Food Accessibility Score

The relative food access variable is created by examining the distance between the major population and their distance to food retailers.

To find the center for each county population, the geometric center weighted by population density was used to determine geographic centers. This data is available through the Census Bureau at various geographic levels.

Relative Food Access $= \frac{\sum \frac{1}{distance}}{population}$

Per county in the project scope, food retailers only within a specified radius would contribute to the overall county score. Additionally, the inverse distance of each food retailer to the center of each county weights the closer food retailers higher than those further away.

Lastly, the food access variable is weighted by county population.

```
# Helper function: calculates distance in meters given 2 sets of coordinates (long, lat)
# longitude first, then latitude
calculate_distance <- function(long1, lat1, long2, lat2) {
  ans <- distm(c(long1, lat1), c(long2, lat2), fun = distHaversine)
  return(ans)
}


# Pass in location points dataset
# radius defaults are 5, 10, 20 miles (in meters)
# uses Tract Population center
loc_within_radius <-
  function(loc_data,
           radius_1 = 8046.72,
           radius_2 = 16093.4,
           radius_3 = 32186.9) {
    centerData_copy <- CenterPopTR_mapNOVA

    centerData_copy$COUNT_5mile <- NA
    centerData_copy$INVERSE_DIST_5mile <- NA
    centerData_copy$COUNT_10mile <- NA
    centerData_copy$INVERSE_DIST_10mile <- NA
    centerData_copy$COUNT_20mile <- NA
    centerData_copy$INVERSE_DIST_20mile <- NA

    for (i in 1:nrow(centerData_copy)) {
      count_1 <- 0
      inverse_dist_1 <- 0
      count_2 <- 0
      inverse_dist_2 <- 0
      count_3 <- 0
      inverse_dist_3 <- 0
      centerData_copy$COUNT_5mile[i] <- 0
      centerData_copy$INVERSE_DIST_5mile[i] <- 0
```

```
      centerData_copy$COUNT_10mile[i] <- 0
      centerData_copy$INVERSE_DIST_10mile[i] <- 0
      centerData_copy$COUNT_20mile[i] <- 0
      centerData_copy$INVERSE_DIST_20mile[i] <- 0

      for (j in 1:nrow(loc_data)) {
        distance <-
          calculate_distance(
            centerData_copy$CENTER.LONGITUDE[i],
            centerData_copy$CENTER.LATITUDE[i],
            loc_data$lon[j],
            loc_data$lat[j]
          )

        if (distance <= radius_1) {
          count_1 <- count_1 + 1
          inverse_dist_1 <- (1 / distance) + inverse_dist_1
        }
        if (distance <= radius_2) {
          count_2 <- count_2 + 1
          inverse_dist_2 <- (1 / distance) + inverse_dist_2
        }
        if (distance <= radius_3) {
          count_3 <- count_3 + 1
          inverse_dist_3 <- (1 / distance) + inverse_dist_3
        }

      }
      if (centerData_copy$POPULATION[i] == 0) {
        centerData_copy$COUNT_5mile[i] <- count_1
        centerData_copy$INVERSE_DIST_5mile[i] <- NA
        centerData_copy$COUNT_10mile[i] <- count_2
        centerData_copy$INVERSE_DIST_10mile[i] <- NA
        centerData_copy$COUNT_20mile[i] <- count_3
        centerData_copy$INVERSE_DIST_20mile[i] <- NA
      }
      else{
        centerData_copy$COUNT_5mile[i] <- count_1
        centerData_copy$INVERSE_DIST_5mile[i] <-
          inverse_dist_1 / centerData_copy$POPULATION[i]
        centerData_copy$COUNT_10mile[i] <- count_2
        centerData_copy$INVERSE_DIST_10mile[i] <-
          inverse_dist_2 / centerData_copy$POPULATION[i]
        centerData_copy$COUNT_20mile[i] <- count_3
        centerData_copy$INVERSE_DIST_20mile[i] <-
          inverse_dist_3 / centerData_copy$POPULATION[i]
      }
    }
    return(centerData_copy)
  }

# Runtime varies by data size ~ 10 minutes
# Output columns are COUNT_5mile... COUNT_20mile, INVERSE_DIST_5mile...INVERSE_DIST_20mile
```

```r
foodRetailer_invDist <- loc_within_radius(foodRetailer_data)
foodPantry_invDist <- loc_within_radius(foodPantry_data)
farmersMarkets_invDist <- loc_within_radius(farmersMarkets_data)

va_basemap <- get_map(location=c(lon = -77.5, lat = 38.8), zoom=9, scale = "auto", source = 'stamen')
```

```
## Source : https://maps.googleapis.com/maps/api/staticmap?center=38.8,-77.5&zoom=9&size=640x640&scale=
## Source : http://tile.stamen.com/terrain/9/144/194.png
## Source : http://tile.stamen.com/terrain/9/145/194.png
## Source : http://tile.stamen.com/terrain/9/146/194.png
## Source : http://tile.stamen.com/terrain/9/147/194.png
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## Source : http://tile.stamen.com/terrain/9/146/197.png
## Source : http://tile.stamen.com/terrain/9/147/197.png
## Coordinate system already present. Adding new coordinate system, which will replace the existing one
```
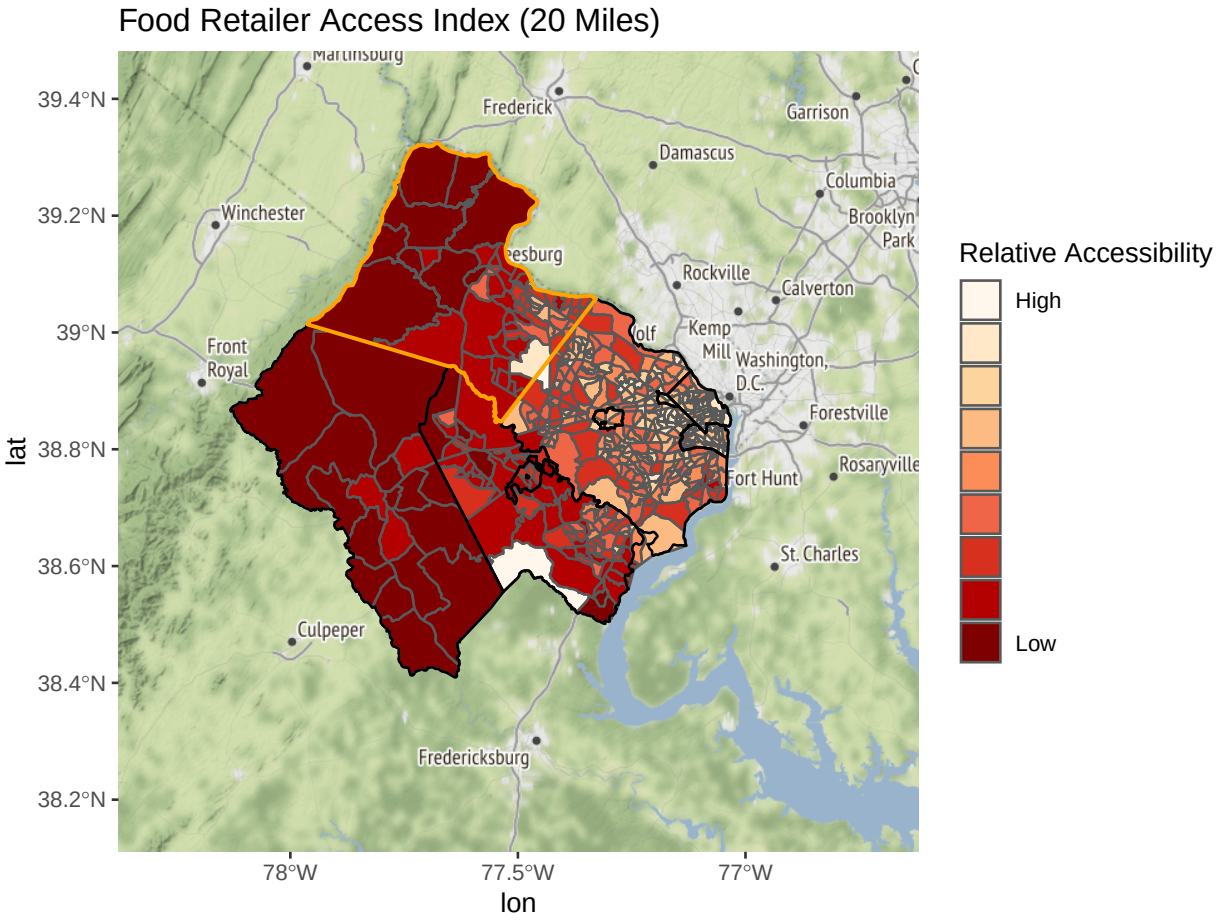
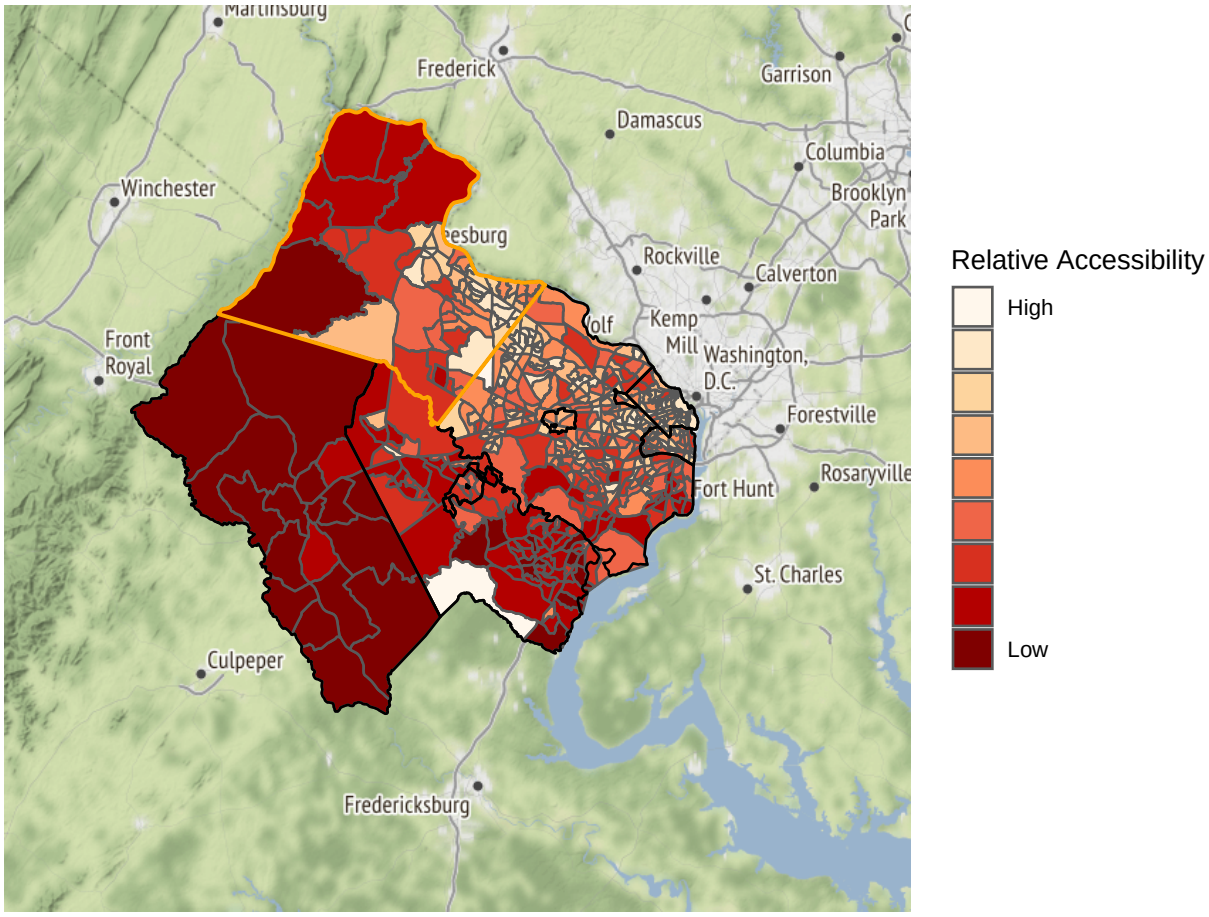



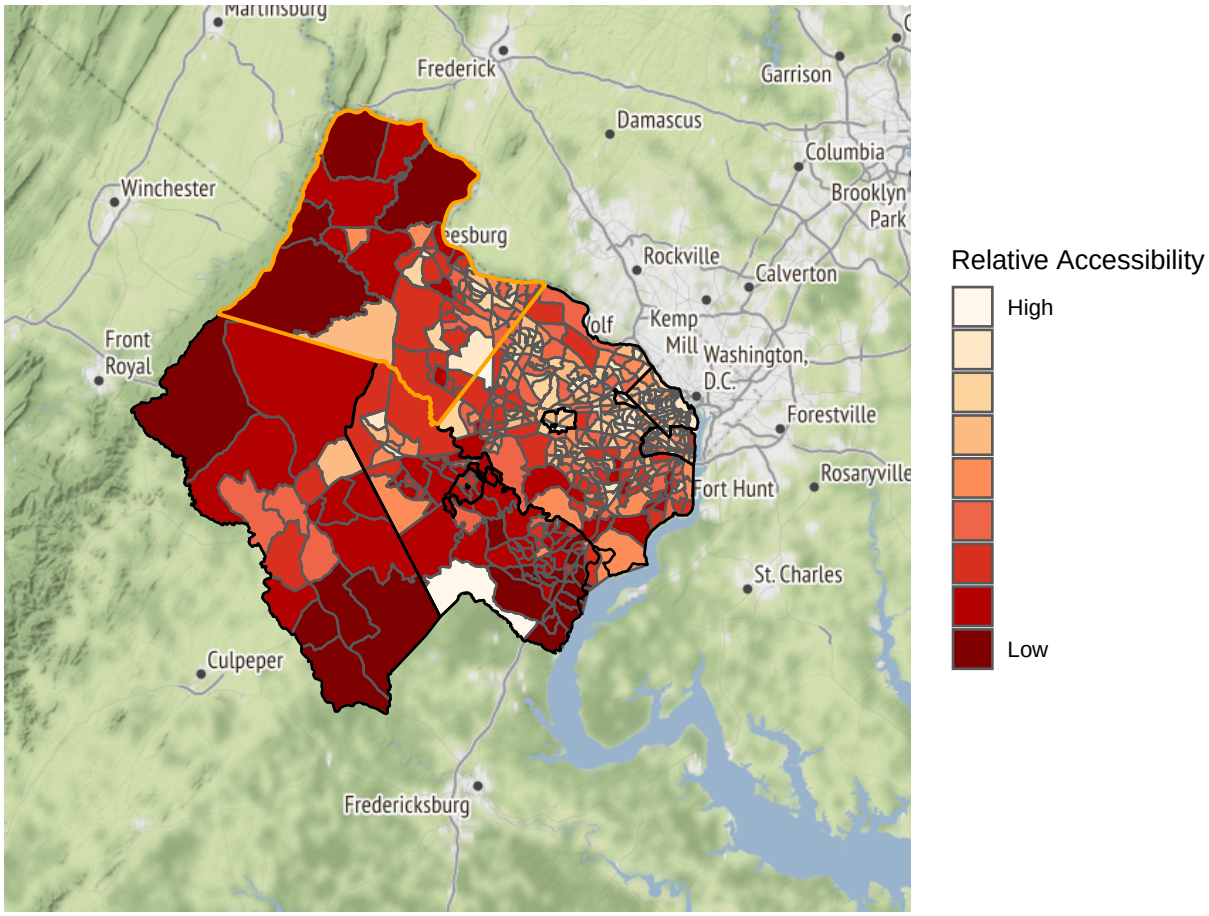

```
## Coordinate system already present. Adding new coordinate system, which will replace the existing one
```

Food Pantry Access Index (20 Miles)




```
## Coordinate system already present. Adding new coordinate system, which will replace the existing one
```

Farmers Market Access Index (20 Miles)



These maps show the relative food access on a county level.
The blue color represents higher food access whereas red represents lower food access.

This food access indicator can be helpful in determining areas that are in need of support to services such as food pantries and food banks.

Centers of Population for the 2010 Census. Retrieved from https://www.census.gov/geographies/reference-files/2010/geo/2010-centers-population.html