

Chapter 2: Making Scientific Observations and Measurements for Spatial Analysis

Concept: In Chapter 2, we learned about making scientific observations and measurements, which entails a systematic process of acquiring knowledge about phenomena of interest. We can do this either directly through the use of our human senses or by recording information using tools and instruments. Science has become a way of life whereby every day we are using mobile devices or sensors (e.g. citizen sensor) that record our locations, daily activities, building height, or body weight. The data is recorded using a specific metric that may consist of non-numeric or numeric attribute with a unit. Our curiosity to learn and gain knowledge leads us to ask specific research questions, formulate hypotheses, design experiments and ensure proper collection of primary data, and validate or reject the hypothesis using observations. In Chapter 2, we discussed these scientific concepts and especially focused on a hypothesis-driven process through which we collect and analyze spatial data. We presented the four scales of measurement, two main scientific approaches for data collection, sampling, and data processing since most data is currently available through secondary sources.

Task: We will use concepts from Chapter 2 to collect scientific observations around places where we live, play, work, worship, shop, eat or go to school.

1. Choose one of any of three topics given below
 - Understanding the urban food environment in low- and high-income settings
 - Understanding access of primary healthcare services among racial and ethnic groups
 - Understanding activity patterns among young working adults
2. Outline a research approach to collect observations to study the selected problem.

Approach/Strategy for solving task: Design a robust sampling data collection mechanism for studying this problem. Use a high grade Global Positioning System (GPS) unit or GPS-enabled mobile devices with sub-meter accuracy (it should have less than 3 meter locational accuracy) to collect at least 30 data points and any relevant attribute within a 10-mile radius around places where you live, play, work, worship, shop, eat or go to school. Compile the data in MS Excel Spreadsheet. Also, find and collect secondary data for the problem you are studying. Compare the two datasets. Are there any significant differences in terms of error for the two datasets? Compile your findings/observations into a meaningful short report.

Possible Solutions:

Answers will vary but here is a possible solution for understanding the urban food environment in low- and high-income setting. Below is a specific research outline for studying this problem:

1. Hypothesis: There are no significant differences in food access between low- and high-income settings in the city of Chicago, Illinois
2. Define food access, low-income, and high-income measures
3. Design: Use either a prospective or respective cohort study. Develop a solid spatial sampling framework that will capture the variation of key factors—such as demographics, social stressors, socioeconomic status, family/household characteristics, location of food stores, type of food stores (e.g. groceries, farmer’s market, restaurants), operating hours of food stores, individual/neighborhood characteristics, income, education, diet intake and requirements/preferences, etc.
4. Analysis plan: Determine the most appropriate food access measures, including distance to nearest food store or fixed distance (spatial access), food stores per unit area or per 1K people (spatial access), temporal access (operation hours), and spatiotemporal access (spatial and temporal considerations). Conduct spatial statistical tests to determine whether there are differences in the food environment between low- and high-income settings in Chicago.
5. Challenges, alternative approaches, and ideas for future direction: develop a strategy to deal and minimize errors between the primary and secondary datasets, incorporate a community engaged research component to understand dietary practices, and plan a follow-up study. Conceptual challenges exist in terms of clearly differentiating between low-income and high-income settings relative to 5As (accessibility, availability, affordability, acceptability, and accommodation). The ideas presented here can be replicated to other urban areas. This research outline template can be adopted to design a study for other towns, cities or places nearest to where you live.