

In-Class Exercise 1

For this in-class exercise, work with your group of 2-3 people, to answer the following questions. These questions are not necessarily easy and sometimes they will not have a clear “correct” answer. The goal is to get you thinking about the material we’ve learned. Some of these questions may require you to discuss and debate with your group members to come up with an answer or can cover topics that we have not yet covered in class.

Be prepared to share your answers with the class and add to the discussion.

After class submit your answers on Moodle for grading. You will be graded as a group on your submission. Only one group member needs to submit the assignment, but make sure add all group member names.

Revisiting Mosquito Nets in Ghana

Suppose you want to understand the causal impact of providing mosquito nets to households in Ghanaian villages on malaria rates. You decide to bring some mosquito nets to various villages in Ghana and let anyone who wants them, take one.

You and your team go to 10 villages in the Western part of Ghana. In each village, you set up a booth and announce that anyone who wants a free mosquito net can take one. You then record who took a mosquito net and who did not. Additionally, you record some demographic information about each person who comes to the booth. You record this on a paper survey form and later enter the data into a computer. The data stay on your computer and you share it through Dropbox.

Problem 1

When you conduct a study like this, you often need to submit your study or design to an IRB (Institutional Review Board) for approval. IRB’s are influenced by the Belmont Report:

The National Research Act (NRA) was passed in 1974 in response to public outcry over the Tuskegee Syphilis Study (see Table 1 for additional information). Hundreds of African-American men were left untreated for syphilis, despite available effective antibiotics (Tuskegee University, 2022). The NRA developed the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research (Department of Health, Education, and Welfare, 1979). The Belmont Report was generated from the National Commission and summarized the three ethical principles required for human-subjects research. The Belmont Report continues to provide a framework for ethically thinking about these issues. The principles are (Moon, 2009):

1. Respect for persons - refers to respecting autonomous decisions made by individuals in making choices about their involvement in research and protecting vulnerable persons in research.
2. Beneficence - obliges researchers to promote the well-being of individuals and groups involved in research by maximizing benefits and minimizing foreseeable risks.
3. Justice - requires that people be treated equitably and that the burden and benefits of research are distributed fairly.

Ethical Guidelines and the Institutional Review Board – An Introduction, Capili and Anastasi (2024)

Why do you think IRB's are necessary? What ethical concerns might arise in a study like this? Think carefully about the design, data collection, and data storage/sharing aspects of the study.

! Solution

Answers will vary and I'm looking for thoughtful responses. Below is an example answer.

IRB's are necessary to protect human subjects from harm. In a study like this, there are several ethical concerns that might arise:

1. Informed Consent: Ensuring that participants fully understand the nature of the study, the risks involved, and their rights as participants.
2. Privacy and Confidentiality: Protecting the personal information of participants, especially since health data is sensitive.
3. Risk of Harm: Ensuring that the study does not expose participants to unnecessary risks, such as stigmatization or discrimination based on their health status.
4. Data Security: Ensuring that the data collected is stored securely and only accessible to authorized personnel.
5. Fairness: Ensuring that the benefits and burdens of the research are distributed fairly among participants.

Problem 2

After collecting data, you want to analyze it to see if providing mosquito nets had an impact on malaria rates. You decide to compare malaria rates between those who took a mosquito net and those who did not. Below is a table with the results of your study.

ID	Malaria (Yes=1, No=0)	Taker (Yes=1, No=0)	Sex	Used mosquito net in past?	No. Child under 5
1	1	1	M	1	2
2	0	0	M	0	0
3	1	1	F	1	3
4	0	1	F	1	2
5	0	1	F	1	3
6	0	0	F	0	1
7	0	0	F	0	0
8	1	1	M	1	5
9	1	0	M	0	1
10	1	1	F	0	3

Calculate the average malaria rate for those that **took a mosquito net and those who did not**. Based on these averages, what is the impact of taking a mosquito net on malaria rates? We know that the answer is: “selection.” But can characterize where the selection is coming from? Who are the people that took the mosquito nets? Look at the other variables in the table to help you answer this question.

i Note

The formula for a mean is:

$$\bar{x} = \sum_{i=1}^n \frac{x_i}{n}$$

where x is your variable of interest and n is the number of observations.

In this case you are being asked to calculate a *conditional mean*, so a mean for those that took a mosquito net and another for those that did not.

! Solution

Average malaria rate for those that took a mosquito net:

$$\bar{x}_{taker=1} = \frac{1 + 1 + 0 + 0 + 1}{6} = \frac{3}{6} = 0.5$$

Average malaria rate for those that did not take a mosquito net:

$$\bar{x}_{taker=0} = \frac{0 + 0 + 0 + 1}{4} = \frac{1}{4} = 0.25$$

Based on these averages, it appears that taking a mosquito net is associated with a higher malaria rate. However, this is likely due to selection bias. Those who took the mosquito nets may be different from those who did not in ways that affect their malaria rates. For example, looking at the other variables in the table, we can see that those who took the mosquito nets were more likely to have used a mosquito net in the past and had more children under 5. These factors could influence their risk of malaria independently of whether they took a mosquito net in this study.

Problem 3

Based on your answer to question 2, what extra information would you need to validate your theory on selection? This can be information that you gather from other sources.

! Solution

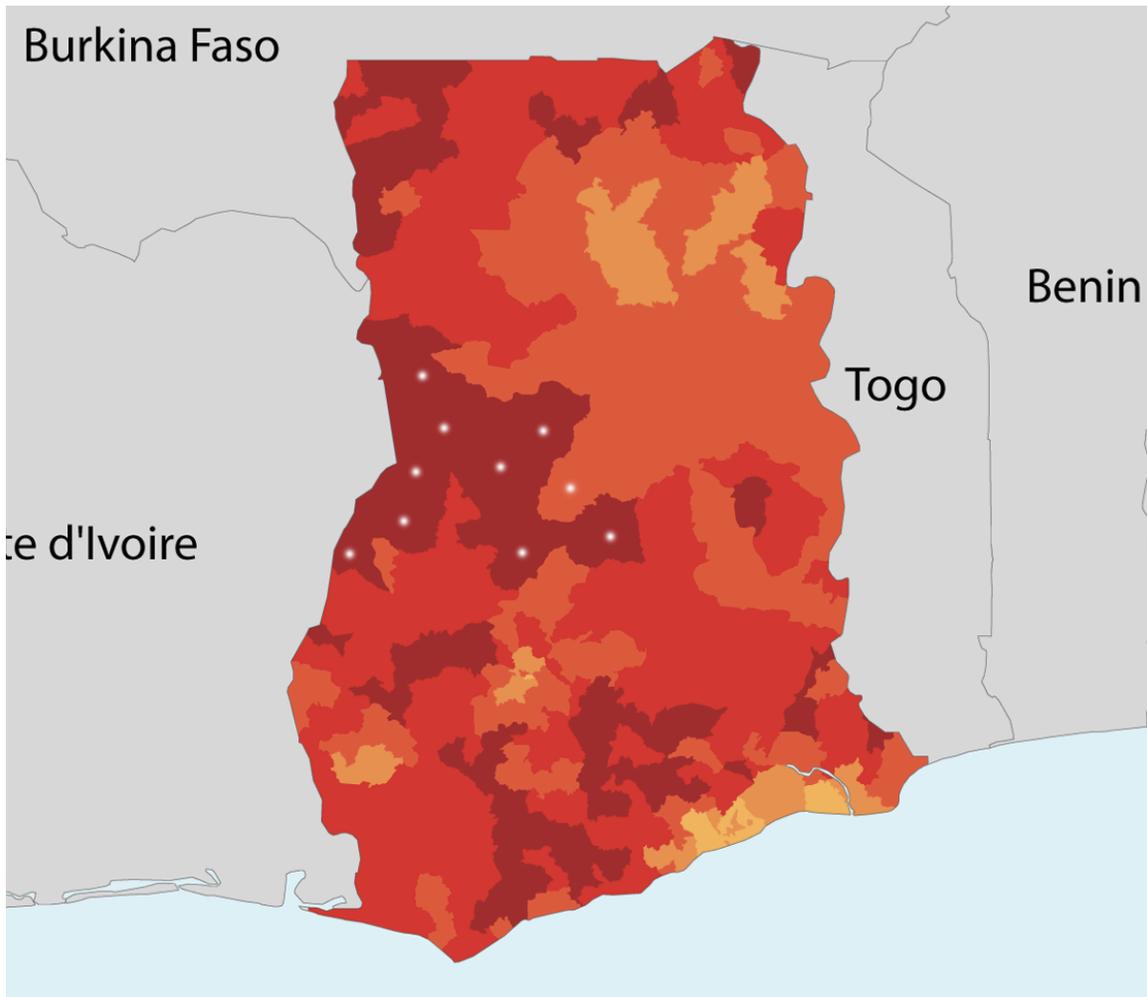
Answers here will vary, but here's an example response.

To validate the theory on selection, we would need additional information on the following:

1. Baseline Malaria Rates: Information on the malaria rates in the villages before the study began to see if there were pre-existing differences between those who took the nets and those who did not.
2. Socioeconomic Status: Data on the socioeconomic status of participants, as this could influence both the likelihood of taking a mosquito net and the risk of malaria.
3. Health Behaviors: Information on other health behaviors, such as use of other malaria prevention methods (e.g., insect repellents, indoor spraying).
4. Environmental Factors: Data on environmental factors that could affect malaria risk, such as proximity to standing water or mosquito breeding sites.
5. Access to Healthcare: Information on access to healthcare services, as this could influence both the likelihood of seeking treatment for malaria and the risk of contracting the disease.

Problem 4

Below is a map of Malaria cases from a WHO report in 2024. I have added points to where you conducted your study in Western Ghana.



Based on the map, do you think the results from your study in Western Ghana can be generalized to the rest of Ghana? Why or why not? By generalized, I mean: if I ran the study again in another part of Ghana, do you think I would get similar results?

! Solution

Based on the map, it appears that Western Ghana has a relatively high number of malaria cases compared to other regions in Ghana. Therefore, the results from the study conducted in Western Ghana may not be generalizable to the rest of Ghana, especially regions with lower malaria prevalence. If the study were to be conducted in areas with different malaria rates, the impact of providing mosquito nets might differ due to varying baseline risks and other contextual factors. Thus, caution should be exercised when attempting to generalize findings from this specific region to the entire country.

Problem 5

Based on your answers, write down a title for the research paper you would write based on this study. A paper title should be concise but informative. It should give the reader a good idea of what the paper is about. It should not overpromise, but also not underpromise. Puns and jokes are discouraged in academic paper titles, but I will accept them if they're really good, without detracting from the informativeness of the title.

! Solution

This is subjective, but here is an example title:

“Assessing the Impact of Mosquito Net Distribution on Malaria Rates in Western Ghana: Evidence of Selection Bias”

Problem 6

Can you think of a way to improve the study design to better understand the impact of mosquito nets on malaria rates? Also, think about how you implement this in the field.

! Solution

To improve the study design, a randomized controlled trial (RCT) could be implemented. In this design, households or individuals in the selected villages would be randomly assigned to either receive a mosquito net or not. This randomization helps to ensure that any differences in malaria rates between the two groups can be attributed to the intervention (mosquito net distribution) rather than other confounding factors.

To implement this in the field, the following steps could be taken: 1. Randomization: Use a random number generator to assign households or individuals to the treatment (receive a net) or control (no net) group. 2. Baseline Data Collection: Collect baseline data on malaria rates and other relevant variables before distributing the nets. 3. Distribution: Provide mosquito nets to the treatment group while ensuring that the control group does not receive any nets during the study period. 4. Follow-up: Monitor both groups over a specified period to track malaria incidence and other health outcomes. 5. Data Analysis: Compare malaria rates between the treatment and control groups using appropriate statistical methods to determine the causal impact of mosquito net distribution.