ACADGILD

SESSION 12: Generalized Linear Models

Assignment 2

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Data Analytics

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1. Problem Statement

1. Use the given link below:
https://archive.ics.uci.edu/ml/machine-learning-databases/communities/

Perform the below operations:

a) Visualize the correlation between all variable in a meaningful way, clear representation of correlations. Find out top 3 reasons for having more crime in a city.

b) What is the difference between covariance and correlation, take an example from this dataset and show the differences if any?

2. Solution

a. Visualize the correlation between all variable in a meaningful way, clear representation of correlations. Find out top 3 reasons for having more crime in a city.

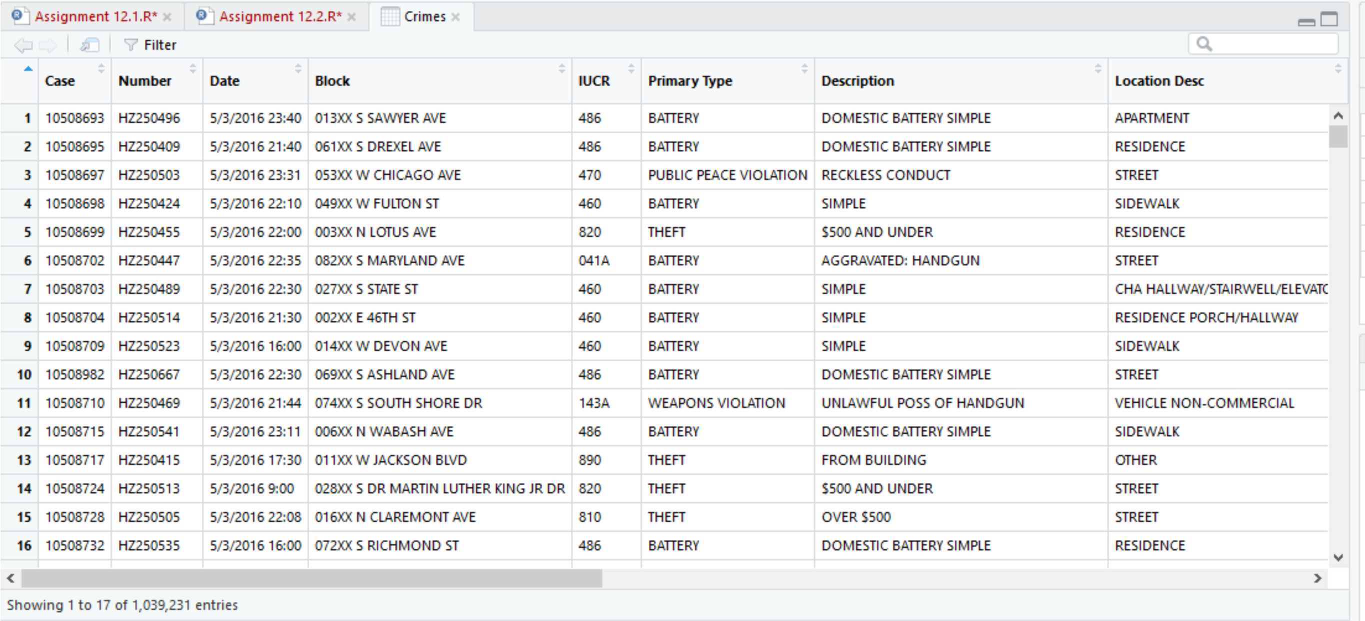
The R-script for the given problem is as follows:

```
library(readr)
Crimes <- read_csv("E:/munmun_acadgild/acadgild data analytics/supporting
files/communities.csv ")
View(Crimes)

names(Crimes) <- c("Case", "Number", "Date", "Block", "IUCR", "Primary Type",
"Description", "Location Desc", "Arrest", "Domestic", "Beat", "District", "Ward",
"Community Area","FBI Code", "X Coordinate", "Y Coordinate", "Year", "Updated On",
"Latitude", "Longitude", "Location")
head(Crimes)
str(Crimes)

#a. Visualize the correlation between all variables in a meaningful and clear way
# of representing.

library(dplyr)
Crimes <- na.omit(Crimes)
names(Crimes)
```

```
c <- cor(Crimes[c(11,12,13,14,18,20,21)])
c

psych::cor.plot(c)

# a.Find out top 3 reasons for having more crime in a city.
x <- as.data.frame(table(Crimes$Description))
x[order(x$Freq, decreasing = T)[1:3],]
```

The output of the R-Script (from Console window) is given as follows:

```
> library(readr)
> Crimes <- read_csv("E:/munmun_acadgild/acadgild data analytics/supporting
files/communities.csv ")
Parsed with column specification:
cols(
  .default = col_character(),
  ID = col_double(),
  Arrest = col_logical(),
  Domestic = col_logical(),
  Beat = col_double(),
  District = col_double(),
  Ward = col_double(),
  `Community Area` = col_double(),
  `X Coordinate` = col_double(),
  `Y Coordinate` = col_double(),
  Year = col_double(),
  Latitude = col_double(),
  Longitude = col_double()
)
See spec(...) for full column specifications.
|=====================================================================================
================| 100%  216 MB
> View(Crimes)
```

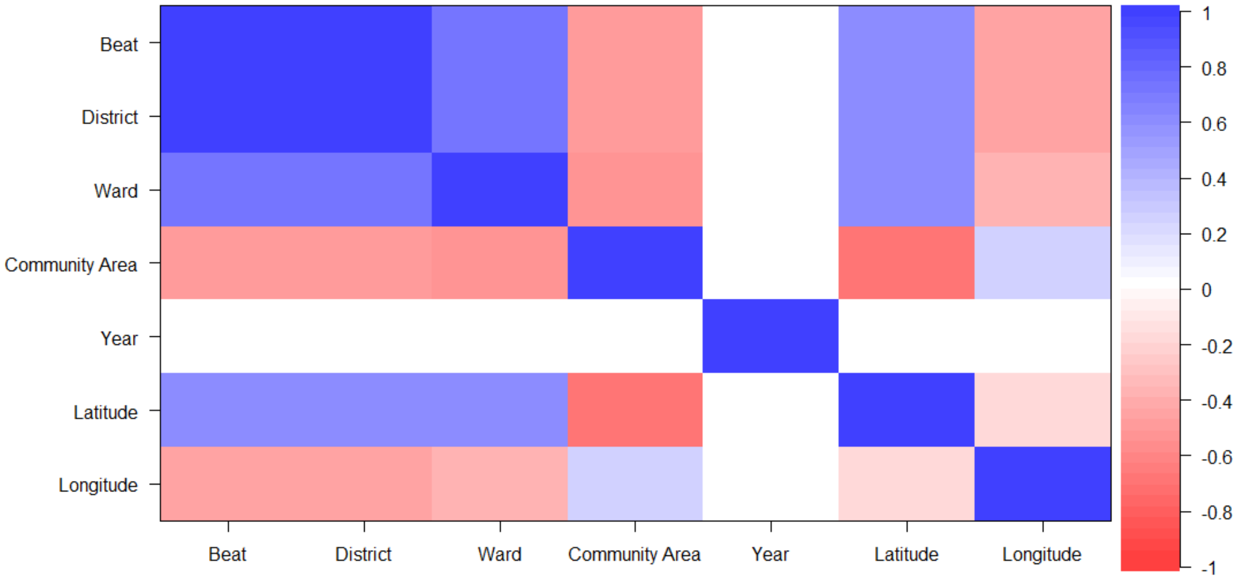


	Case	Number	Date	Block	IUCR	Primary Type	Description	Location Desc
1	10508693	HZ250496	5/3/2016 23:40	013XX S SAWYER AVE	486	BATTERY	DOMESTIC BATTERY SIMPLE	APARTMENT
2	10508695	HZ250409	5/3/2016 21:40	061XX S DREXEL AVE	486	BATTERY	DOMESTIC BATTERY SIMPLE	RESIDENCE
3	10508697	HZ250503	5/3/2016 23:31	053XX W CHICAGO AVE	470	PUBLIC PEACE VIOLATION	RECKLESS CONDUCT	STREET
4	10508698	HZ250424	5/3/2016 22:10	049XX W FULTON ST	460	BATTERY	SIMPLE	SIDEWALK
5	10508699	HZ250455	5/3/2016 22:00	003XX N LOTUS AVE	820	THEFT	$500 AND UNDER	RESIDENCE
6	10508702	HZ250447	5/3/2016 22:35	082XX S MARYLAND AVE	041A	BATTERY	AGGRAVATED: HANDGUN	STREET
7	10508703	HZ250489	5/3/2016 22:30	027XX S STATE ST	460	BATTERY	SIMPLE	CHA HALLWAY/STAIRWELL/ELEVATC
8	10508704	HZ250514	5/3/2016 21:30	002XX E 46TH ST	460	BATTERY	SIMPLE	RESIDENCE PORCH/HALLWAY
9	10508709	HZ250523	5/3/2016 16:00	014XX W DEVON AVE	460	BATTERY	SIMPLE	SIDEWALK
10	10508982	HZ250667	5/3/2016 22:30	069XX S ASHLAND AVE	486	BATTERY	DOMESTIC BATTERY SIMPLE	STREET
11	10508710	HZ250469	5/3/2016 21:44	074XX S SOUTH SHORE DR	143A	WEAPONS VIOLATION	UNLAWFUL POSS OF HANDGUN	VEHICLE NON-COMMERCIAL
12	10508715	HZ250541	5/3/2016 23:11	006XX N WABASH AVE	486	BATTERY	DOMESTIC BATTERY SIMPLE	SIDEWALK
13	10508717	HZ250415	5/3/2016 17:30	011XX W JACKSON BLVD	890	THEFT	FROM BUILDING	OTHER
14	10508724	HZ250513	5/3/2016 9:00	028XX S DR MARTIN LUTHER KING JR DR	820	THEFT	$500 AND UNDER	STREET
15	10508728	HZ250505	5/3/2016 22:08	016XX N CLAREMONT AVE	810	THEFT	OVER $500	STREET
16	10508732	HZ250535	5/3/2016 16:00	072XX S RICHMOND ST	486	BATTERY	DOMESTIC BATTERY SIMPLE	RESIDENCE

Showing 1 to 17 of 1,039,231 entries

```
> names(Crimes) <- c("Case", "Number", "Date", "Block", "IUCR", "Primary Type",
"Description",
+                     "Location Desc", "Arrest", "Domestic", "Beat", "District",
"Ward", "Community Area",
+                     "FBI Code", "X Coordinate", "Y Coordinate", "Year", "Updated
On",
+                     "Latitude", "Longitude", "Location")
```

```
> head(Crimes)
# A tibble: 6 x 22
    Case Number Date  Block IUCR  `Primary Type` Description `Location Desc` Arrest
Domestic  Beat District  Ward
   <dbl> <chr>  <chr> <chr> <chr> <chr>          <chr>       <chr>           <lgl>
<lgl>    <dbl>    <dbl> <dbl>
1 1.05e7 HZ250~ 5/3/~ 013X~ 486   BATTERY        DOMESTIC B~ APARTMENT       TRUE
TRUE      1022       10    24
2 1.05e7 HZ250~ 5/3/~ 061X~ 486   BATTERY        DOMESTIC B~ RESIDENCE       FALSE
TRUE       313        3    20
3 1.05e7 HZ250~ 5/3/~ 053X~ 470   PUBLIC PEACE ~ RECKLESS C~ STREET          FALSE
FALSE     1524       15    37
4 1.05e7 HZ250~ 5/3/~ 049X~ 460   BATTERY        SIMPLE      SIDEWALK        FALSE
FALSE     1532       15    28
5 1.05e7 HZ250~ 5/3/~ 003X~ 820   THEFT          $500 AND U~ RESIDENCE       FALSE
TRUE      1523       15    28
6 1.05e7 HZ250~ 5/3/~ 082X~ 041A  BATTERY        AGGRAVATED~ STREET          FALSE
FALSE      631        6     8
# ... with 9 more variables: `Community Area` <dbl>, `FBI Code` <chr>, `X Coordinate`
<dbl>, `Y Coordinate` <dbl>,
#   Year <dbl>, `Updated On` <chr>, Latitude <dbl>, Longitude <dbl>, Location <chr>
> str(Crimes)
Classes ‘spec_tbl_df’, ‘tbl_df’, ‘tbl’ and 'data.frame':     1048575 obs. of  22
variables:
 $ Case          : num  10508693 10508695 10508697 10508698 10508699 ...
 $ Number        : chr  "HZ250496" "HZ250409" "HZ250503" "HZ250424" ...
 $ Date          : chr  "5/3/2016 23:40" "5/3/2016 21:40" "5/3/2016 23:31" "5/3/2016
22:10" ...
 $ Block         : chr  "013XX S SAWYER AVE" "061XX S DREXEL AVE" "053XX W CHICAGO
AVE" "049XX W FULTON ST" ...
 $ IUCR          : chr  "486" "486" "470" "460" ...
 $ Primary Type  : chr  "BATTERY" "BATTERY" "PUBLIC PEACE VIOLATION" "BATTERY" ...
 $ Description   : chr  "DOMESTIC BATTERY SIMPLE" "DOMESTIC BATTERY SIMPLE" "RECKLESS
CONDUCT" "SIMPLE" ...
 $ Location Desc : chr  "APARTMENT" "RESIDENCE" "STREET" "SIDEWALK" ...
 $ Arrest        : logi  TRUE FALSE FALSE FALSE FALSE FALSE ...
 $ Domestic      : logi  TRUE TRUE FALSE FALSE TRUE FALSE ...
 $ Beat          : num  1022 313 1524 1532 1523 ...
 $ District      : num  10 3 15 15 15 6 1 2 24 7 ...
 $ Ward          : num  24 20 37 28 28 8 3 3 40 17 ...
 $ Community Area: num  29 42 25 25 25 44 35 38 1 67 ...
 $ FBI Code      : chr  "08B" "08B" "24" "08B" ...
 $ X Coordinate  : num  1154907 1183066 1140789 1143223 1139890 ...
 $ Y Coordinate  : num  1893681 1864330 1904819 1901475 1901675 ...
 $ Year          : num  2016 2016 2016 2016 2016 ...
 $ Updated On    : chr  "5/10/2016 15:56" "5/10/2016 15:56" "5/10/2016 15:56"
"5/10/2016 15:56" ...
 $ Latitude      : num  41.9 41.8 41.9 41.9 41.9 ...
 $ Longitude     : num  -87.7 -87.6 -87.8 -87.7 -87.8 ...
 $ Location      : chr  "(41.864073157, -87.706818608)" "(41.782921527, -
87.60436317)" "(41.894908283, -87.758371958)" "(41.885686845, -87.749515983)" ...
 - attr(*, "spec")=
  .. cols(
  ..   ID = col_double(),
  ..   `Case Number` = col_character(),
  ..   Date = col_character(),
  ..   Block = col_character(),
  ..   IUCR = col_character(),
  ..   `Primary Type` = col_character(),
  ..   Description = col_character(),
  ..   `Location Description` = col_character(),
  ..   Arrest = col_logical(),
  ..   Domestic = col_logical(),
  ..   Beat = col_double(),
  ..   District = col_double(),
  ..   Ward = col_double(),
  ..   `Community Area` = col_double(),
  ..   `FBI Code` = col_character(),
  ..   `X Coordinate` = col_double(),
  ..   `Y Coordinate` = col_double(),
  ..   Year = col_double(),
  ..   `Updated On` = col_character(),
  ..   Latitude = col_double(),
  ..   Longitude = col_double(),
  ..   Location = col_character()
  .. )
> library(dplyr)
> Crimes <- na.omit(Crimes)
> names(Crimes)
 [1] "Case"           "Number"         "Date"           "Block"          "IUCR"           
"Primary Type"  
 [7] "Description"    "Location Desc"  "Arrest"         "Domestic"       "Beat"           
"District"      
[13] "Ward"           "Community Area" "FBI Code"       "X Coordinate"   "Y 
Coordinate"   "Year"          
[19] "Updated On"     "Latitude"       "Longitude"      "Location"      
> c <- cor(Crimes[c(11,12,13,14,18,20,21)])
> c
                     Beat     District         Ward Community Area         Year
Latitude    Longitude
Beat            1.00000000  0.996402087  0.687144016    -0.49621344 -0.012652765
0.575284245 -0.479976546
District        0.99640209  1.000000000  0.691655842    -0.49621461 -0.008529942
0.576344843 -0.483244475
Ward            0.68714402  0.691655842  1.000000000    -0.54302431 -0.004215319
0.592008238 -0.397964013
Community Area -0.49621344 -0.496214608 -0.543024307     1.00000000  0.001632430 -
0.691892413  0.221028077
Year           -0.01265277 -0.008529942 -0.004215319     0.00163243  1.000000000 -
0.002721412 -0.004346718
Latitude        0.57528424  0.576344843  0.592008238    -0.69189241 -0.002721412
1.000000000 -0.209999084
Longitude      -0.47997655 -0.483244475 -0.397964013     0.22102808 -0.004346718 -
0.209999084  1.000000000
> 
> psych::cor.plot(c)
```



```
> # Find out top 3 reasons for having more crime in a city.
> x <- as.data.frame(table(Crimes$Description))
> x[order(x$Freq, decreasing = T)[1:3],]
                       Var1   Freq
279                  SIMPLE 107887
```

```
1               $500 AND UNDER  97476
118 DOMESTIC BATTERY SIMPLE  93001
```

Conclusion/Interpretation:

Simple, **$500 and under** and Domestic **Battery Simple** are the top 3 reasons for having more crime

b. What is the difference between covariance and correlation, take an example from this dataset and show the differences if any?

The table showing the difference is shown below:

SR.NO.	BASIS FOR COMPARISON	COVARIANCE	CORRELATION
1	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.
2	What is it?	Measure of correlation	Scaled version of covariance
3	Values	Lie between -∞ and +∞	Lie between -1 and +1
4	Change in scale	Affects covariance	Does not affects correlation
5	Unit free measure	No	Yes

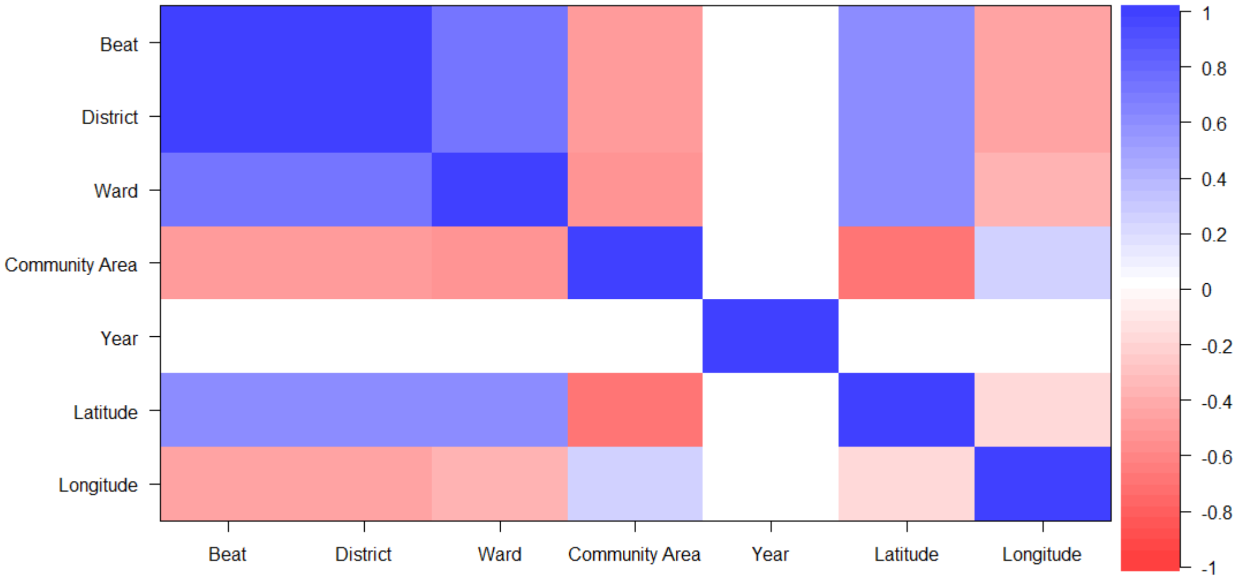
The R-script for the given problem is as follows:

```
correlation <- cor(Crimes[c(11,12,13,14,18,20,21)])
correlation
psych::cor.plot(correlation)

covariance <- cov(Crimes[c(11,12,13,14,18,20,21)])
covariance
psych::cor.plot(covariance)

#or
correlation1 <- cor(Crimes[c(11,12)])
correlation1
covariance1 <- cov(Crimes[c(11,12)])
covariance1

#or
correlation1 <- cor(Crimes[c(14,18)])
correlation1
```

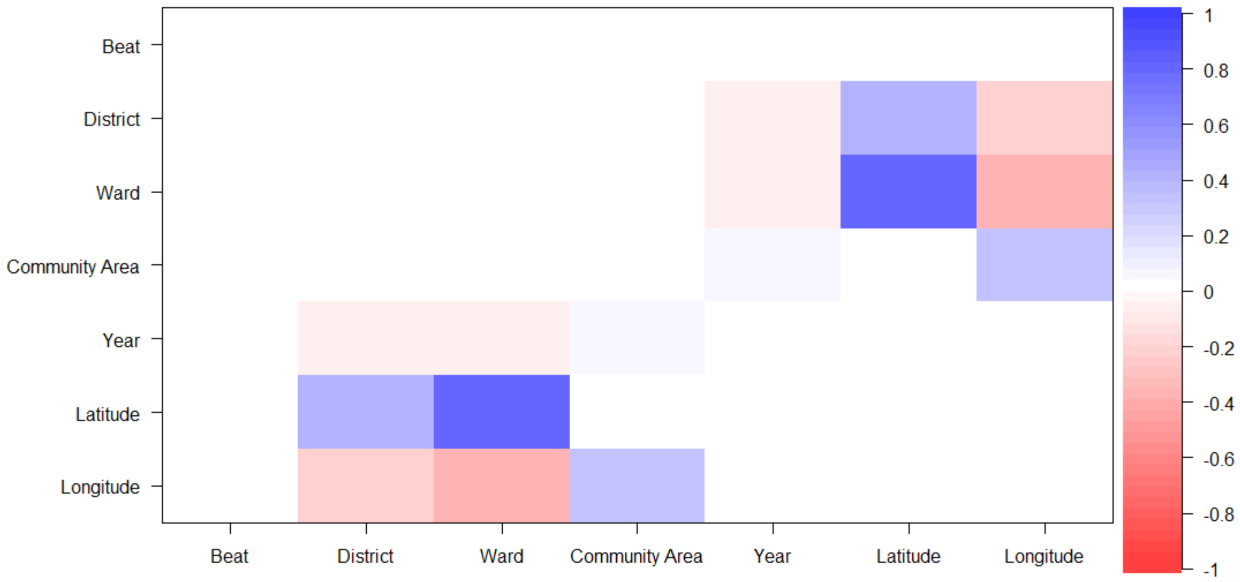
covariance1 <- cov(Crimes[c(14,18)])
covariance1

The output of the R-Script (from Console window) is given as follows:

```
> correlation <- cor(Crimes[c(11,12,13,14,18,20,21)])
> correlation
                     Beat     District         Ward Community Area
Year
Beat            1.00000000  0.996402087  0.687144016    -0.49621344 -
0.012652765
District        0.99640209  1.000000000  0.691655842    -0.49621461 -
0.008529942
Ward            0.68714402  0.691655842  1.000000000    -0.54302431 -
0.004215319
Community Area -0.49621344 -0.496214608 -0.543024307     1.00000000
0.001632430
Year           -0.01265277 -0.008529942 -0.004215319     0.00163243
1.000000000
Latitude        0.57528424  0.576344843  0.592008238    -0.69189241 -
0.002721412
Longitude      -0.47997655 -0.483244475 -0.397964013     0.22102808 -
0.004346718
                   Latitude    Longitude
Beat            0.575284245 -0.479976546
District        0.576344843 -0.483244475
Ward            0.592008238 -0.397964013
Community Area -0.691892413  0.221028077
Year           -0.002721412 -0.004346718
Latitude        1.000000000 -0.209999084
Longitude      -0.209999084  1.000000000
> psych::cor.plot(correlation)
```



```
> covariance <- cov(Crimes[c(11,12,13,14,18,20,21)])
> covariance
                        Beat      District           Ward Community Area
Year
Beat           478745.868597 4760.82948868 6540.34371670  -7.363621e+03 -
9.4366087362
District         4760.829489   47.68600698   65.70309277  -7.349121e+01 -
0.0634920734
Ward             6540.343717   65.70309277  189.23460975  -1.602101e+02 -
0.0625041296
Community Area  -7363.621268  -73.49121476 -160.21012410   4.599820e+02
0.0377383498
Year               -9.436609   -0.06349207   -0.06250413   3.773835e-02
1.1618657281
Latitude           38.573554    0.38568482    0.78919204  -1.438016e+00 -
0.0002842673
Longitude         -22.838536   -0.22948700   -0.37647818   3.259970e-01 -
0.0003222071
                    Latitude     Longitude
Beat           38.5735544021 -2.283854e+01
District        0.3856848236 -2.294870e-01
Ward            0.7891920358 -3.764782e-01
Community Area -1.4380157084  3.259970e-01
Year           -0.0002842673 -3.222071e-04
Latitude        0.0093909455 -1.399483e-03
Longitude      -0.0013994835  4.729241e-03
> psych::cor.plot(covariance)
```



```
> correlation1 <- cor(Crimes[c(11,12)])
> correlation1
              Beat  District
Beat     1.0000000 0.9964021
District 0.9964021 1.0000000
>
```

```
> covariance1 <- cov(Crimes[c(11,12)])
> covariance1
               Beat   District
Beat     478745.869 4760.82949
District   4760.829   47.68601
>
> #or
>
> correlation1 <- cor(Crimes[c(14,18)])
> correlation1
               Community Area       Year
Community Area     1.00000000 0.00163243
Year               0.00163243 1.00000000
>
> covariance1 <- cov(Crimes[c(14,18)])
> covariance1
               Community Area       Year
Community Area   459.98196498 0.03773835
Year               0.03773835 1.16186573
```

Conclusion/Interpretation:

Co-Variance is a systematic relationship between a pair of random variables wherein a change in one variable reciprocated by an equivalent change in another variable. Measure of correlation, Lie between -∞ and +∞. Change in scale affects covariance

Correlation is statistical measure that indicates how strongly two variables are related. Scaled version of covariance, Lie between -1 and +1, Change in scale does not affect the correlation. Unit free measure

Correlation is a special case of covariance which can be obtained when the data is standardized.