NYPD data project

2022-11-03

```
knitr::opts_chunk$set(echo = TRUE)
```

```
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.2 --
## v ggplot2 3.3.6      v purrr   0.3.5
## v tibble  3.1.8      v dplyr   1.0.10
## v tidyr   1.2.1      v stringr 1.4.1
## v readr   2.1.3      v forcats 0.5.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(lubridate)
```

```
##
## Attaching package: 'lubridate'
##
## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
```

```
library(tibble)
```

Getting data

```
url_data <- "https://data.cityofnewyork.us/api/views/833y-fsy8/rows.csv?accessType=DOWNLOAD"
```

Reading the data

```
nypd_data <- read.csv(url_data)
```

Tidying the data

```
summary(nypd_data)
```

```
##   INCIDENT_KEY        OCCUR_DATE         OCCUR_TIME            BORO
##  Min.   :  9953245   Length:25596       Length:25596       Length:25596
##  1st Qu.: 61593633   Class :character   Class :character   Class :character
##  Median : 86437258   Mode  :character   Mode  :character   Mode  :character
##  Mean   :112382648
##  3rd Qu.:166660833
##  Max.   :238490103
##
##     PRECINCT      JURISDICTION_CODE LOCATION_DESC      STATISTICAL_MURDER_FLAG
##  Min.   :  1.00   Min.   :0.0000    Length:25596       Length:25596
##  1st Qu.: 44.00   1st Qu.:0.0000    Class :character   Class :character
##  Median : 69.00   Median :0.0000    Mode  :character   Mode  :character
##  Mean   : 65.87   Mean   :0.3316
##  3rd Qu.: 81.00   3rd Qu.:0.0000
##  Max.   :123.00   Max.   :2.0000
##                   NA's   :2
##  PERP_AGE_GROUP       PERP_SEX          PERP_RACE         VIC_AGE_GROUP
##  Length:25596       Length:25596       Length:25596       Length:25596
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##
##    VIC_SEX             VIC_RACE           X_COORD_CD        Y_COORD_CD
##  Length:25596       Length:25596       Min.   : 914928   Min.   :125757
##  Class :character   Class :character   1st Qu.:1000011   1st Qu.:182782
##  Mode  :character   Mode  :character   Median :1007715   Median :194038
##                                        Mean   :1009455   Mean   :207894
##                                        3rd Qu.:1016838   3rd Qu.:239429
##                                        Max.   :1066815   Max.   :271128
##
##     Latitude       Longitude        Lon_Lat
##  Min.   :40.51   Min.   :-74.25   Length:25596
##  1st Qu.:40.67   1st Qu.:-73.94   Class :character
##  Median :40.70   Median :-73.92   Mode  :character
##  Mean   :40.74   Mean   :-73.91
##  3rd Qu.:40.82   3rd Qu.:-73.88
##  Max.   :40.91   Max.   :-73.70
##
```

```
nypd_data <- nypd_data %>%
  select(OCCUR_DATE:VIC_RACE) %>%
  select(-c(PRECINCT:LOCATION_DESC)) %>%
  select(-c(PERP_SEX, PERP_RACE, VIC_SEX, VIC_RACE))
nypd_data <- nypd_data %>% filter(PERP_AGE_GROUP > 0)
nypd_data <- nypd_data %>% filter(VIC_AGE_GROUP > 0)
nypd_data$STATISTICAL_MURDER_FLAG <- replace(nypd_data$STATISTICAL_MURDER_FLAG, nypd_data$STATISTICAL_MU
nypd_data$STATISTICAL_MURDER_FLAG <- replace(nypd_data$STATISTICAL_MURDER_FLAG, nypd_data$STATISTICAL_MU
nypd_data <- nypd_data %>%
```

```
  rename(death = 'STATISTICAL_MURDER_FLAG',
         date = 'OCCUR_DATE',
         time = 'OCCUR_TIME')
nypd_data$death <- as.double(nypd_data$death)
nypd_data <- nypd_data %>%
  mutate(date = mdy(date)) %>%
  mutate(shooting = 1)
nypd_data <- nypd_data[(nypd_data$PERP_AGE_GROUP != "1020" & nypd_data$PERP_AGE_GROUP != "224" & nypd_da
nypd_data <- nypd_data[(nypd_data$VIC_AGE_GROUP != "UNKNOWN"), ]
nypd_data <- nypd_data %>%
  mutate(month = month(date), year = year(date))
summary(nypd_data)
```

```
##       date                time               BORO               death
##  Min.   :2006-01-01   Length:10579       Length:10579       Min.   :0.0000
##  1st Qu.:2009-04-01   Class :character   Class :character   1st Qu.:0.0000
##  Median :2013-01-23   Mode  :character   Mode  :character   Median :0.0000
##  Mean   :2013-07-23                                         Mean   :0.2495
##  3rd Qu.:2017-09-10                                         3rd Qu.:0.0000
##  Max.   :2021-12-31                                         Max.   :1.0000
##  PERP_AGE_GROUP     VIC_AGE_GROUP         shooting     month
##  Length:10579       Length:10579       Min.   :1   Min.   : 1.000
##  Class :character   Class :character   1st Qu.:1   1st Qu.: 4.000
##  Mode  :character   Mode  :character   Median :1   Median : 7.000
##                                        Mean   :1   Mean   : 6.693
##                                        3rd Qu.:1   3rd Qu.: 9.000
##                                        Max.   :1   Max.   :12.000
##       year
##  Min.   :2006
##  1st Qu.:2009
##  Median :2013
##  Mean   :2013
##  3rd Qu.:2017
##  Max.   :2021
```

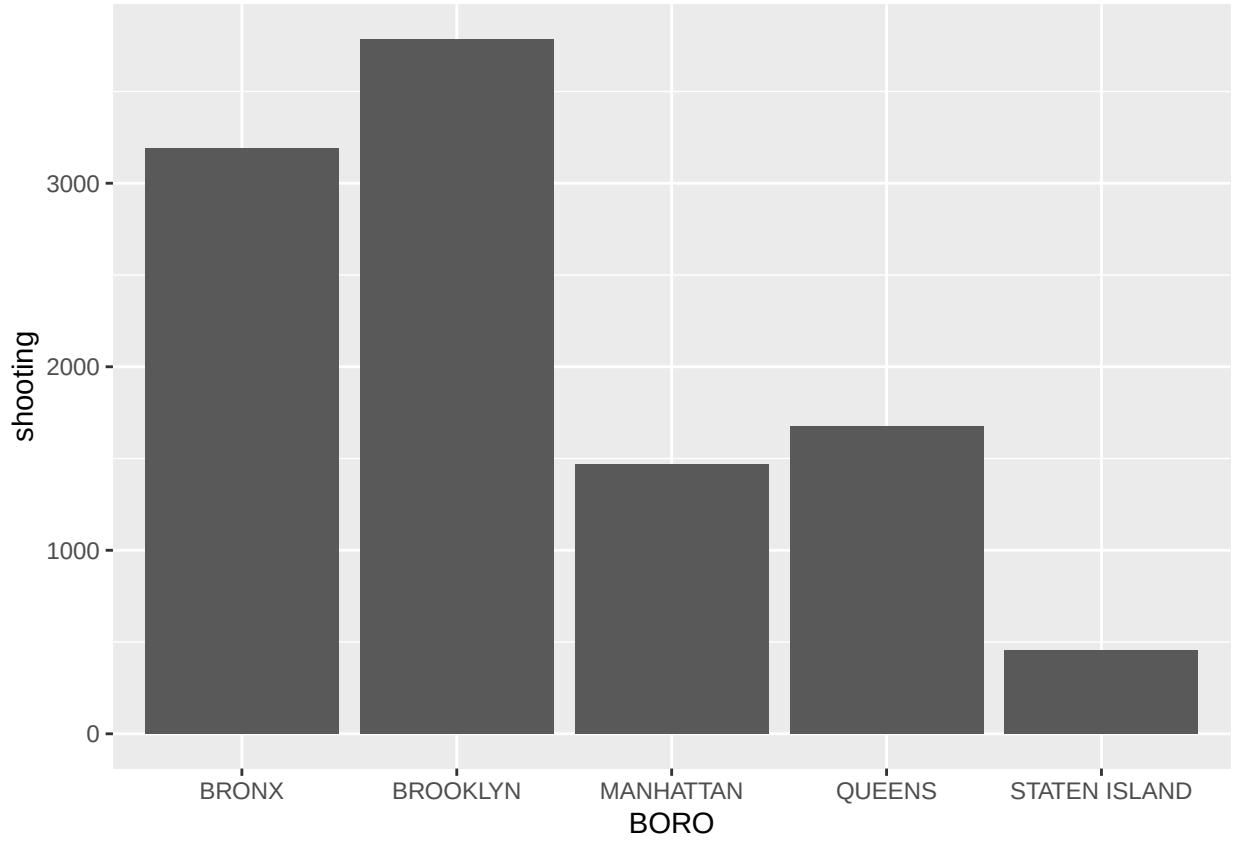
```
all_shootings = sum(nypd_data$shooting)
all_death = sum(nypd_data$death)
partial = all_death / all_shootings
partial
```

```
## [1] 0.2494565
```

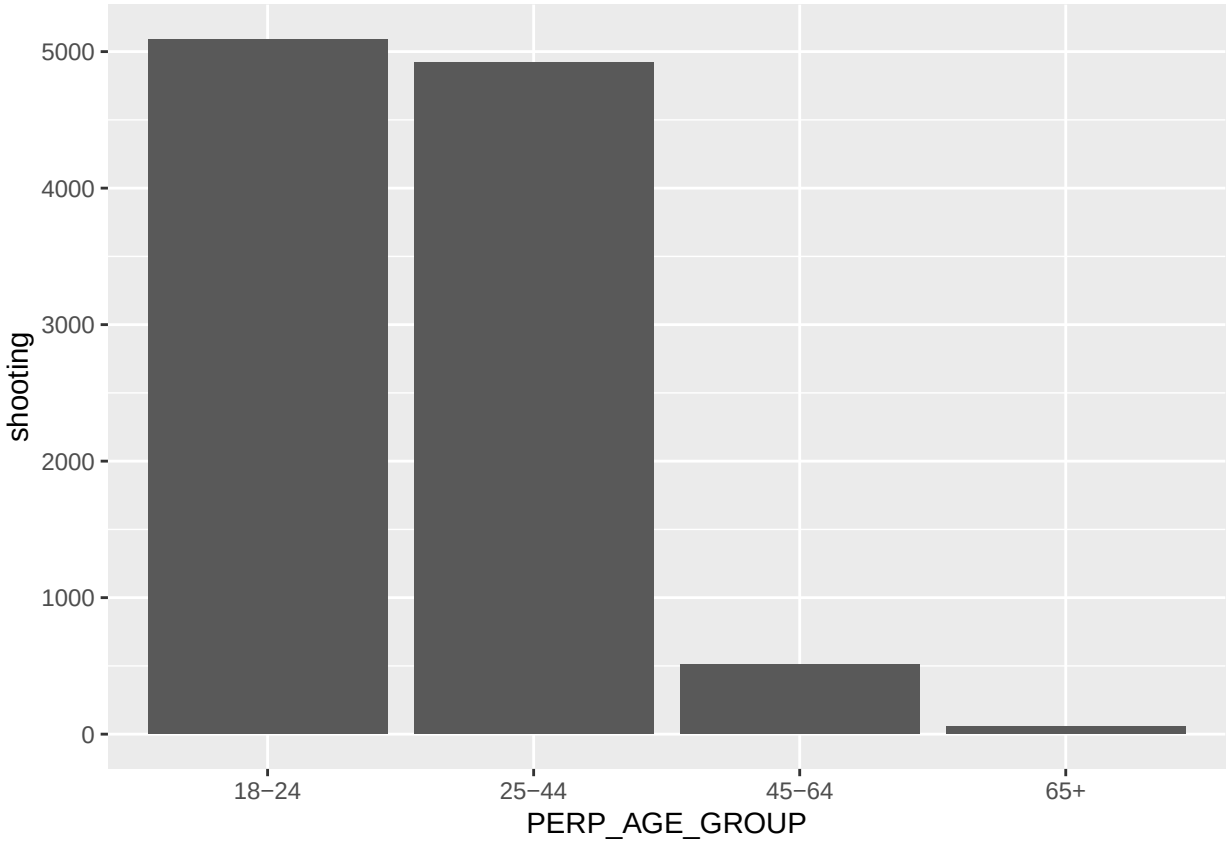
Visualizing and Analyzing the data

```
shootings_by_BORO <- nypd_data %>%
  group_by(BORO) %>%
  summarize(death = sum(death), shooting = sum(shooting)) %>%
  mutate(percentage = (death / shooting) * 100) %>%
  ungroup()
```

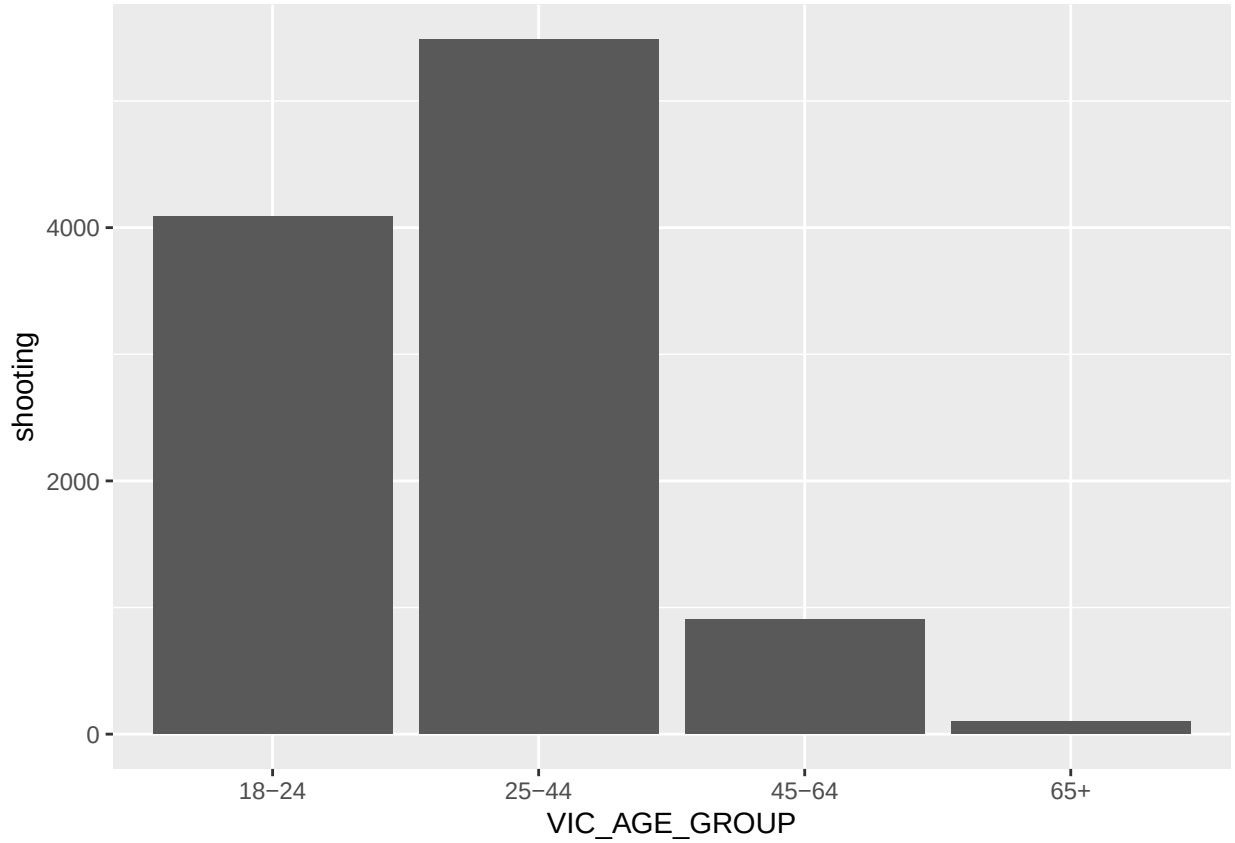
```
shootings_by_BORO %>%
  ggplot(aes(x = BORO, y = shooting)) + geom_bar(stat = "identity")
```



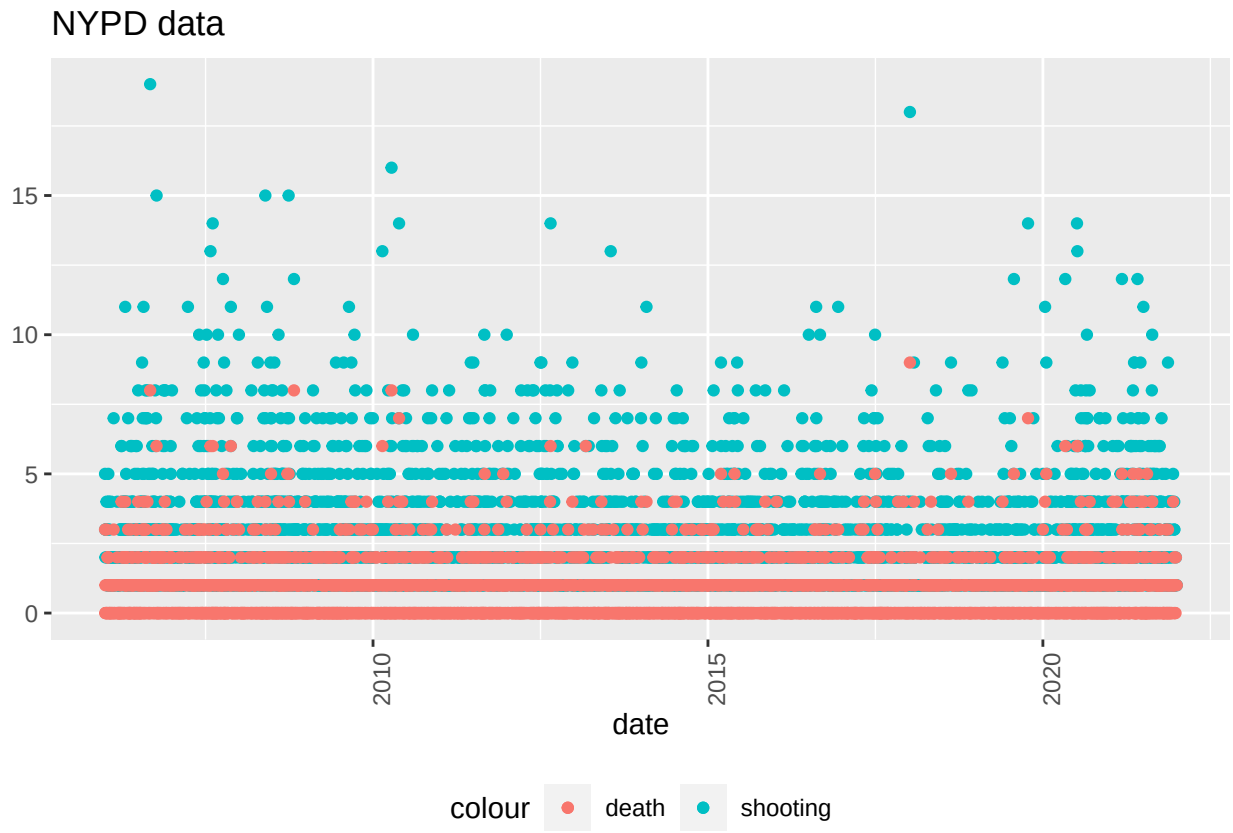

```
shootings_by_perp_age <- nypd_data %>%
  group_by(PERP_AGE_GROUP) %>%
  summarize(death = sum(death), shooting = sum(shooting)) %>%
  mutate(percentage = (death / shooting) * 100) %>%
  ungroup()
shootings_by_perp_age %>%
  ggplot(aes(x = PERP_AGE_GROUP, y = shooting)) + geom_bar(stat = "identity")
```



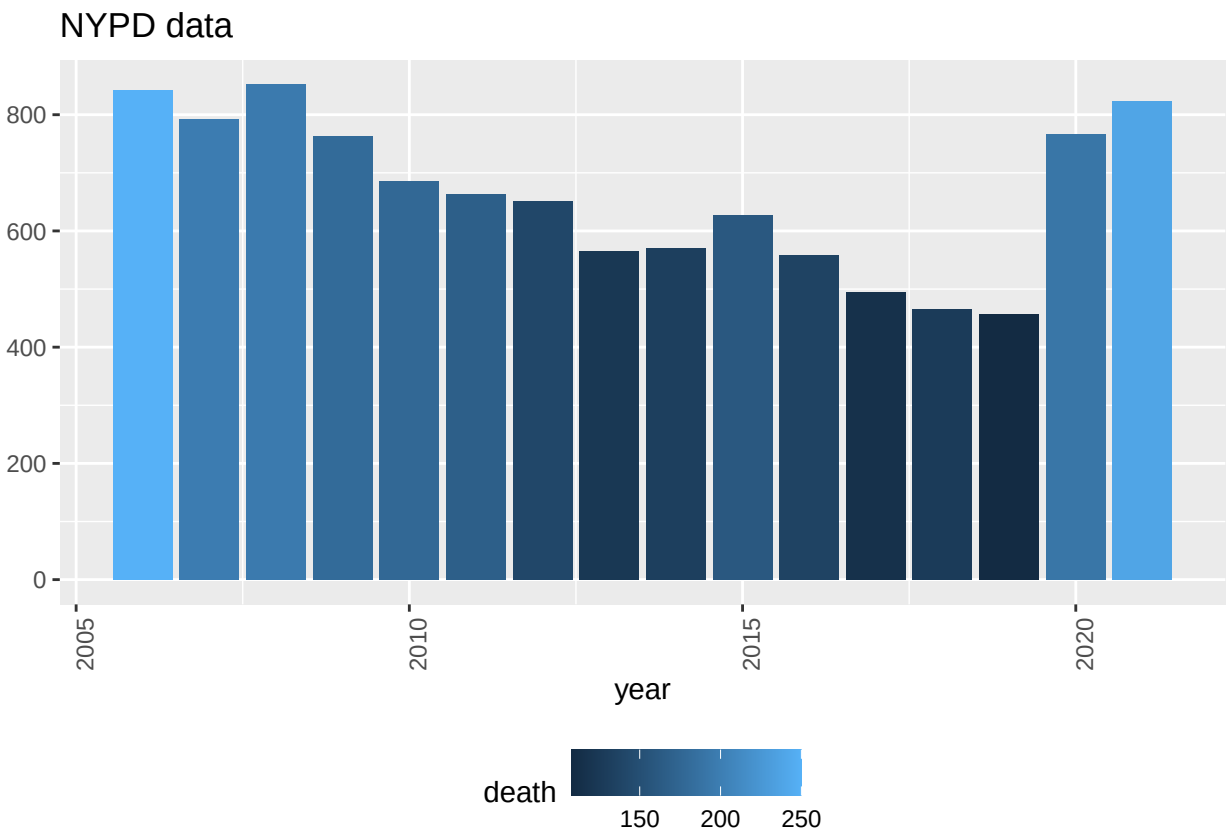

```
shootings_by_vic_age<- nypd_data %>%
  group_by(VIC_AGE_GROUP) %>%
  summarize(death = sum(death), shooting = sum(shooting)) %>%
  mutate(percentage = (death / shooting) * 100) %>%
  ungroup()
shootings_by_vic_age %>%
  ggplot(aes(x = VIC_AGE_GROUP, y = shooting)) + geom_bar(stat = "identity")
```



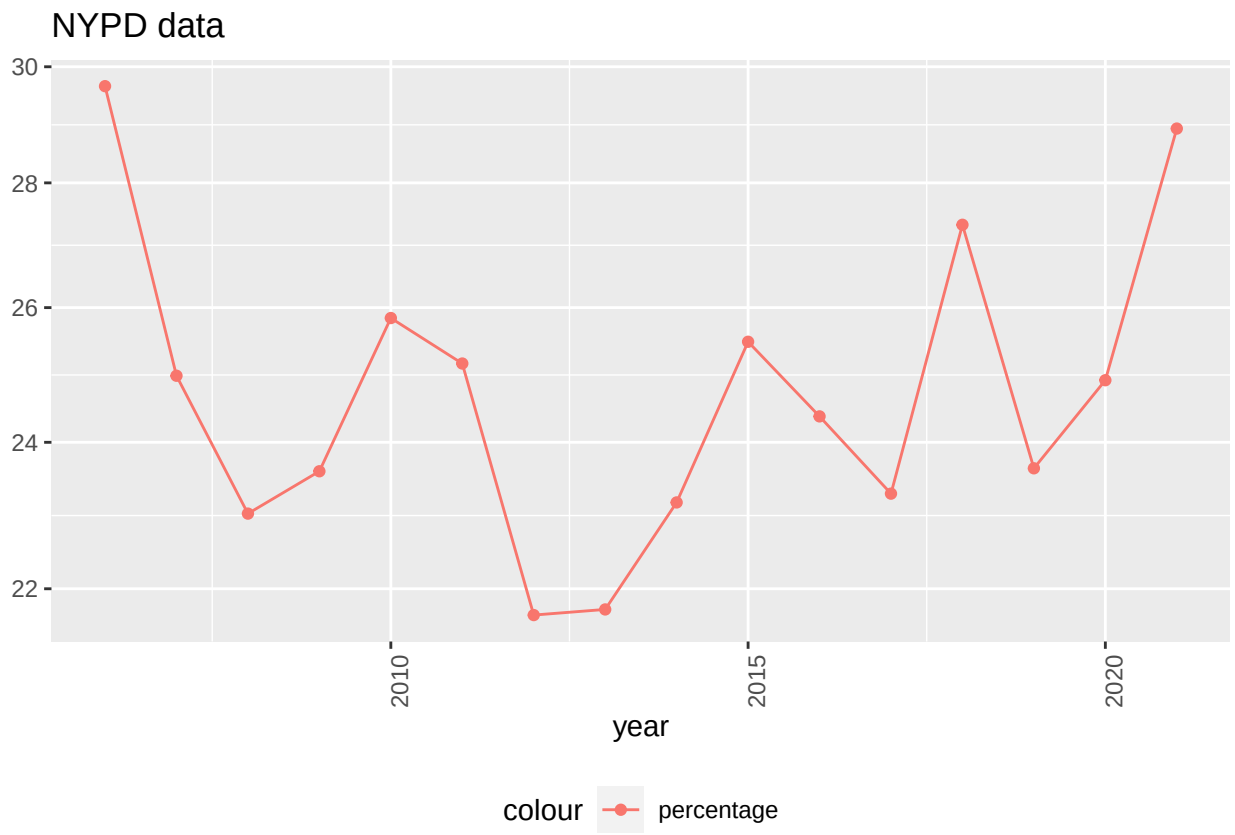

```
shootings_by_date <- nypd_data %>%
  group_by(date) %>%
  summarize(death = sum(death), shooting = sum(shooting)) %>%
  mutate(percentage = (death / shooting) * 100) %>%
  ungroup()
shootings_by_date %>%
  ggplot(aes(x = date, y = shooting)) + geom_point(aes(color = "shooting")) + geom_point(aes(y = death,
  theme(legend.position = "bottom", axis.text.x = element_text(angle = 90)) +
  labs(title = "NYPD data", y = NULL)
```




```
shootings_by_year <- nypd_data %>%
  group_by(year) %>%
  summarize(death = sum(death), shooting = sum(shooting)) %>%
  mutate(percentage = (death / shooting) * 100) %>%
  ungroup()
shootings_by_year %>%
  ggplot(aes(x = year, y = shooting, fill = death)) + geom_bar(stat = "identity") +
  theme(legend.position = "bottom", axis.text.x = element_text(angle = 90)) +
  labs(title = "NYPD data", y = NULL)
```



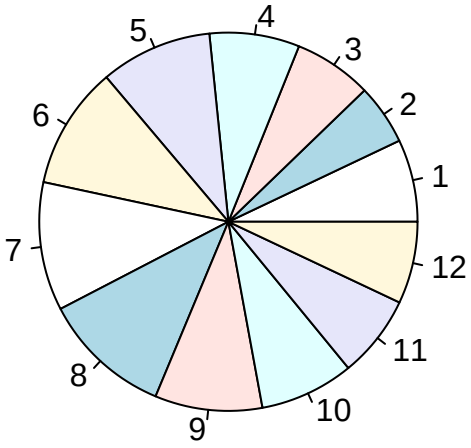

```
shootings_by_year %>%
  ggplot(aes(x = year, y = percentage)) + geom_line(aes(color = "percentage")) + geom_point(aes(color =
  scale_y_log10() +
  theme(legend.position = "bottom", axis.text.x = element_text(angle = 90)) +
  labs(title = "NYPD data", y = NULL)
```




```
shootings_by_month <- nypd_data %>%
  group_by(month) %>%
  summarize(death = sum(death), shooting = sum(shooting)) %>%
  mutate(percentage = (death / shooting) * 100) %>%
  ungroup()
all_shootings = sum(shootings_by_month$shooting)
shootings_by_month <- shootings_by_month %>%
  mutate(part_of_whole = shooting / all_shootings)
shootings_by_month
```

```
## # A tibble: 12 x 5
##    month death shooting percentage part_of_whole
##    <dbl> <dbl>    <dbl>      <dbl>         <dbl>
##  1     1   191      746       25.6        0.0705
##  2     2   128      547       23.4        0.0517
##  3     3   166      708       23.4        0.0669
##  4     4   214      814       26.3        0.0769
##  5     5   273     1011       27.0        0.0956
##  6     6   252     1108       22.7        0.105
##  7     7   270     1162       23.2        0.110
##  8     8   275     1173       23.4        0.111
##  9     9   269      971       27.7        0.0918
## 10    10   209      851       24.6        0.0804
## 11    11   187      746       25.1        0.0705
## 12    12   205      742       27.6        0.0701
```

```
pie(shootings_by_month$part_of_whole)
```



From the analysis, months May, June, July and August have higher number of shootings than other months. How and why this is the case is an interesting question.

Modeling the data

Predicting number of deaths with month and shooting number as independent variables.

```
mod1 <- lm(death ~ BORO + PERP_AGE_GROUP + VIC_AGE_GROUP + year + month, data = nypd_data)
mod2 <- lm(death ~ BORO + PERP_AGE_GROUP + VIC_AGE_GROUP, data = nypd_data)
summary(mod1)
```

```
##
## Call:
## lm(formula = death ~ BORO + PERP_AGE_GROUP + VIC_AGE_GROUP +
##     year + month, data = nypd_data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -0.5115 -0.2676 -0.2183 -0.1785  0.8247
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)          2.1126369  1.7755009   1.190  0.23412
## BOROBROOKLYN        -0.0249237  0.0103808  -2.401  0.01637 *
## BOROMANHATTAN       -0.0293857  0.0135917  -2.162  0.03064 *
## BOROQUEENS          -0.0186006  0.0130026  -1.431  0.15259
## BOROSTATEN ISLAND   -0.0101094  0.0216275  -0.467  0.64020
## PERP_AGE_GROUP25-44  0.0588642  0.0088803   6.629 3.55e-11 ***
## PERP_AGE_GROUP45-64  0.1360379  0.0205414   6.623 3.70e-11 ***
## PERP_AGE_GROUP65+    0.1870450  0.0582256   3.212  0.00132 **
## VIC_AGE_GROUP25-44   0.0164761  0.0092067   1.790  0.07355 .
## VIC_AGE_GROUP45-64   0.0279200  0.0163164   1.711  0.08708 .
## VIC_AGE_GROUP65+     0.0957144  0.0445115   2.150  0.03155 *
## year                -0.0009447  0.0008823  -1.071  0.28432
## month                0.0012021  0.0013208   0.910  0.36280
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.4307 on 10566 degrees of freedom
## Multiple R-squared:  0.01044,    Adjusted R-squared:  0.009319
## F-statistic: 9.292 on 12 and 10566 DF,  p-value: < 2.2e-16
```

```
summary(mod2)
```

```
##
## Call:
## lm(formula = death ~ BORO + PERP_AGE_GROUP + VIC_AGE_GROUP, data = nypd_data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -0.5016 -0.2692 -0.2197 -0.1902  0.8098
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)          0.219722   0.009684  22.689  < 2e-16 ***
## BOROBROOKLYN        -0.024089   0.010355  -2.326  0.02002 *
## BOROMANHATTAN       -0.029505   0.013585  -2.172  0.02989 *
## BOROQUEENS          -0.018504   0.013002  -1.423  0.15473
## BOROSTATEN ISLAND   -0.009191   0.021618  -0.425  0.67074
## PERP_AGE_GROUP25-44  0.057998   0.008842   6.559 5.66e-11 ***
## PERP_AGE_GROUP45-64  0.134707   0.020495   6.573 5.18e-11 ***
## PERP_AGE_GROUP65+    0.185851   0.058209   3.193  0.00141 **
## VIC_AGE_GROUP25-44   0.015610   0.009166   1.703  0.08859 .
## VIC_AGE_GROUP45-64   0.026935   0.016285   1.654  0.09817 .
## VIC_AGE_GROUP65+     0.096008   0.044505   2.157  0.03101 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.4307 on 10568 degrees of freedom
## Multiple R-squared:  0.01025,    Adjusted R-squared:  0.009318
## F-statistic: 10.95 on 10 and 10568 DF,  p-value: < 2.2e-16
```

```
mod3 <- glm(death ~ BORO + PERP_AGE_GROUP + VIC_AGE_GROUP + year + month, data = nypd_data, family = "b
summary(mod3)
```

```
##
## Call:
## glm(formula = death ~ BORO + PERP_AGE_GROUP + VIC_AGE_GROUP +
##     year + month, family = "binomial", data = nypd_data)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.2318  -0.7883  -0.7002  -0.6355   1.8511
##
## Coefficients:
##                       Estimate Std. Error z value Pr(>|z|)
## (Intercept)           8.948512   9.555536   0.936  0.34903
## BOROBROOKLYN         -0.133683   0.055722  -2.399  0.01643 *
## BOROMANHATTAN        -0.158668   0.073728  -2.152  0.03139 *
## BOROQUEENS           -0.099146   0.069754  -1.421  0.15521
## BOROSTATEN ISLAND    -0.053502   0.115371  -0.464  0.64283
## PERP_AGE_GROUP25-44   0.321362   0.048301   6.653 2.87e-11 ***
## PERP_AGE_GROUP45-64   0.676135   0.101646   6.652 2.89e-11 ***
## PERP_AGE_GROUP65+     0.884321   0.275997   3.204  0.00135 **
## VIC_AGE_GROUP25-44    0.091378   0.050276   1.818  0.06914 .
## VIC_AGE_GROUP45-64    0.150504   0.085992   1.750  0.08008 .
## VIC_AGE_GROUP65+      0.468290   0.218890   2.139  0.03240 *
## year                 -0.005102   0.004748  -1.074  0.28262
## month                 0.006541   0.007128   0.918  0.35882
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11885  on 10578  degrees of freedom
## Residual deviance: 11777  on 10566  degrees of freedom
## AIC: 11803
##
## Number of Fisher Scoring iterations: 4
```

```
mod4 <- glm(death ~ BORO + PERP_AGE_GROUP + VIC_AGE_GROUP, data = nypd_data, family = "binomial")
summary(mod4)
```

```
##
## Call:
## glm(formula = death ~ BORO + PERP_AGE_GROUP + VIC_AGE_GROUP,
##     family = "binomial", data = nypd_data)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.2087  -0.7915  -0.7023  -0.6542   1.8150
##
## Coefficients:
##                       Estimate Std. Error z value Pr(>|z|)
## (Intercept)           -1.27408    0.05306 -24.012  < 2e-16 ***
## BOROBROOKLYN          -0.12908    0.05557  -2.323  0.02020 *
## BOROMANHATTAN         -0.15903    0.07368  -2.158  0.03090 *
## BOROQUEENS            -0.09859    0.06975  -1.414  0.15750
## BOROSTATEN ISLAND     -0.04865    0.11532  -0.422  0.67313
```

```
## PERP_AGE_GROUP25-44  0.31658    0.04810   6.582 4.63e-11 ***
## PERP_AGE_GROUP45-64  0.66883    0.10136   6.598 4.16e-11 ***
## PERP_AGE_GROUP65+    0.87767    0.27586   3.182  0.00146 **
## VIC_AGE_GROUP25-44   0.08655    0.05005   1.729  0.08377 .
## VIC_AGE_GROUP45-64   0.14485    0.08582   1.688  0.09146 .
## VIC_AGE_GROUP65+     0.46978    0.21879   2.147  0.03178 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11885  on 10578  degrees of freedom
## Residual deviance: 11779  on 10568  degrees of freedom
## AIC: 11801
##
## Number of Fisher Scoring iterations: 4
```

From the first regression, I see that the coefficients for year and month are not statistically significant, so I drop them and do another regression with the other variables. Then I do a logistic regression. I conclude that boroughs, perpetrator age groups and victim age groups are statistically significant variables when predicting if there is a death that results from a shooting incident in NYC. There may be a bias because there could be other important variables that have been omitted in this analysis.