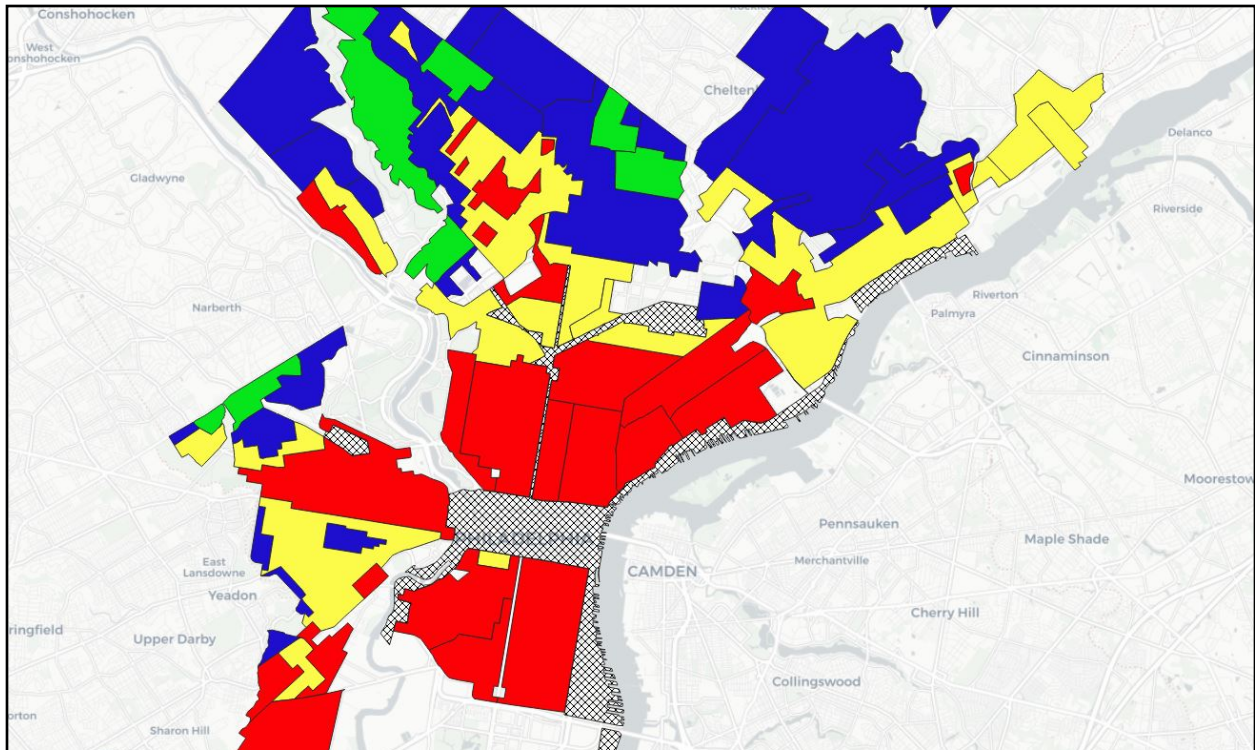# Redlining & Interpolation

Intro: Redlining refers to geographically-based discrimination in lending and insurance practices. During the Great Depression, the federal government created programs to subsidize home ownership. They also supported policies that mapped and rated neighborhoods based on racial and ethnic composition and age of housing, which they connected to risk. Maps produced by the Home Owners Loan Corporation (HOLC), a New Deal program to support home owners at risk of default, visually represented the most "at risk" regions in bold red color, which often corresponded to minority (especially African American) neighborhoods. The historical consensus is that redlined communities had less access to home loans and received them at higher interest rates. We will test these assumptions using data from Philadelphia.

Materials*

1950_tracts - *census data tracts from 1950*

HOLC_1937 - Redlning boundaries from 1937

Mortgages -*point data with information about mortgage lending, interest rates, year, and lender*
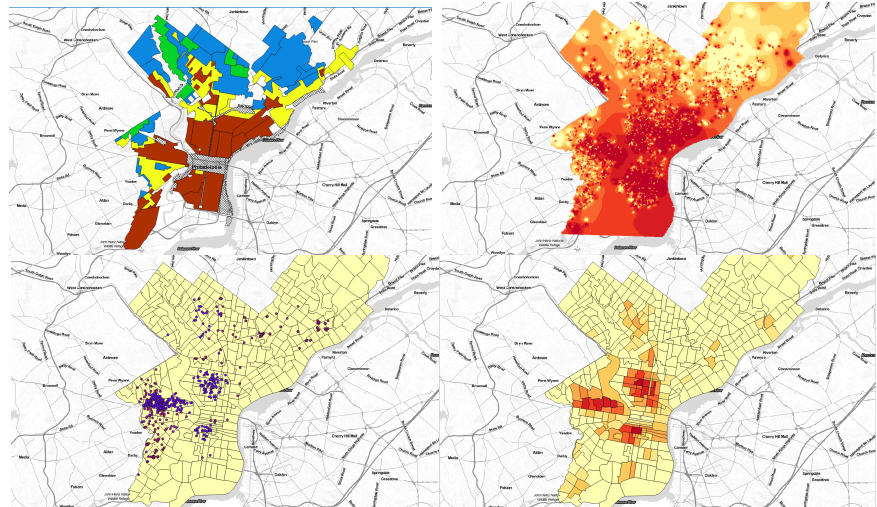
Berean - *African American-owned mortgage lender*

MetLife- *Mortgage lender*

NE_Omaha_rectified

*data from Amy Hillier - Placing History

"Mapping Inequality" website

Instructions:

1. Go to the Google Drive. https://drive.google.com/drive/folders/1zF8CED5pEGhwePCTrnFQydRLu2gUTtaX?usp=sharing Find "Week 7 - Segregation", "Hillier Map Layers" and download the folder to your hard drive. **DO NOT** click and drag the shared folder or cut and paste it. This is a shared drive and changes you make to the original will affect everyone else. Download the folder "Philadelphia Historical Redlining Map" and copy it to your Week 7 folder.

2. Open QGIS.
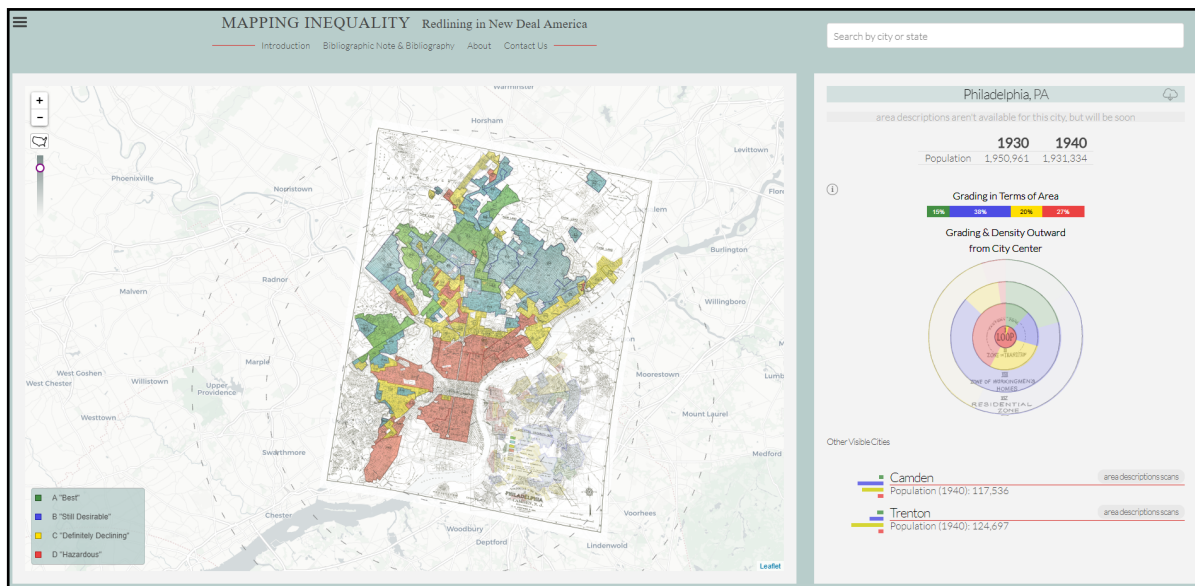
3. Select a basemap of your choice and overlay the georeferenced redlining map (PA_Philadelphia_193711). This is an image file, so you will need to import it as a "raster" layer. You've already georeferenced an historical map like this and created a vector layer based on some of its data, right? You COULD do this yourself, but the University of Richmond has already georeferenced these maps for us. You can view a digitized copy overlaid upon a georeferenced image here:
    https://dsl.richmond.edu/panorama/redlining/
    #loc=11/40.0053/-75.2186&opacity=0.8&sort=138,191&city=philadelphia-pa
    You can also download these maps from the site (which is what I did)

4. The image should now lined up over Philadelphia on your basemap.

5. Let's add the vector shapefile of the redlined districts in Philadelphia. You can find it in the Hillier folder you downloaded. Add the "HOLC_1936" shapefile to your map, by clicking "HOLC_1936.shp," "open." This is the digitized boundary layer for the 1937 Philadelphia HOLC redlining map (traced polygons from the original redlining map). You **may** need to change the projection for this layer as well if it doesn't appear over Philadelphia. Right click "HOLC 1937" in the layers panel, "properties", and "source."
    Under the coordinate reference system dropdown menu, select "NAD 83 / Pennsylvania South." Click ok.
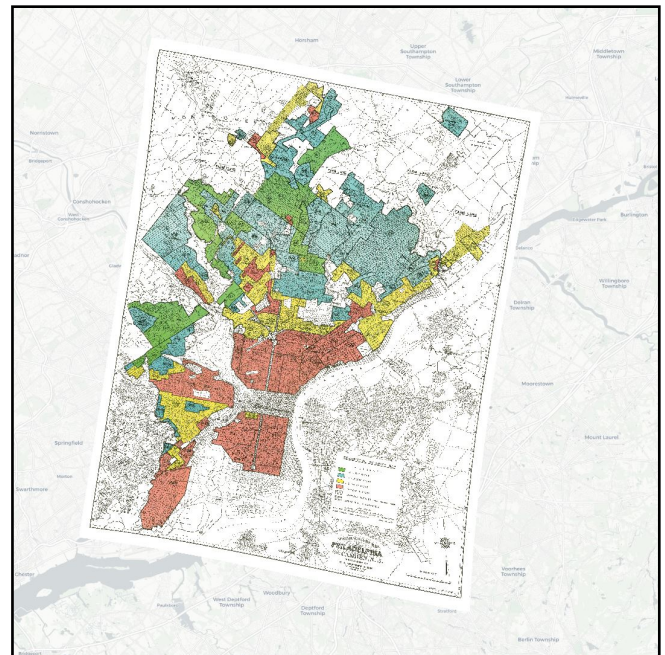
6. When it is loaded, open the attribute table, by right clicking "HOLC_1937" in the layers panel and selecting "open attribute table." The numbers, grades, and HOLC Letters correspond to the grading system you can observe on the original map. This is an example of how you would convert historical mapping data into a GIS format. Close the attribute table.

7. Let's change the styling of the shapefile to more accurately reflect the historical map. Double click the shapefile from the layers panel. This opens the "layer properties" dialogue. We want to change the "symbology" of the shapefile. Click "symbology" on the left panel. Default style is "single symbol", but we want to select a "categorized" style from the dropdown menu. We want to organize the colors according to HOLC grades, so select the HOLCLETTER category from the "values" pull down tab. Click "classify." This assigns random colors to our categories. Look at the styling of the original map. The "best" regions are "green", "still desirable" are blue, "definitely declining" are yellow, "hazardous" are red, and "industrial" are hatched.
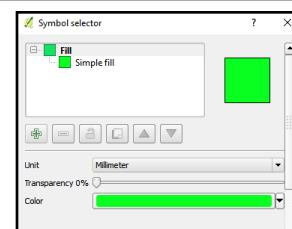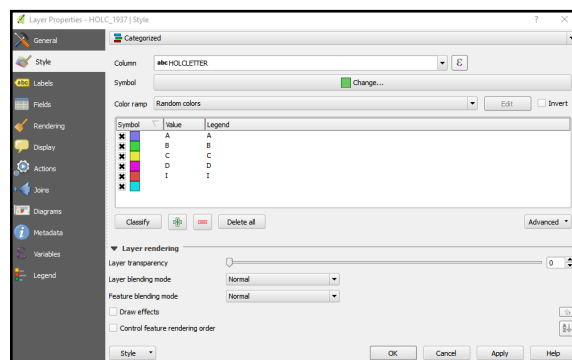
8. To change the styling, double click on the colored square you want to change. Select "simple fill" from the style hierarchy, then click the "fill" color bar and change to the appropriate color. Click Ok and change the other colors as well.
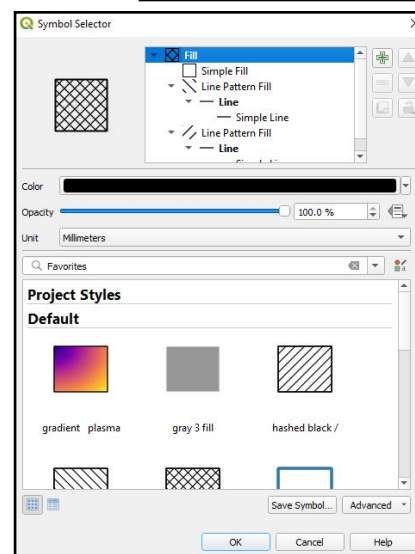
9. Once you're done changing the colors of the 4 categories, let's change "I," which stand for industrial. This one doesn't have a color, it uses hatching. To select this style, double click the colored box and "simple fill again." You should see a hatching option at the bottom of the window. Select a hatched pattern or choice. Click ok. We now have a digitized rendering of the original map that adheres to its styling.

10. One of the criticisms of these HOLC maps (and the state and local policies they represent) is that they disproportionately singled out minority communities, especially African American communities as the most at risk areas. We can observe this using census data.

11. Add the 1950tracts.shp file to your project. These are
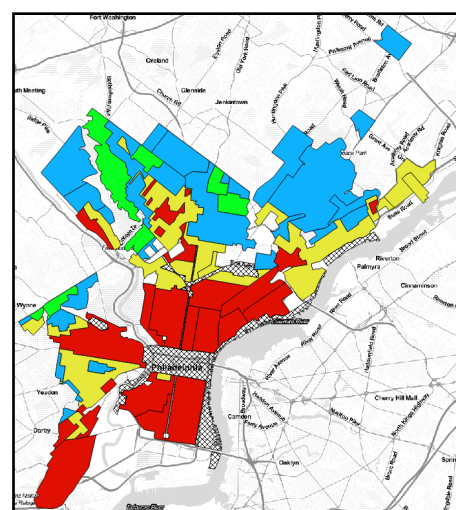
census tracts from the 1950s. You can download these from the National Historical GIS database (https://www.nhgis.org/) (for future reference). Make sure you've saved your project at this point. Once again, you need to style your map. To do so, let's look through the attribute table. The titles of the columns should be intuitive for the most part. With choropleth mapping, you never want to style your map using raw data (like population/renter occupied, built between 1930-39, etc) They all need to be rates or proportions (remember from last week?). Let's map the percentage of white residency by census block. Looking through the attribute table, no columns appear to do that already... we DO have a column for total population (TOTALPOP) and white population (WHITES) We just need to add create a new column that shows the proportion of whites to total population. In the top left of the window, select the pencil icon "edit". Now select "open field calculator" icon.

12. In the field calculator, make sure the "create new field" box is checked, call your "output field name" PctWhite (this will be the name of your new column). The "output field type" should be "Decimal number (real)". Field length and precision should be 10 and 2 respectively (this ensures your cell size is large enough to preserve very large or small values down to a one hundredth of a percent. Your expression should read ("WHITES" / "TOTALPOP") * 100 in the dialogue. Click "ok" and a new column should appear. Click the pencil again and save your changes. Close the attribute table window.
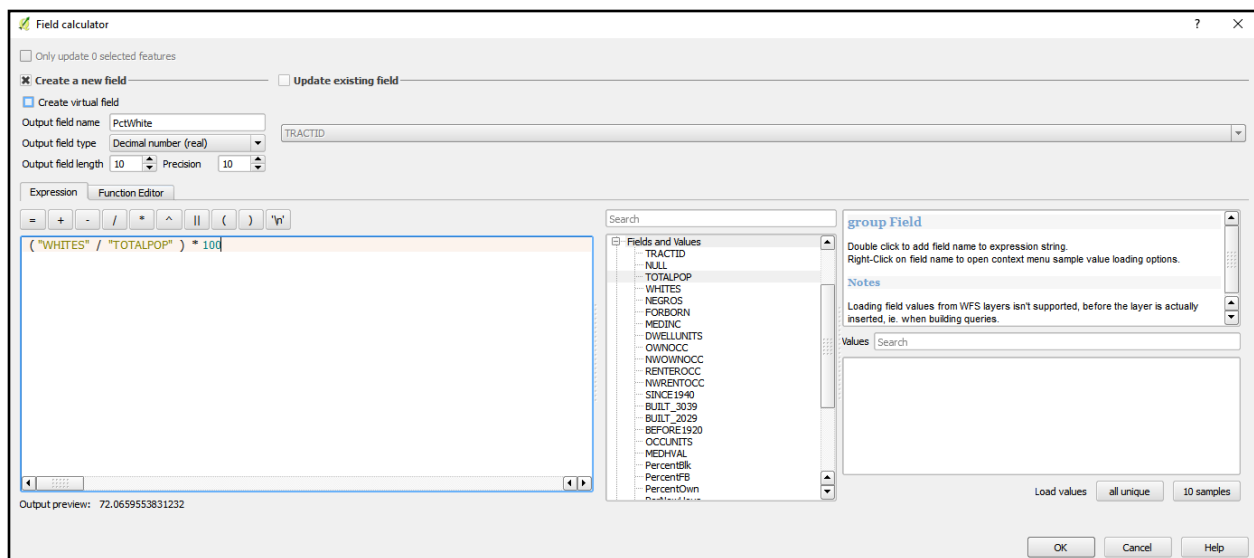
13. Now let's style this layer to see the geography of segregation in Philadelphia. To style it, double click the 1950_tracts layer in the side panel. Instead of "single symbol," select "Graduated." Let's style our newly created PctWhite column. Click "classify." Choose an appropriate "color ramp", Mode = "pretty breaks" with 9 classes. Click ok.

14. Now do the same with PercentBlk and PercentFB (foreign born). Each time you select a new column, make sure to click "classify" again. Notice any trends? Not all "hazardous" area are predominantly African American, but areas with large African American populations are all labelled hazardous.
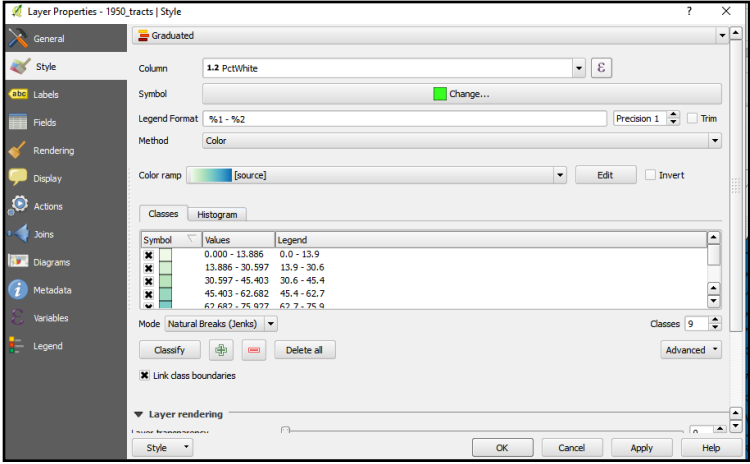

15. This type of mapping is a powerful spatial/visual argument that redlining is related to segregation, but it doesn't prove that HOLC maps actually *caused* redlining (as opposed to mapping preexisting dynamics). One way to test this relationship is by mapping a random sample of mortgages from this era. We would assume that mortgage lenders would avoid redlined areas if they had access to these maps. (drawn from the *Philadelphia Realty Directory between 1940-60*).

16. Add the "mortgages" shapefile to your map. It's a bit visually overwhelming as is, so let's style our point layer as well. Go to layer properties again, click "simple marker," "fill color" to black, and reduce the size to 0.5. It's really hard to tell what, if any, relationships there are here. What are our options?
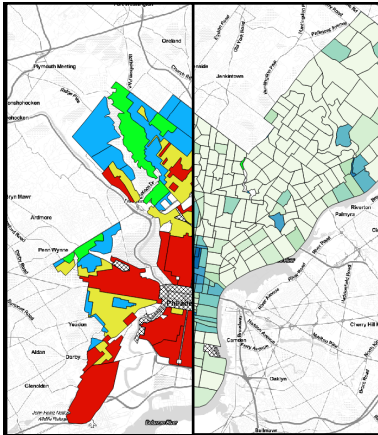

17. Let's create a heatmap to see where the densest clusters of mortgages were located. You can do this by changing your map from "single symbol" to "heatmap" from the drop down menu. Choose a color ramp you like (I like

"Oranges"). Click "apply." Well that's no good! We can't see anything. We need to change the transparency. Click your color ramp color bar. Next click the "color 1" color bar. Change opacity to 0%. This means that if there is a region with no mortgages, it will be transparent, and the greater the clustering of mortgages the deeper the orange.
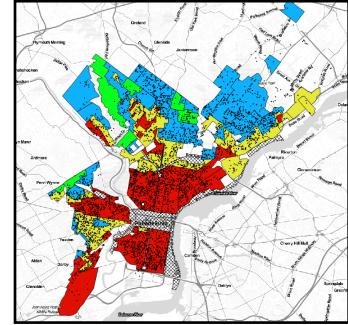

18. That's interesting. The redlined areas continued to receive a large number, even the majority, of mortgages during the era. Did it matter which lenders supplied the loans? The Berean Savings and Loan Association was a black-owned mortgage company. Metropolitan Life (MetLife), by contrast, was not.
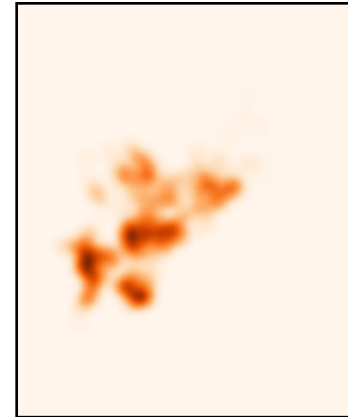

19. Add the shapefiles "Berean" and "Metlife." Style them do maximize visual distinctiveness and overlay them over the census layer and the HOLC map layer. Do you notice any patterns?

20. Let's explore this question from another perspective. Perhaps, it was not just the total *number* of mortgages that might indicate some sort of discrimination. Perhaps more importantly, it was the interest rates of those loans. Luckily, we have that data because its embedded in the mortgages information. Open up the attribute table of the mortgages file. Here you'll see the "Irate" or interest rate for each loan. Our heatmap visualization won't allow us to parse this information, but QGIS includes an "interpolation" tool its its "processing toolbox". Interpolation creates a raster (or image) layer that shows a statistical estimate of the values between points. This is called "interpolation." Let's create an interpolated map of the high/low interest rates in Philadelphia.
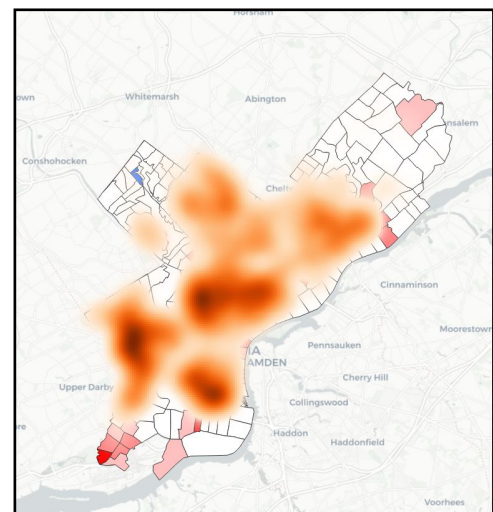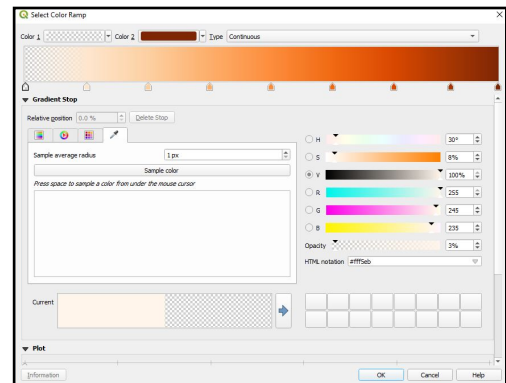
21. Before we can open the interpolation tool, we need to enable the "processing" plugin. Click on the "Plugins" from the toolbar, then "processing." The Processing option should now be available on the main toolbar.

22. To open the interpolation tool, click "processing" from the top menu, then "toolbox." You should see "interpolation" as an option in the toolbox. Click on it and you see four options (including another tool that creates a heatmap raster layer) We want click "IDW interpolation." IDW refers to the algorithm this tool uses. Double click IDW interpolation. Make sure "vector layer" = "Mortgages" and "interpolation attribute" = "Irate." Click the green plus symbol to "add" this to these selections. Click the carrot beside the arrow symbol to the left of "extent". Select "calculate from layer" and "1950_tracts". This means the interpolation will occur across the 1950 census tracts layer, not the whole world! Change rows to 300. Click run.
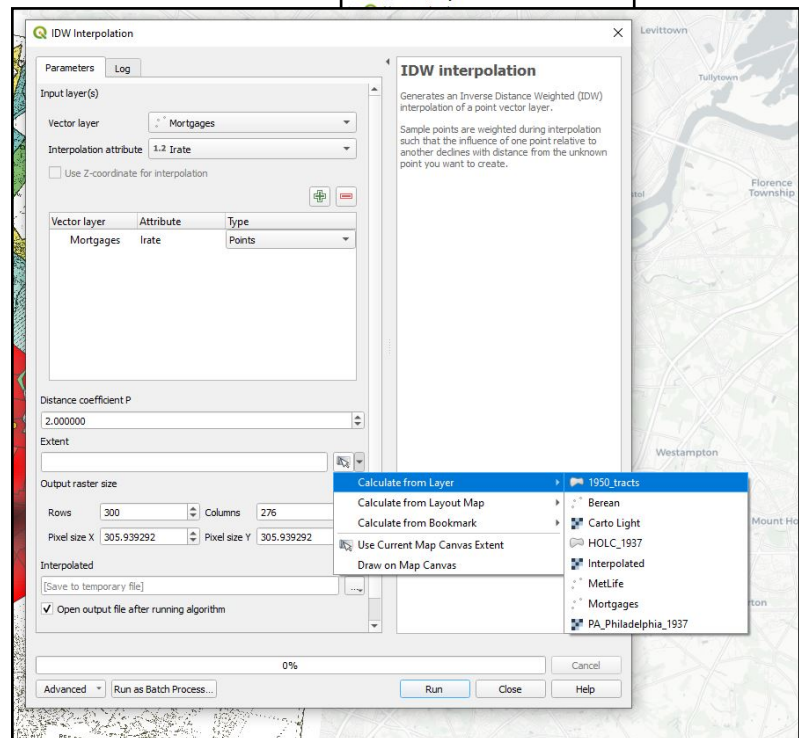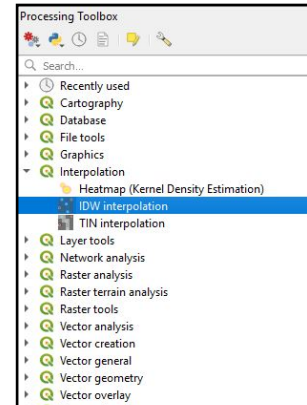

22. Like the heatmap layer, let's restyle this new interpolated raster layer. Double click your new raster. Under "symbology" change render type to "singleband pseudocolor." Choose a color ramp. Interpolation should be "linear," "mode" should be "quantile." Click "ok."

23. We're not interested in an areas outside our census area shapefile, so let's "clip" the interpolated raster to that area.
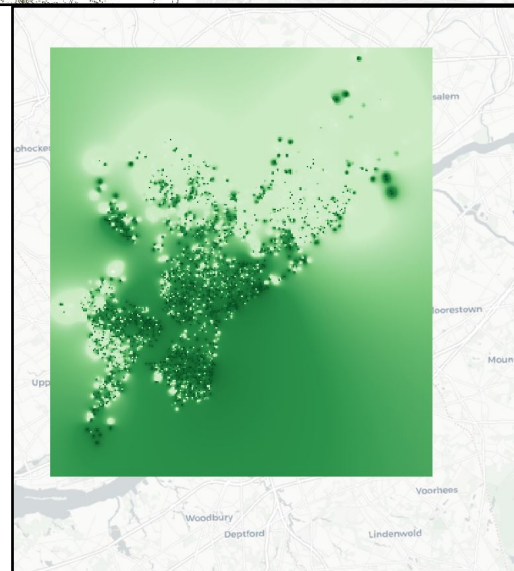
24. Under raster, select "extraction," then "clip raster by mask layer." We only need an interpolation for the census tracts, so let's use the census layer as a "mask" to cut out only those areas from the square interpolation. Input file should be "interpolated," mask layer should be "1950_tracts". "Clipped mask" should be named "interpolation_clip" and saved to your weekly project folder. Click Run.
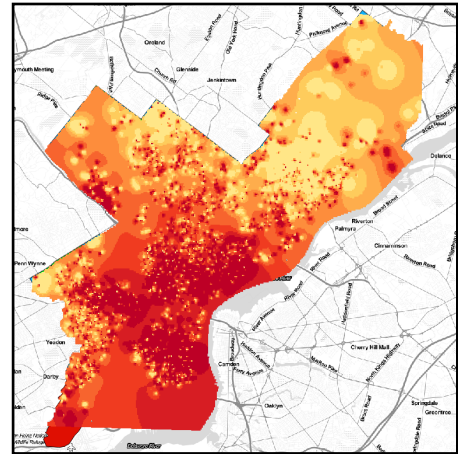
25. Using the same steps outlined above, restyle your layer in singleband pseudocolor, except this time increase your classes to 9 and select a "discrete" interpolation under load min/max values. Your new raster layer gives you a visual indication of areas that received substantially higher interest rates.

26. Compare this layer with all other layers and answer the following questions (using maps) on the blog.

1. What patterns do you see between mortgage companies and locations that supplied lendees in Philadelphia?

2. Which regions had the highest interest rates?

3. What indication do you see (if any) that HOLC maps caused redlining (as opposed to mapping preexisting discrimination). If none, what additional historical evidence do you think you might need to establish this relationship?

4. What additional data layers do you think might supply evidence of discriminatory housing policy/segregated urban development that you don't have access to in this exercise?

5. Create one clear, legible map that you think best demonstrates the most compelling visualization of redlining in Philadelphia.

Post your answers and maps to the blog.