UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the Musqueam people.

Research Methods for Cognitive Systems

Instructor: Gary Neels
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Lectures: Friday, 1-4pm Buchanan B141
Office Hours: Monday, 12-1pm, Zoom

Course Description

The course is intended to help students become more responsible consumers of science. Science is a powerful institution. Often, the adjective *scientific* is attached to an opinion to give it an air of authority. But is that practice always legitimate? Is "Trust the Science" a good motto to live by? What is a sensible approach to evaluating scientific claims? Are there better and worse ways of doing and reporting science? What is the standard by which to judge science? When and how should we revise our opinions in response to scientific research? These are some of the questions we will be exploring in this course.

The course has two sections. The first section focusses on some foundational principles. We begin with a brief overview of philosophy of science, focussing on the question: "What is the logic that justifies scientific inference?" We will consider the problem of induction, the method of falsification, and the problem of underdetermination. We will then take a brief look at the formal tools of probability and decision theory, focussing on objective and subjective understandings of probability, and the use of statistics to inform epistemic probabilities. In the second part of the course, we consider some practical implications of these principles. We will examine experiment design, the role of non-epistemic values in science, the replication crisis in the social sciences, and anti-science conspiracy theories.

Texbook

There is no required textbook. Course readings will be available through Canvas. For further background on the more technical aspects of the course (probability and decision theory), students are encouraged to consult *Choices* by Resnik (1987) (available as an eBook from the library), and this on-line, open source probability course.

Course Outline

Week	Topic	Readings
1	Introduction	None
2	Logic and Inference	•Smith: "Evaluating Arguments" •Rodrigues: "Informal Fallacies" •Henrich et al: "Most People are not WIERD"
3	The Logic of Science	•Reichenbach excerpt from *Experience and Prediction* •Russell: "On Induction" •Popper excerpt from *Conjectures and Refutations*
4	Probability	•Hájek: "Interpretations of Probability"
5	Decision Theory	•Hansson: "Decision Theory: an Overview" •Godfrey-Smith: "Signal, Decision, Action"
6	Probability and Science	•Howson & Urbach "Bayesian Reasoning in Science" •Salmon "Bayes' Theorem and the History of Science"
7	Values in Science	•Russell: "Science and Values" •Bright: "DuBois' Democratic Defense of the Value Free Ideal" •Douglas: "Inductive Risk and Values in Science"
8	The Replication Crisis 1: Overview	•Open Science Collaboration: "Estimating Reproducibility in Psychological Science" •Kerr: "HARKing"
9	The Replication Crisis 2: Statistical Reform	•Travers, Cook, & Cook: "Null Hypothesis Significance Testing and p-values" •Romero & Sprenger: "Scientific Self-Correction the Bayesian Way"
10	Science and Conspiracy Theories	•Dentith & Keeley: "The Applied Epistemology of Conspiracy Theories" •Grimes: "On the Viability of Conspiratorial Beliefs" •O'Connor & Weatherall excerpt from *The Misinformation Age*
11-13	Student Presentations	None

Course Delivery

We will meet in-person for one, three-hour, weekly session. The meetings will feature lectures that explain and provide helpful background to the readings. Students are expected to attend all lectures and to have read the assigned readings prior to the lecture.

Communication

In addition to asking questions in class, you can communicate with me by email or by coming to office hours:

- Email: I will check the email listed at the top of this syllabus daily, during regular working hours. If you email me, you can expect to receive a response before the end of the next day, except for holidays and weekends. Please write "COGS 303" in the subject line.

- Office hours are listed at the top of this syllabus.

Email should be used for communication that is of a more personal nature (eg. concessions, your grade on an assignment, etc.) Questions about course content should be raised during class or during office hours.

Evaluation

With the exception of the final exam, all assignments will be submitted through Canvas.

- Participation (discussion boards) 10%
  From Week 2 to Week 10 students will write 2 posts per week (each post should be approximately one paragraph in length). The first post should raise a question or clarify a point from one of the readings. The second should respond to a post from one of their classmates. To receive participation credit, the posts will need to be submitted by **11:59pm Wednesday** each week.

- Problem set on probability and decision theory 15%
  Part of the course is a short introduction (or review) of probability and decision theory. This short problem set will be an opportunity for students to work with some practical applications of these concepts. **Due Oct 19, 11:59 pm**

- Research project: The structure of this project is meant to simulate the process of academic research. There are four components to the project: a proposal, a literature review, a short presentation, and a paper. The presentations will be given during the last three class sessions.

  - Topic Proposal 5%
    For this assignment, you will submit three topic proposals, each a half-page in length. I will provide feedback as to which proposal seems the most promising. The goal is for you to select a topic suited to your interests and goals. **Due Oct 5, 11:59pm**

  - Literature review 15%
    Having selected your topic, the next step is to prepare a 4-5 page literature review. The purpose of this exercise is for you to familiarize yourself with and summarize the contemporary discussion surrounding your topic. **Due Nov 2, 11:59pm**

  - Presentation 15%
    Having completed your literature review, this assignment gives you the opportunity to share what you have learned with your colleagues. You will give an 8-10 minute presentation of their research, followed by 2-4 minutes of questions from your peers. Slides are mandatory. Presentations will be during the scheduled class time for the last three weeks before the exam period **Nov 17, Nov 24, and Dec 1**

  - Research paper 25%
    The last step is for you to prepare and submit an 8-10 page research paper. **Due Dec 7, 11:59pm**

- Final exam 15%
  There will be a final exam during the regular exam period (date and location TBD). The exam will consist of three sections: some probability problems, short (several sentence) answer questions, and long (several paragraph) answer questions. The exam will be comprehensive, covering material from the entire course.

The course will use the standard UBC grading scale:

Letter Grade	Numerical Grade
A+	90-100
A	86-89
A-	80-85
B+	76-79
B	72-75
B-	68-71
C+	64-67
C	60-63
C-	55-59
D	50-54
F	0-49

Examples for research project topics include (but are not limited to):

- The replication crisis in social sciences (suggestions for causes or cures)

- Bayesian vs frequentist statistical methods

- The role of explanatory considerations in scientific inference

- Ethical implications of Artificial Intelligence

- Privacy concerns in data analytics

- Case study critiquing the methodology of a study

- The role of idealizations in formal representations of belief

- Cognitive biases in science

- Popper's critique of Freudian psychology

- The use of linguistic intuitions as evidence

- The use of interval scales for assessing degrees of grammaticality in linguistics research

- Informal vs experimental methods in linguistics

- Natural language testing in AI research

- Quantitative vs qualitative approaches to research in the social sciences

- Informed consent as a requirement for studying human subjects

- Contrast between academic research and industry research

- Modelling memories

- Brain injury detection

- Data visualization research

- Use of AI in medical research and/or practice

- The Turing Test for defining AI

You are encouraged to select a topic that is relevant to your interests and major.

Special Arrangements

Anyone requiring special arrangements should register with the Center for Accessibility. In addition, feel free to contact me with any concerns you might have.

Late Assignments and Concessions

Everyone is expected to turn their work in by the deadline. Assignments (with the exception of the final research paper) that are submitted after the deadline will be subject to a 10% penalty for each day (or portion thereof) that they are late. Due to time constraints with grading, final research papers will not be accepted after the deadline.

If your work is late because of a reason that is recognized by the University as warranting a concession (illness, family emergency, etc.), you should immediately submit a Student Self Declaration form (available on Canvas). Your first concession request should be submitted directly to me, and will be handled internally. Any subsequent requests must be submitted through your advising faculty.

If you miss the final exam, or are unable to turn in your final research paper on time, your concession request must proceed through your faculty, and will result in an SD. Your SD exam would then be coordinated through enrolment services at a later date.

Academic Honesty

Plagiarism will be taken very seriously. Please review this description of plagiarism taken from the UBC calendar:

> Plagiarism, which is intellectual theft, occurs where an individual submits or presents the oral or written work of another person as his or her own. Scholarship quite properly rests upon examining and referring to the thoughts and writings of others. However, when another person's words (i.e. phrases, sentences, or paragraphs), ideas, or entire works are used, the author must be acknowledged in the text, in footnotes, in endnotes, or in another accepted form of academic citation. Where direct quotations are made, they must be clearly delineated (for example, within quotation marks or separately indented). Failure to provide proper attribution is plagiarism because it represents someone else's work as one's own. Plagiarism should not occur in submitted drafts or final works. A student who seeks assistance from a tutor or other scholastic aids must ensure that the work submitted is the student's own. Students are responsible for ensuring that any work submitted does not constitute plagiarism. Students who are in any doubt as to what constitutes plagiarism should consult their instructor before handing in any assignments.

Note that work that has been produced by generative AI is not your own, and must not be submitted as such. Please let me know if you have any questions about this issue. I am happy to clarify anything that might be unclear.