
barplot(tb,xlab = "Arrest?",ylab = "Frisked?",legend = rownames(tb))
```



The darker area shows that the no arrest is made. The percentage of arrest is more when the suspect have been frisked. This make sense because if the police didn't frisk the suspect illegal items may not have been found.

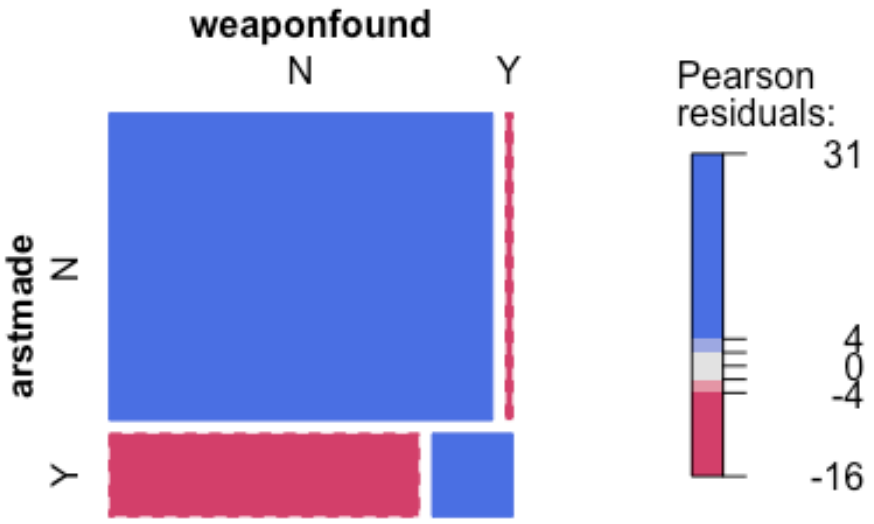
7.Arrest made and Weapon found

The relationship between weapon found and arrest made can be shown by

```
library(vcd)
```

```
## Loading required package: grid
```

```
 mosaic(~arstmade+weaponfound,data = df,gp=shading_Friendly2())
```

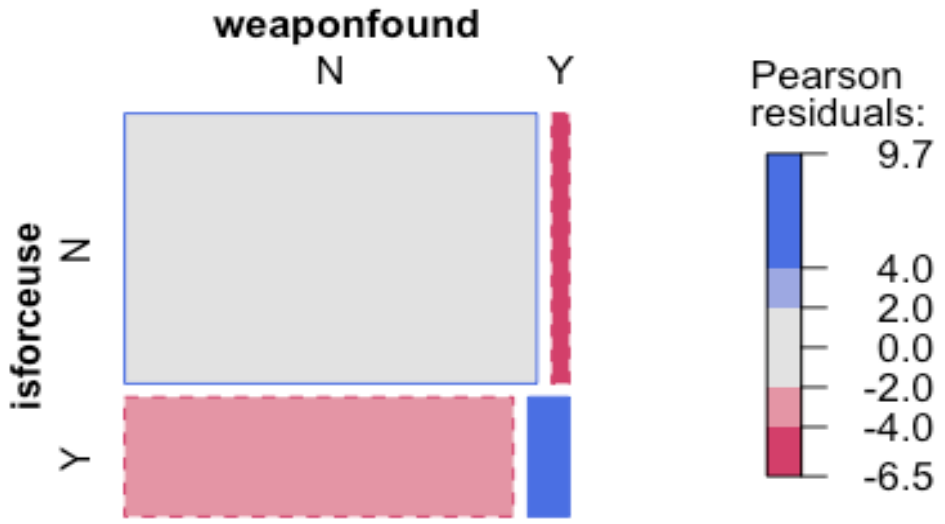


There seems to be a high correlation between weapon found and arrest mande which makes sense. If weapons are found on the suspect an arrest is likely to be made and vice versa.

8.Is force used vs Weapon found

The relationship between is force used and weapon found can be shown with a mosaic plot using 'vcd' library by

```
mosaic(~isforceuse+weaponfound,data = df,gp=shading_Friendly2())
```



Looking at the plot there seems to be some relationship between this 2 attributes. If force is used it is likely that weapon have been found by the police.

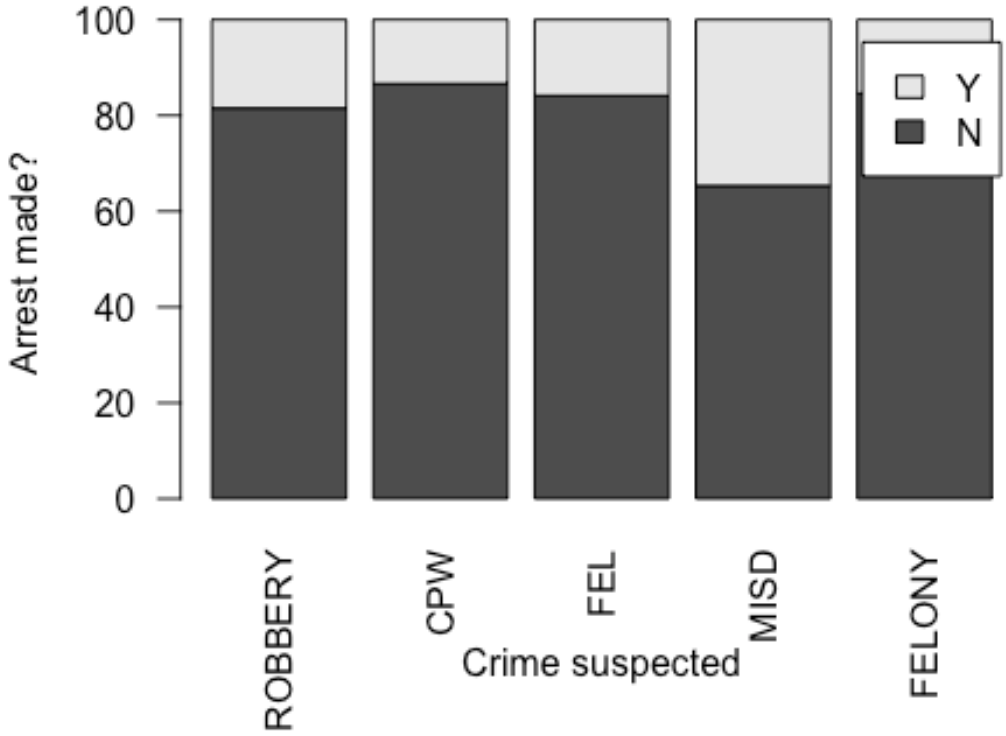
9.Crime suspected(top 5) and Arrest made

The relationship between crime suspected and arrest made can be shown as follows

```
top = 5
x = sort(summary(df$crimsusp)[names(summary(df$crimsusp))!="(Other)"])
x = x[(length(x)-top+1):length(x)]

tb = table(df$arstmade,df$crimsusp)
tb = tb[,(names(x)[1:length(x)])]

for (x in 1:ncol(tb)){
  tb[,x] = tb[,x]*100/sum(tb[,x])
}
barplot(tb,xlab = "Crime suspected",ylab = "Arrest made?",legend = rownames(t
b),las = 2)
```

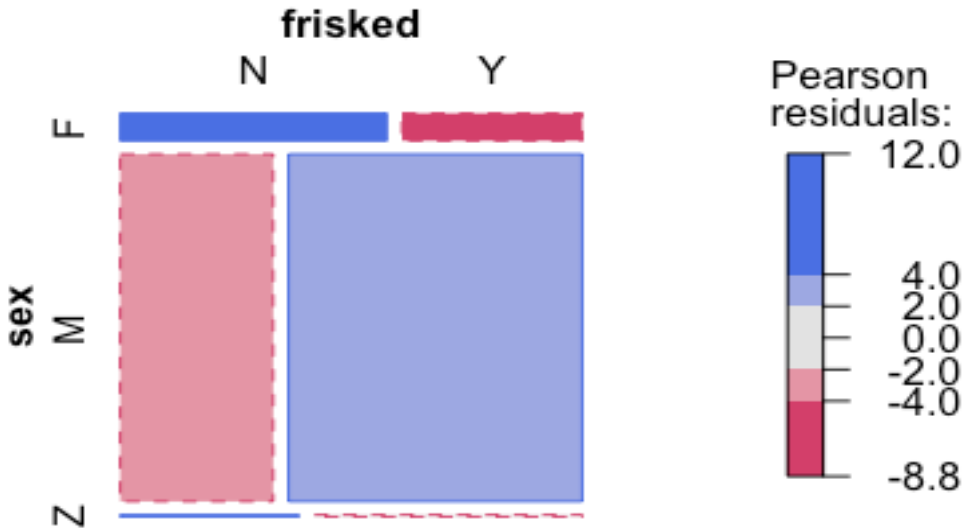


Looking at the graph, pedestrians that are suspected with MISD get arrested most often. This could be that officers suspect MISD crimes with higher accuracy.

10. Sex and Frisked

To see whether chance of getting frisked and sex have relationships among a mosaic plot can be created

```
mosaic(~sex+frisked,data = df,gp=shading_Friendly2())
```



There seems to be a relationship between frisked and sex. If the person is female the chance of getting frisked is low. However, if the person stopped is male the chance of getting frisked is slightly higher.