Assessing Socioeconomic trends in Land Use and Ecosystem Services in Dallas, TX

Social Justice and Community Change Lesson Implementation Plan

**Author**

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**Course Information**

*Department/Program: Environmental Science*

*Level*: Introductory Undergrad Non-Majors

*Course type:* lecture & lab

*Delivery mode: B*lended

*Students:* Non-Majors

*Number of students: 24*

**Expected date or dates of implementation**

April 8 - April 22

**Purpose/Background**

Studies have shown that formerly Redlined neighborhoods are hotter and have significantly poorer air quality than formerly Green-lined neighborhoods in cities across the U.S. These differences in environmental conditions are often attributed to larger cover of impermeable surfaces and lower tree cover in formerly-redlined areas (Locke et al. 2021).Tree cover and vegetation in general, have been shown to improve both mental and physical health for urban residents (McDonald et al. 2020). Increased tree cover is associated with improved air quality and decreased air temperatures in cities. Vegetation also provides habitat for organisms, so biodiversity is generally higher in areas with more tree and vegetation cover (Schell et al. 2020). As a result of these observed trends, many organizations are calling for and implementing tree planting and management programs in urban and formerly-relinde areas.

In this lab exercise, students use a combination of publicly available data sets from the U.S. Census Bureau and Center for Disease Control combined with tree cover data that they generate as a class to develop and test their hypotheses about the relationships between socioeconomic factors, like income and race, and tree cover. They also compare the human health impacts of tree cover and socioeconomic factors using projected life expectancy at the census tract level as a proxy for overall human health within communities.

These activities will coincide with our discussions of land use, urban forests and urban environments. The purpose of these activities is to provide an interactive, data-driven exploration of the social forces, like systemic racism, that structure our urban environments, and the long-term impacts of these forces. Additionally students are encouraged to investigate solutions that are currently underway and to consider and develop plans for actions that we as communities and they as individuals can take to address environmental inequities.

# Objectives

**Quantitative learning objective(s)**

1. Build simple linear regression models and use them to evaluate the type and strength of relationships between two variables.
2. Use simple linear modules to draw conclusions about the relationships between socioeconomic factors, tree cover and human health.
3. Recognize and discuss the limits of these simple linear regression models (causation vs correlation).

**Content learning objective(s)**

1. identify the ecosystem services and human health benefits that trees provide in Urban environments.
2. describe how racist, anti-immigrant and other discriminatory policies have resulted in large disparities in environmental conditions among neighborhoods that correlate with their racial and socioeconomic make-up.
3. identify the costs that disparities in environmental conditions have on human health and biodiversity.

**Social justice and/or diversity/equity/inclusion learning objective(s)**

1. Identify and evaluate the roles that racial, class and other forms of discrimitation play in shaping our urban and suburban communities and relate these factors to the trends that they observed in their data
2. Suggest how observed trends may or may not result in disparities in ecosystem services provided by trees to communities (e.g., pollution removal, temperature moderation)
3. identify and discuss the costs that disparities in environmental conditions have on human health
4. explain how and why trends in these communities may differ from the trends observed in other cities where redlining occurred.
5. Devise three actionable solutions that the city council could employ to remedy disparities
6. Devise three actionable solutions that communities could employ to improve ecosystem services within their communities

# Assessments

For the objectives you listed in the previous section, what assessments will you use to measure student progress? Add rows as needed. Remember that a single assessment can measure multiple objectives.

|  |  |
| --- | --- |
| Objective(s) | Briefly describe assessment. Is it formative, summative? |
| C1, C2, C3 | Pre-lab discussion of readings. Formative and summative.  Pre-lab video and reading Quiz. Quiz will cover content - redlining and its impacts. Predicting relationships between variables. Formative. |
| Q1, Q2 & Q3 | Excel spreadsheet containing graphical analyses. Formative. |
| Q1, Q2 & Q3 | Lab exercise worksheet: summarizing hypotheses, analyses, drawing conclusions from data about relationships between variables: tree cover and socioeconomic, tree cover and life expectancy, life expectancy and Formative and Summative |
|  |  |

# Activities and resources

For your students to accomplish the objectives, as measured by your assessments, what activities will they engage in (this may overlap with your formative assessments above) and what resources will you provide (lectures, readings, etc.)?

|  |  |
| --- | --- |
| Objective(s) | Activity/Resource |
| C1, C2, C3 | Prior to coming to the lab, Students will watch a video and read an npr article that examines redling/socioeconomic impact on tree cover and thus temperature in urban areas. |
| C1, C2, C3 | Small group discussion of questions followed by group discussion of questions:   1. Summarize redling’s role in shaping modern urban environments 2. Describe how environmental conditions differ between formerly greenlined and formerly relined communities 3. Group discussion while examining the redlining and modern maps of Dallas |
| Q | Class discussion of variables in our dataset; using hypothesis graphs to model how we think the variables might be related; example graphing income and life expectancy; discuss R2 and slope. |
| C1-3 | Students assess tree cover using iTree Canopy for two census tracts - post their tree cover estimates in a collaborative Excel sheet |
| Q1 - 3; C1-3; SJ 1 | Students conduct regression analysis for tree cover and income - draw conclusions; discuss findings - worksheet |
| Q 1-3; SJ1 | Students choose their own question and hypothesis from dataset - graph their chosen variables - complete worksheet |
| SJ 3-5 | Group share out - students will incorporate their findings into an infographic or other medium of communication targeted at raising public awareness of the relationships that they found, suggesting actions for change within our communities |

# Prerequisite skills or knowledge

What specific skills or knowledge are you expecting your students to have coming into this lesson?

* Scatter Plots and Simple Linear Regression: this can be a very basic understanding of how data is graphed using scatter plots and interpreting trendline equations and R2 values provided by Excel. Depending on the level of your students, you may choose to make student analysis of the data more in-depth.
* Ecosystem services
* Environmental Justice
* Some experience using excel to graph data
* Experience using Geographic Information Systems is helpful but not necessary
* Knowledge of sustainability concepts (triple bottom line: people, planet, profit)

# Lesson sequence

## Activity 1: Introductory Discussion

Description: This assignment can be carried out as an asynchronous discussion forum or as a pre-lecture reading assignment and in-class discussion. Students read articles and watch a video that introduces the term “redlining,” its origins, and how systemic racism has shaped our urban environments.

* File Associated with this Activity: *tree cover prelab discussion.docx*
* Links to resources used are in the document
* During our class meeting, student groups were assigned to imagine that they were city council members tasked with devising three short-term and three long-term solutions to the environmental inequities in our city. Students were told that solutions needed to have buy-in, and that they were to specifically address how they would promote community involvement, and gain community trust and support. Groups shared their solutions with the class and we voted on which we thought were the top three each for the short-term and long-term solutions.

## Activity2: Pre-lab Quiz

Description: This was a short formative quiz in which students were asked to state hypotheses about relationships between the variables that we would be working with in Lab

* File associated with this activity: Tree Cover Pre-lab Activities and Quiz 05312021
* This assignment was administered in Canvas and was due before the students attended the lab to conduct Tree Cover analyses.

## Activity 3: Assessing Tree Cover Equity

Description: During this activity, students use *iTree canopy* to estimate tree cover at the census tract level across the city of Dallas. Estimated tree cover is compiled into a class dataset that contains Census and CDC data provided by the instructor. Depending on time, tree cover estimates can be completed in one session, and then the data analysis can be conducted during a second session. Alternatively, students can do the graphing and complete the worksheet on their own if they are already familiar with using scatter plots in Excel.

* Online App Used to Assess Tree Cover: <https://canopy.itreetools.org/>
* Files Associated with this Activity:
  + Socioeconomic and tree cover\_Dallas\_05132021.xls
  + Student Instruction\_Dallas Tree Cover and Socioeco\_07012021
  + Tree Cover and Socioeconomic Student Worksheet 07012021
  + Shapefiles for Census Tracts (students will upload these into iTree Canopy to demarcate their tree cover survey area) in zip folder
  + Using Simple Linear Regression.ppt
* First, I reviewed scatter plots (see included PPT) and walked them through the process by graphing life expectancy as a function of income. Then, I outlined what they were to complete by the end of the lab.
* I explained that because we are sharing the workload, they all needed to complete their tree cover estimates in a timely fashion so that we can then add those to the collaborative dataset. No one can continue to the graphing/analysis stage until we all have completed our tree cover estimates. I found that setting a clear deadline was helpful.
* Each student was assigned two census tracts. I chose to assign census tracts based on their former HOLC designations. Each student was assigned one red or yellow and one blue or green census tract (See HOLC Status in the Excel file).
* Then students used the compiled dataset to complete the worksheet, which has them address the following questions:
  + Is tree cover equitably distributed in the city of Dallas?: they can use income or race/ethnicity data and tree cover estimates to address this question.
  + Do people who live in areas with higher tree cover live longer?They can use life expectancy data and tree cover estimates to address this question.
    - This is not a strong correlation between these variables. Stopping to discuss why tree cover doesn’t directly cause people to live longer would be a good activity to add here.
  + Students choose their own analysis to conduct.
    - * My students chose from the variables provided in the Socioeconomic and tree cover\_Dallas\_05132021.xls

## Activity 4: Presenting Findings

* Students summarize their findings and share them as an infographic, tik tok video or other format.
* Guidelines:
  + Who is their audience?
  + What medium will they use to reach their audience?
  + What are the main points that they want their audience to gain from their presentation?
  + How will they communicate their information?
    - Required to include graphs of their data
    - Main findings
    - Suggested solutions

# Notes

1. Activity 1: There are a lot of great options for introducing students to these topics. I have only included the resources that I used inthe list above, but there are more links to other resources in QUBES resource publication.
2. Activity 3 Student choice - I think that this portion of the activity could be expanded in some of the following ways:
   1. Instead of just looking at tree cover in iTree, also assess other cover types - impervious cover or road cover would be good ones for students to look at
   2. Students could compare tree cover across HOLC status
   3. Examining other factors that could impact health - proximity to Super Fund or other courses of pollution, access to health care facilities, grocery stores in census tracts
3. Service Learning Potential - I am still developing this series of activities, but I foresee working with our urban forester to get students involved in expanding tree cover in their own communities. Still a lot of room to grow.

References:

Locke, D.H., Hall, B., Grove, J.M. *et al.* Residential housing segregation and urban tree canopy in 37 US Cities. *npj Urban Sustain* **1,** 15 (2021).<https://doi.org/10.1038/s42949-021-00022-0>

McDonald, R.I., Kroeger, T., Zhang, P. *et al.* The Value of US Urban Tree Cover for Reducing Heat-Related Health Impacts and Electricity Consumption. *Ecosystems* **23,** 137–150 (2020).<https://doi.org/10.1007/s10021-019-00395-5>

Schell, C.J., *et al.* 2020. The ecological and evolutionary consequences of systemic racism in urban environments. *Science* 369(6510): 4497. http://doi.org/10.1126/science.aay4497