Temporal Crime Trends at the Johns Hopkins East Baltimore Campus

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October 23, 2017

Load Necessary Libraries

```r
packages<-c("lubridate", "dplyr","ggplot2","reshape2", "xtable", "magrittr", "chron", "cowplot")

for (i in packages){
  if(!require(i,character.only = T,quietly=T,warn.conflicts = F)){
    install.packages(i)
  }
  require(i,character.only = T,quietly=T,warn.conflicts = F)
}
```

```
## Warning: package 'dplyr' was built under R version 3.3.2
```

```
## Warning: package 'ggplot2' was built under R version 3.3.2
```

```
## Warning: package 'chron' was built under R version 3.3.2
```

```
## Warning: package 'cowplot' was built under R version 3.3.2
```

```r
library(lubridate)
library(dplyr)
library(ggplot2)
library(reshape2)
library(xtable)
library(magrittr)
library(chron)
library(cowplot)
```

Inport data and look at structure of data

Data from Johns Hopkins University Clery Compliance Administrator after conversion to CSV formats.

```r
setwd("./data")
dat.15 <- read.csv("2015crimelog.csv", stringsAsFactor = FALSE)
dat.16 <- read.csv("2016crimelog.csv", stringsAsFactor = FALSE)
dat.17 <- read.csv("2017crimelog.csv", stringsAsFactor = FALSE)

str(dat.15)
```

```
## 'data.frame':    288 obs. of  6 variables:
##  $ Crime            : chr  "Assault" "Assault" "Assault" "Assault" ...
##  $ Case.Number      : chr  "1501M-0095" "1501M-0855" "1501M-1318" "1501M-1796" ...
##  $ Date.Time.Reported: chr  "1/1/15" "1/4/15" "1/6/15" "1/8/15" ...
##  $ Date.Time.Occurred: chr  "1/1/15 7:50 AM" "1/4/15 7:44 PM" "1/6/15 2:43 PM" "1/7/15 3:50 PM" ...
##  $ General.Location : chr  "Meyer Bldg" "Bloomberg Childrens Center 12th Floor" "Zayed Tower 12th Fl
##  $ Disposition      : chr  "Closed-Investigation" "Closed-Investigation" "Closed-Investigation" "Cl
```

```r
str(dat.16)
```

```
## 'data.frame':    333 obs. of  6 variables:
##  $ Crime             : chr  "Disorderly Conduct" "Theft" "Theft" "Theft" ...
##  $ Case.Number       : chr  "IN20160000005" "IN20160000032" "IN20160000039" "IN20160000042" ...
##  $ Date.Time.Reported: chr  "1/4/16 1:20 AM" "1/7/16 5:10 PM" "1/9/16 11:40 AM" "1/10/16 3:00 PM" ..
##  $ Date.Time.Occurred: chr  "1/4/16 1:20 AM" "1/7/16 5:10 PM" "1/9/16 11:19 AM" "1/10/16 2:50 PM" ..
##  $ General.Location  : chr  "200 block Wolfe St" "Weinberg Building 3rd floor" "Nelson/Harvey Buildi
##  $ Disposition       : chr  "Closed-No Further Action" "Closed-No Suspects or\nWitnesses" "Closed-Re
```

```r
str(dat.17)
```

```
## 'data.frame':    291 obs. of  6 variables:
##  $ Crime             : chr  "Auto Theft" "Aggravated Assault" "Theft" "Theft" ...
##  $ Case.Number       : chr  "IN20170000007" "IN20170000011" "IN20170000016" "IN20170000024" ...
##  $ Date.Time.Reported: chr  "1/1/17 11:02 PM" "1/2/17 12:30 PM" "1/3/17 8:20 AM" "1/4/17 8:25 AM" ..
##  $ Date.Time.Occurred: chr  "1/1/17 11:02 PM" "1/2/17 12:30 PM" "12/23/16 11:30 AM -\n1/3/17 8:20 AM
##  $ General.Location  : chr  "1920 Orleans Street" "Nelson Building 8th floor" "CMSC Building 1st flo
##  $ Disposition       : chr  "Closed-Referred to BPD" "Closed-Subject Arrested" "Closed-No Suspects o
```

Crime categories in different years

```r
unique(dat.15$Crime)
```

```
##  [1] "Assault"           "Theft"             "Forgery"
##  [4] "Vandalism"         "Trespassing"       "Sex Offense"
##  [7] "Drug Violation"    "Weapons Violation" "Aggravated Assault"
## [10] "Theft From Vehicle" "Bomb Threat"      "Auto Theft"
## [13] "Hate Crime"        ""
```

```r
unique(dat.16$Crime)
```

```
##  [1] "Disorderly Conduct"        "Theft"
##  [3] "Auto Theft"                "Assault"
##  [5] "Weapons Violation"         "Robbery"
##  [7] "Vandalism"                 "Drug Violation"
##  [9] "Rape"                      "Theft from Auto"
## [11] "CDS Violation"             "Arson"
## [13] "Trespassing"               "Bomb Threat"
## [15] "Burglary"                  "Aggravated Assault"
## [17] "Sex Offense"               "Stalking"
## [19] "Theft of Auto\n(Attempted)" "Homicide/Aggravated\nAssault"
## [21] "Assault/Domestic Violence" "Forgery"
## [23] "21"                        ""
```

```r
unique(dat.17$Crime)
```

```
##  [1] "Auto Theft"
##  [2] "Aggravated Assault"
##  [3] "Theft"
##  [4] "Robbery"
##  [5] "Theft from Auto"
##  [6] "Vandalism"
##  [7] "Trespassing"
##  [8] "Disorderly Conduct"
```

```
##  [9] "Assault"
## [10] "Assault/Domestic Violence"
## [11] "Bomb Threat"
## [12] "Domestic Violence"
## [13] "Aggravated Assault/\nDomestic Violence"
## [14] "Drug Violation"
## [15] "Assault/Hate Crime"
## [16] "Stalking"
## [17] "Fondling"
## [18] "CDS Violation"
## [19] "Forgery"
## [20] "Armed Robbery\n(Attempted)"
## [21] "Burglary"
## [22] "Fraud"
## [23] "Destruction of Property"
## [24] "Tampering"
## [25] "Assault (Domestic)"
## [26] "Assault by Threat"
## [27] "Information Only"
## [28] "Weapons Violation"
## [29] "Theft from Auto;\nDestruction of Property"
## [30] "18"
## [31] ""
```

Clean data

```r
# remove blank entries
dat.15 <- dat.15[!dat.15$Crime == "",]
dat.16 <- dat.16[!dat.16$Crime == "",]
dat.17 <- dat.17[!dat.17$Crime == "",]


dat.16 <- dat.16[!dat.16$Crime == "21",]
dat.17 <- dat.17[!dat.17$Crime == "18",]
```

Format data

create time of day, day of week, month, season, year

```r
# Data for 2015
# extract time information (time without AM, PM)
dat.15$time <- sapply(dat.15$Date.Time.Occurred, function(x) strsplit(as.character(x), " ")[[1]][2])
# AM, PM time information
dat.15$ap <- sapply(dat.15$Date.Time.Occurred, function(x) strsplit(as.character(x), " ")[[1]][3])
# combine time and AM, PM
dat.15$timeap <- paste(dat.15$time, dat.15$ap)
# convert to military time
dat.15$mtime <- substr(strptime(dat.15$timeap, "%I:%M %p"), 11,19)
# remove white space
dat.15$mtime <- trimws(dat.15$mtime)
# extract hour information
dat.15$hours <- as.numeric(substr(dat.15$mtime, 1,2))
```

```r
# categorize times into time of day (tod)
dat.15$ctime <- hour(hms(dat.15$mtime))
tbreaks <- hour(hm("00:00", "5:00", "11:00", "17:00", "23:59"))
tlabels <- c("Night", "Morning", "Afternoon", "Evening")
dat.15$tod <- cut(x=dat.15$ctime, breaks = tbreaks, labels = tlabels, include.lowest = TRUE)

# date, day, month
dat.15$date <- sapply(dat.15$Date.Time.Reported, function(x) strsplit(as.character(x), " ")[[1]][1]) %>%
dat.15$day <- weekdays(dat.15$date)
dat.15$day <- factor(dat.15$day, levels = c("Monday", "Tuesday", "Wednesday", "Thursday", "Friday", "Sa
dat.15$month <- months(dat.15$date)
dat.15$month <- factor(dat.15$month, levels = month.name)

# table crimes by tod
crime.tod.15 <- as.data.frame(table(dat.15$Crime, dat.15$tod))

# Data for 2016
# extract time information (time without AM, PM)
dat.16$time <- sapply(dat.16$Date.Time.Occurred, function(x) strsplit(as.character(x), " ")[[1]][2])
# AM, PM time information
dat.16$ap <- sapply(dat.16$Date.Time.Occurred, function(x) strsplit(as.character(x), " ")[[1]][3])
# combine time and AM, PM
dat.16$timeap <- paste(dat.16$time, dat.16$ap)
# convert to military time
dat.16$mtime <- substr(strptime(dat.16$timeap, "%I:%M %p"), 11,19)
# remove white space
dat.16$mtime <- trimws(dat.16$mtime)
# extract hour information
dat.16$hours <- as.numeric(substr(dat.16$mtime, 1,2))

# categorize times into time of day (tod)
dat.16$ctime <- hour(hms(dat.16$mtime))
tbreaks <- hour(hm("00:00", "5:00", "11:00", "17:00", "23:59"))
tlabels <- c("Night", "Morning", "Afternoon", "Evening")
dat.16$tod <- cut(x=dat.16$ctime, breaks = tbreaks, labels = tlabels, include.lowest = TRUE)

# table crimes by tod
crime.tod.16 <- as.data.frame(table(dat.16$Crime, dat.16$tod))

# date, day, month
dat.16$date <- sapply(dat.16$Date.Time.Reported, function(x) strsplit(as.character(x), " ")[[1]][1]) %>%
dat.16$day <- weekdays(dat.16$date)
dat.16$day <- factor(dat.16$day, levels = c("Monday", "Tuesday", "Wednesday", "Thursday", "Friday", "Sa
dat.16$month <- months(dat.16$date)
dat.16$month <- factor(dat.16$month, levels = month.name)


# Data for 2017
# extract time information (time without AM, PM)
dat.17$time <- sapply(dat.17$Date.Time.Occurred, function(x) strsplit(as.character(x), " ")[[1]][2])
# AM, PM time information
dat.17$ap <- sapply(dat.17$Date.Time.Occurred, function(x) strsplit(as.character(x), " ")[[1]][3])
# combine time and AM, PM
```

```r
dat.17$timeap <- paste(dat.17$time, dat.17$ap) # combine time and AM, PM
# convert to military time
dat.17$mtime <- substr(strptime(dat.17$timeap, "%I:%M %p"), 11,19)
# remove white space
dat.17$mtime <- trimws(dat.17$mtime)
dat.17$hours <- as.numeric(substr(dat.17$mtime, 1,2))

# categorize times into time of day (tod)
dat.17$ctime <- hour(hms(dat.17$mtime))
tbreaks <- hour(hm("00:00", "5:00", "11:00", "17:00", "23:59"))
tlabels <- c("Night", "Morning", "Afternoon", "Evening")
dat.17$tod <- cut(x=dat.17$ctime, breaks = tbreaks, labels = tlabels, include.lowest = TRUE)

# table crimes by tod
crime.tod.17 <- as.data.frame(table(dat.17$Crime, dat.17$tod))

# date, day, month
dat.17$date <- sapply(dat.17$Date.Time.Reported, function(x) strsplit(as.character(x), " ")[[1]][1]) %>%
dat.17$day <- weekdays(dat.17$date)
dat.17$day <- factor(dat.17$day, levels = c("Monday", "Tuesday", "Wednesday", "Thursday", "Friday", "Sa

dat.17$month <- months(dat.17$date)
dat.17$month <- factor(dat.17$month, levels = month.name)

dft.17 <- as.data.frame(table(dat.17$Crime, dat.17[,"month"]))
dft.17 <- melt(dft.17, c("Var1", "Var2"))
g.dft.17 <- dft.17 %>% group_by(Var2) %>% summarize(n = sum(value))
g.dft.17 <- g.dft.17 %>% mutate(year = 2017)
g.dft.17 <- as.data.frame(g.dft.17)
g.dft.17[9:12, "n"] <- NA
```

Plot crime trends

```r
# create function for summarizing total crime vs. variable of interest
crime.sum <- function(df, x){
  dft <- as.data.frame(table(df$Crime, df[,x]))
  dft <- melt(dft, c("Var1", "Var2"))
  g.dft <- dft %>% group_by(Var2) %>% summarize(n = sum(value))
  dg.dft <- as.data.frame(g.dft)

  p <- ggplot(data = dg.dft, aes(x=Var2, y=n)) + theme(axis.text.x = element_text(angle = 90, hjust = 1
  return(p)

}

# function for summarizing total crime vs. month by year
crime.sum.yr <- function(df15, df16, g.dft.17, x){
  dft.15 <- as.data.frame(table(df15$Crime, df15[,x]))
  dft.16 <- as.data.frame(table(df16$Crime, df16[,x]))
  dft.15 <- melt(dft.15, c("Var1", "Var2"))
  dft.16 <- melt(dft.16, c("Var1", "Var2"))
  g.dft.15 <- dft.15 %>% group_by(Var2) %>% summarize(n = sum(value))
```

```r
    g.dft.16 <- dft.16 %>% group_by(Var2) %>% summarize(n = sum(value))
    g.dft.15 <- g.dft.15 %>% mutate(year = 2015)
    g.dft.16 <- g.dft.16 %>% mutate(year = 2016)
    dg.dft.15 <- as.data.frame(g.dft.15)
    dg.dft.16 <- as.data.frame(g.dft.16)
    m.df <- rbind(g.dft.15, g.dft.16)
    m.df <- rbind(m.df, g.dft.17)

    p <- ggplot(data = m.df, aes(x=Var2, y=n, group = factor(year), color = factor(year))) + stat_smooth(a
    return(p)
}


# function for summarizing total crime vs. hour by year
crime.h <- function(df15, df16, df17, x){
    dft.15 <- as.data.frame(table(df15$Crime, df15[,x]))
    dft.16 <- as.data.frame(table(df16$Crime, df16[,x]))
    dft.17 <- as.data.frame(table(df17$Crime, df17[,x]))
    dft.15 <- melt(dft.15, c("Var1", "Var2"))
    dft.16 <- melt(dft.16, c("Var1", "Var2"))
    dft.17 <- melt(dft.17, c("Var1", "Var2"))
    g.dft.15 <- dft.15 %>% group_by(Var2) %>% summarize(n = sum(value))
    g.dft.16 <- dft.16 %>% group_by(Var2) %>% summarize(n = sum(value))
    g.dft.17 <- dft.17 %>% group_by(Var2) %>% summarize(n = sum(value))
    g.dft.15 <- g.dft.15 %>% mutate(year = 2015)
    g.dft.16 <- g.dft.16 %>% mutate(year = 2016)
    g.dft.17 <- g.dft.17 %>% mutate(year = 2017)
    dg.dft.15 <- as.data.frame(g.dft.15)
    dg.dft.16 <- as.data.frame(g.dft.16)
    dg.dft.17 <- as.data.frame(g.dft.17)
    m.df <- rbind(g.dft.15, g.dft.16)
    m.df <- rbind(m.df, g.dft.17)

    p <- ggplot(data = m.df, aes(x=Var2, y=n, group = factor(year), color = factor(year))) + stat_smooth(a
    return(p)

}

# function for summarizing total crime vs. time of day by year
crime.t <- function(df15, df16, df17, x){
    dft.15 <- as.data.frame(table(df15$Crime, df15[,x]))
    dft.16 <- as.data.frame(table(df16$Crime, df16[,x]))
    dft.17 <- as.data.frame(table(df17$Crime, df17[,x]))
    dft.15 <- melt(dft.15, c("Var1", "Var2"))
    dft.16 <- melt(dft.16, c("Var1", "Var2"))
    dft.17 <- melt(dft.17, c("Var1", "Var2"))
    g.dft.15 <- dft.15 %>% group_by(Var2) %>% summarize(n = sum(value))
    g.dft.16 <- dft.16 %>% group_by(Var2) %>% summarize(n = sum(value))
    g.dft.17 <- dft.17 %>% group_by(Var2) %>% summarize(n = sum(value))
    g.dft.15 <- g.dft.15 %>% mutate(year = 2015)
    g.dft.16 <- g.dft.16 %>% mutate(year = 2016)
    g.dft.17 <- g.dft.17 %>% mutate(year = 2017)
    dg.dft.15 <- as.data.frame(g.dft.15)
```

```r
  dg.dft.16 <- as.data.frame(g.dft.16)
  dg.dft.17 <- as.data.frame(g.dft.17)
  m.df <- rbind(g.dft.15, g.dft.16)
  m.df <- rbind(m.df, g.dft.17)

  p <- ggplot(data = m.df, aes(x=Var2, y=n, group = factor(year), color = factor(year))) + stat_smooth(
  return(p)

}

# function for summarizing total crime vs. day of week by year
crime.d <- function(df15, df16, df17, x){
  dft.15 <- as.data.frame(table(df15$Crime, df15[,x]))
  dft.16 <- as.data.frame(table(df16$Crime, df16[,x]))
  dft.17 <- as.data.frame(table(df17$Crime, df17[,x]))
  dft.15 <- melt(dft.15, c("Var1", "Var2"))
  dft.16 <- melt(dft.16, c("Var1", "Var2"))
  dft.17 <- melt(dft.17, c("Var1", "Var2"))
  g.dft.15 <- dft.15 %>% group_by(Var2) %>% summarize(n = sum(value))
  g.dft.16 <- dft.16 %>% group_by(Var2) %>% summarize(n = sum(value))
  g.dft.17 <- dft.17 %>% group_by(Var2) %>% summarize(n = sum(value))
  g.dft.15 <- g.dft.15 %>% mutate(year = 2015)
  g.dft.16 <- g.dft.16 %>% mutate(year = 2016)
  g.dft.17 <- g.dft.17 %>% mutate(year = 2017)
  dg.dft.15 <- as.data.frame(g.dft.15)
  dg.dft.16 <- as.data.frame(g.dft.16)
  dg.dft.17 <- as.data.frame(g.dft.17)
  m.df <- rbind(g.dft.15, g.dft.16)
  m.df <- rbind(m.df, g.dft.17)

  p <- ggplot(data = m.df, aes(x=Var2, y=n, group = factor(year), color = factor(year))) + stat_smooth(
  return(p)

}


dcrime <- crime.d(dat.15, dat.16, dat.17, "day")
tcrime <- crime.t(dat.15, dat.16, dat.17, "tod")
hcrime <- crime.h(dat.15, dat.16, dat.17, "hours")
mcrime <- crime.sum.yr(dat.15, dat.16, g.dft.17, "month")

plot_grid(mcrime, dcrime, hcrime, tcrime, labels = c("A", "B", "C", "D"))

## `geom_smooth()` using method = 'loess'

## Warning: Removed 4 rows containing non-finite values (stat_smooth).

## `geom_smooth()` using method = 'loess'
## `geom_smooth()` using method = 'loess'
## `geom_smooth()` using method = 'loess'

## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =
## parametric, : span too small. fewer data values than degrees of freedom.

## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =
## parametric, : pseudoinverse used at 0.985
```

```
## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =
## parametric, : neighborhood radius 2.015

## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =
## parametric, : reciprocal condition number 0

## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =
## parametric, : There are other near singularities as well. 4.0602

## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =
## parametric, : span too small. fewer data values than degrees of freedom.

## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =
## parametric, : pseudoinverse used at 0.985

## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =
## parametric, : neighborhood radius 2.015

## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =
## parametric, : reciprocal condition number 0

## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =
## parametric, : There are other near singularities as well. 4.0602

## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =
## parametric, : span too small. fewer data values than degrees of freedom.

## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =
## parametric, : pseudoinverse used at 0.985

## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =
## parametric, : neighborhood radius 2.015

## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =
## parametric, : reciprocal condition number 0

## Warning in simpleLoess(y, x, w, span, degree = degree, parametric =
## parametric, : There are other near singularities as well. 4.0602
```
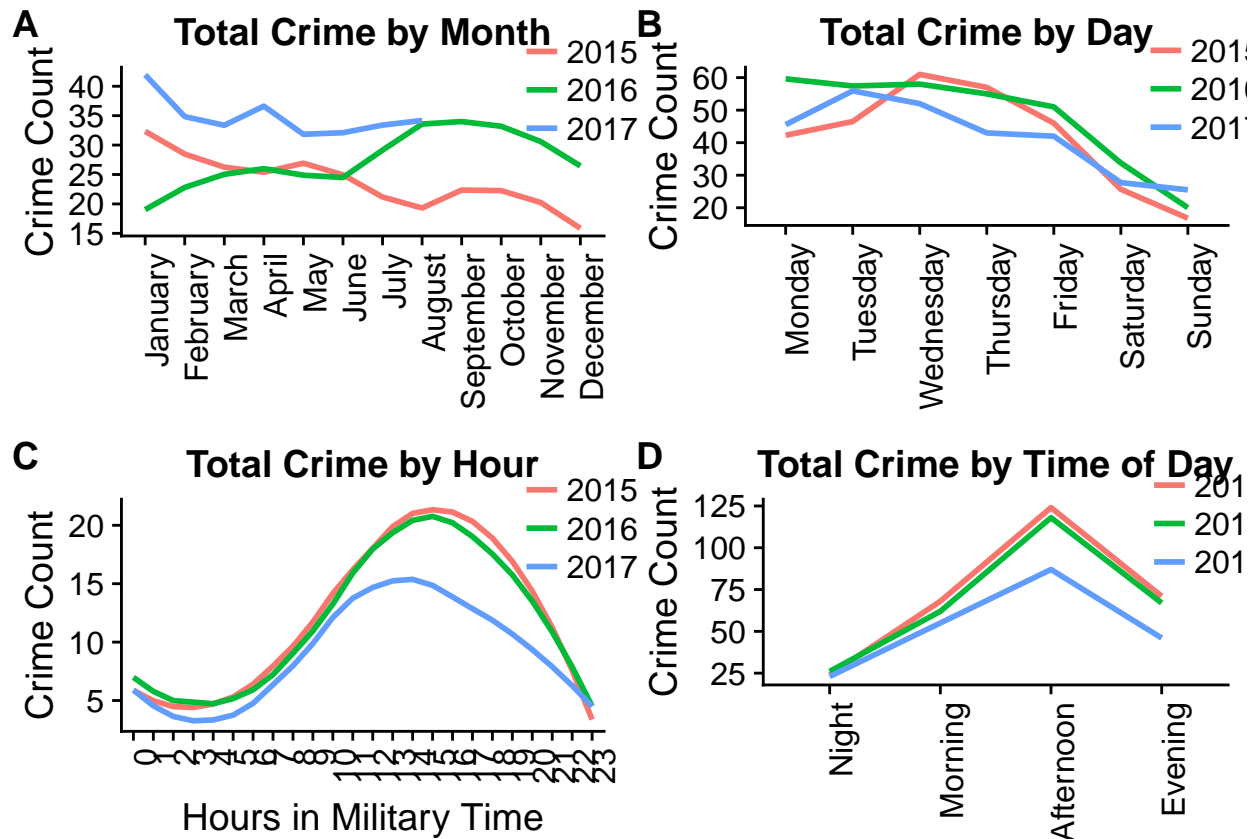
Calendar heatmap

Note: After updating to lastest version of RStudio, calendarHeat() function no longer works. The plot included in the report was generated prior to RStudio update. The code for the calendarHeat() function can be found here: https://github.com/jbryer/makeR/blob/master/R/calendarHeat.R

```r
# tally the total number of crimes on each day
dat.15.total <- dat.15 %>% group_by(date) %>% tally()
dat.16.total <- dat.16 %>% group_by(date) %>% tally()
dat.17.total <- dat.17 %>% group_by(date) %>% tally()
total.yr <- rbind(dat.15.total, dat.16.total, dat.17.total)

require(RColorBrewer)
red_color_ramp = brewer.pal(9, "Reds")
ct <- calendarHeat(total.yr$date, total.yr$n,
varname="Daily Crime", color="red_color_ramp")
```

Statistical testing

```r
# Tukey test to determine what the effect of time of day on the total number of crime during that time
total.15 <- group_by(dat.15, tod) %>%
  summarize(
    count = n()
  )
```

```
total.16 <- group_by(dat.16, tod) %>%
  summarize(
    count = n()
  )

total.17 <- group_by(dat.17, tod) %>%
  summarize(
    count = n()
  )


total.tod <- rbind(total.15, total.16, total.17)
total.aov <- aov(count ~ tod, data = total.tod)
TH.tod <- TukeyHSD(total.aov)


# Tukey test to determine what the effect of day of the week on the total number of crime on that day

day.15 <- group_by(dat.15, day) %>%
  summarize(
    count = n()
  )

day.16 <- group_by(dat.16, day) %>%
  summarize(
    count = n()
  )

day.17 <- group_by(dat.17, day) %>%
  summarize(
    count = n()
  )


total.day <- rbind(day.15, day.16, day.17)
day.aov <- aov(count ~ day, data = total.day)
TH.day <- TukeyHSD(day.aov)

print(xtable(TH.tod$tod))
```

```
## % latex table generated in R 3.3.1 by xtable 1.8-2 package
## % Mon Oct 23 09:32:07 2017
## \begin{table}[ht]
## \centering
## \begin{tabular}{rrrrr}
##   \hline
##  & diff & lwr & upr & p adj \\
##   \hline
## Morning-Night & 37.33 & 4.80 & 69.87 & 0.03 \\
##   Afternoon-Night & 85.33 & 52.80 & 117.87 & 0.00 \\
##   Evening-Night & 37.00 & 4.46 & 69.54 & 0.03 \\
##   Afternoon-Morning & 48.00 & 15.46 & 80.54 & 0.01 \\
##   Evening-Morning & -0.33 & -32.87 & 32.20 & 1.00 \\
##   Evening-Afternoon & -48.33 & -80.87 & -15.80 & 0.01 \\
```

```
##    \hline
## \end{tabular}
## \end{table}
```

```
print(xtable(TH.day$day))
```

```
## % latex table generated in R 3.3.1 by xtable 1.8-2 package
## % Mon Oct 23 09:32:07 2017
## \begin{table}[ht]
## \centering
## \begin{tabular}{rrrrr}
##    \hline
##  & diff & lwr & upr & p adj \\
##    \hline
## Tuesday-Monday & 1.67 & -17.23 & 20.57 & 1.00 \\
##    Wednesday-Monday & 7.33 & -11.57 & 26.23 & 0.83 \\
##    Thursday-Monday & 2.00 & -16.90 & 20.90 & 1.00 \\
##    Friday-Monday & -3.33 & -22.23 & 15.57 & 1.00 \\
##    Saturday-Monday & -25.33 & -44.23 & -6.43 & 0.01 \\
##    Sunday-Monday & -27.67 & -46.57 & -8.77 & 0.00 \\
##    Wednesday-Tuesday & 5.67 & -13.23 & 24.57 & 0.94 \\
##    Thursday-Tuesday & 0.33 & -18.57 & 19.23 & 1.00 \\
##    Friday-Tuesday & -5.00 & -23.90 & 13.90 & 0.97 \\
##    Saturday-Tuesday & -27.00 & -45.90 & -8.10 & 0.00 \\
##    Sunday-Tuesday & -29.33 & -48.23 & -10.43 & 0.00 \\
##    Thursday-Wednesday & -5.33 & -24.23 & 13.57 & 0.95 \\
##    Friday-Wednesday & -10.67 & -29.57 & 8.23 & 0.50 \\
##    Saturday-Wednesday & -32.67 & -51.57 & -13.77 & 0.00 \\
##    Sunday-Wednesday & -35.00 & -53.90 & -16.10 & 0.00 \\
##    Friday-Thursday & -5.33 & -24.23 & 13.57 & 0.95 \\
##    Saturday-Thursday & -27.33 & -46.23 & -8.43 & 0.00 \\
##    Sunday-Thursday & -29.67 & -48.57 & -10.77 & 0.00 \\
##    Saturday-Friday & -22.00 & -40.90 & -3.10 & 0.02 \\
##    Sunday-Friday & -24.33 & -43.23 & -5.43 & 0.01 \\
##    Sunday-Saturday & -2.33 & -21.23 & 16.57 & 1.00 \\
##     \hline
## \end{tabular}
## \end{table}
```

```r
# function to plot effect size and 95% CI
plotTukeyHSD <- plotTukeysHSD <- function(tukey.out,
                          x.axis.label = "Comparison",
                          y.axis.label = "Effect Size",
                       axis.adjust = 0,
                       adjust.x.spacing = 5){

  tukey.out <- as.data.frame(tukey.out[[1]])
  means <- tukey.out$diff
  categories <- row.names(tukey.out)
  groups <- length(categories)
  ci.low <- tukey.out$lwr
  ci.up  <- tukey.out$upr

  n.means <- length(means)
```

```r
#determine where to plot points along x-axis
x.values <- 1:n.means
x.values <- x.values/adjust.x.spacing


# calculate values for plotting limits
y.max <- max(ci.up) +
  max(ci.up)*axis.adjust
y.min <- min(ci.low) -
  max(ci.low)*axis.adjust

if(groups == 2){ x.values <- c(0.25, 0.5)}
if(groups == 3){ x.values <- c(0.25, 0.5,0.75)}

x.axis.min <- min(x.values)-0.05
x.axis.max <- max(x.values)+0.05

x.limits <- c(x.axis.min,x.axis.max)

#Plot means
plot(means ~ x.values,
     xlim = x.limits,
     ylim = c(y.min,y.max),
     xaxt = "n",
     xlab = "",
     ylab = "",
     cex = 1.25,
     pch = 16)

axis(side = 1,
     at = x.values,
     labels = categories
     )

#Plot upper error bar
lwd. <- 2
arrows(y0 = means,
       x0 = x.values,
       y1 = ci.up,
       x1 = x.values,
       length = 0,
       lwd = lwd.)

#Plot lower error bar
arrows(y0 = means,
       x0 = x.values,
       y1 = ci.low,
       x1 = x.values,
       length = 0,
       lwd = lwd.)

#add reference line at 0
abline(h = 0, col = 2, lwd = 2, lty =2)
```
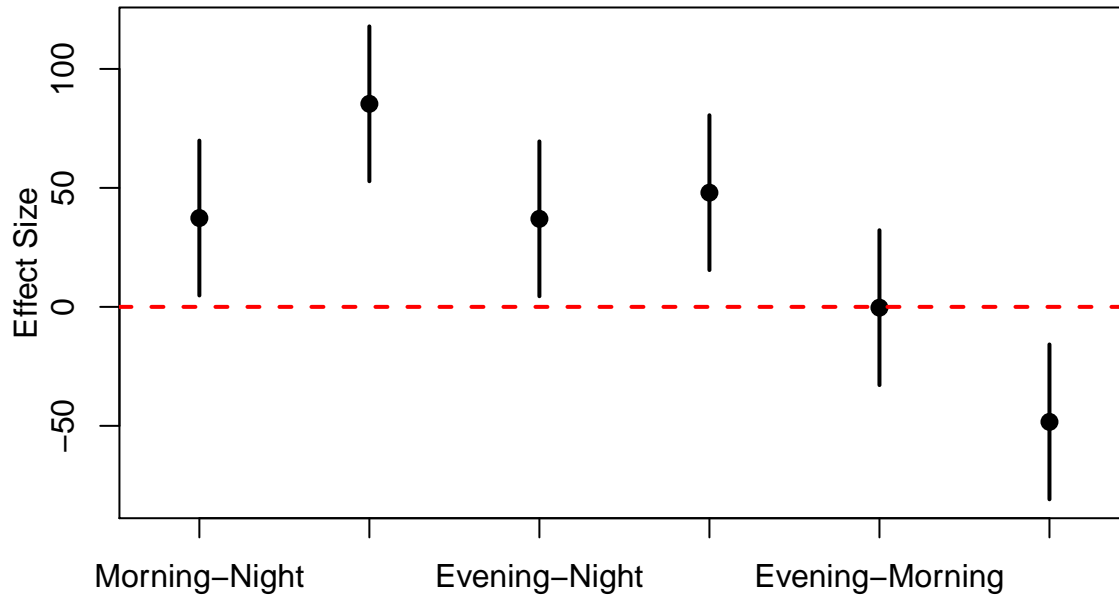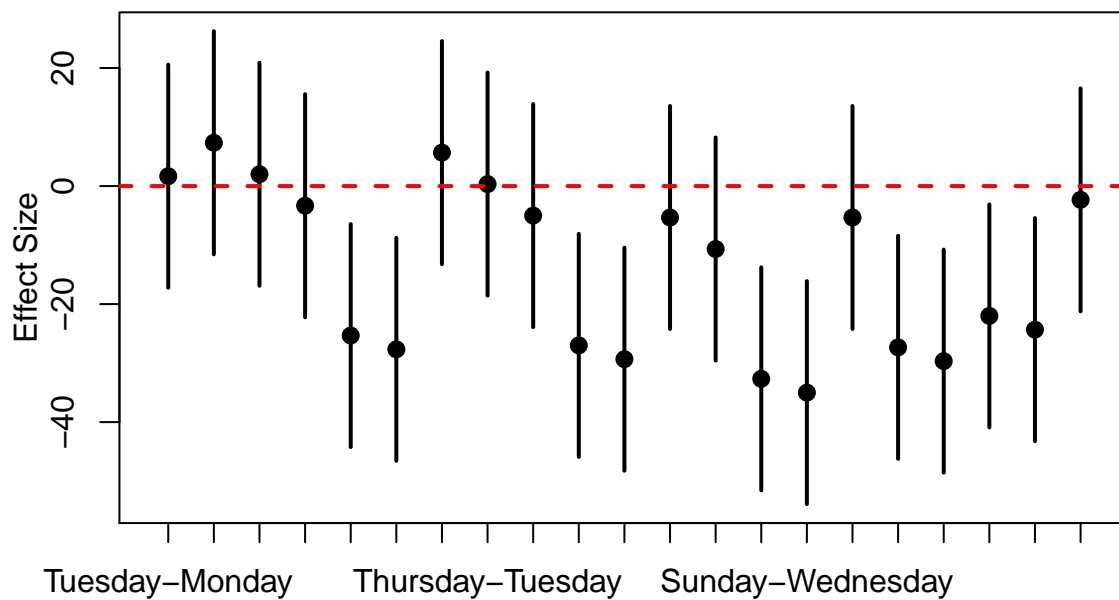
```
    #mtext(text = x.axis.label,side = 1,line = 1.75)
    mtext(text = y.axis.label,side = 2,line = 1.95)
    # Error bars = 95% CI
    # mtext(text = "Effect Size of Time of Day on Total Crime",side = 3,line = 1)
    # mtext(text = "Effect Size of Day of Week on Total Crime",side = 3,line = 1)

}
```

```
plotTukeyHSD(TH.tod)
```



```
plotTukeyHSD(TH.day)
```

Create tables summarizing crime types and results of statistical testing

```r
options(xtable.floating = FALSE)

# crime categories for each year
c.types.15 <- table(dat.15$Crime)
print(xtable(c.types.15))
```

```
## % latex table generated in R 3.3.1 by xtable 1.8-2 package
## % Mon Oct 23 09:32:08 2017
## \begin{tabular}{rr}
##   \hline
##  & V1 \\
##   \hline
## Aggravated Assault &   1 \\
##   Assault &  83 \\
##   Auto Theft &   1 \\
##   Bomb Threat &   2 \\
##   Drug Violation &   1 \\
##   Forgery &   5 \\
##   Hate Crime &   1 \\
##   Sex Offense &   2 \\
##   Theft & 154 \\
##   Theft From Vehicle &  12 \\
##   Trespassing &   6 \\
##   Vandalism &  18 \\
##   Weapons Violation &   1 \\
##    \hline
## \end{tabular}
```

```r
c.types.16 <- table(dat.16$Crime)
print(xtable(c.types.16))
```

```
## % latex table generated in R 3.3.1 by xtable 1.8-2 package
## % Mon Oct 23 09:32:08 2017
## \begin{tabular}{rr}
##   \hline
##  & V1 \\
##   \hline
## Aggravated Assault &   2 \\
##   Arson &   1 \\
##   Assault &  87 \\
##   Assault/Domestic Violence &   2 \\
##   Auto Theft &   2 \\
##   Bomb Threat &   1 \\
##   Burglary &   2 \\
##   CDS Violation &   1 \\
##   Disorderly Conduct &   7 \\
##   Drug Violation &   7 \\
##   Forgery &   1 \\
##   Homicide/Aggravated
## Assault &   1 \\
##   Rape &   1 \\
##   Robbery &  13 \\
```

```
##   Sex Offense &   1 \\
##   Stalking &   1 \\
##   Theft & 152 \\
##   Theft from Auto &  18 \\
##   Theft of Auto
## (Attempted) &   1 \\
##   Trespassing &   1 \\
##   Vandalism &  25 \\
##   Weapons Violation &   4 \\
##     \hline
## \end{tabular}
```

```
c.types.17 <- table(dat.17$Crime)
print(xtable(c.types.17))
```

```
## % latex table generated in R 3.3.1 by xtable 1.8-2 package
## % Mon Oct 23 09:32:08 2017
## \begin{tabular}{rr}
##     \hline
##  & V1 \\
##     \hline
## Aggravated Assault &   4 \\
##   Aggravated Assault/
## Domestic Violence &   1 \\
##   Armed Robbery
## (Attempted) &   1 \\
##   Assault &  65 \\
##   Assault (Domestic) &   1 \\
##   Assault by Threat &   1 \\
##   Assault/Domestic Violence &   9 \\
##   Assault/Hate Crime &   1 \\
##   Auto Theft &   1 \\
##   Bomb Threat &   2 \\
##   Burglary &   1 \\
##   CDS Violation &   1 \\
##   Destruction of Property &   6 \\
##   Disorderly Conduct &  11 \\
##   Domestic Violence &   1 \\
##   Drug Violation &   3 \\
##   Fondling &   1 \\
##   Forgery &   3 \\
##   Fraud &   1 \\
##   Information Only &   1 \\
##   Robbery &   5 \\
##   Stalking &   2 \\
##   Tampering &   1 \\
##   Theft & 115 \\
##   Theft from Auto &  26 \\
##   Theft from Auto;
## Destruction of Property &   3 \\
##   Trespassing &  14 \\
##   Vandalism &   7 \\
##   Weapons Violation &   1 \\
##     \hline
## \end{tabular}
```

```
# results of Tukey test for effect of time of day and day of week on total crime
print(xtable(TH.tod$tod))

## % latex table generated in R 3.3.1 by xtable 1.8-2 package
## % Mon Oct 23 09:32:08 2017
## \begin{tabular}{rrrrr}
##    \hline
##  & diff & lwr & upr & p adj \\
##    \hline
## Morning-Night & 37.33 & 4.80 & 69.87 & 0.03 \\
##    Afternoon-Night & 85.33 & 52.80 & 117.87 & 0.00 \\
##    Evening-Night & 37.00 & 4.46 & 69.54 & 0.03 \\
##    Afternoon-Morning & 48.00 & 15.46 & 80.54 & 0.01 \\
##    Evening-Morning & -0.33 & -32.87 & 32.20 & 1.00 \\
##    Evening-Afternoon & -48.33 & -80.87 & -15.80 & 0.01 \\
##     \hline
## \end{tabular}

print(xtable(TH.day$day))

## % latex table generated in R 3.3.1 by xtable 1.8-2 package
## % Mon Oct 23 09:32:08 2017
## \begin{tabular}{rrrrr}
##    \hline
##  & diff & lwr & upr & p adj \\
##    \hline
## Tuesday-Monday & 1.67 & -17.23 & 20.57 & 1.00 \\
##    Wednesday-Monday & 7.33 & -11.57 & 26.23 & 0.83 \\
##    Thursday-Monday & 2.00 & -16.90 & 20.90 & 1.00 \\
##    Friday-Monday & -3.33 & -22.23 & 15.57 & 1.00 \\
##    Saturday-Monday & -25.33 & -44.23 & -6.43 & 0.01 \\
##    Sunday-Monday & -27.67 & -46.57 & -8.77 & 0.00 \\
##    Wednesday-Tuesday & 5.67 & -13.23 & 24.57 & 0.94 \\
##    Thursday-Tuesday & 0.33 & -18.57 & 19.23 & 1.00 \\
##    Friday-Tuesday & -5.00 & -23.90 & 13.90 & 0.97 \\
##    Saturday-Tuesday & -27.00 & -45.90 & -8.10 & 0.00 \\
##    Sunday-Tuesday & -29.33 & -48.23 & -10.43 & 0.00 \\
##    Thursday-Wednesday & -5.33 & -24.23 & 13.57 & 0.95 \\
##    Friday-Wednesday & -10.67 & -29.57 & 8.23 & 0.50 \\
##    Saturday-Wednesday & -32.67 & -51.57 & -13.77 & 0.00 \\
##    Sunday-Wednesday & -35.00 & -53.90 & -16.10 & 0.00 \\
##    Friday-Thursday & -5.33 & -24.23 & 13.57 & 0.95 \\
##    Saturday-Thursday & -27.33 & -46.23 & -8.43 & 0.00 \\
##    Sunday-Thursday & -29.67 & -48.57 & -10.77 & 0.00 \\
##    Saturday-Friday & -22.00 & -40.90 & -3.10 & 0.02 \\
##    Sunday-Friday & -24.33 & -43.23 & -5.43 & 0.01 \\
##    Sunday-Saturday & -2.33 & -21.23 & 16.57 & 1.00 \\
##     \hline
## \end{tabular}
```