Gun Series

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7/30/2021

Base Panel Construction - ZCTA-Week Level

Hospital Data - ZCTA-Week level

```r
hosp_zcta <- read_csv("Restricted Hospital Data/minnepop_1620_agg_zipfull_updated.csv") %>%
  arrange(zipcode, year, weekofyr) %>%
  select(-c(`_chk`, zippop_tag)) %>%
  filter(!(year==2016 & weekofyr==53))
```

ZCTAs and ACS 5-Year Estimates

```r
#adding in 5-year ACS data
census_api_key("ecda17575f4d914b502c70f2bae7a5f3d253792d")

year <- lst(2016, 2017, 2018, 2019)

acs <- map_dfr(
  year,
  ~ get_acs(geography = "zcta",
            variables = c("B01001_001E", "B03003_003E",
                          "B02001_003E", "B02001_002E",
                          "B02001_004E", "B02001_008E",
                          "B02001_005E", "B02001_006E",
                          "B02001_007E", "B11001_003E",
                          "B17001_002E", "B01002_001E",
                          "B09010_002E", "B06009_005E",
                          "B01001_002E", "B99233_005E"),
            output = "wide",
            survey = "acs5",
            year = .x),  .id = "year") %>%
  rename(total_pop = B01001_001E,
         white_pop = B02001_002E,
         black_pop = B02001_003E,
         na_pop = B02001_004E,
         asian_pop = B02001_005E,
         hpi_pop = B02001_006E,
         other_pop = B02001_007E,
```

```r
        biracial_pop = B02001_008E,
        hisp_pop = B03003_003E,
        ssi_snap = B09010_002E, #snap, ssi, public cash transfers
        med_age = B01002_001E,
        mar_fam = B11001_003E,
        povlevel = B17001_002E,
        bach_degree = B06009_005E,
        male = B01001_002E,
        nowork_12 = B99233_005E) %>%
  select(-ends_with("M", ignore.case = F), -GEOID) %>%
  mutate(zcta = str_sub(NAME, 6)) %>%
  select(-NAME) %>%
  select(zcta, everything()) %>%
  mutate(year = as.numeric(year)) %>%
  mutate_at(vars(-zcta, -year, -total_pop, -med_age), list(~(./total_pop)*100))

#LOCF imputation of 2020 until 2020 ACS release (12/9/2021)
acs_2020 <- acs %>%
  complete(zcta, year = 2016:2020) %>%
  group_by(zcta) %>%
  mutate_at(vars(-zcta, -year),
            funs(if(sum(!is.na(.))<1) {.} else{na_locf(., option = "locf")})) %>%
  filter(year==2020)

acs_imp <- acs %>%
  rbind(acs_2020) %>%
  mutate(zcta = as.numeric(zcta))

#joining to hospital data
hosp_panel <- hosp_zcta %>%
  left_join(acs_imp, by = c("zipcode"="zcta", "year"))

#SF geometries - get all ZCTAs
zcta <- get_acs(geography = "zcta",
                variables = "B01001_001",
                output = "wide",
                year = 2019,
                geometry = T,
                survey = "acs5") %>%
  rename(zcta = GEOID,
         pop_2019 = B01001_001E) %>%
  select(-c(NAME, B01001_001M, pop_2019)) %>%
  mutate(zcta = as.numeric(zcta))
```

```
##   |                                                    |
```

```r
#minneapolis shapefile (source: openminneapolis.gov)
mpls <- st_read("Data/mpls_city-shp/16cdbbfa-ad10-493c-afaf-52b61f2e76e42020329-1-180h9ap.whbo.shp") %>%
  st_set_crs(st_crs(zcta))
```

```
## Reading layer '16cdbbfa-ad10-493c-afaf-52b61f2e76e42020329-1-180h9ap.whbo' from data source 'C:\Users
##   using driver 'ESRI Shapefile'
## Simple feature collection with 1 feature and 4 fields
```

```
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -93.32911 ymin: 44.89059 xmax: -93.19433 ymax: 45.05125
## Geodetic CRS:  WGS 84
```

```r
#zctas that intersect MPLS
zcta_intersect <- zcta %>%
 st_filter(mpls, .predicate = st_intersects) %>%
  mutate(zcta_area = as.numeric(st_area(.)),
         zcta_area_sqkm = zcta_area*.000001,
         zcta_area_sqmi = zcta_area_sqkm*.386102,
         intersection_area = as.numeric(st_area(st_intersection(., mpls))),
         perc_intersection = round(intersection_area/zcta_area*100,2)) %>%
  filter(perc_intersection >= 2)

#filter hospital panel
panel <- hosp_panel %>%
  filter(zipcode %in% zcta_intersect$zcta) %>%
  mutate(zcta = zipcode)

#creating date bookends
panel <- panel %>%
  group_by(zipcode, year) %>%
  mutate(begin_date = ISOweek2date(paste(year, paste0("W", sprintf("%02d", weekofyr)), 1,sep = "-")),
         end_date = begin_date+weeks(1)-days(1))

#number of unique MPLS ZCTAs
n_zcta <- length(unique(panel$zcta))

#vector of intersecting ZCTAs for filtering downstream
zcta_universe <- unique(panel$zcta)
```

ZCTA-Week Level Police Data

```r
#Minneapolis Police Department - Use of Force Dashboard
uof_spatial <- read_csv("Data/Police_Use_Of_Force.csv")  %>%
  mutate(date=ymd_hms(ResponseDate),
         year=isoyear(date),
         week=isoweek(date)) %>%
  select(OBJECTID, year, week, X, Y, Race) %>%
  st_as_sf(coords = c("X", "Y"), crs = "NAD83", remove=F) %>%
  mutate(intersection = as.integer(st_intersects(geometry, zcta)),
         zcta = ifelse(is.na(intersection), NA, zcta$zcta[intersection])) %>%
  st_drop_geometry() %>%
  filter(!is.na(zcta) & year >= 2016 & year <= 2020 & zcta %in% zcta_universe) %>%
  group_by(year, week, zcta, Race, .drop=F) %>%
  tally(name = "use_of_force") %>%
  filter(!is.na(Race) & Race!="not recorded") %>%
  ungroup() %>%
  complete(year, week, zcta=zcta_universe, Race, fill = list(use_of_force = 0)) %>%
  arrange(year, week, zcta, Race) %>%
  mutate(race = str_to_lower(Race)) %>%
```

```r
  select(-Race) %>%
  pivot_wider(names_from = race,
              values_from = use_of_force,
              values_fill = 0,
              names_glue = "{race}_{.value}") %>%
  mutate(total_use_of_force = asian_use_of_force+black_use_of_force+`native american_use_of_force`+
           `other / mixed race_use_of_force`+`pacific islander_use_of_force`+unknown_use_of_force+
           white_use_of_force)

#MPD Stop Dashboard
stop_spatial <- read_csv("Data/Police_Stop_Data.csv") %>%
  mutate(date=ymd_hms(responseDate),
         year=isoyear(date),
         week=isoweek(date)) %>%
  select(OBJECTID, year, week, lat, long, race) %>%
  st_as_sf(coords = c("long", "lat"), crs = "NAD83", remove=F) %>%
  mutate(intersection = as.integer(st_intersects(geometry, zcta)),
         zcta = ifelse(is.na(intersection), NA, zcta$zcta[intersection])) %>%
  st_drop_geometry() %>%
  filter(!is.na(zcta) & year >= 2016& year <= 2020 & zcta %in% zcta_universe) %>%
  group_by(year, week, zcta, race, .drop=F) %>%
  tally(name = "police_stops") %>%
   filter(!is.na(race) & race!="not recorded") %>%
  ungroup() %>%
  complete(year, week, zcta=zcta_universe, race, fill = list(police_stops = 0)) %>%
  mutate(race = str_to_lower(race)) %>%
  arrange(year, week, zcta, race) %>%
  pivot_wider(names_from = race,
              values_from = police_stops,
              values_fill = 0,
              names_glue = "{race}_{.value}") %>%
  mutate(total_police_stops = asian_police_stops+black_police_stops+
         `east african_police_stops`+latino_police_stops+`native american_police_stops`+
          other_police_stops+unknown_police_stops+white_police_stops)

#Officer Involved Shootings - MPD
ois_spatial <- read_csv("Data/Police_Officer_Involved_Shootings.csv") %>%
  mutate(date=ymd_hms(IncidentDate),
         year=isoyear(date),
         week=isoweek(date)) %>%
  select(OBJECTID, year, week, CenterLatitude, CenterLongitude, SubjectOfForceRace) %>%
  rename(race = SubjectOfForceRace,
         lat = CenterLatitude,
         long = CenterLongitude) %>%
  st_as_sf(coords = c("long", "lat"), crs = "NAD83", remove=F) %>%
  mutate(intersection = as.integer(st_intersects(geometry, zcta)),
         zcta = ifelse(is.na(intersection), NA, zcta$zcta[intersection])) %>%
  st_drop_geometry() %>%
  filter(!is.na(zcta) & year >= 2016 & year <= 2020 & zcta %in% zcta_universe) %>%
  group_by(year, week, zcta, race, .drop=F) %>%
  tally(name = "police_shootings") %>%
  filter(!is.na(race) & race!="not recorded") %>%
  ungroup() %>%
```

```
    complete(year=2016:2021, week=1:53, zcta=zcta_universe, race, fill = list(police_shootings = 0)) %>%
    mutate(race = str_to_lower(race)) %>%
    arrange(year, week, zcta, race) %>%
    pivot_wider(names_from = race,
                values_from = police_shootings,
                values_fill = 0,
                names_glue = "{race}_{.value}") %>%
    mutate(total_police_shootings = asian_police_shootings+black_police_shootings+
           hispanic_police_shootings+other_police_shootings+
           unknown_police_shootings+white_police_shootings)

panel <- panel %>%
  left_join(uof_spatial, by = c("year", "weekofyr"="week", "zcta"="zcta")) %>%
  left_join(stop_spatial, by = c("year", "weekofyr"="week", "zcta"="zcta")) %>%
  left_join(ois_spatial, by = c("year", "weekofyr"="week", "zcta"="zcta"))

#creating period indicators for panel
panel <- panel %>%
  mutate(post_floyd = as.numeric(begin_date >= as.Date("2020-05-25")),
         post_floyd_3 = as.numeric(begin_date >= as.Date("2020-05-25")+months(3)),
         stay_at_home = as.numeric(begin_date >= as.Date("2020-03-28") &
         state_of_emerg = as.numeric(begin_date >= as.Date("2020-03-13")),
         period = factor(case_when(
            post_floyd==0 & post_floyd_3==0 ~ "Pre-Killing",
            post_floyd>=1 & post_floyd_3==0 ~ "0-3 Months Post-Killing",
            post_floyd>=1 & post_floyd_3>=1 ~ "3+ Months Post-Killing"),
            levels = c("Pre-Killing", "0-3 Months Post-Killing", "3+ Months Post-Killing"))) %>%
  group_by(zcta) %>%
  arrange(year, weekofyr) %>%
  mutate(t = row_number(),
         uof_lag = dplyr::lag(total_use_of_force, 1),
         stops_lag = dplyr::lag(total_police_stops, 1),
         shoot_lag = dplyr::lag(total_police_shootings, 1))
```

Time Series Construction - Week Level

Aggregate Hospital Panel to Week-Level

```
#panel to week-level, aggregating over ZCTAs
hosp_series <- panel %>%
  group_by(year, weekofyr) %>%
  summarize(assault_tot = sum(assault_tot, na.rm = T),
            unintent_tot = sum(unintent_tot, na.rm = T),
            suicide_tot = sum(suicide_tot, na.rm = T),
            undeter_tot = sum(undeter_tot, na.rm = T),
            legal_tot = sum(legal_tot, na.rm = T),
            combined_tot = sum(combined_tot, na.rm = T),
            total_pop = sum(total_pop, na.rm = T)) %>%
  mutate(assault_incid_c = (assault_tot/total_pop)*1000,
         unintent_incid_c = (unintent_tot/total_pop)*1000,
```

```r
          suicide_incid_c = (suicide_tot/total_pop)*1000,
          undeter_incid_c = (undeter_tot/total_pop)*1000,
          legal_incid_c = (legal_tot/total_pop)*1000,
          combined_incid_c = (combined_tot/total_pop)*1000) %>%
  ungroup() %>%
  mutate(week_id = row_number())
```

Police Data Week-Level

```r
#Minneapolis Police Department – Use of Force Dashboard
uof <- read_csv("Data/Police_Use_Of_Force.csv") %>%
  mutate(date=ymd_hms(ResponseDate),
         year=isoyear(date),
         week=isoweek(date)) %>%
  group_by(year, week, .drop=F) %>%
  tally(name = "use_of_force") %>%
  arrange(year, week) %>%
  ungroup() %>%
  select(year, week, everything())

#merge onto series
series <- hosp_series %>%
  left_join(uof, by=c("year", "weekofyr"="week")) %>%
  mutate(use_of_force_rate = (use_of_force/total_pop)*1000)

#MPD Officer Involved Shootings
ois <- read_csv("Data/Police_Officer_Involved_Shootings.csv") %>%
  mutate(date=ymd_hms(IncidentDate),
         year=isoyear(date),
         week=isoweek(date)) %>%
  group_by(year, week, .drop=F) %>%
  tally(name = "off_inv_shooting") %>%
  arrange(year, week) %>%
  ungroup() %>%
  select(year, week, everything())

#merge onto series
series <- series %>%
  left_join(ois, by=c("year", "weekofyr"="week")) %>%
  mutate(off_inv_shooting = ifelse(is.na(off_inv_shooting), 0, off_inv_shooting),
         off_inv_shooting_rate = (off_inv_shooting/total_pop)*1000)


#Minneapolis Police Department – Police Stops Dashboard
stop <- read_csv("Data/Police_Stop_Data.csv") %>%
  mutate(date=ymd_hms(responseDate),
         year=isoyear(date),
         week=isoweek(date)) %>%
  group_by(year, week, .drop=F) %>%
  tally(name = "police_stops")
```

```
#merge onto series
series <- series %>%
  left_join(stop, by = c("year", "weekofyr"="week")) %>%
  mutate(police_stop_rate = (police_stops/total_pop)*1000)


#creating date variable
series <- series %>%
  mutate(begin_date = ISOweek2date(paste(year, paste0("W", sprintf("%02d", weekofyr)), 1,sep = "-")),
         end_date = begin_date+weeks(1)-days(1))
```

Weather Data

```
# Minnesota DNR Daily Date
 # https://www.dnr.state.mn.us/climate/historical/daily-data.html?sid=mspthr&sname=Minneapolis/St%20Pau
 # Station Name: Minneapolis/St Paul Threaded Record - Station ID: mspthr

weather <- read_csv("Data/dnr_weather.csv") %>%
  mutate(year=isoyear(Date),
         week=isoweek(Date),
         precip_in = as.numeric(ifelse(`Precipitation (inches)`=="T", .001, `Precipitation (inches)`)),
         snow_in = as.numeric(ifelse(`Snow (inches)`=="T", .001, `Snow (inches)`)),
         tmax_f = `Maximum Temperature degrees (F)`) %>%
  filter(year >= 2016 & year <= 2020) %>%
  select(year, week, precip_in, snow_in, tmax_f) %>%
  group_by(year, week) %>%
  summarize(precip_in = mean(precip_in, na.rm = T),
            snow_in = mean(snow_in, na.rm = T),
            tmax_f = mean(tmax_f, na.rm = T))


#join to series
series <- series %>% left_join(weather, by = c("year","weekofyr"="week"))
```

Sunset Data

```
#setting lat-lon for MPLS
mpls_lonlat <- geocode("Minneapolis, MN", output = "latlon", source="google")

#scrape sunset times for each begin date
  #mutate to UTC-6 CST
  #calculate hours of darkness before midnight
sun_series <- getSunlightTimes(date = seq(min(series$begin_date),
                               max(series$begin_date),
                               "days"),
                               lat = 44.97775    ,
                               lon = -93.26501,
                               keep = "sunset",
                               tz = "UTC") %>%
  mutate(sunset = sunset-hours(6),
```

```
        midnight = as.POSIXlt(date+days(1), format = '%Y-%m-%d %H:%M:%S'),
        dark = as.numeric(midnight-sunset),
        year = year(date),
        week = isoweek(date)) %>%
  group_by(year, week) %>%
  summarize(dark_before_12 = mean(dark, na.rm = T))


#joining to series
series <- series %>%
  left_join(sun_series, by = c("year", "weekofyr"="week"))
```

School Data

```
#created manually from online MPLS Public School Calendars: https://mpls.k12.mn.us/calendars
school <- series %>%
  select(year, weekofyr, begin_date, end_date) %>%
  mutate(days_in_week = as.numeric((end_date-begin_date))+1,
         days_in_school = NA_integer_)

school[1,6] <- 5
school[2,6] <- 4
school[3,6] <- 3
school[4,6] <- 5
school[5,6] <- 5
school[6,6] <- 4
school[7,6] <- 4
school[8,6] <- 5
school[9,6] <- 5
school[10,6] <- 4
school[11,6] <- 4
school[12,6] <- 5
school[13,6] <- 0
school[14,6] <- 5
school[15,6] <- 5
school[16,6] <- 5
school[17,6] <- 5
school[18,6] <- 5
school[19,6] <- 5
school[20,6] <- 5
school[21,6] <- 5
school[22,6] <- 4
school[23,6] <- 2
school[24,6] <- 0
school[25,6] <- 0
school[26,6] <- 0
school[27,6] <- 0
school[28,6] <- 0
school[29,6] <- 0
school[30,6] <- 0
school[31,6] <- 0
```

```
school[32,6] <- 0
school[33,6] <- 0
school[34,6] <- 0
school[35,6] <- 5
school[36,6] <- 4
school[37,6] <- 5
school[38,6] <- 5
school[39,6] <- 5
school[40,6] <- 5
school[41,6] <- 5
school[42,6] <- 2
school[43,6] <- 5
school[44,6] <- 3
school[45,6] <- 5
school[46,6] <- 5
school[47,6] <- 2
school[48,6] <- 5
school[49,6] <- 5
school[50,6] <- 5
school[51,6] <- 0
school[52,6] <- 0
school[53,6] <- 4
school[54,6] <- 5
school[55,6] <- 4
school[56,6] <- 4
school[57,6] <- 4
school[58,6] <- 5
school[59,6] <- 4
school[60,6] <- 4
school[61,6] <- 5
school[62,6] <- 5
school[63,6] <- 5
school[64,6] <- 5
school[65,6] <- 3
school[66,6] <- 0
school[67,6] <- 5
school[68,6] <- 5
school[69,6] <- 5
school[70,6] <- 5
school[71,6] <- 5
school[72,6] <- 5
school[73,6] <- 5
school[74,6] <- 4
school[75,6] <- 5
school[76,6] <- 3
school[77,6] <- 0
school[78,6] <- 0
school[79,6] <- 0
school[80,6] <- 0
school[81,6] <- 0
school[82,6] <- 0
school[83,6] <- 0
school[84,6] <- 0
```

```r
school[85,6] <- 0
school[86,6] <- 0
school[87,6] <- 5
school[88,6] <- 4
school[89,6] <- 5
school[90,6] <- 5
school[91,6] <- 5
school[92,6] <- 5
school[93,6] <- 5
school[94,6] <- 2
school[95,6] <- 5
school[96,6] <- 3
school[97,6] <- 5
school[98,6] <- 5
school[99,6] <- 2
school[100,6] <- 5
school[101,6] <- 5
school[102,6] <- 5
school[103,6] <- 5
school[104,6] <- 0
school[105,6] <- 0
school[106,6] <- 0
school[107,6] <- 5
school[108,6] <- 4
school[109,6] <- 3
school[110,6] <- 5
school[111,6] <- 5
school[112,6] <- 4
school[113,6] <- 4
school[114,6] <- 5
school[115,6] <- 5
school[116,6] <- 5
school[117,6] <- 5
school[118,6] <- 4
school[119,6] <- 0
school[120,6] <- 5
school[121,6] <- 5
school[122,6] <- 5
school[123,6] <- 5
school[124,6] <- 5
school[125,6] <- 5
school[126,6] <- 5
school[127,6] <- 4
school[128,6] <- 5
school[129,6] <- 0
school[130,6] <- 0
school[131,6] <- 0
school[132,6] <- 0
school[133,6] <- 0
school[134,6] <- 0
school[135,6] <- 0
school[136,6] <- 0
school[137,6] <- 0
```

```
school[138,6] <- 0
school[139,6] <- 0
school[140,6] <- 5
school[141,6] <- 4
school[142,6] <- 5
school[143,6] <- 5
school[144,6] <- 5
school[145,6] <- 5
school[146,6] <- 5
school[147,6] <- 2
school[148,6] <- 5
school[149,6] <- 3
school[150,6] <- 5
school[151,6] <- 5
school[152,6] <- 2
school[153,6] <- 5
school[154,6] <- 5
school[155,6] <- 5
school[156,6] <- 5
school[157,6] <- 0
school[158,6] <- 0
school[159,6] <- 5
school[160,6] <- 5
school[161,6] <- 2
school[162,6] <- 5
school[163,6] <- 5
school[164,6] <- 4
school[165,6] <- 4
school[166,6] <- 5
school[167,6] <- 5
school[168,6] <- 5
school[169,6] <- 5
school[170,6] <- 4
school[171,6] <- 0
school[172,6] <- 5
school[173,6] <- 5
school[174,6] <- 5
school[175,6] <- 5
school[176,6] <- 5
school[177,6] <- 5
school[178,6] <- 5
school[179,6] <- 4
school[180,6] <- 5
school[181,6] <- 0
school[182,6] <- 0
school[183,6] <- 0
school[184,6] <- 0
school[185,6] <- 0
school[186,6] <- 0
school[187,6] <- 0
school[188,6] <- 0
school[189,6] <- 0
school[190,6] <- 0
```

```
school[191,6] <- 0
school[192,6] <- 0
school[193,6] <- 4
school[194,6] <- 5
school[195,6] <- 5
school[196,6] <- 5
school[197,6] <- 5
school[198,6] <- 5
school[199,6] <- 2
school[200,6] <- 5
school[201,6] <- 4
school[202,6] <- 5
school[203,6] <- 5
school[204,6] <- 5
school[205,6] <- 2
school[206,6] <- 5
school[207,6] <- 5
school[208,6] <- 5
school[209,6] <- 0
school[210,6] <- 0
school[211,6] <- 5
school[212,6] <- 4
school[213,6] <- 4
school[214,6] <- 5
school[215,6] <- 5
school[216,6] <- 5
school[217,6] <- 3
school[218,6] <- 5
school[219,6] <- 5
school[220,6] <- 5
school[221,6] <- 5
school[222,6] <- 4
school[223,6] <- 0
school[224,6] <- 5
school[225,6] <- 5
school[226,6] <- 5
school[227,6] <- 5
school[228,6] <- 5
school[229,6] <- 5
school[230,6] <- 5
school[231,6] <- 4
school[232,6] <- 5
school[233,6] <- 0
school[234,6] <- 0
school[235,6] <- 0
school[236,6] <- 0
school[237,6] <- 0
school[238,6] <- 0
school[239,6] <- 0
school[240,6] <- 0
school[241,6] <- 0
school[242,6] <- 0
school[243,6] <- 0
```

```
school[244,6] <- 0
school[245,6] <- 4
school[246,6] <- 5
school[247,6] <- 5
school[248,6] <- 5
school[249,6] <- 5
school[250,6] <- 5
school[251,6] <- 3
school[252,6] <- 4
school[253,6] <- 5
school[254,6] <- 4
school[255,6] <- 5
school[256,6] <- 5
school[257,6] <- 2
school[258,6] <- 5
school[259,6] <- 5
school[260,6] <- 5
school[261,6] <- 0
school[262,6] <- 0

school <- school %>%
  mutate(school = days_in_school/days_in_week) %>%
  select(year, weekofyr, school)

series <- series %>% left_join(school, by = c("year", "weekofyr"))
```
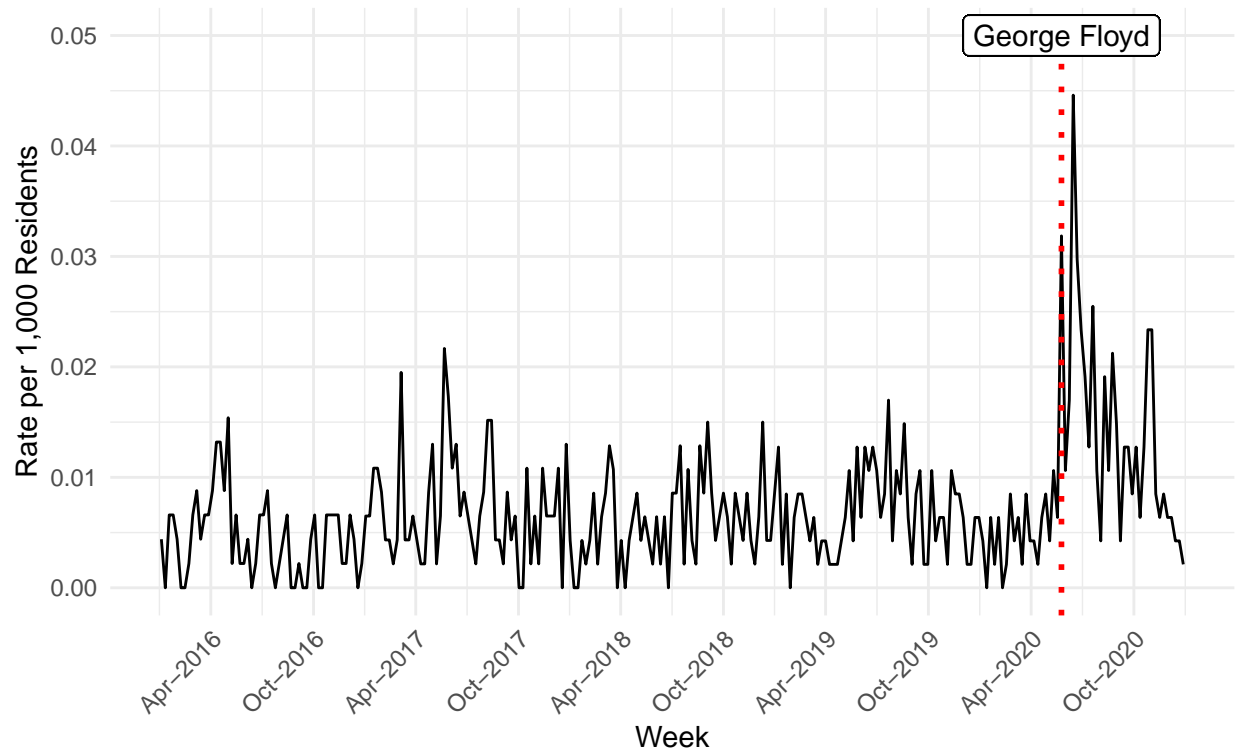
Time Series Vizualization

```
ggplot(series)+
  geom_line(aes(x=begin_date, y=assault_incid_c))+
  scale_x_date(date_labels = "%b-%Y", date_breaks = "6 months")+
  geom_vline(xintercept=series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-05-25
              linetype="dotted", color="red", size=1)+
  geom_label(aes(x=series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-05-25"))],
                y=0.050),
              label = "George Floyd", show.legend = FALSE)+
  labs(title = "Figure 1: Weekly Firearm Assault Injuries, 2016-2020",
        subtitle = "MHA Hospital Data",
        x = "Week",
        y = "Rate per 1,000 Residents")+
  theme_minimal()+
    theme(axis.text.x=element_text(angle=45, hjust=1))
```

Figure 1: Weekly Firearm Assault Injuries, 2016–2020
MHA Hospital Data


```
ggplot(series)+
  geom_line(aes(x=begin_date, y=unintent_incid_c))+
  scale_x_date(date_labels = "%b-%Y", date_breaks = "6 months")+
  geom_vline(xintercept=series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-05-25")
             linetype="dotted", color="red", size=1)+
  geom_label(aes(x=series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-05-25"))],
                 y=0.050),
             label = "George Floyd", show.legend = FALSE)+
  labs(title = "Figure A3: Weekly Firearm Unintentional Injuries, 2016-2020",
       subtitle = "MHA Hospital Data",
       x = "Week",
       y = "Rate per 1,000 Residents")+
  theme_minimal()+
    theme(axis.text.x=element_text(angle=45, hjust=1))
```

Figure A3: Weekly Firearm Unintentional Injuries, 2016–2020
MHA Hospital Data
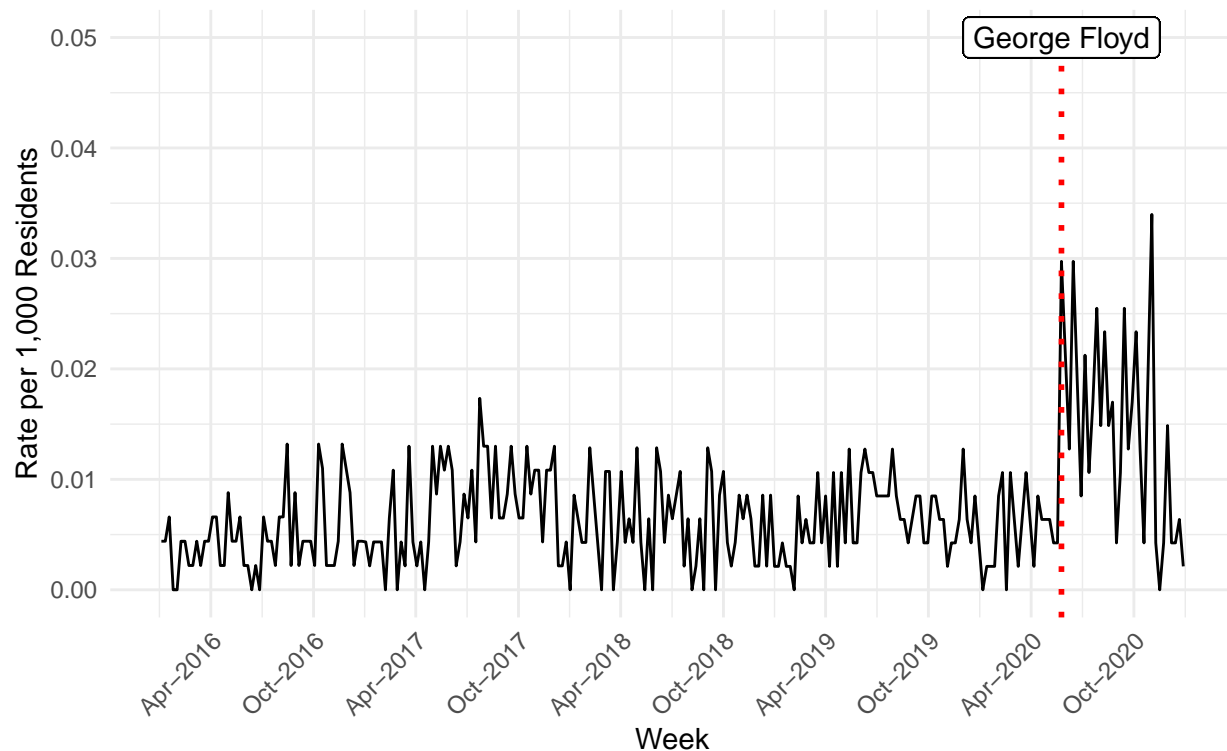
Time Series Analysis

```
series <- series %>%
  mutate(t = 1:length(assault_incid_c),
         post_floyd = as.factor(as.numeric(begin_date >= as.Date("2020-05-25"))),
         post_floyd_3 = as.factor(as.numeric(begin_date >= as.Date("2020-05-25")+months(3))),
         stay_at_home = as.factor(as.numeric(begin_date >= as.Date("2020-03-28") &
         state_of_emerg = as.factor(as.numeric(begin_date >= as.Date("2020-03-13"))),
         uof_lag=lag(use_of_force_rate,1),
         stops_lag = lag(police_stop_rate,1),
         shoot_lag = lag(off_inv_shooting_rate,1))

ts <- lm(assault_incid_c~t+state_of_emerg+stay_at_home+post_floyd+post_floyd_3+
                        tmax_f+snow_in+precip_in+dark_before_12+school,
                        data = series)
summary(ts)
```
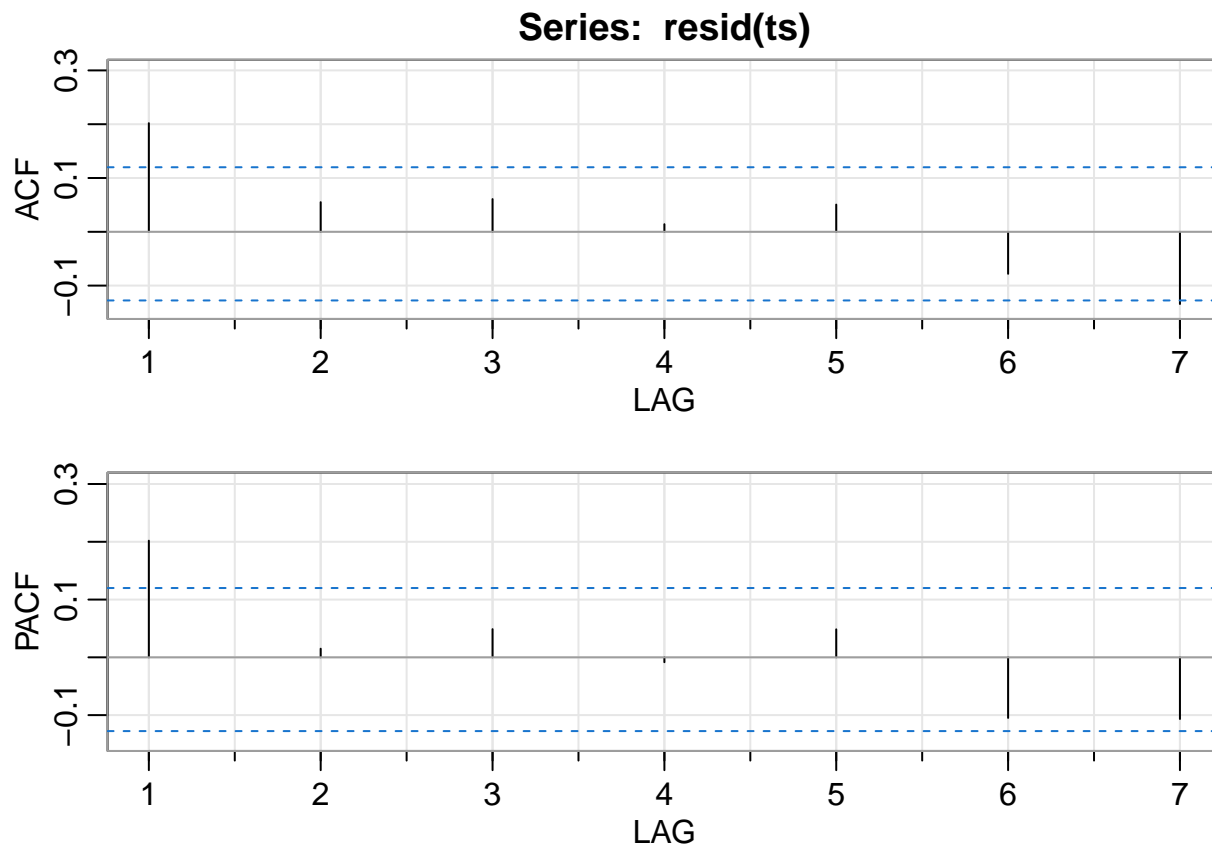
```
##
## Call:
## lm(formula = assault_incid_c ~ t + state_of_emerg + stay_at_home +
##     post_floyd + post_floyd_3 + tmax_f + snow_in + precip_in +
##     dark_before_12 + school, data = series)
##
```

```
## Residuals:
##        Min         1Q     Median         3Q        Max
## -0.0153190 -0.0033359 -0.0003768  0.0023940  0.0248840
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)     7.382e-03  4.046e-03   1.825   0.0693 .
## t               8.314e-06  5.146e-06   1.616   0.1074
## state_of_emerg1 -5.435e-03  2.926e-03  -1.858   0.0644 .
## stay_at_home1    4.592e-03  3.009e-03   1.526   0.1283
## post_floyd1      1.699e-02  2.992e-03   5.677 3.79e-08 ***
## post_floyd_31   -8.252e-03  1.857e-03  -4.443 1.33e-05 ***
## tmax_f           1.372e-05  2.747e-05   0.499   0.6179
## snow_in         -5.824e-04  8.786e-04  -0.663   0.5081
## precip_in       -6.880e-04  2.871e-03  -0.240   0.8108
## dark_before_12  -5.447e-04  4.705e-04  -1.158   0.2480
## school           4.658e-04  1.082e-03   0.431   0.6671
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.004764 on 250 degrees of freedom
## Multiple R-squared:  0.3509, Adjusted R-squared:  0.325
## F-statistic: 13.52 on 10 and 250 DF,  p-value: < 2.2e-16
```

```
acf2(resid(ts), max.lag = 7)
```


Series: resid(ts)

```
##      [,1] [,2] [,3]  [,4] [,5]  [,6]  [,7]
## ACF   0.2 0.06 0.06  0.01 0.05 -0.08 -0.13
## PACF  0.2 0.01 0.05 -0.01 0.05 -0.10 -0.11
```

```r
ts_ar1<- lm(assault_incid_c~t+state_of_emerg+stay_at_home+post_floyd+post_floyd_3+
                      tmax_f+snow_in+precip_in+dark_before_12+school+
                      dplyr::lag(assault_incid_c, 1), data = series)
summary(ts_ar1)
```

```
##
## Call:
## lm(formula = assault_incid_c ~ t + state_of_emerg + stay_at_home +
##     post_floyd + post_floyd_3 + tmax_f + snow_in + precip_in +
##     dark_before_12 + school + dplyr::lag(assault_incid_c, 1),
##     data = series)
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -0.0137903 -0.0032412 -0.0000841  0.0024998  0.0252791
##
## Coefficients:
##                                Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   6.074e-03  4.024e-03   1.509 0.132471
## t                             6.886e-06  5.153e-06   1.337 0.182608
## state_of_emerg1              -5.742e-03  2.893e-03  -1.984 0.048313 *
## stay_at_home1                 5.313e-03  2.985e-03   1.780 0.076255 .
## post_floyd1                   1.541e-02  3.009e-03   5.121 6.11e-07 ***
## post_floyd_31                -7.125e-03  1.878e-03  -3.794 0.000186 ***
## tmax_f                        1.032e-05  2.718e-05   0.380 0.704524
## snow_in                      -5.425e-04  8.683e-04  -0.625 0.532659
## precip_in                    -2.749e-04  2.840e-03  -0.097 0.922964
## dark_before_12               -4.549e-04  4.662e-04  -0.976 0.330078
## school                        5.606e-04  1.069e-03   0.524 0.600630
## dplyr::lag(assault_incid_c, 1)  1.743e-01  6.143e-02   2.838 0.004911 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.004707 on 248 degrees of freedom
##    (1 observation deleted due to missingness)
## Multiple R-squared:  0.3709, Adjusted R-squared:  0.343
## F-statistic: 13.29 on 11 and 248 DF,  p-value: < 2.2e-16
```

```r
acf2(resid(ts_ar1), max.lag = 7)
```

Series: resid(ts_ar1)
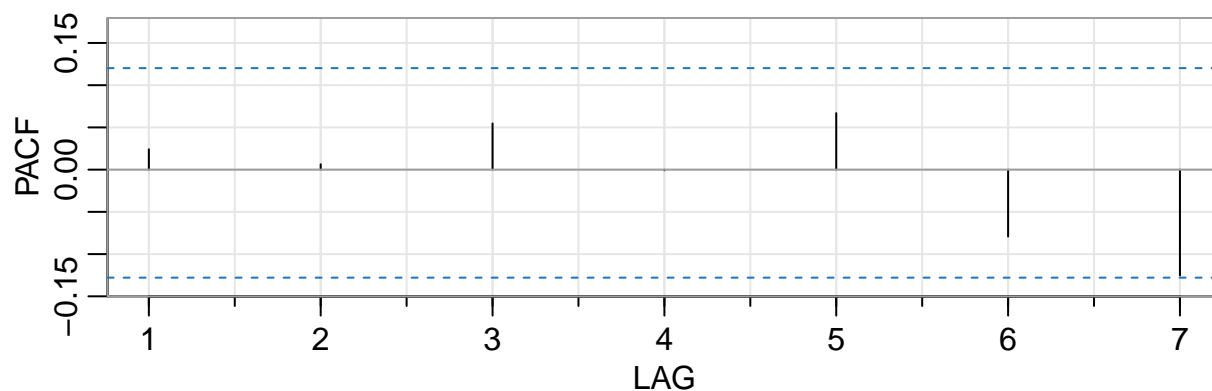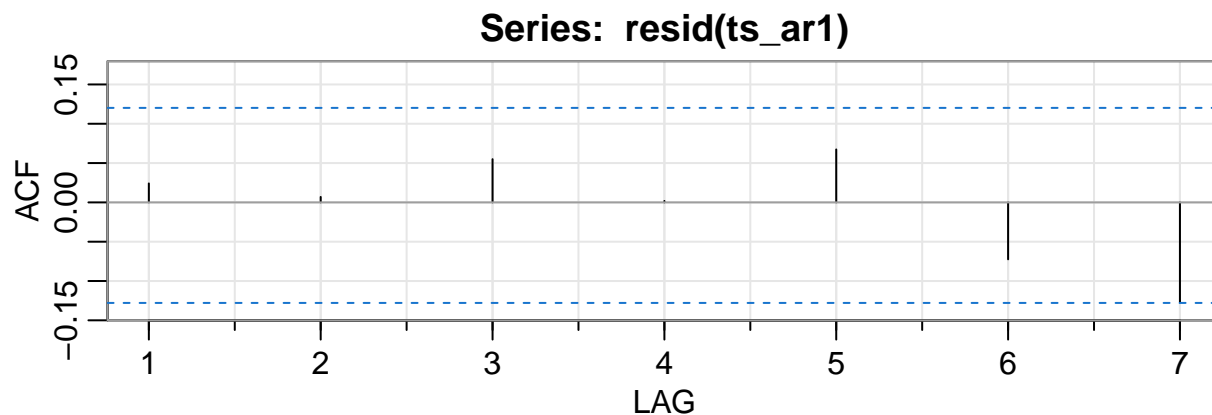

```
##       [,1] [,2] [,3] [,4] [,5]  [,6]  [,7]
## ACF  0.02 0.01 0.05    0 0.07 -0.07 -0.13
## PACF 0.02 0.01 0.05    0 0.07 -0.08 -0.13
```

```
ts_pol <- lm(assault_incid_c~t+state_of_emerg+stay_at_home+post_floyd+post_floyd_3+
                   tmax_f+snow_in+precip_in+dark_before_12+school+
                   uof_lag+stops_lag+shoot_lag,
             data = series)
summary(ts_pol)
```

```
##
## Call:
## lm(formula = assault_incid_c ~ t + state_of_emerg + stay_at_home +
##     post_floyd + post_floyd_3 + tmax_f + snow_in + precip_in +
##     dark_before_12 + school + uof_lag + stops_lag + shoot_lag,
##     data = series)
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -0.0150383 -0.0031439 -0.0005773  0.0023294  0.0238783
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)    1.209e-02  5.866e-03   2.061 0.040569 *
## t             -1.157e-05  9.887e-06  -1.170 0.243357
```

```
## state_of_emerg1 -5.048e-03  3.013e-03  -1.676 0.095363 .
## stay_at_home1    5.198e-03  3.083e-03   1.686 0.093359 .
## post_floyd1      1.583e-02  3.130e-03   5.057 9.52e-07 ***
## post_floyd_31   -7.502e-03  2.148e-03  -3.493 0.000585 ***
## tmax_f           3.200e-05  3.185e-05   1.005 0.316245
## snow_in         -8.813e-04  9.445e-04  -0.933 0.351868
## precip_in        2.070e-03  3.205e-03   0.646 0.519020
## dark_before_12  -4.689e-04  5.470e-04  -0.857 0.392337
## school           2.435e-04  1.242e-03   0.196 0.844840
## uof_lag          2.485e-03  7.500e-03   0.331 0.740676
## stops_lag       -1.846e-03  1.249e-03  -1.478 0.141037
## shoot_lag       -2.573e-01  2.099e-01  -1.226 0.221648
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.004857 on 203 degrees of freedom
##   (44 observations deleted due to missingness)
## Multiple R-squared:  0.3826, Adjusted R-squared:  0.3431
## F-statistic: 9.677 on 13 and 203 DF,  p-value: 1.371e-15
```

```
acf2(resid(ts_pol), max.lag = 7)
```


Series: resid(ts_pol)
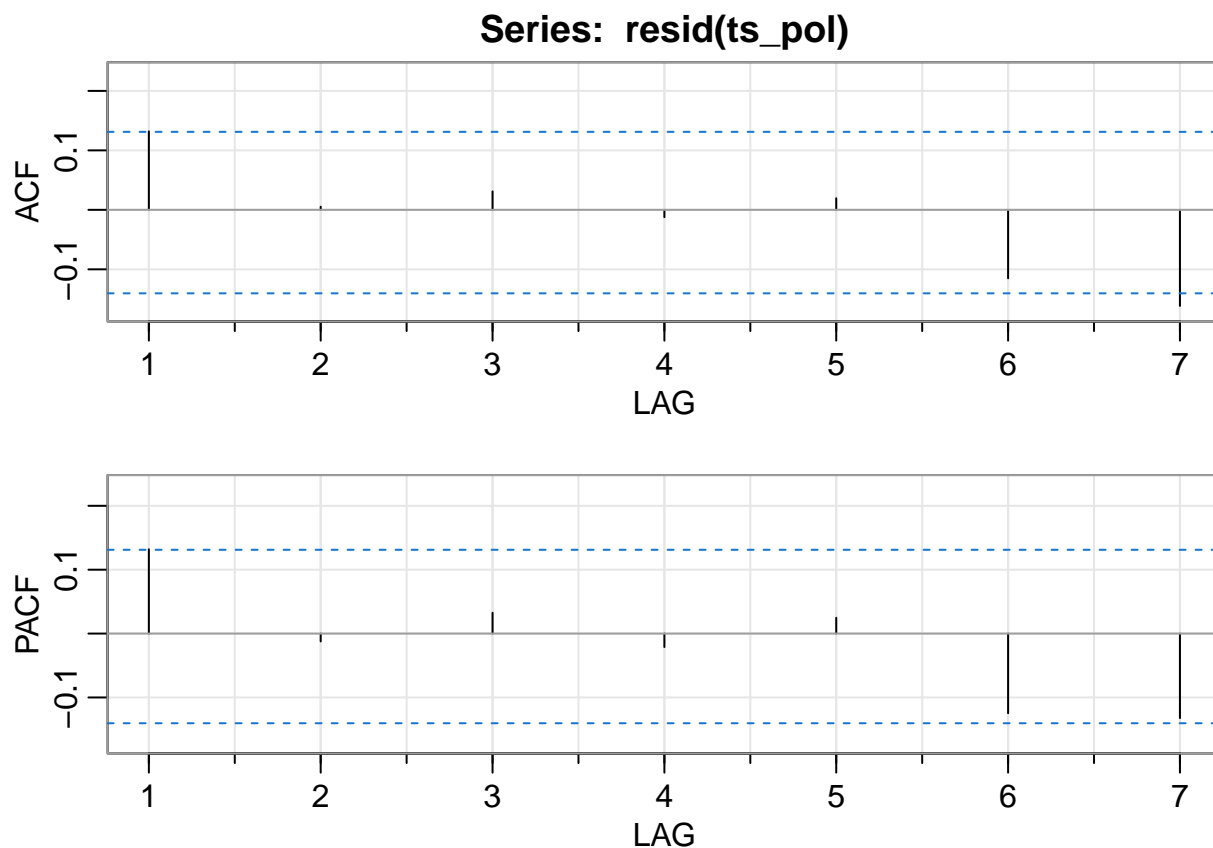
```
##       [,1]  [,2] [,3]  [,4] [,5]  [,6]  [,7]
## ACF  0.13  0.01 0.03 -0.01 0.02 -0.12 -0.16
## PACF 0.13 -0.01 0.03 -0.02 0.02 -0.12 -0.13
```

```
ts_ar1_pol<- lm(assault_incid_c~t+state_of_emerg+stay_at_home+post_floyd+post_floyd_3+
                        tmax_f+snow_in+precip_in+dark_before_12+school+
                uof_lag+stops_lag+shoot_lag+
                        dplyr::lag(assault_incid_c, 1), data = series)


summary(ts_ar1_pol)
```

```
##
## Call:
## lm(formula = assault_incid_c ~ t + state_of_emerg + stay_at_home +
##     post_floyd + post_floyd_3 + tmax_f + snow_in + precip_in +
##     dark_before_12 + school + uof_lag + stops_lag + shoot_lag +
##     dplyr::lag(assault_incid_c, 1), data = series)
##
## Residuals:
##        Min        1Q     Median        3Q        Max
## -0.0141977 -0.0031314 -0.0003472  0.0024388  0.0241791
##
## Coefficients:
##                                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)                     1.088e-02  5.910e-03   1.841  0.06702 .
## t                              -1.006e-05  9.915e-06  -1.015  0.31128
## state_of_emerg1                -5.281e-03  3.009e-03  -1.755  0.08078 .
## stay_at_home1                   5.545e-03  3.084e-03   1.798  0.07370 .
## post_floyd1                     1.509e-02  3.163e-03   4.770 3.52e-06 ***
## post_floyd_31                  -6.837e-03  2.191e-03  -3.120  0.00207 **
## tmax_f                          2.648e-05  3.200e-05   0.827  0.40894
## snow_in                        -8.463e-04  9.423e-04  -0.898  0.37020
## precip_in                       2.294e-03  3.200e-03   0.717  0.47434
## dark_before_12                 -4.325e-04  5.462e-04  -0.792  0.42940
## school                          3.022e-04  1.240e-03   0.244  0.80766
## uof_lag                         1.388e-03  7.518e-03   0.185  0.85376
## stops_lag                      -1.587e-03  1.259e-03  -1.260  0.20897
## shoot_lag                      -2.398e-01  2.097e-01  -1.144  0.25411
## dplyr::lag(assault_incid_c, 1)  1.000e-01  6.930e-02   1.443  0.15054
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.004844 on 202 degrees of freedom
##   (44 observations deleted due to missingness)
## Multiple R-squared:  0.3889, Adjusted R-squared:  0.3466
## F-statistic: 9.183 on 14 and 202 DF,  p-value: 1.714e-15
```
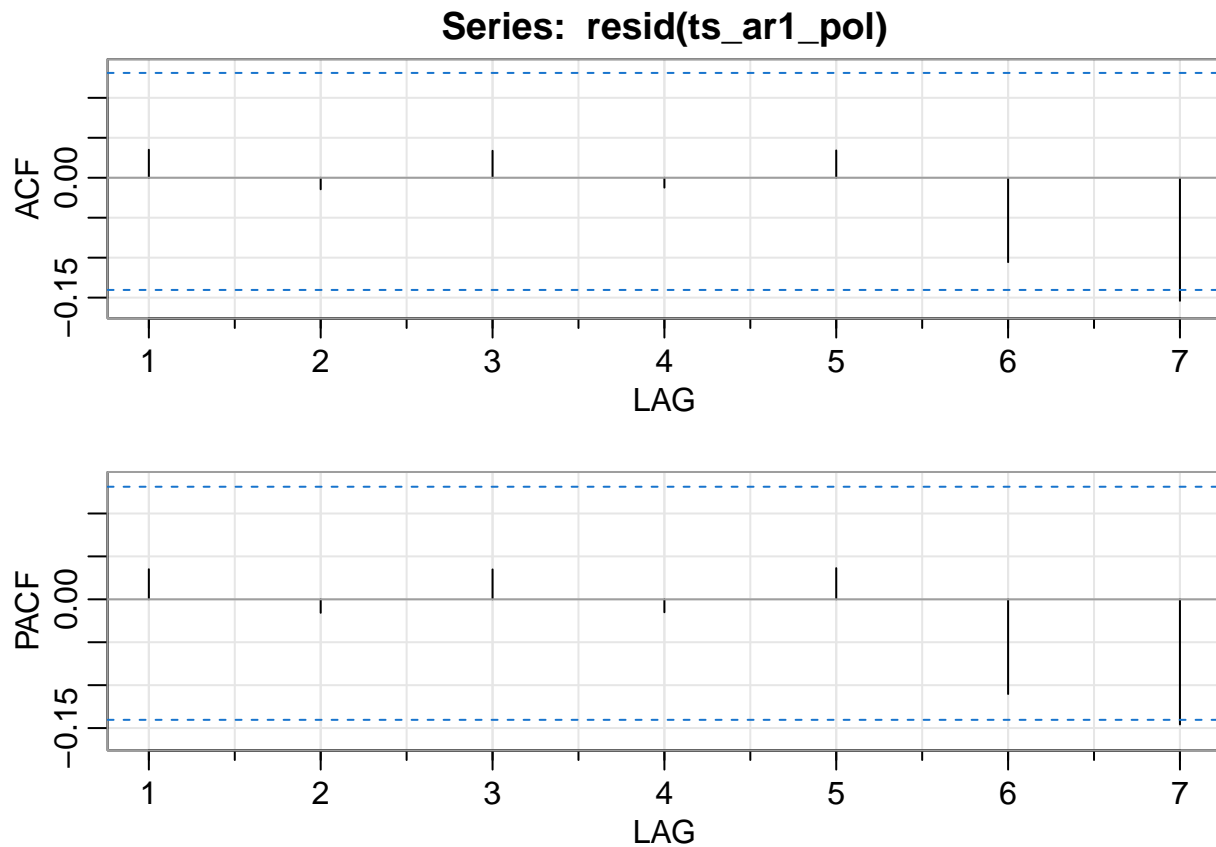
```
acf2(resid(ts_ar1_pol), max.lag = 7)
```

Series: resid(ts_ar1_pol)


```
##       [,1]  [,2] [,3]  [,4] [,5]  [,6]  [,7]
## ACF  0.04 -0.01 0.03 -0.01 0.03 -0.11 -0.15
## PACF 0.04 -0.02 0.03 -0.02 0.04 -0.11 -0.15
```

```
ts_ar1_pol_unintent <- lm(unintent_incid_c~t+state_of_emerg+stay_at_home+post_floyd+post_floyd_3+
                        tmax_f+snow_in+precip_in+dark_before_12+school+
                    uof_lag+stops_lag+shoot_lag+
                        dplyr::lag(assault_incid_c, 1), data = series)
```

ZCTA-Week Level Analysis

```
#aggregate to zip-level over years
zip_level <- panel %>%
  group_by(zcta, period) %>%
  summarize(assault_tot = mean(assault_tot, na.rm = T),
            unintent_tot = mean(unintent_tot, na.rm = T),
            suicide_tot = mean(suicide_tot, na.rm = T),
            undeter_tot = mean(undeter_tot, na.rm = T),
            legal_tot = mean(legal_tot, na.rm = T),
            combined_tot = mean(combined_tot, na.rm = T),
            total_pop = mean(total_pop, na.rm = T)) %>%
  mutate(assault_incid_c = (assault_tot/total_pop)*1000,
```

```r
             unintent_incid_c = (unintent_tot/total_pop)*1000,
             suicide_incid_c = (suicide_tot/total_pop)*1000,
             undeter_incid_c = (undeter_tot/total_pop)*1000,
             legal_incid_c = (legal_tot/total_pop)*1000,
             combined_incid_c = (combined_tot/total_pop)*1000) %>%
  ungroup() %>%
  left_join(zcta, by = "zcta")


#george floyd square
gfs <- geocode("George Floyd Square, Minneapolis", output = "latlon") %>%
  st_as_sf(coords = c("lon", "lat"), crs = "NAD83", remove=F) %>%
  mutate(name = "George Floyd Square")

ggplot() +
  geom_sf(data = zip_level, aes(geometry = geometry, fill = assault_incid_c)) +
  geom_sf(data = mpls, aes(geometry = geometry), color = "black", alpha = 0)+
  geom_sf(data = gfs, aes(geometry = geometry), color = "black")+
  geom_text_repel(data = gfs, aes(x=lon, y=lat, label = name),
                  size = 2,
                  fontface = "bold",
                  nudge_x = 1, nudge_y = -1)+
  facet_wrap(~period)+
  scale_fill_distiller(palette = "Spectral")+
  labs(title = "Figure 2: Firearm Assault Injury Rates by ZCTA and Period",
       subtitle = "MHA Hospital Discharge Data",
       fill = "Incident Rate/1,000")+
  theme(axis.text.x = element_blank(),
        axis.text.y = element_blank(),
  axis.line = element_blank(),
  axis.ticks = element_blank(),
  panel.border = element_blank(),
  panel.grid = element_blank(),
  axis.title = element_blank(),
  panel.background = element_blank(),
  panel.grid.major = element_line(colour="transparent"),
  plot.subtitle = element_text(face="italic"),
  strip.background = element_rect(fill = "white",
                colour = "black"))
```

Figure 2: Firearm Assault Injury Rates by ZCTA and Period
MHA Hospital Discharge Data
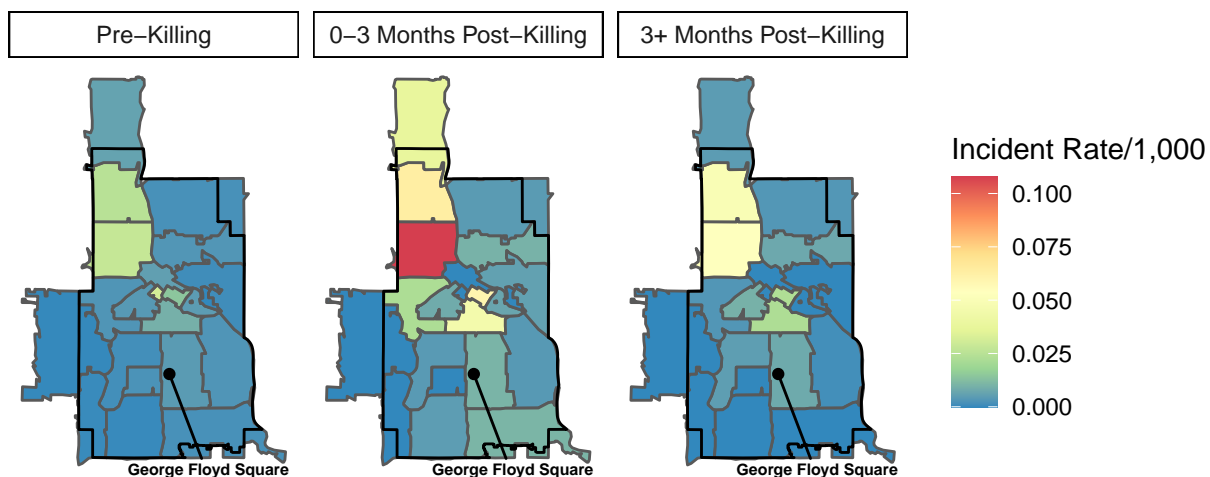

```
ggplot() +
  geom_sf(data = zip_level, aes(geometry = geometry, fill = unintent_incid_c)) +
  geom_sf(data = mpls, aes(geometry = geometry), color = "black", alpha = 0)+
  geom_sf(data = gfs, aes(geometry = geometry), color = "black")+
  geom_text_repel(data = gfs, aes(x=lon, y=lat, label = name),
                  size = 2,
                  fontface = "bold",
                  nudge_x = 1, nudge_y = -1)+
  facet_wrap(~period)+
  scale_fill_distiller(palette = "Spectral")+
  labs(title = "Figure A4: Firearm Unintentional Injury Rates by ZCTA and Period",
       subtitle = "MHA Hospital Discharge Data",
       fill = "Incident Rate/1,000")+
  theme(axis.text.x = element_blank(),
        axis.text.y = element_blank(),
  axis.line = element_blank(),
  axis.ticks = element_blank(),
  panel.border = element_blank(),
  panel.grid = element_blank(),
  axis.title = element_blank(),
  panel.background = element_blank(),
  panel.grid.major = element_line(colour="transparent"),
  plot.subtitle = element_text(face="italic"),
  strip.background = element_rect(fill = "white",
                colour = "black"))
```

Figure A4: Firearm Unintentional Injury Rates by ZCTA and Period
MHA Hospital Discharge Data
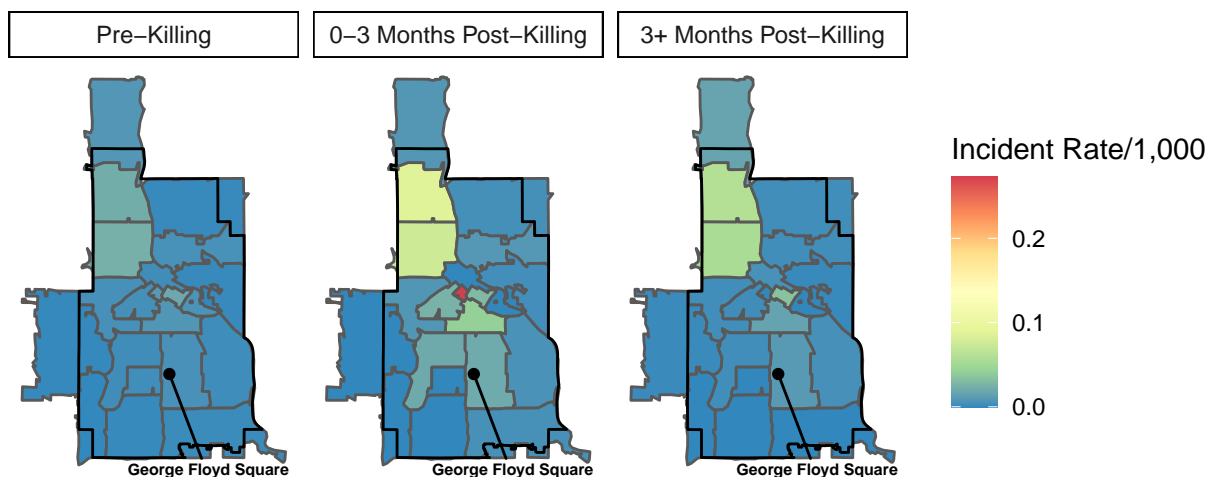
Panel Analysis

```
##
## Call:
## lm(formula = assault_incid_c ~ t + state_of_emerg + stay_at_home +
##     post_floyd + post_floyd_3 + tmax_f + snow_in + precip_in +
##     dark_before_12 + school + as.factor(zcta), data = panel)
##
## Residuals:
##    Min      1Q  Median      3Q     Max
##  -4.513  -0.721  -0.281   0.039 263.997
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)        0.572812   1.043851   0.549  0.58320
## t                  0.002850   0.001259   2.263  0.02365 *
## state_of_emerg    -0.755507   0.716025  -1.055  0.29141
## stay_at_home       0.338377   0.736505   0.459  0.64594
## post_floyd         1.217715   0.732349   1.663  0.09642 .
## post_floyd_3      -0.556566   0.454561  -1.224  0.22085
## tmax_f             0.003435   0.006722   0.511  0.60935
## snow_in           -0.103153   0.215025  -0.480  0.63144
## precip_in         -0.255997   0.702568  -0.364  0.71559
## dark_before_12    -0.093175   0.115134  -0.809  0.41839
## school            -0.224054   0.264737  -0.846  0.39741
```

```
## as.factor(zcta)55402  2.018846    0.478659    4.218 2.51e-05 ***
## as.factor(zcta)55403  0.017175    0.478659    0.036  0.97138
## as.factor(zcta)55404  0.773201    0.478659    1.615  0.10629
## as.factor(zcta)55405 -0.034397    0.478659   -0.072  0.94271
## as.factor(zcta)55406 -0.156014    0.478659   -0.326  0.74448
## as.factor(zcta)55407  0.058258    0.478659    0.122  0.90313
## as.factor(zcta)55408 -0.258652    0.478659   -0.540  0.58896
## as.factor(zcta)55409 -0.236436    0.478659   -0.494  0.62136
## as.factor(zcta)55410 -0.408970    0.478659   -0.854  0.39291
## as.factor(zcta)55411  2.925887    0.478659    6.113 1.04e-09 ***
## as.factor(zcta)55412  2.404515    0.478659    5.023 5.23e-07 ***
## as.factor(zcta)55413 -0.059222    0.478659   -0.124  0.90154
## as.factor(zcta)55414 -0.322758    0.478659   -0.674  0.50015
## as.factor(zcta)55415  1.241611    0.478659    2.594  0.00951 **
## as.factor(zcta)55416 -0.441445    0.478659   -0.922  0.35644
## as.factor(zcta)55417 -0.219008    0.478659   -0.458  0.64730
## as.factor(zcta)55418 -0.226440    0.478659   -0.473  0.63618
## as.factor(zcta)55419 -0.396449    0.478659   -0.828  0.40756
## as.factor(zcta)55430  0.344431    0.478659    0.720  0.47182
## as.factor(zcta)55454  0.008653    0.478659    0.018  0.98558
## as.factor(zcta)55455 -0.465239    0.478659   -0.972  0.33111
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.468 on 5710 degrees of freedom
## Multiple R-squared:  0.03366,    Adjusted R-squared:  0.02841
## F-statistic: 6.415 on 31 and 5710 DF,  p-value: < 2.2e-16


##
## Call:
## lm(formula = assault_incid_c ~ t + state_of_emerg + stay_at_home +
##     post_floyd + post_floyd_3 + tmax_f + snow_in + precip_in +
##     dark_before_12 + school + uof_lag + stops_lag + shoot_lag +
##     as.factor(zcta), data = panel)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
##  -4.776  -0.752  -0.290   0.049 263.759
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)        0.688540   1.050947   0.655   0.5124
## t                  0.002707   0.001348   2.007   0.0448 *
## state_of_emerg    -0.751194   0.719924  -1.043   0.2968
## stay_at_home       0.329243   0.738072   0.446   0.6556
## post_floyd         1.212237   0.735015   1.649   0.0991 .
## post_floyd_3      -0.433745   0.459694  -0.944   0.3454
## tmax_f             0.003895   0.006740   0.578   0.5634
## snow_in           -0.096856   0.215511  -0.449   0.6531
## precip_in         -0.235636   0.704051  -0.335   0.7379
## dark_before_12    -0.092120   0.115577  -0.797   0.4255
## school            -0.218687   0.265780  -0.823   0.4106
## uof_lag           -0.051334   0.026012  -1.973   0.0485 *
## stops_lag          0.001377   0.003667   0.376   0.7073
```

```
## shoot_lag              -0.294427   0.484315  -0.608    0.5433
## as.factor(zcta)55402   2.086772   0.482093   4.329 1.53e-05 ***
## as.factor(zcta)55403   0.040119   0.481611   0.083    0.9336
## as.factor(zcta)55404   0.719704   0.486865   1.478    0.1394
## as.factor(zcta)55405  -0.130710   0.482709  -0.271    0.7866
## as.factor(zcta)55406  -0.268396   0.483832  -0.555    0.5791
## as.factor(zcta)55407  -0.020832   0.486429  -0.043    0.9658
## as.factor(zcta)55408  -0.310747   0.502510  -0.618    0.5363
## as.factor(zcta)55409  -0.376813   0.489285  -0.770    0.4413
## as.factor(zcta)55410  -0.549597   0.492395  -1.116    0.2644
## as.factor(zcta)55411   2.972543   0.549419   5.410 6.55e-08 ***
## as.factor(zcta)55412   2.360603   0.485161   4.866 1.17e-06 ***
## as.factor(zcta)55413  -0.202489   0.485703  -0.417    0.6768
## as.factor(zcta)55414  -0.418256   0.483066  -0.866    0.3866
## as.factor(zcta)55415   1.146760   0.487878   2.351    0.0188 *
## as.factor(zcta)55416  -0.587500   0.493752  -1.190    0.2341
## as.factor(zcta)55417  -0.353324   0.489803  -0.721    0.4707
## as.factor(zcta)55418  -0.371058   0.488864  -0.759    0.4479
## as.factor(zcta)55419  -0.536917   0.485998  -1.105    0.2693
## as.factor(zcta)55430   0.216777   0.491371   0.441    0.6591
## as.factor(zcta)55454  -0.115444   0.489129  -0.236    0.8134
## as.factor(zcta)55455  -0.605851   0.495029  -1.224    0.2211
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.478 on 5685 degrees of freedom
##   (22 observations deleted due to missingness)
## Multiple R-squared:  0.0343, Adjusted R-squared:  0.02852
## F-statistic: 5.939 on 34 and 5685 DF,  p-value: < 2.2e-16
```

Series: resid(fe_full_model)
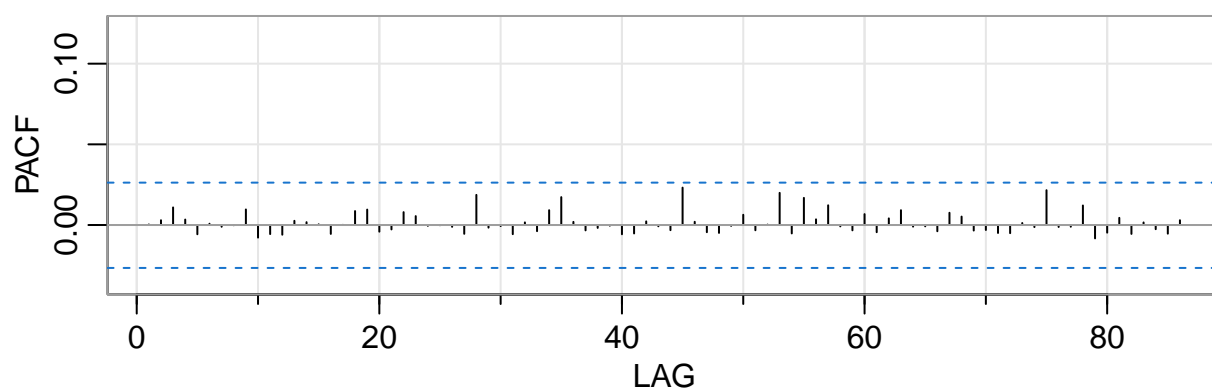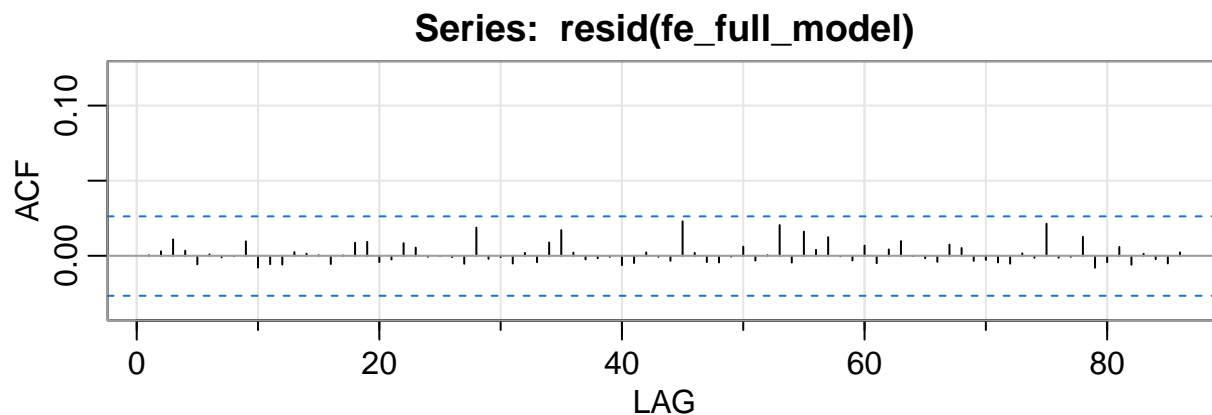

```
##       [,1] [,2] [,3] [,4]  [,5] [,6] [,7] [,8] [,9] [,10] [,11] [,12] [,13]
## ACF     0    0 0.01    0 -0.01    0    0    0 0.01 -0.01 -0.01 -0.01     0
## PACF    0    0 0.01    0 -0.01    0    0    0 0.01 -0.01 -0.01 -0.01     0
##      [,14] [,15] [,16] [,17] [,18] [,19] [,20] [,21] [,22] [,23] [,24] [,25]
## ACF      0     0 -0.01     0  0.01  0.01     0     0  0.01  0.01     0     0
## PACF     0     0 -0.01     0  0.01  0.01     0     0  0.01  0.01     0     0
##      [,26] [,27] [,28] [,29] [,30] [,31] [,32] [,33] [,34] [,35] [,36] [,37]
## ACF      0 -0.01  0.02     0     0 -0.01     0     0  0.01  0.02     0     0
## PACF     0 -0.01  0.02     0     0 -0.01     0     0  0.01  0.02     0     0
##      [,38] [,39] [,40] [,41] [,42] [,43] [,44] [,45] [,46] [,47] [,48] [,49]
## ACF      0     0 -0.01  0.00     0     0     0  0.02     0     0     0     0
## PACF     0     0 -0.01 -0.01     0     0     0  0.02     0     0     0     0
##      [,50] [,51] [,52] [,53] [,54] [,55] [,56] [,57] [,58] [,59] [,60] [,61]
## ACF   0.01     0     0  0.02  0.00  0.02     0  0.01     0     0  0.01     0
## PACF  0.01     0     0  0.02 -0.01  0.02     0  0.01     0     0  0.01     0
##      [,62] [,63] [,64] [,65] [,66] [,67] [,68] [,69] [,70] [,71] [,72] [,73]
## ACF      0  0.01     0     0     0  0.01  0.01     0     0     0 -0.01     0
## PACF     0  0.01     0     0     0  0.01  0.01     0     0     0 -0.01     0
##      [,74] [,75] [,76] [,77] [,78] [,79] [,80] [,81] [,82] [,83] [,84] [,85]
## ACF      0  0.02     0     0  0.01 -0.01     0  0.01 -0.01     0     0 -0.01
## PACF     0  0.02     0     0  0.01 -0.01     0  0.00 -0.01     0     0 -0.01
##      [,86]
## ACF      0
## PACF     0

##
```

```
## Call:
## lm(formula = assault_incid_c ~ t + state_of_emerg + stay_at_home +
##     post_floyd + post_floyd_3 + tmax_f + snow_in + precip_in +
##     dark_before_12 + school + as.factor(zcta) + post_floyd:as.factor(zcta) +
##     post_floyd_3:as.factor(zcta), data = panel)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -10.801  -0.672  -0.292   0.016 263.574
##
## Coefficients:
##                                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)                     7.134e-01  1.050e+00   0.680  0.49678
## t                               2.850e-03  1.258e-03   2.267  0.02345 *
## state_of_emerg                 -7.555e-01  7.150e-01  -1.057  0.29074
## stay_at_home                    3.384e-01  7.355e-01   0.460  0.64548
## post_floyd                     -4.758e-01  1.641e+00  -0.290  0.77182
## post_floyd_3                    4.158e-01  1.955e+00   0.213  0.83152
## tmax_f                          3.435e-03  6.713e-03   0.512  0.60886
## snow_in                        -1.032e-01  2.147e-01  -0.480  0.63097
## precip_in                      -2.560e-01  7.016e-01  -0.365  0.71522
## dark_before_12                 -9.317e-02  1.150e-01  -0.810  0.41775
## school                         -2.241e-01  2.644e-01  -0.847  0.39675
## as.factor(zcta)55402            2.301e+00  5.103e-01   4.509 6.64e-06 ***
## as.factor(zcta)55403           -1.105e-01  5.103e-01  -0.217  0.82856
## as.factor(zcta)55404            4.278e-01  5.103e-01   0.838  0.40192
## as.factor(zcta)55405           -2.036e-01  5.103e-01  -0.399  0.68999
## as.factor(zcta)55406           -2.168e-01  5.103e-01  -0.425  0.67090
## as.factor(zcta)55407           -6.147e-02  5.103e-01  -0.120  0.90412
## as.factor(zcta)55408           -3.636e-01  5.103e-01  -0.713  0.47617
## as.factor(zcta)55409           -2.695e-01  5.103e-01  -0.528  0.59747
## as.factor(zcta)55410           -4.661e-01  5.103e-01  -0.913  0.36106
## as.factor(zcta)55411            2.256e+00  5.103e-01   4.422 9.97e-06 ***
## as.factor(zcta)55412            1.964e+00  5.103e-01   3.849  0.00012 ***
## as.factor(zcta)55413           -1.900e-01  5.103e-01  -0.372  0.70969
## as.factor(zcta)55414           -4.043e-01  5.103e-01  -0.792  0.42821
## as.factor(zcta)55415            8.710e-01  5.103e-01   1.707  0.08792 .
## as.factor(zcta)55416           -5.031e-01  5.103e-01  -0.986  0.32420
## as.factor(zcta)55417           -3.153e-01  5.103e-01  -0.618  0.53669
## as.factor(zcta)55418           -3.157e-01  5.103e-01  -0.619  0.53615
## as.factor(zcta)55419           -4.831e-01  5.103e-01  -0.947  0.34386
## as.factor(zcta)55430            1.214e-01  5.103e-01   0.238  0.81196
## as.factor(zcta)55454           -3.370e-02  5.103e-01  -0.066  0.94735
## as.factor(zcta)55455           -5.303e-01  5.103e-01  -1.039  0.29881
## post_floyd:as.factor(zcta)55402 -2.301e+00  2.126e+00  -1.082  0.27917
## post_floyd:as.factor(zcta)55403  9.617e-01  2.126e+00   0.452  0.65105
## post_floyd:as.factor(zcta)55404  4.076e+00  2.126e+00   1.917  0.05528 .
## post_floyd:as.factor(zcta)55405  2.444e+00  2.126e+00   1.149  0.25041
## post_floyd:as.factor(zcta)55406  6.425e-01  2.126e+00   0.302  0.76251
## post_floyd:as.factor(zcta)55407  1.107e+00  2.126e+00   0.521  0.60251
## post_floyd:as.factor(zcta)55408  8.138e-01  2.126e+00   0.383  0.70189
## post_floyd:as.factor(zcta)55409  2.695e-01  2.126e+00   0.127  0.89914
## post_floyd:as.factor(zcta)55410  4.661e-01  2.126e+00   0.219  0.82647
## post_floyd:as.factor(zcta)55411  8.509e+00  2.126e+00   4.003 6.35e-05 ***
```

```
## post_floyd:as.factor(zcta)55412    4.383e+00  2.126e+00    2.062  0.03928 *
## post_floyd:as.factor(zcta)55413    1.192e+00  2.126e+00    0.561  0.57514
## post_floyd:as.factor(zcta)55414    1.001e+00  2.126e+00    0.471  0.63784
## post_floyd:as.factor(zcta)55415    5.063e+00  2.126e+00    2.381  0.01728 *
## post_floyd:as.factor(zcta)55416    5.031e-01  2.126e+00    0.237  0.81293
## post_floyd:as.factor(zcta)55417    1.390e+00  2.126e+00    0.654  0.51336
## post_floyd:as.factor(zcta)55418    7.871e-01  2.126e+00    0.370  0.71122
## post_floyd:as.factor(zcta)55419    9.939e-01  2.126e+00    0.467  0.64016
## post_floyd:as.factor(zcta)55430    3.680e+00  2.126e+00    1.731  0.08349 .
## post_floyd:as.factor(zcta)55454    7.463e-01  2.126e+00    0.351  0.72559
## post_floyd:as.factor(zcta)55455    5.303e-01  2.126e+00    0.249  0.80305
## post_floyd_3:as.factor(zcta)55402  1.803e-14  2.752e+00    0.000  1.00000
## post_floyd_3:as.factor(zcta)55403  1.419e-01  2.752e+00    0.052  0.95889
## post_floyd_3:as.factor(zcta)55404 -2.237e+00  2.752e+00   -0.813  0.41629
## post_floyd_3:as.factor(zcta)55405 -1.892e+00  2.752e+00   -0.687  0.49182
## post_floyd_3:as.factor(zcta)55406 -2.601e-01  2.752e+00   -0.095  0.92470
## post_floyd_3:as.factor(zcta)55407 -2.324e-01  2.752e+00   -0.084  0.93270
## post_floyd_3:as.factor(zcta)55408  7.504e-02  2.752e+00    0.027  0.97825
## post_floyd_3:as.factor(zcta)55409  1.902e-14  2.752e+00    0.000  1.00000
## post_floyd_3:as.factor(zcta)55410  2.439e-14  2.752e+00    0.000  1.00000
## post_floyd_3:as.factor(zcta)55411 -5.421e+00  2.752e+00   -1.970  0.04889 *
## post_floyd_3:as.factor(zcta)55412 -1.411e+00  2.752e+00   -0.513  0.60825
## post_floyd_3:as.factor(zcta)55413 -2.226e-01  2.752e+00   -0.081  0.93553
## post_floyd_3:as.factor(zcta)55414 -5.965e-01  2.752e+00   -0.217  0.82840
## post_floyd_3:as.factor(zcta)55415 -3.626e+00  2.752e+00   -1.318  0.18764
## post_floyd_3:as.factor(zcta)55416  3.546e-14  2.752e+00    0.000  1.00000
## post_floyd_3:as.factor(zcta)55417 -1.074e+00  2.752e+00   -0.390  0.69623
## post_floyd_3:as.factor(zcta)55418 -1.048e-01  2.752e+00   -0.038  0.96964
## post_floyd_3:as.factor(zcta)55419 -5.108e-01  2.752e+00   -0.186  0.85274
## post_floyd_3:as.factor(zcta)55430 -3.309e+00  2.752e+00   -1.202  0.22924
## post_floyd_3:as.factor(zcta)55454 -7.126e-01  2.752e+00   -0.259  0.79569
## post_floyd_3:as.factor(zcta)55455  4.193e-14  2.752e+00    0.000  1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.46 on 5668 degrees of freedom
## Multiple R-squared:  0.04341,    Adjusted R-squared:  0.03109
## F-statistic: 3.524 on 73 and 5668 DF,  p-value: < 2.2e-16


## Warning: package 'lme4' was built under R version 4.1.3


## Warning: package 'Matrix' was built under R version 4.1.3


## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: assault_incid_c ~ t + state_of_emerg + stay_at_home + post_floyd +
##     post_floyd_3 + tmax_f + snow_in + precip_in + dark_before_12 +
##     school + uof_lag + stops_lag + shoot_lag + (1 | zcta)
##    Data: panel
##
## REML criterion at convergence: 35762.1
##
## Scaled residuals:
```

```
##    Min    1Q Median    3Q    Max
## -0.791 -0.142 -0.062 -0.001 48.201
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  zcta     (Intercept)  0.8264  0.909
##  Residual             30.0102  5.478
## Number of obs: 5720, groups:  zcta, 22
##
## Fixed effects:
##                   Estimate Std. Error        df t value Pr(>|t|)
## (Intercept)      8.158e-01  1.014e+00  3.927e+03   0.805   0.4211
## t                2.352e-03  1.339e-03  5.582e+03   1.756   0.0791 .
## state_of_emerg1 -6.989e-01  7.196e-01  5.692e+03  -0.971   0.3315
## stay_at_home1    3.140e-01  7.381e-01  5.684e+03   0.425   0.6705
## post_floyd1      1.252e+00  7.349e-01  5.688e+03   1.704   0.0885 .
## post_floyd_31   -4.691e-01  4.596e-01  5.689e+03  -1.021   0.3075
## tmax_f           3.744e-03  6.741e-03  5.684e+03   0.555   0.5786
## snow_in         -9.448e-02  2.155e-01  5.684e+03  -0.438   0.6611
## precip_in       -2.269e-01  7.041e-01  5.684e+03  -0.322   0.7472
## dark_before_12  -8.665e-02  1.156e-01  5.688e+03  -0.750   0.4534
## school          -2.354e-01  2.657e-01  5.689e+03  -0.886   0.3758
## uof_lag         -3.476e-02  2.552e-02  4.439e+03  -1.362   0.1733
## stops_lag        4.321e-03  3.419e-03  1.020e+03   1.264   0.2066
## shoot_lag       -2.484e-01  4.841e-01  5.693e+03  -0.513   0.6078
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: unintent_incid_c ~ t + state_of_emerg + stay_at_home + post_floyd +
##     post_floyd_3 + tmax_f + snow_in + precip_in + dark_before_12 +
##     school + uof_lag + stops_lag + shoot_lag + (1 | zcta)
##    Data: panel
##
## REML criterion at convergence: 37591.5
##
## Scaled residuals:
##    Min    1Q Median    3Q    Max
## -0.738 -0.122 -0.056 -0.003 58.652
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  zcta     (Intercept)  0.6252  0.7907
##  Residual             41.4288  6.4365
## Number of obs: 5720, groups:  zcta, 22
##
## Fixed effects:
##                   Estimate Std. Error        df t value Pr(>|t|)
## (Intercept)     -9.985e-01  1.181e+00  4.908e+03  -0.845  0.39796
## t                1.391e-03  1.567e-03  5.416e+03   0.887  0.37494
## state_of_emerg1  3.186e-01  8.453e-01  5.695e+03   0.377  0.70627
## stay_at_home1   -7.133e-01  8.672e-01  5.685e+03  -0.823  0.41081
## post_floyd1      1.650e+00  8.633e-01  5.690e+03   1.911  0.05605 .
```

```
## post_floyd_31    -1.757e+00   5.399e-01   5.691e+03   -3.254  0.00114 **
## tmax_f             1.191e-02   7.920e-03   5.684e+03    1.504  0.13255
## snow_in           -1.798e-02   2.532e-01   5.684e+03   -0.071  0.94339
## precip_in          5.508e-01   8.273e-01   5.684e+03    0.666  0.50552
## dark_before_12     9.609e-02   1.358e-01   5.689e+03    0.708  0.47910
## school             2.773e-01   3.122e-01   5.692e+03    0.888  0.37433
## uof_lag           -4.140e-03   2.967e-02   3.386e+03   -0.140  0.88904
## stops_lag          4.394e-03   3.861e-03   5.009e+02    1.138  0.25564
## shoot_lag         -4.081e-02   5.686e-01   5.697e+03   -0.072  0.94279
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: assault_incid_c ~ t + state_of_emerg + stay_at_home + post_floyd +
##     post_floyd_3 + tmax_f + snow_in + precip_in + dark_before_12 +
##     school + uof_lag + stops_lag + shoot_lag + black_pop + post_floyd:black_pop +
##     (1 | zcta)
##    Data: panel
##
## REML criterion at convergence: 35746.4
##
## Scaled residuals:
##    Min    1Q Median    3Q    Max
## -1.175 -0.140 -0.064 -0.002 48.310
##
## Random effects:
##  Groups    Name        Variance Std.Dev.
##  zcta     (Intercept)  0.43     0.6557
##  Residual              29.93    5.4705
## Number of obs: 5720, groups:  zcta, 22
##
## Fixed effects:
##                        Estimate Std. Error        df t value Pr(>|t|)
## (Intercept)           2.805e-01  1.020e+00  2.873e+03   0.275   0.7834
## t                     2.244e-03  1.333e-03  5.464e+03   1.684   0.0922 .
## state_of_emerg1      -6.891e-01  7.185e-01  5.693e+03  -0.959   0.3375
## stay_at_home1         3.132e-01  7.370e-01  5.684e+03   0.425   0.6709
## post_floyd1          -2.252e-02  7.848e-01  5.685e+03  -0.029   0.9771
## post_floyd_31        -4.714e-01  4.589e-01  5.690e+03  -1.027   0.3044
## tmax_f                3.757e-03  6.731e-03  5.683e+03   0.558   0.5768
## snow_in              -9.577e-02  2.152e-01  5.683e+03  -0.445   0.6563
## precip_in            -2.250e-01  7.031e-01  5.683e+03  -0.320   0.7489
## dark_before_12       -8.531e-02  1.154e-01  5.688e+03  -0.739   0.4597
## school               -2.369e-01  2.653e-01  5.690e+03  -0.893   0.3720
## uof_lag              -3.340e-02  2.528e-02  3.602e+03  -1.321   0.1866
## stops_lag             4.580e-03  3.340e-03  6.188e+02   1.372   0.1707
## shoot_lag            -2.130e-01  4.834e-01  5.695e+03  -0.441   0.6595
## black_pop             2.924e-02  1.126e-02  2.266e+01   2.596   0.0163 *
## post_floyd1:black_pop 7.005e-02  1.536e-02  5.691e+03   4.561 5.21e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
```

```
## lmerModLmerTest]
## Formula: unintent_incid_c ~ t + state_of_emerg + stay_at_home + post_floyd +
##     post_floyd_3 + tmax_f + snow_in + precip_in + dark_before_12 +
##     school + uof_lag + stops_lag + shoot_lag + black_pop + post_floyd:black_pop +
##     (1 | zcta)
##    Data: panel
##
## REML criterion at convergence: 37583.7
##
## Scaled residuals:
##    Min    1Q Median    3Q    Max
## -0.977 -0.133 -0.055  0.000 58.758
##
## Random effects:
##  Groups    Name        Variance Std.Dev.
##  zcta     (Intercept)  0.2812   0.5303
##  Residual              41.3750  6.4323
## Number of obs: 5720, groups:  zcta, 22
##
## Fixed effects:
##                        Estimate Std. Error        df t value Pr(>|t|)
## (Intercept)          -1.613e+00  1.185e+00  4.297e+03  -1.361  0.17349
## t                     1.462e-03  1.560e-03  5.262e+03   0.937  0.34871
## state_of_emerg1       3.031e-01  8.446e-01  5.696e+03   0.359  0.71973
## stay_at_home1        -7.056e-01  8.666e-01  5.685e+03  -0.814  0.41557
## post_floyd1           7.136e-01  9.227e-01  5.686e+03   0.773  0.43933
## post_floyd_31        -1.757e+00  5.395e-01  5.694e+03  -3.257  0.00113 **
## tmax_f                1.195e-02  7.915e-03  5.685e+03   1.510  0.13103
## snow_in              -2.181e-02  2.531e-01  5.685e+03  -0.086  0.93133
## precip_in             5.472e-01  8.267e-01  5.684e+03   0.662  0.50805
## dark_before_12        9.493e-02  1.357e-01  5.690e+03   0.700  0.48409
## school                2.829e-01  3.119e-01  5.692e+03   0.907  0.36444
## uof_lag              -4.529e-03  2.927e-02  2.425e+03  -0.155  0.87703
## stops_lag             3.060e-03  3.717e-03  3.073e+02   0.823  0.41106
## shoot_lag            -3.288e-02  5.682e-01  5.699e+03  -0.058  0.95386
## black_pop             3.566e-02  1.042e-02  2.435e+01   3.423  0.00220 **
## post_floyd1:black_pop 5.051e-02  1.806e-02  5.694e+03   2.797  0.00517 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

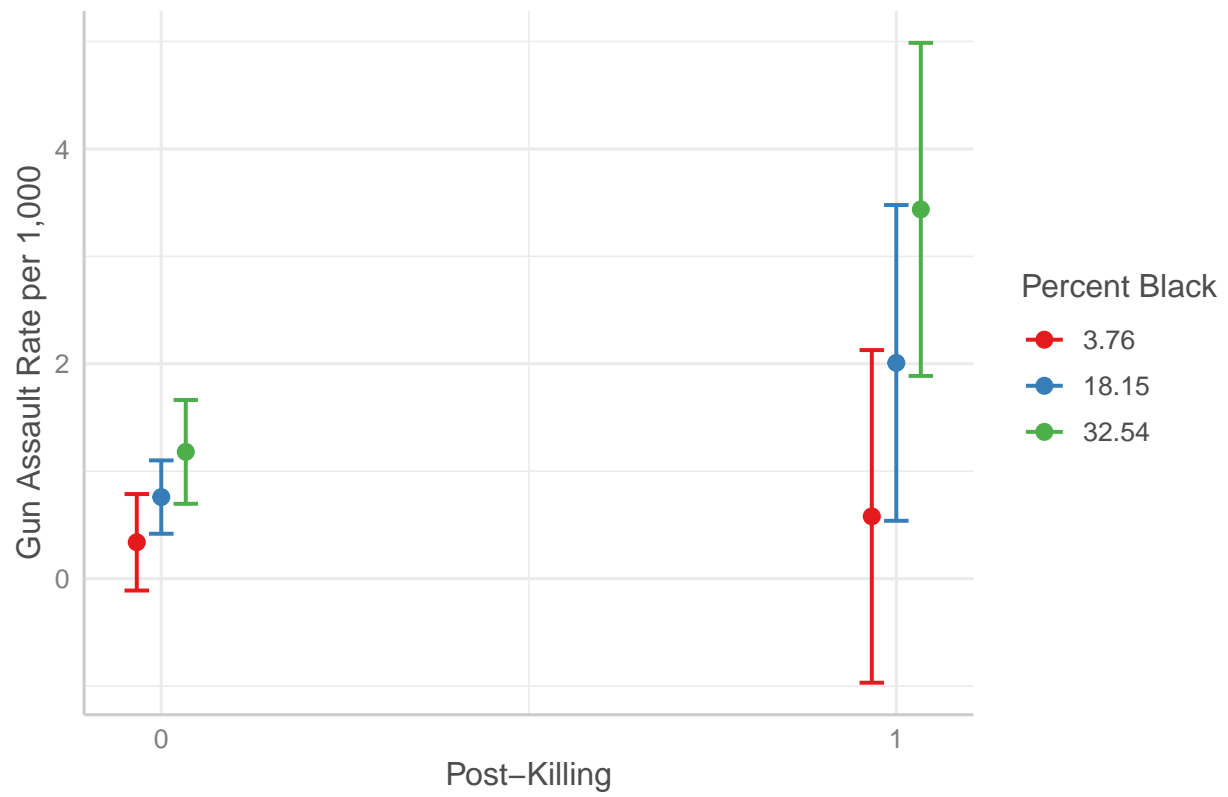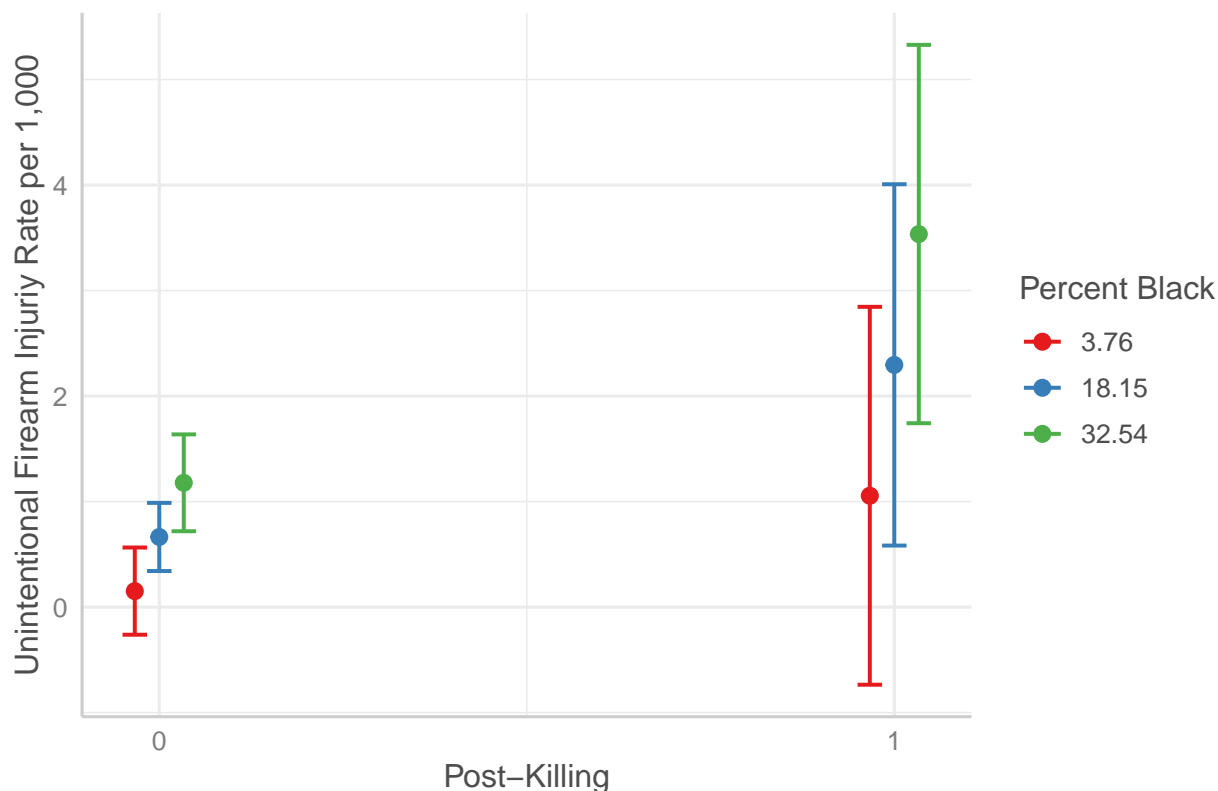Figure 3: Post−Killing X Percent Black Interaction Plot

Figure A5: Post−Killing X Percent Black Interaction Plot


```
class(re_base) <- "lmerMod"
class(re_int) <- "lmerMod"

stargazer(ts_ar1_pol, re_base, re_int,
          title = "Interrupted Time Series Models of Firearm Assault Injuries",
          covariate.labels = c("T","COVID - State of Emergency", "COVID - Stay at Home",
                               "Post-Killing", "Post-Killing 3 Months",
                               "MPD Use of Force t-1", "MPD Stops t-1",
                               "MPD Officer Involved Shootings t-1",
                                "AR(1)",
                               "Percent Black",
                               "Post-Killing X Percent Black"),
          header = F,
          dep.var.caption = "Firearm Assault Injuries",
          dep.var.labels = "Rate per 1,000",
          model.names = FALSE,
          column.labels = c("AR(1) TSR", "RE HLM","RE HLM +Int."),
          report = "vcs",
          ci=TRUE,
          ci.level=0.95,
          ci.separator = "|",
          notes = "95\\% Confidence Intervals in parentheses",
          single.row = F,
          omit = c("tmax_f", "snow_in","precip_in","dark_before_12","school"),
          omit.stat = c("adj.rsq"),
          #star.cutoffs = c(.05, .01, .001), star.char = c("*","**","***"),
```

```r
          add.lines = list(c("SD(ZCTA)", "", .826, .642),
                           c("SD(Residual)", "", 30.010, 5.461)),
          notes.label = "Models include controls ,for seasonality.",
          notes.append = F)
```

```r
class(re_base_unintent) <- "lmerMod"
class(re_int_unintent) <- "lmerMod"

stargazer(ts_ar1_pol_unintent, re_base_unintent, re_int_unintent,
          title = "Interrupted Time Series Models of Firearm Unintentional Injuries",
          covariate.labels = c("T","COVID - State of Emergency", "COVID - Stay at Home",
                               "Post-Killing", "Post-Killing 3 Months",
                               "MPD Use of Force t-1", "MPD Stops t-1",
                               "MPD Officer Involved Shootings t-1",
                                "AR(1)",
                               "Percent Black",
                               "Post-Killing X Percent Black"),
          header = F,
          dep.var.caption = "Firearm Unintentional Injuries",
          dep.var.labels = "Rate per 1,000",
          model.names = FALSE,
          column.labels = c("AR(1) TSR", "RE HLM","RE HLM +Int."),
          model.numbers = TRUE,
          report = "vcs",
          ci=TRUE,
          ci.level=0.95,
          ci.separator = "|",
          notes = "95\\% Confidence Intervals in parentheses",
          single.row = F,
          align = T,
          omit = c("tmax_f", "snow_in","precip_in","dark_before_12","school"),
          omit.stat = c("adj.rsq"),
        #star.cutoffs = c(.05, .01, .001), star.char = c("*","**","***"),
          add.lines = list(c("SD(ZCTA)", "", .826, .642),
                           c("SD(Residual)", "", 30.010, 5.461)),
          notes.label = "Models include controls ,for seasonality.",
          notes.append = F)
```

```r
#maps of post_floyd and post_floyd_3 coefficients by zip - colored divergently
coef <- broom::tidy(fe_int_model$coefficients) %>%
  filter(str_detect(names, "post_floyd")) %>%
  mutate(period = ifelse(str_detect(names, "post_floyd_3"), "3+ Months Post-Killing", "0-3 Months Post-K
         main_effect = ifelse(period=="3+ Months Post-Killing", round(0.3399083,2), round(-0.5604477,2))
         zcta = as.numeric(str_sub(names, -5)),
         zcta = as.numeric(ifelse(is.na(zcta), "55401", zcta)),
         interaction_effect = ifelse(zcta=="55401", 0, round(x,2)),
         coef = main_effect+interaction_effect) %>%
  select(zcta, period, coef, main_effect, interaction_effect) %>%
  arrange(zcta, period)
```

```
## Warning: 'tidy.numeric' is deprecated.
## See help("Deprecated")
```

Table 1: Interrupted Time Series Models of Firearm Assault Injuries

	Firearm Assault Injuries		
	Rate per 1,000		
	AR(1) TSR	RE HLM	RE HLM +Int.
	(1)	(2)	(3)
T	−0.00001	0.002	0.002
	(−0.00003|0.00001)	(−0.0003|0.005)	(−0.0004|0.005)
COVID - State of Emergency	−0.005	−0.699	−0.689
	(−0.011|0.001)	(−2.109|0.712)	(−2.097|0.719)
COVID - Stay at Home	0.006	0.314	0.313
	(−0.001|0.012)	(−1.133|1.761)	(−1.131|1.758)
Post-Killing	0.015	1.252	−0.023
	(0.009|0.021)	(−0.188|2.692)	(−1.561|1.516)
Post-Killing 3 Months	−0.007	−0.469	−0.471
	(−0.011|−0.003)	(−1.370|0.432)	(−1.371|0.428)
MPD Use of Force t-1	0.001	−0.035	−0.033
	(−0.013|0.016)	(−0.085|0.015)	(−0.083|0.016)
MPD Stops t-1	−0.002	0.004	0.005
	(−0.004|0.001)	(−0.002|0.011)	(−0.002|0.011)
MPD Officer Involved Shootings t-1	−0.240	−0.248	−0.213
	(−0.651|0.171)	(−1.197|0.700)	(−1.161|0.734)
AR(1)	0.100		
	(−0.036|0.236)		
Percent Black			0.029
			(0.007|0.051)
Post-Killing X Percent Black			0.070
			(0.040|0.100)
Constant	0.011	0.816	0.280
	(−0.001|0.022)	(−1.172|2.803)	(−1.720|2.281)
SD(ZCTA)		0.826	0.642
SD(Residual)		30.01	5.461
Observations	217	5,720	5,720
R^2	0.389		
Log Likelihood		−17,881.070	−17,873.220
Akaike Inf. Crit.		35,794.140	35,782.440
Bayesian Inf. Crit.		35,900.560	35,902.170
Residual Std. Error	0.005 (df = 202)		
F Statistic	9.183*** (df = 14; 202)		

Models include controls ,for seasonality.   95% Confidence Intervals in parentheses

Table A1: Interrupted Time Series Models of Firearm Unintentional Injuries

	Firearm Unintentional Injuries		
	Rate per 1,000		
	AR(1) TSR	RE HLM	RE HLM +Int.
	(1)	(2)	(3)
T	−0.00001	0.001	0.001
	(-0.00003|0.00001)	(-0.002|0.004)	(-0.002|0.005)
COVID - State of Emergency	−0.002	0.319	0.303
	(-0.007|0.004)	(-1.338|1.975)	(-1.352|1.958)
COVID - Stay at Home	0.002	−0.713	−0.706
	(-0.004|0.008)	(-2.413|0.986)	(-2.404|0.993)
Post-Killing	0.012	1.650	0.714
	(0.007|0.018)	(-0.042|3.342)	(-1.095|2.522)
Post-Killing 3 Months	−0.006	−1.757	−1.757
	(-0.010|-0.002)	(-2.815|-0.699)	(-2.814|-0.700)
MPD Use of Force t-1	−0.0002	−0.004	−0.005
	(-0.014|0.014)	(-0.062|0.054)	(-0.062|0.053)
MPD Stops t-1	−0.002	0.004	0.003
	(-0.004|0.001)	(-0.003|0.012)	(-0.004|0.010)
MPD Officer Involved Shootings t-1	0.213	−0.041	−0.033
	(-0.175|0.601)	(-1.155|1.074)	(-1.147|1.081)
AR(1)	−0.005		
	(-0.133|0.123)		
Percent Black			0.036
			(0.015|0.056)
Post-Killing X Percent Black			0.051
			(0.015|0.086)
Constant	0.004	−0.998	−1.613
	(-0.007|0.015)	(-3.314|1.317)	(-3.935|0.709)
SD(ZCTA)		0.826	0.642
SD(Residual)		30.01	5.461
Observations	217	5,720	5,720
R^2	0.406		
Log Likelihood		-18,795.730	-18,791.830
Akaike Inf. Crit.		37,623.460	37,619.670
Bayesian Inf. Crit.		37,729.890	37,739.400
Residual Std. Error	0.005 (df = 202)		
F Statistic	9.850*** (df = 14; 202)		

Models include controls ,for seasonality.   95% Confidence Intervals in parentheses

```
## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion
```

```r
#creating period rows in other spatial layers
coef_zip_level <- zip_level %>%
  filter(period!="Pre-Killing") %>%
  left_join(coef, by = c("zcta", "period"))
coef_gfs <- gfs
coef_gfs[2,] <- gfs[1,]
coef_gfs$period <- c("3+ Months Post-Killing", "0-3 Months Post-Killing")
coef_mpls <- mpls
coef_mpls[2,] <- mpls[1,]
coef_mpls$period <- c("3+ Months Post-Killing", "0-3 Months Post-Killing")


ggplot() +
  geom_sf(data = coef_zip_level, aes(geometry = geometry, fill = coef)) +
  geom_sf(data = mpls, aes(geometry = geometry), color = "black", alpha = 0)+
  geom_sf(data = coef_gfs, aes(geometry = geometry), color = "black")+
  geom_text_repel(data = gfs, aes(x=lon, y=lat, label = name),
                  size = 2,
                  fontface = "bold",
                  nudge_x = 1, nudge_y = -1)+
  scale_fill_gradient2(trans="reverse")+
  facet_wrap(~period)+
  labs(title = "Figure 3: Treatment Effects by ZCTA",
       fill = "Coef.")+
  theme(axis.text = element_blank(),
  axis.line = element_blank(),
  axis.ticks = element_blank(),
  panel.border = element_blank(),
  panel.grid = element_blank(),
  axis.title = element_blank(),
  panel.background = element_blank(),
  panel.grid.major = element_line(colour="transparent"),
  plot.subtitle = element_text(face="italic"),
  strip.background = element_rect(fill = "white",
                colour = "black"))+
  guides(fill = guide_colorbar(reverse = TRUE))
```

Figure 3: Treatment Effects by ZCTA
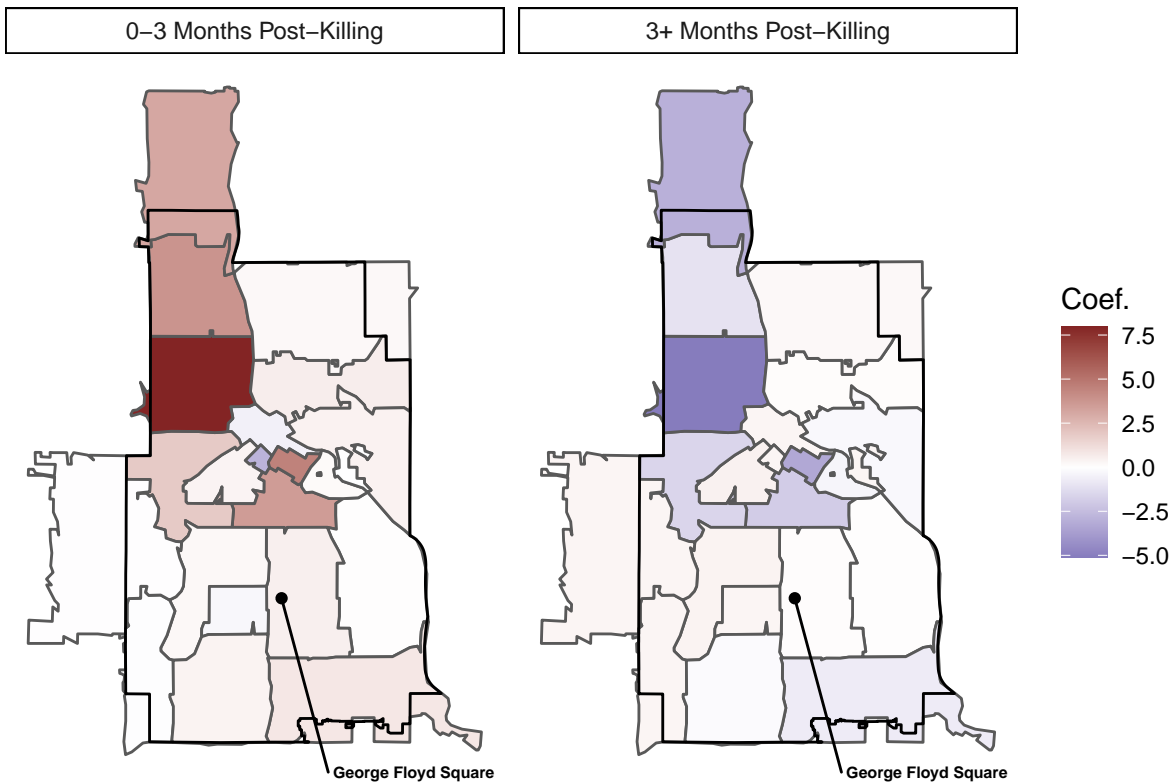
MPD Murders: Figures 4 and 5

```r
#pre-pims
mpd_2016 <- read_csv("Data/Police_Incidents_2016.csv")
mpd_2017 <- read_csv("Data/Police_Incidents_2017.csv")
mpd_2018a <- read_csv("Data/Police_Incidents_2018.csv")

#pims
mpd_2018b <- read_csv("Data/Police_Incidents_2018_PIMS.csv")
mpd_2019 <- read_csv("Data/Police_Incidents_2019.csv")
mpd_2020 <- read_csv("Data/Police_Incidents_2020.csv")
mpd_2021 <- read_csv("Data/Police_Incidents_2021.csv")

pre_pims_base <- mpd_2016 %>%
  rbind(mpd_2017) %>%
  rbind(mpd_2018a) %>%
  rename(reportedDate = ReportedDate,
         centerLong = Long,
         centerLat = Lat) %>%
  select(FID, centerLong, centerLat, Offense, reportedDate) %>%
  rename(OBJECTID = FID,
         X = centerLong,
         Y = centerLat,
```

```
            offense = Offense)

post_pims_base <- mpd_2018b %>%
  rbind(mpd_2019) %>%
  rbind(mpd_2020) %>%
  rbind(mpd_2021) %>%
  select(OBJECTID, X, Y, offense, reportedDate)

mpd <- pre_pims_base %>%
  rbind(post_pims_base)

mpd_series <- mpd %>%
  mutate(date=ymd_hms(reportedDate),
         year=isoyear(date),
          week=isoweek(date)) %>%
  st_as_sf(coords = c("X", "Y"), crs = "NAD83", remove=F) %>%
  mutate(intersection = as.integer(st_intersects(geometry, zcta)),
         zcta = ifelse(is.na(intersection), NA, zcta$zcta[intersection])) %>%
  st_drop_geometry() %>%
  filter(offense=="MURDR" & zcta %in% zcta_universe) %>%
  group_by(year, week, .drop=F) %>%
  tally(name = "murder") %>%
  arrange(year, week) %>%
  filter(year <= 2021 & year >= 2016) %>%
  ungroup() %>%
  complete(year, week = 1:52, fill = list(murder = 0))

mpls_pops_year <- series %>%
  group_by(year) %>%
  summarize(total_pop = mean(total_pop, na.rm = T)) %>%
  add_row(year = 2021, total_pop = 603465)


mpd_series <- mpd_series %>%
  left_join(mpls_pops_year, by = "year") %>%
  mutate(murder_rate = (murder/total_pop)*1000,
         begin_date = ISOweek2date(paste(year, paste0("W", sprintf("%02d", week)), 1,sep = "-")),
         end_date = begin_date+weeks(1)-days(1))

ggplot(mpd_series)+
  geom_line(aes(x=begin_date, y=murder_rate))+
  scale_x_date(date_labels = "%b-%Y", date_breaks = "6 months")+
  geom_vline(xintercept=mpd_series$begin_date[mpd_series$year==2020 & mpd_series$week==isoweek(date("20:
             linetype="dotted", color="red", size=1)+
  geom_label(aes(x=mpd_series$begin_date[mpd_series$year==2020 & mpd_series$week==isoweek(date("2020-05-
                 y=0.0150),
             label = "George Floyd", show.legend = FALSE)+
  scale_y_continuous(limits = c(0,.015))+
  labs(title = "Figure 4: Weekly Murder Rate, 2016-2021",
       subtitle = "MPD Data",
       x = "Week",
       y = "Rate per 1,000 Residents")+
  theme_minimal()+
```
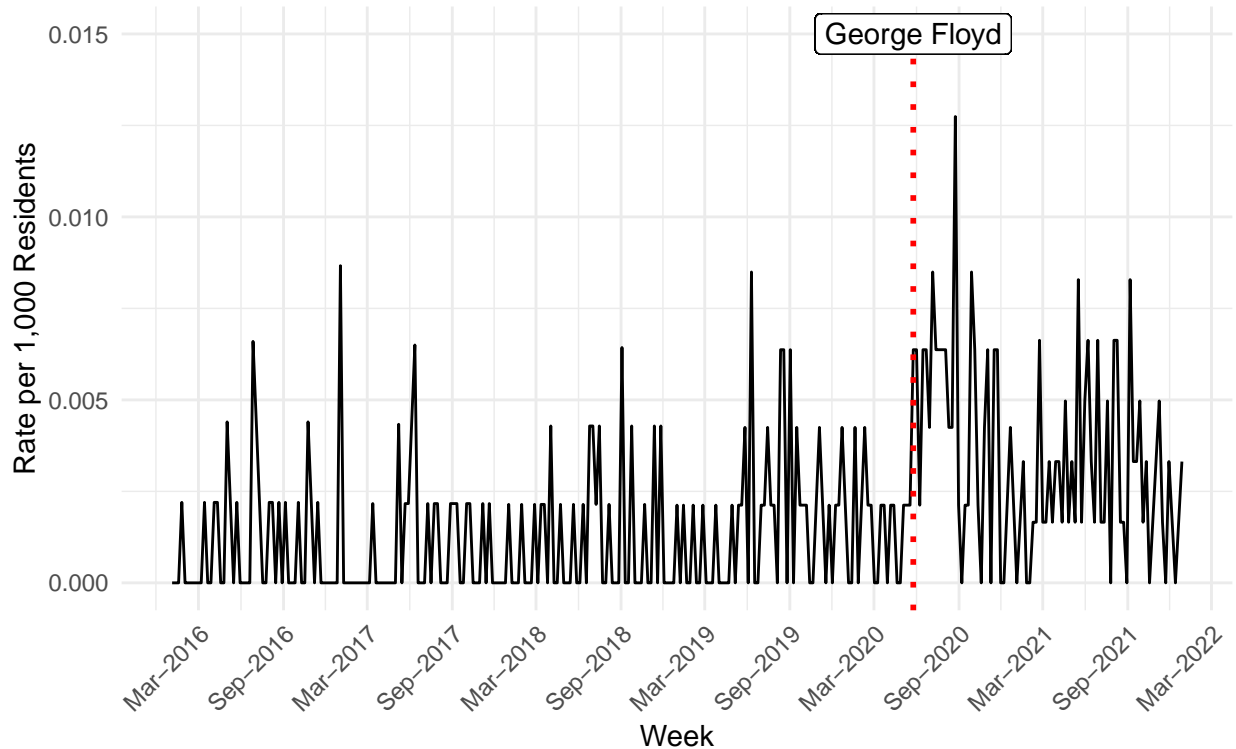
```
    theme(axis.text.x=element_text(angle=45, hjust=1))
```

Figure 4: Weekly Murder Rate, 2016–2021
MPD Data


```
mpd_series <- mpd_series %>%
  mutate(csma = forecast::ma(murder_rate, order=5,centre=TRUE),
         tsma = TTR::SMA(murder_rate, n=5))

ggplot(mpd_series)+
  geom_line(aes(x=begin_date, y=murder_rate))+
  scale_x_date(date_labels = "%b-%Y", date_breaks = "6 months")+
  geom_vline(xintercept=mpd_series$begin_date[mpd_series$year==2020 & mpd_series$week==isoweek(date("20
             linetype="dotted", color="red", size=1)+
  geom_label(aes(x=mpd_series$begin_date[mpd_series$year==2020 & mpd_series$week==isoweek(date("2020-05-
             y=0.0150),
             label = "George Floyd", show.legend = FALSE)+
  scale_y_continuous(limits = c(0,.015))+
  labs(title = "Figure A1: Weekly Murder Rate, 2016-2021",
       subtitle = "MPD Data",
       x = "Week",
       y = "Rate per 1,000 Residents",
       color = NULL)+
  theme_minimal()+
  theme(axis.text.x=element_text(angle=45, hjust=1)) +
  geom_line(aes(x=begin_date, y=csma, color = "CSMA(5)"))+
  #geom_line(aes(x=begin_date, y=tsma, color = "TSMA(5)"))+
  #geom_ma(aes(x = begin_date, y = murder_rate, color = "MA4"), ma_fun = SMA, n = 4)
```

```
scale_color_manual(values = c("blue", "green"))
```

Figure A1: Weekly Murder Rate, 2016–2021
MPD Data
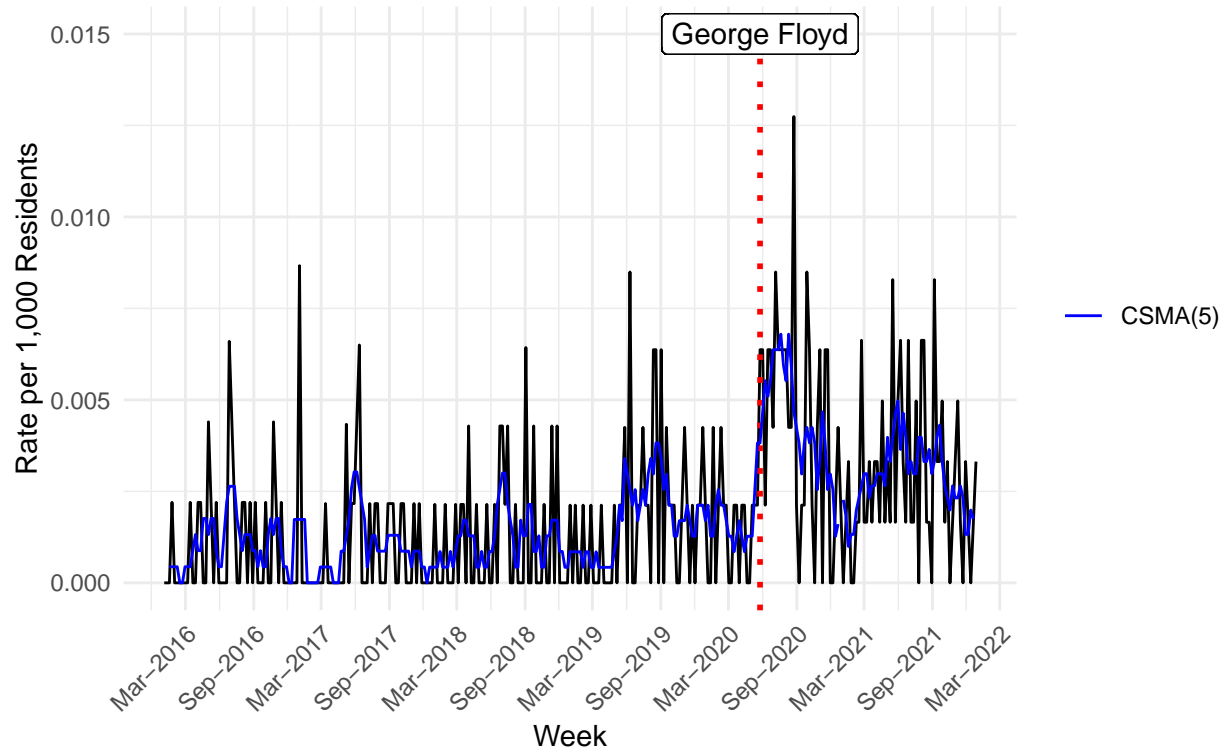

```
mpls_pops_zcta <- panel %>%
  select(zcta, year, weekofyr, total_pop) %>%
  ungroup() %>%
  complete(zcta, year = 2016:2021, weekofyr = 1:52) %>%
  arrange(zcta, year, weekofyr) %>%
  mutate(total_pop = ifelse(is.na(total_pop), na_locf(total_pop), total_pop)) %>%
  group_by(zcta) %>%
  summarize(total_pop = mean(total_pop, na.rm = T))


mpd_zip <- mpd %>%
  mutate(date=ymd_hms(reportedDate),
         year=isoyear(date),
          week=isoweek(date)) %>%
  st_as_sf(coords = c("X", "Y"), crs = "NAD83", remove=F) %>%
  mutate(intersection = as.integer(st_intersects(geometry, zcta)),
         zcta = ifelse(is.na(intersection), NA, zcta$zcta[intersection])) %>%
  st_drop_geometry() %>%
  filter(offense=="MURDR" & zcta %in% zcta_universe) %>%
  group_by(year, week, zcta, .drop=F) %>%
  tally(name = "murder") %>%
  arrange(zcta, year, week) %>%
  ungroup() %>%
```

```
complete(year, week=1:52, zcta=zcta_universe, fill = list(murder = 0)) %>%
filter(year <= 2021 & year >= 2016) %>%
mutate(begin_date = ISOweek2date(paste(year, paste0("W", sprintf("%02d", week)), 1,sep = "-")),
       end_date = begin_date+weeks(1)-days(1),
       post_floyd = as.numeric(begin_date >= as.Date("2020-05-25")),
       post_floyd_3 = as.numeric(begin_date >= as.Date("2020-05-25")+months(3)),
       period = factor(case_when(
         post_floyd==0 & post_floyd_3==0 ~ "Pre-Killing",
         post_floyd>=1 & post_floyd_3==0 ~ "0-3 Months Post-Killing",
         post_floyd>=1 & post_floyd_3>=1 ~ "3+ Months Post-Killing"),
         levels = c("Pre-Killing", "0-3 Months Post-Killing", "3+ Months Post-Killing"))) %>%
left_join(mpls_pops_zcta, by = "zcta") %>%
group_by(period, zcta, .drop=F) %>%
summarize(murder = mean(murder, na.rm = T),
          total_pop = mean(total_pop, an.rm = T)) %>%
left_join(zcta, by = "zcta") %>%
mutate(murder_rate = (murder/total_pop)*1000)
```

```
## `summarise()` has grouped output by 'period'. You can override using the
## `.groups` argument.
```

```
ggplot() +
  geom_sf(data = mpd_zip, aes(geometry = geometry, fill = murder_rate)) +
  geom_sf(data = mpls, aes(geometry = geometry), color = "black", alpha = 0)+
  geom_sf(data = gfs, aes(geometry = geometry), color = "black")+
  geom_text_repel(data = gfs, aes(x=lon, y=lat, label = name),
                  size = 2,
                  fontface = "bold",
                  nudge_x = 1, nudge_y = -1)+
  facet_wrap(~period)+
  scale_fill_distiller(palette = "Spectral")+
  labs(title = "Figure A2: Murder Rates by ZCTA and Period",
       subtitle = "MPD Data",
       fill = "Murder Rate/1,000")+
  theme(axis.text.x = element_blank(),
        axis.text.y = element_blank(),
axis.line = element_blank(),
axis.ticks = element_blank(),
panel.border = element_blank(),
panel.grid = element_blank(),
axis.title = element_blank(),
panel.background = element_blank(),
panel.grid.major = element_line(colour="transparent"),
plot.subtitle = element_text(face="italic"),
strip.background = element_rect(fill = "white",
                colour = "black"))
```

Figure A2: Murder Rates by ZCTA and Period
MPD Data