

crimedata Atlanta-Session13 assignment2

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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/seshan/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_offi
ce_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      : 1
42
## A      : 120  3393 PEACHTREE RD NE @LENOX MALL      : 1
40
## B      : 108  1275 CAROLINE ST NE @TARGET - CAROLINE : 1
36

```

```

## 1      : 61 3393 PEACHTREE RD NE      : 1
29

## 2      : 48 835 MARTIN L KING JR DR NW      : 1
08

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

## (Other): 4243 (Other)      :260
09

##      MinOfucr      MinOfibr_code      dispo_code      MaxOfnum_vict
ims
## 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 VEHI
CLE:9840
## Eve :9151 Sun      :3569 1st Qu.:13.00 LARCENY-NON VEHIC
LE :6589
## Morn:7014 Tue      :3542 Median :18.00 AUTO THEFT
:3197
## Unk :3712 Wed      :3539 Mean     :20.76 BURGLARY-RESIDENC
E :2635
##
##      Mon      :3492 3rd Qu.:20.00 AGG ASSAULT
:2024
##
##      Thu      :3455 Max.      :99.00 ROBBERY-PEDESTRIA
N :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          1
2.49673007

##          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 | ap t_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.Da y 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_victi ms 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 2.2097  
172 2.5066403
```

```
## [8] 1.3674533 1.2135926 2.3049017 1.5394682 2.4264711 2.3560  
555 1.4429536
```

```
## [15] 1.9525326 2.8921570 2.8218232 2.0948454 2.9282604 1.6813  
430 2.8007640
```

```
## [22] 2.4313354 2.7598386 2.5998863 3.1127215 2.0842223 1.5925  
865 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 N E",...: 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.fac
tor()

COBRA_YTD2017$days <- COBRA_YTD2017$Avg.Day %>%
  as.factor()

kable(count(COBRA_YTD2017, loc_type, sort=TRUE), "html", col.nam
es=c("Crime Type", "Frequency")) %>%
kable_styling(bootstrap_options="striped", full_width=FALSE)
```

Crime Type

Frequency

| 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 = "late
x",
##           listings = "latex", sweave = "latex", html =
"html",
##           markdown = "markdown", rst = "rst", stop("tab
le 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(aligned) || (format == "latex" && is.null(aligned)))
##         aligned = 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 burgla

ry 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/ge
ocode/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 89
24159 8924160 8924161 8924162 8924163 8924164 ...
##  $ offense_id    : num   1.74e+08 1.74e+08 1.74e+08 1.74e+0
8 1.74e+08 ...
##  $ rpt_date      : Factor w/ 365 levels "1/1/2017","1/10/2
017",...: 117 117 117 117 117 117 117 117 117 117 ...
##  $ occur_date    : Factor w/ 471 levels "1/1/2008","1/1/20
15",...: 174 145 174 174 176 174 176 176 174 176 ...
##  $ occur_time    : Factor w/ 1355 levels "", "0:00:00", "0:0
1:00",...: 955 290 883 763 43 940 112 2 2 2 ...
##  $ poss_date     : Factor w/ 412 levels "1/1/2015","1/1/20
17",...: 147 145 147 147 147 147 147 147 147 147 ...
##  $ poss_time     : Factor w/ 1434 levels "", "0:00:00", "0:0
1:00",...: 32 902 62 68 50 88 121 722 1024 1056 ...
```

```
## $ beat : int 510 501 303 507 409 612 605 603 60
5 304 ...

## $ 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 N
E",...: 9394 1133 10955 7860 5557 1525 8250 9706 9456 455 ...

## $ MinOfucr : int 640 640 640 640 640 650 311 640 64
0 531 ...

## $ 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$MI_PRINX <- at$aapt_office_prefix <- at$aapt_office_num <- at$l
ocation <- 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")
```

```

"West End" | neighborhood=="Vine City" | neighborhood=="North Bu
ckhead")

topLocations <- within(topLocations, neighborhood <- factor(nei
ghborhood, 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(t
itle = "Neighborhood")) + theme(axis.text.x = element_text(angle
= 45, hjust = 1))

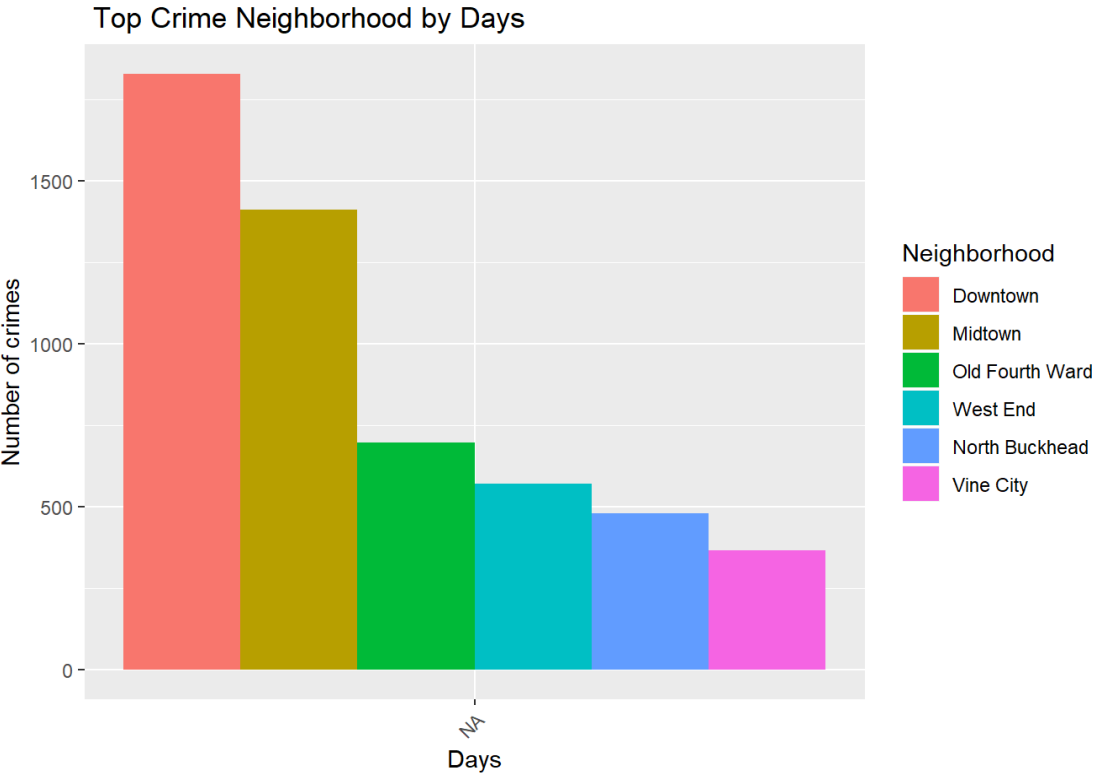
```

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

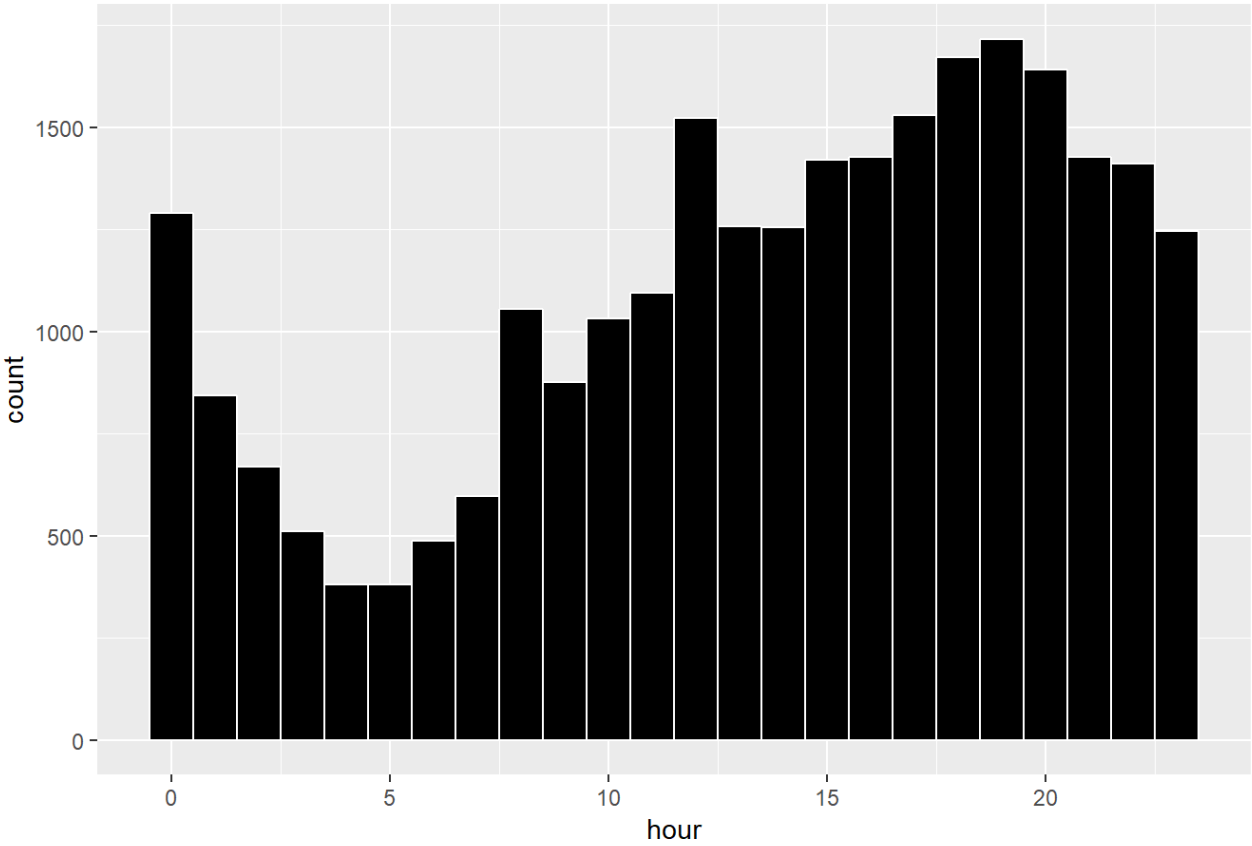
Plots and graphs are attached in the HTML document attached along with the session 13
Assignment``

**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.**

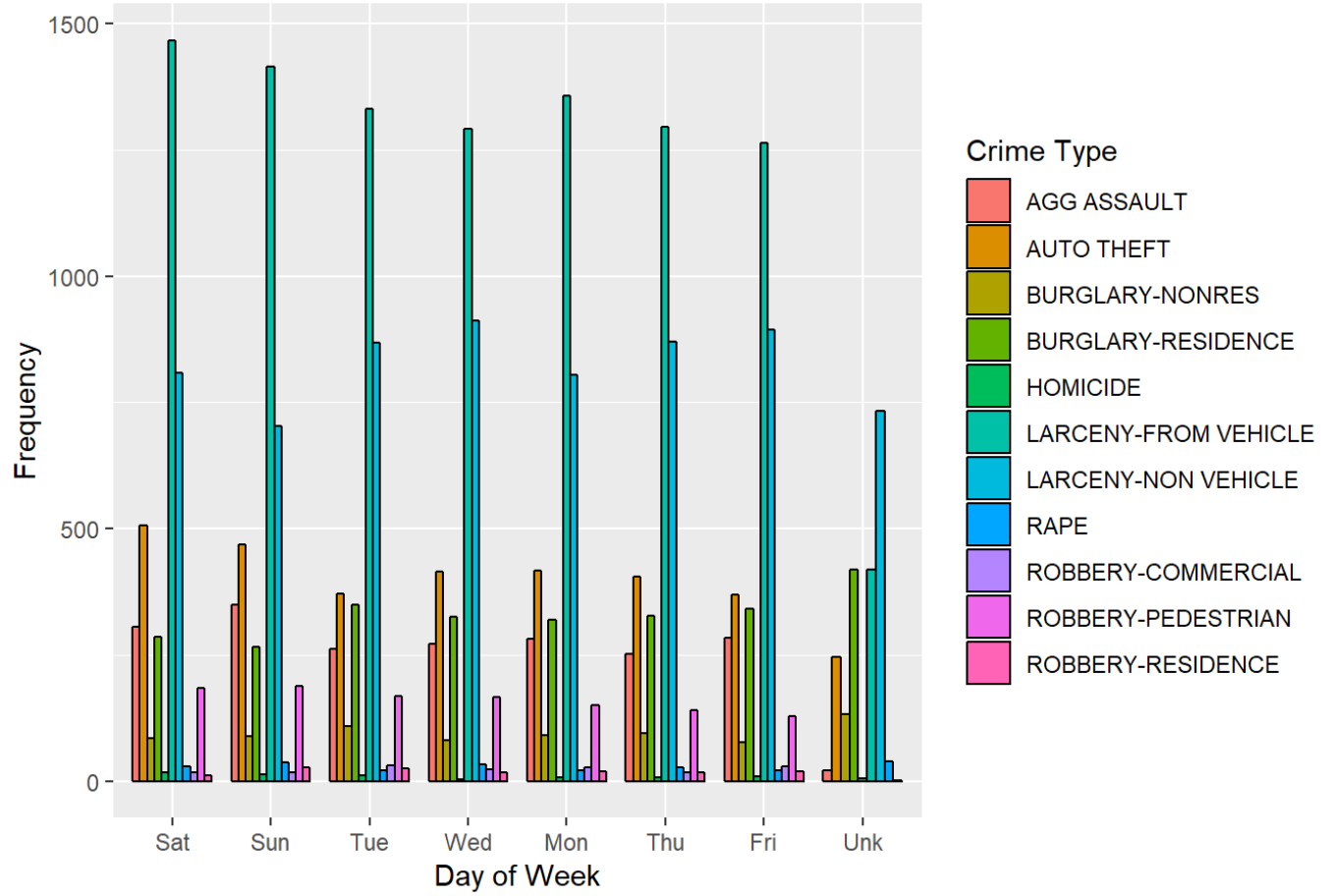
| Crime Type | Frequency |
|----------------------|-----------|
| LARCENY-FROM VEHICLE | 9840 |
| LARCENY-NON VEHICLE | 6589 |
| AUTO THEFT | 3197 |
| BURGLARY-RESIDENCE | 2635 |
| AGG ASSAULT | 2024 |
| ROBBERY-PEDESTRIAN | 1126 |
| BURGLARY-NONRES | 758 |
| RAPE | 226 |
| ROBBERY-COMMERCIAL | 157 |

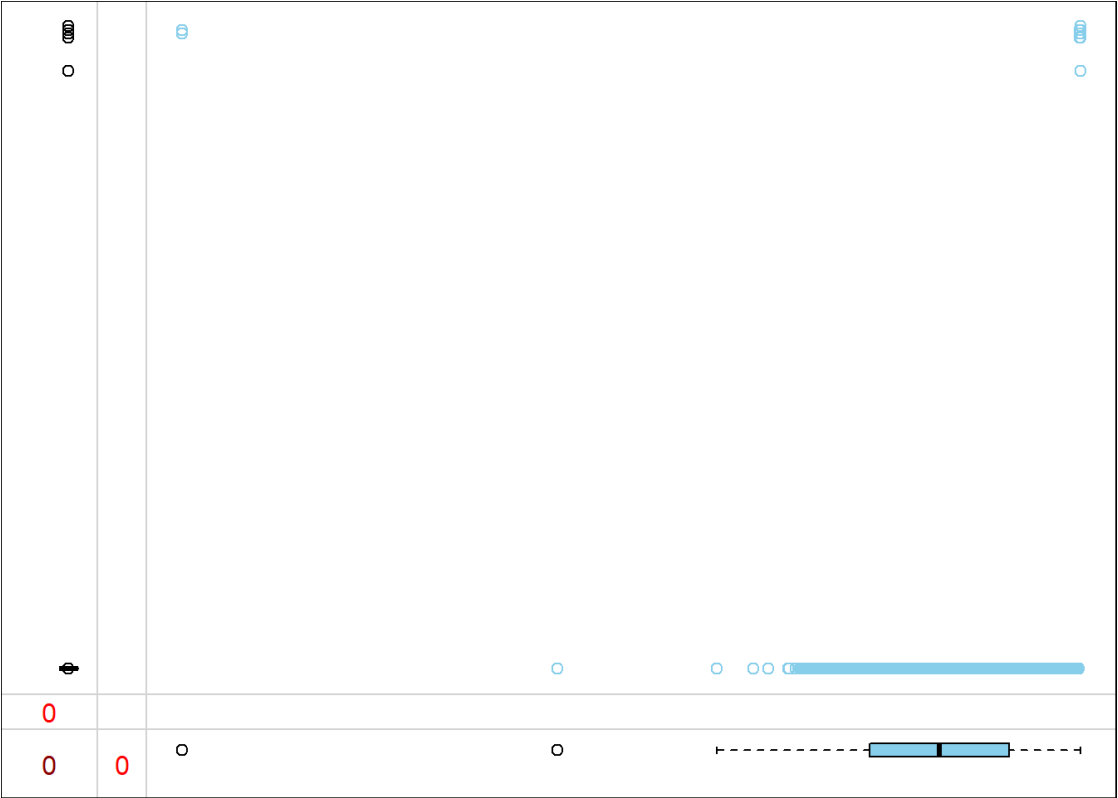


Histogram of Crime Time

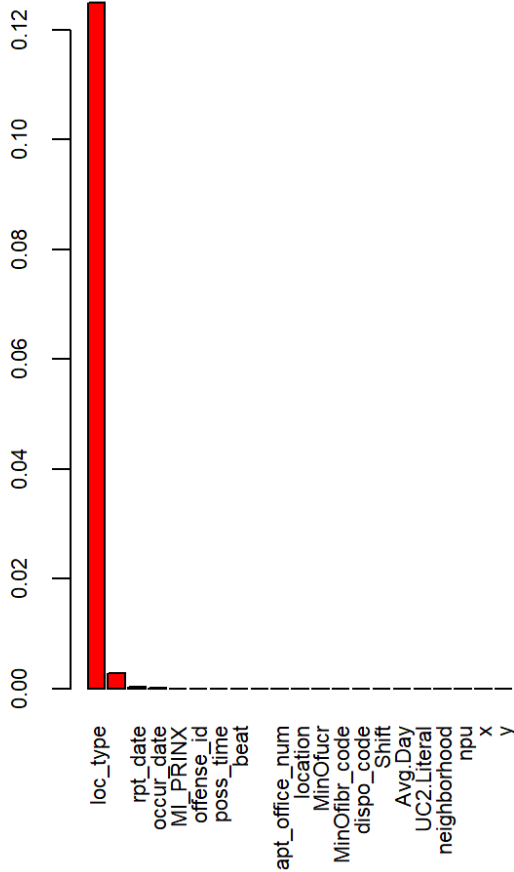


Crime by Day of the Week

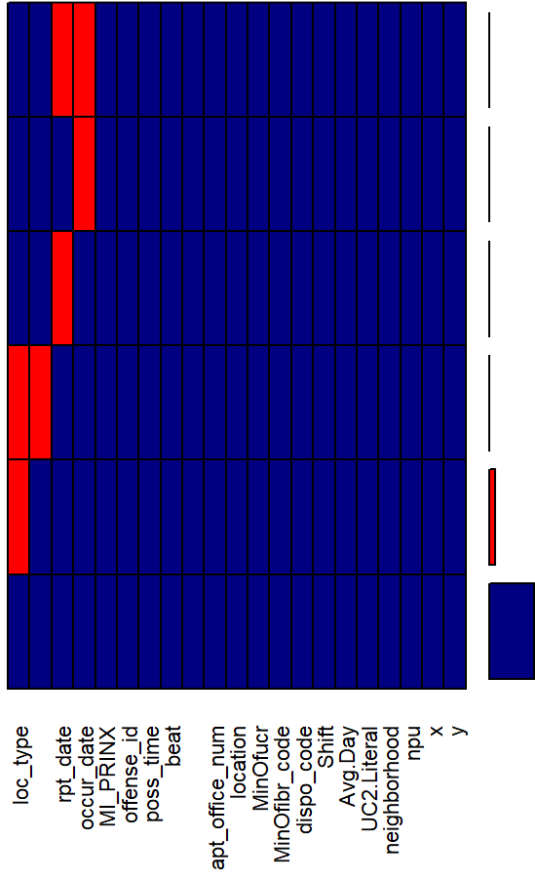


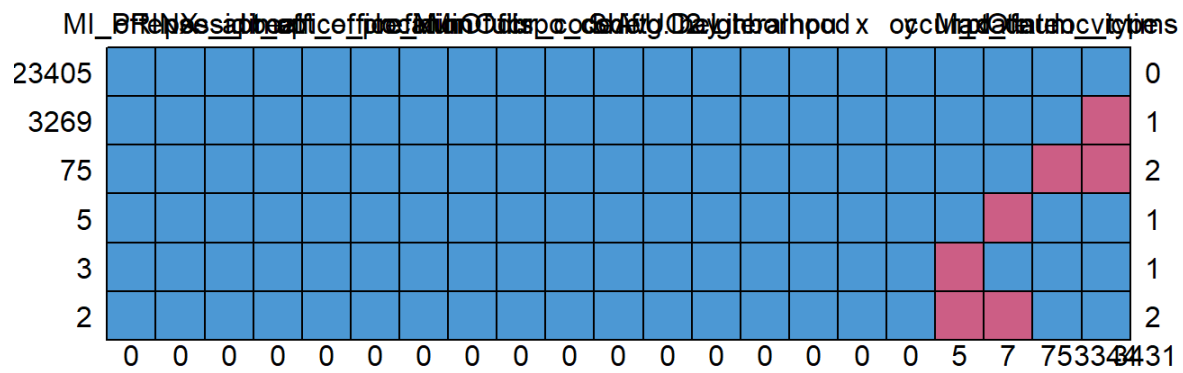


Histogram of missing data



Pattern



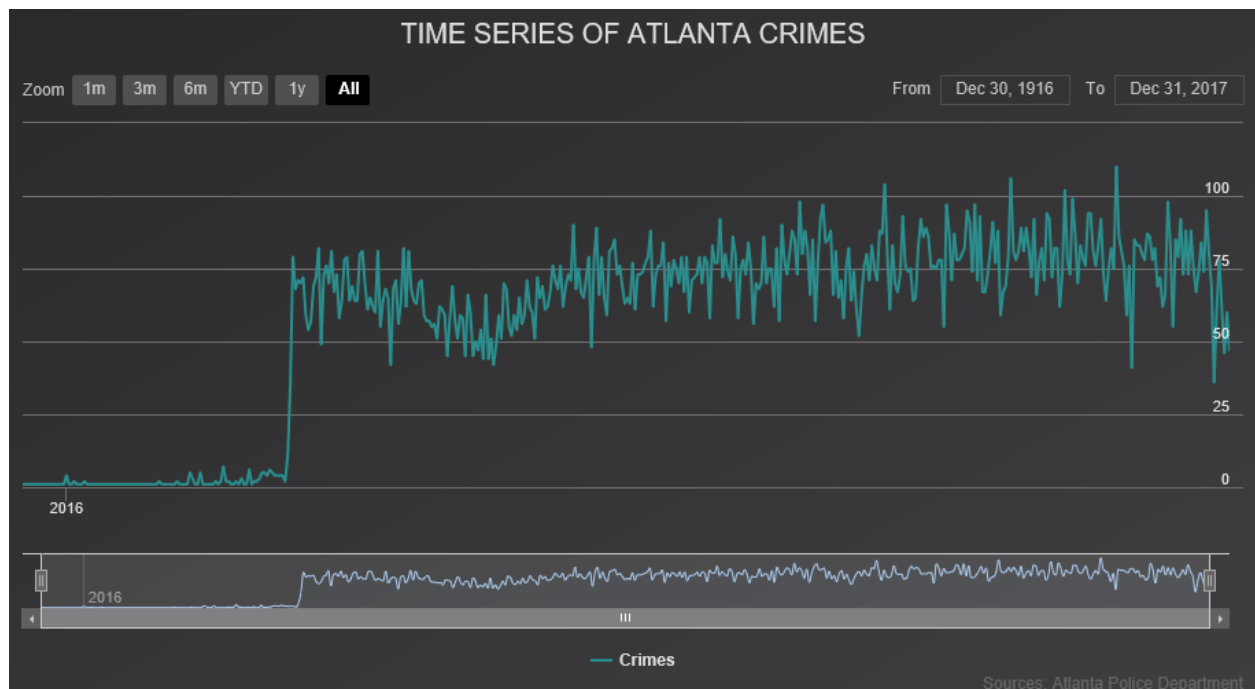


| Crime Type | Frequency |
|----------------------|-----------|
| LARCENY-FROM VEHICLE | 9840 |
| LARCENY-NON VEHICLE | 6589 |
| AUTO THEFT | 3197 |
| BURGLARY-RESIDENCE | 2635 |
| AGG ASSAULT | 2024 |
| ROBBERY-PEDESTRIAN | 1126 |
| BURGLARY-NONRES | 758 |
| RAPE | 226 |
| ROBBERY-COMMERCIAL | 157 |



graph6.svg

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 $-\infty$ and $+\infty$ | 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 |
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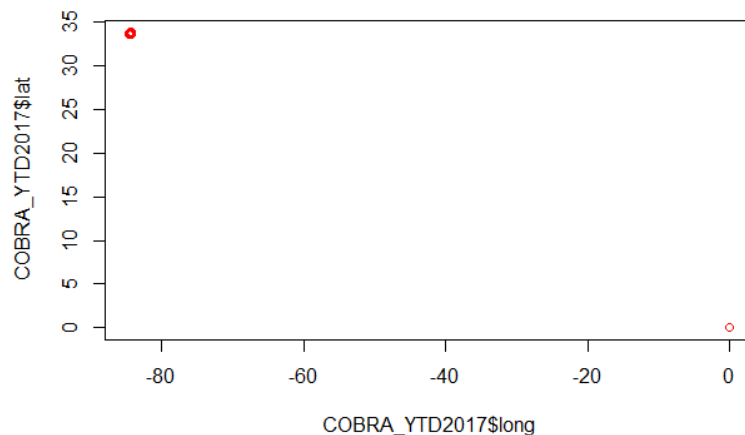
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[ reached get option("max.print") -- omitted 25759 entries ]

```

```

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>.

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.