MPD Crime Proximal to UMN

Ryan Larson

10/12/2021

Data Setup

```
#Minneapolis Data
#5-year ACS data
census_api_key("ecda17575f4d914b502c70f2bae7a5f3d253792d")

year <- lst(2013, 2014, 2015, 2016, 2017, 2018, 2019)

acs <- map(
  year,
  ~ get_acs(geography = "block group",
              state = "MN",
              variables = c("B01001_001E"),
              output = "wide",
              survey = "acs5",
              year = .x,
            geometry = T),
  .id = "year") %>%
  map2(year, ~mutate(.x, year=.y)) # add year id to each element of list
```

```
##   |                                                                      |
```

```
mn <- reduce(acs, rbind) %>%
  dplyr::select(GEOID, year, block_group=NAME, pop=B01001_001E) %>%
  arrange(block_group, year)

#creating block_group=years for LOCF
  #just change year to carry last observation forward, then append
mn_2020 <- mn %>%
  filter(year==2019) %>%
  dplyr::select(-year) %>%
  mutate(year=2020)
```

```r
mn_2021 <- mn %>%
  filter(year==2019) %>%
  dplyr::select(-year) %>%
  mutate(year=2021)

mn_locf <- mn %>%
  rbind(mn_2020) %>%
  rbind(mn_2021) %>%
  arrange(block_group, year) %>%
  st_transform("WGS84")


#block_group data for filtering
mn_bg <- get_acs(geography = "block group",
                 state = "MN",
                 variables = c("B01001_001E"),
                 output = "wide",
                 survey = "acs5",
                 year = 2019,
               geometry = T) %>%
  st_transform("WGS84")

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

```
## 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
#MPD Crime Data

#pre-pims
mpd_2013 <- read_csv("Police_Incidents_2013.csv")
mpd_2014 <- read_csv("Police_Incidents_2014.csv")
mpd_2015 <- read_csv("Police_Incidents_2015.csv")
mpd_2016 <- read_csv("Police_Incidents_2016.csv")
mpd_2017 <- read_csv("Police_Incidents_2017.csv")
mpd_2018a <- read_csv("Police_Incidents_2018.csv")

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

pre_pims_base <- mpd_2013 %>%
  rbind(mpd_2014) %>%
  rbind(mpd_2015) %>%
```

```
  rbind(mpd_2016) %>%
  rbind(mpd_2017) %>%
  rbind(mpd_2018a) %>%
  rename(reportedDate = ReportedDate,
         centerLong = Long,
         centerLat = Lat) %>%
  dplyr::select(reportedDate, centerLong, centerLat, UCRCode)

post_pims_base <- mpd_2018b %>%
  rbind(mpd_2019) %>%
  rbind(mpd_2020) %>%
  rbind(mpd_2021) %>%
  dplyr::select(reportedDate, centerLong, centerLat, UCRCode)

mpd_base <- pre_pims_base %>%
  rbind(post_pims_base) %>%
  mutate(date=ymd_hms(reportedDate),
         year=isoyear(date),
         week=isoweek(date)) %>%
  dplyr::select(year, week, centerLat, centerLong) %>%
   st_as_sf(coords = c("centerLong", "centerLat"), crs = "WGS84", remove=F) %>%
  mutate(intersection = as.integer(as.character(st_intersects(geometry, mn_bg))),
         block_group = ifelse(is.na(intersection), NA, mn_bg$GEOID[intersection])) %>%
  st_drop_geometry() %>%
  count(year, week, block_group, name = "crime")

mpd_serious_base <- pre_pims_base %>%
  rbind(post_pims_base) %>%
  mutate(date=ymd_hms(reportedDate),
         year=isoyear(date),
         week=isoweek(date)) %>%
  dplyr::select(year, week, centerLat, centerLong, UCRCode) %>%
   st_as_sf(coords = c("centerLong", "centerLat"), crs = "WGS84", remove=F) %>%
  mutate(intersection = as.integer(as.character(st_intersects(geometry, mn_bg))),
         block_group = ifelse(is.na(intersection), NA, mn_bg$GEOID[intersection])) %>%
  st_drop_geometry() %>%
  count(year, week, block_group, UCRCode, name = "crime") %>%
  mutate(UCRCode = as.numeric(UCRCode)) %>%
  filter(UCRCode <= 5) %>%
  group_by(year, week, block_group) %>%
  summarize(crime = sum(crime, na.rm = T))

mpd_bg_20_21 <- mpd_base %>%
  filter(year >= 2020) %>%
  group_by(block_group) %>%
  summarize(crime = sum(crime, na.rm = T))

mpd_bg_20_21_serious <- mpd_serious_base %>%
  filter(year >= 2020) %>%
  group_by(block_group) %>%
  summarize(crime = sum(crime, na.rm = T))
```

```r
#find UMN minneapolis campus
umn_latlon <- geocode("University of Minnesota, Minneapolis", output = "latlon") %>%
  st_as_sf(coords = c("lon", "lat"), crs="WGS84", remove=F) %>%
  mutate(name = "UMN")
```

```
## Source : https://maps.googleapis.com/maps/api/geocode/json?address=University+of+Minnesota,+Minneapol
```

```r
umn_east_bank <- geocode("University of Minnesota East Bank, Minneapolis", output = "latlon") %>%
  st_as_sf(coords = c("lon", "lat"), crs="WGS84", remove=F) %>%
  mutate(name = "UMN East Bank")
```

```
## Source : https://maps.googleapis.com/maps/api/geocode/json?address=University+of+Minnesota+East+Bank

## "University of Min..." not uniquely geocoded, using "east bank, minneapolis, mn 55455, usa"
```

```r
umn_west_bank <- geocode("University of Minnesota Social Science Building, Minneapolis", output = "latl
  st_as_sf(coords = c("lon", "lat"), crs="WGS84",remove=F) %>%
  mutate(name = "UMN West Bank")
```

```
## Source : https://maps.googleapis.com/maps/api/geocode/json?address=University+of+Minnesota+Social+Sc
```

```r
#filter those block_groups within a .5 mile of UMN & inside MPLS
mn_bg_umn <- mn_bg %>%
  filter(st_is_within_distance(geometry, umn_latlon, dist = 5280/2, sparse = FALSE) &
         st_intersects(geometry, mpls, sparse = FALSE))


#merge on mpd data at block group level
mn_bg_umn_crime <- mn_bg_umn %>%
  left_join(mpd_bg_20_21, by = c("GEOID"="block_group")) %>%
  mutate(crime_rate = (crime/B01001_001E)*100000) %>% #FYI this is 2020 and 2021 crime using 2019 pop d
  filter(!is.na(crime)) #effectively filters out St. Paul intersecting block_groups

mn_bg_umn_crime_serious <- mn_bg_umn %>%
  left_join(mpd_bg_20_21_serious, by = c("GEOID"="block_group")) %>%
  mutate(crime_rate = (crime/B01001_001E)*100000) %>% #FYI this is 2020 and 2021 crime using 2019 pop d
  filter(!is.na(crime)) #effectively filters out St. Paul intersecting block_groups

bg_intersect <- unique(mn_bg_umn_crime$GEOID)

#UMN shapefile
st_layers(dsn = "UMN_BaseMapData.gdb")
```

```
## Driver: OpenFileGDB
## Available layers:
##                       layer_name     geometry_type features fields
## 1           TwinCities_Bus_Route Multi Line String       15      6
## 2  TwinCities_Disability_Parking             Point       67      8
## 3           TwinCities_Bike_Lane Multi Line String       98      6
## 4            TwinCities_Bus_Stop             Point       40     21
## 5    TwinCities_Parking_Facility             Point      182     43
```

```
## 6        TwinCities_Bike_Amenity             Point       61      6
## 7           UMN_Building_Polygon     Multi Polygon      914     48
## 8     TwinCities_Parking_Polygon     Multi Polygon      279      9
## 9      TwinCities_Street_Polygon     Multi Polygon      186      3
## 10           TwinCities_Sidewalk     Multi Polygon      490      2
## 11        TwinCities_Sportsfield     Multi Polygon       25      7
## 12        Morris_Parking_Polygon     Multi Polygon       10      8
## 13           Morris_Road_Polygon     Multi Polygon        6      8
## 14            Morris_Sportsfield     Multi Polygon       13      8
## 15               Morris_Sidewalk     Multi Polygon       35      7
## 16               TwinCities_Tree             Point    18758     40
```

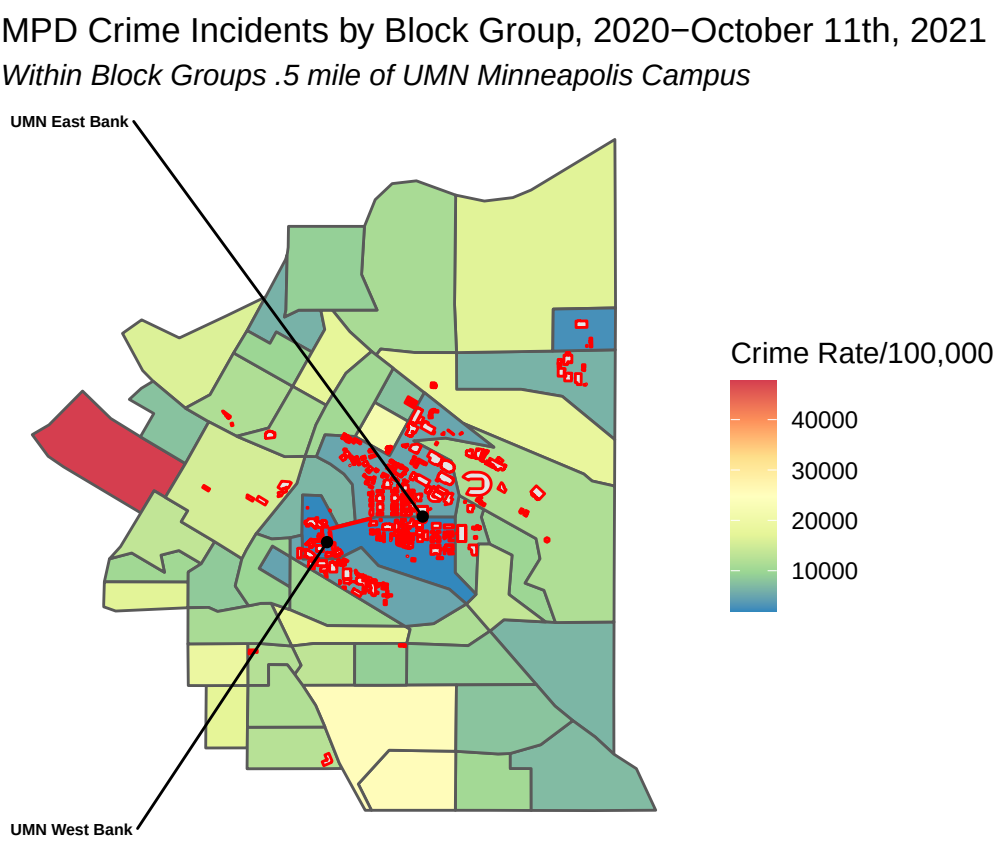
```
ensure_multipolygons <- function(X) {
    tmp1 <- tempfile(fileext = ".gpkg")
    tmp2 <- tempfile(fileext = ".gpkg")
    st_write(X, tmp1)
    ogr2ogr(tmp1, tmp2, f = "GPKG", nlt = "MULTIPOLYGON")
    Y <- st_read(tmp2)
    st_sf(st_drop_geometry(X), geom = st_geometry(Y))
}

umn_shape <- st_read(dsn = "UMN_BaseMapData.gdb", layer = "UMN_Building_Polygon") %>%
  ensure_multipolygons() %>%
  filter(TRI_CAMPUS_NAME=="Minneapolis Campus (01)" & SITE_BUILDING!="01-156") %>% #civil engineering b
  filter(st_is_within_distance(geom, umn_latlon, dist = 5280/2, sparse=FALSE)) %>%
  filter(st_intersects(geom, mpls, sparse = F))
```

```
## Reading layer 'UMN_Building_Polygon' from data source
##   'C:\Users\DELL\Documents\UMN\UMN Projects\Chris RA 18_19\Gun Violence MN\UMN_BaseMapData.gdb'
##   using driver 'OpenFileGDB'
## Simple feature collection with 914 features and 48 fields
## Geometry type: GEOMETRY
## Dimension:     XY
## Bounding box:  xmin: -96.76416 ymin: 35.07781 xmax: -77.00928 ymax: 48.84879
## Geodetic CRS:  WGS 84
## Writing layer 'file5f803de1ca5' to data source
##   'C:\Users\DELL\AppData\Local\Temp\Rtmp8QUOQm\file5f803de1ca5.gpkg' using driver 'GPKG'
## Writing 914 features with 48 fields and geometry type Unknown (any).
## Reading layer 'file5f803de1ca5' from data source
##   'C:\Users\DELL\AppData\Local\Temp\Rtmp8QUOQm\file5f80156d6771.gpkg'
##   using driver 'GPKG'
## Simple feature collection with 914 features and 48 fields
## Geometry type: MULTIPOLYGON
## Dimension:     XY
## Bounding box:  xmin: -96.76416 ymin: 35.07781 xmax: -77.00928 ymax: 48.84879
## Geodetic CRS:  WGS 84
```

```
ggplot()+
  geom_sf(data = mn_bg_umn_crime, aes(geometry = geometry, fill = crime_rate))+
  geom_sf(data = umn_shape, aes(geometry = geom), color = "red")+
  geom_sf(data = umn_east_bank, aes(geometry = geometry), color = "black")+
  geom_sf(data = umn_west_bank, aes(geometry = geometry), color = "black")+
  geom_text_repel(data = umn_east_bank, aes(x=lon, y=lat, label = name),
```

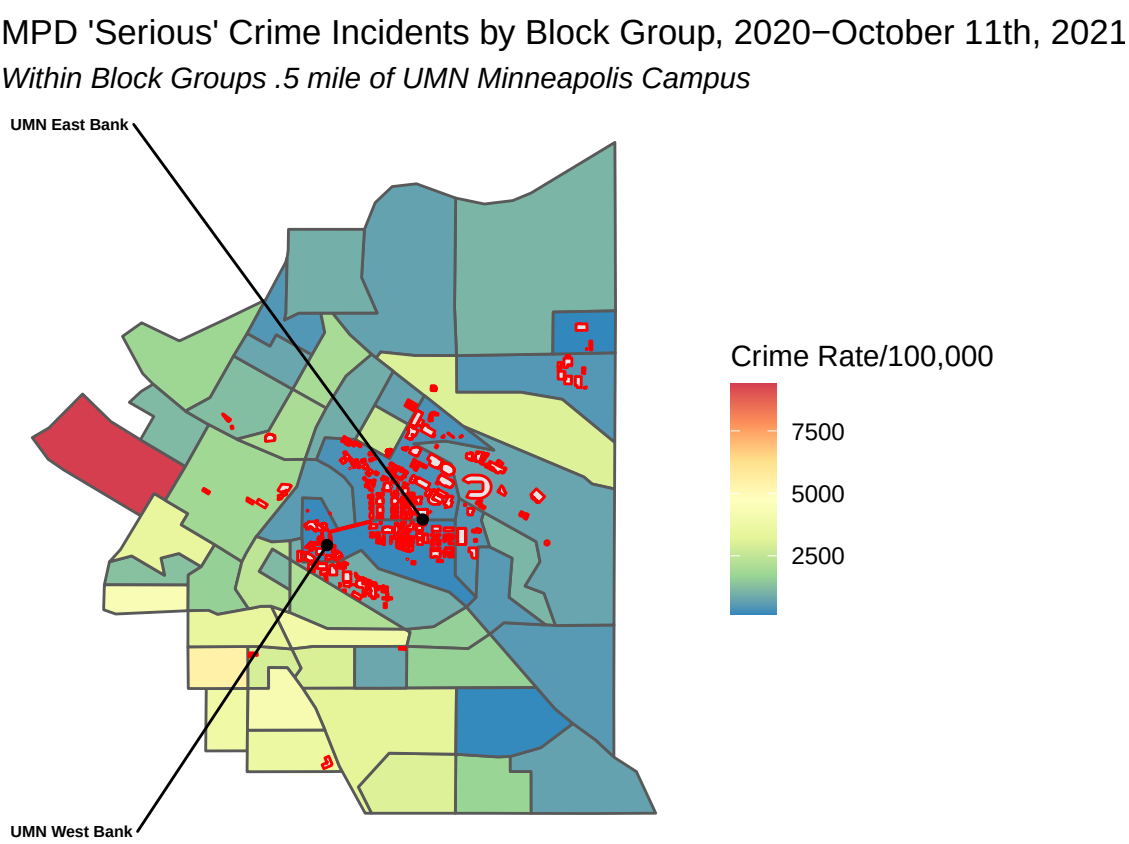
```
                 size = 2,
                fontface = "bold",
                nudge_x = -1, nudge_y = 1)+
geom_text_repel(data = umn_west_bank, aes(x=lon, y=lat, label = name),
                 size = 2,
                fontface = "bold",
                nudge_x = -1, nudge_y = -1)+
scale_fill_distiller(palette = "Spectral")+
labs(title = "MPD Crime Incidents by Block Group, 2020-October 11th, 2021",
     subtitle = "Within Block Groups .5 mile of UMN Minneapolis Campus",
     fill = "Crime Rate/100,000")+
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"))
```




```
ggsave("umn_crime_map.png")
```

```
## Saving 6.5 x 4.5 in image
```

```
ggplot()+
  geom_sf(data = mn_bg_umn_crime_serious, aes(geometry = geometry, fill = crime_rate))+
  geom_sf(data = umn_shape, aes(geometry = geom), color = "red")+
  geom_sf(data = umn_east_bank, aes(geometry = geometry), color = "black")+
  geom_sf(data = umn_west_bank, aes(geometry = geometry), color = "black")+
  geom_text_repel(data = umn_east_bank, aes(x=lon, y=lat, label = name),
                  size = 2,
                 fontface = "bold",
                 nudge_x = -1, nudge_y = 1)+
  geom_text_repel(data = umn_west_bank, aes(x=lon, y=lat, label = name),
                  size = 2,
                 fontface = "bold",
                 nudge_x = -1, nudge_y = -1)+
  scale_fill_distiller(palette = "Spectral")+
  labs(title = "MPD 'Serious' Crime Incidents by Block Group, 2020-October 11th, 2021",
       subtitle = "Within Block Groups .5 mile of UMN Minneapolis Campus",
       fill = "Crime Rate/100,000")+
  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"))
```




```
ggsave("umn_serious_crime_map.png")
```

```
## Saving 6.5 x 4.5 in image
```

```
#pops
mn_locf_year <- mn_locf %>%
  st_drop_geometry() %>%
  dplyr::select(GEOID, year, pop) %>%
  filter(GEOID %in% bg_intersect) %>%
  group_by(year) %>%
  summarize(pop = sum(pop, na.rm = T))

mpd_base_umn <- mpd_base %>%
   filter(block_group %in% bg_intersect) %>%
  dplyr::select(year, week, block_group, crime) %>%
  group_by(year, week) %>%
  summarize(crime = sum(crime, na.rm  = T)) %>%
    left_join(mn_locf_year, by = "year") %>%
  mutate(crime_rate = (crime/pop)*100000) %>%
   mutate(begin_date = ISOweek2date(paste(year, paste0("W", sprintf("%02d", week)), 1,sep = "-")),
          end_date = begin_date+weeks(1)-days(1))
```

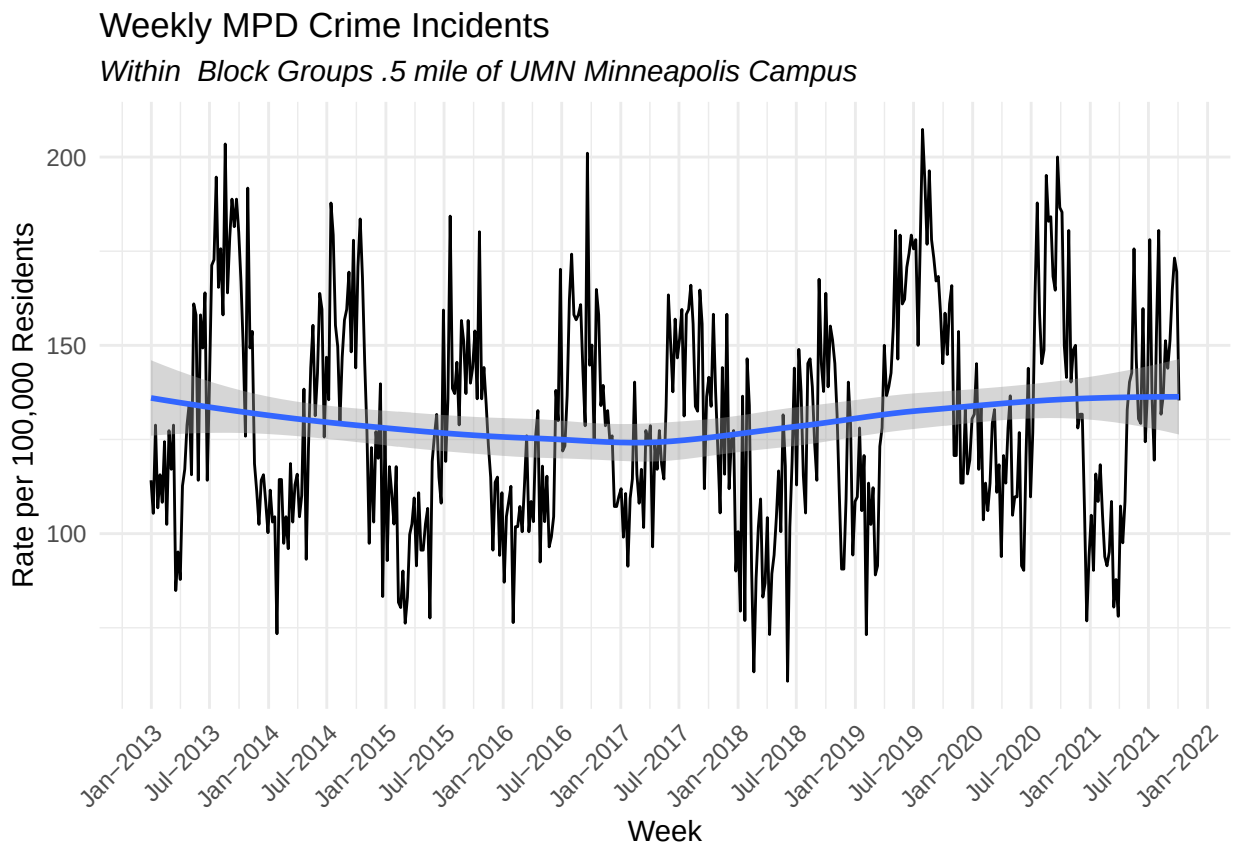
```
## `summarise()` has grouped output by 'year'. You can override using the `.groups` argument.
```

```
mpd_base_umn_serious <- mpd_serious_base %>%
   filter(block_group %in% bg_intersect) %>%
  dplyr::select(year, week, block_group, crime) %>%
  group_by(year, week) %>%
  summarize(crime = sum(crime, na.rm  = T)) %>%
    left_join(mn_locf_year, by = "year") %>%
  mutate(crime_rate = (crime/pop)*100000) %>%
   mutate(begin_date = ISOweek2date(paste(year, paste0("W", sprintf("%02d", week)), 1,sep = "-")),
          end_date = begin_date+weeks(1)-days(1))
```

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

```
ggplot(mpd_base_umn)+
  geom_line(aes(x=begin_date, y=crime_rate))+
  scale_x_date(date_labels = "%b-%Y", date_breaks = "6 months")+
  labs(title = "Weekly MPD Crime Incidents",
       subtitle = "Within  Block Groups .5 mile of UMN Minneapolis Campus ",
       x = "Week",
       y = "Rate per 100,000 Residents")+
  theme_minimal()+
    theme(axis.text.x=element_text(angle=45, hjust=1)) +
  geom_smooth(aes(x=begin_date, y=crime_rate))+
  theme(plot.subtitle = element_text(face="italic"))
```

```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```

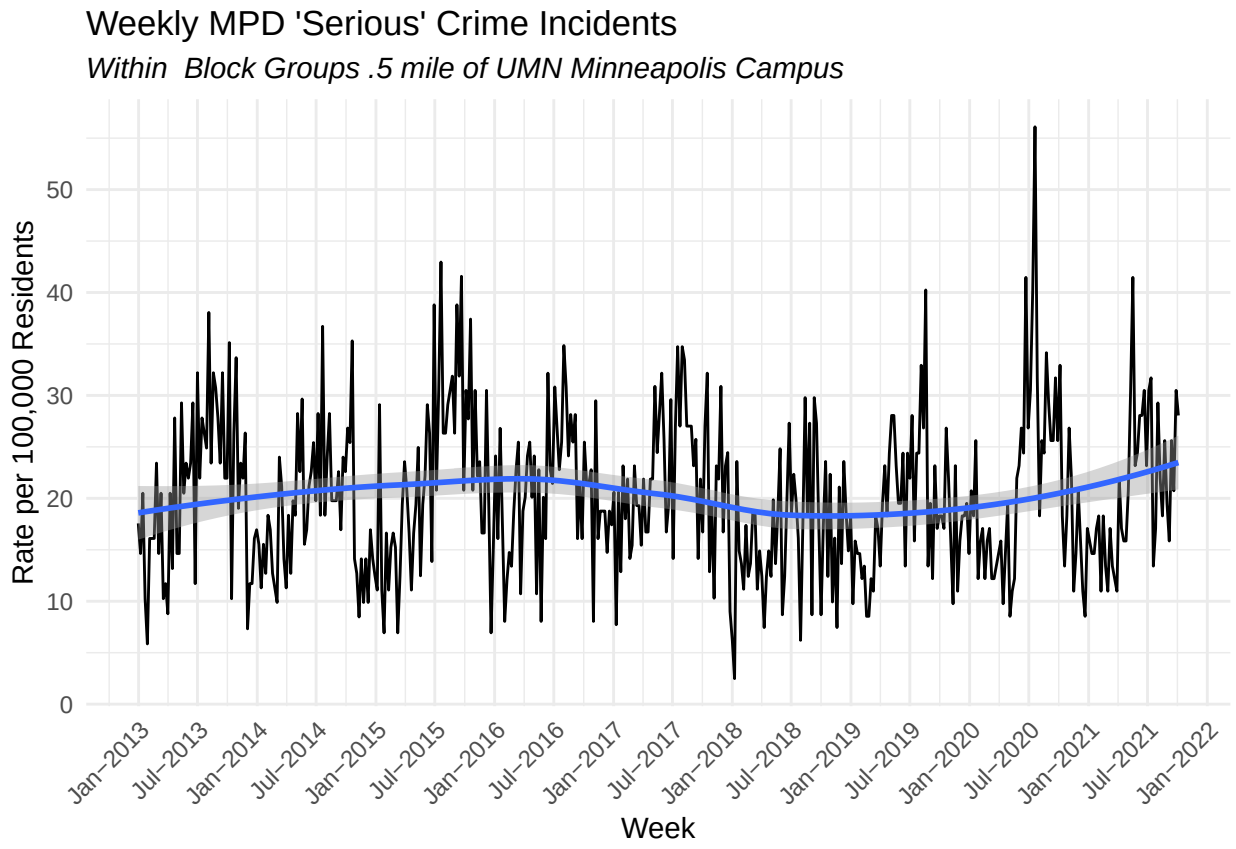


```
ggsave("umn_crime_time.png", width = 6, height = 4)
```

```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```

```
ggplot(mpd_base_umn_serious)+
  geom_line(aes(x=begin_date, y=crime_rate))+
  scale_x_date(date_labels = "%b-%Y", date_breaks = "6 months")+
  labs(title = "Weekly MPD 'Serious' Crime Incidents",
       subtitle = "Within  Block Groups .5 mile of UMN Minneapolis Campus ",
       x = "Week",
       y = "Rate per 100,000 Residents")+
  theme_minimal()+
    theme(axis.text.x=element_text(angle=45, hjust=1)) +
  geom_smooth(aes(x=begin_date, y=crime_rate))+
  theme(plot.subtitle = element_text(face="italic"))
```

```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```




```
ggsave("umn_crime_time_serious.png", width = 6, height = 4)
```

```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```