COURSEWORK - CRITICAL REASONING - PHI 169 - SPRING 2018

Research Project In this project, you will research a question of interest to you, collect evidence to answer it and apply probability theory to this task. The work for the project is broken down in smaller stages. The deadlines for each stage are as follows:

Stage 1	Research question	Feb 14	Pass/Fail
Stage 2	Hypotheses	Feb 26	Pass/Fail
Stage 3	Collet evidence	Mar 12	Pass/Fail
Stage 4	Prior probabilities	Apr 30	Pass/Fail
Stage 5	Evidence given hypothesis	May 7	Pass/Fail
Stage 6	Bayes' theorem	May 14	Pass/Fail
Stage 7	Presentation	*schedule to be posted*	30%
Stage 8	Final report	May 18	30%

When no page requirement is expressly mentioned, keep in mind that your work will be judged on quality, not length or quantity. Do not fill up pages for the sake of filling up pages. Make sure you answer all the questions and show rigorous and precise thinking and writing. Do not plagiarize or copy/paste from random websites.

You may work in groups (2-3 people) or alone. *Working in groups is recommended*. If you work in a group, please hand in only one written copy of the work. For the oral presentation, the group should 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 as a whole.

In-class exams These will assess your knowledge of probability theory. Knowledge of probability theory is necessary in order for you to succeed in your research project. The dates of the two in-class exams are as follows:

Exam 1	Probability basics	Mar 26	15%
Exam 2	Bayes' theorem	Apr 18	15%

Class participation This will count toward 10% of your final grade.

Grading To pass this class, you must pass all Pass/Fail assignments. Your final grade will be computed by weighing the other assignments according to their percentage.

STAGE I – Research question

(1a) Describe a topic that interests you. You may write on anything controversial.

(1b) Narrow the topic down to a few questions, keeping in mind the distinction between:

- questions that seek to define the terminology;
- questions about events in space and time (who, when, where, how);
- questions about causality;
- questions about morality (what is good/bad, right/wrong); and
- questions about what should be done at the political, legal or personal level.

Write down a question for each type of question within the topic you have selected.

(1c) Single out one question—this will be your research question—making sure that:

- it is about contested facts, not opinions (see *www.rootclaim.com* for examples);
- it has an answer, but given what you currently know, you are unsure about it;
- you have good reasons to believe you'll find out the answer by doing research.

(1d) Explain why the question is about facts, not opinions.

(1e) Explain why the question interests you and why others should also be interested.

(1f) Before doing research, what is your guess about the correct answer to the question?

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

Grading scheme

criteria	*unsatisfactory*	*satisfactory*	*good*	*very good*
QUESTIONS				
CLARITY				
PRECISION				
ORGANIZATION				
GRAMMAR				

STAGE 2 – Hypotheses

(2a) What definitional questions do you need to addresses before you address the research question itself? Formulate them and answer them.

(2b) Formulate some competing hypotheses as possible answers to your research question. You should at least identify two hypotheses, but they could be more.

(2c) Make sure that the competing hypotheses

- cover all possible answers, i.e. at least one of the hypotheses must be correct
- do not overlap, i.e. at most one of the hypotheses must be correct.

Explain your reasoning. Look up *www.rootclaim.com* for examples of hypotheses.

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

Grading scheme

criteria	*unsatisfactory*	*satisfactory*	*good*	*very good*
DEFINITIONS				
HYPOTHESES				
CLARITY				
PRECISION				
ORGANIZATION				
GRAMMAR				

STAGE 3 – Collect Evidence

(3a) Collect evidence to answer your research question. For each hypothesis, try to find one piece of evidence in favor and one piece against. Describe each piece.

(3b) Cite your sources, indicating author, title, year and place of publication.

(3c) Make sure your sources are reliable, and explain and motivate your choices.

(3d) Is the evidence you found what you had hoped to find? See (1g). Explain.

(3e) Given the evidence/information you now have, which is the correct hypothesis?

- If you can, explain why you think one hypothesis is correct and the others false.
- If you are uncertain, explain the reasons for your uncertainty. If helpful to overcome your uncertainty, collect and summarize additional evidence/information.

Grading scheme

criteria	*unsatisfactory*	*satisfactory*	*good*	*very good*
FINDING EVIDENCE				
WEIGHING EVIDENCE				
CITATIONS				
CLARITY				
PRECISION				
ORGANIZATION				
GRAMMAR				

EXAM 1 – Probability Basics

In preparation for the exam, review the following topics:

- meanings of probability
- probability laws
- coin tossing
- probabilities from data
- axioms of probability
- negation rule
- conditional probability
- dependence and independence
- product rule

EXAM 2 – Bayes' theorem

In preparation for the exam, review the following topics:

- topics in Exam 1
- prior probability of a hypothesis, i.e. $P(H)$
- posterior probability of a hypothesis given the evidence, i.e. $P(H|E)$
- probability of the evidence given hypothesis, i.e. $P(E|H)$
- probability of the evidence, i.e. $P(E)$
- Bayes' theorem
- medical diagnoses

STAGE 4 – Prior Probabilities

(4a) Find base rate statistics to estimate the prior probabilities of your competing hypotheses. Describe the statistics and your sources.

- NB: If you could not find relevant statistics, describe your (failed) attempts.

(4b) For each hypothesis, give an estimate of its prior probability on the basis of the statistics you've found. Look up *www.rootclaim.com* for examples of how this is done.

- NB: If you could not find relevant statistics, offer your best subjective estimate.

Carefully motivate your statistics-based or subjective estimates.

(4c) Ensure your prior probabilities are normalized and add up to 1 or 100%.

Grading scheme

criteria	*unsatisfactory*	*satisfactory*	*good*	*very good*
RELEVANT STATISTICS				
ESTIMATING PROBABILITIES				
CLARITY				
PRECISION				
ORGANIZATION				
GRAMMAR				

Stage 5 – Evidence Given Hypothesis

(5a) Consider a hypothesis and a piece of evidence, say $H1$ and $E1$. Estimate the conditional probability $P(E1|H1)$.

- NB: You may need to look for suitable statistics or additional information to arrive at an estimate. Look up *www.rootclaim.com* for examples.
- Keep in mind that $P(E1|H1)$ is different from $P(H1|E1)$.

(5b) Do the same for any combination of hypothesis and piece of evidence. With three hypotheses and three pieces of evidence, you should assess:

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

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

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

(5c) Record the difficulties you have encountered in assigning these probabilities and how you addressed them. Be specific.

Grading scheme

criteria	*unsatisfactory*	*satisfactory*	*good*	*very good*
UNDERSTANDING $P(E\|H)$				
ESTIMATING PROBABILITIES				
CLARITY				
PRECISION				
ORGANIZATION				
GRAMMAR				

Stage 6 – Bayes' Theorem

(6a) Put all your probabilities together in the formula for Bayes' theorem and calculate the posterior probability of each hypothesis given the evidence you have.

- NB: Calculations are tedious to do by hand. Instead, use *Genie* and output a Bayesian network with probabilities for each hypothesis.[1]

(6b) What is the most probable hypothesis given the evidence?

(6c) Does this result agree with your initial guess in (1f) and your assessment in (4e)?

(6d) Does this result differ from the prior probability in (3b)? Why is that?

Grading scheme

criteria	*unsatisfactory*	*satisfactory*	*good*	*very good*
BAYES' THEOREM				
GENIE				
CLARITY				
PRECISION				
ORGANIZATION				
GRAMMAR				

[1] You can download the academic version of Genie at *www.bayesfusion.com*. Since Genie works on Windows, if you are using Mac OS, you should first download PlayOnMac at *www.playonmac.com*.

Stage 7 – Presentation

Present your research to the class. Your presentation should

- contain a "hook" meant to draw your audience into your research question
- contain all the content and findings in the previous stages
- communicate your findings in a precise, well-structured and engaging manner
- take into account my feedback at every stage
- rely on a handout, visual aid or any other devise you deem appropriate
- 5-10 minutes (if you work alone) or 10-15 (if you work in groups of 2-3)

Grading scheme

criteria	*unsatisfactory*	*satisfactory*	*good*	*very good*
HOOK				
ENGAGING				
CLARITY				
PRECISION				
ORGANIZATION				

Stage 8 – Final Report

(8a) Write a final report for the project. The report should

- contain all the content and findings in the previous stages
- take into account my feedback at every stage
- communicate your findings in a well-structured and engaging written form
- discuss what you have learned (if anything) from applying probability to your research question
- length is 5-7 pages (if you work alone) or 10-12 (if you work in groups of 2-3)

(8b) Attach to the report itself what you handed in to me for the previous stages along with my written comments, criticisms and suggestions.

(8c) Describe in one or two pages how you have addressed my comments, criticisms and suggestions, as you wrote the final report.

Grading scheme

criteria	*unsatisfactory*	*satisfactory*	*good*	*very good*
EXHAUSTIVITY				
ADDRESSING COMMENTS				
WRITING ENGAGINGLY				
CLARITY				
PRECISION				
ORGANIZATION				
GRAMMAR				