**Assignment 7.2**

**Visualize the correlation between all variables in a meaningful and clear way of representing. Find out top 3 reasons for having more crime in a city.**

**What is the difference between co-variance and correlation? Take an example from this dataset and show the differences if any?**

COBRA\_YTD2017<-read.csv('C:/Users/rakesh1/Desktop/COBRA-YTD2017.csv')

**require**(Amelia)

## Loading required package: Amelia

## Loading required package: Rcpp

## ##

## ## Amelia II: Multiple Imputation

## ## (Version 1.7.5, built: 2018-05-07)

## ## Copyright (C) 2005-2018 James Honaker, Gary King and Matthew Blackwell

## ## Refer to http://gking.harvard.edu/amelia/ for more information

## ##

**library**(Rcpp)

data<-COBRA\_YTD2017

data[4:10,3] <- rep(NA,7)

data[1:5,4] <- NA

data <- data[-c(5,6)]

summary(data)

## MI\_PRINX offense\_id rpt\_date

## Min. :8838438 Min. :1.608e+08 7/26/2017 : 106

## 1st Qu.:8904204 1st Qu.:1.711e+08 10/16/2017: 103

## Median :8910894 Median :1.720e+08 11/1/2017 : 103

## Mean :8910851 Mean :6.523e+08 9/21/2017 : 101

## 3rd Qu.:8917584 3rd Qu.:1.728e+08 11/28/2017: 100

## Max. :8924410 Max. :1.730e+11 (Other) :26239

## NA's : 7

## occur\_date poss\_time beat apt\_office\_prefix

## 11/17/2017: 110 8:00:00 : 526 Min. :101.0 :26213

## 10/7/2017 : 106 7:00:00 : 430 1st Qu.:208.0 APT : 314

## 8/19/2017 : 105 12:00:00: 426 Median :312.0 STE : 25

## 10/28/2017: 102 10:00:00: 376 Mean :355.6 ROOM : 21

## 10/31/2017: 99 9:00:00 : 376 3rd Qu.:505.0 BLDG : 12

## (Other) :26232 16:00:00: 375 Max. :710.0 UNIT : 12

## NA's : 5 (Other) :24250 (Other): 162

## apt\_office\_num location

## :22133 1801 HOWELL MILL RD NW : 142

## A : 120 3393 PEACHTREE RD NE @LENOX MALL : 140

## B : 108 1275 CAROLINE ST NE @TARGET - CAROLINE : 136

## 1 : 61 3393 PEACHTREE RD NE : 129

## 2 : 48 835 MARTIN L KING JR DR NW : 108

## 5 : 46 2841 GREENBRIAR PKWY SW @GREENBRIAR MALL: 95

## (Other): 4243 (Other) :26009

## MinOfucr MinOfibr\_code dispo\_code MaxOfnum\_victims

## Min. :110.0 2305 :9024 :22959 Min. : 0.00

## 1st Qu.:521.0 2404 :2774 10 : 2893 1st Qu.: 1.00

## Median :640.0 2303 :2486 20 : 632 Median : 1.00

## Mean :598.8 2399 :1946 30 : 210 Mean : 1.16

## 3rd Qu.:660.0 2202 :1802 40 : 36 3rd Qu.: 1.00

## Max. :730.0 2308 :1381 60 : 20 Max. :27.00

## (Other):7346 (Other): 9 NA's :75

## Shift Avg.Day loc\_type UC2.Literal

## Day :6882 Sat :3713 Min. : 1.00 LARCENY-FROM VEHICLE:9840

## Eve :9151 Sun :3569 1st Qu.:13.00 LARCENY-NON VEHICLE :6589

## Morn:7014 Tue :3542 Median :18.00 AUTO THEFT :3197

## Unk :3712 Wed :3539 Mean :20.76 BURGLARY-RESIDENCE :2635

## Mon :3492 3rd Qu.:20.00 AGG ASSAULT :2024

## Thu :3455 Max. :99.00 ROBBERY-PEDESTRIAN :1126

## (Other):5449 NA's :3344 (Other) :1348

## neighborhood npu x

## Downtown : 1828 M : 3077 Min. :-84.55

## Midtown : 1410 E : 2742 1st Qu.:-84.43

## : 1185 B : 2716 Median :-84.40

## Old Fourth Ward : 697 D : 1281 Mean :-83.69

## Lindbergh/Morosgo: 595 V : 1281 3rd Qu.:-84.37

## West End : 571 T : 1140 Max. : 0.00

## (Other) :20473 (Other):14522

## y

## Min. : 0.00

## 1st Qu.:33.73

## Median :33.76

## Mean :33.47

## 3rd Qu.:33.79

## Max. :33.88

##

pMiss <- **function**(x){sum(is.na(x))/length(x)\*100}

apply(data,2,pMiss)

## MI\_PRINX offense\_id rpt\_date occur\_date

## 0.00000000 0.00000000 0.02615942 0.01868530

## poss\_time beat apt\_office\_prefix apt\_office\_num

## 0.00000000 0.00000000 0.00000000 0.00000000

## location MinOfucr MinOfibr\_code dispo\_code

## 0.00000000 0.00000000 0.00000000 0.00000000

## MaxOfnum\_victims Shift Avg.Day loc\_type

## 0.28027953 0.00000000 0.00000000 12.49673007

## UC2.Literal neighborhood npu x

## 0.00000000 0.00000000 0.00000000 0.00000000

## y

## 0.00000000

apply(data,1,pMiss)

## [1] 4.761905 4.761905 4.761905 9.523810 9.523810 4.761905 4.761905

## [8] 4.761905 4.761905 4.761905 0.000000 4.761905 4.761905 0.000000

## [15] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [22] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [29] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [36] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [43] 0.000000 4.761905 0.000000 0.000000 0.000000 0.000000 0.000000

## [50] 0.000000 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000

## [57] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [64] 0.000000 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000

## [71] 4.761905 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [78] 4.761905 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [85] 0.000000 4.761905 0.000000 4.761905 0.000000 0.000000 0.000000

## [92] 4.761905 0.000000 0.000000 0.000000 4.761905 0.000000 4.761905

## [99] 0.000000 0.000000 4.761905 0.000000 0.000000 0.000000 0.000000

## [106] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [113] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [120] 4.761905 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000

## [127] 0.000000 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000

## [134] 0.000000 4.761905 4.761905 0.000000 0.000000 0.000000 0.000000

## [141] 0.000000 4.761905 0.000000 0.000000 0.000000 0.000000 0.000000

## [148] 0.000000 0.000000 4.761905 0.000000 0.000000 0.000000 0.000000

## [155] 0.000000 0.000000 0.000000 0.000000 0.000000 4.761905 4.761905

## [162] 0.000000 0.000000 0.000000 4.761905 0.000000 4.761905 4.761905

## [169] 0.000000 4.761905 0.000000 0.000000 4.761905 0.000000 0.000000

## [176] 4.761905 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [183] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [190] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [197] 0.000000 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000

## [204] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26419] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26426] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26433] 0.000000 0.000000 4.761905 0.000000 0.000000 4.761905 0.000000

## [26440] 0.000000 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000

## [26447] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26454] 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000 0.000000

## [26461] 0.000000 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000

## [26468] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 4.761905

## [26475] 0.000000 0.000000 4.761905 0.000000 0.000000 0.000000 0.000000

## [26482] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26489] 4.761905 4.761905 0.000000 0.000000 0.000000 4.761905 0.000000

## [26496] 0.000000 4.761905 0.000000 0.000000 4.761905 0.000000 0.000000

## [26503] 0.000000 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000

## [26510] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26517] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26524] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26531] 0.000000 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000

## [26538] 4.761905 0.000000 0.000000 4.761905 0.000000 0.000000 0.000000

## [26545] 0.000000 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000

## [26552] 0.000000 4.761905 0.000000 0.000000 0.000000 0.000000 0.000000

## [26559] 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000 0.000000

## [26566] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26573] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26580] 0.000000 4.761905 0.000000 0.000000 0.000000 0.000000 0.000000

## [26587] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26594] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26601] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26608] 0.000000 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000

## [26615] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26622] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26629] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26636] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26643] 0.000000 0.000000 0.000000 4.761905 4.761905 0.000000 0.000000

## [26650] 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000 0.000000

## [26657] 0.000000 0.000000 0.000000 4.761905 0.000000 0.000000 0.000000

## [26664] 4.761905 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26671] 0.000000 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000

## [26678] 9.523810 4.761905 0.000000 0.000000 4.761905 0.000000 4.761905

## [26685] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26692] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26699] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26706] 4.761905 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000

## [26713] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26720] 0.000000 0.000000 0.000000 0.000000 4.761905 0.000000 0.000000

## [26727] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26734] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26741] 0.000000 0.000000 0.000000 4.761905 0.000000 4.761905 0.000000

## [26748] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

## [26755] 0.000000 0.000000 0.000000 0.000000 0.000000

**library**(mice)

## Warning: package 'mice' was built under R version 3.5.1

## Loading required package: lattice

##

## Attaching package: 'mice'

## The following objects are masked from 'package:base':

##

## cbind, rbind

md.pattern(data)

## MI\_PRINX offense\_id poss\_time beat apt\_office\_prefix apt\_office\_num

## 23405 1 1 1 1 1 1

## 3269 1 1 1 1 1 1

## 75 1 1 1 1 1 1

## 5 1 1 1 1 1 1

## 3 1 1 1 1 1 1

## 2 1 1 1 1 1 1

## 0 0 0 0 0 0

## location MinOfucr MinOfibr\_code dispo\_code Shift Avg.Day UC2.Literal

## 23405 1 1 1 1 1 1 1

## 3269 1 1 1 1 1 1 1

## 75 1 1 1 1 1 1 1

## 5 1 1 1 1 1 1 1

## 3 1 1 1 1 1 1 1

## 2 1 1 1 1 1 1 1

## 0 0 0 0 0 0 0

## neighborhood npu x y occur\_date rpt\_date MaxOfnum\_victims loc\_type

## 23405 1 1 1 1 1 1 1 1

## 3269 1 1 1 1 1 1 1 0

## 75 1 1 1 1 1 1 0 0

## 5 1 1 1 1 1 0 1 1

## 3 1 1 1 1 0 1 1 1

## 2 1 1 1 1 0 0 1 1

## 0 0 0 0 5 7 75 3344

##

## 23405 0

## 3269 1

## 75 2

## 5 1

## 3 1

## 2 2

## 3431

**library**(VIM)

## Warning: package 'VIM' was built under R version 3.5.1

## Loading required package: colorspace

## Loading required package: grid

## Loading required package: data.table

## VIM is ready to use.

## Since version 4.0.0 the GUI is in its own package VIMGUI.

##

## Please use the package to use the new (and old) GUI.

## Suggestions and bug-reports can be submitted at: https://github.com/alexkowa/VIM/issues

##

## Attaching package: 'VIM'

## The following object is masked from 'package:datasets':

##

## sleep

aggr\_plot <- aggr(data, col=c('navyblue','red'), numbers=TRUE, sortVars=TRUE, labels=names(data), cex.axis=.7, gap=3, ylab=c("Histogram of missing data","Pattern"))

## Warning in plot.aggr(res, ...): not enough horizontal space to display

## frequencies

##

## Variables sorted by number of missings:

## Variable Count

## loc\_type 0.1249673007

## MaxOfnum\_victims 0.0028027953

## rpt\_date 0.0002615942

## occur\_date 0.0001868530

## MI\_PRINX 0.0000000000

## offense\_id 0.0000000000

## poss\_time 0.0000000000

## beat 0.0000000000

## apt\_office\_prefix 0.0000000000

## apt\_office\_num 0.0000000000

## location 0.0000000000

## MinOfucr 0.0000000000

## MinOfibr\_code 0.0000000000

## dispo\_code 0.0000000000

## Shift 0.0000000000

## Avg.Day 0.0000000000

## UC2.Literal 0.0000000000

## neighborhood 0.0000000000

## npu 0.0000000000

## x 0.0000000000

## y 0.0000000000

marginplot(data[c(1,2)])

*# All below charts provide the visualization of missing data in the data set*

m <- matrix(data=cbind(rnorm(30, 0), rnorm(30, 2), rnorm(30, 5)), nrow=30, ncol=3)

apply(m, 1, mean)

## [1] 3.6966102 2.5742466 2.7391286 2.1355486 2.0897085 2.2097172 2.5066403

## [8] 1.3674533 1.2135926 2.3049017 1.5394682 2.4264711 2.3560555 1.4429536

## [15] 1.9525326 2.8921570 2.8218232 2.0948454 2.9282604 1.6813430 2.8007640

## [22] 2.4313354 2.7598386 2.5998863 3.1127215 2.0842223 1.5925865 0.5778122

## [29] 2.3238416 1.2541749

apply(m, 2, **function**(x) length(x[x<0]))

## [1] 14 0 0

apply(m, 2, **function**(x) is.matrix(x))

## [1] FALSE FALSE FALSE

apply(m, 2, is.vector)

## [1] TRUE TRUE TRUE

apply(m, 2, **function**(x) mean(x[x>0]))

## [1] 0.5386839 1.9773260 4.7891772

sapply(1:3, **function**(x) x^2)

## [1] 1 4 9

lapply(1:3, **function**(x) x^2)

## [[1]]

## [1] 1

##

## [[2]]

## [1] 4

##

## [[3]]

## [1] 9

sapply(1:3, **function**(x) mean(m[,x]))

## [1] -0.1154391 1.9773260 4.7891772

sapply(1:3, **function**(x, y) mean(y[,x]), y=m)

## [1] -0.1154391 1.9773260 4.7891772

**library**(tidyverse)

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

## v ggplot2 3.0.0 v purrr 0.2.5

## v tibble 1.4.2 v dplyr 0.7.6

## v tidyr 0.8.1 v stringr 1.3.1

## v readr 1.1.1 v forcats 0.3.0

## -- Conflicts ------------------------------------------------ tidyverse\_conflicts() --

## x dplyr::between() masks data.table::between()

## x tidyr::complete() masks mice::complete()

## x dplyr::filter() masks stats::filter()

## x dplyr::first() masks data.table::first()

## x dplyr::lag() masks stats::lag()

## x dplyr::last() masks data.table::last()

## x purrr::transpose() masks data.table::transpose()

**library**(ggmap)

## Warning: package 'ggmap' was built under R version 3.5.1

**library**(readxl)

**library**(kableExtra)

## Warning: package 'kableExtra' was built under R version 3.5.1

**library**(knitr)

str(COBRA\_YTD2017)

## 'data.frame': 26759 obs. of 23 variables:

## $ MI\_PRINX : int 8924155 8924156 8924157 8924158 8924159 8924160 8924161 8924162 8924163 8924164 ...

## $ offense\_id : num 1.74e+08 1.74e+08 1.74e+08 1.74e+08 1.74e+08 ...

## $ rpt\_date : Factor w/ 365 levels "1/1/2017","1/10/2017",..: 117 117 117 117 117 117 117 117 117 117 ...

## $ occur\_date : Factor w/ 471 levels "1/1/2008","1/1/2015",..: 174 145 174 174 176 174 176 176 174 176 ...

## $ occur\_time : Factor w/ 1355 levels "","0:00:00","0:01:00",..: 955 290 883 763 43 940 112 2 2 2 ...

## $ poss\_date : Factor w/ 412 levels "1/1/2015","1/1/2017",..: 147 145 147 147 147 147 147 147 147 147 ...

## $ poss\_time : Factor w/ 1434 levels "","0:00:00","0:01:00",..: 32 902 62 68 50 88 121 722 1024 1056 ...

## $ beat : int 510 501 303 507 409 612 605 603 605 304 ...

## $ apt\_office\_prefix: Factor w/ 88 levels "","#8","1","10",..: 1 1 1 1 1 1 1 1 1 1 ...

## $ apt\_office\_num : Factor w/ 2044 levels "","#5","]","`",..: 1 1 1 1 1 1 213 1 1 1372 ...

## $ location : Factor w/ 13865 levels ": 565 Main St NE",..: 9394 1133 10955 7860 5557 1525 8250 9706 9456 455 ...

## $ MinOfucr : int 640 640 640 640 640 650 311 640 640 531 ...

## $ MinOfibr\_code : Factor w/ 68 levels "","1101","1101A",..: 51 51 51 51 51 50 30 51 51 42 ...

## $ dispo\_code : Factor w/ 8 levels "","10","20","30",..: 1 1 1 1 1 1 1 1 1 1 ...

## $ MaxOfnum\_victims : int 2 1 1 1 2 1 1 1 1 1 ...

## $ Shift : Factor w/ 4 levels "Day","Eve","Morn",..: 3 4 3 2 3 3 3 3 4 3 ...

## $ Avg.Day : Factor w/ 8 levels "Fri","Mon","Sat",..: 3 7 3 3 4 4 4 4 3 4 ...

## $ loc\_type : int 13 13 18 18 18 18 26 18 13 26 ...

## $ UC2.Literal : Factor w/ 11 levels "AGG ASSAULT",..: 6 6 6 6 6 6 10 6 6 4 ...

## $ neighborhood : Factor w/ 239 levels "","Adair Park",..: 80 117 145 64 3 83 103 164 103 175 ...

## $ npu : Factor w/ 26 levels "","A","B","C",..: 14 6 22 14 19 23 23 14 23 22 ...

## $ x : num -84.4 -84.4 -84.4 -84.4 -84.5 ...

## $ y : num 33.8 33.8 33.7 33.8 33.7 ...

COBRA\_YTD2017$long <- COBRA\_YTD2017$x %>%

as.numeric()

COBRA\_YTD2017$lat <- COBRA\_YTD2017$y %>%

as.numeric()

COBRA\_YTD2017$loc\_type <- COBRA\_YTD2017$UC2.Literal %>% as.factor()

COBRA\_YTD2017$days <- COBRA\_YTD2017$Avg.Day %>%

as.factor()

kable(count(COBRA\_YTD2017, loc\_type, sort=TRUE), "html", col.names=c("Crime Type", "Frequency")) %>%

kable\_styling(bootstrap\_options="striped", full\_width=FALSE)

| **Crime Type** | **Frequency** |
| --- | --- |
| LARCENY-FROM VEHICLE | 9840 |
| LARCENY-NON VEHICLE | 6589 |
| AUTO THEFT | 3197 |
| BURGLARY-RESIDENCE | 2635 |
| AGG ASSAULT | 2024 |
| ROBBERY-PEDESTRIAN | 1126 |
| BURGLARY-NONRES | 758 |
| RAPE | 226 |
| ROBBERY-COMMERCIAL | 157 |
| ROBBERY-RESIDENCE | 132 |
| HOMICIDE | 75 |

COBRA\_YTD2017 %>%

group\_by(days, loc\_type) %>%

summarize(freq=n()) %>%

ggplot(aes(reorder(days, -freq), freq)) +

geom\_bar(aes(fill=loc\_type), position="dodge", stat="identity", width=0.8, color="black") +

xlab("Day of Week") +

ylab("Frequency") +

labs(fill="Crime Type") +

ggtitle("Crime by Day of the Week")

kable

## function (x, format, digits = getOption("digits"), row.names = NA,

## col.names = NA, align, caption = NULL, format.args = list(),

## escape = TRUE, ...)

## {

## if (missing(format) || is.null(format))

## format = getOption("knitr.table.format")

## if (is.null(format))

## format = if (is.null(pandoc\_to()))

## switch(out\_format() %n% "markdown", latex = "latex",

## listings = "latex", sweave = "latex", html = "html",

## markdown = "markdown", rst = "rst", stop("table format not implemented yet!"))

## else if (isTRUE(opts\_knit$get("kable.force.latex")) &&

## is\_latex\_output()) {

## "latex"

## }

## else "pandoc"

## if (is.function(format))

## format = format()

## if (format != "latex" && !missing(align) && length(align) ==

## 1L)

## align = strsplit(align, "")[[1]]

## if (!is.null(caption) && !is.na(caption))

## caption = paste0(create\_label("tab:", opts\_current$get("label"),

## latex = (format == "latex")), caption)

## if (inherits(x, "list")) {

## if (format == "pandoc" && is\_latex\_output())

## format = "latex"

## res = lapply(x, kable, format = format, digits = digits,

## row.names = row.names, col.names = col.names, align = align,

## caption = NA, format.args = format.args, escape = escape,

## ...)

## res = unlist(lapply(res, paste, collapse = "\n"))

## res = if (format == "latex") {

## kable\_latex\_caption(res, caption)

## }

## else if (format == "html" || (format == "pandoc" && is\_html\_output()))

## kable\_html(matrix(paste0("\n\n", res, "\n\n"), 1),

## caption = caption, escape = FALSE, table.attr = "class=\"kable\_wrapper\"")

## else {

## res = paste(res, collapse = "\n\n")

## if (format == "pandoc")

## kable\_pandoc\_caption(res, caption)

## else res

## }

## return(structure(res, format = format, class = "knitr\_kable"))

## }

## if (!is.matrix(x))

## x = as.data.frame(x)

## if (identical(col.names, NA))

## col.names = colnames(x)

## m = ncol(x)

## isn = if (is.matrix(x))

## rep(is.numeric(x), m)

## else sapply(x, is.numeric)

## if (missing(align) || (format == "latex" && is.null(align)))

## align = ifelse(isn, "r", "l")

## digits = rep(digits, length.out = m)

## for (j in seq\_len(m)) {

## if (is\_numeric(x[, j]))

## x[, j] = round(x[, j], digits[j])

## }

## if (any(isn)) {

## if (is.matrix(x)) {

## if (is.table(x) && length(dim(x)) == 2)

## class(x) = "matrix"

## x = format\_matrix(x, format.args)

## }

## else x[, isn] = format\_args(x[, isn], format.args)

## }

## if (is.na(row.names))

## row.names = has\_rownames(x)

## if (!is.null(align))

## align = rep(align, length.out = m)

## if (row.names) {

## x = cbind(` ` = rownames(x), x)

## if (!is.null(col.names))

## col.names = c(" ", col.names)

## if (!is.null(align))

## align = c("l", align)

## }

## n = nrow(x)

## x = replace\_na(to\_character(as.matrix(x)), is.na(x))

## if (!is.matrix(x))

## x = matrix(x, nrow = n)

## x = trimws(x)

## colnames(x) = col.names

## if (format != "latex" && length(align) && !all(align %in%

## c("l", "r", "c")))

## stop("'align' must be a character vector of possible values 'l', 'r', and 'c'")

## attr(x, "align") = align

## res = do.call(paste("kable", format, sep = "\_"), list(x = x,

## caption = caption, escape = escape, ...))

## structure(res, format = format, class = "knitr\_kable")

## }

## <bytecode: 0x0000000024a52558>

## <environment: namespace:knitr>

*#The data provides crime type frequency and crime by day of the week.#Among the high crime categories, larceny tend to increase on Fridays and Saturdays. while burglary residence generally occurred more often during the weekdays than the weekends. Auto theft were least reported on Thursdays and increase for the weekends.*

atlanta\_map <- qmap("atlanta",

zoom=12,

**source**="stamen",

maptype="toner",

color="bw")

## Map from URL : http://maps.googleapis.com/maps/api/staticmap?center=atlanta&zoom=12&size=640x640&scale=2&maptype=terrain&sensor=false

## Information from URL : http://maps.googleapis.com/maps/api/geocode/json?address=atlanta&sensor=false

## Map from URL : http://tile.stamen.com/toner/12/1086/1638.png

## Map from URL : http://tile.stamen.com/toner/12/1087/1638.png

## Map from URL : http://tile.stamen.com/toner/12/1088/1638.png

## Map from URL : http://tile.stamen.com/toner/12/1089/1638.png

## Map from URL : http://tile.stamen.com/toner/12/1086/1639.png

## Map from URL : http://tile.stamen.com/toner/12/1087/1639.png

## Map from URL : http://tile.stamen.com/toner/12/1088/1639.png

## Map from URL : http://tile.stamen.com/toner/12/1089/1639.png

## Map from URL : http://tile.stamen.com/toner/12/1086/1640.png

## Map from URL : http://tile.stamen.com/toner/12/1087/1640.png

## Map from URL : http://tile.stamen.com/toner/12/1088/1640.png

## Map from URL : http://tile.stamen.com/toner/12/1089/1640.png

## Warning: `panel.margin` is deprecated. Please use `panel.spacing` property

## instead

atlanta\_map

## Theme element panel.border missing

## Theme element axis.line.x.bottom missing

## Theme element axis.ticks.x.bottom missing

## Theme element axis.line.x.top missing

## Theme element axis.ticks.x.top missing

## Theme element axis.line.y.left missing

## Theme element axis.ticks.y.left missing

## Theme element axis.line.y.right missing

## Theme element axis.ticks.y.right missing

## Theme element plot.title missing

## Theme element plot.subtitle missing

## Theme element plot.tag missing

## Theme element plot.caption missing

**library**(dplyr)

**library**(data.table)

**library**(ggplot2)

at <- COBRA\_YTD2017

str(at)

## 'data.frame': 26759 obs. of 26 variables:

## $ MI\_PRINX : int 8924155 8924156 8924157 8924158 8924159 8924160 8924161 8924162 8924163 8924164 ...

## $ offense\_id : num 1.74e+08 1.74e+08 1.74e+08 1.74e+08 1.74e+08 ...

## $ rpt\_date : Factor w/ 365 levels "1/1/2017","1/10/2017",..: 117 117 117 117 117 117 117 117 117 117 ...

## $ occur\_date : Factor w/ 471 levels "1/1/2008","1/1/2015",..: 174 145 174 174 176 174 176 176 174 176 ...

## $ occur\_time : Factor w/ 1355 levels "","0:00:00","0:01:00",..: 955 290 883 763 43 940 112 2 2 2 ...

## $ poss\_date : Factor w/ 412 levels "1/1/2015","1/1/2017",..: 147 145 147 147 147 147 147 147 147 147 ...

## $ poss\_time : Factor w/ 1434 levels "","0:00:00","0:01:00",..: 32 902 62 68 50 88 121 722 1024 1056 ...

## $ beat : int 510 501 303 507 409 612 605 603 605 304 ...

## $ apt\_office\_prefix: Factor w/ 88 levels "","#8","1","10",..: 1 1 1 1 1 1 1 1 1 1 ...

## $ apt\_office\_num : Factor w/ 2044 levels "","#5","]","`",..: 1 1 1 1 1 1 213 1 1 1372 ...

## $ location : Factor w/ 13865 levels ": 565 Main St NE",..: 9394 1133 10955 7860 5557 1525 8250 9706 9456 455 ...

## $ MinOfucr : int 640 640 640 640 640 650 311 640 640 531 ...

## $ MinOfibr\_code : Factor w/ 68 levels "","1101","1101A",..: 51 51 51 51 51 50 30 51 51 42 ...

## $ dispo\_code : Factor w/ 8 levels "","10","20","30",..: 1 1 1 1 1 1 1 1 1 1 ...

## $ MaxOfnum\_victims : int 2 1 1 1 2 1 1 1 1 1 ...

## $ Shift : Factor w/ 4 levels "Day","Eve","Morn",..: 3 4 3 2 3 3 3 3 4 3 ...

## $ Avg.Day : Factor w/ 8 levels "Fri","Mon","Sat",..: 3 7 3 3 4 4 4 4 3 4 ...

## $ loc\_type : Factor w/ 11 levels "AGG ASSAULT",..: 6 6 6 6 6 6 10 6 6 4 ...

## $ UC2.Literal : Factor w/ 11 levels "AGG ASSAULT",..: 6 6 6 6 6 6 10 6 6 4 ...

## $ neighborhood : Factor w/ 239 levels "","Adair Park",..: 80 117 145 64 3 83 103 164 103 175 ...

## $ npu : Factor w/ 26 levels "","A","B","C",..: 14 6 22 14 19 23 23 14 23 22 ...

## $ x : num -84.4 -84.4 -84.4 -84.4 -84.5 ...

## $ y : num 33.8 33.8 33.7 33.8 33.7 ...

## $ long : num -84.4 -84.4 -84.4 -84.4 -84.5 ...

## $ lat : num 33.8 33.8 33.7 33.8 33.7 ...

## $ days : Factor w/ 8 levels "Fri","Mon","Sat",..: 3 7 3 3 4 4 4 4 3 4 ...

at$MI\_PRINX <- at$apt\_office\_prefix <- at$apt\_office\_num <- at$location <- at$dispo\_code <- at$loc\_type <- at$npu <- NULL

**library**(chron)

**library**(lubridate)

##

## Attaching package: 'lubridate'

## The following objects are masked from 'package:chron':

##

## days, hours, minutes, seconds, years

## The following objects are masked from 'package:data.table':

##

## hour, isoweek, mday, minute, month, quarter, second, wday,

## week, yday, year

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

##

## date

at$lon <- at$x

at$lat <- at$y

at$occur\_date <- mdy(at$occur\_date)

at$rpt\_date <- mdy(at$rpt\_date)

at$occur\_time <- chron(times=at$occur\_time)

at$lon <- as.numeric(at$lon)

at$lat <- as.numeric(at$lat)

at$x <- at$y <- NULL

**library**(xts)

## 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:dplyr':

##

## first, last

## The following objects are masked from 'package:data.table':

##

## first, last

by\_Date <- na.omit(at) %>% group\_by(occur\_date) %>% summarise(Total = n())

tseries <- xts(by\_Date$Total, order.by= by\_Date$occur\_date)

**library**(highcharter)

## Warning: package 'highcharter' was built under R version 3.5.1

## Highcharts (www.highcharts.com) is a Highsoft software product which is

## not free for commercial and Governmental use

hchart(tseries, name = "Crimes") %>%

hc\_add\_theme(hc\_theme\_darkunica()) %>%

hc\_credits(enabled = TRUE, text = "Sources: Atlanta Police Department", style = list(fontSize = "12px")) %>%

hc\_title(text = "Time Series of Atlanta Crimes") %>%

hc\_legend(enabled = TRUE)



Zoom1m3m6mYTD1yAllFromDec 30, 1916ToDec 31, 2017Time Series of Atlanta CrimesCrimes201620160255075100125Sources: Atlanta Police Department

hchart

## function (object, ...)

## {

## UseMethod("hchart")

## }

## <bytecode: 0x0000000021bb6d30>

## <environment: namespace:highcharter>

*#Graph provides the data spread of the crime during the year*

at$dayofWeek <- weekdays(as.Date(at$occur\_date))

at$hour <- sub(":.\*", "", at$occur\_time)

at$hour <- as.numeric(at$hour)

ggplot(aes(x = hour), data = at) + geom\_histogram(bins = 24, color='white', fill='black') +

ggtitle('Histogram of Crime Time')

## Warning: Removed 11 rows containing non-finite values (stat\_bin).

*#The crime time distribution appears bimodal with peaking around midnight and again at the noon, then again between 6pm and 8pm.*

*#topCrimes\_1 <- topCrimes %>% group\_by(`UC2 Literal`,occur\_time) %>%*

*#summarise(total = n())*

*#ggplot(aes(x = occur\_time, y = total), data = topCrimes\_1) +*

*#geom\_point(colour="blue", size=1) +*

*#geom\_smooth(method="loess") +*

*#xlab('Hour(24 hour clock)') +*

*# ylab('Number of Crimes') +*

*#ggtitle('Top Crimes Time of the Day') +*

*#facet\_wrap(~`UC2 Literal`)*

*#Downtown and midtown are the most common locations where crimes take place, followed by Old Fourth Ward and West End.*

topLocations <- subset(at, neighborhood =="Downtown"|neighborhood =="Midtown" | neighborhood=="Old Fourth Ward" | neighborhood=="West End" | neighborhood=="Vine City" | neighborhood=="North Buckhead")

topLocations <- within(topLocations, neighborhood <- factor(neighborhood, levels = names(sort(table(neighborhood), decreasing = T))))

topLocations$days <- ordered(topLocations$days,

levels = c('Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday', 'Saturday', 'Sunday'))

ggplot(data = topLocations, aes(x = days, fill = neighborhood)) +

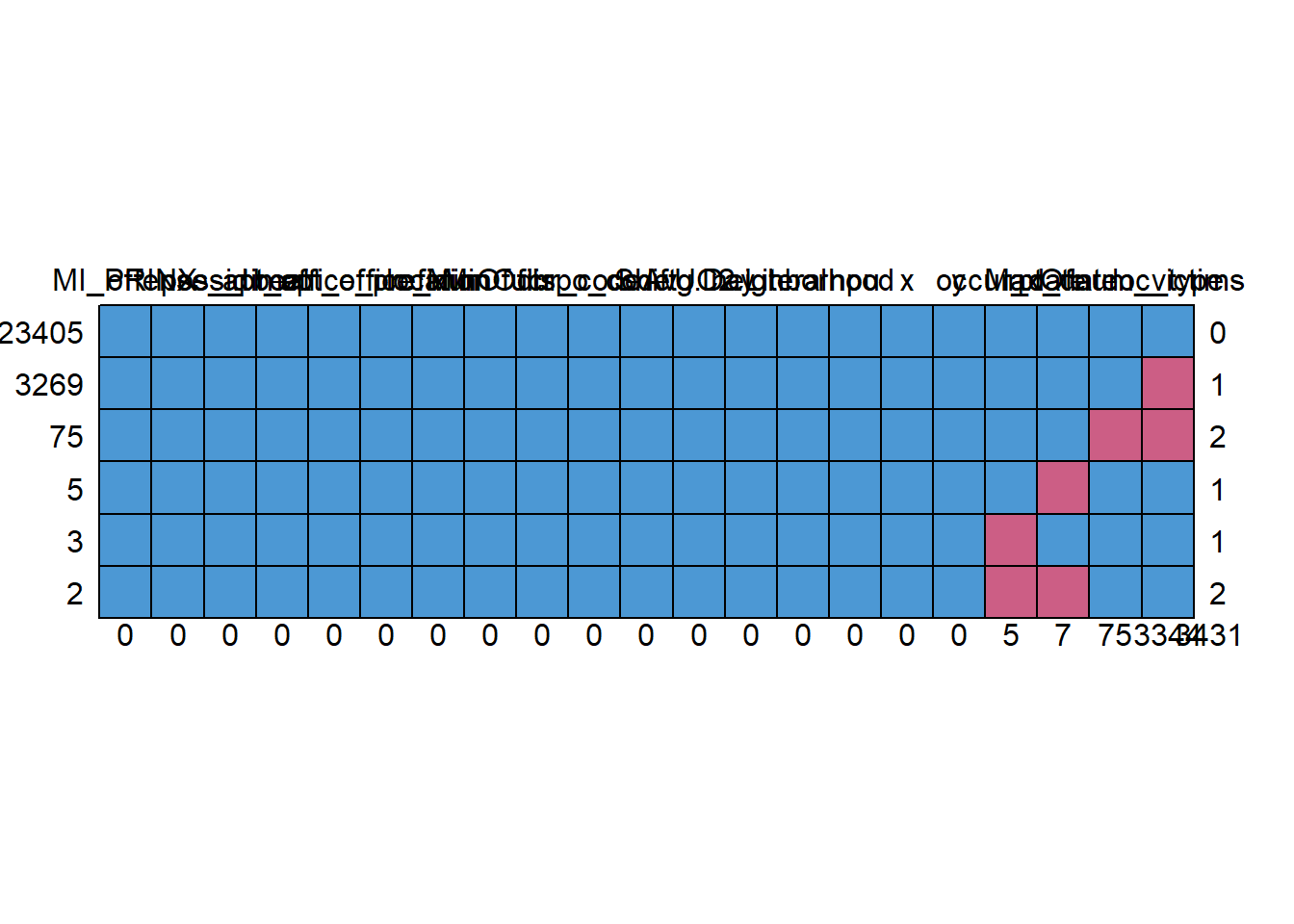
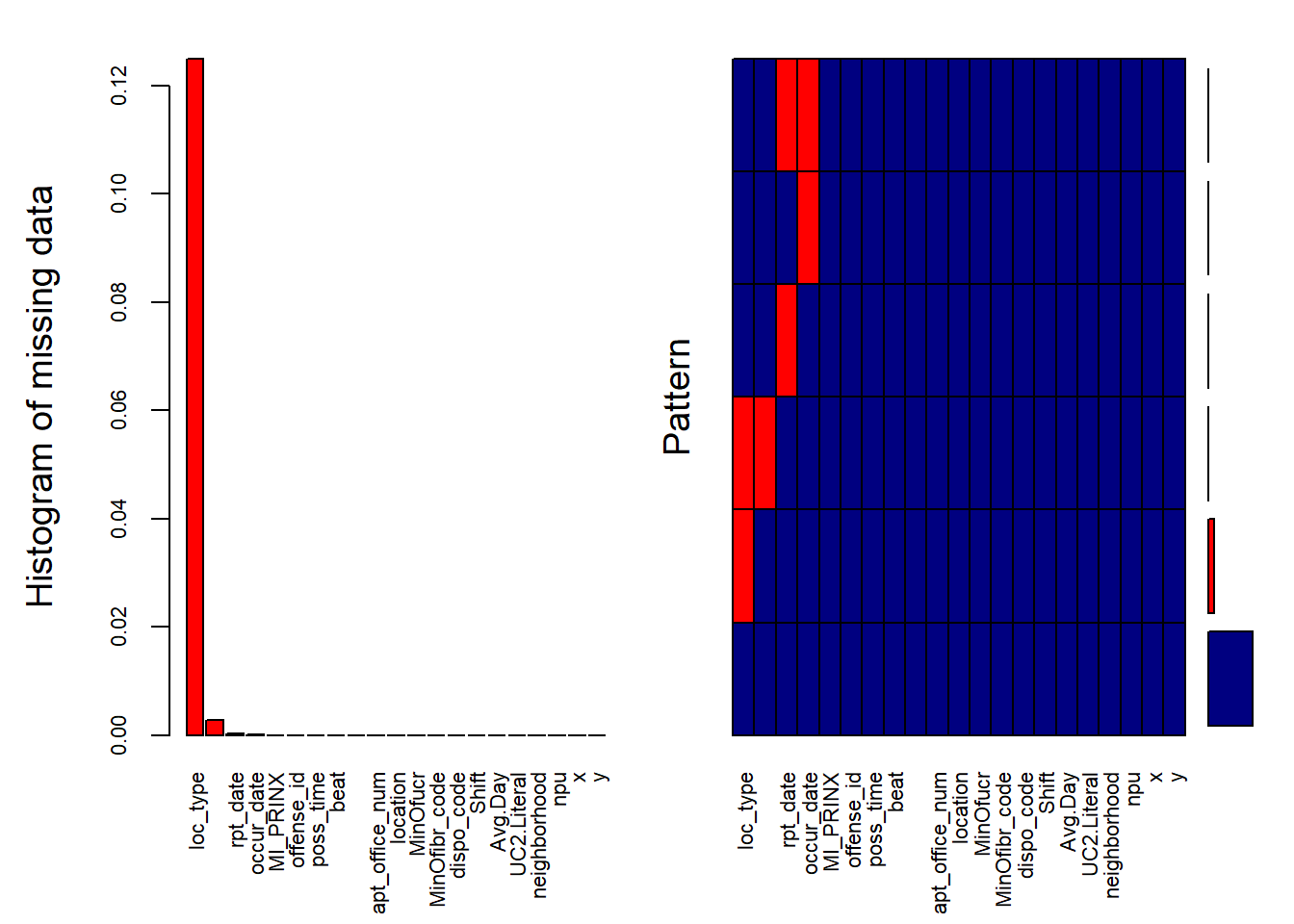
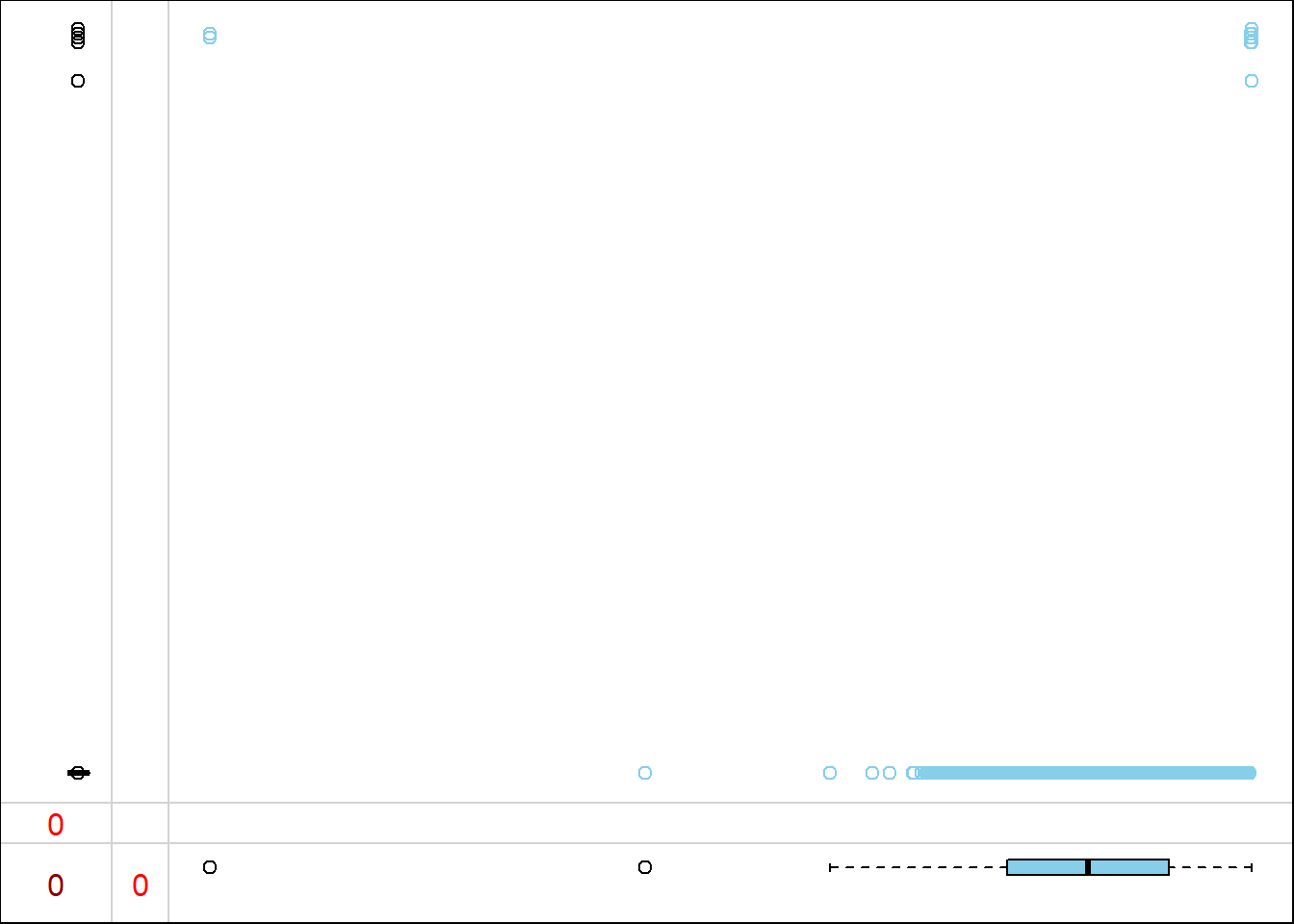
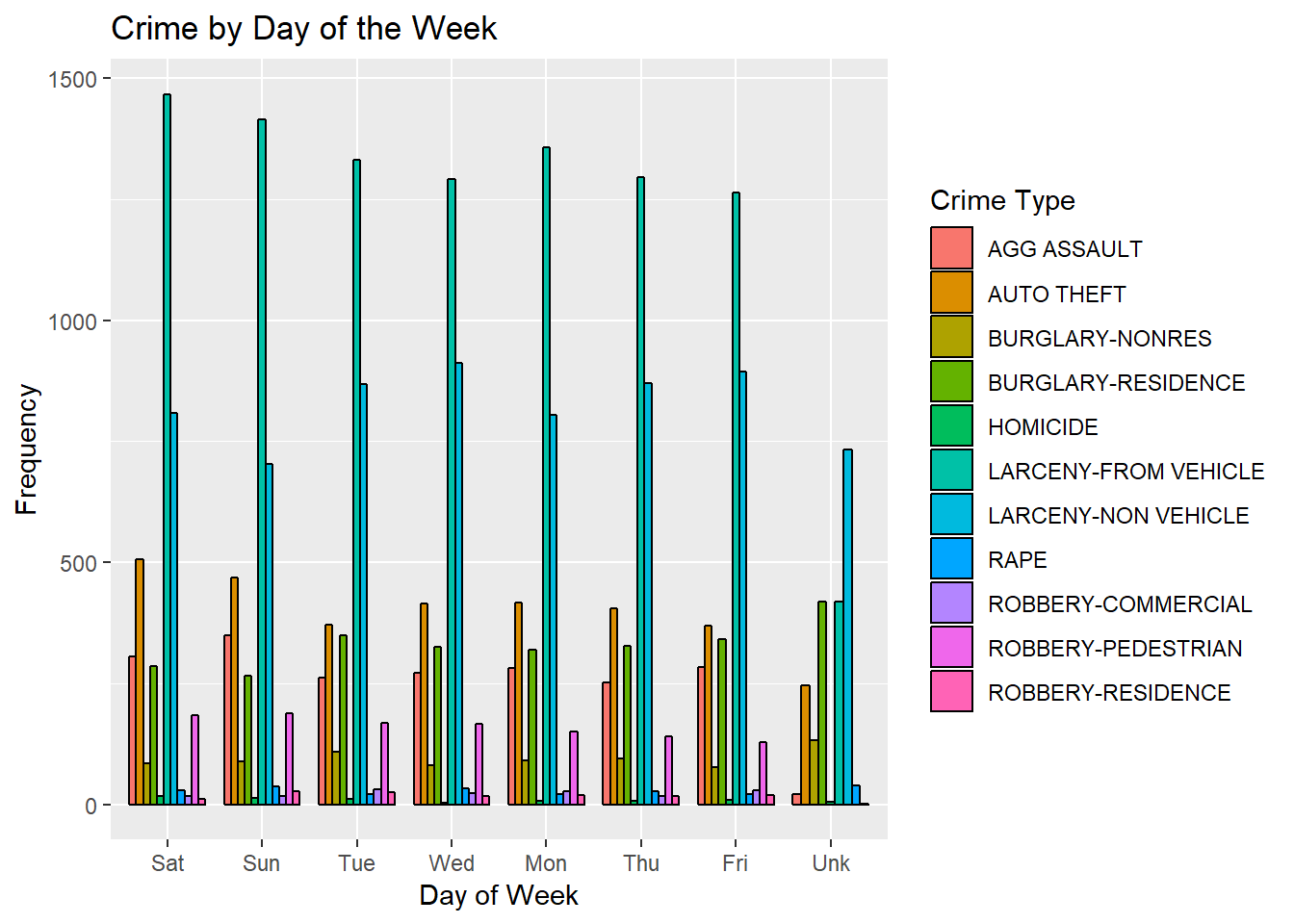
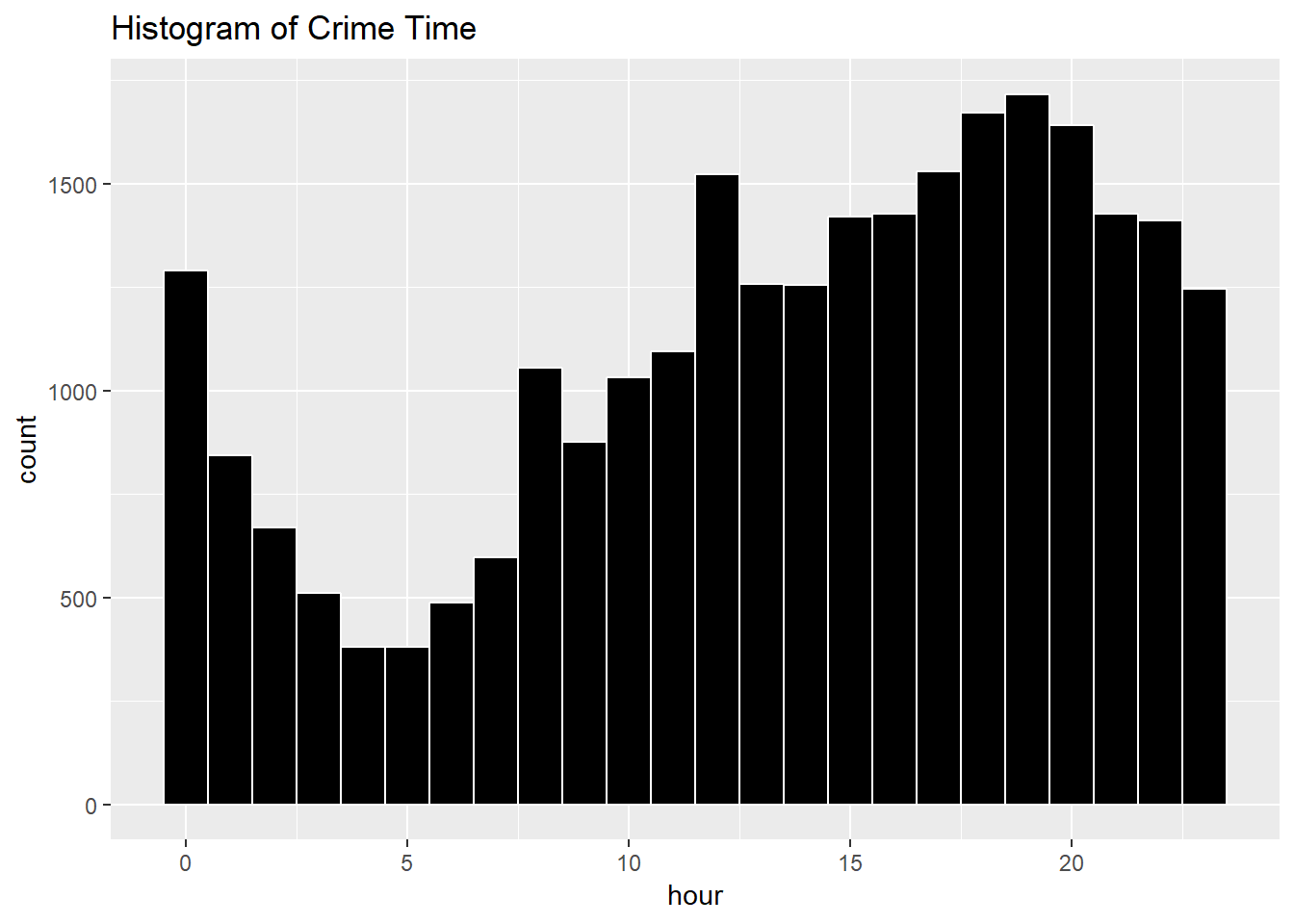
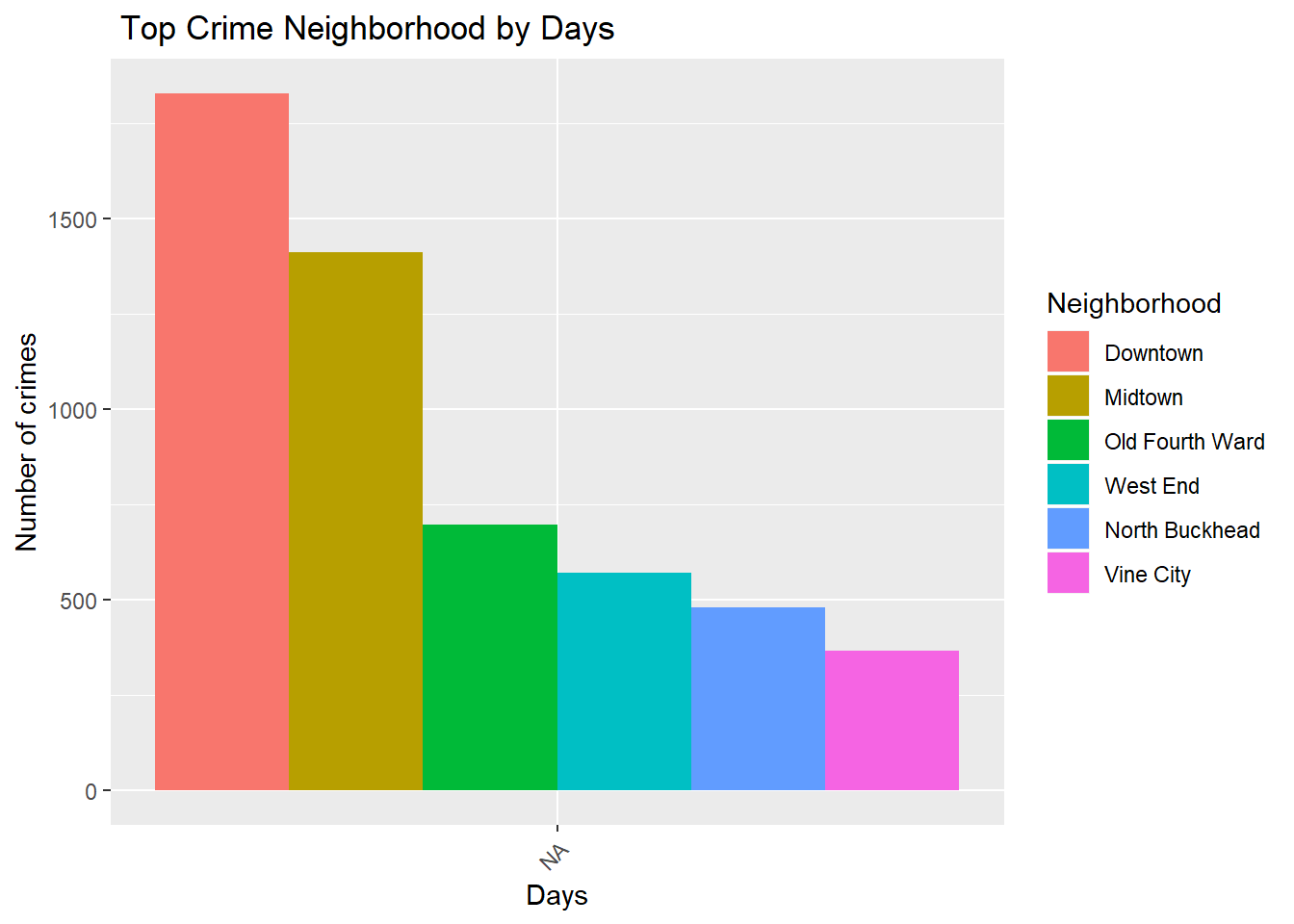
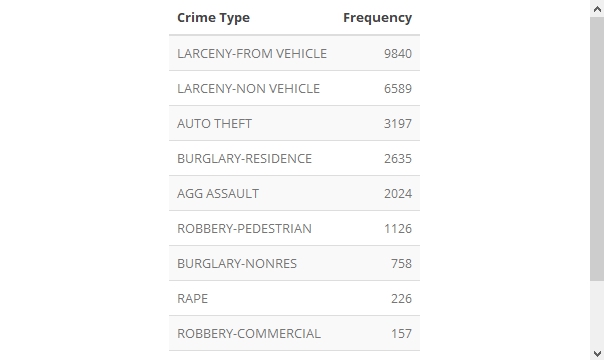
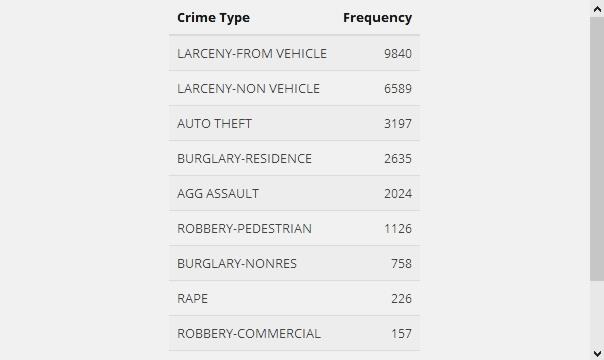
geom\_bar(width = 0.9, position = position\_dodge()) + ggtitle(" Top Crime Neighborhood by Days") +

labs(x = "Days", y = "Number of crimes", fill = guide\_legend(title = "Neighborhood")) + theme(axis.text.x = element\_text(angle = 45, hjust = 1))

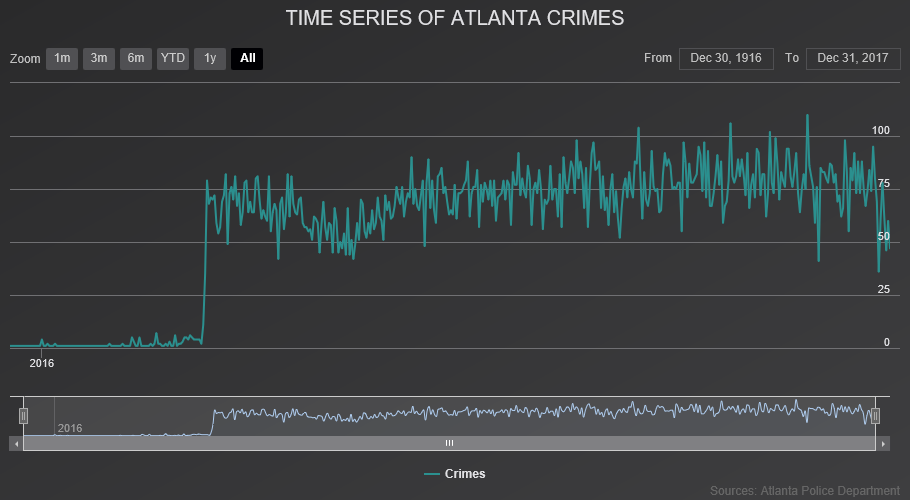
*#among the high crime categories, larceny tend to increase on Fridays and Saturdays. while burglary residence generally occurred more often during the weekdays than the weekends. Auto theft were least reported on Thursdays and increase for the weekends.*

Plots and graphs are attached in the HTML document attached along with the session 13 Assignment```

**Visualize the correlation between all variables in a meaningful and clear way of representing. Find out top 3 reasons for having more crime in a city.**

****

**Time series graphs for crime during the period**



What is the difference between co-variance and correlation? Take an example from this dataset and show the differences if any?

**Covariance** and **Correlation** are two mathematical concepts which are quite commonly used in business statistics. Both of these two determine the relationship and measures the dependency between two random variables. Despite, some similarities between these two mathematical terms, they are different from each other. Correlation is when the change in one item may result in the change in another item.

Correlation is considered as the best tool for for measuring and expressing the quantitative relationship between two variables in formula. On the other hand, covariance is when two items vary together. Read the given article to know the differences between covariance and correlation.

| **BASIS FOR COMPARISON** | **COVARIANCE** | **CORRELATION** |
| --- | --- | --- |
| Meaning | Covariance is a measure indicating the extent to which two random variables change in tandem. | Correlation is a statistical measure that indicates how strongly two variables are related. |
| What is it? | Measure of correlation | Scaled version of covariance |
| Values | Lie between -∞ and +∞ | Lie between -1 and +1 |
| Change in scale | Affects covariance | Does not affects correlation |
| Unit free measure | No | Yes |

### Similarities

Both measures only linear relationship between two variables, i.e. when the correlation coefficient is zero, covariance is also zero. Further, the two measures are unaffected by the change in location.

Correlation is a special case of covariance which can be obtained when the data is standardized. Now, when it comes to making a choice, which is a better measure of the relationship between two variables*, correlation is preferred over covariance, because it remains unaffected by the change in location and scale, and can also be used to make a comparison between two pairs of variables.*

**Take an example from this dataset and show the differences if any?**

#Correlation & covariance

#Correlation & covariance

cor(COBRA\_YTD2017$x,COBRA\_YTD2017$y)

cov(COBRA\_YTD2017$x,COBRA\_YTD2017$y)

cor.test(COBRA\_YTD2017$x,COBRA\_YTD2017$y)

cor(COBRA\_YTD2017$long,COBRA\_YTD2017$lat)

cor.test(COBRA\_YTD2017$long,COBRA\_YTD2017$lat)

cov(COBRA\_YTD2017$long,COBRA\_YTD2017$lat)

plot(COBRA\_YTD2017$x,COBRA\_YTD2017$y)

mod=lm(COBRA\_YTD2017$long~COBRA\_YTD2017$lat)

summary(mod)

predict(mod)

pred= predict(mod)

COBRA\_YTD2017$predicted=NA

COBRA\_YTD2017$predicted=pred

COBRA\_YTD2017$error=COBRA\_YTD2017$residuals

library(car)

dwt(mod)

plot(COBRA\_YTD2017$long,COBRA\_YTD2017$lat,abline(COBRA\_YTD2017$long~COBRA\_YTD2017$lat),col='red')

**[1] -0.9998355**

**[1] -23.86342**

Pearson's product-moment correlation

data: COBRA\_YTD2017$x and COBRA\_YTD2017$y

t = -9017.2, df = 26757, p-value < 2.2e-16

alternative hypothesis: true correlation is not equal to 0

95 percent confidence interval:

-0.9998394 -0.9998315

sample estimates:

cor

-0.9998355

[1] -0.9998355

Pearson's product-moment correlation

data: COBRA\_YTD2017$long and COBRA\_YTD2017$lat

t = -9017.2, df = 26757, p-value < 2.2e-16

alternative hypothesis: true correlation is not equal to 0

95 percent confidence interval:

-0.9998394 -0.9998315

sample estimates:

cor

-0.9998355

[1] -23.86342

156 157 158 159 160

-84.42579683 -84.51468279 -84.35395817 -84.32176325 -84.62601522

161 162 163 164 165

-84.24112598 -84.34355981 -84.61686666 -84.52210662 -84.55457650

166 167 168 169 170

-84.41107415 -84.52540610 -84.43749498 -84.36698111 -84.53340484

171 172 173 174 175

-84.31936363 -84.41764811 -84.43677009 -84.36185692 -84.47736369

176 177 178 179 180

-84.42814646 -84.39302700 -84.11039662 -84.14436626 -84.41507352

181 182 183 184 185

-84.41789807 -84.39345193 -84.35360822 -84.39540163 -84.39000248

186 187 188 189 190

-84.31583919 -84.30746551 -84.54732764 -84.49833538 -84.40007589

191 192 193 194 195

-84.57079894 -84.27072131 -84.38625307 -84.52508115 -84.29791702

196 197 198 199 200

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201 202 203 204 205

-84.52418130 -84.35438310 -84.42687166 -84.39625149 -84.38500327

206 207 208 209 210

-0.02197167 -84.47451414 -84.48048819 -84.41507352 -84.29656723

211 212 213 214 215

-84.37737947 -84.39345193 -84.40407526 -84.39315198 -84.21048082

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-84.53747920 -84.53502958 -84.62551530 -84.39052740 -84.49731054

226 227 228 229 230

-84.42054766 -84.63816330 -84.53415472 -84.39392686 -84.41342378

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236 237 238 239 240

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241 242 243 244 245

-84.38017903 -84.26067290 -84.41802305 -84.40050082 -84.41952282

246 247 248 249 250

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266 267 268 269 270

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271 272 273 274 275

-84.30826538 -84.54475305 -84.39625149 -84.56537479 -84.35955728

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296 297 298 299 300

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386 387 388 389 390

-84.44069448 -84.39145225 -84.24954965 -84.37987908 -84.57672300

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401 402 403 404 405

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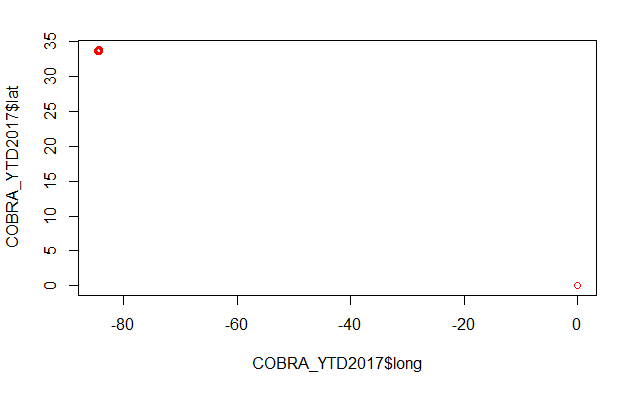
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[ reached get Option("max.print") -- omitted 25759 entries ]

lag Autocorrelation D-W Statistic p-value

1 0.02809992 1.943799 0

Alternative hypothesis: rho != 0



R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see [http://rmarkdown.rstudio.com](http://rmarkdown.rstudio.com/).

When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

summary(cars)

## speed dist

## Min. : 4.0 Min. : 2.00

## 1st Qu.:12.0 1st Qu.: 26.00

## Median :15.0 Median : 36.00

## Mean :15.4 Mean : 42.98

## 3rd Qu.:19.0 3rd Qu.: 56.00

## Max. :25.0 Max. :120.00

Including Plots

You can also embed plots, for example:

Note that the echo = FALSE parameter was added to the code chunk to prevent printing of the R code that generated the plot.