

Many researchers have found that both minorities and the poor in American cities bear a disproportionate burden of risk to toxic exposure. The Environmental Protection Agency (EPA) website (www.epa.gov/swerosps/ej/index) defines Environmental Justice (EJ) as the “Fair treatment for people of all races, cultures, and incomes, regarding the development of environmental laws, regulations, and policies.” EJ policies seek to create environmental equity, the concept that all people should bear a proportionate share of environmental pollution and health risk, and enjoy equal access to environmental amenities. EJ policies are intended to overcome environmental racism caused by racial and economic advantages built into policy-making, enforcement, and locating of waste disposal and polluting industries. Executive Order 12898 (1994) requires each federal agency to adopt the principle of environmental justice in policy development.

In this exercise, you will determine whether there is any environmental injustice in Colorado Springs. You will see if minority and low-income people live in greater proportions than the rest of the population near toxic sites. You have a GIS layer showing all toxic sites in the city (which comes from a compilation of several different federal and state databases that keeps track of different types of toxic sites), and you have Census data for racial and ethnic minorities and low-income areas. You are perfectly situated, therefore, to think like a geographer and do some good-old spatial analysis.

First, though, to whom are we referring when we say “minorities?” The Census records 6 racial categories: Black or African American, Asian, American Indian or Alaskan Native, Native Hawaiian or Other Pacific Islander, White, or “Some Other Race” (They also, for the first time in the 2000 census, allowed people to choose multiple categories). The Census also records information on “Hispanic or Latino,” which the census considers an ethnic group, not a racial group (there is much to discuss about what constitutes “race,” and whether it even exists, but we will not go into that now). Therefore, Hispanics can be of any racial category, so the 2 variables are not mutually exclusive. For the purpose of this exercise, you will generate 4 measures of EJ, one for *all* non-whites, one for Blacks, on for Hispanics, and one for low income.

I. Preparing to Process

1. Using ArcCatalog, copy the following folder to your NT account: `g:\ges405\ej2000`
2. Connect to this folder in your NT account. Inside you will find three shapefiles: `ep2000bg` (El Paso County Block Groups, 2000 Census), `toxicpoly` (toxic sites that are polygons), and `toxicpts` (Toxic sites that are points). You also have one Dbase file called `ep2000bgdata.dbf`, which contains the census information you will need for the block groups.
3. Start ArcMap, then drag all files from ArcCatalog into ArcMap. This might be a good time to *Save* before you do much more. Save often as you work through the project.
4. Join the attribute table `ep2000bgdata.dbf` to the table *Attribute of ep2000bg* using the common items `C02000BG_` or `CO2000BG_1`. Either one works, but *select the same attribute for both tables!* Be consistent..
5. Make a choropleth map of any of the 3 variables: *black*, *hisp*, or *pov* (number below poverty level). Be sure to *normalize* by *tot* (total population) in your symbology tab window so that you map the *percent* of these variables, not total number (normalization divides you variable by the normalization variable, which in this case calculates a percent of total population. Remember, choropleth maps are not good to map total numbers). Look at your toxic points and toxic polygons (change symbology to your liking) on top of this map to look for visual correlation between the themes. Since these maps are in the Colorado Central Stateplane projection, the coordinates are feet.

There are many ways to measure EJ. You will be using a measure that asks the question, “Are racial minorities and low-income people more likely to be exposed to environmental hazards than the rest of the population?” To do this, you will compare the demographics for at-risk block groups to those not-at-risk. Specifically, you will sum the non-Whites in at-risk block groups and divide by the total MSA (El Paso County) non-Whites, then do the same for the Whites. The index you will generate is a quotient (a ratio of ratios) of the two, or percent of non-Whites at risk divided by the percent of Whites at risk. You will repeat this measure for Blacks, Hispanics, and then for persons below poverty level. The equations for your four indices are:

Index 1:
$$\frac{(\text{at-risk non-whites}/\text{total MSA non-whites})}{(\text{at-risk whites}/\text{total MSA whites})}$$

Index 2:
$$\frac{(\text{at-risk hispanic}/\text{total MSA hispanic})}{(\text{at-risk non-hispanic}/\text{total MSA non-hispanic})}$$

Index 3:
$$\frac{(\text{at-risk poor}/\text{total MSA poor})}{(\text{at-risk non-poor}/\text{total MSA non-poor})}$$

Index 4:
$$\frac{(\text{at-risk blacks}/\text{total MSA black})}{(\text{at-risk non-blacks}/\text{total MSA non-blacks})}$$

To determine the block groups that are at-risk, you will generate buffers around the toxic sites and select only those block groups that *have their center in* the buffers (recognize that there are many other ways to select those “at-risk”). Note, however, that all of these toxic sites are not the same. Some are “worse” than others. We have accounted for this with a code in the `toxicpts` and `toxicpoly` attribute tables called *NPL* (for “National Priority List,” otherwise known as “superfund” sites). NPL code 2 are “worse” sites than NPL code 1. Corresponding to the NPL codes is another field called *Buffdist* that has a

value of 2640 (where NPL = 1) and 5280 (where NPL = 2). We will use *Buffdist* to generate different buffer sizes, in this case, ½ mile (2640 feet) around NPL code 1 and 1 mile (5280 feet) around NPL code 2.

6. In ArcMap, select *Tools, Buffer Wizard*. The Buffer Wizard starts.
7. State that you wish to buffer *the features of a layer* called *toxicpts* and click *Next*.
8. You want to make buffers *Based on a distance from an attribute field* called *buffdis*. At the bottom, change *buffer distance units* to *feet*. Click *Next*.
9. *Yes*, you want to *Dissolve barriers between buffers*, and you want your buffer output to be saved *in a new layer*. Make sure you browse to your NT account and call your new buffer output theme something appropriate (do *NOT* save your output on the C: drive). Save it as a shapefile, and click *Finish*.
10. Change the symbology so that your buffers are no fill but with a prominent outline so that you can see how the buffers have been generated around your toxic points.
11. Repeat the previous steps to generate buffers around *toxicpoly*, the toxic polygons. On the last wizard screen there is a new option for polygon themes that you didn't see for the point theme. Be sure to select that your buffers be made *outside the polygons and include inside*.
12. Now you have your buffers, but how can you do your analysis with 2 sets of buffers? You can, but its not easy. Therefore, we will first combine the polygon and point buffers into one buffer theme. Select *Tools, Geoprocessing Wizard*.
13. You need to *union* your two buffer themes together. Be sure to specify a good output name and click *Finish*.
14. Look at the resultant union theme. It has both buffer areas combined into one. We could use it as is, but it still has internal lines showing the overlap of the original point and polygon buffers. They are messy, and since we are thorough and dedicated GIS people, we will clean those up. To do so, we must *dissolve* the internal lines. To do that, you need an attribute item that has the same value on both sides of the lines so ArcGIS knows which lines to dissolve. We are in luck—when your original buffers were made, ArcGIS assigns an attribute to the buffer polygons called *ID* and assigns all areas inside the buffer a value of zero. When you unioned the two buffers together, ArcGIS kept one *ID* field and renamed the other of those fields to *ID_1* (because you can never have two attribute items with a common name). We can therefore use either of these attribute items to dissolve our internal boundaries, because all buffers have a zero value for both of these items.
15. Select *Tools, Geoprocessing Wizard* and *Dissolve features based on an attribute*. Click *Next*.
16. Select your union buffer theme, keep *ID* as the field on which to dissolve, browse to your NT account and select a good output name. In the last box about additional fields to include, leave as is and click *Finish*.
17. Turn off all unnecessary intermediate files and look at the theme you just made. Understand what you just did. Look good? Yes, you are clever.

II. Gathering Statistics

18. We are ready to select our at-risk block groups and gather statistics. *Selection, Select by Location*. You want to select features from *ep2000bg* (block groups) that *have their center in* the features of your final dissolved and unioned buffer theme. Click *Apply*. LOOK at your selected block groups and see if they make sense. In the past, there has been a funny bug that yields a selection of far too many block groups. If you see that some block groups whose centers are NOT within the buffers have been selected the cause is some strange artifact of the table join that causes the selection to be incorrect. If this occurs, *Selection, Clear Selected Features*, then right-click on *ep2000bg* and *remove all joins*. Now, do your *select by location* again, verify that it looks good, and re-join *epbg2000daat* to *ep2000bg*. Don't ask me why this quirk exists, it is just one of the many fun surprises that ESRI provides for you. Hopefully you will not get it.
19. Open the attribute table for *Ep2000bg*. You will see that the records for the selected block groups are highlighted cyan. You view only selected records if you wish with the *Selected* button at the bottom of the table.
20. Scroll across to the column *epbg2000data.Black*. This is the number of Blacks in each block group. Right click on the column header and select *Statistics*. You get a table of statistics *for the selected records only*. The *sum* value is the total number of Blacks in the block groups at-risk (make sure you understand this). Write this number down.
21. Now, you need to gather the total number of non-blacks in the at-risk areas. However, you don't have an attribute field called "Non-Blacks." What do you do? Click on the column header *epbg2000data.Tot* (the total population in each block group) and again *Statistics*. This is the total number of people in the at-risk block groups. To get the total number of non-Blacks, subtract your "total Blacks at-risk" from this value. Write this number down.
22. In your table, *Options, Clear Selection* to unselect your records. Repeat the previous 2 steps to get the sum of Blacks and non-Blacks for the entire Metro Area (because with no records selected, you will gather statistics for *every* block group). Write down the total number of Blacks and non-Blacks.
23. To generate your first EJ measure, divide the at-risk number of Blacks by the total number of Blacks (use up to 5 decimal places). Next, divide the at-risk non-Blacks by the total number of non-Blacks. Look at these two numbers. Which is

higher? What does that tell you? What do these numbers measure, what do they mean? Finally, divide your two results, so that the first value (number of at-risk Blacks divided by the total number of Blacks) is divided by the second value (number of at-risk non-Blacks divided by the total number of non-Blacks). This final measure is a quotient, or a ratio of ratios. If the two numbers are equal, the quotient equals 1.0. If the first number is *twice as large* as the second, the quotient equals 2.0. If the first number is one-half as large as the second, the quotient equals 0.5. Based on this first quotient, is there environmental injustice for the Colorado Springs Black population? How much are Blacks more (or less) likely to be exposed to toxic sites than the rest of the population?

24. Now, you are on your own. You need to repeat the appropriate steps from above to generate an EJ measure for non-Whites (which you get by subtracting the variable *Whi* for *Tot*), Hispanics (variable name *Hisp*), and the number of people below poverty level (variable name *Pov*). Let me clarify a few issues: First, for these tests you will always be comparing your population of interest to the rest of the population. So our tests compare Blacks to non-Blacks, non-Whites to Whites, Hispanics to non-Hispanics, and the Poor to non-Poor. Be sure you calculate the correct values for your base group (Whites are calculated for you, non-Blacks, non-Hispanics, and non-Poor are not pre-calculated) by subtracting from the total population. Note we could just use Whites as a base because they comprise about 81% of the Colorado Springs population, rather than non-Blacks, non-Hispanics, and non-Poor. This is a slightly different test and would give you different results. But it is a less-valid measure because categories like “Poor” and “White” or “Hispanic” and “White” are not mutually exclusive. Always recognize that it is very easy to lie with statistics, just as it is easy to lie with maps. Always question the results you see in tests such as these so you know how the measures are generated. Second, the Census does report what would seem to be better measures for the low-income category than number of people below poverty level (by the way, poverty level is calculated annually by the Census Bureau based on a ratio of income to costs of an economic food plan. Number of family members is included in the calculation to determine the total number of persons below poverty level). There are measures for average household income and median household income, which probably better measure areas that are well-off and areas that are not. The problem is that we cannot use these “average” or “median” values in our test. What does it mean to sum up, or even to “average”, a bunch of “average” values? Nothing! You could easily generate an EJ measure, but it would be meaningless! And people have actually done this in research papers! Again, THINK about the tests that are done and what they mean.
25. Feel free to experiment with an Asian index if you like.
26. To hand in this time, you should make a very clear table showing all of your results for the 4 groups you are measuring. I also want a clear written interpretation of all of the numbers you generate—what do they mean? Next, a very short summary as usual of the main conceptual points and what you learned. Finally, make a choropleth map of the *Percent* of the *group that bears the highest relative burden*. Use percent of that group because, as I previously said, you shouldn’t make a choropleth of a variable that is total numbers. You will need to first either calculate a new field for percentages, or use the normalization tool in the legend editor to normalize total number of your racial group by the total population (which calculates the percentage for you on the fly). Include on your map toxic sites and buffers (clear fill with outlines visible) overlain. Hand in the map with your written report.

Due November 6, 2002 at 4:30 pm