Final Project: Light Pollution Research Study

Background:

Light pollution is any unwanted, artificial light that compromises the darkness of the night sky. This additional light represents wasted electricity costs, can negatively impact animals, and makes studying the stars more difficult. While there are multiple different types of light pollution, we'll be studying skyglow, defined as the glow of the sky due to the sum of many light sources.

This light pollution can come from any number of sources, including outdoor residential lighting, signs and advertisements, and exterior lighting for parking lots, to name just a few. Although each unshielded light fixture may allow only a small amount of light upwards towards the sky, every little bit starts to add up. As the light travels upwards, it is scattered in random directions by small dust particles, pollution, moisture in the air, or the air molecules themselves. The result is a sky that appears to glow.

The amount of skyglow light pollution can be measured via a Sky Quality Meter, or SQM for short. Specifically, an SQM measures the visible brightness of the sky in some location in units of magnitudes per square arcsecond and, all else being equal (like moonlight, cloud cover, etc.), this sky brightness is related to the amount of light pollution affecting the area. For this project, you will be making measurements with SQMs over the course of a semester and analyzing the results.

Skills:

Please demonstrate the skills you have developed this semester in a way that addresses the objectives of this project, which are intentionally somewhat vague in order to offer you some freedom in exactly how you format your contribution to the class's study. Your final grade will be determined according to the following rubric:

- The student demonstrated a number of different data analysis skills in their portions of the project (40 points)
- The student communicated the methods and results of their analysis in a clear and concise way through some subset of the following modalities: verbal communication, written communication, graphical story-telling, well documented code, etc. (40 points)
- The student demonstrated engagement with and understanding of the topic (20 points)

Project Objectives:

Some subset of the following items will be finished as a class, and you will have to contribute to some of them. The interests of the class will guide which particular items are completed.

- Data Collection
  - Collecting data via Sky Quality Meters (SQMs)
  - Organizing the data in a useful way, including any potentially confounding variables
  - Documentation of the data (explaining in some document format the organization scheme of your data set, why it is organized that way, the contents, the units of any measurements, where the data originated, who contributed, etc.)
  - Calibrating measurements
  - Etc.
- Data Analysis
  - Organizing an Excel spreadsheet or Python program that performs any necessary sorting or pre-processing of the data before it is useful
  - Creating time-series graphs of light pollution levels over time
  - Creating spatial maps of light pollution levels
  - Calculating meaningful statistics and tabulating them
  - Exploring possible confounding variables
  - Documenting code
  - Etc.
- Writing
  - Research paper
    - Introduction section
    - Methodology section
    - Analysis section
    - Results and conclusion section
    - Bibliography
  - Executive summary (one page)
  - Special memos
    - TBD - Depends on student interest. Examples include connecting to environmental impacts, human health, financial impacts, etc.
  - Etc.
- Presentation
  - To class
    - More detailed, as your peers have studied the topics involved
    - Covers methodology, code, data, results, etc.
    - Intended to guide class towards agreement on what to include in research paper
  - To campus and community
    - Intended for broader audience, covers more of the basics of light pollution
    - Less focused on the process and more focused on the results

    - To special audiences
        - TBD - Depends on student interest. Examples include connecting to environmental impacts, human health, financial impacts, etc.
- Miscellaneous
    - Collecting images and locations of lights which add to light pollution in the area
    - Collecting images and locations of lights which are exemplars for the community to follow
    - Mapping light pollution sources in the area
    - Creation of informational posters to hang up around campus
    - Etc.

Additionally, all students will have to fill out a one-page self-evaluation of their contributions to the class's project.