

BSc Population Health Dissertation (18/19)

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```
##### Package Library #####

library(data.table)
library(readr)
library(foreign)
library(haven)
library(grid)
library(gridExtra)
library(factoextra)

## Loading required package: ggplot2
## Welcome! Related Books: `Practical Guide To Cluster Analysis in R` at https://goo.gl/13EFCZ
library(PerformanceAnalytics)

## Loading required package: xts
## Warning: package 'xts' was built under R version 3.4.4
## Loading required package: zoo
##
## Attaching package: 'zoo'
## The following objects are masked from 'package:base':
##
##   as.Date, as.Date.numeric
##
## Attaching package: 'xts'
## The following objects are masked from 'package:data.table':
##
##   first, last
##
## Attaching package: 'PerformanceAnalytics'
## The following object is masked from 'package:graphics':
##
##   legend
library(factoextra)
library(ca)
library(highcharter)

## Highcharts (www.highcharts.com) is a Highsoft software product which is
## not free for commercial and Governmental use
library(tidyverse)

## -- Attaching packages ----- tidyverse 1.2.1 --
```

```

## v tibble 1.4.2      v dplyr 0.7.4
## v tidyr 0.8.2       v stringr 1.2.0
## v purrr 0.2.4       v forcats 0.2.0

## Warning: package 'tidyr' was built under R version 3.4.4

## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::between()   masks data.table::between()
## x dplyr::combine()   masks gridExtra::combine()
## x dplyr::filter()    masks stats::filter()
## x dplyr::first()     masks xts::first(), data.table::first()
## x dplyr::lag()       masks stats::lag()
## x dplyr::last()      masks xts::last(), data.table::last()
## x purrr::transpose() masks data.table::transpose()

library(rwars)
library(Matching)

## Loading required package: MASS

##
## Attaching package: 'MASS'

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

## ##
## ## Matching (Version 4.9-2, Build Date: 2015-12-25)
## ## See http://sekhon.berkeley.edu/matching for additional documentation.
## ## Please cite software as:
## ## Jasjeet S. Sekhon. 2011. ``Multivariate and Propensity Score Matching
## ## Software with Automated Balance Optimization: The Matching package for R.''
## ## Journal of Statistical Software, 42(7): 1-52.
## ##

library(Hmisc)

## Loading required package: lattice
## Loading required package: survival
## Loading required package: Formula

##
## Attaching package: 'Hmisc'

## The following objects are masked from 'package:dplyr':
##
##   combine, src, summarize

## The following object is masked from 'package:gridExtra':
##
##   combine

## The following objects are masked from 'package:base':
##
##   format.pval, round.POSIXt, trunc.POSIXt, units

library(dplyr)

```

```
##### Write in 2005-2015 datasets #####
```

```
hse05 = read_dta("/Users/vincentmay/Desktop/Dissertation/Codes/dataset/hse05ai.dta")
write.csv(hse05, file = "hse05.csv")

hse06 = read_dta("/Users/vincentmay/Desktop/Dissertation/Codes/dataset/hse06ai.dta")
write.csv(hse06, file = "hse06.csv")

hse07 = read_dta("/Users/vincentmay/Desktop/Dissertation/Codes/dataset/hse07ai.dta")
write.csv(hse07, file = "hse07.csv")

hse08 = read_dta("/Users/vincentmay/Desktop/Dissertation/Codes/dataset/hse08ai.dta")
write.csv(hse08, file = "hse08.csv")

hse09 = read_dta("/Users/vincentmay/Desktop/Dissertation/Codes/dataset/hse09ai.dta")
write.csv(hse09, file = "hse09.csv")

hse10 = read_dta("/Users/vincentmay/Desktop/Dissertation/Codes/dataset/hse10ai.dta")
write.csv(hse10, file = "hse10.csv")

hse11 = read_dta("/Users/vincentmay/Desktop/Dissertation/Codes/dataset/hse2011ai.dta")
write.csv(hse11, file = "hse11.csv")

hse12 = read_dta("/Users/vincentmay/Desktop/Dissertation/Codes/dataset/hse2012ai.dta")
write.csv(hse12, file = "hse12.csv")

hse13 = read_dta("/Users/vincentmay/Desktop/Dissertation/Codes/dataset/hse2013ai.dta")
write.csv(hse13, file = "hse13.csv")

hse14 = read_dta("/Users/vincentmay/Desktop/Dissertation/Codes/dataset/hse2014ai.dta")
write.csv(hse14, file = "hse14.csv")

hse15 = read_dta("/Users/vincentmay/Desktop/Dissertation/Codes/dataset/hse2015ai.dta")
write.csv(hse15, file = "hse15.csv")
```

```
##### Load CSV files #####
```

```
hse05 <-read.csv("hse05.csv")
hse06 <-read.csv("hse06.csv")
hse07 <-read.csv("hse07.csv")
hse08 <-read.csv("hse08.csv")
hse09 <-read.csv("hse09.csv")
hse10 <-read.csv("hse10.csv")
hse11 <-read.csv("hse11.csv")
hse12 <-read.csv("hse12.csv")
hse13 <-read.csv("hse13.csv")
hse14 <-read.csv("hse14.csv")
hse15 <-read.csv("hse15.csv")
```

Part 1/4: Data Preparation

```
##### Data Preparation -- Get variables needed #####

#      In this section, variables in interest are selected.
#      Children are filtered from the datasets by "age", which is further converted to three age groups

hse05.pc <- c("sys1om","dias1om","sex","tenureb","age","ethinda","hhszize","addnum","imd2004",
             "birthwt","porftvg","gor","sys2om","sys3om","dias2om","dias3om")
hse05.mk2 <- hse05[,hse05.pc]
colnames(hse05.mk2)[6] <- "origin"
colnames(hse05.mk2)[9] <- "imd"
hse05.mk2$year <- 05
hse05.mk2$aggr <- ifelse(hse05.mk2$age > 10 & hse05.mk2$age < 16 , 3,
                        ifelse(hse05.mk2$age > 4 & hse05.mk2$age < 14 , 2,
                              ifelse(hse05.mk2$age > 1 & hse05.mk2$age < 5 , 1, 0)))
hse05.mk2$porftvg <- ifelse(hse05.mk2$porftvg > 5, 6, hse05.mk2$porftvg)
hse05.2 <- -c(which(hse05.mk2$aggr == 0))
hse05.mk2 <- hse05.mk2[hse05.2,]
hse05.mk2$age <- NULL

hse06.pc <- c("sys1om","dias1om","sex","tenureb","age","ethinda","hhszize","addnum","imd2004",
             "birthwt","porftvg","gor06","sys2om","sys3om","dias2om","dias3om")
hse06.mk2 <- hse06[,hse06.pc]
colnames(hse06.mk2)[6] <- "origin"
colnames(hse06.mk2)[9] <- "imd"
colnames(hse06.mk2)[12] <- "gor"
hse06.mk2$year <- 06
hse06.mk2$aggr <- ifelse(hse06.mk2$age > 10 & hse06.mk2$age < 16 , 3,
                        ifelse(hse06.mk2$age > 4 & hse06.mk2$age < 11 , 2,
                              ifelse(hse06.mk2$age > 1 & hse06.mk2$age < 5 , 1, 0)))
hse06.mk2$porftvg <- ifelse(hse06.mk2$porftvg > 5, 6, hse06.mk2$porftvg)
hse06.2 <- -c(which(hse06.mk2$aggr == 0))
hse06.mk2 <- hse06.mk2[hse06.2,]
hse06.mk2$age <- NULL

hse07.pc <- c("sys1om","dias1om","sex","tenureb","age","ethinda","hhszize","addnum","imd2007",
             "birthwt","porftvg","gor07","sys2om","sys3om","dias2om","dias3om")
hse07.mk2 <- hse07[,hse07.pc]
colnames(hse07.mk2)[6] <- "origin"
colnames(hse07.mk2)[7] <- "hhszize"
colnames(hse07.mk2)[9] <- "imd"
colnames(hse07.mk2)[12] <- "gor"
hse07.mk2$year <- 07
hse07.mk2$aggr <- ifelse(hse07.mk2$age > 10 & hse07.mk2$age < 16 , 3,
                        ifelse(hse07.mk2$age > 4 & hse07.mk2$age < 11 , 2,
                              ifelse(hse07.mk2$age > 1 & hse07.mk2$age < 5 , 1, 0)))
hse07.mk2$porftvg <- ifelse(hse07.mk2$porftvg > 5, 6, hse07.mk2$porftvg)
hse07.2 <- -c(which(hse07.mk2$aggr == 0))
hse07.mk2 <- hse07.mk2[hse07.2,]
hse07.mk2$age <- NULL
```

```

hse08.pc <- c("sys1om","dias1om","sex","tenureb","age","origin","hhszize","addnum","qimd",
             "birthwt","porftvg","GOR","sys2om","sys3om","dias2om","dias3om")
hse08.mk2 <- hse08[,hse08.pc]
colnames(hse08.mk2)[9] <- "imd"
colnames(hse08.mk2)[12] <- "gor"
hse08.mk2$year <- 08
hse08.mk2$aggr <- ifelse(hse08.mk2$age > 10 & hse08.mk2$age < 16 , 3,
                        ifelse(hse08.mk2$age > 4 & hse08.mk2$age < 11 , 2,
                              ifelse(hse08.mk2$age > 1 & hse08.mk2$age < 5 , 1, 0)))
hse08.mk2$porftvg <- ifelse(hse08.mk2$porftvg > 5, 6, hse08.mk2$porftvg)
hse08.2 <- -c(which(hse08.mk2$aggr == 0))
hse08.mk2 <- hse08.mk2[hse08.2,]
hse08.mk2$age <- NULL

hse09.pc <- c("sys1om","dias1om","sex","tenureb","age","origin","hhszize","addnum","IMD2007",
             "birthwt","porftvg","GOR07","sys2om","sys3om","dias2om","dias3om")
hse09.mk2 <- hse09[,hse09.pc]
colnames(hse09.mk2)[9] <- "imd"
colnames(hse09.mk2)[12] <- "gor"
hse09.mk2$year <- 09
hse09.mk2$aggr <- ifelse(hse09.mk2$age > 10 & hse09.mk2$age < 16 , 3,
                        ifelse(hse09.mk2$age > 4 & hse09.mk2$age < 11 , 2,
                              ifelse(hse09.mk2$age > 1 & hse09.mk2$age < 5 , 1, 0)))
hse09.mk2$porftvg <- ifelse(hse09.mk2$porftvg > 5, 6, hse09.mk2$porftvg)
hse09.2 <- -c(which(hse09.mk2$aggr == 0))
hse09.mk2 <- hse09.mk2[hse09.2,]
hse09.mk2$age <- NULL

hse10.pc <- c("sys1om","dias1om","sex","tenureb","age","origin","hhszize","addnum","imd2007",
             "birthwt","porftvg","gor1","sys2om","sys3om","dias2om","dias3om")
hse10.mk2 <- hse10[,hse10.pc]
colnames(hse10.mk2)[9] <- "imd"
colnames(hse10.mk2)[12] <- "gor"
hse10.mk2$year <- 10
hse10.mk2$aggr <- ifelse(hse10.mk2$age > 10 & hse10.mk2$age < 16 , 3,
                        ifelse(hse10.mk2$age > 4 & hse10.mk2$age < 11 , 2,
                              ifelse(hse10.mk2$age > 1 & hse10.mk2$age < 5 , 1, 0)))
hse10.mk2$porftvg <- ifelse(hse10.mk2$porftvg > 5, 6, hse10.mk2$porftvg)
hse10.2 <- -c(which(hse10.mk2$aggr == 0))
hse10.mk2 <- hse10.mk2[hse10.2,]
hse10.mk2$age <- NULL

hse11.pc <- c("sys1om","dias1om","Sex","tenureb","Age","Origin","HHSzize","addnum","qimd",
             "BirthWt","porftvg","gor1","sys2om","sys3om","dias2om","dias3om")
hse11.mk2 <- hse11[,hse11.pc]
colnames(hse11.mk2)[3] <- "sex"
colnames(hse11.mk2)[6] <- "origin"
colnames(hse11.mk2)[7] <- "hhszize"
colnames(hse11.mk2)[9] <- "imd"

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colnames(hse11.mk2)[10] <- "birthwt"
colnames(hse11.mk2)[12] <- "gor"
hse11.mk2$year <- 11
hse11.mk2$aggr <- ifelse(hse11.mk2$Age > 10 & hse11.mk2$Age < 16 , 3,
                        ifelse(hse11.mk2$Age > 4 & hse11.mk2$Age < 11 , 2,
                              ifelse(hse11.mk2$Age > 1 & hse11.mk2$Age < 5 , 1, 0)))
hse11.mk2$porftvg <- ifelse(hse11.mk2$porftvg > 5, 6, hse11.mk2$porftvg)
hse11.2 <- -c(which(hse11.mk2$aggr == 0))
hse11.mk2 <- hse11.mk2[hse11.2,]
hse11.mk2$Age <- NULL

hse12.pc <- c("sys1om","dias1om","Sex","tenureb","Age","Origin","HHSsize","Addnum","qimd",
             "BirthWt",                "gor1","sys2om","sys3om","dias2om","dias3om")
hse12.mk2 <- hse12[,hse12.pc]
colnames(hse12.mk2)[3] <- "sex"
colnames(hse12.mk2)[6] <- "origin"
colnames(hse12.mk2)[7] <- "hhszize"
colnames(hse12.mk2)[8] <- "addnum"
colnames(hse12.mk2)[9] <- "imd"
colnames(hse12.mk2)[10] <- "birthwt"
colnames(hse12.mk2)[11] <- "gor"
hse12.mk2$porftvg <- NA
hse12.mk2$year <- 12
hse12.mk2$aggr <- ifelse(hse12.mk2$Age > 10 & hse12.mk2$Age < 16 , 3,
                        ifelse(hse12.mk2$Age > 4 & hse12.mk2$Age < 11 , 2,
                              ifelse(hse12.mk2$Age > 1 & hse12.mk2$Age < 5 , 1, 0)))
hse12.mk2$porftvg <- ifelse(hse12.mk2$porftvg > 5, 6, hse12.mk2$porftvg)
hse12.2 <- -c(which(hse12.mk2$aggr == 0))
hse12.mk2 <- hse12.mk2[hse12.2,]
hse12.mk2$Age <- NULL

hse13.pc <- c("SYS10M","DIAS10M","Sex","tenureb","Age","Origin","HHSsize","Addnum","qimd",
             "BirthWt","porftvg","gor1","SYS20M","SYS30M","DIAS20M","DIAS30M")
hse13.mk2 <- hse13[,hse13.pc]
colnames(hse13.mk2)[1] <- "sys1om"
colnames(hse13.mk2)[2] <- "dias1om"
colnames(hse13.mk2)[3] <- "sex"
colnames(hse13.mk2)[6] <- "origin"
colnames(hse13.mk2)[7] <- "hhszize"
colnames(hse13.mk2)[8] <- "addnum"
colnames(hse13.mk2)[9] <- "imd"
colnames(hse13.mk2)[10] <- "birthwt"
colnames(hse13.mk2)[12] <- "gor"
colnames(hse13.mk2)[13] <- "sys2om"
colnames(hse13.mk2)[14] <- "sys3om"
colnames(hse13.mk2)[15] <- "dias2om"
colnames(hse13.mk2)[16] <- "dias3om"
hse13.mk2$year <- 13
hse13.mk2$aggr <- ifelse(hse13.mk2$Age > 10 & hse13.mk2$Age < 16 , 3,
                        ifelse(hse13.mk2$Age > 4 & hse13.mk2$Age < 11 , 2,
                              ifelse(hse13.mk2$Age > 1 & hse13.mk2$Age < 5 , 1, 0)))

```

```

hse13.mk2$porftvg <- ifelse(hse13.mk2$porftvg > 5, 6, hse13.mk2$porftvg)
hse13.2 <- -c(which(hse13.mk2$aggr == 0))
hse13.mk2 <- hse13.mk2[hse13.2,]
hse13.mk2$Age <- NULL

hse14.pc <- c("SYS10M", "DIAS10M", "Sex", "tenureb", "Age90", "origin2", "HHSIZE9", "Addnum", "qimd",
             "BirthWt", "PorFV05", "gor1", "SYS20M", "SYS30M", "DIAS20M", "DIAS30M")
hse14.mk2 <- hse14[,hse14.pc]
colnames(hse14.mk2)[1] <- "sys10m"
colnames(hse14.mk2)[2] <- "dias10m"
colnames(hse14.mk2)[3] <- "sex"
colnames(hse14.mk2)[6] <- "origin"
colnames(hse14.mk2)[7] <- "hhsz"
colnames(hse14.mk2)[8] <- "addnum"
colnames(hse14.mk2)[9] <- "imd"
colnames(hse14.mk2)[10] <- "birthwt"
colnames(hse14.mk2)[11] <- "porftvg"
colnames(hse14.mk2)[12] <- "gor"
colnames(hse14.mk2)[13] <- "sys20m"
colnames(hse14.mk2)[14] <- "sys30m"
colnames(hse14.mk2)[15] <- "dias20m"
colnames(hse14.mk2)[16] <- "dias30m"
hse14.mk2$year <- 14
hse14.mk2$aggr <- ifelse(hse14.mk2$Age90 > 10 & hse14.mk2$Age90 < 16, 3,
                        ifelse(hse14.mk2$Age90 > 4 & hse14.mk2$Age90 < 11, 2,
                              ifelse(hse14.mk2$Age90 > 1 & hse14.mk2$Age90 < 5, 1, 0)))
hse14.2 <- -c(which(hse14.mk2$aggr == 0))
hse14.mk2 <- hse14.mk2[hse14.2,]
hse14.mk2$Age90 <- NULL

hse15.pc <- c("SYS10M", "DIAS10M", "Sex", "tenureb", "Ag015g4", "origin2", "HHSIZE6", "addnum", "qimd",
             "BirthWt", "PorFV05b", "Gor1", "SYS20M", "SYS30M", "DIAS20M", "DIAS30M")
hse15.mk2 <- hse15[,hse15.pc]
colnames(hse15.mk2)[1] <- "sys10m"
colnames(hse15.mk2)[2] <- "dias10m"
colnames(hse15.mk2)[3] <- "sex"
colnames(hse15.mk2)[6] <- "origin"
colnames(hse15.mk2)[7] <- "hhsz"
colnames(hse15.mk2)[9] <- "imd"
colnames(hse15.mk2)[10] <- "birthwt"
colnames(hse15.mk2)[11] <- "porftvg"
colnames(hse15.mk2)[12] <- "gor"
colnames(hse15.mk2)[13] <- "sys20m"
colnames(hse15.mk2)[14] <- "sys30m"
colnames(hse15.mk2)[15] <- "dias20m"
colnames(hse15.mk2)[16] <- "dias30m"
hse15.mk2$year <- 15
hse15.mk2$aggr <- ifelse(hse15.mk2$Ag015g4 > 0, hse15.mk2$Ag015g4, 0)
hse15.2 <- -c(which(hse15.mk2$aggr == 0))
hse15.mk2 <- hse15.mk2[hse15.2,]
hse15.mk2$Ag015g4 <- NULL

```

```
##### Data Preparation -- Merge (Row bind) the datasets #####

hse.mk20 <- rbind(hse05.mk2, hse06.mk2)
hse.mk20 <- rbind(hse.mk20, hse07.mk2)
hse.mk20 <- rbind(hse.mk20, hse08.mk2)
hse.mk20 <- rbind(hse.mk20, hse09.mk2)
hse.mk20 <- rbind(hse.mk20, hse10.mk2)
hse.mk20 <- rbind(hse.mk20, hse11.mk2)
hse.mk20 <- rbind(hse.mk20, hse12.mk2)
hse.mk20 <- rbind(hse.mk20, hse13.mk2)
hse.mk20 <- rbind(hse.mk20, hse14.mk2)
hse.mk20 <- rbind(hse.mk20, hse15.mk2)

##### Data Preparation -- Convert the missing values to NAs & Keep only the valid BP measur

# As some of the missing observations are recorded as negative number or huge number in the dataset
# This step ensures those cases are marked as NAs rather than continuous number

colnames(hse.mk20)

## [1] "sys1om" "dias1om" "sex" "tenureb" "origin" "hhsiz" "addnum"
## [8] "imd" "birthwt" "porftvg" "gor" "sys2om" "sys3om" "dias2om"
## [15] "dias3om" "year" "aggr"

range(hse.mk20$sex)

## [1] 1 2
range(hse.mk20$tenureb)

## [1] -9 6
range(hse.mk20$origin)

## [1] -9 18
range(hse.mk20$hhsiz)

## [1] 2 12
range(hse.mk20$addnum)

## [1] 1 56
range(hse.mk20$imd)

## [1] 1 5
range(hse.mk20$birthwt, na.rm = T)

## [1] -1.00 7.14
range(hse.mk20$porftvg, na.rm = T)

## [1] -9 6
range(hse.mk20$gor)

## [1] 1 9
```



```

range(hse.mk20$year)

## [1] 5 15
range(hse.mk20$aggr)

## [1] 1 3
range(hse.mk20$sys1om)

## [1] -9 186
range(hse.mk20$sys2om)

## [1] -9 996
range(hse.mk20$sys3om)

## [1] -9 194
range(hse.mk20$dias1om)

## [1] -9 131
range(hse.mk20$dias2om)

## [1] -9 135
range(hse.mk20$dias3om)

## [1] -9 140

# tenureb, origin, birthwt, porftvg, & six BP measurements have negative/huge values
# birthwt, porftvg have NA values originally which require to be imputed later.

#      Covert the missing values to NAs

hse.mk20$tenureb <- ifelse(hse.mk20$tenureb < 0, NA, hse.mk20$tenureb)
hse.mk20$origin <- ifelse(hse.mk20$origin < 0, NA, hse.mk20$origin)
hse.mk20$birthwt <- ifelse(hse.mk20$birthwt < 0, NA, hse.mk20$birthwt)
hse.mk20$porftvg <- ifelse(hse.mk20$porftvg < 0, NA, hse.mk20$porftvg)

#      Keep only the valid measurements
#      Note: As children age from 2-4 does not have valid BP measurements, so they are dropped from the

hse.mk20.pc <- -c(which(hse.mk20$sys1om < 0 | hse.mk20$sys1om > 200 |
                      hse.mk20$sys2om < 0 | hse.mk20$sys2om > 200 |
                      hse.mk20$sys3om < 0 | hse.mk20$sys3om > 200 |
                      hse.mk20$dias1om < 0 | hse.mk20$dias1om > 200 |
                      hse.mk20$dias2om < 0 | hse.mk20$dias2om > 200 |
                      hse.mk20$dias3om < 0 | hse.mk20$dias3om > 200))
hse.mk20 <- hse.mk20[hse.mk20.pc,]

#      Last check

colnames(hse.mk20)

## [1] "sys1om" "dias1om" "sex"      "tenureb" "origin" "hhszsize" "addnum"
## [8] "imd"    "birthwt" "porftvg" "gor"     "sys2om" "sys3om" "dias2om"

```

```
## [15] "dias3om" "year"    "aggr"
```

```
range(hse.mk20$sex)
```

```
## [1] 1 2
```

```
range(hse.mk20$tenureb, na.rm = T)
```

```
## [1] 1 6
```

```
range(hse.mk20$origin, na.rm = T)
```

```
## [1] 1 18
```

```
range(hse.mk20$hhszsize)
```

```
## [1] 2 11
```

```
range(hse.mk20$addnum)
```

```
## [1] 1 56
```

```
range(hse.mk20$imd)
```

```
## [1] 1 5
```

```
range(hse.mk20$birthwt, na.rm = T)
```

```
## [1] 0.91 6.75
```

```
range(hse.mk20$porftvg, na.rm = T)
```

```
## [1] 0 6
```

```
range(hse.mk20$gor)
```

```
## [1] 1 9
```

```
range(hse.mk20$year)
```

```
## [1] 5 15
```

```
range(hse.mk20$aggr)
```

```
## [1] 2 3
```

```
range(hse.mk20$sys1om, na.rm = T)
```

```
## [1] 51 183
```

```
range(hse.mk20$sys2om, na.rm = T)
```

```
## [1] 52 187
```

```
range(hse.mk20$sys3om, na.rm = T)
```

```
## [1] 53 194
```

```
range(hse.mk20$dias1om, na.rm = T)
```

```
## [1] 31 131
```

```
range(hse.mk20$dias2om, na.rm = T)
```

```
## [1] 31 135
```

```
range(hse.mk20$dias3om, na.rm = T)
```

```
## [1] 30 140
```

```
##### Data Preparation -- Average the BP for each row #####
```

```
# Looking into the distribution of BP measurements
```

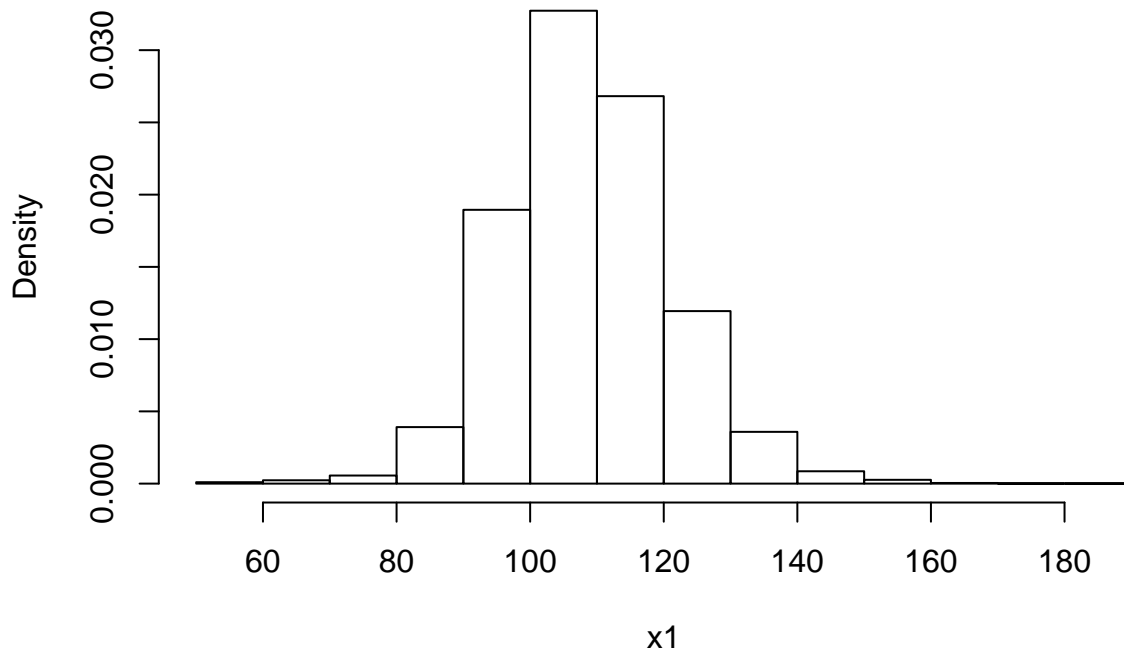
```
x1 <- hse.mk20$sys1om
```

```
range(hse.mk20$sys1om, na.rm = T)
```

```
## [1] 51 183
```

```
hist(x1, freq = FALSE)
```

Histogram of x1



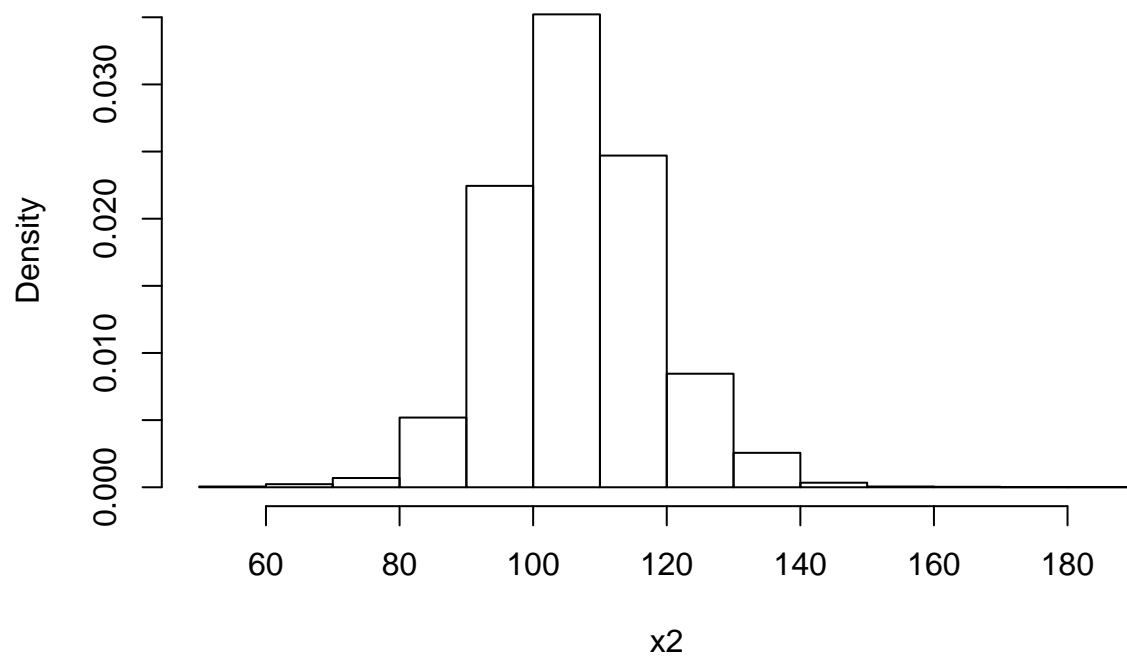
```
x2 <- hse.mk20$sys2om
```

```
range(hse.mk20$sys2om, na.rm = T)
```

```
## [1] 52 187
```

```
hist(x2, freq = FALSE)
```

Histogram of x2

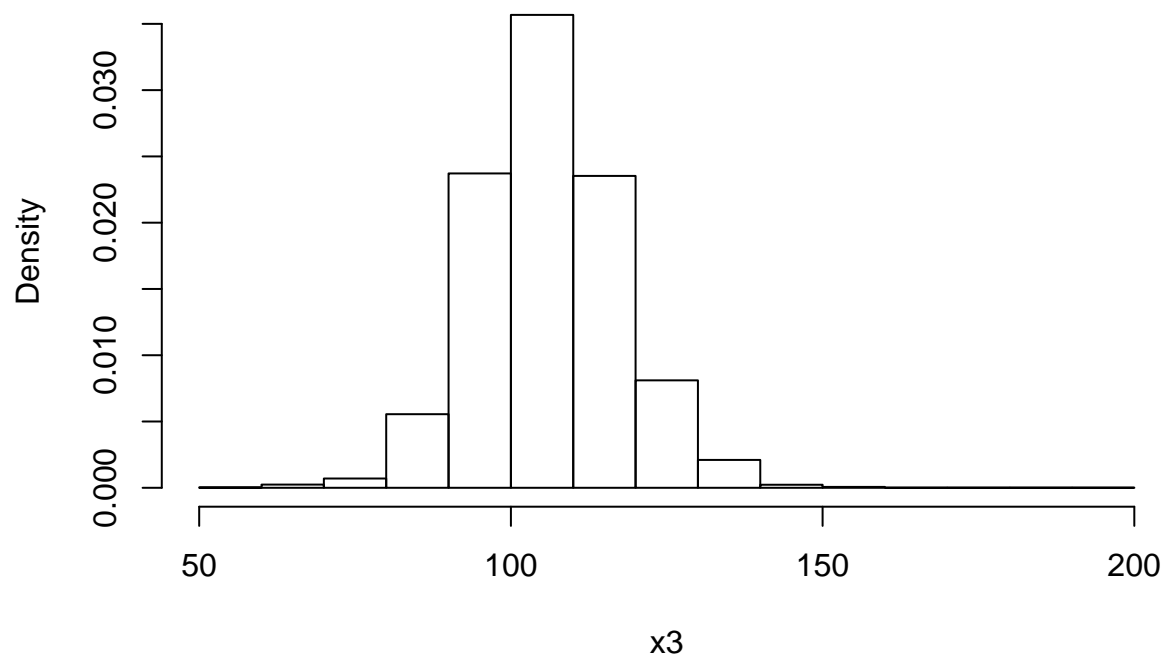


```
x3 <- hse.mk20$sys3om  
range(hse.mk20$sys3om, na.rm = T)
```

```
## [1] 53 194
```

```
hist(x3, freq = FALSE)
```

Histogram of x3

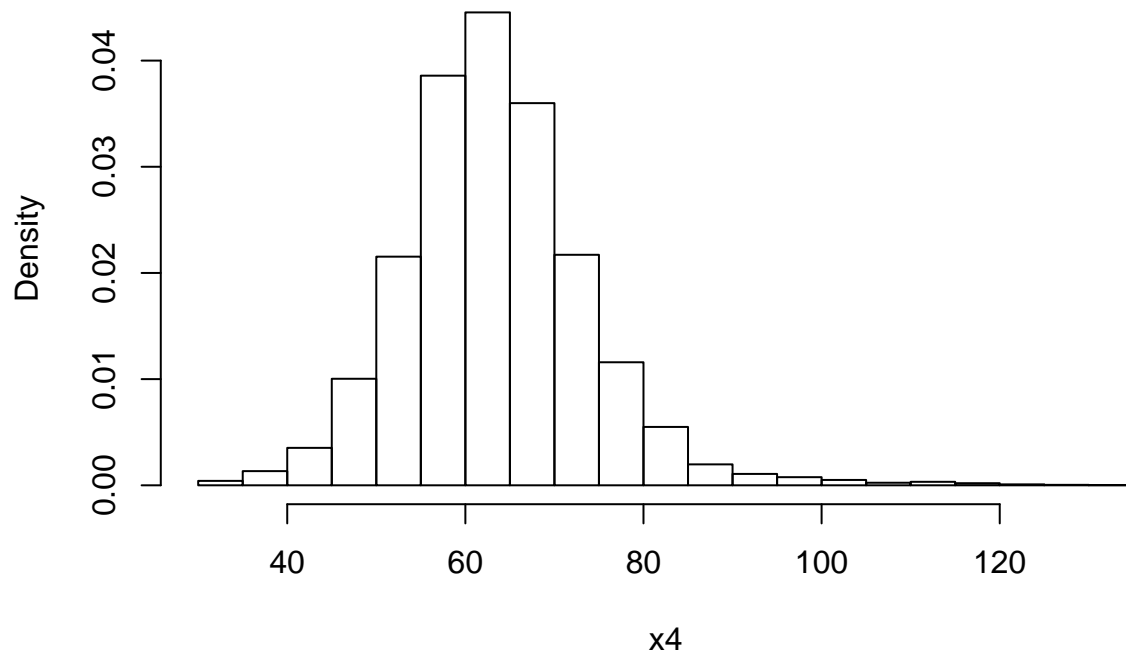


```
x4 <- hse.mk20$diaslom  
range(hse.mk20$diaslom, na.rm = T)
```

```
## [1] 31 131
```

```
hist(x4, freq = FALSE)
```

Histogram of x4

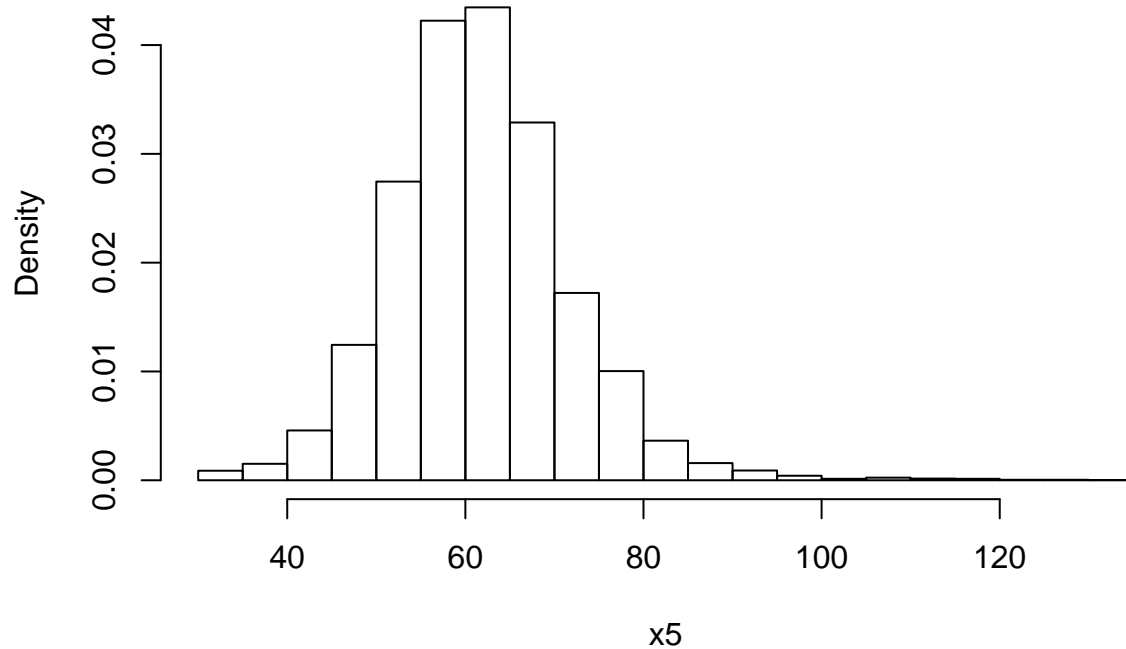


```
x5 <- hse.mk20$dias2om  
range(hse.mk20$dias2om, na.rm = T)
```

```
## [1] 31 135
```

```
hist(x5, freq = FALSE)
```

Histogram of x5

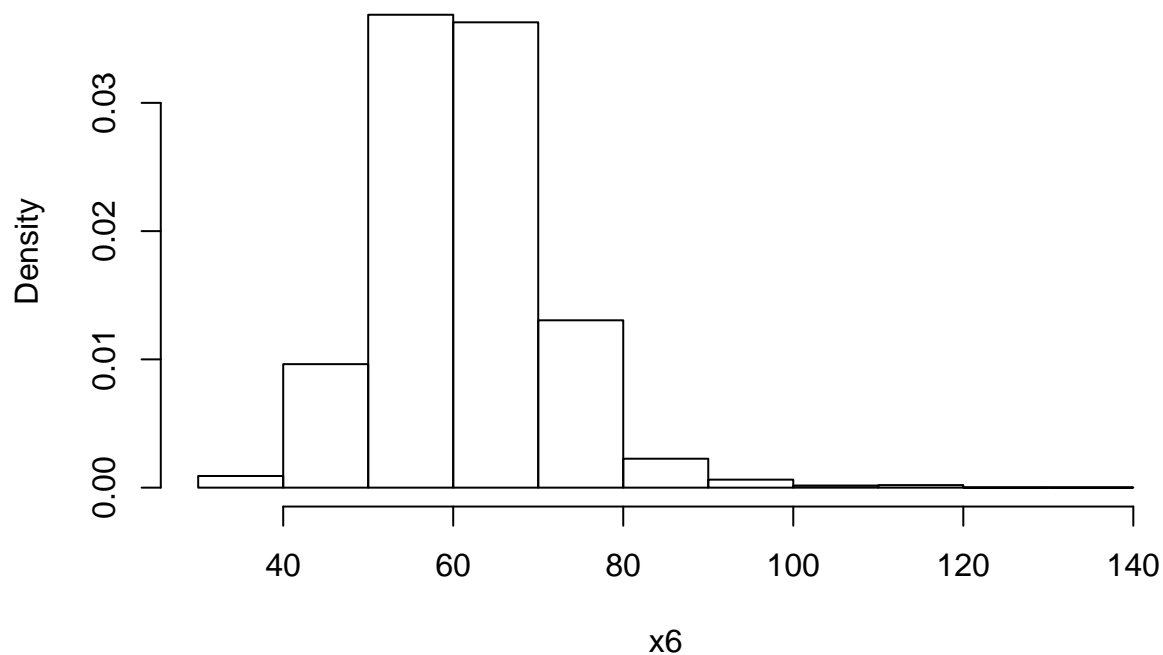


```
x6 <- hse.mk20$dias3om  
range(hse.mk20$dias3om, na.rm = T)
```

```
## [1] 30 140
```

```
hist(x6, freq = FALSE)
```

Histogram of x6



```

#           Get the average of the diastolic and systolic measurements for each row

hse.mk20$sysavg <- NA
hse.mk20$diaavg <- NA

for ( i in 1 : dim(hse.mk20)[1] ) {
  hse.mk20$sysavg[i] <- (hse.mk20$sys1om[i] + hse.mk20$sys2om[i] + hse.mk20$sys3om[i]) / 3
  hse.mk20$diaavg[i] <- (hse.mk20$dias1om[i] + hse.mk20$dias2om[i] + hse.mk20$dias3om[i]) / 3
}
hse.mk20$sys1om <- NULL
hse.mk20$sys2om <- NULL
hse.mk20$sys3om <- NULL
hse.mk20$dias1om <- NULL
hse.mk20$dias2om <- NULL
hse.mk20$dias3om <- NULL

##### Data Preparation -- Get the hypertensive group #####

# Calculate .95 quantiles of the systolic and diastolic bp for each of age group,
# if the child's systolic / diastolic bp is higher than .95 age group's threshold,
# the child is classified as hypertensive

# systolic bp comparison for age group 2
hse.mk20$sys.hyper2 <- NA
hse.mk20$sys.hyper2 <- ifelse(hse.mk20$aggr == 2, hse.mk20$sysavg, NA)
range(hse.mk20$sys.hyper2, na.rm = T)

## [1] 66.33333 148.33333

quantile(hse.mk20$sys.hyper2, .95, na.rm = T)

##      95%
## 120.6667

hse.mk20$sys.hyper2.mk <- NA
hse.mk20$sys.hyper2.mk <- ifelse(hse.mk20$sys.hyper2 >= quantile(hse.mk20$sys.hyper2, .95, na.rm = T)[1],
length(which(hse.mk20$sys.hyper2.mk == 1 )))

## [1] 240

#           group 3
hse.mk20$sys.hyper3 <- NA
hse.mk20$sys.hyper3 <- ifelse(hse.mk20$aggr == 3, hse.mk20$sysavg, NA)
range(hse.mk20$sys.hyper3, na.rm = T)

## [1] 66 186

quantile(hse.mk20$sys.hyper3, .95, na.rm = T)

##      95%
## 129.6667

hse.mk20$sys.hyper3.mk <- NA
hse.mk20$sys.hyper3.mk <- ifelse(hse.mk20$sys.hyper3 >= quantile(hse.mk20$sys.hyper3, .95, na.rm = T)[1],
length(which(hse.mk20$sys.hyper3.mk == 1 )))

## [1] 225

```

```

# diastolic bp comparison for age group 2
hse.mk20$dia.hyper2 <- NA
hse.mk20$dia.hyper2 <- ifelse(hse.mk20$aggr == 2, hse.mk20$diaavg, NA)
range(hse.mk20$dia.hyper2, na.rm = T)

## [1] 34.66667 102.00000

quantile(hse.mk20$dia.hyper2, .95, na.rm = T)

##      95%
## 77.33333

hse.mk20$dia.hyper2.mk <- NA
hse.mk20$dia.hyper2.mk <- ifelse(hse.mk20$dia.hyper2 >= quantile(hse.mk20$dia.hyper2, .95, na.rm = T)[1],
length(which(hse.mk20$dia.hyper2.mk == 1 )))

## [1] 247

#                               group 3
hse.mk20$dia.hyper3 <- NA
hse.mk20$dia.hyper3 <- ifelse(hse.mk20$aggr == 3, hse.mk20$diaavg, NA)
range(hse.mk20$dia.hyper3, na.rm = T)

## [1] 35.66667 114.33333

quantile(hse.mk20$dia.hyper3, .95, na.rm = T)

## 95%
## 77

hse.mk20$dia.hyper3.mk <- NA
hse.mk20$dia.hyper3.mk <- ifelse(hse.mk20$dia.hyper3 >= quantile(hse.mk20$dia.hyper3, .95, na.rm = T)[1],
length(which(hse.mk20$dia.hyper3.mk == 1 )))

## [1] 229

#      Get the hypertensive group
#      if the child is classified as hypertensive by one of the age groups'threshold
#      then the child is hypertensive

hse.mk20$sys.hyper2.mk <- ifelse(is.na(hse.mk20$sys.hyper2.mk), 0, hse.mk20$sys.hyper2.mk)
hse.mk20$sys.hyper3.mk <- ifelse(is.na(hse.mk20$sys.hyper3.mk), 0, hse.mk20$sys.hyper3.mk)

hse.mk20$dia.hyper2.mk <- ifelse(is.na(hse.mk20$dia.hyper2.mk), 0, hse.mk20$dia.hyper2.mk)
hse.mk20$dia.hyper3.mk <- ifelse(is.na(hse.mk20$dia.hyper3.mk), 0, hse.mk20$dia.hyper3.mk)

hse.mk20$hyper <- NA
hse.mk20$hyper <- ifelse(hse.mk20$sys.hyper2.mk == 1 | hse.mk20$sys.hyper3.mk == 1
| hse.mk20$dia.hyper2.mk == 1 | hse.mk20$dia.hyper3.mk == 1 ,1, 0)
length(which(hse.mk20$hyper == 1 ))

## [1] 781

#      Delete used rows
hse.mk20$sys.hyper2 <- NULL
hse.mk20$sys.hyper2.mk <- NULL
hse.mk20$sys.hyper3 <- NULL
hse.mk20$sys.hyper3.mk <- NULL

```



```

hse.mk20$dia.hyper2 <- NULL
hse.mk20$dia.hyper2.mk <- NULL
hse.mk20$dia.hyper3 <- NULL
hse.mk20$dia.hyper3.mk <- NULL

```

```

##### Data Preparation -- Multiple Imputation #####

```

```

hse.mk50 <- hse.mk20

```

```

# Multiple imputation

```

```

set.seed(1)

```

```

hse.mk50.mi <- aregImpute(~ hyper + sex + tenureb + origin + hhsize + addnum + imd + birthwt +
                           porftvg + gor + aggr + year + sysavg + diaavg, data = hse.mk50, n.impute = 5)

```

```

## Iteration 1

```

```

Iteration 2
Iteration 3
Iteration 4
Iteration 5
Iteration 6
Iteration 7
Iteration 8
Iteration 9
Iteration 10
Iteration 11
Iteration 12
Iteration 13
Iteration 14
Iteration 15
Iteration 16
Iteration 17
Iteration 18
Iteration 19
Iteration 20
Iteration 21
Iteration 22
Iteration 23
Iteration 24
Iteration 25
Iteration 26
Iteration 27
Iteration 28
Iteration 29
Iteration 30
Iteration 31
Iteration 32
Iteration 33
Iteration 34
Iteration 35
Iteration 36
Iteration 37
Iteration 38
Iteration 39
Iteration 40

```

```
Iteration 41
Iteration 42
Iteration 43
Iteration 44
Iteration 45
Iteration 46
Iteration 47
Iteration 48
Iteration 49
Iteration 50
Iteration 51
Iteration 52
Iteration 53
```

```
# Retrieve the imputed values
```

```
hse.mk50.mi.r <- impute.transcan(hse.mk50.mi, data = hse.mk50, imputation=1, list.out=TRUE, pr=FALSE, cl
```

```
# Arrange the columns accordingly
```

```
hse.mk60 <- hse.mk50
```

```
hse.mk60$tenureb <- hse.mk50.mi.r$tenureb
```

```
hse.mk60$origin <- hse.mk50.mi.r$origin
```

```
hse.mk60$birthwt <- hse.mk50.mi.r$birthwt
```

```
hse.mk60$porftvg <- hse.mk50.mi.r$porftvg
```

```
##### Data Preparation -- Subset the hypertensive group for the clustering analysis
```

```
# hse.mk60 is the dataset for all children with regardless of whether they are hypertensive or no
```

```
# hse.mk85 contains only the hypertensive children
```

```
hse.mk60.pc <- -c(which(hse.mk60$hyper == 0))
```

```
hse.mk85 <- hse.mk60[hse.mk60.pc,]
```

```
hse.mk85$hyper <- NULL
```

```
hse.mk85$sysavg <- NULL
```

```
hse.mk85$diaavg <- NULL
```

```
hse.mk85$sysavg <- NULL
```

```
hse.mk85$diaavg <- NULL
```

Part 2/4: Current Hypertension Phenomenon Plotting

```
##### Current Hypertension Phenomenon Plotting #####
```

```
prop <- data.frame(table(hse.mk60$year[hse.mk60$hyper == 1]))
```

```
colnames(prop)[1] <- "year"
```

```
colnames(prop)[2] <- "number"
```

```
prop$group <- ifelse(prop$year %in% c(5:8), 1, 2)
```

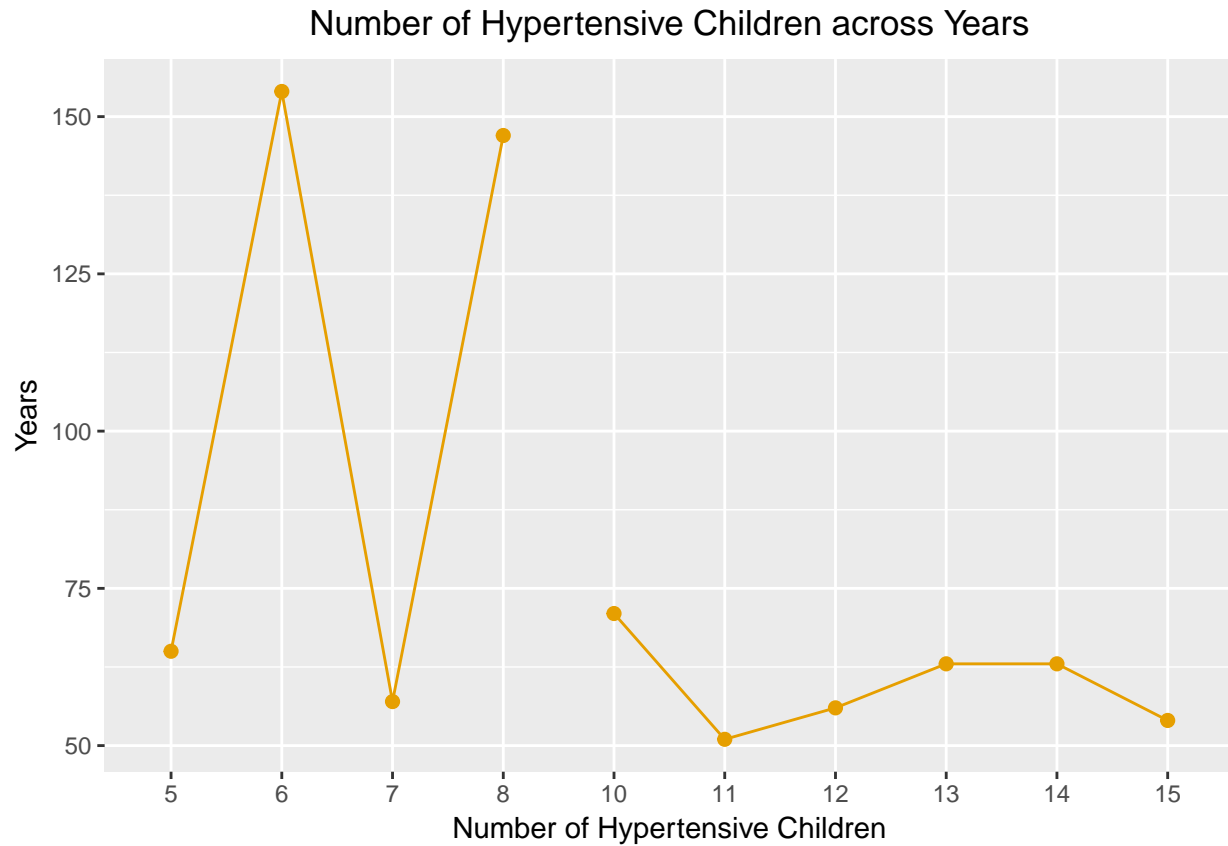
```
ggplot(data = prop, mapping = aes(x = year, y = number, group = group)) +
```

```
  geom_line(color="#E69F00") +
```

```
  geom_point(color="#E69F00", size=2) +
```

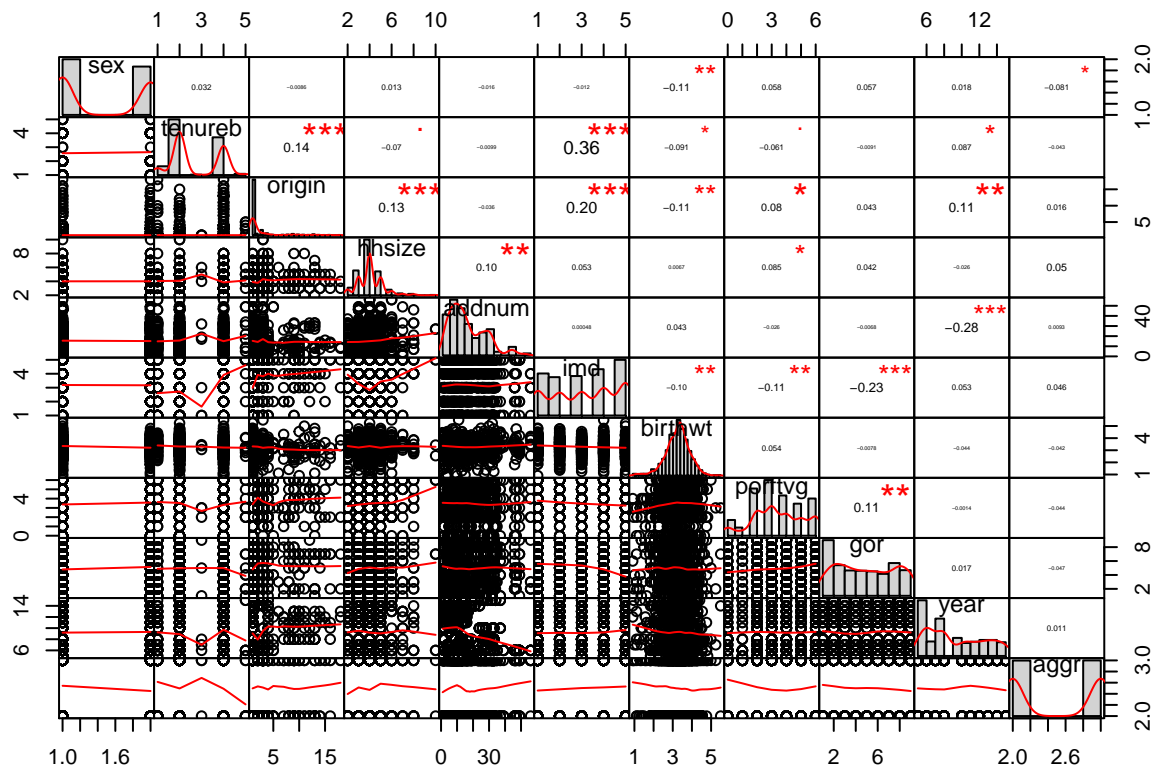
```
  labs(x="Number of Hypertensive Children",y="Years",title = "Number of Hypertensive Children across Ye
```

```
theme(plot.title = element_text(hjust = 0.5))
```



Part 3/4: Principal Components Analysis (PCA) & Correspondence analysis (CORA)

```
##### Pairwise Correlations & Correlation Matrix #####
# Plot the pairwise correlations
chart.Correlation(hse.mk85, histogram=TRUE, pch=19)
```



and the correlation matrix:

```
cor(hse.mk85)
```

```
##          sex      tenureb      origin      hhsz      addnum
## sex      1.000000000  0.032417927 -0.008604396  0.013400676 -0.0162555127
## tenureb  0.032417927  1.000000000  0.138691314 -0.070010414 -0.0099494051
## origin  -0.008604396  0.138691314  1.000000000  0.125300694 -0.0356240083
## hhsz     0.013400676 -0.070010414  0.125300694  1.000000000  0.1019075663
## addnum  -0.016255513 -0.009949405 -0.035624008  0.101907566  1.0000000000
## imd     -0.011701401  0.360434975  0.199830386  0.053353413  0.0004755454
## birthwt -0.110554645 -0.090559327 -0.110419365  0.006704787  0.0425466873
## porftvg  0.057974983 -0.060507403  0.080352101  0.085146930 -0.0257302882
## gor      0.057357270 -0.009123849  0.042795023  0.041744105 -0.0067576125
## year     0.017830535  0.086812986  0.112924233 -0.025591251 -0.2809383590
## aggr     -0.080776257 -0.043188987  0.015528203  0.050358235  0.0093275242
##          imd      birthwt      porftvg      gor      year
## sex      -0.011701408 -0.110554645  0.057974983  0.057357270  0.017830535
## tenureb  0.3604349751 -0.090559327 -0.060507403 -0.009123849  0.086812986
## origin   0.1998303857 -0.110419365  0.080352101  0.042795023  0.112924233
## hhsz     0.0533534132  0.006704787  0.085146930  0.041744105 -0.025591251
## addnum   0.0004755454  0.042546687 -0.025730288 -0.006757613 -0.280938359
## imd      1.0000000000 -0.103795819 -0.109717956 -0.234176752  0.053088789
## birthwt -0.1037958194  1.000000000  0.054341549 -0.007760230 -0.043703547
## porftvg -0.1097179565  0.054341549  1.000000000  0.107895548 -0.001402858
## gor      -0.2341767523 -0.007760230  0.107895548  1.000000000  0.016672702
## year     0.0530887892 -0.043703547 -0.001402858  0.016672702  1.000000000
## aggr     0.0456080353 -0.041830433 -0.044178573 -0.046981949  0.011454565
##          aggr
## sex      -0.080776257
## tenureb  -0.043188987
```

```
## origin    0.015528203
## hhsiz     0.050358235
## addnum    0.009327524
## imd       0.045608035
## birthwt  -0.041830433
## porftvg   -0.044178573
## gor       -0.046981949
## year      0.011454565
## aggr      1.000000000
```

```
##### Principal Components Analysis (PCA) #####
```

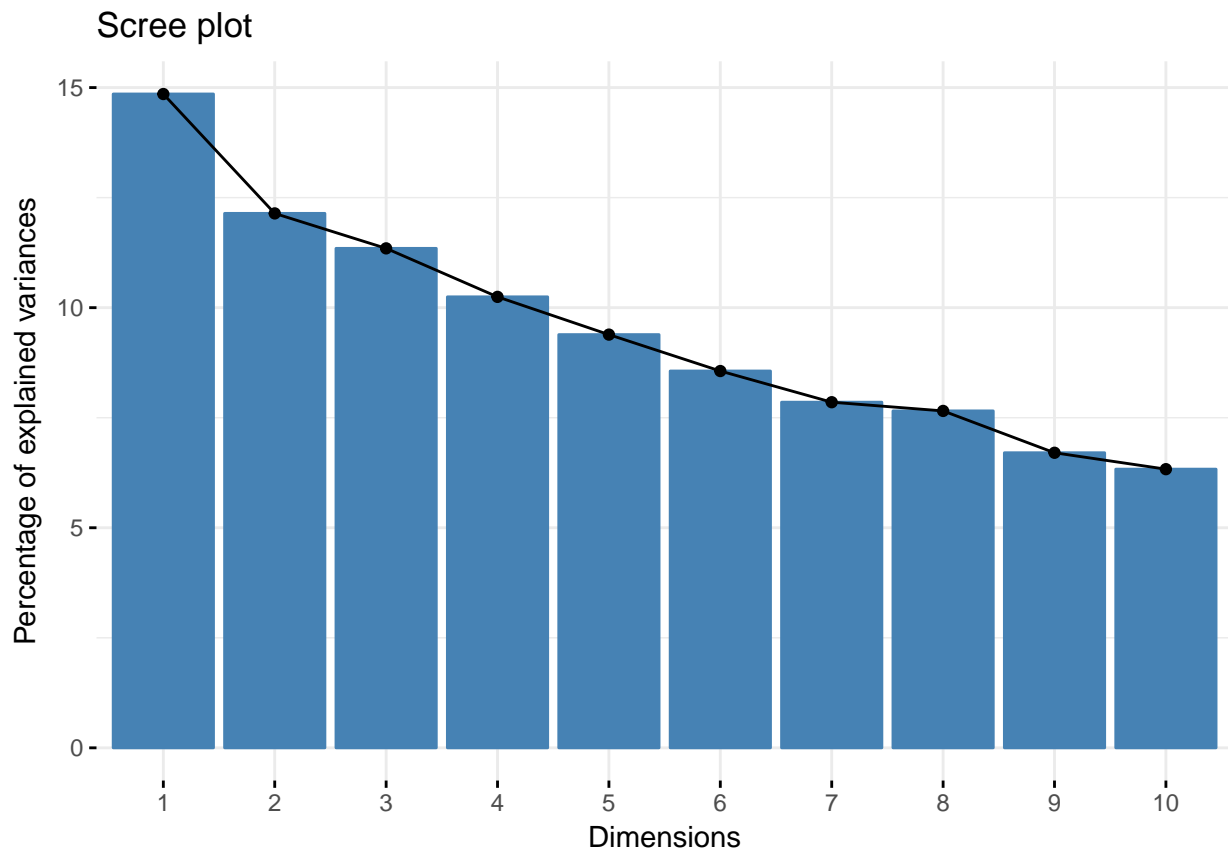
```
# The eigen values (explained variances) and the scree plot:
```

```
pca <- princomp(na.omit(hse.mk85), cor = T, scores = TRUE)
summary(pca)
```

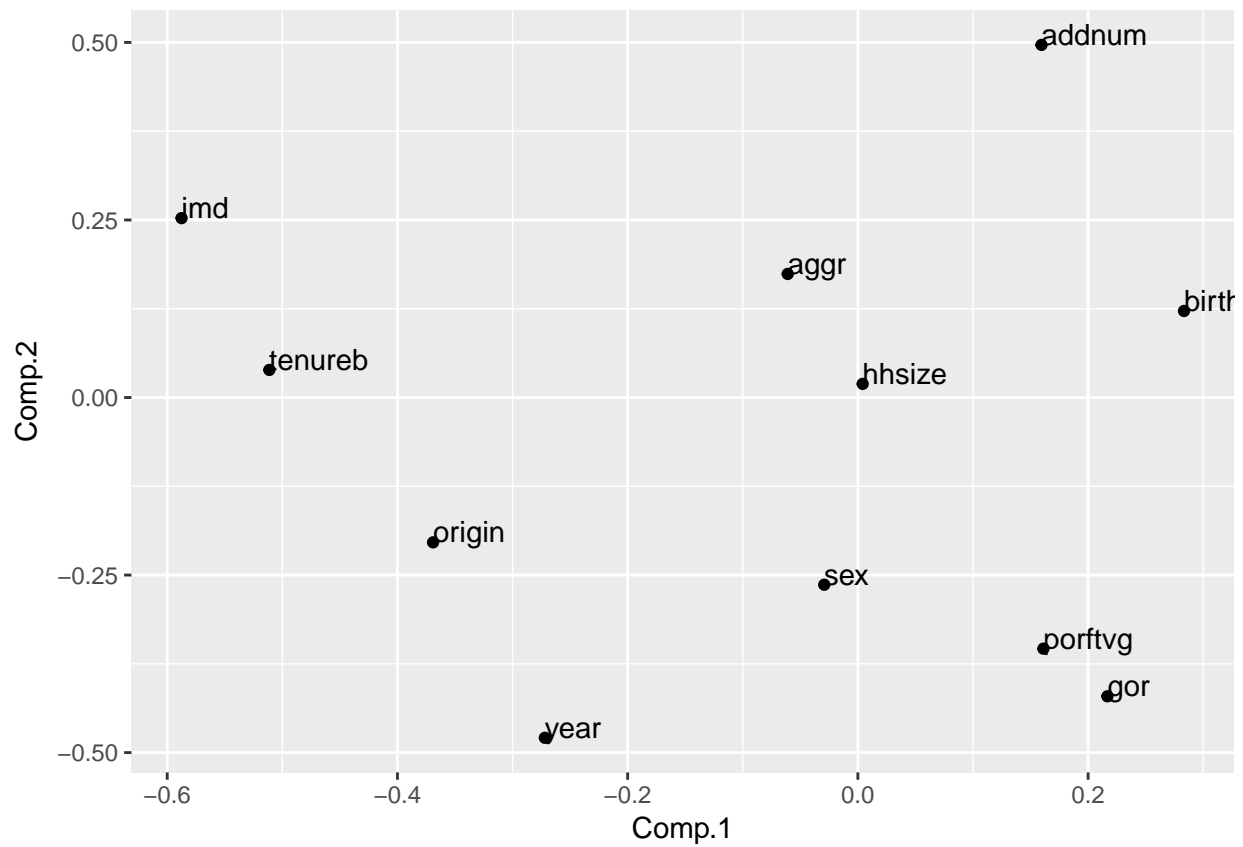
```
## Importance of components:
```

```
##               Comp.1    Comp.2    Comp.3    Comp.4    Comp.5
## Standard deviation    1.2782534 1.1556594 1.1172116 1.0615910 1.01619180
## Proportion of Variance 0.1485392 0.1214135 0.1134693 0.1024523 0.09387689
## Cumulative Proportion 0.1485392 0.2699528 0.3834220 0.4858743 0.57975120
##               Comp.6    Comp.7    Comp.8    Comp.9
## Standard deviation    0.97038590 0.92937644 0.91757061 0.8587035
## Proportion of Variance 0.08560444 0.07852187 0.07653962 0.0670338
## Cumulative Proportion 0.66535564 0.74387751 0.82041713 0.8874509
##               Comp.10   Comp.11
## Standard deviation    0.83451462 0.73595187
## Proportion of Variance 0.06331042 0.04923865
## Cumulative Proportion 0.95076135 1.00000000
```

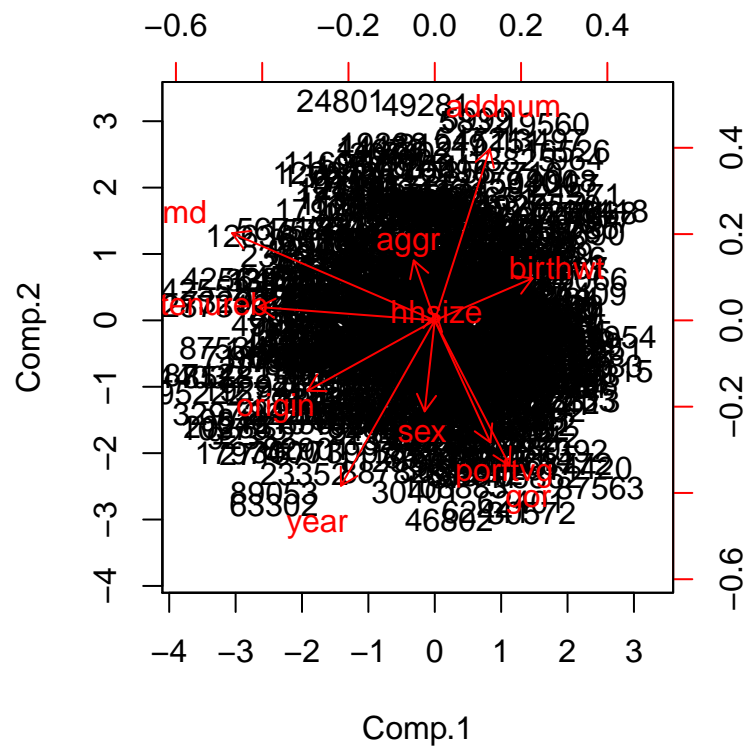
```
fviz_eig(pca)
```



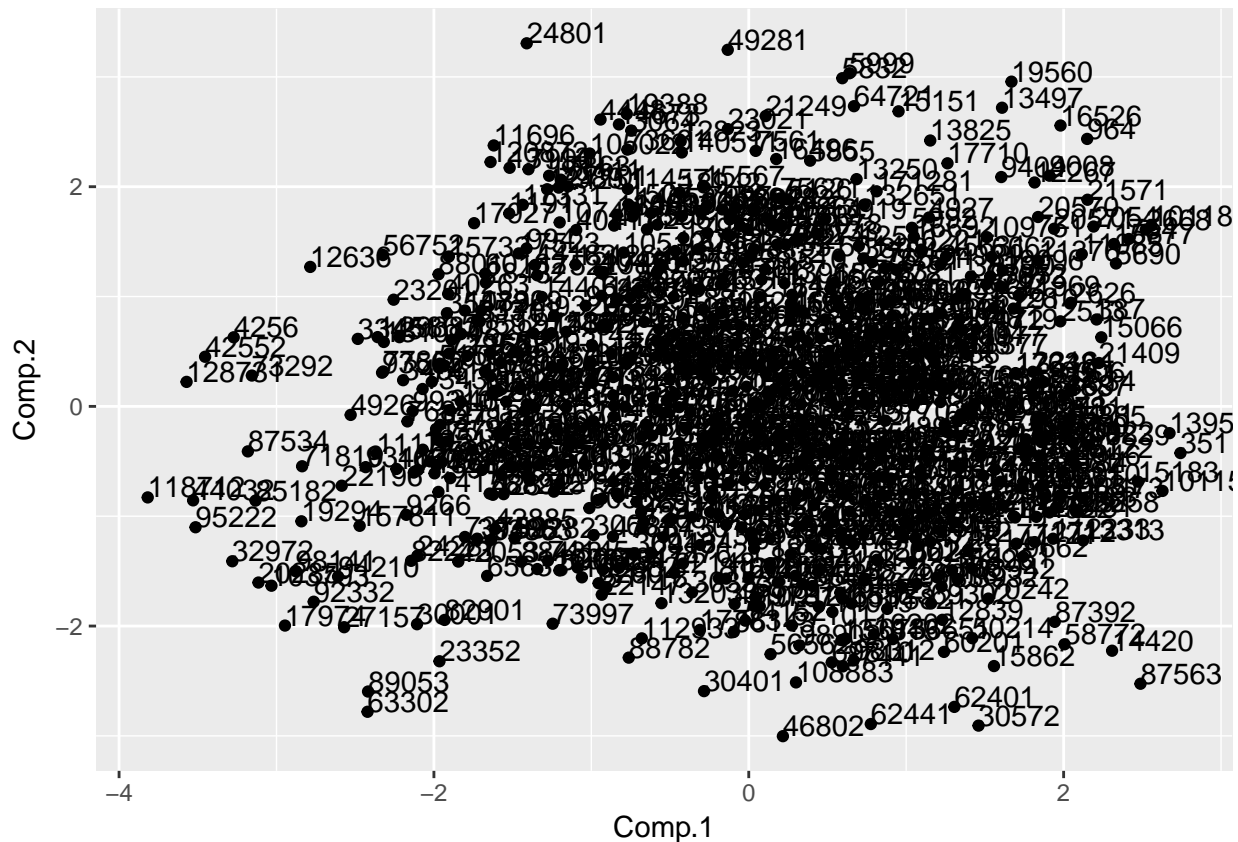
```
# Overall, it seems that we'll need two or three components to account for the variation in the data.  
  
# Variables' contribution to the principal components  
pca.df <- data.frame(pca$loadings[,1:2])  
ggplot(pca.df, aes(x = Comp.1, y = Comp.2)) + geom_point() + geom_text(aes(label=rownames(pca.df)), hjust=
```



```
# Dimension Reduction
biplot(pca, scale = 0)
```



```
prediction <- data.frame(predict(pca))
ggplot(prediction,aes(x = Comp.1, y = Comp.2)) + geom_point() + geom_text(aes(label=rownames(prediction)))
```



```
##### Correspondence Analysis (CORA) #####
```

```
cora <- ca(na.omit(hse.mk85))
summary(cora)
```

```
##
## Principal inertias (eigenvalues):
##
## dim    value      %   cum%   scree plot
## 1      0.115351  45.5  45.5   *****
## 2      0.055700  22.0  67.4   *****
## 3      0.027461  10.8  78.3   ***
## 4      0.016668   6.6  84.8   **
## 5      0.015196   6.0  90.8   *
## 6      0.007862   3.1  93.9   *
## 7      0.006129   2.4  96.3   *
## 8      0.003720   1.5  97.8
## 9      0.003405   1.3  99.1
## 10     0.002193   0.9 100.0
## -----
## Total: 0.253686 100.0
##
##
## Rows:
```


##	name	mass	qlt	inr	k=1	cor	ctr	k=2	cor	ctr
## 1	152	1	389	1	-312	301	1	-169	88	0
## 2	303	1	125	1	99	65	0	-95	60	0
## 3	609	1	72	1	40	10	0	-98	62	0
## 4	754	1	641	1	339	632	1	-39	8	0
## 5	994	1	50	1	-132	47	0	-37	4	0
## 6	1082	2	410	1	217	368	1	-74	43	0
## 7	1507	1	459	1	244	448	1	-39	11	0
## 8	1567	1	389	1	210	381	0	-30	8	0
## 9	1702	1	313	0	176	305	0	-30	9	0
## 10	2004	1	463	0	208	448	0	-38	15	0
## 11	2545	1	130	1	-89	55	0	-104	75	0
## 12	2752	1	401	1	235	386	1	-46	15	0
## 13	2910	1	142	1	-133	90	0	-102	53	0
## 14	2944	1	671	1	377	670	1	15	1	0
## 15	2984	2	467	1	220	449	1	-44	18	0
## 16	3064	1	168	1	167	160	0	-36	8	0
## 17	3212	1	291	0	74	79	0	120	211	0
## 18	3303	1	106	1	116	91	0	-48	15	0
## 19	3594	1	493	1	140	159	0	203	334	1
## 20	4022	1	155	1	163	150	0	-30	5	0
## 21	4062	1	524	1	254	523	1	6	0	0
## 22	4268	1	187	1	-196	140	0	-113	46	0
## 23	4388	1	544	2	-533	480	2	-196	65	0
## 24	4446	1	63	1	118	59	0	-28	3	0
## 25	4573	1	534	1	256	530	1	-25	5	0
## 26	4887	1	272	0	159	232	0	-67	41	0
## 27	4927	1	486	0	227	478	0	-30	8	0
## 28	5614	1	703	1	310	701	1	-15	2	0
## 29	5709	1	150	1	-96	42	0	-154	108	0
## 30	5818	1	631	2	-539	562	2	-189	69	1
## 31	5855	1	321	1	221	321	0	-8	0	0
## 32	5992	1	768	1	325	764	1	-25	4	0
## 33	6128	1	644	1	336	641	1	-21	3	0
## 34	6634	1	343	1	211	308	0	-72	35	0
## 35	6821	1	273	1	152	221	0	-74	52	0
## 36	7012	1	352	1	185	300	0	-77	52	0
## 37	7073	1	634	0	242	621	1	-36	14	0
## 38	7615	1	451	1	-309	378	1	-136	73	0
## 39	8065	1	523	2	-556	441	2	-240	82	1
## 40	8715	1	316	1	-190	201	0	-144	115	0
## 41	8730	1	783	1	305	779	1	-24	5	0
## 42	9048	1	578	1	328	578	1	6	0	0
## 43	9138	1	452	1	254	437	1	-47	15	0
## 44	9483	1	294	1	171	276	0	-44	18	0
## 45	9543	1	270	0	146	242	0	-50	29	0
## 46	9662	1	386	2	-351	282	1	-213	104	1
## 47	9764	1	90	1	75	47	0	-71	43	0
## 48	9788	1	258	1	193	255	0	-21	3	0
## 49	9958	1	156	1	-91	44	0	-145	112	0
## 50	1030	1	276	1	165	237	0	-67	38	0
## 51	1080	1	310	0	171	290	0	-45	20	0
## 52	11376	1	652	1	375	652	2	-6	0	0
## 53	11377	1	763	1	409	763	2	9	0	0

## 54		1141		1	461	2		-412	458	2		32	3	0	
## 55		1169		1	349	1		283	347	1		20	2	0	
## 56		11946		1	270	1		-213	162	0		-173	107	1	
## 57		1201		1	303	1		-283	256	1		-120	47	0	
## 58		12034		1	250	1		-206	158	0		-157	92	0	
## 59		12264		1	282	1		-205	185	0		-149	98	0	
## 60		1232		1	408	0		210	407	0		-9	1	0	
## 61		1251		1	748	0		258	748	1		-6	0	0	
## 62		1264		1	545	2		-541	456	2		-239	89	1	
## 63		1286		1	641	2		-544	561	2		-206	80	1	
## 64		1297		2	434	1		194	319	0		117	115	0	
## 65		1312		1	210	1		156	201	0		-34	9	0	
## 66		146		2	915	3		565	880	6		112	35	1	
## 67		274		1	126	1		-28	6	0		-120	119	0	
## 68		328		1	124	1		-18	2	0		-130	122	0	
## 69		351		2	744	2		442	738	3		-38	5	0	
## 70		387		2	890	3		591	890	6		6	0	0	
## 71		6221		2	919	3		588	917	6		29	2	0	
## 72		6512		1	614	1		-418	610	1		-33	4	0	
## 73		7241		1	802	1		307	801	1		-11	1	0	
## 74		825		2	752	1		330	749	2		-21	3	0	
## 75		920		1	159	0		-16	3	0		-119	156	0	
## 76		964		2	971	3		674	967	7		47	5	0	
## 77		1078		1	360	1		-456	341	1		-109	19	0	
## 78		1179		1	165	1		-80	42	0		-137	122	0	
## 79		1424		1	103	1		1	0	0		-111	103	0	
## 80		1463		2	884	2		415	814	3		121	69	0	
## 81		1749		1	74	1		-27	4	0		112	70	0	
## 82		1867		1	110	1		30	7	0		-121	104	0	
## 83		1912		2	560	1		326	509	1		104	51	0	
## 84		1935		2	185	1		145	157	0		62	28	0	
## 85		1936		2	189	1		152	158	0		68	31	0	
## 86		1946		2	771	1		335	708	2		100	63	0	
## 87		2054		2	784	2		488	783	3		-10	0	0	
## 88		2138		1	679	1		295	675	1		-23	4	0	
## 89		2302		2	881	2		469	880	3		18	1	0	
## 90		2480		2	896	4		662	887	7		68	9	0	
## 91		2506		2	781	1		374	775	2		-34	6	0	
## 92		2513		2	712	1		349	655	2		103	57	0	
## 93		2626		2	871	3		549	871	5		-1	0	0	
## 94		2668		2	927	3		600	914	6		72	13	0	
## 95		2729		1	343	1		-294	254	1		-174	89	1	
## 96		2738		1	107	0		-5	0	0		-99	107	0	
## 97		2751		1	693	0		252	682	1		-31	10	0	
## 98		2784		1	630	1		348	625	1		-29	4	0	
## 99		2796		1	424	1		-194	278	0		-141	146	0	
## 100		2819		1	158	0		90	91	0		-77	67	0	
## 101		3091		1	631	2		-500	521	2		-230	110	1	
## 102		3259		1	124	0		-24	8	0		-92	116	0	
## 103		3492		2	785	2		449	785	3		12	1	0	
## 104		3519		1	466	1		-304	372	1		-152	94	0	
## 105		3812		1	461	1		-329	334	1		-203	127	1	
## 106		4020		1	298	1		155	236	0		-80	62	0	
## 107		4206		2	906	2		482	859	4		112	46	0	

## 108		4233		1	455	1		-318	333	1		-192	122	1	
## 109		4234		1	319	1		-277	241	1		-157	78	0	
## 110		4341		1	552	2		-502	462	2		-221	89	1	
## 111		4448		1	215	1		225	213	0		18	1	0	
## 112		4928		2	966	4		701	958	9		65	8	0	
## 113		4942		1	660	1		-359	573	1		-140	86	0	
## 114		5126		2	690	1		306	612	1		109	78	0	
## 115		5411		1	132	1		-68	43	0		-98	89	0	
## 116		5690		2	931	3		617	931	6		19	1	0	
## 117		5832		2	961	3		637	954	6		56	7	0	
## 118		5936		1	882	1		422	881	2		15	1	0	
## 119		5999		2	977	4		692	971	9		54	6	0	
## 120		6103		1	67	1		16	2	0		-87	65	0	
## 121		6157		1	274	0		79	136	0		-80	138	0	
## 122		6430		2	846	1		405	846	2		-2	0	0	
## 123		6662		1	856	1		469	856	3		6	0	0	
## 124		7001		1	52	1		54	19	0		-71	33	0	
## 125		7366		2	922	2		495	872	5		118	50	1	
## 126		7561		2	952	3		642	947	7		48	5	0	
## 127		7562		2	953	3		613	950	6		38	4	0	
## 128		7989		1	495	1		241	493	1		-16	2	0	
## 129		7990		1	496	1		259	496	1		-7	0	0	
## 130		7992		1	653	1		337	653	1		-7	0	0	
## 131		7997		1	841	1		432	838	2		25	3	0	
## 132		8051		1	427	1		-389	384	1		-130	43	0	
## 133		8198		1	417	1		-239	346	0		-108	71	0	
## 134		8801		2	704	1		293	457	1		216	248	1	
## 135		8819		1	100	1		114	69	0		-76	31	0	
## 136		8936		1	377	1		-344	314	1		-154	63	0	
## 137		8990		1	521	1		-363	474	1		-114	47	0	
## 138		9008		1	901	2		509	899	3		23	2	0	
## 139		9111		2	714	1		368	714	2		2	0	0	
## 140		9404		2	900	3		624	896	6		44	4	0	
## 141		9718		1	500	2		-522	500	2		17	0	0	
## 142		9802		1	309	0		-109	142	0		-118	166	0	
## 143		10056		2	729	1		385	716	2		52	13	0	
## 144		10118		2	925	5		747	920	10		59	6	0	
## 145		1063		1	785	2		471	782	3		26	2	0	
## 146		1066		1	162	0		-66	52	0		96	110	0	
## 147		1108		2	872	3		570	872	5		4	0	0	
## 148		1136		1	617	1		-394	517	1		-173	100	0	
## 149		1145		2	750	1		313	666	1		111	84	0	
## 150		12086		1	100	1		-76	25	0		131	75	0	
## 151		12267		2	906	3		643	902	6		44	4	0	
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## 153		1271		1	482	2		-413	370	1		-227	112	1	
## 154		13113		1	8	1		-40	6	0		-23	2	0	
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## 162		1395		2	618	1		366	605	2		-56	14	0	
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## 184		1667		1	238	0		-138	186	0		-73	52	0	
## 185		1692		1	435	1		-303	302	1		-201	133	1	
## 186		1715		1	526	1		-283	405	1		-155	121	0	
## 187		17331		1	38	1		83	38	0		-12	1	0	
## 188		1745		1	93	0		-33	14	0		-80	79	0	
## 189		17522		2	906	3		471	726	4		234	179	2	
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## 191		1765		1	137	0		51	45	0		-73	92	0	
## 192		1771		2	950	3		606	946	6		39	4	0	
## 193		1781		1	318	1		-211	231	0		-129	87	0	
## 194		1786		1	183	1		157	182	0		-14	1	0	
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## 200		19031		1	160	1		-57	20	0		-153	140	0	
## 201		19035		1	96	1		34	7	0		-119	89	0	
## 202		1909		1	713	1		412	713	2		8	0	0	
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## 216	21120	1 461	1 -332 346	1 -191 115	1
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## 220	233	1 288	1 175 214	0 102 73	0
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## 224	10851	1 442	1 -174 265	0 -142 177	0
## 225	1282	2 758	2 438 757	3 16 1	0
## 226	1635	1 68	0 -69 35	0 -67 33	0
## 227	1731	1 189	1 -153 112	0 -128 77	0
## 228	2484	1 509	1 -263 392	1 144 117	0
## 229	2632	2 811	1 403 810	2 -9 0	0
## 230	3196	1 551	1 -438 538	2 -69 13	0
## 231	4416	1 594	1 248 584	1 -33 11	0
## 232	4563	1 755	1 273 748	1 -26 7	0
## 233	4600	1 166	0 61 52	0 -90 114	0
## 234	4626	1 731	1 -396 634	1 -155 97	0
## 235	4698	1 214	0 -16 7	0 88 207	0
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## 237	4976	1 846	1 372 846	2 1 0	0
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## 240	5274	1 264	1 -169 135	0 -165 129	1
## 241	5473	1 404	1 -201 245	0 -162 159	1
## 242	5894	1 666	1 -272 381	1 236 285	1
## 243	6248	1 405	1 176 341	0 -76 64	0
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## 245	6467	1 662	1 293 662	1 -4 0	0
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## 247	6801	1 351	1 -185 192	0 -168 158	1
## 248	6878	2 957	1 407 956	2 -11 1	0
## 249	7039	1 158	0 48 37	0 -88 122	0
## 250	7185	1 230	1 -135 90	0 -167 140	1
## 251	7411	1 123	1 -139 102	0 -63 21	0
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## 259	95021	1 153	0 -52 34	0 -98 119	0
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## 261	9754	1 665	1 331 649	1 -52 16	0
## 262	10510	1 30	1 29 5	0 -64 25	0
## 263	1067	1 375	0 -162 295	0 85 80	0
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## 267	12037	1 554	1 -282 432	1 150 122	0
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## 270		1296		1	238	0		56	66	0		-90	173	0	
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## 275		14053		1	81	1		116	77	0		-26	4	0	
## 276		1432		1	388	1		-389	353	1		-122	35	0	
## 277		5433		1	217	0		14	3	0		-124	215	0	
## 278		111		1	810	2		-596	716	3		216	94	1	
## 279		4185		1	94	1		-161	86	0		-51	9	0	
## 280		533		1	544	2		-510	473	2		-198	71	1	
## 281		585		2	764	1		352	748	2		-51	16	0	
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## 293		3466		2	971	3		36	3	0		662	968	15	
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## 298		4196		1	925	2		-171	83	0		546	843	8	
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## 309		6456		1	360	1		-143	160	0		-160	200	1	
## 310		6561		1	45	1		-15	1	0		-86	44	0	
## 311		66012		2	712	0		225	664	1		-61	48	0	
## 312		6746		1	616	2		-511	562	2		-158	54	0	
## 313		6830		1	762	1		340	753	1		-38	10	0	
## 314		6856		1	818	1		354	818	1		0	0	0	
## 315		6974		1	538	1		142	104	0		290	434	2	
## 316		7024		1	207	1		-161	198	0		34	9	0	
## 317		72653		1	804	1		309	792	1		-38	12	0	
## 318		7495		1	510	1		-268	363	1		-171	147	1	
## 319		7712		1	408	1		-200	227	0		-179	182	1	
## 320		7875		1	323	0		-63	84	0		-105	239	0	
## 321		8044		1	130	1		-149	88	0		-103	42	0	
## 322		8071		1	742	1		375	741	2		-12	1	0	
## 323		8464		1	151	0		-19	4	0		-111	147	0	

## 324		8571		1	722	1		292	716	1		-26	6	0	
## 325		9273		2	740	1		391	732	2		-40	8	0	
## 326		9407		1	102	0		-31	13	0		-81	88	0	
## 327		9581		2	844	1		404	844	2		0	0	0	
## 328		9585		2	910	1		462	910	3		5	0	0	
## 329		9814		2	954	7		-393	142	2		940	812	26	
## 330		9984		1	202	0		-63	53	0		-105	148	0	
## 331		10003		1	296	1		-209	187	0		-160	109	0	
## 332		10004		1	353	1		-214	226	0		-161	127	0	
## 333		10115		2	643	1		324	618	2		-66	26	0	
## 334		1081		1	497	0		-197	337	0		-135	160	0	
## 335		10823		1	821	2		-169	101	0		450	719	5	
## 336		1106		1	616	0		-211	413	0		-148	203	0	
## 337		11988		2	775	1		361	770	2		-31	6	0	
## 338		12087		1	584	1		378	583	2		16	1	0	
## 339		12092		2	816	1		410	815	2		7	0	0	
## 340		1225		2	876	1		393	876	2		-7	0	0	
## 341		12420		1	411	1		-130	174	0		-152	237	1	
## 342		1245		2	879	3		66	12	0		555	866	11	
## 343		1248		2	860	3		61	8	0		613	851	13	
## 344		1260		1	39	1		2	0	0		-76	39	0	
## 345		1284		1	156	1		-50	21	0		-126	135	0	
## 346		1287		2	884	5		39	2	0		810	882	20	
## 347		13106		2	728	2		431	725	2		-27	3	0	
## 348		1315		2	928	3		111	30	0		609	898	13	
## 349		1317		2	657	1		364	646	2		-47	11	0	
## 350		1318		1	159	1		14	2	0		-136	157	0	
## 351		1326		1	742	1		387	740	2		-16	1	0	
## 352		1339		1	857	1		301	841	1		-42	16	0	
## 353		13476		1	432	1		-211	323	0		-123	109	0	
## 354		13490		2	779	1		293	772	1		-28	7	0	
## 355		13781		1	922	6		-446	191	2		873	731	19	
## 356		13782		1	929	6		-446	183	2		902	746	20	
## 357		1396		1	84	1		98	68	0		-48	16	0	
## 358		1401		1	629	2		-528	519	2		-242	109	1	
## 359		1420		1	562	0		-206	392	0		-136	170	0	
## 360		14254		1	551	1		-218	352	0		-163	199	0	
## 361		1428		2	918	2		128	73	0		434	845	7	
## 362		1437		1	814	2		579	804	4		65	10	0	
## 363		1442		1	639	2		-574	510	3		-288	128	1	
## 364		1461		1	778	3		-390	238	1		588	540	7	
## 365		1465		1	720	2		-573	608	3		-246	112	1	
## 366		1471		2	941	1		423	940	2		-14	1	0	
## 367		1474		1	700	2		-527	573	2		-248	127	1	
## 368		1483		1	406	0		-106	173	0		-123	233	0	
## 369		1512		1	38	1		56	23	0		-44	15	0	
## 370		1519		1	346	1		-189	263	0		-106	83	0	
## 371		1530		2	777	1		324	756	2		-54	21	0	
## 372		1554		1	238	0		90	91	0		-113	146	0	
## 373		15567		1	622	1		290	621	1		-11	1	0	
## 374		1569		1	841	1		368	841	2		-6	0	0	
## 375		1571		1	142	0		57	38	0		-96	105	0	
## 376		1578		2	915	2		-185	86	0		573	828	9	
## 377		1581		1	593	1		285	575	1		-51	18	0	

## 378		1586		1	645	2		-583	530	3		-272	115	1	
## 379		1640		1	722	2		-571	633	2		-214	89	1	
## 380		1650		2	792	1		345	780	2		-43	12	0	
## 381		1669		2	536	1		223	485	1		-72	51	0	
## 382		1681		1	853	2		-156	86	0		465	767	6	
## 383		1683		2	514	1		212	429	1		-94	85	0	
## 384		1687		1	837	1		349	832	2		-29	6	0	
## 385		1707		1	157	0		3	0	0		-98	157	0	
## 386		1710		1	827	2		-565	712	3		-228	116	1	
## 387		1712		2	764	1		406	763	2		-14	1	0	
## 388		17332		1	370	0		148	308	0		-66	62	0	
## 389		1736		2	668	1		395	666	2		-18	1	0	
## 390		1753		1	197	1		97	85	0		-111	112	0	
## 391		1788		1	885	1		333	879	1		-26	5	0	
## 392		1792		2	669	1		355	669	2		7	0	0	
## 393		18154		1	784	1		353	783	1		9	1	0	
## 394		18155		1	793	1		338	793	1		3	0	0	
## 395		1817		1	304	0		115	178	0		-97	126	0	
## 396		1880		1	311	1		-236	217	1		-155	94	0	
## 397		18942		2	849	1		404	849	2		9	0	0	
## 398		18977		1	172	0		-60	39	0		-110	133	0	
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## 400		1900		1	672	1		391	671	2		-16	1	0	
## 401		1929		1	933	7		-701	337	5		932	596	20	
## 402		2037		1	745	1		374	745	2		4	0	0	
## 403		2040		2	916	1		317	901	1		-41	15	0	
## 404		2074		1	194	0		126	148	0		-70	46	0	
## 405		2081		1	825	1		-509	707	2		-208	118	1	
## 406		2095		2	780	1		352	770	2		-39	10	0	
## 407		2133		2	726	1		396	726	2		-5	0	0	
## 408		2136		2	845	1		283	760	1		95	85	0	
## 409		2140		2	704	1		327	678	2		-64	26	0	
## 410		2157		1	818	2		497	817	3		14	1	0	
## 411		2161		1	39	1		-21	4	0		-66	35	0	
## 412		21718		1	594	1		-500	533	2		-168	60	0	
## 413		21719		1	634	1		-498	579	2		-153	55	0	
## 414		2173		1	86	0		81	66	0		-44	20	0	
## 415		2187		1	832	3		-239	102	1		639	730	10	
## 416		2196		1	738	2		451	738	3		5	0	0	
## 417		22127		1	656	0		-240	562	1		98	94	0	
## 418		22128		1	627	0		-247	550	1		92	76	0	
## 419		22147		1	699	2		-528	591	2		-226	108	1	
## 420		22148		1	753	2		-526	630	2		-233	123	1	
## 421		2216		2	765	1		384	755	2		-43	10	0	
## 422		2225		2	424	1		214	353	1		-96	70	0	
## 423		2254		1	551	2		-507	506	2		-151	45	0	
## 424		1851		1	581	0		-212	410	0		-137	171	0	
## 425		2904		2	650	1		307	591	1		97	59	0	
## 426		4081		1	350	1		-161	227	0		-119	123	0	
## 427		4761		2	589	1		216	518	1		80	72	0	
## 428		4771		2	578	1		219	503	1		85	75	0	
## 429		4946		2	676	1		339	656	2		-60	20	0	
## 430		10451		2	878	1		78	34	0		389	844	5	
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## 432		1417		1	950	8		-509	186	3		1032	765	28	
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## 441		3068		1	759	1		-355	573	1		-203	187	1	
## 442		3290		1	380	1		-304	328	1		-122	53	0	
## 443		3574		1	450	1		261	430	1		-56	20	0	
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## 450		4532		2	832	2		111	64	0		384	768	5	
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## 454		5984		2	434	0		107	204	0		-114	230	0	
## 455		6016		1	319	1		199	303	0		-46	16	0	
## 456		6020		1	672	1		-409	508	2		-232	164	1	
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## 459		6256		2	893	1		387	890	2		-21	3	0	
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## 462		7103		2	956	2		33	3	0		569	953	11	
## 463		7217		1	604	1		-348	504	1		-155	100	0	
## 464		7512		1	400	1		-290	289	1		-180	111	1	
## 465		7513		1	451	1		-275	325	1		-171	126	1	
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## 467		7718		2	728	1		339	719	2		-38	9	0	
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## 473		9583		1	670	0		222	645	1		-44	25	0	
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## 475		1026		1	616	1		243	584	1		-56	31	0	
## 476		10394		1	819	2		-591	678	3		-270	141	1	
## 477		10502		2	760	2		475	759	3		15	1	0	
## 478		10829		1	679	1		-411	569	2		181	110	1	
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## 486		1247		1	609	1		-369	466	1		-204	143	1	
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## 500		1207		1	842	1		-317	614	1		-193	228	1	
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## 504		2534		1	571	1		-293	409	1		-184	162	1	
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## 508		3297		2	945	5		-344	137	2		834	808	20	
## 509		3547		1	597	2		-483	536	2		-163	61	0	
## 510		4129		1	780	1		-484	645	2		-221	134	1	
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## 515		4980		1	233	0		-53	51	0		-100	183	0	
## 516		5164		1	70	0		-11	1	0		-81	69	0	
## 517		5367		1	615	1		-336	510	1		-153	105	0	
## 518		5656		1	758	2		-254	148	1		515	610	7	
## 519		5889		1	599	1		-367	503	1		-160	96	0	
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## 521		6006		1	56	1		52	21	0		-66	34	0	
## 522		6127		1	75	0		-23	6	0		-77	69	0	
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## 524		7146		1	796	1		-326	604	1		-184	192	1	
## 525		7544		1	636	2		-604	552	3		-236	84	1	
## 526		7694		1	394	1		-148	163	0		-176	230	1	
## 527		8126		1	649	1		-307	449	1		-205	201	1	
## 528		8127		1	777	1		-322	540	1		-213	237	1	
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## 531		8333		1	378	0		-105	126	0		-148	252	0	
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## 540		9546		1	167	1		-137	110	0		-98	57	0	
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## 549		9421		2	867	3		-334	202	2		606	665	11	
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## 551		1582		1	843	2		-556	699	2		-252	144	1	
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## 584		7632		1	134	1		-59	28	0		-114	106	0	
## 585		7972		1	738	1		-293	330	1		326	408	3	
## 586		7973		1	651	1		-206	353	1		-189	297	1	
## 587		8039		1	787	1		-443	663	2		-192	124	1	
## 588		8165		1	195	0		-119	119	0		-95	76	0	
## 589		8222		1	897	4		-646	428	4		675	468	9	
## 590		8334		1	557	0		-131	240	0		-150	317	1	
## 591		8601		1	507	1		-205	352	0		-136	155	0	
## 592		8669		1	446	1		-353	372	1		-157	74	0	
## 593		8878		2	922	6		-317	123	1		809	799	20	

## 594		8896		1	309	1		-235	225	0		-143	83	0	
## 595		90481		1	703	1		-402	561	1		-203	142	1	
## 596		9233		1	922	3		-407	299	2		587	623	9	
## 597		9346		1	686	2		-476	639	2		130	48	0	
## 598		9811		1	319	1		-228	246	0		-124	72	0	
## 599		9871		1	627	1		-405	504	1		-200	123	1	
## 600		1003		1	78	1		-68	23	0		-103	55	0	
## 601		1027		1	724	1		-447	598	2		-205	126	1	
## 602		6038		1	196	0		-8	1	0		-116	195	0	
## 603		6761		1	455	0		-74	87	0		-151	368	1	
## 604		6931		1	178	1		-136	101	0		-119	77	0	
## 605		7181		1	966	11		-547	159	4		1230	807	40	
## 606		10501		1	889	3		-349	255	1		551	634	8	
## 607		10511		1	892	3		-344	229	1		586	663	8	
## 608		1055		1	233	1		-149	144	0		-116	88	0	
## 609		1089		1	439	2		-545	405	2		-157	34	0	
## 610		1524		1	808	1		-242	524	1		-178	284	1	
## 611		15675		1	800	1		-469	629	2		-245	172	1	
## 612		1705		1	652	1		-353	465	1		-223	186	1	
## 613		1780		1	187	1		-95	85	0		-104	101	0	
## 614		2028		2	958	6		-379	159	2		849	799	20	
## 615		2335		1	954	4		-719	646	6		497	308	6	
## 616		2514		1	532	1		-369	410	1		-202	122	1	
## 617		2601		1	195	0		-1	0	0		-136	195	0	
## 618		2715		2	961	5		-524	343	4		703	618	14	
## 619		3345		1	318	2		-398	284	1		-137	34	0	
## 620		3783		1	392	1		-278	313	1		-140	80	0	
## 621		4026		1	190	1		-211	146	0		-116	44	0	
## 622		4403		1	742	2		-370	441	2		306	301	2	
## 623		4680		1	800	3		-498	440	3		451	360	5	
## 624		4908		1	723	2		-554	637	2		-204	86	1	
## 625		5086		1	266	1		-139	136	0		-136	130	0	
## 626		55312		1	625	0		-150	296	0		-158	329	1	
## 627		6056		1	782	2		-518	772	3		61	11	0	
## 628		6070		1	875	2		-560	726	3		-253	149	1	
## 629		6124		1	434	2		-374	369	1		-156	65	0	
## 630		6159		1	163	1		-157	100	0		-124	62	0	
## 631		6240		1	797	2		-562	637	3		-282	160	1	
## 632		6244		1	709	2		-474	551	2		-254	158	1	
## 633		6280		1	571	0		-150	280	0		-153	291	1	
## 634		6552		1	684	2		-464	530	2		-250	154	1	
## 635		6653		1	743	2		-555	654	2		-205	89	1	
## 636		6730		1	915	4		-464	300	2		664	615	10	
## 637		6930		1	718	1		-373	539	1		-215	179	1	
## 638		7173		1	409	1		-311	332	1		-149	76	0	
## 639		72654		1	712	2		-610	627	3		-224	85	1	
## 640		7285		1	755	1		-365	584	1		-198	171	1	
## 641		7375		1	801	2		-570	777	3		99	23	0	
## 642		7603		1	651	1		-447	541	2		-201	109	1	
## 643		7626		1	763	1		-426	588	2		-232	175	1	
## 644		7785		1	470	2		-409	405	1		-164	65	0	
## 645		7918		1	492	1		-214	291	0		-178	201	1	
## 646		8346		1	239	1		-194	172	0		-121	67	0	
## 647		8355		1	66	1		80	37	0		-70	29	0	

## 648		8382		1	770	1		-406	596	2		-219	173	1	
## 649		8386		1	582	1		-302	413	1		-193	169	1	
## 650		8415		1	108	0		-1	0	0		-90	108	0	
## 651		8753		1	893	3		-485	371	3		575	522	8	
## 652		8905		1	945	4		-654	564	5		538	381	7	
## 653		8928		2	946	2		-335	298	2		493	647	7	
## 654		8999		1	380	1		-148	208	0		-134	172	0	
## 655		9000		1	298	1		-145	164	0		-131	133	0	
## 656		9112		1	313	1		-223	185	1		-186	128	1	
## 657		9203		1	109	1		-59	20	0		-123	88	0	
## 658		9642		1	535	1		-203	305	0		-176	230	1	
## 659		10057		1	462	1		-238	336	1		-146	126	0	
## 660		1016		1	543	1		-258	373	1		-175	171	1	
## 661		1025		1	355	1		-187	199	0		165	156	1	
## 662		1037		1	932	5		-702	482	6		678	449	11	
## 663		107492		1	148	1		-156	93	0		-120	55	0	
## 664		1091		1	865	2		-473	682	2		-244	182	1	
## 665		1255		1	163	1		41	15	0		-130	148	0	
## 666		108513		1	281	0		-19	6	0		-133	276	0	
## 667		1142		2	119	0		-48	71	0		-40	48	0	
## 668		1283		1	646	1		-383	489	1		-217	157	1	
## 669		1338		1	447	1		-275	406	1		87	40	0	
## 670		1689		1	271	1		-90	69	0		-155	202	1	
## 671		1793		1	648	2		-510	642	2		50	6	0	
## 672		1853		1	446	1		-315	444	1		18	1	0	
## 673		2073		1	146	1		32	9	0		-122	136	0	
## 674		2219		1	387	1		-238	374	1		-44	13	0	
## 675		2320		1	374	2		-370	322	1		-148	52	0	
## 676		2552		1	516	1		-254	328	1		-193	188	1	
## 677		3057		1	495	1		-240	277	1		-213	218	1	
## 678		30913		2	154	0		-17	13	0		-56	141	0	
## 679		3503		1	663	1		-282	659	1		-21	4	0	
## 680		3552		1	418	0		-127	179	0		-148	239	1	
## 681		3734		1	652	1		-424	652	2		-4	0	0	
## 682		3940		1	856	1		-427	834	2		69	22	0	
## 683		4134		1	107	1		40	18	0		90	90	0	
## 684		42054		1	120	1		77	58	0		-79	62	0	
## 685		4214		1	781	2		-514	649	2		-232	132	1	
## 686		4231		1	455	2		-510	403	2		-184	52	1	
## 687		4288		1	280	1		-180	279	0		9	1	0	
## 688		4407		1	370	1		-206	230	0		-161	140	1	
## 689		4524		1	499	2		-389	418	1		-171	80	1	
## 690		5059		1	45	1		47	15	0		-65	30	0	
## 691		5155		1	397	2		-372	347	1		-143	51	0	
## 692		5170		1	127	1		-107	65	0		-105	62	0	
## 693		5415		1	550	1		-217	329	1		-178	221	1	
## 694		5416		1	536	1		-222	321	1		-181	215	1	
## 695		5675		1	61	1		-98	35	0		-85	26	0	
## 696		5731		1	476	1		-290	358	1		-167	118	1	
## 697		5816		1	382	1		-201	382	0		2	0	0	
## 698		5824		1	620	1		-299	433	1		-197	187	1	
## 699		5891		1	300	1		180	263	0		-67	36	0	
## 700		5943		1	153	0		-24	7	0		-110	146	0	
## 701		6563		1	743	1		-372	565	1		-208	177	1	

## 702		7023		1	135	1		104	76	0		-91	59	0	
## 703		7081		1	786	2		-568	648	3		-262	138	1	
## 704		7164		1	243	1		-62	38	0		-146	206	1	
## 705		7165		1	373	0		-88	88	0		-158	285	1	
## 706		72954		1	154	0		48	28	0		-101	125	0	
## 707		7347		1	763	1		-435	763	2		3	0	0	
## 708		8241		2	133	1		95	68	0		92	65	0	
## 709		8552		1	399	0		-93	106	0		-155	293	1	
## 710		8553		1	456	0		-79	101	0		-148	355	1	
## 711		8762		2	510	0		-53	65	0		-139	445	1	
## 712		8843		2	203	0		-93	154	0		52	48	0	
## 713		8978		1	442	1		-205	438	0		20	4	0	
## 714		9143		1	720	2		-624	697	3		113	23	0	
## 715		9189		1	749	2		-528	697	2		145	52	0	
## 716		9324		1	280	0		-31	13	0		-140	267	1	
## 717		93253		1	145	1		-6	0	0		-126	145	0	
## 718		93504		2	178	0		29	14	0		101	164	0	
## 719		9428		2	26	0		3	0	0		-38	26	0	
## 720		9437		1	533	0		-145	234	0		-164	299	1	
## 721		9632		1	188	1		-92	62	0		-131	126	0	
## 722		9635		1	277	0		-81	86	0		-121	192	0	
## 723		9831		1	753	1		-381	540	2		-239	213	1	
## 724		9880		1	525	1		-261	522	1		21	3	0	
## 725		9881		1	647	1		-270	646	1		11	1	0	
## 726		9890		1	777	2		-568	636	3		-267	141	1	
## 727		1001		1	394	1		-306	323	1		-143	70	0	
## 728		9266		1	780	1		-452	647	2		-205	133	1	
## 729		7810		2	603	1		267	581	1		-52	22	0	
## 730		6021		1	587	1		-195	324	0		-176	264	1	
## 731		66015		2	526	1		240	470	1		83	56	0	
## 732		9931		1	589	2		-470	586	2		33	3	0	
## 733		1117		1	292	1		-155	173	0		-129	119	0	
## 734		1214		1	348	0		-111	143	0		-133	206	0	
## 735		13101		2	476	1		188	446	1		49	30	0	
## 736		1963		2	356	1		233	311	1		-88	44	0	
## 737		2425		2	577	1		318	568	2		-38	8	0	
## 738		2428		1	766	1		-447	637	2		-201	129	1	
## 739		30002		2	686	0		-156	331	0		-162	355	1	
## 740		3035		1	862	2		-502	859	3		28	3	0	
## 741		3040		1	658	2		-538	527	3		-268	131	1	
## 742		3195		1	498	0		-118	175	0		-161	323	1	
## 743		3232		2	582	1		294	562	1		55	20	0	
## 744		3271		2	406	1		187	363	1		-64	43	0	
## 745		3728		1	607	1		-329	484	1		-166	123	1	
## 746		4308		1	636	1		-190	336	0		-180	299	1	
## 747		4411		1	216	1		-126	93	0		-145	122	0	
## 748		4521		2	679	1		293	636	1		-76	43	0	
## 749		5111		1	870	2		-569	733	3		-246	137	1	
## 750		5875		2	656	1		315	646	2		-39	10	0	
## 751		5974		2	452	1		287	444	1		-39	8	0	
## 752		6446		1	717	2		-531	611	3		-221	106	1	
## 753		6586		2	363	1		222	321	1		-80	41	0	
## 754		6724		1	502	1		-173	284	0		-152	219	1	
## 755		7066		1	606	2		-518	531	2		-196	76	1	

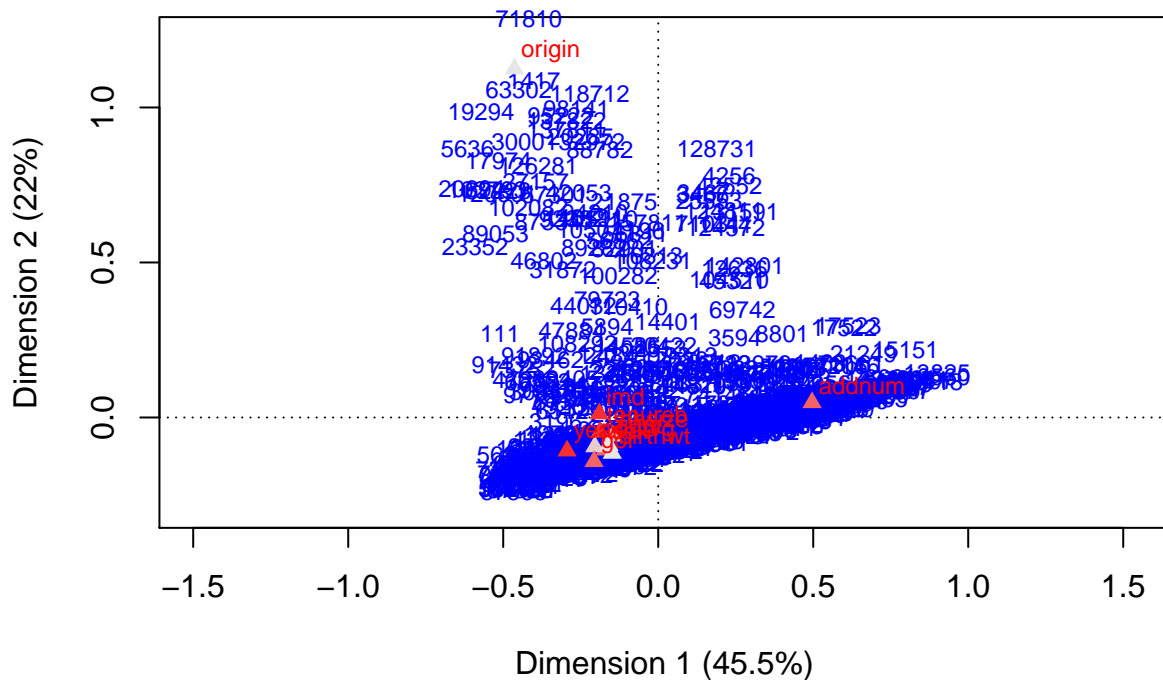
```
## 756 | 72955 | 1 87 1 | -4 0 0 | -93 86 0 |
## 757 | 7317 | 2 224 1 | 126 124 0 | -113 100 0 |
## 758 | 7329 | 1 56 1 | -67 22 0 | -84 34 0 |
## 759 | 7399 | 1 700 0 | -239 697 1 | -15 3 0 |
## 760 | 7414 | 2 141 0 | 63 130 0 | 18 11 0 |
## 761 | 7535 | 1 363 1 | -281 289 1 | -143 74 0 |
## 762 | 7559 | 2 284 1 | 149 212 0 | -87 73 0 |
## 763 | 7684 | 1 411 1 | -180 309 0 | 104 102 0 |
## 764 | 7844 | 1 544 1 | -322 368 1 | -222 176 1 |
## 765 | 8518 | 1 444 1 | -329 436 1 | 43 8 0 |
## 766 | 8614 | 1 729 2 | -571 608 3 | -255 121 1 |
## 767 | 9251 | 2 399 1 | 159 279 0 | -105 120 0 |
## 768 | 9602 | 2 530 1 | 279 503 1 | -64 26 0 |
## 769 | 10114 | 1 529 1 | -300 389 1 | -180 140 1 |
## 770 | 1041 | 1 208 1 | 203 201 1 | -39 7 0 |
## 771 | 108883 | 2 387 1 | -182 382 0 | -19 4 0 |
## 772 | 1129 | 1 809 1 | -320 565 1 | -210 244 1 |
## 773 | 11632 | 2 361 1 | 253 329 1 | -79 32 0 |
## 774 | 11638 | 1 695 1 | -357 517 1 | -209 177 1 |
## 775 | 1235 | 2 486 1 | 233 450 1 | -66 36 0 |
## 776 | 1300 | 2 355 1 | 176 269 0 | -100 87 0 |
## 777 | 1301 | 2 262 1 | 155 231 0 | 56 30 0 |
## 778 | 132033 | 1 650 1 | -371 647 2 | -26 3 0 |
## 779 | 1322 | 2 571 1 | 281 556 1 | -46 15 0 |
## 780 | 1343 | 1 84 1 | -10 1 0 | -95 83 0 |
## 781 | 1359 | 1 156 1 | -107 66 0 | -125 90 0 |
```

```
##
```

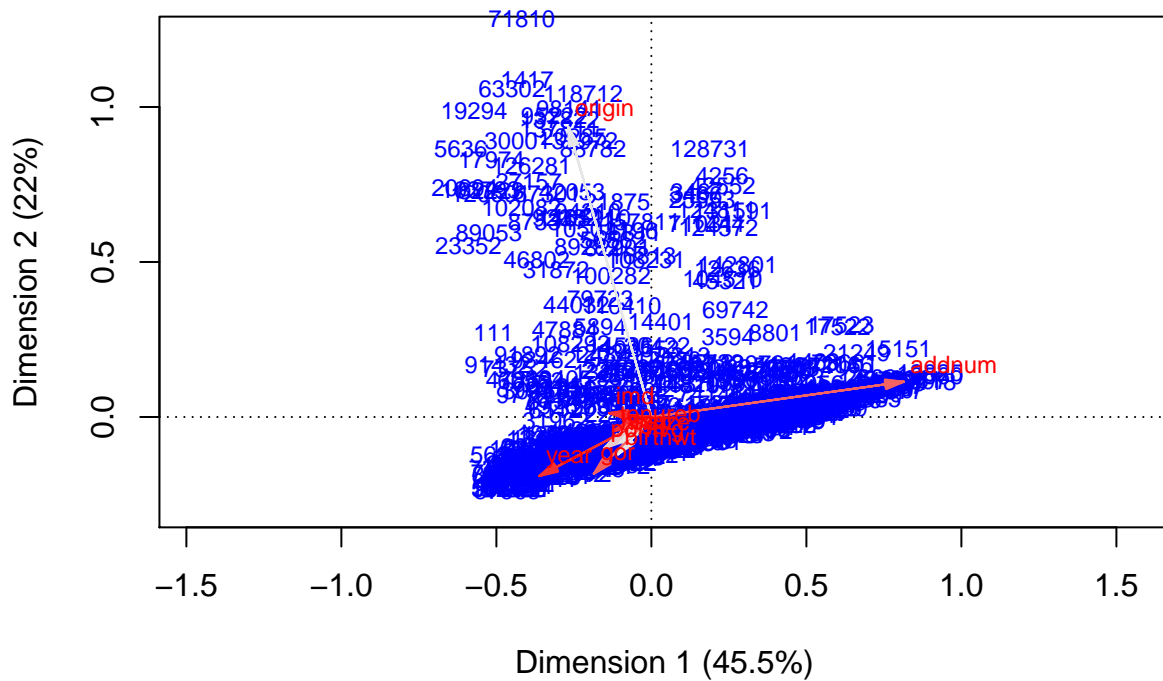
```
## Columns:
```

```
##      name  mass  qlt  inr      k=1 cor ctr      k=2 cor ctr
## 1 | sex | 27 236 18 | -171 172 7 | -104 64 5 |
## 2 | tnrb | 50 194 38 | -188 182 15 | -47 11 2 |
## 3 | orgn | 38 994 226 | -464 144 72 | 1125 850 873 |
## 4 | hhsz | 76 249 30 | -147 214 14 | -60 35 5 |
## 5 | addn | 311 998 305 | 496 988 664 | 48 9 13 |
## 6 | imd | 59 146 57 | -190 146 18 | 12 1 0 |
## 7 | brth | 61 376 22 | -148 235 12 | -115 141 14 |
## 8 | prft | 64 185 69 | -205 153 23 | -94 32 10 |
## 9 | gor | 93 219 105 | -207 149 35 | -142 70 34 |
## 10 | year | 174 606 111 | -294 534 130 | -108 72 36 |
## 11 | aggr | 47 357 17 | -159 270 10 | -90 87 7 |
```

```
plot(cora, contrib = "absolute")
```



```
plot(cora, mass = TRUE, contrib = "absolute", map = "rowgreen", arrows = c(FALSE, TRUE))
```



```
# The first dimension explains 45.5% of the inertia.
# The 2nd dimension explains a further 22%.
# The first two dimensions seem to explain much of the data.
```


Part 4/4: The Effect of Urban Deprivation – Propensity Analysis

```
##### Propensity Analysis #####

# Covert the ordinal scale of treatment variable (imd) to binary scale
hse.mk90 <- hse.mk60

hse.mk90$imd <- ifelse(hse.mk90$imd == 1, 1,
                      ifelse(hse.mk90$imd == 5, 0, NA))
table(hse.mk90$imd)

##
##      0      1
## 1830 2097

hse.mk90 <- hse.mk90[complete.cases(hse.mk90), ]

# Compute the Propensity scores
reg <- glm(imd ~ sex + tenureb + origin + hhsize + addnum + birthwt + porftvg + gor + aggr + year + hyper,
           family=binomial, data=hse.mk90)
hse.mk90$fit.value <- fitted.values(reg)

# Propensity Scores Matching & Average Treatment Effect on Treated
set.seed(11)
matching.vars <- cbind(hse.mk90$fit.value)
psm <- Match(Y=hse.mk90$hyper, Tr=hse.mk90$imd, X=matching.vars, Weight = 2, ties = F)
summary.Match(psm)

##
## Estimate... 0.018598
## SE..... 0.0075139
## T-stat..... 2.4751
## p.val..... 0.013319
##
## Original number of observations..... 3927
## Original number of treated obs..... 2097
## Matched number of observations..... 2097
## Matched number of observations (unweighted). 2097

# 1 -- Estimate effect of deprivation on hypertension (significant)
# Balance test
MatchBalance(imd ~ sex + tenureb + origin + hhsize + addnum + birthwt + porftvg + gor + aggr + year,
             match.out=psm, data=hse.mk90)

##
## ***** (V1) sex *****
##
##          Before Matching      After Matching
## mean treatment.....      1.4831      1.4831
## mean control.....      1.4956      1.4649
## std mean diff.....     -2.5123      3.6254
##
## mean raw eQQ diff..... 0.012568      0.018121
## med raw eQQ diff.....      0      0
```

```

## max raw eQQ diff..... 1 1
##
## mean eCDF diff..... 0.0062787 0.0090606
## med eCDF diff..... 0.0062787 0.0090606
## max eCDF diff..... 0.012557 0.018121
##
## var ratio (Tr/Co)..... 0.99886 1.0038
## T-test p-value..... 0.43243 0.24
##
##
## ***** (V2) tenureb *****
## Before Matching After Matching
## mean treatment..... 2.1497 2.1497
## mean control..... 3.1869 2.0482
## std mean diff..... -128.24 12.559
##
## mean raw eQQ diff..... 1.0377 0.14354
## med raw eQQ diff..... 1 0
## max raw eQQ diff..... 2 2
##
## mean eCDF diff..... 0.17286 0.028708
## med eCDF diff..... 0.031363 0.0090606
## max eCDF diff..... 0.49059 0.11683
##
## var ratio (Tr/Co)..... 0.5675 0.816
## T-test p-value..... < 2.22e-16 5.8512e-08
## KS Bootstrap p-value.. < 2.22e-16 < 2.22e-16
## KS Naive p-value..... < 2.22e-16 7.4074e-13
## KS Statistic..... 0.49059 0.11683
##
##
## ***** (V3) origin *****
## Before Matching After Matching
## mean treatment..... 1.5131 1.5131
## mean control..... 2.8087 1.7787
## std mean diff..... -67.155 -13.767
##
## mean raw eQQ diff..... 1.2984 0.28755
## med raw eQQ diff..... 0 0
## max raw eQQ diff..... 9 2
##
## mean eCDF diff..... 0.076049 0.016859
## med eCDF diff..... 0.079276 0.003815
## max eCDF diff..... 0.21319 0.12732
##
## var ratio (Tr/Co)..... 0.28059 0.87491
## T-test p-value..... < 2.22e-16 2.3668e-06
## KS Bootstrap p-value.. < 2.22e-16 < 2.22e-16
## KS Naive p-value..... < 2.22e-16 3.4417e-15
## KS Statistic..... 0.21319 0.12732
##
##
## ***** (V4) hhsize *****
## Before Matching After Matching

```

```

## mean treatment.....      4.0877      4.0877
## mean control.....        4.1743      4.1149
## std mean diff.....      -9.7108      -3.049
##
## mean raw eQQ diff.....    0.40546    0.19504
## med  raw eQQ diff.....      0          0
## max  raw eQQ diff.....      2          3
##
## mean eCDF diff.....       0.040475    0.021671
## med  eCDF diff.....       0.028262    0.015737
## max  eCDF diff.....       0.10353     0.065808
##
## var ratio (Tr/Co).....    0.45237     0.55952
## T-test p-value.....       0.018052     0.40808
## KS Bootstrap p-value.. < 2.22e-16    < 2.22e-16
## KS Naive p-value.....     1.5955e-09    0.00022749
## KS Statistic.....         0.10353     0.065808
##
##
## ***** (V5) addnum *****
##                               Before Matching    After Matching
## mean treatment.....         16.147         16.147
## mean control.....           16.685         16.417
## std mean diff.....         -4.5391         -2.28
##
## mean raw eQQ diff.....      0.62459         0.79542
## med  raw eQQ diff.....        0             1
## max  raw eQQ diff.....        5             8
##
## mean eCDF diff.....         0.014179        0.015794
## med  eCDF diff.....         0.013992        0.015498
## max  eCDF diff.....         0.037979        0.044826
##
## var ratio (Tr/Co).....      0.97447         1.0978
## T-test p-value.....         0.15888         0.45047
## KS Bootstrap p-value..       0.064          0.028
## KS Naive p-value.....       0.11931        0.029585
## KS Statistic.....          0.037979        0.044826
##
##
## ***** (V6) birthwt *****
##                               Before Matching    After Matching
## mean treatment.....         3.4064         3.4064
## mean control.....           3.2368         3.3824
## std mean diff.....         28.26          4.0128
##
## mean raw eQQ diff.....      0.16895         0.076757
## med  raw eQQ diff.....       0.17           0.06
## max  raw eQQ diff.....       0.61           0.7
##
## mean eCDF diff.....         0.055606        0.022989
## med  eCDF diff.....         0.051557        0.018121
## max  eCDF diff.....         0.1313         0.073915
##

```

```

## var ratio (Tr/Co)..... 0.92313          0.98438
## T-test p-value..... < 2.22e-16          0.19158
## KS Bootstrap p-value.. < 2.22e-16          < 2.22e-16
## KS Naive p-value..... 4.6629e-15          2.1154e-05
## KS Statistic..... 0.1313          0.073915
##
##
## ***** (V7) porftvg *****
##                               Before Matching      After Matching
## mean treatment..... 3.7492          3.7492
## mean control..... 3.2437          3.6371
## std mean diff..... 31.067          6.888
##
## mean raw eQQ diff..... 0.50437          0.11874
## med raw eQQ diff..... 0          0
## max raw eQQ diff..... 2          1
##
## mean eCDF diff..... 0.072207          0.016963
## med eCDF diff..... 0.064757          0.01526
## max eCDF diff..... 0.116          0.047687
##
## var ratio (Tr/Co)..... 0.87716          1.0186
## T-test p-value..... < 2.22e-16          0.020721
## KS Bootstrap p-value.. < 2.22e-16          0.002
## KS Naive p-value..... 7.5787e-12          0.016983
## KS Statistic..... 0.116          0.047687
##
##
## ***** (V8) gor *****
##                               Before Matching      After Matching
## mean treatment..... 5.825          5.825
## mean control..... 4.0792          5.7129
## std mean diff..... 69.839          4.4831
##
## mean raw eQQ diff..... 1.7443          0.23891
## med raw eQQ diff..... 2          0
## max raw eQQ diff..... 3          1
##
## mean eCDF diff..... 0.19397          0.026546
## med eCDF diff..... 0.22449          0.019075
## max eCDF diff..... 0.30776          0.07773
##
## var ratio (Tr/Co)..... 1.0481          1.031
## T-test p-value..... < 2.22e-16          0.057349
## KS Bootstrap p-value.. < 2.22e-16          < 2.22e-16
## KS Naive p-value..... < 2.22e-16          6.2881e-06
## KS Statistic..... 0.30776          0.07773
##
##
## ***** (V9) aggr *****
##                               Before Matching      After Matching
## mean treatment..... 2.4902          2.4902
## mean control..... 2.4672          2.4912
## std mean diff..... 4.602          -0.19074

```

```

##
## mean raw eQQ diff..... 0.022951      0.00095374
## med  raw eQQ diff.....      0              0
## max  raw eQQ diff.....      1              1
##
## mean eCDF diff..... 0.011506      0.00047687
## med  eCDF diff..... 0.011506      0.00047687
## max  eCDF diff..... 0.023011      0.00095374
##
## var ratio (Tr/Co)..... 1.0039      0.99993
## T-test p-value..... 0.14993      0.95084
##
##
## ***** (V10) year *****
##               Before Matching      After Matching
## mean treatment..... 9.5031      9.5031
## mean control..... 9.7022      9.609
## std mean diff..... -6.1378      -3.2638
##
## mean raw eQQ diff..... 0.20164      0.38817
## med  raw eQQ diff.....      0              0
## max  raw eQQ diff.....      2              2
##
## mean eCDF diff..... 0.018896      0.034812
## med  eCDF diff..... 0.018954      0.028135
## max  eCDF diff..... 0.037739      0.086314
##
## var ratio (Tr/Co)..... 0.95043      0.86366
## T-test p-value..... 0.058498      0.31015
## KS Bootstrap p-value.. 0.038      < 2.22e-16
## KS Naive p-value..... 0.1236      3.282e-07
## KS Statistic..... 0.037739      0.086314
##
##
## Before Matching Minimum p.value: < 2.22e-16
## Variable Name(s): tenureb origin hhsize birthwt porftvg gor Number(s): 2 3 4 6 7 8
##
## After Matching Minimum p.value: < 2.22e-16
## Variable Name(s): tenureb origin hhsize birthwt gor year Number(s): 2 3 4 6 8 10
##
# Regression with a matched dataset
# Create a new dataset after matching
hse.mk.FX <- rbind(hse.mk90[psm$index.control,],hse.mk90[psm$index.treated,])
summary(lm(hyper ~ imd,data=hse.mk.FX))

##
## Call:
## lm(formula = hyper ~ imd, data = hse.mk.FX)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.07058 -0.07058 -0.05198 -0.05198  0.94802
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)

```

```
## (Intercept) 0.051979 0.005235 9.930 <2e-16 ***
## imd 0.018598 0.007403 2.512 0.012 *
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2397 on 4192 degrees of freedom
## Multiple R-squared: 0.001503, Adjusted R-squared: 0.001265
## F-statistic: 6.311 on 1 and 4192 DF, p-value: 0.01204

# 2 -- Balance our datasets for more accurate measure & conduct regression analysis
# Estimate effect of deprivation on hypertension (significant)

summary(lm(hyper ~ imd + sex + tenureb + origin + hhsize + addnum + birthwt + porftvg + gor + aggr + year, data = hse.mk.FX))

##
## Call:
## lm(formula = hyper ~ imd + sex + tenureb + origin + hhsize +
## addnum + birthwt + porftvg + gor + aggr + year, data = hse.mk.FX)
##
## Residuals:
## Min 1Q Median 3Q Max
## -0.15217 -0.07680 -0.05710 -0.03777 0.99000
##
## Coefficients:
## Estimate Std. Error t value Pr(>|t|)
## (Intercept) 0.0741306 0.0386723 1.917 0.05532 .
## imd 0.0182801 0.0074174 2.464 0.01376 *
## sex -0.0064419 0.0074358 -0.866 0.38635
## tenureb 0.0165997 0.0043746 3.795 0.00015 ***
## origin -0.0001792 0.0018568 -0.096 0.92314
## hhsize -0.0011908 0.0035517 -0.335 0.73744
## addnum 0.0005219 0.0003337 1.564 0.11787
## birthwt -0.0032394 0.0061842 -0.524 0.60044
## porftvg -0.0016013 0.0022934 -0.698 0.48509
## gor -0.0075311 0.0015073 -4.997 6.07e-07 ***
## aggr 0.0006887 0.0074212 0.093 0.92607
## year 0.0008354 0.0011428 0.731 0.46483
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2388 on 4182 degrees of freedom
## Multiple R-squared: 0.01133, Adjusted R-squared: 0.008727
## F-statistic: 4.356 on 11 and 4182 DF, p-value: 1.619e-06

# 3 -- However, if we control other variables, deprivation is not very important predictors
# but still significant in explaining hypertension disparities between urban and rural areas
```