El Camino College
COURSE OUTLINE OF RECORD – Official

Subject:	PHIL
Course Number:	116
Descriptive Title:	Introduction to Inductive Logic and Probability Theory
Division:	Behavioral and Social Sciences
Department:	Philosophy
Course Disciplines:	Philosophy
Catalog Description:	This course will focus on the basics of inductive logic and probability theory. Students will learn about traditional statistical methods, the basics of probability theory, Bayes' rule, the role of induction in scientific reasoning, and the philosophical problem of induction. Students will also learn about normative issues surrounding inductive inference.
Prerequisite:	Intermediate algebra or appropriate assessment for CCSM (common core standards for math)
Co-requisite:	
Recommended Preparation:	
Enrollment Limitation:	
Hours Lecture (per week):	3
Hours Laboratory (per week):	0
Outside Study Hours:	6
Total Course Hours:	54
Course Units:	3
Grading Method:	Letter Grade and Pass/No Pass
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	pending
Transfer UC:	Yes
Effective Date:	pending
General Education ECC:	Area 4B - Language and Rationality: Communication and Analytical Thinking, Area 6 - Mathematics Competency
Term:	
Other:	
CSU GE:	Area B4 - Physical Universe and its Life Forms: Mathematics/Quantitative Reasoning
Term:	
Other:	
IGETC:	Area 2A - Mathematical Concepts and Quantitative Reasoning
Term:	
Other:	

Student Learning Outcomes:	**SLO #1 Basics methods of inductive reasoning** Students will be able to use and understand various inductive reasoning methods, including interpreting statistical data, using Bayes' rule, and employing basic probability theory and decision theory. **SLO #2 Inductive reasoning in practice** Students will be able to explain the relevance of inductive reasoning in the process of science as well as the various ethical issues that might arise in the use of inductive methods in daily life. **SLO #3 Problems about induction and probability** Students will be able to recognize and explain problems in the foundations of inductive reasoning and probability theory, including the so-called "statistics wars" and the problem of induction.
Course Objectives:	1. Differentiate between inductive and deductive arguments. 2. Calculate and understand basic probabilities. 3. Use the basic tools of decision theory to combine probabilities and utilities. 4. Identify basic fallacies associated with probabilistic reasoning. 5. Explain the different approaches to probability itself, including frequentism and Bayesianism. 6. Use methods where probability is understood as relating to frequency. 7. Understand and explain Bernoulli's Theorem. 8. Understand the basic theories behind why one might accept or rejecting a hypothesis, including significance testing and the power of a test to discriminate false hypothesis. 9. Understand how inferences can and should be made using statistical methods. 10. Use methods where probability is understood as a measure of belief. 11. Employ methods in conditional probability as well as Bayes' rule. 12. Identify various ethical issues that might arise during data collection. 13. Explain why practices like p-hacking, HARKing, and using poor-quality data are potentially unethical practices in inductive reasoning. 14. Understand and explain why using opaque machine learning models raises ethical questions.

	15. Explain the philosophical problem of induction, as well as some proposed solutions.
Major Topics:	I. **Logic (3 hours, lecture)** A. The Two Branches of Logic B. Inductive Logic II. **Calculating Probabilities (9 hours, lecture)** A. Elementary Probability B. Conditional Probability C. The Rules of Probability D. Inductive Fallacies E. Bayes' Rule III. **Decision Theory (9 hours, lecture)** A. Basic Concepts in Decision Theory B. Decision-making Under Uncertainty IV. **Competing Theories about Probability (9 hours, lecture)** A. Probability as a Measure of Belief B. Probability as Frequency V. **Methods in (Frequentist) Statistics (9 hours, lecture)** A. Calculation and Interpretation B. Methods of Data Collection C. Linear regression and correlation D. Distributions E. Inferential Statistical Methods VI. **Ethical and Philosophical Issues (15 hours, lecture)** A. The Replication Crisis B. P-hacking, HARKing, and Poor-quality Data C. Unethical Data Collection D. Unethical Use of Opaque Models E. The Problem of Induction F. The Relationship Between Induction and Scientific Progress
Total Lecture Hours:	54
Total Laboratory Hours:	0
Total Hours:	54
Primary Method of Evaluation:	3) Skills demonstration
Typical Assignment Using Primary Method of Evaluation:	PHIL 116 <u>To Insure or Not to Insure—That is the Question!</u> *Directions*. Consider the situation that William is in and answer items a-f below. William's only valuable possessions are a used car, worth $5,400, and his grandfather's gold pocket watch, which he keeps unlocked in his boarding house. It is worth $600.

	The probability of his car being stolen in the course of one year is 1/900. But there are so many untrustworthy strangers dropping in at the boarding house, that the probability of his watch being stolen is 1/30. Assume that the two types of theft are statistically independent. a. What is the probability that both watch and car are stolen? Watch and not car? Car and not watch? Probability of no loss either way? An insurance company offers William theft insurance on both items for $60, with a deductible of 10% (it pays him only 90% of the true value of a stolen item). Let I be the act of buying insurance. Let D be the act of declining to buy insurance. b. What are the possible consequences of D? Determine Exp(D). b. What are the possible consequences of I? Determine Exp(I). b. Should William insure or not? Suppose that William has a note in the car telling where the watch is, so that we expect that someone who steals the car is more likely to steal the watch too: Pr(watch stolen/ car stolen) > Pr(watch stolen). e. Are the two types of theft still statistically independent? e. Now explain, qualitatively, how such nonindependence would affect Exp (I).
Critical Thinking Assignment 1:	PHIL 116 <u>The Ethical Use of Algorithms</u> *Directions*. Consider the situation that Denise is in and answer the questions below. Denise is a teacher at a high school that has implemented machine learning (ML) algorithms to predict which teachers are “effective” and which are not. The ML model is trained on students’ standardized test scores, course grades, and number of absences. To motivate teachers, the principal has decided to give bonuses to those teachers who score high and fire those who score very low. Considering the dataset that the ML models are trained on, how might one argue that these algorithms are not designed to gauge how effective a teacher is? What other factors might affect students’ standardized test performance, course grades, and attendance *other than* what Denise does or does not do? Because of all the excitement around the bonuses, some teachers began to cheat: they would correct the wrong answers on standardized tests after their students had turned in the exam. Denise, however, does not cheat. What’s going to happen when a class

	with doctored test scores (from a cheating teacher) becomes Denise's class next year? Can this justifiably be attributed to Denise's teaching? Suppose Denise received a poor evaluation from the ML algorithms. She asks to see the code for the algorithms, but she is told that it is proprietary (private property). What ethical concerns does this raise?
Critical Thinking Assignment 2:	PHIL 116 <u>To HARK or not to HARK?</u> *Directions*. Consider the situation that Andy is in and answer the questions below. Andy is a grad student. She is assisting one of her professors with a new article, but she suspects this professor is HARKing. HARKing stands for **h**ypothesizing **a**fter **r**esults are **k**nown. Basically, it is when you take a data set and run a bunch of statistical tests with no particular hypothesis in mind. If and when a publishable p-value is found, the researcher in question forms a hypothesis after the fact to fit the finding, making it look as if that's what was being tested for all along. 1. If someone takes a data set and runs enough statistical tests on it, why is it that a publishable result will eventually be found? 2. Suppose this professor eventually finds a statistical test that gets a p-value under 0.05. Andy is then instructed to ignore all the other statistical tests that were run and write a paper based on the hypothesis that aligns with the publishable p-value. Why might one object to this practice?
Other Evaluation Methods:	
If Other:	
Instructional Methods:	Lecture
If other:	
Work Outside of Class:	Answer questions, Problem solving activity
If Other:	
Up-To-Date Representative Texts:	Hacking, Ian. An introduction to probability and inductive logic. Cambridge University Press. 2001. (Discipline Standard) Huber, Franz. A Logical Introduction to Probability and Induction. Oxford University Press. 2018. (Discipline Standard) Johnson, Gregory. Argument and Inference: An Introduction to Inductive Logic. MIT Press. 2017. (Discipline Standard)
Alternative Texts:	
Required Supplementary Readings:	
Other Required Materials:	
Requisite	

Category	
Requisite course:	
Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).	
Requisite Skill:	Intermediate algebra or appropriate assessment for CCSM (common core standards for math)
Requisite Skill and Matching skill(s): Bold the requisite skill(s). if applicable	Recognize functional relationships in the form of graphs, data or symbolic equations. Using numerical, symbolic and graphical methods, model application problems, solve them and interpret the results in the context of the problem.
Requisite course:	
Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).	
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Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Roberto Carlos García
Date:	10/19/2023
Original Board Approval Date:	01/17/2024
Effective Term:	FALL 2025
COURSE CODING (completed by Division)	
TOP Code:	1509
CIP Code:	38.0101
CID:	N/A
Basic Skills:	N/A
Cooperative Work Experience:	No
Course Classification Status:	Credit Course

Approved Special Class:	No
Noncredit Category (N/A, ESL, Workforce Prep, etc.):	N/A
Course Prior to Transfer Level (N/A, 1 level prior to transfer, 2 levels, etc.):	N/A
Funding Agency Category:	N/A
Course Program Status:	Program Applicable
Support Course Status:	Course IS NOT a Support Course
Course Fulfills CSU GE Area F (Ethnic Studies):	No