FINAL PROJECT - CRITICAL REASONING - PHI 169

In this final project, you will research a question of interest to you, collect evidence to answer this question and apply probability theory to this task. You will conduct what we might call *evidence-based probabilistic fact-checking*.

The work for the final project is broken down in five smaller and more manageable units, called stages. The work for each stage builds on the work done in the previous stage. The deadlines for each stage are as follows:

Stage 1: Nov 15 – *bring a written copy to class and be prepared to briefly present your work*
Stage 2: Nov 22 "
Stage 3: Nov 29 "
Stage 4: Dec 6 "
Stage 5: Dec 15 "

You may work in groups (2-5 people) or alone. Working in groups is reccomeneded. If you work in a group, please hand in only one written copy of the work. For the oral presentation, the group may designate one presenter for the entire group or conduct the oral presentation together as a group. Each member of the group will receive the same grade for the work done by the group considered as a whole. If you work in a group, you will not receive an individual grade.

Your work will be judged on quality, not length or quantity. Do not fill up pages for the sake of filling up pages. Please don't. Do not plagiarize or copy/paste from random websites. Please don't. The penalty for plagiarism is failing the class as per syllabus.

Make sure you answer all the questions the best you can and you show rigorous, careful and precise thinking and writing. Your work should be original research of the highest college-level quality.

Stage 1 Identify a question of interest whose answer is uncertain and about which you have good reasons to believe progress can be made by collecting evidence. The question should be about contested facts, not about personal opinions, taste or inclinations. If you look up the *www.rootclaim.com* website, you'll see that the questions there are about contested facts, not opinions. This does not mean you are limited in the choice of your question. Not at all. Be curious and think about what most interests you!

(1a) Formulate precisely the question you want to focus on in your final project.

(1b) Explain why you want to focus on this question, i.e. why it is of interest to you and why others should also be interested in it.

(1c) Explain why this is a question about contested facts and not about opinions.

(1d) Before doing research, what do you think the right answer to your question is?

(1e) What evidence do you hope to find that should help you answer your question?

Stage 2 Identify the possible answers to the question in Stage 1. That is, identify a set of competing hypotheses one of which would be the true answer to your research question. You should at least identify two competing hypotheses, but there could be more than two. If you look up the *www.rootclaim.com* website, you'll see that many research questions have multiple competing hypotheses as possible answers to them.

(2a) Formulate the competing hypotheses as possible answers to your research question.

(2b) Make sure that the competing hypotheses you have formulated cover all the possible answers and do not overlap with one another, that is, at least one and at most one of the hypotheses must be the true answer to your research question. Explain your reasoning.

(2c) Before doing research, what is your guess about the hypothesis that is the true answer to your research question? Motivate your guess.

Stage 3 Collect evidence to find out the right answer to your research question. Find out two or three reliable pieces of information/evidence that you think should be helpful in answering your research question. If you can find more, that's fine, but focus on quality of information/evidence rather than quantity. Make sure your sources are reliable and trustworthy.

(3a) Summarize the pieces of evidence/information you have collected.

(3b) Properly cite your sources. Any citation style is fine so long as you are consistent.

(3c) Are these reliable or unreliable sources of information? Make sure they are reliable. Are these official sources, for example, from the government, United Nations, peer-reviewed scientific articles? If they are not official sources, for example, reports from independent organizations, why do you think they are reliable and trustworthy?

(3d) Given the pieces of evidence/information you have collected, which one of the competing hypotheses you have identified in Stage 2 do you think is the right answer to your research question? Explain—*very carefully!*—your evidence-based reasoning.

(3e) Could you give a definite answer to your research question or are you uncertain?

- If you could give a definitive answer, explain why the other hypotheses are definitely false given the evidence/information you have collected.
- If you are uncertain, explain the reasons for your uncertainty. What additional evidence could help you overcome your uncertainty?
- If needed, collect additional evidence/information. Assess whether the additional evidence/information can or cannot overcome your uncertainty. Explain your reasoning. It is fine if you are still uncertain about the right answer/hypothesis so long as you explain why.

Stage 4 Apply Bayes' theorem as a tool to determine the probability of each of your competing hypotheses given the evidence you have collected. Say you have identified three competing hypotheses, $H1, H2, H3$, and you have identified three pieces of evidence/information $E1, E2, E3$. Do the following:

(4a) Assign prior probabilities to each of the competing hypotheses. That is, you should assign a probability prior to considering the evidence/information you have collected. For guidance, you might need to look for other evidence that is generic and not specific to your question. You could also rely on your educated guess in (2c). If you have no idea about which hypothesis is more or less probable prior to considering the evidence/information you have collected, assign to each hypothesis the same probability. Ensure the prior probabilities of each hypothesis add up to one hundred percent. Have a look at the *www.rootclaim.come* website to see how prior probabilities are assigned.

(4b) Consider a hypothesis and a piece of evidence, say $H1$ and $E1$. Asses the probability that if the hypothesis is true, the evidence would come out the way it did or be what it is, that is, $P(E1|H1)$. Keep in mind that this is not the probability of the hypothesis given the evidence, $P(H1|E2)$, but the other way around.

(4c) It might seem arbitrary to assign numbers to the relationship between hypothesis and evidence. Sometimes assigning those numbers will be easy because the evidence itself tells you what numbers to assign, and sometimes it will be harder. Try to do your best. If any, record in writing difficulties you have encountered in assigning probabilities at this stage.

(4d) Do the same for any combination of hypothesis and piece of evidence/information. With three hypotheses and three pieces of evidence/information, you should assess:

$P(E1|H1), P(E1|H2), P(E1|H3)$

$P(E2|H1), P(E2|H2), P(E2|H3)$

$P(E3|H1), P(E3|H2), P(E3|H3)$

Have a look at the *www.rootclaim.com* website to see how this is done.

(4e) Put all your numbers together in the formula for Bayes' theorem and calculate the posterior probability of each hypothesis given the evidence you have collected. To keep the calculations simple, feel free to assume that the pieces of evidence/information you have collected are probabilistically independent of one another.

(4f) What is the most probable hypothesis given the evidence? Does this result agree with your initial guess? Do you agree with the probability you have calculated?

Stage 5 Write a final report for the project. The report should contain all the content and findings in the previous four stages and take into account my feedback. The report should communicate your research findings in a well structured and engaging written form. The desired length is 10 pages, but the report could be longer or shorter so long as the required content is present. Focus on quality, not quantity.