CORE CURRICULUM COMPONENT APPLICATION
Sam Houston State University

Revised October, 2012

PART I – Course Information

Course Type
☒ Existing/Restructured
☐ New Course Proposed Fall 2013
If new, have you submitted a Form B to the SHSU Curriculum Committee? ☐ Yes ☐ No

Course Prefix & Number: PHIL 2303

Texas Common Course Number (TCCN Matrix)**:** phil 2303

Course Title: Critical Thinking

Course Catalog Description (Copy and paste from online catalog for existing courses): [PHIL 2303] Designed to improve students' ability to think critically. The course covers the fundamentals of deductive reasoning, the identification of common fallacies, and an introduction to inductive reasoning, as well as sensitizing the students to some of the ways information is distorted, e.g., by advertising and news management. Credit 3

Course Prerequisites: None

Available Online?
☒ Yes, currently developed in online delivery mode
☐ Anticipated development in online delivery mode (Semester, Year:)
☐ No

Number of Sections to be Offered per Academic Year: 8-10

Estimated Enrollment per Section: 35

Course Level (freshman, sophomore): sophomore

Designated Contact Person (for follow-up communication purposes): Frank Fair

E-Mail Address: psy_fkf@shsu.edu

Phone: 936-294-1509

Approvals

Department Chair: _____ Signature 10-15-12 Date

Academic Dean: _____ Signature 10/19/12 Date

Submit completed, signed form to Core Curriculum Committee - Box 2478 or Fax 4-1271

PART II – THECB Foundational Component Areas

See Appendix for full description of each component area.

Select Component Area: VIII. Social and Behavioral Sciences

In one paragraph, describe how the proposed course will fulfill the core and skill objectives of the component area:

The PHIL 2303 Critical Thinking course is currently an option in the Core Curriculum under this component area, and it is required by the Psychology faculty that their majors take this course because it reinforces or anticipates lessons they will be learning in many of their psychology courses. The overarching goal of a Critical Thinking course is to teach students methods that are used generally across cultures to differentiate between strong or valid inferences and those inferences that are weak or invalid. To this end topics covered include the deductive and inductive reasoning involved in testing hypotheses, generalizing on the basis of samples, the basics of comparative experimental design, and an emphasis on recognizing and explaining various fallacious inferences such as jumping too quickly from a correlation to a cause and effect conclusion, and classics like Straw Man, Ad Hominen, Begging the Question, and False Dilemma. This embodies the Content Objective of recognizing and applying criteria for the acceptability of social research and the Critical Thinking Skills Objective, especially with regard to the inquiry, analysis and evaluation components. Also, the Philosophy Program has made a commitment to improving students' reasoning about probabilities, including using Bayes' theorem. This is a commitment which we assess by using a pre-post test item comparison from the Texas Assessment of Critical Thinking Skills Test. This relates directly to the Empirical and Quantitative Skills Objective. The mode of instruction in the course, following a standard textbook presentation (see a Table of Contents of the current textbook as one of the attachments), is to discuss a relevant concept and then move directly to in-class, student-led, active discussion, often in groups, of assigned homework problems that require the application of that concept. The discussion of the homework problems allows students to sharpen their grasp on the concept, and it gives them an opportunity to communicate orally their analyses of the arguments in the problems Some of the problems involve diagramming arguments to clarify their structure, and students turn in their written analysis of the homework problems. This meets the Communication Skills objective. The homework problems typically involve issues that are controversial, and thus they involve analyzing sometimes sharply different points of view, thereby meeting the Content Objective of "Differentiate and analyze different points of view." One of the central goals of the course is to better equip students, as the language of the Content Objectiveputs it, to "recognize and assume one's responsibility as a citizen in a democratic society by learning to think for onself, by engaging in public discourse" about issues in a way that strives to present fairly the various sides of an issue (avoiding the Straw Man), that does not prematurely close off discusson (avoiding Begging the Question), that focuses on relevant considerations (avoiding Ad Hominem), that considers a full range of options (avoiding a False Dilemma), and that seeks and uses the best evidence available. Hence the Social Responsibility Skill Objective involving the "ability to engage effectively in regional, national, and global communities" is addressed.

PART III – Course Objectives & Student Learning Outcomes (SLO)

Insert the applicable course objectives stated as student learning outcomes (e.g., Students completing the course will be able to...) that support the core component area objectives. Please reference the component rubric for additional information on core component area objectives.

Objective/SLO 1: Objectives are spelled out in text below

How will the objective be addressed (including strategies and techniques)?
The language of the Objective: "There is a focus on the application of empirical and scientific methods, so students who complete the course should recognize and apply reasonable criteria for the acceptability of social research." Ways in which the Objective is addressed:(1) First, the course stresses the need to think in terms of testable hypotheses, hypotheses that generate predictions that can be compared with data. The notion of an "intelligent designer" for example seems to fail this test because there is no way of predicting what the alleged designer will do next. (2) If we say that the data support a particular hypothesis because its predictions came true, the logic of testing stresses that we need first to conceive of and rule out alternative possible explanations before we simply accept that the hypothesis has been confirmed. Thus the standard issue: if the occurrence of A is correlated with the occurrence of B, this may be because (a) A causes B, (b) B causes A, (c) C causes both A and B, or (d) chance. If the other three possible explanations can be legitimately ruled out, then the correlation of A with B is evidence that A causes B. Homework exercises discussed in class will deal with a number of specific illustrations of this principle. (3) Generalizations need to be supported by samples that are large enough and relatively unbiased--not simply by a vivid anecdote that typically provides a single, carefully chosen case, in other words a biased sample of size one. Again, homework examples will present a variety of cases for analysis. (4) Designing an experiment whose results avoid (at least obvious) confounding results in a task for students to respond to given a description of the research question and the resources available by outlining how they would set up the experiment and why they take the steps they do.

Describe how the objective will be assessed: Here are two examples:(1) With regard to the logic of hypothesis testing the student will be required to produce the relevant logical patterns (Refutation: If H, then P, P is false, so therefore Not H and Confirmation: If H then P, P is true, so therefore H is true) and explain the difference in logical strength between the two inferences (Refutation is deductively valid, confirmation is not.) (2) With regard to inductive reasoning, here is a sample exam question: "You have a sample of 200 patients with lung cancer who have volunteered to help you test a new chemotherapy regimen. Of course you are trying to see if the new treatment increases the 5-year survival rate. Describe how you would set up the experiment to test the new chemotherapy regimen and as you do be sure to use and define such relevant concepts as: (a) confounding, (b) control, (c) blocking, (d) double blind, (e) null hypothesis, (f) statistically significant difference, (g) level of significance." This item checks for correct definitions of key concepts and then the accurate use of those concepts in describing the construction and execution of a randomized controlled clinical trial.

Objective/SLO 2: Objectives are spelled out in text below

How will the objective be addressed (including strategies and techniques)?
In the language of the Objective: "This course explores behavior and interactions among individuals, groups, institutions, and events" so that the student will be able to "differentiate and analyze differing points of view." This objective is addressed throughout the course. For instance, here is a representative example homework item from the textbook Critical Thinking: Consider the Verdict by Bruce Waller (6th ed. p. 208): "Mike Huckabee, the former governor of Arkansas. claimed in his recent book (A Simple Government) that research on the comparative effectiveness of various medical treatments ... are the 'seeds from which the poisonous tree of death panels will grow.'" This is obviously a controversial assertion, and that presents the opportunity to evoke the differing points of view that would accept the statement as true on the one hand and that would reject it on the other. Only after that work is done can one attempt to give one's own reasoned assessment of the assertion.

Describe how the objective will be assessed: With regard to the example problem, the student will be required (a) to notice the assertion of an alleged connection between the research on comparative effectiveness and "the poisonous tree of death panels," (b) to present clarification of the meanings of the key terms, "comparative effectiveness research" and "death panels," and (c) express both the point of view the sees the research as very likely leading to death panels and the point of view that sees such connection as as unlikely.

Objective/SLO 3: Objectives are spelled out in text below

How will the objective be addressed (including strategies and techniques)?
The language of the Objective states that a student will "recognize and assume one's resposibility as a citizen in a democratic society by learning to think for oneself, by engaging in public discourse, and by obtaining information through the news media and other appropriate information sources." How this objective is addressed is a cumulative matter for the course as a whole. The point of the instruction in things like the logic of hypothesis testing, the need for representative samples, the reason for relying on carefully controlled studies, and the identification of common fallacies is precisely to equip students with tools that enable them to "think for oneself." Preparing written responses to homework problems and then presenting those analyses to fellow students either in small groups or to the class as a whole gives students significant opportunities to practice so that they may better "engage in public discourse."

Describe how the objective will be assessed: Here is an example item that students can be required to analyze: "A genetic biochemical deficiency could be the reason some persons become alcoholics while others don't. Dr. Stanley Gitlow, President of the American Medical Society on Alcoholism, [stated] that more than 80 percent of the alcoholics he has seen had a blood relative who also was an alcoholic." A thorough analysis of this item would note first that this is an Appeal to Authority and explain why or why not to rely on Dr. Gitlow's authority on this matter. Then one should note that a correlation is being used as a basis for an assertion about a genetic biochemical deficiency leading to alcoholism. But there is not enough evidence for the existence of the correlation, since it may be that 80% of all of us have a blood relative who is an alcoholic. Then we are asked to take Dr. Gitlow's practice as a representative sample--is it? Specify what would one like to know before jumping to that conclusion. Perhaps, finally, even if the practice is representative and the correlation is definitely in the data, specify an alternative possible explanation for the correlation since you cannot confirm a hypothesis without first thinking of and being able to rule out alternative possibilities. In this case, for example, the fact

blood relatives often share much more than genes--often they live with one another, they share a similar family history, they model significant behavior, etc.--presents another possible explanation.

Objective/SLO 4:

How will the objective be addressed (including strategies and techniques)?

Describe how the objective will be assessed:

Objective/SLO 5:

How will the objective be addressed (including strategies and techniques)?

Describe how the objective will be assessed:

PART IV – THECB Skill Objectives

Address each of the THECB skill objectives required within the component area. Explain how the skill is addressed, including specific strategies to address the skill(s). *Address ALL skill objectives associated with the selected Component Area. (See Appendix)*

1. Critical Thinking Skills: to include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information

How will the skill be addressed (including specific strategies, activities, and techniques)?
The focus in a critical thinking class is on the analysis and evaluation of information. The goal is to familiarize students with tools to use to analyze a piece of reasoning from the standpoint of how valid or how strong, or how weak and fallacious it is. The usual introduction to the course is to present concepts such as premise, conclusion, inference indicator words like "since" and "hence," and then the homework is to look at specific bits of prose to be able to successfully identify those that contain arguments--reasoning for conclusions--versus other forms of prose such a narratives. What follows the introduction will often involve practice in distinguishing deductive reasoning--reasoning where the truth of the premises would absolutely guarantee the truth of the conclusion--from inductive reasoning wherein if the premises (the evidence, data, etc.) are true they render the conclusion to some degree more likely to be true than false. This matter of degree then needs to be explored with specific homework examples. Finally, there is a set of mistakes in reasoning that are wide-spread such as False Dilemma , Begging the Question, Straw Man, Ad Hominem, etc. After becoming familiar with the terminology, the students are asked to apply the fallacy labels to specific examples of reasoning and to give an explanation of why a label fits as a way of expressing the particular mistake.

2. Communication Skills: to include effective development, interpretation and expression of ideas through written, oral and visual communication

How will the skill be addressed (including specific strategies, activities, and techniques)?
The skill will be addressed by having regular homework assignments, usually problems from the textbook, which require students (a) to write up their analyses of the problems assigned and then (b) bring their analyses to class where they serve as the basis for class discussion, either in small groups or as a whole class. The writing and the oral discussion are to be focused on giving reasons why a particular analysis fits a given homework item. So, for example, if the item presents an argument that involves an Appeal to Authority (X says P is true, so therefore we should think P is true), reasons need to be given as to whether the Appeal to Authority is valid or fallacious--Is X in a position to know that P is true? Does X have some reason to misrepresent the truth? What credentials should X have before we simply accept X's word? Do the experts agree? Or do they disagree? etc. etc. As far as visual communication is concerned,

one way to represent argument structure, instead of presenting a list of statements, is to make diagrams that indicates what the starting point of the argument is and connects (often with arrows) the subsequent steps of the argument. This technique often clarifies just which parts of an argument are supported by other parts and which are unsupported.

3. Empirical and Quantitative Skills: to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions

How will the skill be addressed (including specific strategies, activities, and techniques)?
The basics of the logic of hypothesis testing, using both inductive and deductive reasoning, are presented in a step-by-step fashion.This includes familiarizing students with concepts such a random sampling error and biased sampling, the use of control groups in experimentation in order to rule out confounding variables, and Bayes' theorem.Then homework problems present students with situations to analyze using these concepts. For example, when it was proposed during the early years of the AIDS epidemic that everyone be subject to mandatory AIDS testing, given the relatively low base rate in the population and even a small propensity to generate false positives, using Baye' theorem to represent the situation shows that such a program would have meant false positive "death sentences" for literally hundreds of thousands of people. Fast forwarding to more recent times, proposals to require mandatory retinal eye scans of airline passengers before boarding in order to detect false answers to "Are you a terrorist?" would obviously have similar problems of producing a huge number of false positives.

4. Teamwork: to include the ability to consider different points of view and to work effectively with others to support a shared purpose or goal

How will the skill be addressed (including specific strategies, activities, and techniques)?
N/A

5. Personal Responsibility: to include the ability to connect choices, actions and consequences to ethical decision-making

How will the skill be addressed (including specific strategies, activities, and techniques)?

N/A

6. Social Responsibility: to include intercultural competence, knowledge of civic responsibility, and the ability to engage effectively in regional, national, and global communities

How will the skill be addressed (including specific strategies, activities, and techniques)?
Fundamental to the concept of responsibility is the ability to give reasoned explanations for specific courses of action. Often the examples in the homework relate to giving reasons in response to issues that have presented or may present themselves to people in the course of their lives as citizens. The point of the process in the classroom is to stress careful analysis of the reasoning and to offer a diagnosis of its strength or weakness based on consideration of the evidence, how it was procured, whether there is importantly relevant information that has been neglected, etc. etc. This stengthens the students' ability to engage effectively in regional, national, and global communities. So when former astronaut Walter Cunningham writes an op-ed piece in the 8/15/2010 edition of the Houston Chronicle that "About 20 years ago, a small group of scientists became concerned that temperatures around the Earth were unreasonably high and a threat to humanity. In their infinite wisdom, they decided that 1) CO2 (carbon dioxide) levels were abnormally high, 2) that higher levels of CO2 were bad for humanity, 3) that warmer temperatures would be worse for the world, and 4) that we are capable of overriding natural forces to control the Earth's temperature. Not one of these presumptions (opinions) has proven to be valid! The group decided to challenge the accepted "theory" of climate change when they hypothesized that human generated CO2 was responsible for global warming. They have been trying to generate support for their beliefs ever since. Their new hypothesis of anthropogenic global warming (AGW) gained immediate traction with environmentalists and the "green movement," the media and, eventually, politicians. It has gained little acceptance among legitimate scientists." It is a simple thing to do to require students to check this last assertion. When they find that it is utter rubbish, since the fact of consensus among climate scientists is easy to verify, then the lesson that one of requirements of living in a demcratic society is that one needs to be on the alert for all sorts of people who are trying their best to sell you a phony bill of goods, and you can do something to lessen the likelihood being snookered.

PART V – SHSU Core Curriculum Committee Requirements

1. Using a 15-week class schedule, identify the topics to be covered during each week of the semester. Provide sufficient detail to allow readers to understand the scope and sequence of topics covered.

Week 1	Introduce basic concepts such as argument, premise, conclusion, premise and conclusion indicators. Begin to see reasoning as a structured process and be able to identify components of the structure. Present deductive reasoning patterns such as Affirming the Antecedent (Modus Ponens), Denying the Consequent (Modus Tollens), Disjunctive Syllogism, Hypothetical Syllogism.
Week 2	Extend the scope of the basic concepts by working with arguments that are longer and have more

	diverse structures. Have students present their analyses of the argument structures from their homework problems.
Week 3	Extend the scope of the basic concepts by going over further homework exercises in class and look at the psychological studies of human inferencing that document tendencies to leap to misguided conclusions--hence the ironic title of Gilovich's How We Know What Isn't So.
Week 4	The logic of hypothesis testing--in simple versions, then in more complex, but more realistic versions. A basic theme is the difference in logical strength between falsifying inferences versus confirming inferences. Testability as a requirement for genuinely scientific hypotheses.
Week 5	Basic argument diagramming to display structure--chain arguments, convergent arguments, and arguments with linked premises. Also some notes on classical syllogistic reasoning involving the Square of Opposition with Universal Affirmatives, Universal Negatives, etc.
Week 6	One class period for review for first exam and one class period to administer first exam
Week 7	Start the Unit on Inductive Reasoning: The Quality of the Evidence and Evaluating Explanations by studying concepts concerning sampling--random and nonrandom sampling error--and experimental design. Begin homework assignments on problems that call for the application of those concepts. In particular, note the issue of jumping from correlations in the data to conclusions about cause and effect.
Week 8	More homework problems, a writing assignment using FactCheck.org to illustrate the contrast between a source that does careful fact checking and all too many other sources.
Week 9	More homework assignments accompanied by reading in Gilovich's How We Know What Isn't So about various human propensities to jump to faulty conclusions that only seem well supported. Gilovich's research on the "hot hand" illusion in basketball is a classic. A quiz administered to check how well the students are grasping the material before the exam over the unit.
Week 10	More homework problems and more from Gilovich.
Week 11	Review and administer major unit exam.
Week 12	Begin unit that focuses on fallacy analysis by introducing fallacies such as Ad Hominem, Straw Man, False Dilemma, Begging the Question, etc. This unit makes essential use of the material presented in the first two units. Thus a Hasty Conclusion fallacy may be the result of a failure to secure a representative sample that is needed to support a generalization. A False Dilemma may be committed by a piece of reasoning that is powerful in the sense that if you were to grant the premises you would have to grant the conclusion, but in the actual case the premise that presents the alternatives omits one that should be considered before a conclusion is drawn. Homework problems and class discussion proceed accordingly.
Week 13	Homework analyzing particular examples and attempting to give reasons for a particular fallacy diagnosis.
Week 14	Focus on evaluating probability statements using the well-known work of Tversky and Kahneman as illustrated by the "Linda" problem. Special attention to Bayes' theorem as a way of thinking about the power of a piece of evidence to raise the probability of a hypothesis in connection with medical diagnostic testing and the law.
Week 15	Review for comprehensive final exam.

2. Attachments (Syllabus Required)

Syllabus Attached? ☒ Yes ☐ No

Other Attached? ☒ Yes ☐ No If yes, specify: There are several handouts attached that help to convey in summary fashion the ways in which topics such as the logic of

hypothesis testing, generalizing on the basis of samples, design of a randomized controlled clinical trial, and probabilty reasoning using Bayes' theorem are addressed.

Appendix: THECB Component Area Descriptions and Skill Requirements

I. Communication (Courses in this category focus on developing ideas and expressing them clearly, considering the effect of the message, fostering understanding, and building the skills needed to communicate persuasively. Courses involve the command of oral, aural, written, and visual literacy skills that enable people to exchange messages appropriate to the subject, occasion, and audience.)

II. Mathematics (Courses in this category focus on quantitative literacy in logic, patterns, and relationships. Courses involve the understanding of key mathematical concepts and the application of appropriate quantitative tools to everyday experience.)

III. Life and Physical Sciences (Courses in this category focus on describing, explaining, and predicting natural phenomena using the scientific method. Courses involve the understanding of interactions among natural phenomena and the implications of scientific principles on the physical world and on human experiences.)

IV. Language, Philosophy, and Culture (Courses in this category focus on how ideas, values, beliefs, and other aspects of culture express and affect human experience. Courses involve the exploration of ideas that foster aesthetic and intellectual creation in order to understand the human condition across cultures.)

V. Creative Arts (Courses in this category focus on the appreciation and analysis of creative artifacts and works of the human imagination. Courses involve the synthesis and interpretation of artistic expression and enable critical, creative, and innovative communication about works of art.)

VI. American History (Courses in this category focus on the consideration of past events and ideas relative to the United States, with the option of including Texas History for a portion of this component area. Courses involve the interaction among individuals, communities, states, the nation, and the world, considering how these interactions have contributed to the development of the United States and its global role.)

VII. Government/ Political Science (Courses in this category focus on consideration of the Constitution of the United States and the constitutions of the states, with special emphasis on that of Texas. Courses involve the analysis of governmental institutions, political behavior, civic engagement, and their political and philosophical foundations.)

VIII. Social and Behavioral Sciences (Courses in this category focus on the application of empirical and scientific methods that contribute to the understanding of what makes us human.
Courses involve the exploration of behavior and interactions among individuals, groups, institutions, and events, examining their impact on the individual, society, and culture.)

Required Skill Objectives

Foundational Component Areas	Skill Objectives					
	Critical Thinking	Communication	Empirical & Quantitative	Team Work	Social Responsibility	Personal Responsibility
Communication	✓	✓		✓		✓
Mathematics	✓	✓	✓			
Life and Physical Sciences	✓	✓	✓	✓		
Language, Philosophy & Culture	✓	✓			✓	✓
Creative Arts	✓	✓		✓	✓	
American History	✓	✓			✓	✓
Government/Political Science	✓	✓			✓	✓
Social and Behavioral Sciences	✓	✓	✓		✓	

Submit completed, signed form to Core Curriculum Committee - Box 2478 or Fax 4-1271

PHIL 2303: Critical Thinking Generic Syllabus Semester _____

Instructor_____, Office: _____ Phone: _____ Email:_____
Office Hours: MWF 9:00-10:00, TTH 9:30-10:30 and other times by appointment.

CATALOGUE COURSE DESCRIPTION PHIL 2303 Critical Thinking--Designed to improve students' ability to think critically. The course covers the fundamentals of deductive reasoning, the identification of common fallacies, and an introduction to inductive reasoning, as well as sensitizing the students to some of the ways information is distorted, e.g., by advertising and news management. Credit 3.

OBJECTIVES:
(1) To acquaint each student with some basic concepts used in the analysis and evaluation of deductive and inductive reasoning,
(2) to give each student practice in analyzing such reasoning, and
(3) to help the student recognize common fallacies.

TEXTS: Lewis Vaughn *The Power of Critical Thinking* (3rd edition)
Thomas Gilovich *How We Know What Isn't So*
Also some material will be on electronic reserve at the Library

BLACKBOARD: The syllabus and many other relevant course documents will be posted on Blackboard..

TESTS: There will be three quizzes worth 50 points each, two major exams worth 100 points each, and a comprehensive final exam worth 200 points--an overall total of 550 points. Homework and extra credit opportunities also contribute to the overall point total. To determine your final average, simply divide your overall point total by 5.5. All tests are announced in advance, and there will be time for review before each of them. I use the grading scale: 90-100 = A, 80-89 = B, 70-79 = C, 60-69 = D, and below 60 = F.

HOMEWORK:
(1) Regular daily assignments: since this is meant to be a practical course, there will be regular homework assignments which are NOT optional. Each assignment done acceptably ADDS one point to your point total. One point will be SUBTRACTED for every assignment not done acceptably. "Acceptably" means that EVERY PROBLEM IS ATTEMPTED, and the assignment is turned in ON TIME--no excuses.
(2) There are three large writing assignments due on dates specified in the syllabus. These assignments will be worth up to 10 points apiece on your final, comprehensive exam for a possible total of 30 points.

EXTRA CREDIT **(Note: These are due on or before Thursday December 11 and are open only to those who have attempted more than 50 % of the homework and missed no more than 4 classes.)**
(1) Check it out on the Snopes website at http://www.snopes.com/. Find two "urban legends," one of which you are surprised to find out is true and the other of which you are surprised to find out is false. Describe the two "legends" and explain what led to your surprise in each case. Up to 8 points.
(2) The "Fallacy Hunt": Find "classroom usable" examples of the fallacies we will be discussing, but no more than one advertisement. The fallacies must be properly referenced, and you must analyze the argument and explain specifically how it goes wrong. There is a limit of 3 items that can receive of up to 5 points for each item. Turn in the examples with your analyses.

ABSENCES: In accordance with University regulations, I take roll every period. I make no use of the absence record in determining grades. NOTE: If you find you are unable attend class, YOU MUST DROP THE COURSE; otherwise you will receive an F.

MAKE-UPS: I **hate** to give make-ups. If one is necessary, it is likely to be longer and harder than the regular test. You must have a good reason for missing a test, and if you do miss a test, see me as soon as possible. Your excuse must be written out and appropriately documented. ANY EXCUSE THAT DOES NOT WITHSTAND VERIFICATION WILL RESULT IN A GRADE OF ZERO FOR THAT EXAM. If you do have a valid excuse, then we should make the arrangements for you to take a make-up AS SOON AS POSSIBLE.

Q-DROPS: A Q-drop is a drop made after the last date for tuition refunds (12th class day for fall/spring; 4th class day for summer) but before the date for which a drop would result in the grade of 'F' as published in the Academic Calendar . **Students will be allowed no more than five Q-drops during their academic career at Sam Houston State University**. Classes that are dropped prior to the Q-drop date will not count toward the limit. Students who have used their limit of five Q-drops will need to petition their respective dean to drop a class. If the dean refuses to grant permission to drop a class, a student will be required to remain in the class. This limit took effect with the start of the fall 2004 semester. Any drops accumulated prior to the fall 2004 semester will not be included in the five Q-drop limit, nor will Q-drops from other universities.

STANDARD POLICIES: Each of these standard policies is stated in full on the Blackboard website for this course under Course Documents. I have extracted from the full statement a key element as a reminder of the policy in its entirety, but the student must download the posting on Blackboard to have the full policy statement. Here are the six standard policy matters: (1) NOTICE TO PERSONS WITH A DISABILITY: No accommodation can be made until you register with the Counseling Center. There will be no retroactive accommodations. (2) ACADEMIC DISHONESTY: Any student found guilty of dishonesty in any phase of academic work will be subject to disciplinary action. (3) CLASSROOM RULES OF CONDUCT: Students are expected to assist in maintaining a classroom environment that is conducive to learning. (4) VISITORS IN THE CLASSROOM: It is at the instructor's discretion whether or not he/she will be allowed to remain. (5) ABSENCE ON RELIGIOUS HOLY DAYS: A student desiring to absent himself/herself from a scheduled class in order to observe (a) religious holy day(s) shall present in advance to each instructor involved a written statement concerning the religious holy day(s). (6) COURSE EVALUATIONS: In accordance with University policy, students will have an opportunity near the end of the semester on a set day and time to complete a course evaluation.

TENTATIVE SCHEDULE PHIL 2303 Critical Thinking Semester _____ Day/Time
August Location_____

August

Unit I. Logic: Reasoning as a Structured Process

Tue 26 Recognizing argument structure. Do Handout Ex. Set No. 1 problems in class. Look at Handout No. 2 to introduce deductive reasoning.

Thu 28 Vaughn *Power of Critical Thinking* (PCT) Chap. 1 pp. 3-20 and Assignment #1: Chap. 1 Ex. 1.3 (pp. 22-23) and Ex. 1.7 (pp. 26-27) NOTE: do the unstarred items only in both exercise sets

September

Tue 02 Read PCT Chap. 2. Assignment #2:(unstarred items in Ex. 2.4 and 2.5 pp. 58-59)

Thu 04 PCT Chap. 3 pp. 67-87 and Read Handout No. 3 Assignment #3: Unstarred only in both Ex. 3.2 pp. 78-79 and Ex. 3.4 pp. 85-86

Tue 09 Assignment #4: (PCT Unstarred only in both Ex 3.5 and Ex. 3.6 pp. 93-94)

Thu 11 Gilovich Chaps. 1 and 2.

Tue 16 Read Handout No. 5. Assignment #5:(Do Handout Exercise No. 4)

Thu 18 Read a Handout on the logic of hypothesis testing. Assignment #6:(Do problems in Handout No. 5)

Tue 23 PCT Chap. 3 95-111 Assignment #7:(Ex. 3.9 DIAGRAM #3, #4, #5, #8 PP. 102-103 and do #1-#7 in Integrative Exercises pp. 113-114—BUT YOU DO NOT HAVE TO DIAGRAM THESE.)

Thu 25 PCT Chap 7 pp. 245-254 and a handout on the Square of Opposition. **FIRST QUIZ--50 points. BRING A SCANTRON**

Tue 30 Review for First Unit Exam.

October

Thu 02 **FIRST UNIT EXAM--100 points. NO SCANTRON NEEDED**

Unit II. Inductive Reasoning: The Quality of the Evidence and Evaluating Explanations

Tue 07 Read a Handout on Sampling and Generalizing, a Handout on Comparative Experimentation, and PCT Chap. 8 pp. 278-321.

Thu 09 Read Gilovich Chap. 3 Assignment #8:(Ex. 8.1 pp. 291-292, Ex. 8.3 pp. 293-294, and Ex. 8.5 pp. 295-296
Tue 14 Read Gilovich Chap. 4. Assignment #9:(Ex. 8.7 pp. 304-305 #2, #3, and #4 only, and Ex. 8.8 pp. 321-324 NOTE: #1 to #15 only)
Thu 16 PCT Chap. 4 pp. 136-148, 167-171, and a Handout on definitions. **FIRST WRITIING ASSIGNMENT DUE—the FactCheck.org assignment**

Tue 21 PCT Chap. 9 pp. 335-356. Assignment #10:(Ex. 9.2 p. 344 and Ex. 9.5 pp. 346-347)
Thu 23 PCT Chap. 9 pp. 357-363 Assignment #11:(Ex. 9.7 p. 364 and Ex. 9.9 #3 and #5 p. 374) **Last 30 minutes: SECOND QUIZ--50 points—NO SCANTRON NEEDED**

Tue 28 PCT Chap 10 pp. 382-409 Assignment #12:(Ex. 10.5 and Ex. 10.6 pp. 407-409)
Thu 30 PCT Chap. 10 pp. 409-430 and Gilovich Chap. 5 Assignment #13:(Ex.10.10 pp. 433-435)

November
Tue 04 Review for Second Unit Exam.
Thu 06 **SECOND UNIT EXAM--100 points. NO SCANTRON NEEDED**

Unit III Analyzing Common Fallacies and Working with Probability
Tue 11 PCT Chap. 5 pp. 173-195 and a handout on Fallacies and
Thu 13 Assignment #12: Ex. 5.2 #1 to #15 pp. 196-197 and Ex. 5.3 #1 to #5 p.198

Tue 18 Gilovich Chap. 6 Assignment #13: (Do Handout No. 24 Fallacy analysis problems #1-#12)

Thu 20 Gilovich Chap. 7 Assignment #14: (Do remaining Handout No. 24 fallacy analysis items.

Tue 25 Gilovich Chap. 8 **SECOND WRITING ASSIGNMENT DUE—the Skeptical Inquirer assignment. Last 30 minutes of class--THIRD QUIZ—50 points**

Wednesday November 26 to Sunday November 30—Thanksgiving Holiday

December
Tue 02 Read a handout on Bayes' Theorem and a handout on Probability and Premises
Thu 04 Read Gilovich Chaps. 9 and 10. PCT 129-139 **THIRD WRITING ASSIGNMENT DUE--How Much Should You Trust These Experts?**

Tue 09 Assignment #15:(Integrative Exercises #5-#20 pp. 438-440) Begin review for the Final Exam
Thu 11 **Last Class Day.** Review for Final Exam

FINAL EXAM—170 points—COMPREHENSIVE plus 30 points for the three writing assignments for a total of 200. Roughly 85 points for Units I & II combined and 85 points for Unit III.
BRING A SCANTRON.

Three major writing assignments for PHIL 2303

A. The FactCheck.org assignment is to be done in conjunction with Vaughn Chap. 4 pp. 148-158 on the news and on advertising:

(1) Read Vaughn pp. 148-158 and then go to http://www.factcheck.org/

(2) Explore the website, including the relevant background in About Us, and find two instances that seem to you to be important "misleadings." For the sake of balance there should be one Democratic instance and one Republican instance.

(3) Describe each of the misleadings, what they are about and how they are misleading, then explain why you deem them to be important, and finally explain which one is more important and why.

(4) As part of (3) identify any of the specific techniques described in Vaughn Chap. 4 pp. 148-158 that are part of the misleadings.

(5) The basic mechanics of English grammar, spelling, and style need to be in order.

B. *The Skeptical Inquirer* assignment is in conjunction with Vaughn Chap. 10 pp. 409-430 and the idea that "extraordinary claims require extraordinary evidence."

(1) Read Vaughn Chap. 10 pp. 409-430 and then pick a substantive article about some extraordinary claim from *The Skeptical Inquirer*, copies of which are in our library and online.

(2) Analyze the logic of the article by stating the conclusion argued for, the evidence presented, the assumptions made, the methods used, etc.

(3) Once you have distilled the argument, then you must explain your evaluation of the soundness of the argument--be specific! Turn in a copy of the article with your analysis.

C. The "How Much Should You Trust These Experts?" assignment is in conjunction with Vaughn Chap. 4 pp. 129-136.

(1) Read Vaughn Chap. 4 pp. 129-136 "Experts and Evidence"

(2) Go to the library home page at http://library.shsu.edu/ and from there follow the directions after clicking on Course Reserves and getting to the page that gives you access to Electronic Reserves. You will need the password thinking to access the PHL 2303 reserve material. You will find that there are two articles from the *New York Times* on reserve, "Behind TV Analysts" and "Follow Up Article." You will need to print copies of each of the article so that you can easily read them. The first one is somewhat long; the second is short.

(3) The writing assignment itself consists of three parts: (a) briefly summarize the factual conclusion(s) and the evidence for them presented in the article about the relationships between the Pentagon and many military analysts for major TV news organizations, (b) develop two arguments, one of which concludes that these relationships have a serious, negative effect on the analysts credibility as sources of expert testimony, and the second of which argues for the conclusion that either these relationships do not matter or even positively enhance the credibility of these analysts, and finally (c) tell which argument you tend to accept and why.

PHL 262 Critical Thinking--Study Guide for Gilovich *How We Know What Isn't So*

Chap. 1—what is a cognitive illusion? What are two explanations for questionable beliefs that Gilovich will not be considering in the book? What are the explanations that he proposes that have to do with flawed rationality?

Chap. 2--With regard to the "hot hand" belief: (a) What general tendency of thinking is it an example of? (b) How did Gilovich and his colleagues test the belief? (Give details) (c) Give two possible explanations from Gilovich for why people have this belief.

Chap. 2--Explain the notion of "the regression effect." Describe a couple of G.'s examples of this effect in operation.

Chap. 3--Describe the Wason experiment discussed on p. 33. How is it set up? What are the typical results? How do they allegedly show a bias toward confirmatory information? On pp. 41-42 what is a related difficulty with effective policy evaluation?

Chap. 4--the biased evaluation of ambiguous information: (a) how can some bias be essential? (b) the difference between skepticism and closed mindedness, (c) example of how we may interpret ambiguous information, (d) how we may treat unambiguous information in a biased way--gamblers and the capital punishment study, (e) what safeguards science has built into it, (f) the Barnum effect and "multiple end points" and (g) the role of "asymmetries" in producing one-sided vs. two-sided events

Chap. 5- Motivational effects on information processing: (a) Describe the "Lake Wobegon effect," and then (b) describe some possible cognitive (as opposed to motivational) explanations for why we tend to do things like attributing success to our own efforts versus attributing failure to external circumstances. Also, how motivational factors might affect our drawing of conclusions (c) by the way we frame our questions, (d) by whose opinions we consult, and (e) by about the amount of evidence we consider when "optional stopping" plays a role.

Chap. 6--G. thinks that "sharpening" and "leveling" take place in the telling of stories--explain. How does this appear in the "Little Albert" story? What effect can this have on forming estimates of another person's character based on a second person's accounts? Has this happened in your experience? Give examples of how the desire to be informative and to entertain may lead to distortions. What paradox does G. think this may lead to? What are 4 guidelines that one can follow in evaluating secondhand claims?

Chap. 7--According to G. what systematic defect is present in our ability to estimate the beliefs of others? There seem to be several determinants of this phenomenon, and one that especially interests Gilovich is the way we resolve ambiguities by interpretation--explain his view. Also, describe how we are likely to receive inadequate "feedback" from others. Have you seen this operate in your experience?

Chap. 8--What are a couple of ways "Post hoc, ergo propter hoc" reasoning can affect a person's belief in the effectiveness of a treatment? What are some of the things that can make explaining away failure all too easy? What, in G.'s opinion, is the "upside" of the holistic health movement? What is its "downside"?

Chap. 9--What are some examples of questionable interpersonal strategies? Explain--with examples--the two common limitations on the evidence that G. thinks leads to persistence in using ineffective or even counterproductive strategies.

Chap. 10--What "disturbing pattern" has appeared in relation to claims of scientific evidence for ESP? What is the single biggest reason to disbelieve ESP claims? Describe in detail one of the examples of failure to prove ESP claims.

Chap. 10-- Explain how G. critiques personal experience as a basis for belief in ESP by appeals to (a) everyday coincidence (be sure to describe the Luis Alavarez case), everyday "premonitions," and (c) extraordinary "premonitions."

Chap. 11--Describe the research that gives G. cause for optimism concerning the usefulness of social science in challenging dubious beliefs. Explain your opinion about whether his optimism is well-founded.

PHIL 2303: Critical Thinking Confirmation and Disconfirmation in Hypothesis Testing

I. THE SIMPLE LOGIC OF CONFIRMATION AND DISCONFIRMATION: The basic logical processes involved in testing hypotheses seem to be straightforward. The investigator takes a hypothesis and infers from it a prediction about the data that s/he should be able to observe in the laboratory or in the field IF the hypothesis is true. The data are then examined to see whether or not they fit with the predicted result. If the prediction is true, then the hypothesis is confirmed or verified. If the data falsify the prediction, then the hypothesis is disconfirmed or refuted. The simple logic of the process looks like this pattern:

DISCONFIMRMATION (the logic of Denying the Consequent) [also known as Refutation or Falsification]

(1) If we suppose the Hypothesis is true, then we make a Prediction of specific observable results
(2) The observable data are not what the Prediction says they should be so the Prediction is false.
(3) Therefore the Hypothesis is false

Symbolized as:
(1) If H, then P
(2) Not P
(3) Not H

CONFIRMATION (the logic of Affirming the Consequent)

(4) If we suppose the Hypothesis is true, then we make a Prediction of specific observable results
(5) The observable data are what the prediction says they should be, so the Prediction is true
(6) Therefore the Hypothesis is true

Symbolized as:
(4) If H, then P
(5) P
(6) H

NOTE: These two logical processes differ in logical strength. Refutation as represented here is deductively valid: IF the premises (1) and (2) are true, THEN the conclusion (3) HAS TO BE true. In fact, it is an instance of the Denying the Consequent pattern. In contrast, confirmation is NOT deductively valid. The truth of premises (4) and (5) does NOT guarantee the truth of the conclusion (6). It is the fallacy of Affirming the Consequent. So, refutation is logically stronger than confirmation.

II. HOW THE LOGIC OF DISCONFIRMATION IS IN REALITY MORE COMPLICATED

The complication that needs to be considered is that a hypothesis ALL BY ITSELF rarely, if ever, implies any prediction about what we should observe in the data. In order to generate a particular prediction the hypothesis must be accompanied by a mass of background assumptions about the test situation, e.g., that any measuring instruments have been properly calibrated. These assumptions are necessary in the sense that if they are violated, then there is no reason to expect the particular predicted observation to occur. The logic of the actual situation is then, more like this with 'BA' standing for background assumptions:

A MORE COMPLEX LOGIC OF DISCONFIRMATION

(1) IF both the Hypothesis and BA are true, THEN Prediction	Premise
(2) The Prediction is false	Premise
(3) Therefore, NOT BOTH the Hypothesis and the BA	Initial conclusion
(4) All of the BA are correct	Additional Premise needed
(5) Therefore, the Hypothesis is false	Final conclusion

There are two important lessons to be drawn from this outline of the logic of refutation. First, a successful refutation requires three premises to be taken for granted: (1) that the derivation of the prediction from the

hypothesis united with the background assumptions is correct, (2) that the failure of the prediction is accurately observed, and (3) that all of the necessary background assumptions are correct. This third assumption is an important source of potential ambiguity in interpreting negative experimental results. People can differ in their judgments about whether all of the background assumptions in a given experimental set-up are actually correct. If they differ about this, then some will see the attempted refutation as successful while others will see it as a failure.

Second, the reasoning that leads from the three premises to the conclusion that the hypothesis is false is deductively valid, so then IF all three of the premises are correct, the hypothesis being tested MUST BE FALSE. So, even in this more complicated version, refutation is a logically stronger process than confirmation.

Some writers on methodology (e. g. Karl Popper) go further and claim that refutation is what is really important for science to make progress. It is only when nature challenges our ideas by refuting them that we are compelled to rethink our hypotheses and thereby to find better ones. Also, Popper and others claim that in order to be considered a scientific hypothesis, an idea must be refutable--potentially able to be falsified. That is, there must be some prediction that the idea makes which, if the predicted event does not occur, would refute the idea. Notice that the point is that an idea be refutable, i. e, testable with the possibility of a negative outcome, not that it be actually refuted. So on this view, an idea that is totally irrefutable, that cannot be challenged by experience, is not scientific.

III. THE MORE COMPLEX LOGIC OF CONFIRMATION

Now let us turn to the logical processes involved in confirmation. Take another look at this pattern which fits the Affirming the Consequent Fallacy:

(4) IF Hypothesis, THEN Prediction
(5) The Prediction comes true
(6) Therefore, the Hypothesis is true

The point is that a predicted result may be consistent with a hypothesis and yet not confirm it to any great degree. The hypothesis is not confirmed as long as the possibility remains open that some other mechanism generated the predicted result instead.

As an example, the hypothesis that I have malaria would lead us to predict that I would suffer from a fever, but finding that I had a fever would do little to confirm the hypothesis that I have malaria, since so many other diseases also produce a feverish condition. What is needed is a predicted result that is NOT MERELY CONSISTENT with the hypothesis, but which also TENDS TO REFUTE ALL THE ALTERANTIVE HYPOTHESES. This gives the prediction greater specificity. So we confirm a hypothesis **BOTH** by seeing that the observed result is consistent with the hypothesis **AND** by seeing that the observed result refutes all alternative hypotheses. If, on the contrary, the predicted result is truly consistent with an alternative hypothesis, then to that extent our hypothesis has NOT been confirmed.

Confirmation in this way essentially involves refutation. It contains all of refutation's potential for ambiguity due to the need to use background assumptions to derive the prediction. Plus, there is an additional source of difficulty in the requirement that ALL alternatives be examined. It can be difficult to have much confidence that we have in fact examined all of the relevant alternatives. The degree of confidence that we have that a hypothesis has been confirmed can increase to a very high point, but only to the degree that we are confident that we know all of the alternative hypothesis and that the evidence from the observations rules out all of them and fits only the one we take to be confirmed.

Nevertheless, a single genuine refutation outweighs a hundred confirmations. Of course, we may be slow to decide that we really do have a genuine refutation if it flies in the face of much that we think we know. For example, we are likely to insist upon replication of a refuting observation and will carefully check to satisfy ourselves that all of the relevant background assumptions are correct. Once we have done that, however, then we must in some way revise our old hypothesis or come up with a totally new one.

Two Applications of Bayes' Theorem—How New Evidence Affects the Probability of a Hypothesis

Case 1. What Can Medical Tests Tell Us?

Here is a very useful formulation of Bayes' theorem:

$$P(H/E) = \frac{[P(E/H) \times P(H)]}{([P(E/H) \times P(H)] + [P(E/\sim H) \times P(\sim H)])}$$

Remember that

1. P(H/E) is the posterior probability, the probability of the hypothesis H after getting the new evidence E. It reflects the impact of the new evidence on raising or lowering the probability that the hypothesis H is true.
2. P(H) is the prior probability since it is the probability of H before getting the evidence E.
3. P(E/H) is a conditional probability, that is, how probable the evidence would be if the hypothesis is true. This term and the next one are often called likelihoods. If P(E/H) is greater than P(E/~H), then the evidence E raises the posterior probability P(H/E).
4. P(E/~H) is how probable the evidence would be if the hypothesis is not true (~H = not H).
5. P(~H) is the prior probability that hypothesis is not true, and P(~H) = 1 – P(H)

Think about medical tests: suppose that you have a test for a disease we will call "Hepatitis Z," and this test has a really good true positive rate of 99%. The test is not perfect, but if you do have Hepatitis Z, then 99% of the time the test will give a positive result indicating that you do. This is called the sensitivity of the test. The other 1% of the time it gives a false negative result indicating that you do not have the disease when in fact you do.

So Joe tests positive for Hepatitis Z. What is the probability that he has the disease?

A. Highly likely B. Moderately likely C. Moderately unlikely D. Highly unlikely
E. Can't tell from the information given.

For those of you who picked E, let me give you more information. This test is a really good test because only one tenth of a percent (.001) of the time does it give a false positive result, that is giving a positive result when the person does NOT have the disease. The rest of the time, 99.9%, the test gives a true negative result. This is called the specificity of the test. And this test is both highly sensitive—it has a low false negative rate—and highly specific—it has a very low false positive rate.

So Joe tests positive for Hepatitis Z. What is the probability that he has the disease?

A. Highly likely B. Moderately likely C. Moderately unlikely D. Highly unlikely
E. Can't tell from the information given.

Let's give you one piece of information more. Fortunately, the base rate of infection of Hepatitis Z is only 1/100,000 = .00001. Now you are ready to calculate the posterior probability P(H/E) using Bayes' theorem.

P(H) = .00001 = the prior probability of someone having hepatitis Z
P(~H) = .99999 = the prior probability of someone NOT having hepatitis Z
P(E/H) = .99 = the true positive rate, someone tests positive if they have hepatitis Z
P(E/~H) = .001 = the false positive rate, someone test positive if they do NOT have hepatitis Z

$$P(H/E) = \frac{[.99 \times .00001]}{([.99 \times .00001] + [.001 \times .99999])}$$

Now get out a calculator and find out what the result is.

From the previous page:

If I calculated correctly, P(H/E) = about .0098. That means there is a slightly less than 1% chance of Joe having Hepatitis Z. Even thought the test is a very good test, the base rate prior probability plays a huge role in determining how probable the hypothesis is in relation to the positive test outcome.

Case 2. Bayes' Theorem and Why Two Witnesses are Better Than One

Here is Bayes' Theorem again:

$$P(H/E) = \frac{[P(E/H) \times P(H)]}{([P(E/H) \times P(H)] + [P(E/\sim H) \times P(\sim H)])}$$

Now let's specify it in a way relevant to our deliberations in a court of law. George is being tried for burglary. The hypothesis in this case is that George is guilty. Let's say that because of circumstantial evidence we are willing to think early on in the trial that there is a 10% chance that George is guilty. So now the prior probability of P(H) = .1, and the probability of him not being guilty P(~H) = .9.

There are two witnesses who are independent of each other. Ted says he saw George entering the house that was burgled on the evening when the crime occurred, and Ralph says he saw George leaving the house a little later that same evening. Witnesses are often not as reliable as medical tests, but we can think about them in the same way. We won't be very confident about Ted's testimony, rating his true positive rate at only 60% or .6. This means we are saying that if George really did it (H), then the chance of Ted saying he did so (E) is .6. So, the P(E/H) = .6.

But what about Ted's false positive rate? What do we think the chance is that, if George was not the person he saw, that Ted would say it was George—through innocent mistake or malice? Given what we know about the reliability of testimony, the false positive rate can be fairly high, perhaps 10%. So P(E/~H) = 10% or .1, and Bayes' theorem looks like this:

$$P(H/E) = \frac{[.6 \times .1]}{([.6 \times .1] + [.1 \times .9])} = .06 / (.06 + .09) = .06/.15 = .40$$

So because of Ted's testimony, we should adjust our sense of the chance that George is guilty to 40% instead of the 10% that we started with. A significant change, but at this point the chances are 60% that George is not guilty.

As we approach assessing the impact of Ralph's testimony, our new prior probability is now 40% after the impact of Ted's testimony, hence P(H) = .4 and P(~H) = .6. To keep things simple let's give Ralph the same profile of reliability that we gave Ted, so P(E/H) = .6 and P(E/~H) = .1.

Here is the calculation with the second witness being taken into account:

$$P(H/E) = \frac{[.6 \times .4]}{([.6 \times .4] + [.1 \times .6])} = .24/ (.24 + .06) = .24/.30 = .80$$

So, taking two witnesses into account, there is an 80% chance George is guilty. That is quite a change from the 40% chance with only one witness.

Question for reflection: Is George at this point guilty beyond a reasonable doubt?

PHIL 2303: Critical Thinking

An Outline of the General Logic of Comparative Experimentation

I. INTERNAL VALIDITY: The issue under this heading is whether "something real" happened in the experiment. In a complex world, the central difficulty in detecting cause and effect relationships is the need to avoid CONFOUNDING, i. e., the "mixing up" of the effects of different variables so that you cannot tell what really was the cause of an effect. The basic idea is to create a situation that allows you to screen out the action of extraneous factors so that, if there is a difference between the experimental and the control group, the difference can plausibly be claimed to be due to the experimental treatment. CONTROL is the general term for all of these efforts to avoid confounding. The efforts at control, if they are successful, allow the experimenter to rule out other variables as the source of any difference between the EXPERIMENTAL GROUP and the CONTROL GROUP.

BLOCKING is one such effort at control. Before forming the experimental and control groups by random selection, you divide the group of objects into "blocks" based on similarities that could have an impact on the outcome of the experiment. So, for example, in testing a new chemotherapy drug, one should, if possible, sort the patients by degree of severity of their cancer so that you do not by chance put more of the most advanced cases in the experimental group or in the control group.

However, a difference between the experimental and control groups MAY OCCUR JUST BY CHANCE, so in addition to controlling for extraneous variables the experimenter must be able to argue that the difference between the experimental and control groups is large enough to be unlikely to be due just to chance. The way to do that is to refute the NULL HYPOTHESIS. The null hypothesis is usually the "no real difference" hypothesis, a hypothesis which states that any difference between the experimental and control groups is likely to be due just to chance. In other words, the null hypothesis predicts that there will NOT be a STATISTICALLY SIGNIFICANT DIFFERENCE between the two groups. A statistically significant difference is a difference that--in context—IS TOO LARGE TO BE LIKELY TO BE DUE TO CHANCE. Part of the great usefulness of modern statistics is that this likelihood—the odds that the difference occurred just by chance--involved can be stated with some precision. The statement of those odds is the LEVEL OF SIGNIFICANCE. Thus, for example, a common level of significance is "the .05 level." This means that the experimenter is claiming that, in the particular context, the likelihood of the difference being due just to chance is 5/100. There is a trade-off between the number of items in the sample worked with and what size difference turns out to be "significant." If you work with a small group of items you generally need a large difference to be significant. In contrast, with a large sample a small difference can be significant. (But do not confuse the level of significance with the "effect size.")

In summary, IF the experimenter obtains a difference that is statistically significant at some appropriate level, THEN that tends to refute the null hypothesis, so the difference was not likely to be due just to chance. And IF the experimenter succeeded in CONTROLLING FOR all of the other factors, THEN chances are good that the difference was due to the experimental treatment. So, the experimenter has collected evidence of a difference between the two groups which not only fits with the experimental hypothesis but which also allows him or her to rule out alternative explanations for the difference, thus confirming the experimental hypothesis.

II. EXTERNAL VALIDITY—Now that the investigator has established the internal validity of her experimental work, she is not yet finished. She must go on to establish the generalizabiliy of these results to other items and other situations. To do this she faces TWO ISSUES: (1) Experiments are often done with CONVENIENCE SAMPLES which are not usually random samples. Therefore, the issue arises of WHAT POPULATION the results can be generalized to. (2) A second issue may also arise of whether the experimental treatment in the lab is a REALISTIC SIMULATION of the processes in the outside world so that we can safely generalize from the lab results to the real world environment. External validity depends on giving credible answers to both of these questions.

III. AN IMPORTANT WARNING: Statistical significance is NOT the same as practical significance or importance. A treatment may have so little effect or be so expensive that it has no real value for us. Nonetheless, people are often in the habit of saying experimental results are "significant" when all that they mean is that the results are statistically significant. An indication of possible practical significance is the measure of EFFECT SIZE. This measure can be defined in various ways, but the basic idea starts with subtracting one result from the other to find the size of the difference between the two groups.

PHIL 2303:Critical Thinking Sampling and Generalizing

A GENERALIZATION is an attempt to characterize a whole group of objects. Thus the statement "All of Shakespeare's plays are in blank verse" is a generalization about the Bard's plays. "None of the people in the room is wearing a fur coat" is also a generalization. What may be less obvious is that statements such as "67% of the American people do not want to intervene in Bosnia" and "32% of Harvard students rate foreign language courses as the best" are also generalizations. Each of these statements tells you something about a whole group. The point is that generalizations can range from assertions about 100% to 0% and anywhere in between. One more point: many people think that generalizations are inherently vague or shaky. But the generalization about Shakespeare's plays is neither vague nor shaky. Whether a statement asserts a generalization is a separate matter from how clear or how well-founded the generalization is.

We gather evidence for and against a generalization by looking at a SAMPLE taken from a larger POPULATION of objects. The population is the group the generalization will be about, and how well-supported the generalization is depends on how likely it is that the sample is representative of the population from which it was drawn. We generalize on the basis of samples all the time. We could not cope with the world if we refused to generalize, and so the real issue is to generalize as well as we can. Here are a couple of concepts that can help us to do a better job of generalizing:

I. RANDOM SAMPLING ERROR--this occurs when the sample is unrepresentative due to "bad luck." Since we are only looking at a sample, we have no absolute guarantee that it will be representative no matter how careful we are. There are two basic things we can do to lessen the likelihood of random sampling error occurring, and I will call these things the ANTIDOTES for random sampling error:

(1) Get a bigger sample. Bigger is better, though there is no simple answer to the question of how big a sample should be. See the accompanying chart on the next page from George Gallup to get some quantitative sense of how much better a sample gets as it increases in size.
(2) Stratify your sample. For example, if you are investigating the occurrence of episodes of sexual harassment on the job, it would not make sense to sample only male employees' opinions. A purely random sample runs the risk of over-representing some subgroups in the population just by chance. So, if you suspect that there are subgroups in the population that may differ significantly in regard to the property you are sampling for, then it makes sense to represent each of those subgroups by taking a random sample from within it and then combining the results to form your overall sample. The subgroups are called "strata," hence the term "stratified sampling." Note that stratification injects a nonrandom aspect into the sampling process.

II. SYSTEMATIC, NONRANDOM SAMPLING ERROR--This occurs when a sample is gathered in a way which has a systematic tendency to produce unrepresentative samples. For example, many surveys that use voluntary responses run the risk that those people who volunteer are systematically different from those who do not respond. The term for this problem is BIAS. Note that bias in sampling is NOT the same as "bias" in the sense of prejudice. A biased sampling method may be used in utter innocent ignorance of the fact that it is biased. There are two ANTIDOTES for systematic sampling error:

(1) Clear, persistent, painstaking thought about the sampling process in relation to the population about which one desires to draw a conclusion as we try to imagine all of the possible ways the sampling could be systematically unrepresentative of that population. Then we take steps to try to rule out those ways.

(2) Randomization--the more confident we can be that our sample was selected in a truly random fashion, the more confident we can be that it is an unbiased sampling. However, it turns out that producing genuinely random samples is harder than one might suppose. For example, many experimental studies in the biomedical and behavioral sciences must be done with CONVENIENCE SAMPLES, i. e., with people who are available to participate; consequently, these are seldom thoroughly random samples. This does not mean that the information obtained from such experiments is useless. It does mean that generalizing the results to a specific population must be done with careful attention paid to the issue of how well the sample used is likely to represent that specific population.

GENERALIZATIONS and CORRELATIONS are related but should be distinguished from each other. For example, the statement (a) "76% of firefighters smoke" expresses a generalization, but it does not all by itself express a correlation between being a firefighter and being a smoker. It is only after another bit of comparative information such as (b) "31% of nonfirefighters are smokers" is added that we can say that being a firefighter is positively correlated with being a smoker. In fact, even a statement such as "39% of firefighters smoke" would express a positive correlation as long as the information in (b) is correct. Understand that two things can be correlated without one being the cause of the other, but looking for correlations is valuable for at least two reasons: (1) the absence of a correlation between two things is good evidence for the absence of a cause and effect relationship between them and (2) finding that two things are correlated can be a useful clue to additional fruitful lines of research.

Here is a table from George Gallup that illustrates the relationship between the margin of error and the absolute size of a sample, NOT the relative size. Be sure to read the fine print underneath the Table.

TABLE 1-1 Precision of the sampling procedure used by the Gallop Poll as of 1972

Sample Size

Population percentage	100	200	400	600	750	1000	1500
Near 10	7	5	4	3	3	2	2
Near 20	9	7	5	4	4	3	2
Near 30	10	8	6	4	4	4	3
Near 40	11	8	6	5	4	4	3
Near 50	11	8	6	5	4	4	3
Near 60	11	8	6	5	4	4	3
Near 70	10	8	6	4	4	4	3
Near 80	9	7	5	4	4	3	2
Near 90	7	5	4	3	3	2	2

SOURCE: George Gallup, *The Sophisticated Poll Watcher's Guide* (Princeton Opinion Press, 1972), p. 228.

The table shows the range, plus or minus, within which the sample percentage p falls in 95% of all samples. This margin of error depends on the size of the sample and on the population percentage p. For example, when [the population percentage] p is near 60%, 95% of all samples of size 1000 will have a [sample percentage] between 56% and 64%, because the margin of error is $\pm$ 4%.

(This table is taken from David Moore's *Statistics: Concepts and Controversies*, 4th edition, 1997, W. H. Freeman publisher, p. 40. Moore cautions that this Table is for a complex national sampling and that the margins of error for a simple random sample would be a bit smaller.)