# Mental Health Series

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### 12/28/2022

## Base Panel Construction - ZCTA-Week Level

### Hospital Data - ZCTA-Week level

```r
hosp_zcta <- read_csv("Data/Restricted MHA Data/minnepop_1620_agg_zipfull_MH_102222.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, 2020)

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,
         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),
         zcta = as.numeric(zcta))

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

#SF geometries - get all ZCTAs
zcta <- get_acs(geography = "zcta",
                variables = "B01001_001",
                output = "wide",
                year = 2020,
                geometry = T,
                survey = "acs5") %>%
  rename(zcta = GEOID,
         pop_2019 = B01001_001E) %>%
  select(-c(NAME, B01001_001M, pop_2019)) %>%
  mutate(zcta = as.numeric(zcta))
```

```
##   |                                                    |
```

```
#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
```

```
#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 >= 5)

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

```r
  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 <= 2021 & 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)) %>%
  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() %>%
```

```r
  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")),
```

```r
        post_floyd_3 = as.numeric(begin_date >= as.Date("2020-05-25")+months(3)),
        t_post_floyd = ifelse(as.numeric(as.Date("2020-05-25")-begin_date)/7 >=0,
                              as.numeric(as.Date("2020-05-25")-begin_date)/7,
                              0),
        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))
```

## Weather Data

```r
# 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 panel
panel <- panel %>% left_join(weather, by = c("year","weekofyr"="week"))
```

## Time Series Construction - Week Level

### Aggregate Hospital Panel to Week-Level

```r
#panel to week-level, aggregating over ZCTAs
hosp_series <- panel %>%
  group_by(year, weekofyr) %>%
  summarize(mh_all_tot = sum(mh_all_tot, na.rm = T),
            white_mh_all_tot =  sum(white_mh_all_tot, na.rm = T),
            indig_mh_all_tot =  sum(indig_mh_all_tot, na.rm = T),
            asian_mh_all_tot =  sum(asian_mh_all_tot, na.rm = T),
```

```
          black_mh_all_tot =  sum(black_mh_all_tot, na.rm = T),
          latin_mh_all_tot =  sum(latin_mh_all_tot, na.rm = T),
          total_pop = sum(total_pop, na.rm = T),
          white_pop = sum(white_pop, na.rm = T),
          na_pop = sum(na_pop, na.rm = T),
          hisp_pop = sum(hisp_pop, na.rm = T),
          asian_pop = sum(asian_pop, na.rm = T),
          black_pop = sum(black_pop, na.rm = T)) %>%
  mutate(mh_incid_c = (mh_all_tot/total_pop)*1000,
         white_mh_incid_c = (white_mh_all_tot/white_pop)*1000,
         indig_mh_incid_c = (indig_mh_all_tot/na_pop)*1000,
         asian_mh_incid_c = (asian_mh_all_tot/asian_pop)*1000,
         black_mh_incid_c = (black_mh_all_tot/black_pop)*1000,
         latin_mh_incid_c = (latin_mh_all_tot/hisp_pop)*1000) %>%
  ungroup() %>%
  mutate(week_id = row_number())
```

## Police Data Week-Level

```
#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)
```

```r
#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
#removing week 53 of 2020

series <- series %>%
  mutate(begin_date = ISOweek2date(paste(year, paste0("W", sprintf("%02d", weekofyr)), 1,sep = "-")),
         end_date = begin_date+weeks(1)-days(1)) %>%
  filter(!(year==2020 & weekofyr== 53)) %>%
  left_join(weather, by = c("year","weekofyr"="week"))
```

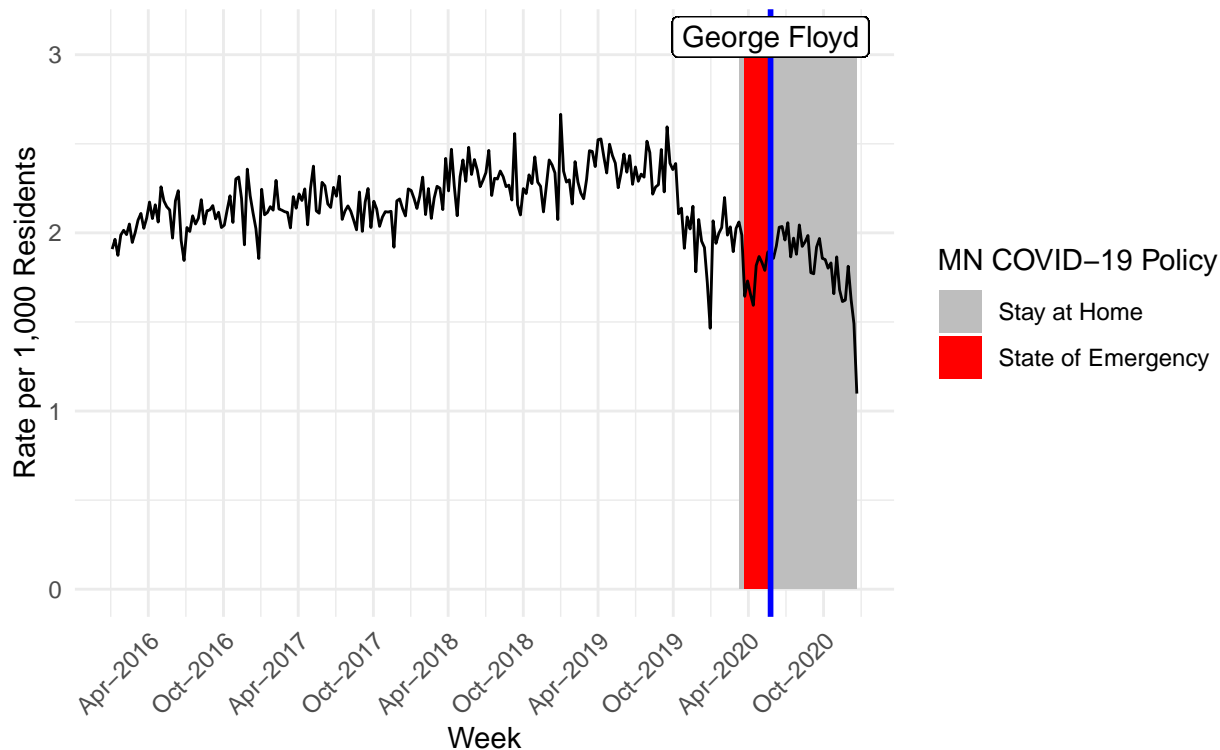## Time Series Vizualization

```r
ggplot(series)+
  scale_x_date(date_labels = "%b-%Y", date_breaks = "6 months")+
  geom_rect(aes(
    xmin = series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-03-13"))],
    xmax = series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-12-25"))],
    ymin = 0,
    ymax = 3,
    fill = "State of Emergency"
  )) +
  geom_rect(aes(
    xmin = series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-03-28"))],
    xmax = series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-05-18"))],
    ymin = 0,
    ymax = 3,
    fill = "Stay at Home"
  )) +
  scale_fill_manual(values=c("grey","red"), labels=c("Stay at Home", "State of Emergency")) +
  geom_line(aes(x=begin_date, y=mh_incid_c))+
  geom_vline(xintercept=series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-05-25
             linetype="solid", color="blue", size=1) +
  geom_label(aes(x=series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-05-25"))],
                 y=3.1),
             label = "George Floyd", show.legend = FALSE)+
  labs(title = "Figure 1: Weekly Mental Health Discharges, 2016-2020",
       subtitle = "MHA Hospital Data",
       x = "Week",
       y = "Rate per 1,000 Residents",
       fill = "MN COVID-19 Policy")+
```

```
theme_minimal()+
  theme(axis.text.x=element_text(angle=45, hjust=1))
```
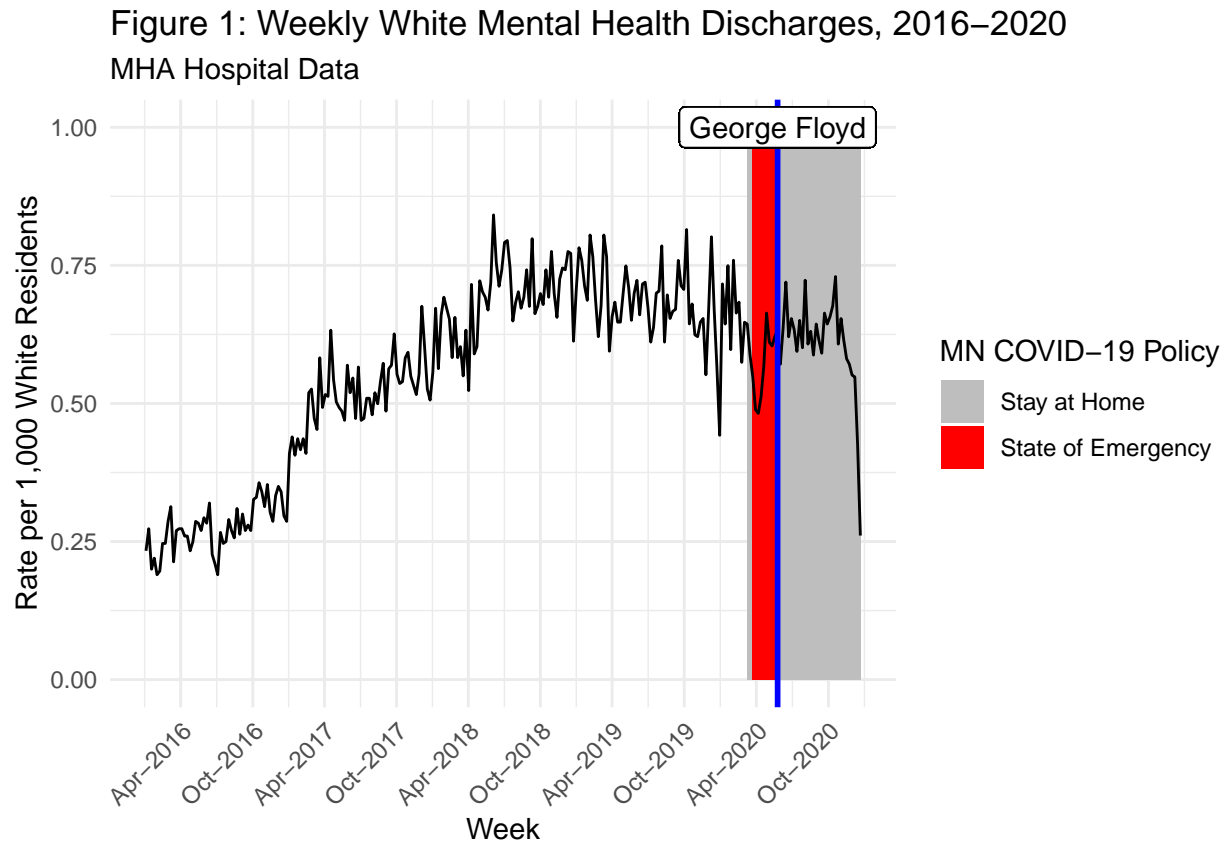
## Figure 1: Weekly Mental Health Discharges, 2016–2020
MHA Hospital Data



```
ggplot(series)+
  scale_x_date(date_labels = "%b-%Y", date_breaks = "6 months")+
   geom_rect(aes(
    xmin = series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-03-13"))],
    xmax = series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-12-25"))],
    ymin = 0,
    ymax = 1,
    fill = "State of Emergency"
)) +
  geom_rect(aes(
    xmin = series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-03-28"))],
    xmax = series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-05-18"))],
    ymin = 0,
    ymax = 1,
    fill = "Stay at Home"
)) +
  scale_fill_manual(values=c("grey","red"), labels=c("Stay at Home", "State of Emergency")) +
  geom_line(aes(x=begin_date, y=white_mh_incid_c))+
  geom_vline(xintercept=series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-05-25"
              linetype="solid", color="blue", size=1) +
  geom_label(aes(x=series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-05-25"))],
              y=1),
            label = "George Floyd", show.legend = FALSE)+
```

```r
labs(title = "Figure 1: Weekly White Mental Health Discharges, 2016-2020",
     subtitle = "MHA Hospital Data",
     x = "Week",
     y = "Rate per 1,000 White Residents",
     fill = "MN COVID-19 Policy")+
theme_minimal()+
  theme(axis.text.x=element_text(angle=45, hjust=1))
```

## Figure 1: Weekly White Mental Health Discharges, 2016–2020
### MHA Hospital Data



```r
ggplot(series)+
  scale_x_date(date_labels = "%b-%Y", date_breaks = "6 months")+
   geom_rect(aes(
    xmin = series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-03-13"))],
    xmax = series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-12-25"))],
    ymin = 0,
    ymax = 1.7,
    fill = "State of Emergency"
)) +
  geom_rect(aes(
    xmin = series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-03-28"))],
    xmax = series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-05-18"))],
    ymin = 0,
    ymax = 1.7,
    fill = "Stay at Home"
)) +
  scale_fill_manual(values=c("grey","red"), labels=c("Stay at Home", "State of Emergency")) +
  geom_line(aes(x=begin_date, y=black_mh_incid_c))+
```

```
geom_vline(xintercept=series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-05-25
           linetype="solid", color="blue", size=1) +
geom_label(aes(x=series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-05-25"))],
           y=1.7),
           label = "George Floyd", show.legend = FALSE)+
labs(title = "Figure X: Weekly Black Mental Health Discharges, 2016-2020",
     subtitle = "MHA Hospital Data",
     x = "Week",
     y = "Rate per 1,000 Black Residents",
     fill = "MN COVID-19 Policy")+
theme_minimal()+
   theme(axis.text.x=element_text(angle=45, hjust=1))
```

## Figure X: Weekly Black Mental Health Discharges, 2016–2020
### MHA Hospital Data
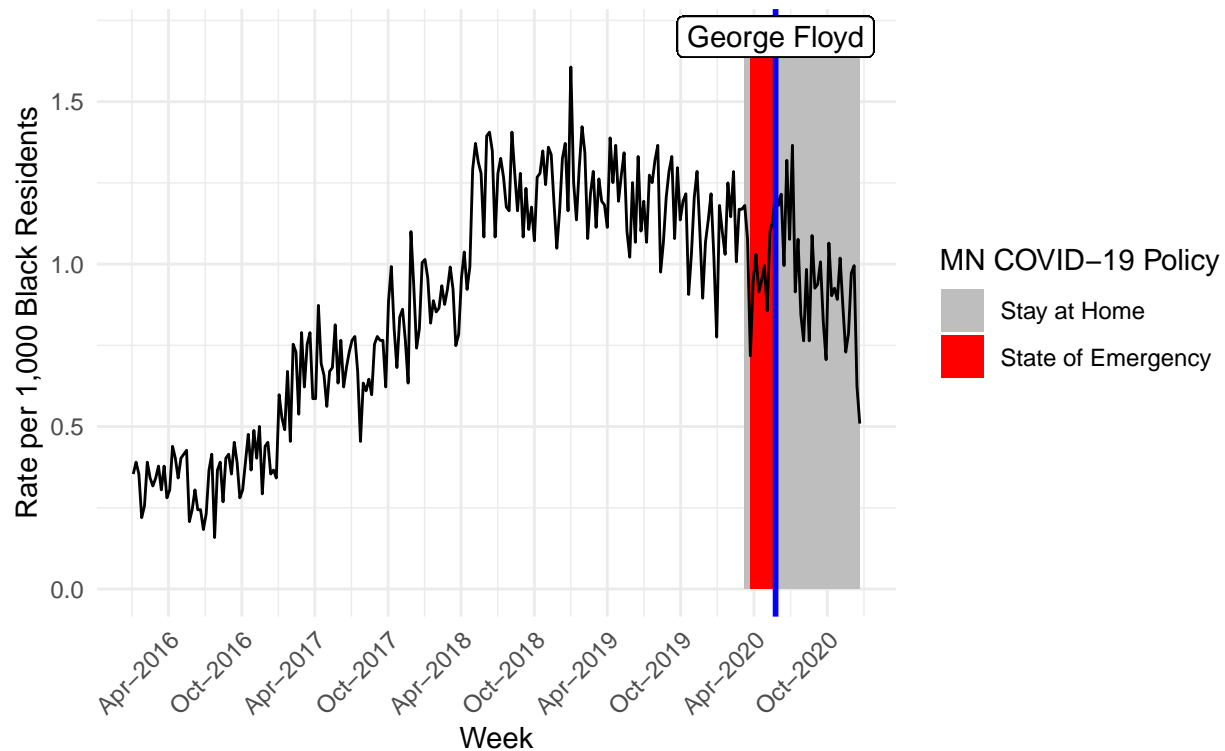


```
ggplot(series)+
  scale_x_date(date_labels = "%b-%Y", date_breaks = "6 months")+
   geom_rect(aes(
     xmin = series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-03-13"))],
     xmax = series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-12-25"))],
     ymin = 0,
     ymax = 1.25,
     fill = "State of Emergency"
   )) +
   geom_rect(aes(
     xmin = series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-03-28"))],
     xmax = series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-05-18"))],
     ymin = 0,
```

```
    ymax = 1.25,
    fill = "Stay at Home"
)) +
scale_fill_manual(values=c("grey","red"), labels=c("Stay at Home", "State of Emergency")) +
geom_line(aes(x=begin_date, y=latin_mh_incid_c))+
geom_vline(xintercept=series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-05-25
           linetype="solid", color="blue", size=1) +
geom_label(aes(x=series$begin_date[series$year==2020 & series$weekofyr==isoweek(date("2020-05-25"))],
           y=1.25),
           label = "George Floyd", show.legend = FALSE)+
labs(title = "Figure X: Weekly Latino/a Mental Health Discharges, 2016-2020",
     subtitle = "MHA Hospital Data",
     x = "Week",
     y = "Rate per 1,000 Latino/a Residents",
     fill = "MN COVID-19 Policy")+
theme_minimal()+
    theme(axis.text.x=element_text(angle=45, hjust=1))
```

### Figure X: Weekly Latino/a Mental Health Discharges, 2016–2020
MHA Hospital Data
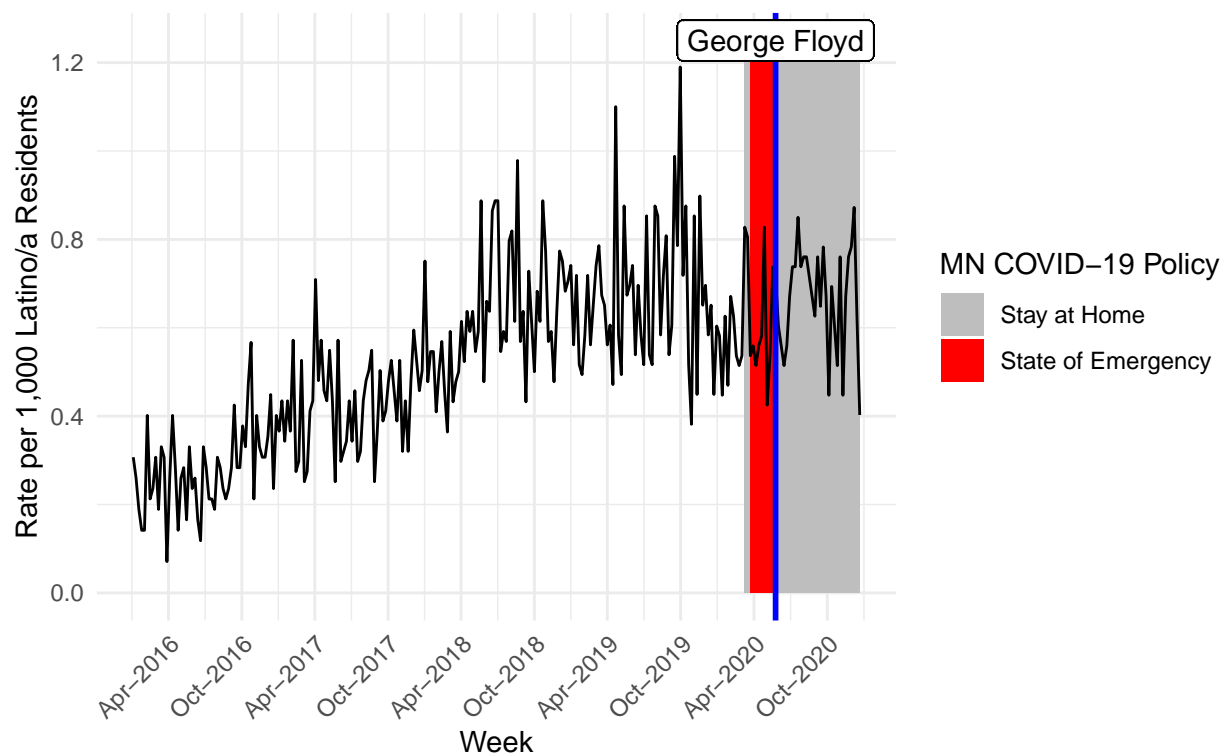


## Time Series Analysis

```
series <- series %>%
  mutate(t = 1:length(mh_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"))),
         t_post_floyd = ifelse(as.numeric(as.Date("2020-05-25")-begin_date)/7 >=0,
                               as.numeric(as.Date("2020-05-25")-begin_date)/7,
                               0),
       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(mh_incid_c~t+state_of_emerg+stay_at_home+post_floyd+t_post_floyd+
         tmax_f+snow_in+precip_in+
         uof_lag+stops_lag+shoot_lag,
                    data = series)
summary(ts)
```
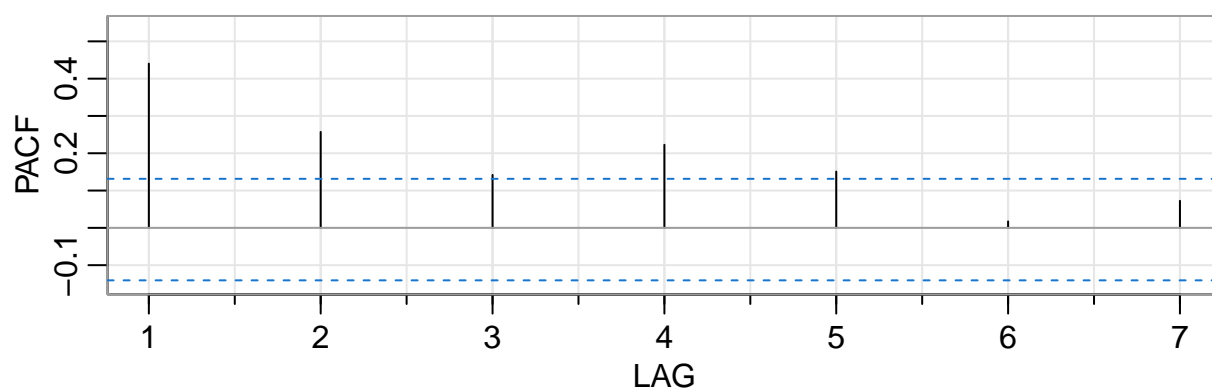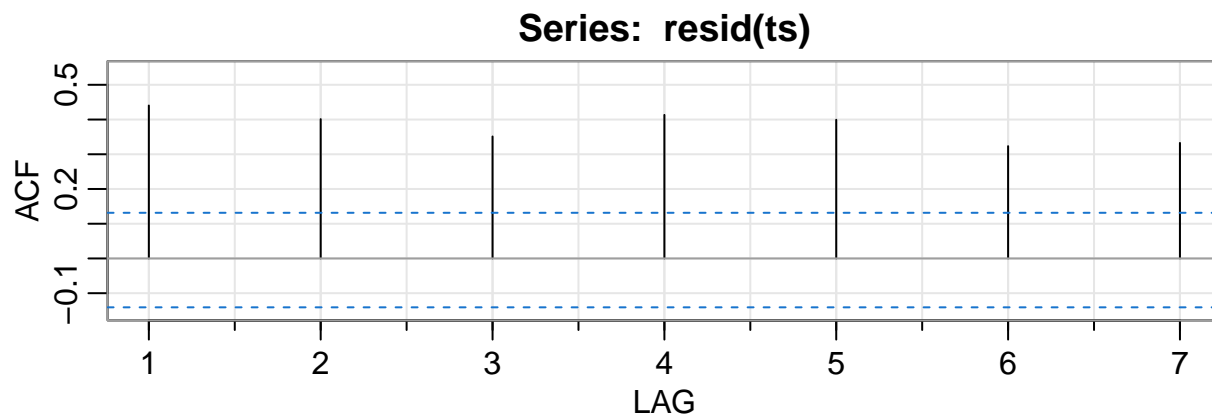
```
##
## Call:
## lm(formula = mh_incid_c ~ t + state_of_emerg + stay_at_home +
##     post_floyd + t_post_floyd + tmax_f + snow_in + precip_in +
##     uof_lag + stops_lag + shoot_lag, data = series)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.74151 -0.06959 -0.00027  0.08705  0.49370
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)     5.255e+00  7.995e-01   6.573 4.05e-10 ***
## t              -1.366e-02  3.475e-03  -3.931 0.000116 ***
## state_of_emerg1 -3.895e-01  9.404e-02  -4.142 5.05e-05 ***
## stay_at_home1  -9.748e-02  9.707e-02  -1.004 0.316456
## post_floyd1     9.962e-02  1.018e-01   0.978 0.329139
## t_post_floyd   -1.377e-02  3.505e-03  -3.928 0.000117 ***
## tmax_f          3.226e-03  6.541e-04   4.931 1.69e-06 ***
## snow_in         2.271e-02  2.842e-02   0.799 0.425180
## precip_in      -1.316e-01  9.978e-02  -1.319 0.188612
## uof_lag         3.674e-01  2.248e-01   1.634 0.103788
## stops_lag      -4.011e-02  3.728e-02  -1.076 0.283296
## shoot_lag      -1.348e+01  6.536e+00  -2.062 0.040472 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1514 on 204 degrees of freedom
##   (44 observations deleted due to missingness)
## Multiple R-squared:  0.5965, Adjusted R-squared:  0.5747
## F-statistic: 27.42 on 11 and 204 DF,  p-value: < 2.2e-16
```

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

## Series: resid(ts)



```
##      [,1] [,2] [,3] [,4] [,5] [,6] [,7]
## ACF  0.44 0.40 0.35 0.41 0.40 0.32 0.33
## PACF 0.44 0.26 0.14 0.22 0.15 0.02 0.07
```

```
ts_ar3<- lm(mh_incid_c~t+state_of_emerg+stay_at_home+post_floyd+t_post_floyd+
                        uof_lag+stops_lag+shoot_lag+
                        tmax_f+snow_in+precip_in+
                        dplyr::lag(mh_incid_c, 1)+ dplyr::lag(mh_incid_c, 2)+
               dplyr::lag(mh_incid_c, 3),
            data = series)
summary(ts_ar3)
```

```
##
## Call:
## lm(formula = mh_incid_c ~ t + state_of_emerg + stay_at_home +
##     post_floyd + t_post_floyd + uof_lag + stops_lag + shoot_lag +
##     tmax_f + snow_in + precip_in + dplyr::lag(mh_incid_c, 1) +
##     dplyr::lag(mh_incid_c, 2) + dplyr::lag(mh_incid_c, 3), data = series)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.47466 -0.07480  0.00068  0.06902  0.45274
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  2.823e+00  7.132e-01    3.958 0.000105 ***
## t                           -9.743e-03  2.938e-03   -3.317 0.001082 **
```

```
## state_of_emerg1            -1.982e-01  8.105e-02  -2.445 0.015335 *
## stay_at_home1               6.603e-02  8.258e-02   0.800 0.424862
## post_floyd1                 1.521e-01  8.520e-02   1.785 0.075803 .
## t_post_floyd               -9.658e-03  2.966e-03  -3.256 0.001325 **
## uof_lag                     4.116e-01  1.884e-01   2.185 0.030036 *
## stops_lag                  -3.021e-02  3.118e-02  -0.969 0.333756
## shoot_lag                  -1.114e+01  5.470e+00  -2.036 0.043053 *
## tmax_f                      1.522e-03  5.766e-04   2.640 0.008951 **
## snow_in                     1.109e-02  2.379e-02   0.466 0.641547
## precip_in                  -2.594e-01  8.433e-02  -3.076 0.002389 **
## dplyr::lag(mh_incid_c, 1)   3.154e-01  6.905e-02   4.567  8.6e-06 ***
## dplyr::lag(mh_incid_c, 2)   2.679e-01  6.944e-02   3.859 0.000154 ***
## dplyr::lag(mh_incid_c, 3)   1.350e-01  6.843e-02   1.973 0.049870 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.126 on 201 degrees of freedom
##   (44 observations deleted due to missingness)
## Multiple R-squared:  0.7247, Adjusted R-squared:  0.7055
## F-statistic:  37.8 on 14 and 201 DF,  p-value: < 2.2e-16
```

```
acf2(resid(ts_ar3), max.lag = 7)
```



**Series: resid(ts_ar3)**
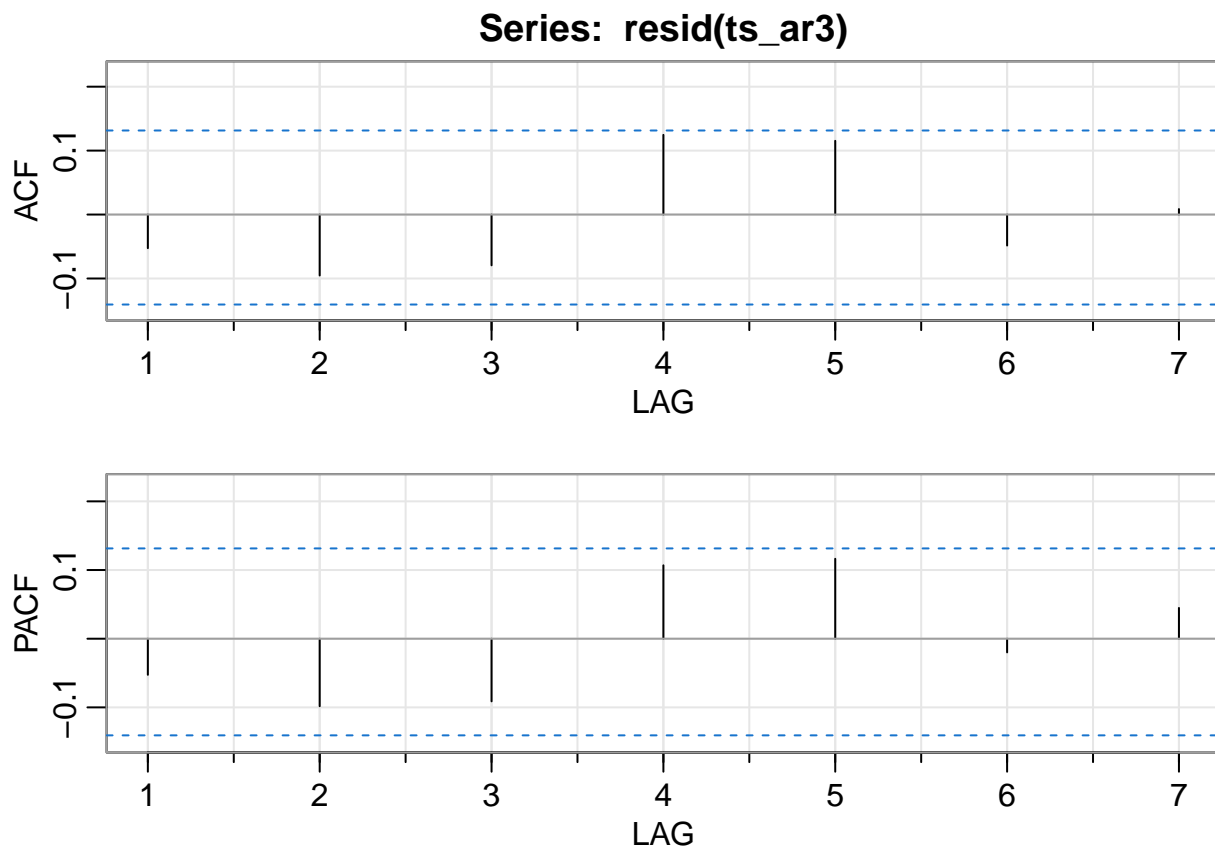
```
##       [,1] [,2]  [,3] [,4] [,5]  [,6] [,7]
## ACF  -0.05 -0.1 -0.08 0.12 0.12 -0.05 0.01
## PACF -0.05 -0.1 -0.09 0.11 0.12 -0.02 0.04
```

```
#race specific models

ts_ar3_white <- lm(white_mh_incid_c~t+state_of_emerg+stay_at_home+post_floyd+t_post_floyd+
                    uof_lag+stops_lag+shoot_lag+
                    tmax_f+snow_in+precip_in+
                    dplyr::lag(white_mh_incid_c, 1)+ dplyr::lag(white_mh_incid_c, 2)+
              dplyr::lag(white_mh_incid_c, 3),
          data = series)
summary(ts_ar3_white)
```

```
##
## Call:
## lm(formula = white_mh_incid_c ~ t + state_of_emerg + stay_at_home +
##     post_floyd + t_post_floyd + uof_lag + stops_lag + shoot_lag +
##     tmax_f + snow_in + precip_in + dplyr::lag(white_mh_incid_c,
##     1) + dplyr::lag(white_mh_incid_c, 2) + dplyr::lag(white_mh_incid_c,
##     3), data = series)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.205278 -0.034589 -0.002865  0.038491  0.161720
##
## Coefficients:
##                                Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   1.1112187  0.3344785   3.322  0.00106 **
## t                            -0.0042313  0.0014438  -2.931  0.00377 **
## state_of_emerg1              -0.0570246  0.0404216  -1.411  0.15987
## stay_at_home1                 0.0159212  0.0405788   0.392  0.69521
## post_floyd1                   0.0610518  0.0422839   1.444  0.15034
## t_post_floyd                 -0.0045808  0.0014591  -3.140  0.00195 **
## uof_lag                       0.2409374  0.0943712   2.553  0.01142 *
## stops_lag                     0.0032860  0.0157758   0.208  0.83521
## shoot_lag                    -3.6088769  2.7283081  -1.323  0.18742
## tmax_f                        0.0004023  0.0002739   1.469  0.14338
## snow_in                       0.0116618  0.0118124   0.987  0.32471
## precip_in                    -0.0772824  0.0415641  -1.859  0.06444 .
## dplyr::lag(white_mh_incid_c, 1)  0.4573811  0.0695599   6.575  4.1e-10 ***
## dplyr::lag(white_mh_incid_c, 2)  0.2006716  0.0754443   2.660  0.00845 **
## dplyr::lag(white_mh_incid_c, 3)  0.1099192  0.0712538   1.543  0.12449
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.06272 on 201 degrees of freedom
##   (44 observations deleted due to missingness)
## Multiple R-squared:  0.7117, Adjusted R-squared:  0.6917
## F-statistic: 35.45 on 14 and 201 DF,  p-value: < 2.2e-16
```

```
ts_ar3_black <- lm(black_mh_incid_c~t+state_of_emerg+stay_at_home+post_floyd+t_post_floyd+
                    uof_lag+stops_lag+shoot_lag+
                    tmax_f+snow_in+precip_in+
                    dplyr::lag(black_mh_incid_c, 1)+ dplyr::lag(black_mh_incid_c, 2)+
              dplyr::lag(black_mh_incid_c, 3),
          data = series)
summary(ts_ar3_black)
```

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```
## 
## Call:
## lm(formula = black_mh_incid_c ~ t + state_of_emerg + stay_at_home +
##     post_floyd + t_post_floyd + uof_lag + stops_lag + shoot_lag +
##     tmax_f + snow_in + precip_in + dplyr::lag(black_mh_incid_c,
##     1) + dplyr::lag(black_mh_incid_c, 2) + dplyr::lag(black_mh_incid_c,
##     3), data = series)
## 
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.36839 -0.09540  0.00568  0.08856  0.38696
## 
## Coefficients:
##                                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)                    1.5119944  0.7755315   1.950 0.052612 .
## t                             -0.0052704  0.0032778  -1.608 0.109430
## state_of_emerg1               -0.2775568  0.0884554  -3.138 0.001958 **
## stay_at_home1                  0.1934573  0.0908775   2.129 0.034491 *
## post_floyd1                    0.2276755  0.0944241   2.411 0.016800 *
## t_post_floyd                  -0.0065160  0.0033862  -1.924 0.055731 .
## uof_lag                        0.1122348  0.2087306   0.538 0.591378
## stops_lag                      0.0400787  0.0347849   1.152 0.250613
## shoot_lag                      0.9174678  6.0390611   0.152 0.879401
## tmax_f                         0.0002117  0.0006119   0.346 0.729732
## snow_in                       -0.0014666  0.0262880  -0.056 0.955563
## precip_in                     -0.1545481  0.0919805  -1.680 0.094467 .
## dplyr::lag(black_mh_incid_c, 1)  0.3398593  0.0687560   4.943 1.62e-06 ***
## dplyr::lag(black_mh_incid_c, 2)  0.1749467  0.0712258   2.456 0.014889 *
## dplyr::lag(black_mh_incid_c, 3)  0.2308650  0.0691262   3.340 0.000999 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 0.1395 on 201 degrees of freedom
##   (44 observations deleted due to missingness)
## Multiple R-squared:  0.7486, Adjusted R-squared:  0.7311
## F-statistic: 42.75 on 14 and 201 DF,  p-value: < 2.2e-16
```

```r
ts_ar3_latin <- lm(latin_mh_incid_c~t+state_of_emerg+stay_at_home+post_floyd+t_post_floyd+
                     uof_lag+stops_lag+shoot_lag+
                     tmax_f+snow_in+precip_in+
                     dplyr::lag(latin_mh_incid_c, 1)+ dplyr::lag(latin_mh_incid_c, 2)+
              dplyr::lag(latin_mh_incid_c, 3),
            data = series)
summary(ts_ar3_latin)
```

```
## 
## Call:
## lm(formula = latin_mh_incid_c ~ t + state_of_emerg + stay_at_home +
##     post_floyd + t_post_floyd + uof_lag + stops_lag + shoot_lag +
##     tmax_f + snow_in + precip_in + dplyr::lag(latin_mh_incid_c,
##     1) + dplyr::lag(latin_mh_incid_c, 2) + dplyr::lag(latin_mh_incid_c,
##     3), data = series)
## 
## Residuals:
##      Min       1Q   Median       3Q      Max
```

```
## -0.32579 -0.08927 -0.00465  0.07260  0.46798
##
## Coefficients:
##                                Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   0.3746036  0.7223009   0.519   0.6046
## t                             0.0004607  0.0031588   0.146   0.8842
## state_of_emerg1              -0.0954767  0.0853309  -1.119   0.2645
## stay_at_home1                -0.0255143  0.0884495  -0.288   0.7733
## post_floyd1                   0.0222977  0.0922099   0.242   0.8092
## t_post_floyd                 -0.0011048  0.0031700  -0.349   0.7278
## uof_lag                      -0.0464674  0.2038473  -0.228   0.8199
## stops_lag                     0.0243096  0.0338002   0.719   0.4728
## shoot_lag                    -0.7723934  5.9016926  -0.131   0.8960
## tmax_f                        0.0006489  0.0005994   1.083   0.2803
## snow_in                      -0.0166781  0.0258966  -0.644   0.5203
## precip_in                    -0.0139046  0.0906698  -0.153   0.8783
## dplyr::lag(latin_mh_incid_c, 1)  0.0758069  0.0708497   1.070   0.2859
## dplyr::lag(latin_mh_incid_c, 2)  0.1223659  0.0705450   1.735   0.0843 .
## dplyr::lag(latin_mh_incid_c, 3)  0.1008496  0.0707014   1.426   0.1553
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1366 on 201 degrees of freedom
##   (44 observations deleted due to missingness)
## Multiple R-squared:  0.3949, Adjusted R-squared:  0.3527
## F-statistic: 9.369 on 14 and 201 DF,  p-value: 8.675e-16
```

```r
ts_ar3_indig <- lm(indig_mh_incid_c~t+state_of_emerg+stay_at_home+post_floyd+t_post_floyd+
                     uof_lag+stops_lag+shoot_lag+
                     tmax_f+snow_in+precip_in+
                     dplyr::lag(indig_mh_incid_c, 1)+ dplyr::lag(indig_mh_incid_c, 2)+
             dplyr::lag(indig_mh_incid_c, 3),
         data = series)
summary(ts_ar3_indig)
```

```
##
## Call:
## lm(formula = indig_mh_incid_c ~ t + state_of_emerg + stay_at_home +
##     post_floyd + t_post_floyd + uof_lag + stops_lag + shoot_lag +
##     tmax_f + snow_in + precip_in + dplyr::lag(indig_mh_incid_c,
##     1) + dplyr::lag(indig_mh_incid_c, 2) + dplyr::lag(indig_mh_incid_c,
##     3), data = series)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.94513 -0.47980 -0.03261  0.41043  2.16181
##
## Coefficients:
##                                Estimate Std. Error t value Pr(>|t|)
## (Intercept)                    6.511441   4.411115   1.476 0.141470
## t                             -0.016809   0.018839  -0.892 0.373309
## state_of_emerg1               -1.077793   0.512862  -2.102 0.036841 *
## stay_at_home1                  0.615713   0.517523   1.190 0.235556
## post_floyd1                   -0.006802   0.542786  -0.013 0.990014
## t_post_floyd                  -0.027923   0.019385  -1.440 0.151310
```

```
## uof_lag                             1.091052    1.211417    0.901 0.368857
## stops_lag                           0.129736    0.205540    0.631 0.528629
## shoot_lag                         -20.886282   34.962687   -0.597 0.550921
## tmax_f                              0.012841    0.003692    3.478 0.000619 ***
## snow_in                            -0.096711    0.151970   -0.636 0.525252
## precip_in                          -0.297486    0.534188   -0.557 0.578220
## dplyr::lag(indig_mh_incid_c, 1)     0.089007    0.070456    1.263 0.207945
## dplyr::lag(indig_mh_incid_c, 2)     0.002713    0.071394    0.038 0.969725
## dplyr::lag(indig_mh_incid_c, 3)     0.102463    0.070031    1.463 0.145002
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8053 on 201 degrees of freedom
##   (44 observations deleted due to missingness)
## Multiple R-squared:  0.4718, Adjusted R-squared:  0.435
## F-statistic: 12.82 on 14 and 201 DF,  p-value: < 2.2e-16
```

```r
ts_ar3_asian <- lm(asian_mh_incid_c~t+state_of_emerg+stay_at_home+post_floyd+t_post_floyd+
                     uof_lag+stops_lag+shoot_lag+
                     tmax_f+snow_in+precip_in+
                     dplyr::lag(asian_mh_incid_c, 1)+ dplyr::lag(asian_mh_incid_c, 2)+
                dplyr::lag(asian_mh_incid_c, 3),
            data = series)
summary(ts_ar3_asian)
```

```
##
## Call:
## lm(formula = asian_mh_incid_c ~ t + state_of_emerg + stay_at_home +
##     post_floyd + t_post_floyd + uof_lag + stops_lag + shoot_lag +
##     tmax_f + snow_in + precip_in + dplyr::lag(asian_mh_incid_c,
##     1) + dplyr::lag(asian_mh_incid_c, 2) + dplyr::lag(asian_mh_incid_c,
##     3), data = series)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.178990 -0.056598 -0.002371  0.053889  0.249423
##
## Coefficients:
##                                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)                     0.3489031  0.4270761   0.817   0.4149
## t                              -0.0004342  0.0018456  -0.235   0.8142
## state_of_emerg1                -0.1011590  0.0526152  -1.923   0.0559 .
## stay_at_home1                   0.0830573  0.0526202   1.578   0.1160
## post_floyd1                     0.0378355  0.0555700   0.681   0.4967
## t_post_floyd                   -0.0011296  0.0018702  -0.604   0.5465
## uof_lag                         0.0070316  0.1193611   0.059   0.9531
## stops_lag                      -0.0060339  0.0198558  -0.304   0.7615
## shoot_lag                      -3.9888752  3.4669359  -1.151   0.2513
## tmax_f                          0.0003517  0.0003468   1.014   0.3116
## snow_in                        -0.0011596  0.0151291  -0.077   0.9390
## precip_in                      -0.0309055  0.0528961  -0.584   0.5597
## dplyr::lag(asian_mh_incid_c, 1)  0.0300318  0.0713681   0.421   0.6744
## dplyr::lag(asian_mh_incid_c, 2)  0.0269563  0.0709769   0.380   0.7045
## dplyr::lag(asian_mh_incid_c, 3) -0.0796674  0.0714802  -1.115   0.2664
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.08022 on 201 degrees of freedom
##   (44 observations deleted due to missingness)
## Multiple R-squared:  0.1816, Adjusted R-squared:  0.1246
## F-statistic: 3.185 on 14 and 201 DF,  p-value: 0.0001512
```

```
stargazer(ts_ar3, ts_ar3_white, ts_ar3_black, ts_ar3_latin,
          title = "Interrupted Time Series Models of Mental Health Discharges",
          covariate.labels = c("T","COVID - State of Emergency", "COVID - Stay at Home",
                            "Post-Killing", "T Post-Killing",
                            "MPD Use of Force t-1", "MPD Stops t-1",
                            "MPD Officer Involved Shootings t-1",
                            "Mean Max. Temp.", "Snow (in.)", "Precip. (in.)",
                            "AR(1)", "AR(2)", "AR(3)"),
          dep.var.caption = "Mental Health Discharges",
          dep.var.labels = "Rate per 1,000",
          column.labels = c("Overall", "White", "Black", "Latio/a"),
          model.numbers = TRUE,
          single.row = TRUE,
          align = T,
          omit.stat = "adj.rsq",
          star.cutoffs = c(.05, .01, .001), star.char = c("*","**","***"))
```

% Table created by stargazer v.5.2.3 by Marek Hlavac, Social Policy Institute. E-mail: marek.hlavac at gmail.com % Date and time: Wed, Jan 04, 2023 - 3:36:24 PM % Requires LaTeX packages: dcolumn

```
#coefficient plot for SER abstract
```

# ZCTA-Week Level Analysis

## Panel Analysis

```
##
## Call:
## lm(formula = mh_rate ~ t + state_of_emerg + stay_at_home + post_floyd +
##     t_post_floyd + uof_lag + stops_lag + shoot_lag + tmax_f +
##     snow_in + precip_in + as.factor(zipcode) + as.factor(weekofyr),
##     data = panel)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -15.4320 -0.3479 -0.0290  0.3127 21.4859
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)          1.094e+01  2.065e+00   5.296 1.23e-07 ***
## t                   -3.773e-02  8.965e-03  -4.209 2.61e-05 ***
## state_of_emerg      -4.298e-01  2.643e-01  -1.626  0.10401
## stay_at_home        -3.072e-01  2.737e-01  -1.122  0.26170
## post_floyd1          1.312e-01  2.751e-01   0.477  0.63335
## t_post_floyd        -3.850e-02  8.957e-03  -4.298 1.75e-05 ***
## uof_lag             -8.017e-03  8.495e-03  -0.944  0.34538
## stops_lag            3.807e-05  1.210e-03   0.031  0.97490
## shoot_lag           -4.391e-02  1.593e-01  -0.276  0.78283
```

Table 1: Interrupted Time Series Models of Mental Health Discharges

| | Mental Health Discharges | | |
|---|---|---|---|
| | Rate per 1,000<br>Overall | white_mh_incid_c<br>White | black_mh_i<br>Black |
| | (1) | (2) | (3) |
| T | −0.010** (0.003) | −0.004** (0.001) | −0.00 |
| COVID - State of Emergency | −0.198* (0.081) | −0.057 (0.040) | −0.27 |
| COVID - Stay at Home | 0.066 (0.083) | 0.016 (0.041) | 0.19 |
| Post-Killing | 0.152 (0.085) | 0.061 (0.042) | 0.22 |
| T Post-Killing | −0.010** (0.003) | −0.005** (0.001) | −0.00 |
| MPD Use of Force t-1 | 0.412* (0.188) | 0.241* (0.094) | 0.11 |
| MPD Stops t-1 | −0.030 (0.031) | 0.003 (0.016) | 0.04 |
| MPD Officer Involved Shootings t-1 | −11.137* (5.470) | −3.609 (2.728) | 0.91 |
| Mean Max. Temp. | 0.002** (0.001) | 0.0004 (0.0003) | 0.00 |
| Snow (in.) | 0.011 (0.024) | 0.012 (0.012) | −0.00 |
| Precip. (in.) | −0.259** (0.084) | −0.077 (0.042) | −0.15 |
| AR(1) | 0.315*** (0.069) | | |
| AR(2) | 0.268*** (0.069) | | |
| AR(3) | 0.135* (0.068) | | |
| dplyr::lag(white_mh_incid_c, 1) | | 0.457*** (0.070) | |
| dplyr::lag(white_mh_incid_c, 2) | | 0.201** (0.075) | |
| dplyr::lag(white_mh_incid_c, 3) | | 0.110 (0.071) | |
| dplyr::lag(black_mh_incid_c, 1) | | | 0.34 |
| dplyr::lag(black_mh_incid_c, 2) | | | 0.17 |
| dplyr::lag(black_mh_incid_c, 3) | | | 0.23 |
| dplyr::lag(latin_mh_incid_c, 1) | | | |
| dplyr::lag(latin_mh_incid_c, 2) | | | |
| dplyr::lag(latin_mh_incid_c, 3) | | | |
| Constant | 2.823*** (0.713) | 1.111** (0.334) | 1.51 |
| Observations | 216 | 216 | 216 |
| $R^2$ | 0.725 | 0.712 | 0.749 |
| Residual Std. Error (df = 201) | 0.126 | 0.063 | 0.140 |
| F Statistic (df = 14; 201) | 37.797*** | 35.448*** | 42.751* |

*Note:*

```
## tmax_f                    2.699e-04  3.843e-03   0.070  0.94402
## snow_in                   4.920e-02  8.104e-02   0.607  0.54383
## precip_in                 2.373e-01  2.686e-01   0.883  0.37709
## as.factor(zipcode)55402   1.519e+01  1.580e-01  96.132  < 2e-16 ***
## as.factor(zipcode)55403   1.662e+00  1.583e-01  10.498  < 2e-16 ***
## as.factor(zipcode)55404   3.973e+00  1.601e-01  24.816  < 2e-16 ***
## as.factor(zipcode)55405  -1.313e-01  1.580e-01  -0.831  0.40615
## as.factor(zipcode)55406  -7.705e-01  1.583e-01  -4.867 1.16e-06 ***
## as.factor(zipcode)55407  -2.324e-01  1.595e-01  -1.457  0.14521
## as.factor(zipcode)55408  -3.776e-01  1.653e-01  -2.284  0.02241 *
## as.factor(zipcode)55409  -7.397e-01  1.600e-01  -4.624 3.84e-06 ***
## as.factor(zipcode)55410  -1.374e+00  1.608e-01  -8.548  < 2e-16 ***
## as.factor(zipcode)55411   1.270e+00  1.815e-01   6.998 2.91e-12 ***
## as.factor(zipcode)55412   1.070e+00  1.592e-01   6.719 2.01e-11 ***
## as.factor(zipcode)55413  -5.059e-01  1.591e-01  -3.181  0.00148 **
## as.factor(zipcode)55414  -1.341e+00  1.582e-01  -8.475  < 2e-16 ***
## as.factor(zipcode)55415   8.254e+00  1.594e-01  51.785  < 2e-16 ***
## as.factor(zipcode)55416  -9.960e-01  1.612e-01  -6.177 7.00e-10 ***
## as.factor(zipcode)55417  -9.284e-01  1.601e-01  -5.801 6.97e-09 ***
## as.factor(zipcode)55418  -4.610e-01  1.605e-01  -2.873  0.00408 **
## as.factor(zipcode)55419  -1.188e+00  1.590e-01  -7.473 9.08e-14 ***
## as.factor(zipcode)55430  -2.292e-01  1.605e-01  -1.428  0.15331
## as.factor(zipcode)55454  -9.911e-01  1.598e-01  -6.201 6.02e-10 ***
## as.factor(zipcode)55455  -5.440e-01  1.839e-01  -2.958  0.00311 **
## as.factor(weekofyr)2     -1.268e-01  2.619e-01  -0.484  0.62840
## as.factor(weekofyr)3     -1.071e-01  2.601e-01  -0.412  0.68063
## as.factor(weekofyr)4      2.749e-01  2.641e-01   1.041  0.29793
## as.factor(weekofyr)5      1.474e-01  2.612e-01   0.564  0.57255
## as.factor(weekofyr)6     -1.040e-02  2.622e-01  -0.040  0.96836
## as.factor(weekofyr)7     -2.291e-03  2.623e-01  -0.009  0.99303
## as.factor(weekofyr)8     -3.079e-01  2.702e-01  -1.140  0.25439
## as.factor(weekofyr)9     -2.255e-01  2.629e-01  -0.858  0.39106
## as.factor(weekofyr)10     1.365e-01  2.679e-01   0.510  0.61036
## as.factor(weekofyr)11     1.482e-01  2.691e-01   0.551  0.58181
## as.factor(weekofyr)12     8.978e-02  2.767e-01   0.325  0.74557
## as.factor(weekofyr)13     6.396e-01  2.842e-01   2.250  0.02447 *
## as.factor(weekofyr)14     1.690e-01  2.805e-01   0.603  0.54685
## as.factor(weekofyr)15     3.719e-01  3.030e-01   1.227  0.21975
## as.factor(weekofyr)16     2.308e-01  2.921e-01   0.790  0.42948
## as.factor(weekofyr)17    -8.791e-02  2.953e-01  -0.298  0.76591
## as.factor(weekofyr)18     1.498e-01  3.124e-01   0.479  0.63166
## as.factor(weekofyr)19     3.427e-01  3.037e-01   1.128  0.25923
## as.factor(weekofyr)20    -1.696e-01  3.221e-01  -0.527  0.59845
## as.factor(weekofyr)21     3.306e-01  3.252e-01   1.016  0.30948
## as.factor(weekofyr)22    -7.139e-04  3.379e-01  -0.002  0.99831
## as.factor(weekofyr)23     3.656e-01  3.466e-01   1.055  0.29160
## as.factor(weekofyr)24     1.241e-01  3.402e-01   0.365  0.71528
## as.factor(weekofyr)25     6.152e-03  3.376e-01   0.018  0.98546
## as.factor(weekofyr)26     6.870e-02  3.430e-01   0.200  0.84124
## as.factor(weekofyr)27    -1.270e-01  3.565e-01  -0.356  0.72174
## as.factor(weekofyr)28     1.417e-01  3.518e-01   0.403  0.68719
## as.factor(weekofyr)29    -1.292e-01  3.563e-01  -0.363  0.71678
## as.factor(weekofyr)30    -2.488e-01  3.427e-01  -0.726  0.46786
## as.factor(weekofyr)31     3.668e-01  3.416e-01   1.074  0.28288
```

```
## as.factor(weekofyr)32     3.029e-01  3.441e-01   0.880  0.37878
## as.factor(weekofyr)33    -1.652e-01  3.484e-01  -0.474  0.63549
## as.factor(weekofyr)34    -9.757e-02  3.351e-01  -0.291  0.77093
## as.factor(weekofyr)35    -1.307e-01  3.337e-01  -0.392  0.69541
## as.factor(weekofyr)36     2.911e-01  3.248e-01   0.896  0.37021
## as.factor(weekofyr)37     2.883e-01  3.250e-01   0.887  0.37506
## as.factor(weekofyr)38     7.408e-02  3.326e-01   0.223  0.82375
## as.factor(weekofyr)39     9.404e-02  3.089e-01   0.304  0.76084
## as.factor(weekofyr)40     1.558e-01  3.018e-01   0.516  0.60573
## as.factor(weekofyr)41     1.774e-01  2.933e-01   0.605  0.54528
## as.factor(weekofyr)42    -2.031e-02  2.922e-01  -0.070  0.94459
## as.factor(weekofyr)43     7.776e-02  2.788e-01   0.279  0.78034
## as.factor(weekofyr)44    -6.990e-02  2.730e-01  -0.256  0.79795
## as.factor(weekofyr)45     1.736e-01  2.735e-01   0.635  0.52553
## as.factor(weekofyr)46     1.312e-01  2.681e-01   0.489  0.62471
## as.factor(weekofyr)47    -2.502e-02  2.692e-01  -0.093  0.92597
## as.factor(weekofyr)48     3.637e-02  2.711e-01   0.134  0.89328
## as.factor(weekofyr)49     2.494e-01  2.632e-01   0.948  0.34340
## as.factor(weekofyr)50     2.073e-01  2.623e-01   0.790  0.42930
## as.factor(weekofyr)51     2.177e-02  2.641e-01   0.082  0.93433
## as.factor(weekofyr)52    -1.745e-01  2.634e-01  -0.662  0.50783
## as.factor(weekofyr)53    -1.165e+00  4.745e-01  -2.455  0.01412 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.795 on 5535 degrees of freedom
##   (122 observations deleted due to missingness)
## Multiple R-squared:   0.82,  Adjusted R-squared:  0.8172
## F-statistic: 300.1 on 84 and 5535 DF,  p-value: < 2.2e-16

## Warning: package 'lme4' was built under R version 4.2.2

## Warning: package 'Matrix' was built under R version 4.2.2

## Warning: package 'lmerTest' was built under R version 4.2.2

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: mh_rate ~ 1 + (1 | zcta)
##    Data: panel
##
## REML criterion at convergence: 22964.8
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -8.4225 -0.1512 -0.0041  0.1433 11.9686
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  zcta     (Intercept) 14.770   3.843
##  Residual              3.341   1.828
## Number of obs: 5641, groups:  zcta, 22
##
## Fixed effects:
##             Estimate Std. Error       df t value Pr(>|t|)
## (Intercept)   3.0906     0.8197 21.0009    3.77  0.00112 **
```
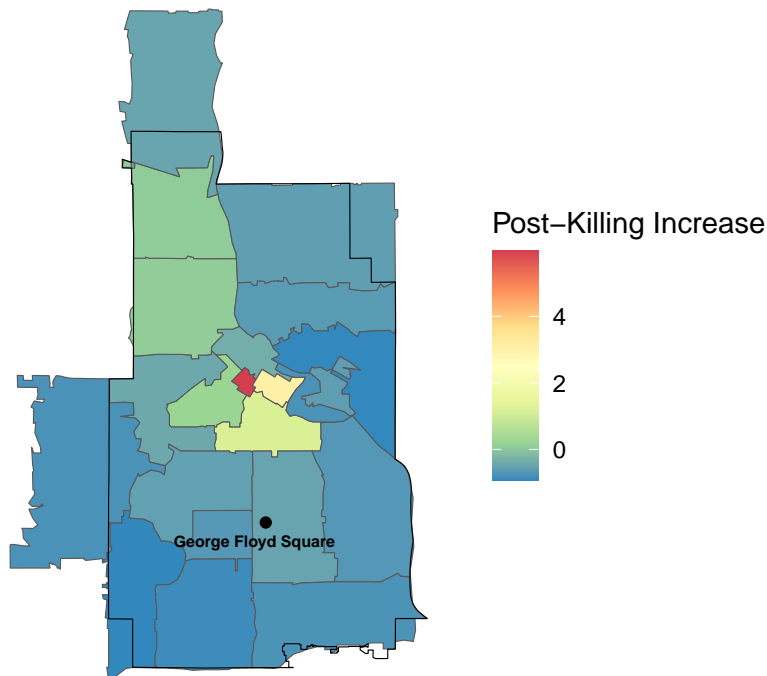
```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## mh_rate ~ t + state_of_emerg + stay_at_home + post_floyd + t_post_floyd +
##     uof_lag + stops_lag + shoot_lag + tmax_f + snow_in + precip_in +
##     (1 + post_floyd | zcta)
##    Data: panel
##
## REML criterion at convergence: 22259
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -9.4865 -0.1648 -0.0087  0.1512 12.1823
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  zcta     (Intercept) 16.339   4.042
##           post_floyd1  2.574   1.604    -1.00
##  Residual              2.959   1.720
## Number of obs: 5620, groups:  zcta, 22
##
## Fixed effects:
##                  Estimate Std. Error         df t value Pr(>|t|)
## (Intercept)     1.337e+01  1.967e+00  5.332e+02   6.796 2.89e-11 ***
## t              -4.438e-02  7.613e-03  5.578e+03  -5.829 5.88e-09 ***
## state_of_emerg -1.186e-01  2.266e-01  5.569e+03  -0.524   0.6006
## stay_at_home   -5.136e-01  2.339e-01  5.570e+03  -2.196   0.0281 *
## post_floyd1    -8.574e-02  4.174e-01  4.293e+01  -0.205   0.8382
## t_post_floyd   -4.498e-02  7.613e-03  5.578e+03  -5.908 3.67e-09 ***
## uof_lag        -6.617e-03  8.056e-03  5.335e+03  -0.821   0.4114
## stops_lag       7.686e-04  1.170e-03  5.586e+03   0.657   0.5112
## shoot_lag      -5.624e-02  1.521e-01  5.576e+03  -0.370   0.7116
## tmax_f          1.746e-03  1.341e-03  5.567e+03   1.302   0.1929
## snow_in         8.286e-02  6.620e-02  5.567e+03   1.252   0.2108
## precip_in       5.674e-02  2.233e-01  5.567e+03   0.254   0.7994
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) t      stt_f_ sty_t_ pst_f1 t_pst_ uof_lg stps_l sht_lg
## t           -0.897
## state_f_mrg  0.132 -0.158
## stay_at_hom -0.159  0.180 -0.822
## post_floyd1 -0.170 -0.209 -0.449  0.377
## t_post_flyd -0.898  0.998 -0.146  0.180 -0.208
## uof_lag      0.083 -0.098  0.010 -0.001  0.009 -0.099
## stops_lag   -0.025  0.001  0.077 -0.031  0.034  0.020 -0.003
## shoot_lag   -0.011  0.010  0.006  0.001 -0.004  0.011  0.027  0.020
## tmax_f      -0.218  0.209  0.006 -0.031 -0.104  0.204 -0.046 -0.050  0.020
## snow_in     -0.012 -0.013  0.051 -0.035 -0.028 -0.010 -0.011  0.019  0.017
## precip_in   -0.061  0.073 -0.038  0.041  0.018  0.074 -0.003  0.021 -0.011
```

```
##              tmax_f snow_n
## t
## state_f_mrg
## stay_at_hom
## post_floyd1
## t_post_flyd
## uof_lag
## stops_lag
## shoot_lag
## tmax_f
## snow_in       0.493
## precip_in   -0.408 -0.240
```

## Figure X: RE Coefficients of Post–Killing Effect
### *MHA Hospital Discharge Data*



```
## Warning: Some predictor variables are on very different scales: consider
## rescaling

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, :
## Model failed to converge with max|grad| = 0.00553088 (tol = 0.002, component 1)

## Warning: Some predictor variables are on very different scales: consider
## rescaling

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## mh_rate ~ t + state_of_emerg + stay_at_home + post_floyd + t_post_floyd +
##     uof_lag + stops_lag + shoot_lag + tmax_f + snow_in + precip_in +
##     black_pop + post_floyd:black_pop + (1 + post_floyd | zcta)
```

```
##      Data: panel
##
## REML criterion at convergence: 22291.7
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -9.5009  -0.1667  -0.0071   0.1509  12.1774
##
## Random effects:
##  Groups     Name        Variance Std.Dev. Corr
##  zcta       (Intercept) 16.391   4.049
##             post_floyd1  2.548   1.596    -1.00
##  Residual                2.959   1.720
## Number of obs: 5620, groups:  zcta, 22
##
## Fixed effects:
##                          Estimate Std. Error        df t value Pr(>|t|)
## (Intercept)             1.378e+01  1.994e+00 5.372e+02   6.908 1.40e-11 ***
## t                      -4.423e-02  7.613e-03 5.576e+03  -5.810 6.60e-09 ***
## state_of_emerg         -1.280e-01  2.266e-01 5.570e+03  -0.565   0.5723
## stay_at_home           -5.135e-01  2.338e-01 5.570e+03  -2.196   0.0281 *
## post_floyd1            -3.801e-01  4.434e-01 5.177e+01  -0.857   0.3953
## t_post_floyd           -4.497e-02  7.613e-03 5.577e+03  -5.907 3.69e-09 ***
## uof_lag                -7.730e-03  8.071e-03 5.429e+03  -0.958   0.3383
## stops_lag               9.058e-04  1.173e-03 5.565e+03   0.772   0.4402
## shoot_lag              -5.313e-02  1.521e-01 5.574e+03  -0.349   0.7269
## tmax_f                  1.766e-03  1.341e-03 5.566e+03   1.317   0.1878
## snow_in                 8.518e-02  6.622e-02 5.567e+03   1.286   0.1984
## precip_in               5.491e-02  2.232e-01 5.566e+03   0.246   0.8057
## black_pop              -1.120e-04  8.397e-05 7.929e+02  -1.334   0.1826
## post_floyd1:black_pop   7.417e-05  3.885e-05 1.704e+02   1.909   0.0579 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## fit warnings:
## Some predictor variables are on very different scales: consider rescaling
## optimizer (nloptwrap) convergence code: 0 (OK)
## Model failed to converge with max|grad| = 0.00553088 (tol = 0.002, component 1)

## Warning: package 'sjPlot' was built under R version 4.2.2

## Warning in checkMatrixPackageVersion(): Package version inconsistency detected.
## TMB was built with Matrix version 1.5.1
## Current Matrix version is 1.5.3
## Please re-install 'TMB' from source using install.packages('TMB', type = 'source') or ask CRAN for a
```
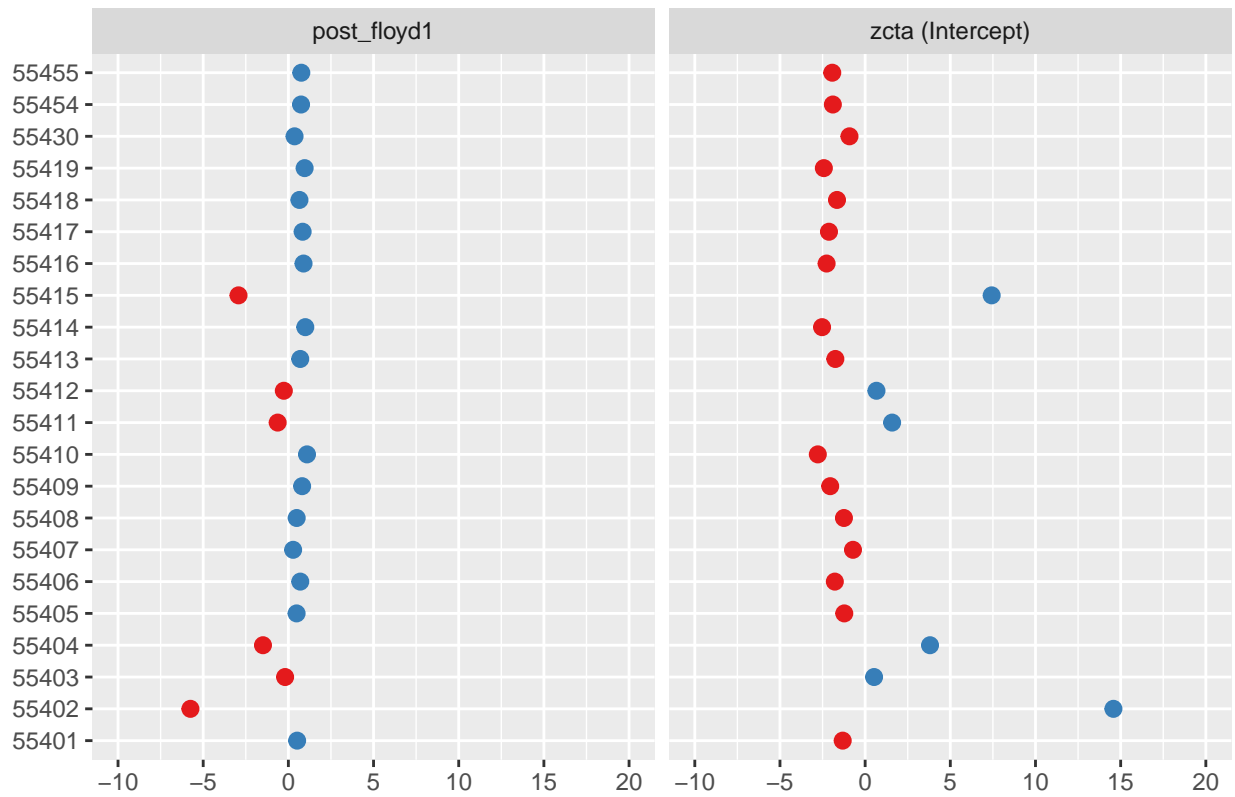
# Random effects

Figure X: Post−Killing X Black Pop Interaction Plot