

# Harrison Montoya Assignments

## Assignment 1

Due on Canvas on Monday 9/20 before class at 10:15 am

### Problem 1

Install the datasets package on the console below using `install.packages("datasets")`. Now load the library.

USArrests

##	Murder	Assault	UrbanPop	Rape
## Alabama	13.2	236	58	21.2
## Alaska	10.0	263	48	44.5
## Arizona	8.1	294	80	31.0
## Arkansas	8.8	190	50	19.5
## California	9.0	276	91	40.6
## Colorado	7.9	204	78	38.7
## Connecticut	3.3	110	77	11.1
## Delaware	5.9	238	72	15.8
## Florida	15.4	335	80	31.9
## Georgia	17.4	211	60	25.8
## Hawaii	5.3	46	83	20.2
## Idaho	2.6	120	54	14.2
## Illinois	10.4	249	83	24.0
## Indiana	7.2	113	65	21.0
## Iowa	2.2	56	57	11.3
## Kansas	6.0	115	66	18.0
## Kentucky	9.7	109	52	16.3
## Louisiana	15.4	249	66	22.2
## Maine	2.1	83	51	7.8
## Maryland	11.3	300	67	27.8
## Massachusetts	4.4	149	85	16.3
## Michigan	12.1	255	74	35.1
## Minnesota	2.7	72	66	14.9
## Mississippi	16.1	259	44	17.1
## Missouri	9.0	178	70	28.2
## Montana	6.0	109	53	16.4
## Nebraska	4.3	102	62	16.5
## Nevada	12.2	252	81	46.0
## New Hampshire	2.1	57	56	9.5
## New Jersey	7.4	159	89	18.8
## New Mexico	11.4	285	70	32.1
## New York	11.1	254	86	26.1
## North Carolina	13.0	337	45	16.1
## North Dakota	0.8	45	44	7.3
## Ohio	7.3	120	75	21.4

```
## Oklahoma      6.6      151      68 20.0
## Oregon         4.9      159      67 29.3
## Pennsylvania   6.3      106      72 14.9
## Rhode Island   3.4      174      87  8.3
## South Carolina 14.4      279      48 22.5
## South Dakota    3.8       86      45 12.8
## Tennessee      13.2     188      59 26.9
## Texas          12.7     201      80 25.5
## Utah           3.2     120      80 22.9
## Vermont        2.2       48      32 11.2
## Virginia       8.5     156      63 20.7
## Washington     4.0     145      73 26.2
## West Virginia  5.7       81      39  9.3
## Wisconsin      2.6       53      66 10.8
## Wyoming        6.8     161      60 15.6
```

Load the USArrests dataset and rename it `dat`. Note that this dataset comes with R, in the package `datasets`, so there's no need to load data from your computer. Why is it useful to rename the dataset?

```
dat<-USArrests
dat.USArrests <- dat
```

*Answer:* It is useful to rename the dataset for two reasons. First, it will help you keep track of your work and not confuse it with other generic-looking names of other datasets. Second, it will allow you to keep an original copy of the file while creating a new file with all of the changes you are currently making on it.

## Problem 2

Use this command to make the state names into a new variable called `State`.

```
dat.USArrests$state <- tolower(rownames(USArrests))
dat.USArrests
```

```
##           Murder Assault UrbanPop Rape      state
## Alabama      13.2      236      58 21.2    alabama
## Alaska       10.0      263      48 44.5    alaska
## Arizona       8.1      294      80 31.0    arizona
## Arkansas      8.8      190      50 19.5    arkansas
## California    9.0      276      91 40.6    california
## Colorado      7.9      204      78 38.7    colorado
## Connecticut   3.3      110      77 11.1    connecticut
## Delaware      5.9      238      72 15.8    delaware
## Florida       15.4     335      80 31.9    florida
## Georgia       17.4     211      60 25.8    georgia
## Hawaii        5.3       46      83 20.2    hawaii
## Idaho         2.6      120      54 14.2    idaho
## Illinois      10.4     249      83 24.0    illinois
## Indiana       7.2      113      65 21.0    indiana
## Iowa          2.2       56      57 11.3    iowa
## Kansas        6.0      115      66 18.0    kansas
## Kentucky      9.7      109      52 16.3    kentucky
## Louisiana     15.4     249      66 22.2    louisiana
## Maine         2.1       83      51  7.8    maine
## Maryland      11.3     300      67 27.8    maryland
## Massachusetts 4.4      149      85 16.3    massachusetts
## Michigan      12.1     255      74 35.1    michigan
## Minnesota     2.7       72      66 14.9    minnesota
```

## Mississippi	16.1	259	44	17.1	mississippi
## Missouri	9.0	178	70	28.2	missouri
## Montana	6.0	109	53	16.4	montana
## Nebraska	4.3	102	62	16.5	nebraska
## Nevada	12.2	252	81	46.0	nevada
## New Hampshire	2.1	57	56	9.5	new hampshire
## New Jersey	7.4	159	89	18.8	new jersey
## New Mexico	11.4	285	70	32.1	new mexico
## New York	11.1	254	86	26.1	new york
## North Carolina	13.0	337	45	16.1	north carolina
## North Dakota	0.8	45	44	7.3	north dakota
## Ohio	7.3	120	75	21.4	ohio
## Oklahoma	6.6	151	68	20.0	oklahoma
## Oregon	4.9	159	67	29.3	oregon
## Pennsylvania	6.3	106	72	14.9	pennsylvania
## Rhode Island	3.4	174	87	8.3	rhode island
## South Carolina	14.4	279	48	22.5	south carolina
## South Dakota	3.8	86	45	12.8	south dakota
## Tennessee	13.2	188	59	26.9	tennessee
## Texas	12.7	201	80	25.5	texas
## Utah	3.2	120	80	22.9	utah
## Vermont	2.2	48	32	11.2	vermont
## Virginia	8.5	156	63	20.7	virginia
## Washington	4.0	145	73	26.2	washington
## West Virginia	5.7	81	39	9.3	west virginia
## Wisconsin	2.6	53	66	10.8	wisconsin
## Wyoming	6.8	161	60	15.6	wyoming

This dataset has the state names as row names, so we just want to make them into a new variable. We also make them all lower case, because that will help us draw a map later - the map function requires the states to be lower case.

List the variables contained in the dataset `USArrests`.

```
names(dat.USArrests)
```

```
## [1] "Murder" "Assault" "UrbanPop" "Rape" "state"
```

*Answer:* The variables include Murder, Assault, Urban Population, and State.

### Problem 3

What type of variable (from the DVB chapter) is Murder?

*Answer:* In the DVB chapter, “Murder” would be considered a qualitative, or categorical, variable.

What R Type of variable is it?

*Answer:* “Murder” is considered a character in R.

### Problem 4

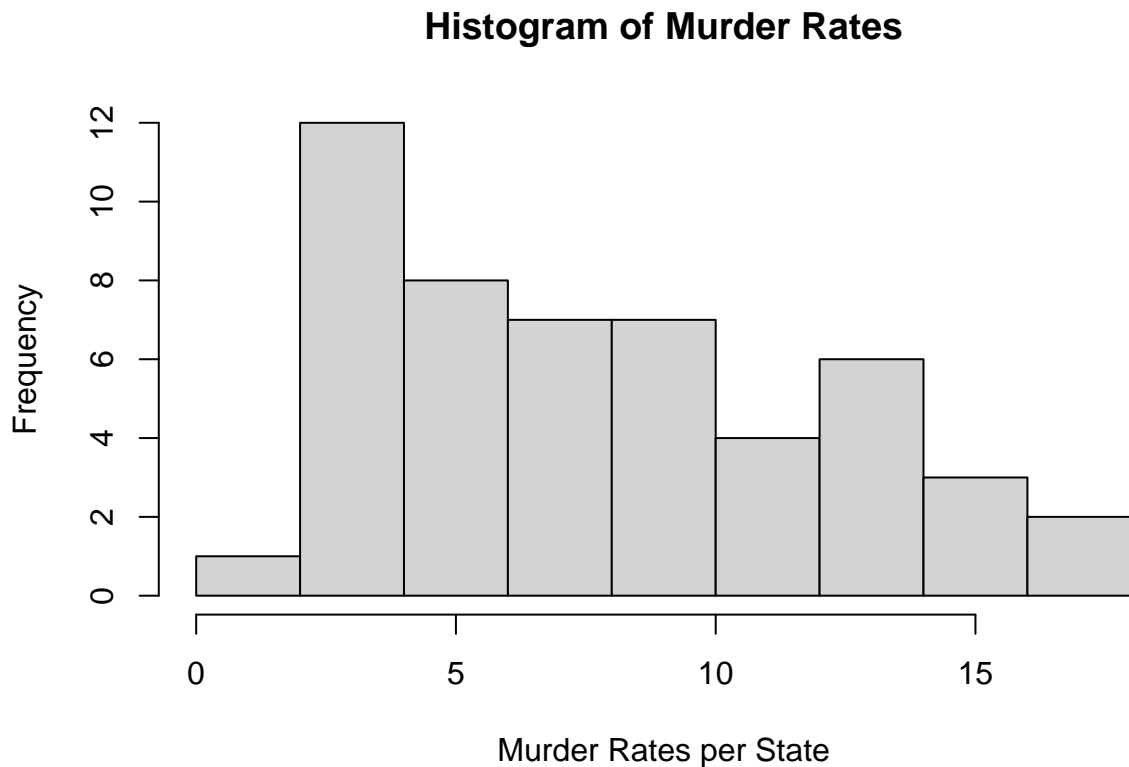
What information is contained in this dataset, in general? What do the numbers mean?

*Answer:* The dataset includes the arrest rates for murder, assault, and rape per 100,000 residents in each of the US’s 50 states. Additionally, the percent of the population living in urban areas is given. Here, then, the numbers mean either the arrest rates for a crime per 100k residents in a state or the percent of residents living in urban spaces in a state.

### Problem 5

Draw a histogram of `Murder` with proper labels and title.

```
hist(dat.USArrests$Murder, main="Histogram of Murder Rates", xlab="Murder Rates per State", ylab="Frequency")
```



### Problem 6

Please summarize `Murder` quantitatively. What are its mean and median? What is the difference between mean and median? What is a quartile, and why do you think R gives you the 1st Qu. and 3rd Qu.?

```
summary(dat.USArrests$Murder)
```

```
##      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.800   4.075   7.250   7.788  11.250   17.400
```

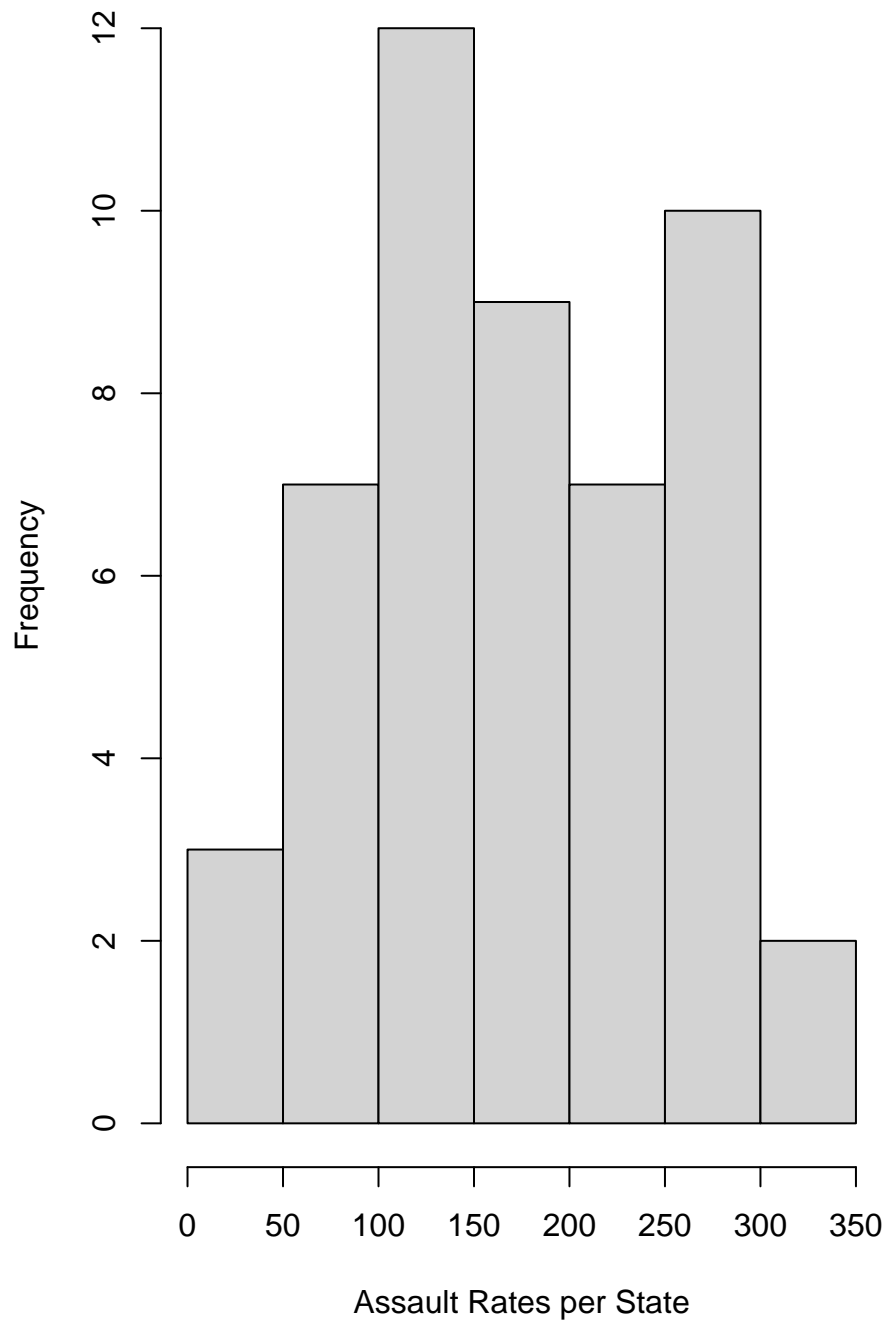
*Answer:* The mean of “Murder” is 7.788, while its median is 7.250. Generally, mean signifies the solution of all of the values added together and then divided by the number of values, while median signifies the middle value when all values are lined up in ascending order. A quartile constitutes one of three values that divides a data distribution into fourths. Lastly, R would provide the first and third quartile in order to help the statistician understand where the majority of values lie (in between the first and third quartile) or what values might be considered outliers (before the first and after the third).

### Problem 7

Repeat the same steps you followed for `Murder`, for the variables `Assault` and `Rape`. Now plot all three histograms together. You can do this by using the command `par(mfrow=c(3,1))` and then plotting each of the three.

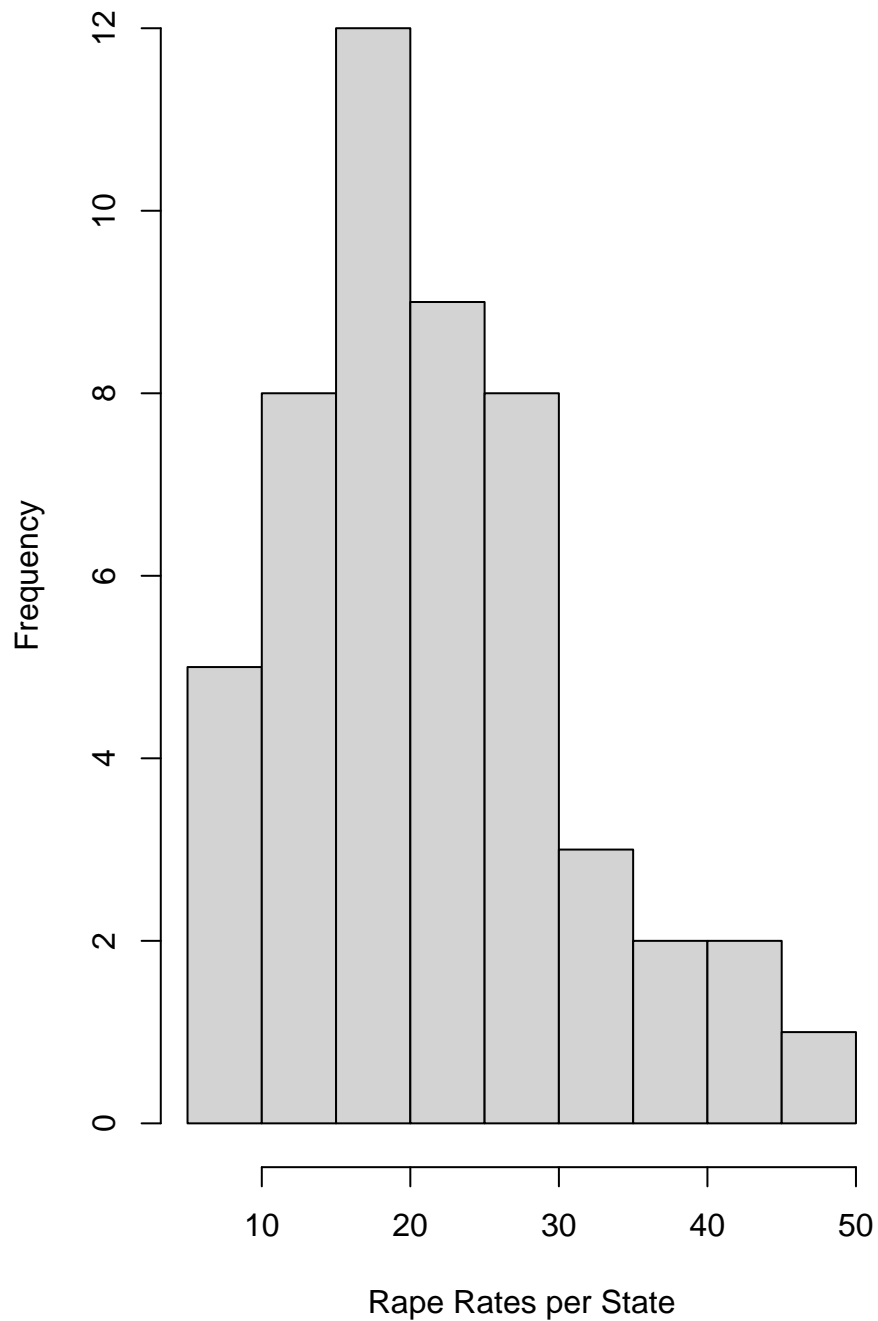
```
hist(dat.USArrests$Assault, main="Histogram of Assault Rates", xlab="Assault Rates per State", ylab="Frequency")
```

## Histogram of Assault Rates

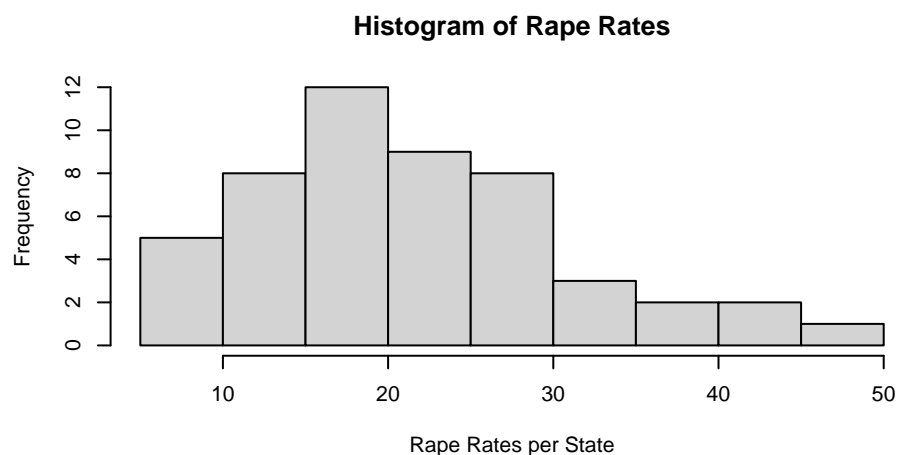
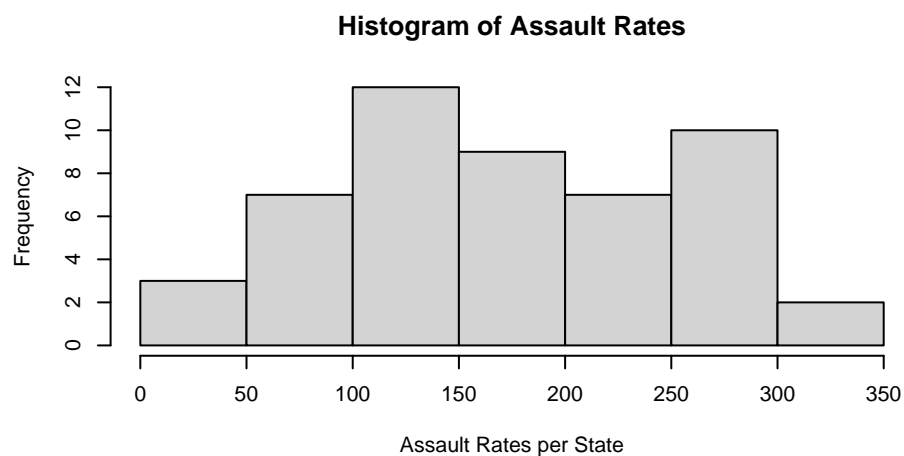
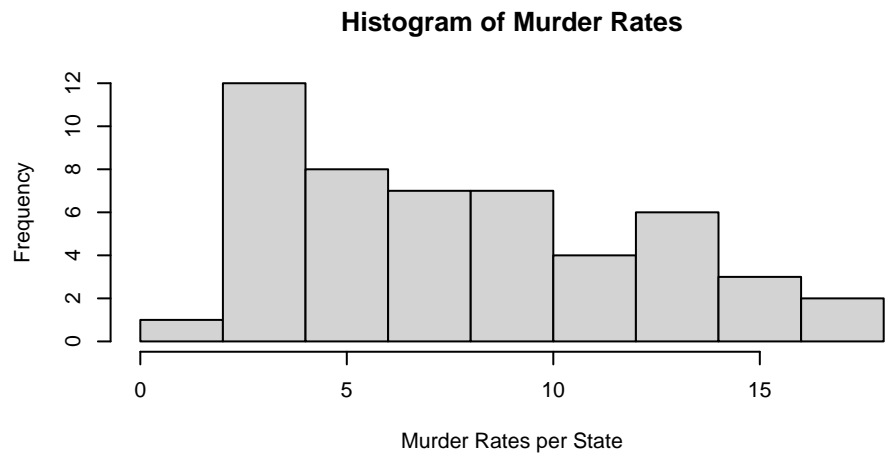


```
hist(dat.USArrests$Rape, main="Histogram of Rape Rates", xlab="Rape Rates per State", ylab="Frequency")
```

## Histogram of Rape Rates



```
par(mfrow=c(3,1))
hist(dat.USArrests$Murder, main="Histogram of Murder Rates", xlab="Murder Rates per State", ylab="Frequency")
hist(dat.USArrests$Assault, main="Histogram of Assault Rates", xlab="Assault Rates per State", ylab="Frequency")
hist(dat.USArrests$Rape, main="Histogram of Rape Rates", xlab="Rape Rates per State", ylab="Frequency")
```



What does the command `par` do, in your own words (you can look this up by asking R `?par`)?

*Answer:* The command `par` enables the statistician to set graphical parameters for data in either a singular graph or multiple graphs.

What can you learn from plotting the histograms together?

*Answer:* By plotting histograms together, you are able to compare the data between different categories – in this case, comparing the differences in assault and murder rates per state, for example. Additionally, you can

gain a better understand of the data overall by looking at it holistically instead of piece-by-piece.

### Problem 8

In the console below (not in text), type `install.packages("maps")` and press Enter, and then type `install.packages("ggplot2")` and press Enter. This will install the packages so you can load the libraries.

Run this code:

```
library('maps')
library('ggplot2')

ggplot(dat, aes(map_id=state, fill=Murder)) +
  geom_map(map=map_data("state")) +
  expand_limits(x=map_data("state")$long, y=map_data("state")$lat)
```

What does this code do? Explain what each line is doing.

*Answer:* This code is mapping the arrest rates of murder per 100,000 citizens per state. With this, we are able to see the salience and prominence of arrest rates through a colored map of the United States. The first line is using the data groups of “state” and “Murder” to construct aesthetic mapping in a ggplot, filling the map with “Murder” rates. Next, the second line is the direction to map the states, while the third line is expanding the x and y axes, i.e. longitude and latitude, in the graph.