**Module Title: Exploring EnvironmenATL Justice with Data Analytics and Visualization**

**Module Developed By: Dr. Ethell Vereen, Jr.**

**Module Aims**

The environmental studies laboratory is an exciting place where students investigate, analyze, and reflect. Students test and apply theories and make abstract concepts concrete. This module introduces environmental justice and some of the basic data handling and data analysis skills that will give students an understanding of data types, descriptive statistics, sampling, and basic inferential statistics. Environmental justice is an important part of the struggle to improve and maintain a clean and healthful environment, especially for those who have traditionally lived, worked and played closest to the sources of pollution. Many of the skills learned and knowledge gained will be directly transferable to post-baccalaureate studies (e.g. graduate school, medical school, professional training etc.) and the world of employment.

*Overview*

This module introduces some of the basic data handling and data analysis skills that will give students an understanding of data types, descriptive statistics, sampling, and basic inferential statistics. It will include the use of spreadsheets and statistics software to handle, plot, describe and analyze environmental datasets and will help students in the communication of data analysis using tables, graphs and appropriate statistics.

The module introduces an environmental justice framework to give students an understanding of tools and strategies to engage, assess, and intervene at multiple levels; while also developing advocacy and communication skills. Through mapping and other techniques, students will explore, visualize, and discuss how to engage, assess, and potentially eliminate unfair, unjust, and inequitable conditions and decisions. The framework also attempts to uncover the underlying assumptions that may contribute to and produce differential exposure and unequal protection.



**Purpose/Background**

Ecology and environmental science are increasingly using ‘big data’ to expand and refine research questions. In this module we will examine, analyze, and interpret datasets that represent a wide range of ecological topics and approaches, including nutrient cycling, hydrology, climate change, and human and animal migration. We will build skills in data collection, data analytics, data visualization, and science communication.

We also note that poor and minority populations have historically borne the brunt of environmental inequalities in the United States, suffering disproportionally from the effects of pollution, resource depletion, dangerous jobs, limited access to common resources, and exposure to environmental hazards. Paying particular attention to ‘redlining’ and the ways that race, ethnicity, class and gender have shaped the political and economic dimensions of environmental injustices, this module challenges students to critically examine redlining, socioeconomic, and environmental factors in Atlanta, GA (USA) to develop and explore research questions that may visually and/or statistically illuminate trends, patterns and processes of environmenATL justice.

**Module Learning Outcomes**

On successful completion of this module students will be able to:

1. Perform data gathering of large data from a range of data sources.
2. Critically analyze existing Big Data datasets
3. Understand and demonstrate the role of statistics in the analysis of large datasets.
4. Select and apply suitable statistical measures and analyses techniques for data of various structure and content and present summary statistics.
5. Understand and demonstrate competency, intermediate to advanced knowledge, of statistical data analytics as applied to large data sets.
6. Employ statistical analytical skills to test assumptions, and to generate and present new information and insights from large datasets

**Quantitative learning objective(s)**

1. Perform data gathering of ‘big data’ (socioeconomic and environmental) from a range of data sources focused on Atlanta, GA (USA).
2. Select and apply suitable statistical measures and analyses techniques for data of various structure and content and present summary statistics and/or data visualizations.

**Content learning objective(s)**

1. Identify and select the data necessary to formulate a hypothesis driven ‘big data’ research question.
2. Describe environmental justice and discuss the history of the environmental justice movement in your own words.
3. Communicate scientific findings using a range of modes and technologies (e.g. oral, visual, social media, and/or multimedia technologies).

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

1. Identify, describe, and analyze environmental justice issues in Atlanta, GA (USA)
2. Engage with diverse groups of people (peers, community stakeholders, and/or advocacy groups…maybe policy makers/local government officials).
3. Identify barriers to equity and equality and/or environmental inclusiveness, and discuss (or explore) strategies to remove them (if applicable).

**Other learning objective(s)**

1. Reflect on your own perception, biases, and assumptions and how this might inform your understanding of environmenATL justice (and science).

**Prerequisite skills or knowledge**

*What specific skills or knowledge are you expecting your students to have before this?*

How to perform and analyze descriptive statistical tests.

*Familiarity with statistical processing software (e.g. Microsoft Excel, R/R Studio, etc.)*

How to formulate a hypothesis and design a hypothesis driven experiment.

**Module Session/Lesson Plan Overview**

1. environmenATL module introduction
   1. Introduction to ‘big data’, environmental justice and redlining
   2. Demonstrate finding a data set, and exploring strengths and limitations of data
   3. Demonstrate data analysis using excel and/or R (as needed)
2. Experimental design on Your Own
   1. From previous session students will be tasked with finding a data set and developing a research question and hypothesis
   2. Students will share experimental design and receive feedback from class and instructor
   3. Students will also complete discussion board posting to demonstrate understanding of environmental justice
   4. Instructor will share how to make a scientific poster template (as needed)
3. Analysis and Mini-Literature Review
   1. Students will perform statistical analysis on their dataset
   2. Students will perform a mini-literature review on their topic
   3. Students will write a technical report and create a poster for presentation incorporating findings from statistical analyses and literature review
4. Scientific Communication
   1. Posters will be presented to class as a ‘mock’ community town hall emphasizing findings and barriers identified to equity and equality and/or environmental inclusiveness, with potential strategies to remove them (if applicable). Technical report submitted to instructor separately.
   2. Students will complete a post-module reflective writing
   3. Presentation Peer Assessment. Your feedback will be considered in assigning the grade for the activity. Please try to be as honest and fair as possible in your assessment. Link to evaluation form: [INSERT LINK TO FORM]

**Assessment**

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| --- | --- |
| **Points** | **Activity/Assignment** |
|  | **Experimental Design** |
| 10 | Determine an environmenATL justice topic of interest (water quality, air quality, climate change, Superfund sites, etc.). Formulate a research question of interest. |
| 10 | Identify datasets to address environmenATL justice research questions. |
| 10 | Share strengths and limitations of datasets; and highlight opportunities to use the data to address environmenATL justice research questions. |
| 10 | Generate hypothesis and significance level |
| 10 | Determine test statistic (technique used) to address hypothesis |
|  |  |
| 20 | Respond to the environmenATL justice discussion board post |
|  |  |
|  | **Analysis (Inference of test statistic and/or mapping)** |
| 50 | Descriptive stats in excel, bar charts with SD error bars, scatterplots and linear regression  Import, analyzing, and visualizing data using R  t-tests, ANOVA  mapping using EJSCREEN |
|  |  |
|  | **Scientific Communication** |
| 50 | Write a technical memorandum |
| 50 | Create a poster for presentation incorporating findings from analyses and literature review |
| 50 | Posters will be presented to class as a ‘mock’ community town hall emphasizing findings and barriers identified to equity and equality and/or environmental inclusiveness, with potential strategies to remove them (if applicable). |
|  |  |
| 25 | Post-module reflective writing |
| 5 | Active participation, engagement |
| **300** | **TOTAL POINTS POSSIBLE** |

Poster Design

* Posters should stimulate discussion, not give a long presentation. Therefore, keep text to a minimum, emphasize graphics, and make sure every item in your poster is necessary
* Space your information proportionally: divide your poster either horizontally or vertically into three or four sections, and place your materials within those spaces. Like a layout of a magazine
* When choosing a background, remember that neutral or gray colors will be easier on the eyes than a bright color. In addition, color photos look best when mounted on gray

Presentation

Town hall meetings, also referred to as town halls or town hall forums, are a way for local and national government leaders to meet with their constituents either to hear from them on topics of interest or to discuss specific upcoming legislation or regulation. For this presentation, you will take on the role of a constituent presenting your poster. The presentation should include: a short intro, your hypotheses, a brief description of the methods, tables and/or graphs related to your findings, and inference of your data and results that would be understandable to a general audience. **The presentations should be no more than 10 to 15 minutes long.**

Technical Report

The technical report typically has five sections: Introduction, Experimental, Results, Discussion, and Conclusions. Many technical reports have an abstract or executive summary; our reports are too short to merit either of these sections. However, students should include a short summary of key findings and conclusions of the report, as well as key recommendations in the report before the Introduction section. This section will be titled Key Findings, Conclusions, and Recommendations. Adopt a professional tone: Do not use contractions; you may use the first person (“I” and “we” are fine); avoid slang and colloquialisms; be formal. Ensure proper use of citations and include appropriate tables, figures, and/or diagrams. This is a technical report and should be written for a key local stakeholders and policy makers. You may include appendices for supplemental material including excel descriptive stats formulas used, and/or R/R studio script for data analysis and graphs used. Report length will vary depending on topic; however generally reports will not be less than 3 pages or more than 5 pages (not including title page, references, appendices). General format should be 1 inch margins, 1.5 spacing, Arial font size 12.

**Student Groups**

Students may work in groups of no more than 3 for this module. Groups will create one poster and all members will contribute to the presentation. Each member of the group will be responsible for submitting an individual technical report. As groups are working together, it is understandable that there will be some similarity in sections of the report. However, reports should not all be facsimiles, exact copies of each other. Each student is also responsible for an individual reflective writing.

**Resources and** **Potential Databases**

Not Even Past: Social Vulnerability and the Legacy of Redlining

<https://dsl.richmond.edu/socialvulnerability/>

The Lines that Shape Our Cities

<https://storymaps.arcgis.com/stories/0f58d49c566b486482b3e64e9e5f7ac9>

EJSCREEN: Environmental Justice Screening and Mapping Tool

<https://www.epa.gov/ejscreen>

Hypothesis Testing for Inference using a dataset

<https://medium.com/swlh/hypothesis-testing-for-inference-using-a-data-set-aaa799e94cdf>

* [Data.gov](https://www.data.gov/) [www.data.gov](http://www.data.gov)   
  Following the 2013 Federal Open Data Policy, many new government-generated datasets have become available. At Data.gov, you can browse data by subject (e.g., searching by the subject "Environment"). Some datasets that may be particularly useful are the USEPA Environmental Quality Index (EQI), EPA Office of Water (OW): Impaired Waters with TMDLs NHDPlus Indexed Dataset, CDC National Environmental Public Health Tracking Network (Tracking Network), the National Mental Health Services Survey, and the National Household Survey on Drug Abuse.
* [Census.gov](https://census.gov/data.html) [www.census.gov/data/](http://www.census.gov/data/)   
  The census bureau has great nationally representative data. Often used for public policy or economic research, it also offers data about families, income and poverty, and health that may be of use in environmental research. It is easy to browse by topic and download excel sheets with data summaries and graphs.
* Global Environmental Database <http://db.cger.nies.go.jp/portal/>
* Environmental data explorer: [http://geodata.grid.unep.ch/](https://www.researchgate.net/deref/http%3A%2F%2Fgeodata.grid.unep.ch%2F)
* Microsoft FetchClimate: [http://research.microsoft.com/en-us/projects/fetchclimate/](https://www.researchgate.net/deref/http%3A%2F%2Fresearch.microsoft.com%2Fen-us%2Fprojects%2Ffetchclimate%2F)
* Gapminder: [http://www.gapminder.org](https://www.researchgate.net/deref/http%3A%2F%2Fwww.gapminder.org)
* Google Data Explorer: [http://www.google.com/publicdata/directory](https://www.researchgate.net/deref/http%3A%2F%2Fwww.google.com%2Fpublicdata%2Fdirectory)
* Environmental Protection Agency (EPA). (2020, June 3). Search for Superfund Sites Where You Live. Retrieved from <https://www.epa.gov/superfund/search-superfund-sites-where-you-live>
* United States Census Bureau. (2019). QuickFacts: Georgia. Retrieved from <https://www.census.gov/quickfacts/GA>
* World Population Review. (2020). Atlanta, Georgia Population 2020. (2020). Retrieved from <https://worldpopulationreview.com/us-cities/atlanta-ga-population>

