Introduction to Formal Reasoning and Decision Making
Philosophy 109
Section 01, Fall 2020

Instructor: Dr. Max Bialek   **Email:** mbialek@rutgers.edu
Lecture: Online (Zoom), MTh 11:30am–12:50pm   **Office Hours:** TBA

Course Description.   "Fundamentals of logical, probabilistic, and statistical thinking, as well as the basic principles of rational decision making. Reasoning through data (and rhetoric) encountered on a daily basis using elementary principles of deductive logic and inference."

Resolving differences of opinion isn't always impossible. Figuring out what you should believe isn't just a matter of checking what's true. Deciding what you should do doesn't have to be left up to your whim. Formal tools have been (and continue to be) developed that enable us to talk very precisely about the strength of arguments and of evidence, the rationality of beliefs we have, and the value of choices we make.

This course will introduce students to some of those formal tools and their applications to formal reasoning and decision making: Sentential Logic will be used as a model for expressing ourselves carefully and judging deductive arguments. Probability and Statistics serve as tools for making inductive inferences, evaluating evidence, and quantifying risk and uncertainty. Decision Theory and Game Theory will provide methods that employ those logical and probabilistic tools in order to help guide our decision making. For all of these, we will also discuss their peculiarities, limits to their application, and their potential for expansion and sophistication.

Core Curriculum Learning Goals.   Please note that this course satisfies the SAS Core Quantitative and Formal Reasoning learning goals

(QQ) Formulate, evaluate, and communicate conclusions and inferences from quantitative information.
(QR) Apply effective and efficient mathematical or other formal processes to reason and to solve problems.

This is a Philosophy course, so the qualitative conceptual foundations and implications of the mathematics discussed will constitute a significant portion of the course material on which you are assessed. However, quantitative mathematical skills themselves will play no less of a role in the course material and assessment. It is assumed that you have some pre-college level mathematical skills (especially algebra and fractions), and success in this course depends heavily on the *kind* of thinking that one has to do in math classes.

If you are concerned about the math content of this course or whether you are prepared for it, please discuss the matter with the instructor as soon as possible.

Course Website. The course website is done through Canvas, and is available directly at https://rutgers.instructure.com/courses/67606. It is expected that you turn on alerts for announcements made on the course site so that you can stay up-to-date on any changes to the course.

Course Materials. We will be working exclusively from a book PDF provided by the instructor that will be hosted on the course's Perusall site (available via the course Canvas site).

Each chapter of the book ends with practice exercises. Solutions to those exercises can be found in the first appendix of the book, and video walkthroughs of some of the exercises will be posted to the course site.

Accessibility and Accommodations. Any needed accommodations or issues that might affect your academic performance should be brought to the attention of the instructor as soon as possible. Consult with the instructor or any of the following offices for help or more information:

- Academic Advising
- Student Health and Counseling
- Office of Disability Services
- Violence Prevention and Victim Assistance
- Scarlet Listeners

Student Conduct. You should make sure you are familiar with the rules regarding proper academic conduct as detailed at the Student Affairs' Academic Integrity website. Additional information regarding student conduct in general is available at the Office of Student Conduct website.

Assessment. The course is divided into three units—*Logic*, *Probability*, and *Decisions*—and eleven topics (four each in the first two units, and three in the third unit) that correspond with single chapters in the book. Assessment will be based on a mixture of exams, quizzes, and participation in both live meetings and asynchronous online discussions.

Each of the three units of the course will end with an exam worth 15% of the course grade. A comprehensive final exam will be worth 15% of the course grade. The lowest exam grade will be dropped, for a total of 45% of the course grade coming from exams. This means that if you do poorly on an exam, you can make up for it with the final, or, if you are happy with your grade going into the final, you can skip it. Exams will be conducted online during the regular scheduled course period and will require you to upload video answers and images of work that you do on paper.

There will be 11 online quizzes (one for each chapter), each worth 2.5% of the course grade. Each quiz may be taken twice, with the higher score being retained. The lowest of the 11 (retained) quiz grades will be dropped, for a total of 25% of the course grade.

There will be 11 asynchronous online discussion assignments (one for each chapter) conducted through **Perusall** (see below for more information). These will each be worth 2% of the course grade, and the lowest scoring discussion will be dropped, for a total 20% of the course grade being based on discussion posts.

There will be live meetings twice per week at the course's regular scheduled lecture time. The live meetings will be structured more like office hours than a lecture—i.e. most of the time will be taken up with back-and-forth Q&A and activities like breaking up into groups to do practice problems before working through them as a class. Your participation in these meetings will be evaluated (see below) and constitute 10% of the course grade.

In short:

20% — 10 Discussions at 2% each (best of 11)
25% — 10 Quizzes at 2.5% each (best of 11)
10% — Live Meetings
45% — 3 Exams at 15% each (best of 3 Unit Exams and 1 Comprehensive Final)

All grades will be given in numerical form. The course grade will be based on the weighted average described above, and the following scheme will be used to convert its numerical value to a letter grade:

$$A \geqslant 90 > B+ \geqslant 87 > B \geqslant 80 > C+ \geqslant 77 > C \geqslant 70 > D \geqslant 60 > F$$

Extra Credit. The "best of" structure to the course's grading makes the last discussion post, the last quiz, and the comprehensive final exam function as extra credit that is already built into the course.

Please do not ask for additional extra credit.

Perusall. Perusall helps you learn faster by collaboratively annotating the readings and communicating with your classmates. Collaboration gets you help whenever you need it, makes learning more fun, enables you to help others (which research shows is also a great way for you to learn), and helps your instructor improve the course by emphasizing information that you need.

If you have a question or information to share about a passage in the readings, highlight the text and type in a comment as an annotation. You can also respond to a classmate's annotation in threads in real time or upvote questions you find helpful. Good annotations contribute to the class by stimulating discussion, explaining your thought processes, helping others, and drawing attention to good points. (I strongly encourage you to look at these examples and to pay special attention to what is said about the "meets expectations"/"improvement needed"/"deficient" ratings.) If a particular classmate's point is relevant, you can explicitly @/mention them and they will be immediately notified, even if not presently signed on—you can even mention the instructor if you'd like to specifically request their input on a discussion.

Research shows that the following behaviors on Perusall predict higher end-of-semester grades and long term mastery of the subject.

- Contributing thoughtful questions and comments to the class discussion, spread throughout the entire reading
- Starting the reading early
- Breaking the reading into chunks (instead of trying to do it all at once)
- Reading all the way to the end of the assigned reading
- Posing thoughtful questions and comments that elicit responses from classmates
- Answering questions from others
- Upvoting thoughtful questions and helpful answers

The extent to which you do these things will play a role in determining your score. Between them, there is 160% of a full score to be earned, so you do not actually have to do any of them perfectly. If you are concerned about your score on a particular assignment, you can contact the instructor for advice on where there is room for improvement.

Live Meetings. Attendance is expected. It is also expected that you will read the relevant chapter before the first live meeting that covers it.

The most reliable way to succeed in this course is by being present, prepared, engaged, and asking questions if you don't understand something. Our synchronous meeting time is, first and foremost, an opportunity for you to interact with the instructor so as to improve your understanding of the course content. Passively listening to a live meeting discussion or exercise walk-through is likely to help you even less than simply sitting on your own and reading the book. Everyone—you, the instructor, and the rest of the class—will have a better time and learn more when course content is *discussed* and not merely reported.

If you expect to miss any live meetings, please use the University's absence reporting website to indicate the date(s) and reason(s) for your absence.

Schedule. Below is a *tentative* schedule for the course. Check the course website announcements at least once a week for any possible changes. Readings should be done *before* the class on which they are listed. Note that the online quizzes and discussion posts are not listed below. One of each will be due per chapter. Specific due dates will be listed online.

(Th) Sep 3 Introduction

- **Unit I: Logic**

(M) Sep 7 NO CLASS (Labor Day)
(Tu) Sep 8 *Ch. 1: Simple Sentences* (designated Monday classes)
(Th) Sep 10

(M) Sep 14 *Ch. 2: Complex Sentences*
(Th) Sep 17

Sep 21 *Ch. 3: Translations*

Sep 24

Sep 28 *Ch. 4: Arguments*
  Oct 1

  Oct 5 Review
  Oct 8 *Exam 1*

- **Unit II: Probability**

Oct 12 *Ch. 5: Classical Probability*
Oct 15

Oct 19 *Ch. 6: Axiomatic Probability*
Oct 22

Oct 26 *Ch. 7: Frequentism*
Oct 29

 Nov 2 *Ch. 8: Bayesianism*
 Nov 5

 Nov 9 Review
Nov 12 *Exam 2*

- **Unit III: Decisions**

Nov 16 *Ch. 9: Representing Decisions*
Nov 19

Nov 23 *Ch. 10: Decision Rules*
Nov 26 NO CLASS (Thanksgiving Recess)

Nov 30
  Dec 3 *Ch. 11: Games*

  Dec 7 Review
 Dec 10 *Exam 3*

- **Final**

(M) Dec 21 *Final Exam*, 12–3pm