Analysis of Traffic Stops and Violations

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Introduction

Our Project deals with police traffic stops that happen every day on roadways across America. It is an essential part of law enforcment to stop drivers from speeding, carrying illegal substances, or to return stolen vehicles to their rightful owner. There are many different violations of traffic law that can initiate a traffic stop and the data regarding those stops is what we chose to look at. We thought that it would be interesting to analyze data from police traffic stops because there is a lot of information police are required to keep track of when they pull someone over such as the Date, Time of Day, Traffic Violation, Vehicle Make, Model and Year, Use of Alcohol, Race, Sex, Seatbelt Use, Accidents, Injuries, City, State, Etc. We sourced our data specifically from Montgomery County in Maryland. The data does not have information that can be used to uniquely identify the vehicle, the vehicle owner or the officer, but has plenty of other stuff for our use. The dataset we use is an excel file containing 10,000 rows, each being its own traffic stop. With all this data, we had to determine what questions we could ask that would be interesting and informative. We came up with the list below:

With the data analysis and graphs in this report we seek to answer the following questions:

1.) What vehicle makes get pulled over the most often? 2.) What times during the week are traffic stops more likely to happen? 3.) What times during the year are traffic stops more likely to happen? 4.) What times during the past decade did traffic stops happen the most? 5.) Does using your seatbelt actually help prevent injury when in an accident? 6.) How do race and gender apply to traffic violations? 7.) Who is most likely to commit a traffic violation in Maryland? (Marylanders or Non-Marylanders?)

Here is our implementation of our R code:

Load Packages

```r
#install.packages('rmarkdown')
#install.packages('readxl') -- Used for importing xlsx spreadsheets.
#install.packages('tidyverse')
#install.packages('ggrounded') -- Used for fancier bars.
library(rmarkdown)
library(readxl)
library(tidyverse)
```

```
-- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
v dplyr     1.1.4     v readr     2.1.5
v forcats   1.0.0     v stringr   1.5.1
v ggplot2   3.5.2     v tibble    3.2.1
v lubridate 1.9.4     v tidyr     1.3.1
v purrr     1.0.4
-- Conflicts ------------------------------------------ tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to becor
```

```r
library(ggrounded)
```

Load the Data

```r
traff_violations <- read_excel('AttemptTwo.xlsx')
traff_violations
```

```
# A tibble: 10,000 x 25
   `Date Of Stop`      `Time Of Stop`      Description            Accident Belts
   <dttm>              <dttm>              <chr>                  <chr>    <chr>
 1 2015-10-20 00:00:00 1899-12-31 15:02:00 EXCEEDING MAXIMUM SPE~ No       No
 2 2013-12-02 00:00:00 1899-12-31 16:23:00 FAILURE TO DISPLAY RE~ No       No
 3 2013-08-20 00:00:00 1899-12-31 22:48:00 EXCEEDING THE POSTED ~ No       No
 4 2017-08-27 00:00:00 1899-12-31 16:39:00 DRIVER FAILURE TO OBE~ No       No
 5 2012-03-25 00:00:00 1899-12-31 13:16:00 DRIVING VEHICLE ON HI~ No       No
 6 2014-04-10 00:00:00 1899-12-31 03:44:00 DRIVING WHILE IMPAIRE~ No       No
 7 2023-11-17 00:00:00 1899-12-31 20:04:00 FAILURE TO ATTACH VEH~ No       No
 8 2018-10-15 00:00:00 1899-12-31 23:47:00 EXCEEDING POSTED MAXI~ No       No
 9 2013-04-17 00:00:00 1899-12-31 17:44:00 DRIVER FAILURE TO OBE~ No       No
```

```
10 2019-07-01 00:00:00 1899-12-31 09:08:00 DRIVER USING HANDS TO~ No       No
# i 9,990 more rows
# i 20 more variables: `Personal Injury` <chr>, `Property Damage` <chr>,
#   Fatal <chr>, `Commercial License` <chr>, HAZMAT <chr>,
#   `Commercial Vehicle` <chr>, Alcohol <chr>, `Work Zone` <chr>,
#   `Search Conducted` <chr>, VehicleType <chr>, Year <dbl>, Make <chr>,
#   Model <chr>, Color <chr>, `Contributed To Accident` <lgl>, Race <chr>,
#   Gender <chr>, `Driver City` <chr>, `Driver State` <chr>, ...
```

Tidy the Data

```r
# Modifications for proper time and day.
traff_violations <- traff_violations %>%
  mutate(
    TimeOnly = format(`Time Of Stop`, "%H:%M:%S"),
    FullDateTime = ymd_hms(paste(`Date Of Stop`, TimeOnly)),
    Hour = hour(FullDateTime),
    Day = wday(FullDateTime, label = TRUE, abbr = FALSE)
  )

#Description of Violation
most_common_desc <- traff_violations %>%
  count(Description) %>%
  arrange(desc(n)) %>%
  slice(1:5)

#Vehicle Year
most_common_vyear <- traff_violations %>%
  count(Year) %>%
  arrange(desc(n)) %>%
  slice(1:10)

#Vehicle Make
most_common_vmake <- traff_violations %>%
  mutate(Make = str_replace_all(Make, c(
    "CHEVY" = "CHEVROLET",
    "CHEV" = "CHEVROLET",
    "TOYT" = "TOYOTA",
    "HOND" = "HONDA",
    "HONDAA" = "HONDA",
```

```
    "CHEVROLETROLET" = "CHEVROLET",
    "VOLK" = "VOLKSWAGON",
    "VW" = "VOLKSWAGON",
    "HYUN" = "HYUNDAI",
    "TOTOTA" = "TOYOTA",
    "TOTYOA" = "TOYOTA",
    "TOYORA" = "TOYOTA",
    "HYUNDAIDAI" = "HYUNDAI",
    "MERZ" = "MERCEDES",
    "NISS" = "NISSAN",
    "DODG" = "DODGE",
    "MAZD" = "MAZDA",
    "MAZDAA" = "MAZDA",
    "DODGEE" = "DODGE",
    "ACUR" = "ACURA",
    "ACURAA" = "ACURA",
    "NISSANAN" = "NISSAN",
    "SUBA" = "SUBARU",
    "SUBARURU" = "SUBARU",
    "VOLKSWAGONSWAGEN" = "VOLKSWAGON",
    "VOLKSWAGONSWAGON" = "VOLKSWAGON",
    "INFI" = "INFINITI",
    "INFINITINITI" = "INFINITI",
    "MITS" = "MITSUBISHI",
    "MITSUBISHIUBISHI" = "MITSUBISHI",
    "VOLKSWAGONS" = "VOLKSWAGON",
    "TOYOT" = "TOYOTA",
    "TOYOTAAA" = "TOYOTA",
    "TOYO" = "TOYOTA",
    "TOYOTATA" = "TOYOTA",
    "TOYOTAA" = "TOYOTA",
    "HYUNDAID" = "HYUNDAI",
    "MAZADA" = "MAZDA",
    "CHRY" = "CRYSLER",
    "CHEVROLETORLET" = "CHEVROLET",
    "TOYOTAOA" = "TOYOTA",
    "VOLV" = "VOLVO",
    "VOLVOO" = "VOLVO",
    "MERCEDES" = "MERCEDES BENZ",
    "MERC" = "MERCEDES BENZ",
    "MERCEDES BENZURY" = "MERCEDES BENZ",
    "MERCEDES BENZEDES BENZ" = "MERCEDES BENZ",
```

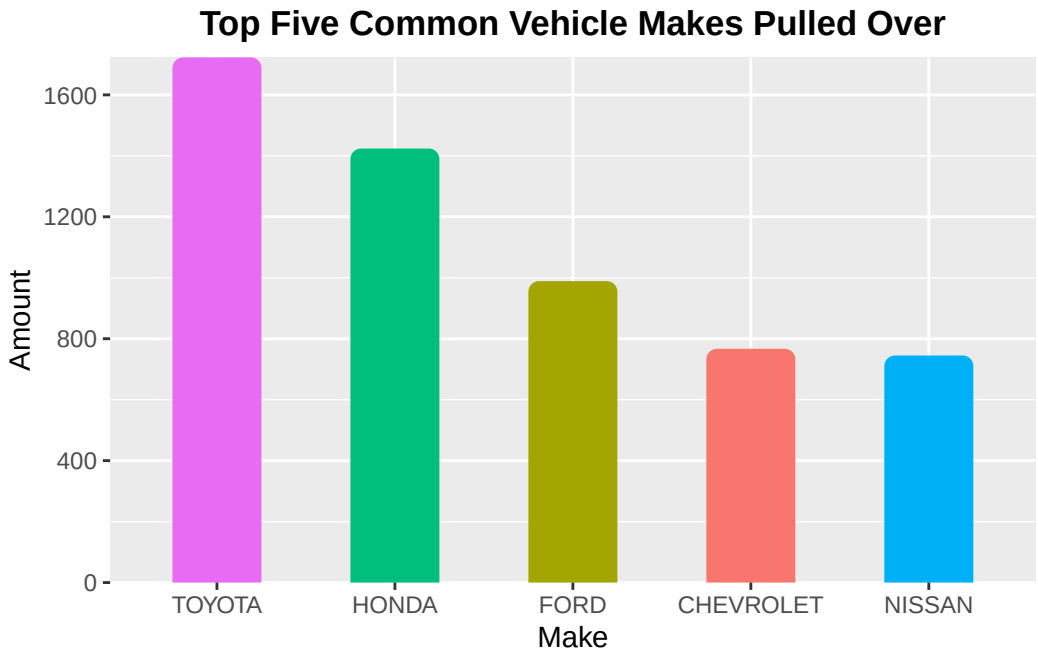
```
    "MERCEDES BENZEDEZ" = "MERCEDES BENZ",
    "MERCEDES BENZ BENZ" = "MERCEDES BENZ",
    "MERCEDES BENZ-BENZ" = "MERCEDES BENZ",
    "CRYSLERSLER" = "CHRYSLER",
    "CRYSLER" = "CHRYSLER",
    "CHEVROLETE" = "CHEVROLET",
    "CHEVROLETY" = "CHEVROLET",
    "CHEVROLETROLET" = "CHEVROLET",
    "CHECY" = "CHEVROLET",
    "CVEVROLET" = "CHEVROLET",
    "HYUNDAII" = "HYUNDAI",
    "HYUNDAIIA" = "HYUNDAI",
    "HYUNDAIA" = "HYUNDAI",
    "TOY" = "TOYOTA",
    "TOYOTAOTA" = "TOYOTA",
    "HINDA" = "HONDA"
  ))) %>%
  count(Make) %>%
  arrange(desc(n)) %>%
  slice(1:5)


#Race of Driver
most_common_race <- traff_violations %>%
  count(Race) %>%
  arrange(desc(n))
  #%>% slice(1:5)
```

Analyze the Tidy Data

Plot 1 - Top Five Common Vehicle Makes Pulled Over

```
ggplot(data = most_common_vmake, aes(x= reorder(Make, -n), y= n, fill = Make)) +
 geom_col_rounded(width = 0.5) + scale_y_continuous(expand = c(0, 0))+
 labs(title = "Top Five Common Vehicle Makes Pulled Over") + xlab("Make") + ylab("Amount") +
```

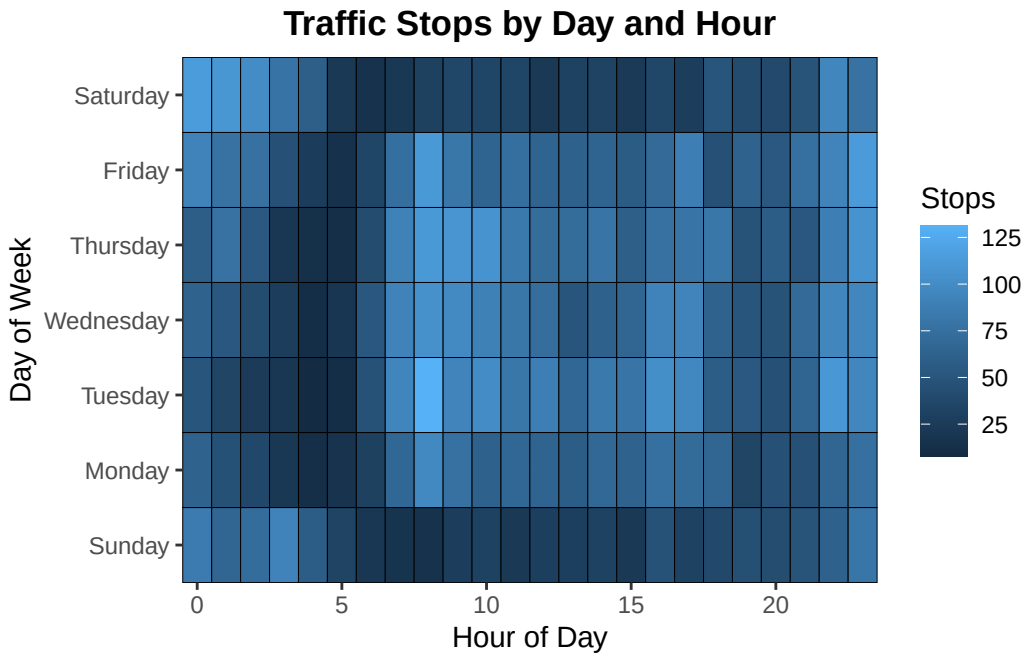



```
print(most_common_vmake)
```

```
# A tibble: 5 x 2
  Make           n
  <chr>      <int>
1 TOYOTA      1723
2 HONDA       1424
3 FORD         989
4 CHEVROLET    767
5 NISSAN       745
```

Plot 2 - Traffic Stops by Day and Hour

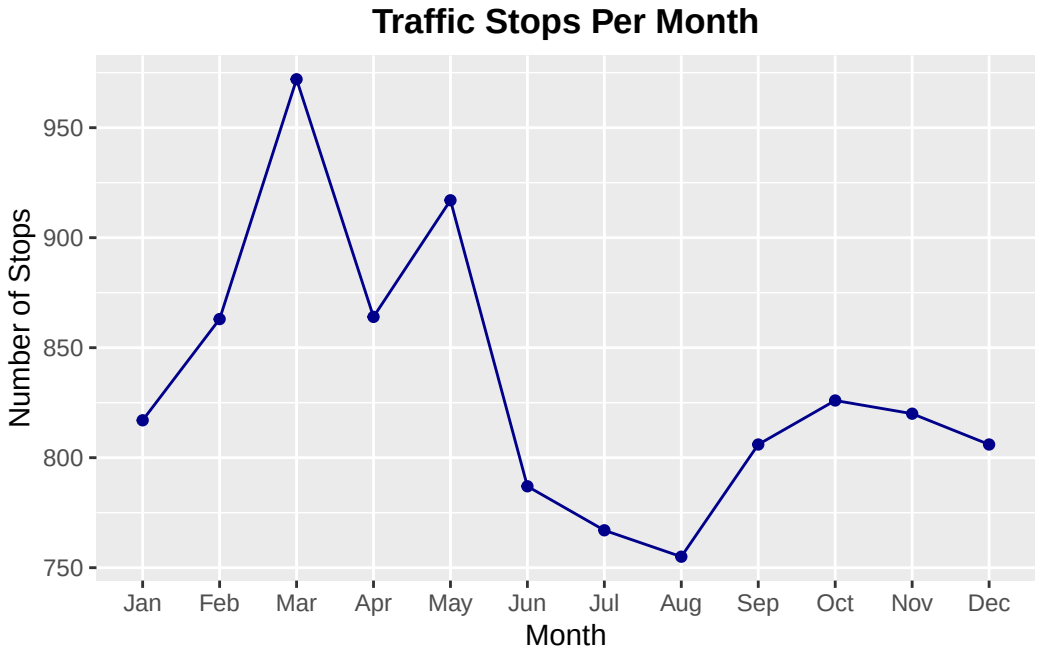
```
traff_violations %>%
  count(Hour, Day) %>%
  ggplot(aes(Hour, Day, fill = n)) + geom_tile(color = 'black') + scale_x_continuous(expand =
  theme(plot.title = element_text(hjust = 0.5, face = "bold"))
```



Plot 3 - Traffic Stops Per Month

```
monthly_stops <- traff_violations %>%
  mutate(Month = month(`Date Of Stop`, label = TRUE, abbr = TRUE)) %>%
  count(Month)

ggplot(monthly_stops, aes(Month, n))+geom_line(group = 1, color = 'darkblue')+geom_point(colo
```



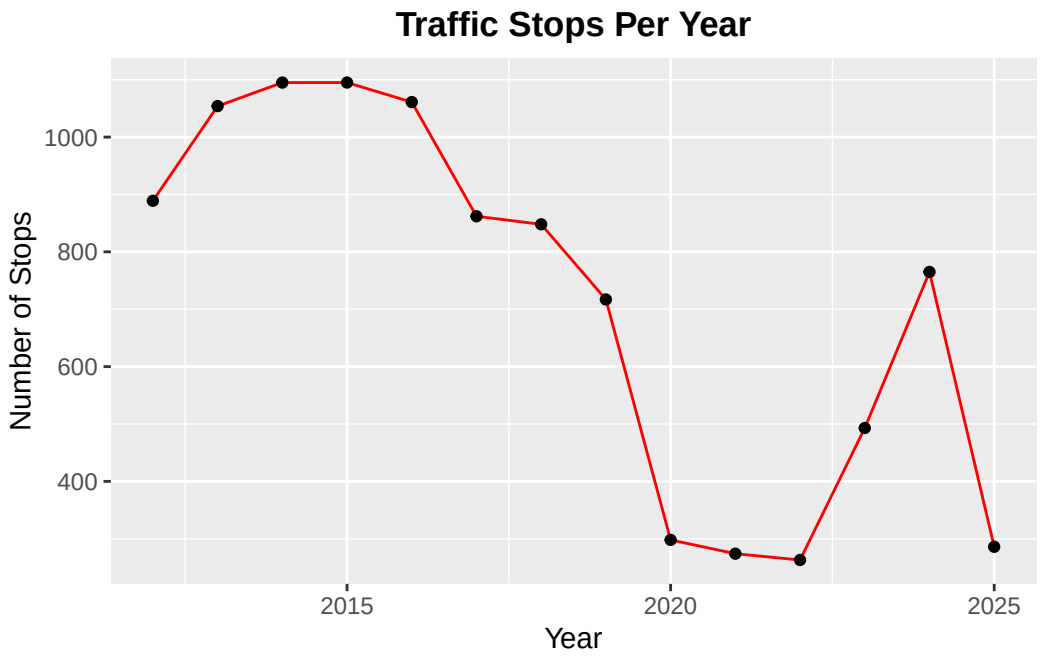

```
monthly_stops
```

```
# A tibble: 12 x 2
   Month     n
   <ord> <int>
 1 Jan     817
 2 Feb     863
 3 Mar     972
 4 Apr     864
 5 May     917
 6 Jun     787
 7 Jul     767
 8 Aug     755
 9 Sep     806
10 Oct     826
11 Nov     820
12 Dec     806
```

Plot 4 - Traffic Stops Per Year

```r
yearly_stops <- traff_violations %>%
  mutate(Year = year(`Date Of Stop`)) %>%
  count(Year)

ggplot(yearly_stops, aes(Year, n))+geom_line(group = 1, color = 'red')+geom_point(color ='bla
```



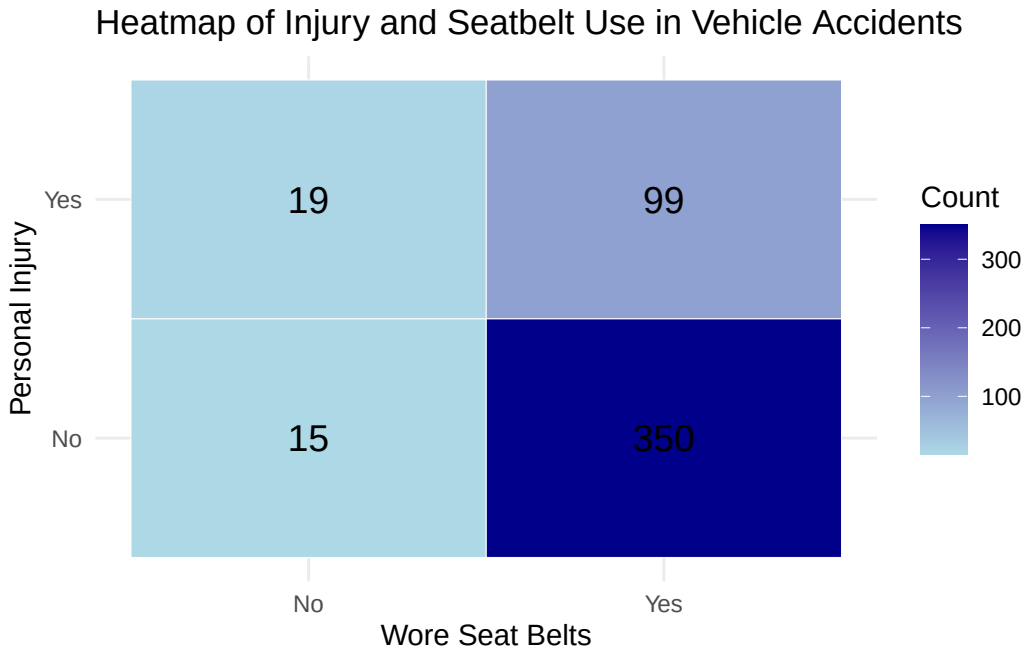

```r
yearly_stops
```

```
# A tibble: 14 x 2
    Year     n
   <dbl> <int>
 1  2012   889
 2  2013  1054
 3  2014  1095
 4  2015  1095
 5  2016  1061
 6  2017   862
 7  2018   848
 8  2019   717
 9  2020   298
10  2021   274
11  2022   263
```

```
12   2023    493
13   2024    765
14   2025    286
```

Plot 5 - Correlation of Injury and Seatbelt Use in Accidents

```
traff_violations_filtered <- traff_violations %>% filter(Accident == "Yes")
traff_violations_filtered <- traff_violations_filtered %>%
  mutate(Belts = ifelse(Belts == "Yes", "N", Belts))
traff_violations_filtered <- traff_violations_filtered %>%
  mutate(Belts = ifelse(Belts == "No", "Yes", Belts))
traff_violations_filtered <- traff_violations_filtered %>%
  mutate(Belts = ifelse(Belts == "N", "No", Belts))
traff_violations_filtered %>%
  count(`Belts`, `Personal Injury`) %>%
  ggplot(aes(x = `Belts`, y = `Personal Injury`, fill = n)) +
  geom_tile(color = "white") +
  geom_text(aes(label = n), color = "black", size = 5) +
  scale_fill_gradient(low = "lightblue", high = "darkblue") +
  labs(title = "Heatmap of Injury and Seatbelt Use in Vehicle Accidents",
       x = "Wore Seat Belts", y = "Personal Injury", fill = "Count") +
  theme_minimal()
```



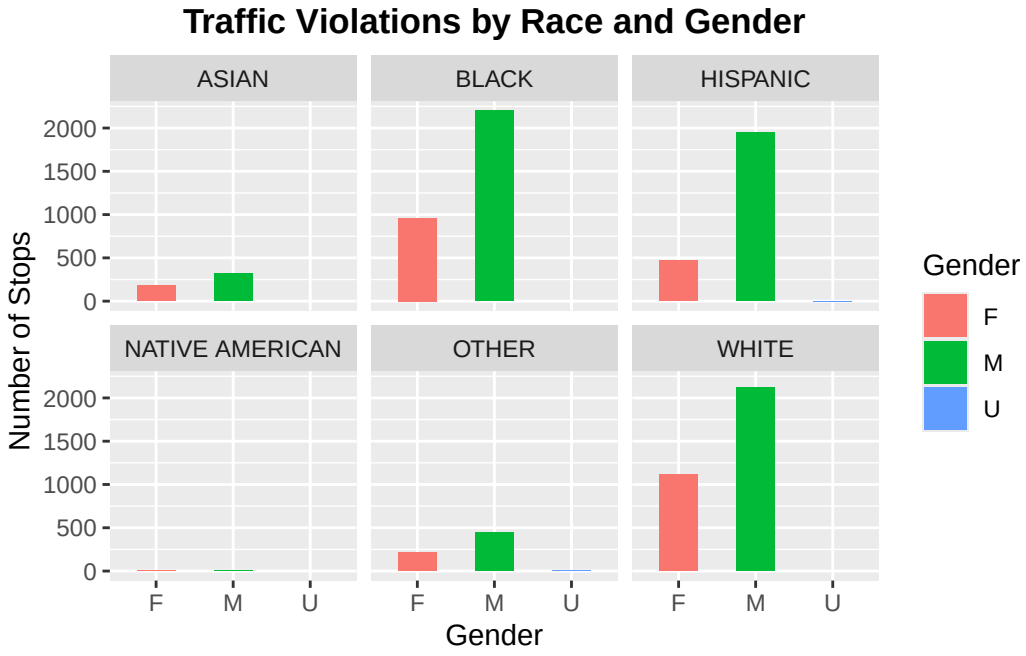
Plot 6 - Traffic Violations by Race and Gender

```
race_gender_counts <- traff_violations %>%
  count(Race, Gender)

race_gender_counts
```

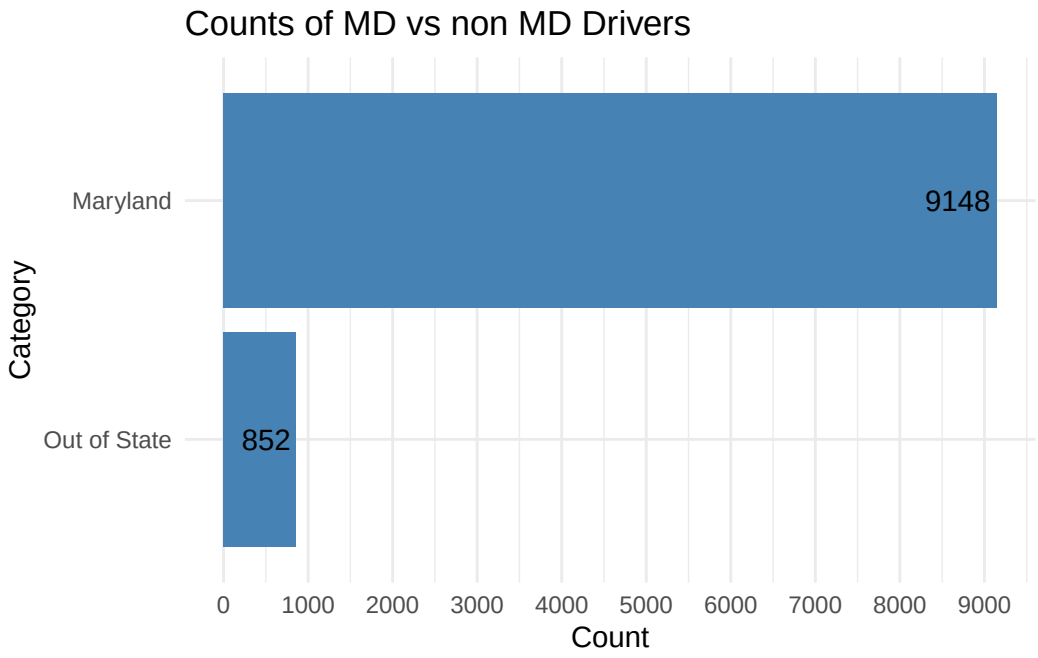
```
# A tibble: 14 x 3
   Race            Gender     n
   <chr>           <chr>  <int>
 1 ASIAN           F        177
 2 ASIAN           M        316
 3 BLACK           F        962
 4 BLACK           M       2199
 5 HISPANIC        F        469
 6 HISPANIC        M       1950
 7 HISPANIC        U          1
 8 NATIVE AMERICAN F          5
 9 NATIVE AMERICAN M          7
10 OTHER           F        217
11 OTHER           M        450
12 OTHER           U          7
13 WHITE           F       1118
14 WHITE           M       2122
```

```
ggplot(race_gender_counts, aes(x = Gender, y = n, fill = Gender)) +
  geom_col(width = 0.5) +
  facet_wrap(~ Race)+ labs(title = "Traffic Violations by Race and Gender")+
  ylab("Number of Stops")+theme(plot.title = element_text(hjust = 0.5, face = "bold"))
```



Plot 7 – Traffic Violations per Geographic Area

```
traff_violations_filtered_2 <- traff_violations %>%
  mutate(`Driver State` = ifelse(`Driver State` != "MD", "Out of State", `Driver State`))
traff_violations_filtered_2 <- traff_violations_filtered_2 %>%
  mutate(`Driver State` = ifelse(`Driver State` == "MD", "Maryland", `Driver State`))
traff_violations_filtered_2 %>%
  count(`Driver State`) %>%
  ggplot(aes(x = reorder(`Driver State`, n), y = n)) +
  geom_bar(stat = "identity", fill = "steelblue") +
  geom_text(aes(label = n), hjust = 1.1, size = 4) +
  coord_flip() +
  labs(title = "Counts of MD vs non MD Drivers",
       x = "Category",
       y = "Count") +
  #scale_y_continuous(expand = expansion(mult = c(0, 0.1))) +
  scale_y_continuous(breaks = seq(0, max(9000), by = 1000)) +
  theme_minimal()
```



Further Analyses / Conclusion