Warranted Inferences
Learning Outcomes

1. Evaluate the logical strength of inferences presented to justify or support the belief that their conclusions are very probably, but not necessarily, true if we take their premises to be true.

2. Recognize reasoning fallacies masquerading as warranted inferences.

HOW do we evaluate the logical strength of inferences offered as if their conclusions are very probably but not necessarily true?

HOW can we recognize common fallacies related to these inferences?

When you do the numbers, which looks like it is probably the better deal, the public university or the private university? The answer is hidden in the details.
“Why would you think that Indiana State is less expensive for you than Butler University?” asked Justin.

“Easy,” replied his brother Silas. “The in-state tuition and fees at ISU come to something like $8,500, and at Butler, which is private, the tuition and fees are more like $34,500.¹

Advantage ISU by $26,000 per year! You have to figure that the cost of room and board is a wash. So it comes down to tuition.”

“That’s not true. You forgot to consider financial aid. My grades are good enough, maybe I will get a scholarship. I’ve already talked with the financial aid offices at both universities. The people at Butler are saying I’ll probably get about $14,500 in scholarship money. For me that brings Butler’s tuition down to $20,000. The ISU people were less certain about the status of my scholarship application. They wanted to be conservative, so they talked about maybe $2,500 in scholarships. If that’s how it goes, then my ISU tuition would be $6,000. Now the difference is only $14,000 per year.”

“So? That’s still a lot.”

“Yes, but there are student loans too. Both places just about guaranteed that I could make up the rest of what I’d need that way,” said Justin.

Silas said, “Which means you can defer starting to pay back the loans until six months after you graduate, right?”

“Right. And let’s look at how long it will take me to graduate. I’ll transfer in from Ivy Tech with enough credits to be a junior. I could graduate from Butler in two years for sure.”

“Well,” said Silas, “then it would be two years at ISU too.”

“Not necessarily,” replied Justin. “I’ve heard that because the state budget cut backs it is more difficult to get required courses at ISU. It might take an extra year at ISU. But private colleges like Butler work hard to get everyone graduated on time.”

“Alright, let’s assume that it would take you three years to graduate from ISU, but only two to graduate from Butler. So considering only the tuition minus the scholarships, you’re still looking at borrowing $14,000 each year for two years at Butler as compared to $6,000 each year for three years at ISU. It seems clear to me that $28,000 in loans is a bigger problem than $18,000. All in all ISU looks like the better deal financially by about $10,000.”

“No, you forgot one other thing,” said Justin. “What?” asked Silas.

“If I graduate from Butler a year earlier, then I can get a full-time job that much sooner. And suppose I find a job that pays maybe $30,000. Or, who knows? Maybe $35,000. In one year of working I will have covered that $10,000 spread. I realize that there are risks and uncertainties. I could be wrong. But financially speaking Butler is probably the better choice given my particular situation.”

In this chapter we focus on arguments such that the premises supply enough support or justification for us to infer with confidence that the conclusion is very probably true, but not necessarily true.² From the context and the evidence at hand we accept these inferences knowing that it is possible that the conclusion might turn out to be false, even if all the premises are true. In the opening example about selecting a college the argument maker, Justin, uses the word “probably” to qualify the force of his claim. Justin is not absolutely certain that Butler University is the best choice financially. And yet, Justin is justified in thinking that Butler probably is the better choice for him financially given the evidence currently at hand.

If the assumption that all the premises are true makes it very probable or highly likely that the conclusion is true, that is if the premises justify or strongly support confidently taking the conclusion to be true, then we will evaluate the argument or inference as warranted. Warranted arguments pass the Test of Logical Strength. In this chapter we will expand our tool kit for evaluating the logical strength of arguments and inferences. Our focus here will be on arguments presented to show that their conclusions are very probably, but not necessarily, true. We will also examine a group of common and beguiling fallacies that masquerade as warranted arguments.

1 The Evidence Currently at Hand

One way warranted arguments can be distinguished from valid arguments is by how new information impacts the reasoning. With warranted arguments new information can lead us to reconsider our conclusions without abandoning any of our original premises. With new information in hand, we may reasonably determine that our original conclusion was mistaken, even though all of our original premises remain true. With valid arguments, the conclusion is implied or entailed by the premises which means that if the conclusion is false, then one or more of the premises must be false too.

A moment ago we said Justin’s conclusion that Butler was probably the best place for him financially was warranted, given the information he had at the time. Let’s revisit that example and add some new information. Good news, Justin. Indiana State has decided to award you a full scholarship. Notice that the new information does not contradict anything Justin knew before. It is still true that when he talked to the people at ISU they were uncertain and gave him a conservative response. The news of the full scholarship only expands and updates Justin’s knowledge.
Inductive Reasoning

The core idea here is this: A large, important and quite diverse group of inferences justify the confident belief that their conclusion is very probably true given that their premises are all true. The key critical thinking question is how to recognize and evaluate those inferences.

Traditionally the term “induction” named this vast class of inferences. But, as endnote 2 for this chapter indicates, logicians often use more specific names for some of the major sub-groupings. Without inductive reasoning our species would not be able to explain, predict, and in some cases control natural phenomena. We would not have the basic scientific, agricultural, and logistical knowledge that enables us to grow, preserve, and distribute food efficiently. We would not have the scientific and medical knowledge or equipment to enable us to predict, diagnose, manage, and treat diseases. We would not have discovered the multiple contributing factors to climate change and, in turn, the capacity to build models that help us anticipate the impact climate change will have on long term global weather patterns, sea levels, and the habitats of thousands of species of plants and animals, including our own species and those upon which we rely for food.

This chapter deals with various aspects of inductive reasoning. The organization of the text is driven by its purpose, which is the development of your critical thinking skills and habits of mind. We drew on decades of experience teaching for thinking and no small measure of professional expertise in learning theory when organizing the topics, examples, and exercises. But, yes, if the text were for a different purpose we would of course have organized it differently.

How do we understand inductive reasoning? We wrote this after decades of research: “Decision making in contexts of uncertainty relies on inductive reasoning. We use inductive reasoning skills when we draw inferences about what we think is probably true based on analogies, case studies, prior experience, statistical analyses, simulations, hypotheticals, and patterns recognized in familiar objects, events, experiences, and behaviors. As long as there is the possibility, however remote, that a highly probable conclusion might be mistaken even though the evidence at hand is unchanged, the reasoning is inductive. Although it does not yield certainty, inductive reasoning can provide a confident basis for solid belief in our conclusions and a reasonable basis for action.”

None of the premises changed from true to false. Yet Justin’s conclusion regarding which institution is the better financial choice for him does change. With a full ride, he can now more confidently conclude that ISU would be better for him financially.

The “Weight of Evidence”

Consider this example, based on a story from the CBS series CSI.

- A man is found dead of a gunshot wound to the stomach, his body in a seated position at the base of a tree in a forest. It is deer hunting season. Except for not wearing an orange safety vest, he is dressed like a hunter. His hunting rifle, never having been fired, lies on the ground at his side. The evidence strongly suggests that his death resulted from a hunting accident. The investigator infers that had the man been wearing his orange safety vest, he probably would be alive today.

The investigator’s inference is plausible. Although we can imagine alternative scenarios, but in the absence of any further information, we have no basis for evaluating the investigator’s inference as other than warranted.
As you could have predicted with a TV cop drama, so it is with the CSI story. New facts come to light:

- The time of death was mid-afternoon, a time when deer are not hunted. Deer are hunted at dawn and at dusk. The dead man had not purchased a hunting license.
- There was gunshot residue on the man’s clothing, which indicates that he was shot at very close range. The gun that shot him could not have been more than a foot or two from his body. A $1,000,000 insurance policy had been purchased on his life only two weeks prior to his death. The policy had been paid for with his wife’s credit card. The wife is the beneficiary who would receive the money if he should die by illness or by accident.

The initial conclusion, death by accident, looks mistaken in the light of this new information. Now a more plausible conclusion would be that the man had been murdered by his wife or perhaps by someone she hired. Her motive, of course, would be the insurance money.

In the CSI example and in the ISU–Butler example, we can say that the weight of evidence leads us toward one conclusion rather than another. Of course “weight of evidence” is a metaphor. We do not have a method to apply to either example that allows us to measure how much confidence we should have in our conclusion. We know it is not 100 percent, because some other new information might turn up leading us to change our minds again. And we know that our confidence is greater than 50 percent.

In the eyes of the law, “probable cause for arrest” is a much lower legal standard than “clear and convincing evidence.” Check out “How Courts Work” at www.uscourts.gov.

In the CSI example, a $1,000,000 insurance policy as motivation, the detective would not say that the odds that the shooting was murder were only 50-50. How high would you estimate the detective’s confidence should be, given the evidence at hand? 75 percent? 90 percent? What do you think?

One tool that would makes it easier to evaluate the logical strength of probabilistic arguments is a systematic method for assigning levels of confidence. We do not have standards in every professional field, but some do. The law, for example, provides a set of increasingly stronger standards that must be met to justify taking various legal actions. The lowest level is “reasonable suspicion.” A police officer who observes a vehicle weaving across the lane lines may have a reasonable suspicion that the driver is drunk. If the police officer stops the driver and places the driver under arrest, then the police officer may have “reason to believe” that a search of the vehicle might provide more evidence regarding the DUI, for example, an open container. The standards of evidence continue up from these lower levels to “probable cause for arrest,” “credible evidence,” and “substantial evidence.”

Continuing up the legal standards progression, next comes “preponderance of evidence.” As used in legal proceedings “preponderance of evidence” means evidence that provides more than a 50-50 chance that the conclusion is true. That is hardly enough to convict a person of a crime. But it is enough to get an indictment from a grand jury and it is enough to win disputes in civil court over money. A higher standard is “clear and convincing evidence.” A jury might base a finding of fact on a witness’ testimony because the jury regarded the testimony as substantially more true than false. The highest standard of evidence in legal proceedings is, of course, “proof beyond a reasonable doubt.” At this level the evidence is so convincing that there is no plausible or reasonable basis for doubting the truth of the conclusion. Proof beyond a reasonable doubt is strong enough that we would rely upon it and use it as a basis for action.

Notice how much the legal standards at each level call for an unbiased, informed, and fair-minded reasoned judgment, rather than a precise mathematical calculation. All the critical thinking skills and all the positive habits of mind are essential for applying the legal standards well.

Proof beyond a reasonable doubt is enough to put a criminal in prison for life. But even this high standard is not 100 percent certitude. A great many people who are found guilty beyond a reasonable doubt really are guilty. Even so, new information may come to light years later to demonstrate that, in some cases, the guilty verdict was mistaken. In 2014 the prizefighter Rubin “Hurricane” Carter died a free man. He was exonerated after spending 19 years in prison, wrongly convicted for a triple murder. During his life Carter became a worldwide symbol of racial injustice. To learn more about Hurricane Carter search the 1999 film starring Denzel Washington. His story inspired others to work, as he did, to achieve justice for people wrongly convicted of murder and other serious crimes. The Innocence Project,
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which has exonerated hundreds of innocent people wrongly convicted, is a sobering reminder to us about how difficult and yet how important it is to evaluate the logical strength of arguments carefully. A strong but fair criminal justice system is essential to the rule of law. But a weak or unfair system undermines respect for law enforcement and undercuts trust in the court system. To learn more about the causes of wrongful convictions, such as eye witness misidentifications, improper forensics, false confessions, government misconduct, and self-interested informants, one place to begin your search at the Innocence Project website. Or, Google “social justice film awards” for a rich array of high quality media.

Evaluating Generalizations

A generalization may be based on data gathered systematically or unsystematically. We would be wise to place greater confidence in the claim if it were supported by data gathered more systematically, rather than on simply one or two happenstance personal observations. Consider the following three generalizations. Their conclusions, which are bolded, are supported by premises that report personal experiences, conversations focused on these topics, or information derived from historical records or opinion surveys.

1. People over the age of 60 tend to prefer to listen to oldies.
   This claim is based on the data gathered in telephone surveys of persons between the ages of 60 and 90, which were conducted in Florida, Arizona, Ohio, and Connecticut. In all, 435 interviews were conducted. Participants were asked to identify which type of music they preferred to listen to most. They were given eight choices: Classical, Pop, R&B, Country, Oldies, Broadway, Religious, and Top 40.

2. In May, inspectors from the city sanitation department made unannounced visits to all 20 hotels in the downtown area and to 10 of the other 30 hotels within the city limits. The 10 were representative of the type and quality ratings of those other 30 hotels. The inspectors by law could demand access to any room in the hotel to look for pests and to evaluate cleanliness. Careful records were kept of each room inspected. In all, 2,000 beds were examined for bedbugs. 1,460 beds tested positive. Based on the data from these inspections, we estimate that 73 percent of the hotel room beds in this city are infested with bedbugs.

3. I have visited San Francisco maybe seven times over the past 25 years. It is one of my favorite vacation cities. I’ve gone in the summer and in the winter. And I can tell you one thing, bring a jacket because it’s probably going to be cloudy and cold in San Francisco if you go in August.

Notice that in the first example we have a somewhat modest assertion about what people over the age of 60 “tend to” prefer. The second says that it applies to 73 percent of the hotel beds, but not that the infected beds are evenly distributed among the city’s 50 hotels. And the third says that it is “probably” going to be cold in San Francisco in August. It is easy to imagine scenarios in which the information in the premises is true but the conclusion may not apply. We can conjure the possibility that someone over 60 does not like oldies. We can imagine that there may be one hotel in the city where most of the beds are not infested. It is no problem to think of the possibility that there should be at least one warm sunny August day in San Francisco. But, developing a possible counterexample does not necessarily diminish the logical strength of a warranted argument.

How does the Innocence Project use critical thinking to free dead men walking who are innocent? Yes, “innocent until proven guilty” is the legal standard to be applied to everyone accused of a crime. But how does our system actually function? Locate and watch the HBO award winning documentary Gideon’s Army for an accurate portrayal of efforts to correct structural injustices in our legal system.
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To evaluate the logical strength of probabilistic generalizations, we need to do more than find one or two counterexamples. We must, instead, examine whether the sampling of cases reported in the premises is adequate to support the probabilistic inferences that are drawn. This means asking four questions and finding satisfactory answers to each of them.

- **Was the correct group sampled?**
- **Were the data obtained in an effective way?**
- **Were enough cases considered?**
- **Was the sample representatively structured?**

**WAS THE CORRECT GROUP SAMPLED?** The first example makes a claim about people over the age of 60. The premises tell us that adults between the ages of 60 and 90 were sampled. That is the correct group to sample if one wishes to make generalizations about persons in that age range. It would not do, obviously, to sample people under the age of 60 and then present those data as a basis for a claim about people over that age. One would think that sampling the wrong population would not be a mistake commonly made. But for years, pharmaceutical companies made inferences about children’s drug dosages and the effects of various medications on women based largely on studies conducted on adult males. More recently, we have learned that there are genetic factors that affect the rate at which common pain relievers, like the ibuprofen in Motrin, are metabolized. This new finding should influence dosage recommendations for those who are poor metabolizers (e.g., 6 to 10 percent of Caucasians).7

**WERE THE DATA OBTAINED IN AN EFFECTIVE WAY?** In our example about the music listening preferences of adults over 60, we see that the data were obtained via telephone surveys. We might think that a telephone survey may not be as efficient as using a Web-based survey, which would reach many more people and be much more cost-effective. But, upon reflection, it seems reasonable to use the telephone to reach older adults, many of whom may not be comfortable with the use of computers and Web-based survey tools. Finding an effective method to gather data from the sample is often a major challenge for researchers.8 For example, consider how difficult it is to gather high-quality data about the state of mind of combat veterans in the year after their return from a war zone.

**WERE ENOUGH CASES CONSIDERED?** In general, the more cases the better. But there comes a point of diminishing returns. If we are trying to make a reasonable generalization about millions of people who live in major metropolitan areas like Boston, New York, Chicago, or Los Angeles, it is neither necessary nor cost-effective to survey even one percent of a group so large. At some point the distribution of responses simply adds numbers, but the proportions of responses selecting each possible answer do not change significantly. Social scientists have worked out sophisticated statistical methods to provide a precise answer to the question of sample size. The answer establishes a minimum necessary depending on the kinds of statistical analysis to be conducted and the degree of accuracy needed for the question at hand. For example, to keep us up to date on the likely voting patterns in a forthcoming election, it is sufficient to track what likely voters are going to do within a margin of error of plus or minus 2 percent. Called a “power analysis,” the calculations social scientists make begin with a projection of the number of cases expected to fall randomly into each possible category. Scientists can then determine whether the observed distribution varies significantly from the expected random distribution.9 As a rough rule of thumb, they would want at least 25 cases per possible response category. In our “Oldies” example there are eight categories of music. So, we would need a sample of at least 200 individuals. We have 435, so the sample size is adequate. But we do not have a claim that reports a percentage. In our example the claim reports a tendency. Social scientists would not regard a tendency as being a strong enough deviation from random to be called “statistically significant.”

**WAS THE SAMPLE REPRESENTATIVELY STRUCTURED?** We said that 435 was an adequate sample size for our example, but were the 435 representative of the population being talked about in the claim? The claim talks about everyone over the age of 60. Because more than half of the people between 60 and 90 are women, and because women might have different music listening preferences, we would need to be satisfied that the 435 reflected the actual ratio of women and men in that age group. We do not know that...
from the information given. If we hypothesize that music-listening preferences might be related to educational background, race, ethnicity, or socioeconomic status, then we would want to assure ourselves that the sample of 435 was representative of the distribution of those factors among the target population. Because we do not know if 435 is a representative sample, we cannot answer this fourth question in the affirmative. And, as a result, example #1 is not logically strong.

**Coincidences, Patterns, Correlations, and Causes**

Decades ago scientists first observed that there were a number of cases of heart disease where, coincidentally, the person was a smoker. Further systematic research demonstrated a strong positive correlation between smoking and heart disease. Scientists hypothesized that perhaps smoking was a contributing factor. However, before making a defensible argument that quitting smoking would reduce a person’s chances of heart disease, researchers had to explain scientifically how smoking caused heart disease. Researchers demonstrated scientifically that nicotine constricts blood vessels in the heart, which reduces blood flow to the heart muscle, thus causing heart attacks.

*The progression from coincidence to correlation to causal explanations marks our progress in being able to explain and to predict events.* At first we may observe two events and think that their occurrence might merely be a chance coincidence. Then, as more data are systematically gathered and analyzed, we may discover that the two events are in fact statistically correlated. And, with further experimental investigation, we may learn that what had at first seemed like a coincidence actually occurs because of important causal factors. When and if we reach that stage we will have generated a causal explanation.

**COINCIDENCES** If two events happen to occur together by chance, we call that a coincidence. For example, in 2013 a total of 23 people were killed by lightning in the United States.\(^{10}\) In 2013 what are the chances that a given individual would have been killed by lightning in the United States, given that the population is roughly 317,300,000? That coincidence has roughly one chance in 13,800,000 of occurring, all else being equal. The qualifier “all else being equal” means that weather patterns do not change substantially and that substantial numbers of people do not behave in ways which increase or decrease their chances of being killed by lightning in the United States, such as becoming residents of another country or standing in an open field holding aluminum rods in the air during lightning storms. But, all things being equal, we can use probabilistic reasoning and statistical facts to calculate the probabilities that a given coincidence might occur.

Although we cannot predict with certainty that the next time you flip a coin it will come up heads, we can predict with a high level of confidence what will happen 50 percent of the time in the long run. We know how to calculate mathematical probabilities for events such as these because we know that each individual outcome occurs randomly with equal frequency. If we roll two regular dice, the result will be two 6s 1 time out of 36 rolls over the long haul. We calculate that by multiplying the chance of rolling a 6 on die #1, which is 1 out of 6, times the chance of rolling a 6 on die #2, which is also 1 out of 6. Then we multiply those odds to get the mathematical probability of both outcomes happening together—the product is 1 out of 36.

**PATTERNS** Occasionally we see patterns in events that initially appear to be random coincidences. For example, lightning does strike more than once in the same place. That’s why people put lightning rods on the tops of buildings. The lightning rod offers an attractive location for lightning to strike. Because the lightning rod is connected to the ground by a sturdy wire, the electrical charge from the lightning is directed safely into the earth, instead of causing damage to the tall building or starting a fire. We do not know where or when the lightning will strike, but we know there will be storms and lightning every year. And we have observed the pattern that lightning is much more likely to strike tall, pointy, isolated objects, like barns in the prairie or skyscrapers in cities.\(^{11}\) To ignore that pattern would be foolish of us.
One powerful example of research that uses statistical analysis is the Nurses' Health Study (NHS). This project is perhaps the most comprehensive descriptive investigation of health-related behavior ever conducted. Since its inception in 1976, over 238,000 nurses have provided information. The NHS reports findings based on statistical analyses of millions of data points. Some remarkable, unexpected, and important correlations were discovered. Measured expressions like “investigations … suggested …”, “… is associated with reduced risk …,” and “strong correlations … support …” characterize the annual reports. The scientists who conducted this research are presenting probabilistic conclusions. Their conclusions are warranted because the statistical analyses provide sufficient confidence to assert that the relationships on which they report are highly unlikely to have occurred by random chance. Google “Nurses’ Health Study” for the website at Harvard.

2009—Early Life Factors and Risk of Breast Cancer

“Epidemiologic investigations conducted by our group and others have suggested that during childhood and early adult life breast tissue is particularly sensitive to factors that influence the likelihood of developing cancer many years later. For example, if the breast is exposed to multiple x-rays or other types of radiation during this early period, the risk of breast cancer rises steadily with higher doses, but after age 40 radiation has little effect. Also, we have seen that being overweight before age 20 is paradoxically associated with a reduced risk of breast cancer for the rest of a woman’s life, although subsequent weight gain and becoming overweight after menopause increases risk of breast cancer in these later years. These findings led us to develop sets of questions focusing on diet and physical activity during the high school years…. In addition, to assess the validity of the recalled dietary data, we invited a sample of mothers of NHS II participants to also complete a questionnaire about the high school diets of their NHS II daughters; strong correlation between the mother–daughter reports supported the validity of our dietary data.

We have now begun to examine the relation of high school diet and activity patterns to subsequent risk of breast cancer. We have seen that higher intake of red meat during high school years is related to a greater risk of pre-menopausal breast cancer. Also, higher levels of physical activity during high school were associated with lower risk of breast cancer before menopause. This is particularly important, as many schools do not include regular physical activity in the curriculum, and many girls are now quite inactive during these years.” (Nurses’ Health Study Newsletter Volume 16, 2009)

2013—Adolescent Alcohol Intake and Benign Breast Disease

Based on the findings reported in 2009 and on the additional data collected about school diets from the daughters of the participants of NSH II, further research was possible. Good science progresses carefully. Five years later this report appeared.

“Alcohol consumption during adulthood is a well-established risk factor for breast cancer. However, less research has been conducted about alcohol consumption during adolescence (when breast cells undergo rapid growth) and later risk of breast cancer. In the NHS II, we found that higher levels of alcohol consumption between ages 18 and 22 was associated with increased risk of proliferative benign breast disease (BBD), a type of breast lesion that is a known risk marker for invasive breast cancer. Compared to non-drinkers, moderate drinkers (less than ½ drink per day) had an 11 percent greater risk of developing proliferative BBD, whereas heavier drinkers (more than ½ drink per day) had a 36 percent greater risk. Each additional drink consumed per day was associated with a 15 percent increase in risk of proliferative BBD. An assessment of alcohol consumption in young women in the Growing Up Today Study, or GUTS (children of the NHS II participants), also showed that drinking between ages 16 and 22 years was associated with increased risk of BBD. These results provide evidence that drinking alcohol during adolescence may increase the risk of BBD. (Nurses’ Health Study Newsletter Volume 20 2013.)
Another pattern that is difficult to miss is the concentration of multi-million dollar luxury casinos in Las Vegas, Atlantic City, and other gambling hubs. Casinos are monuments to the reliability, over the long run, of these calculated coincidences. If 98 percent of the money bet in a casino on any given day goes back to the players as winnings that day, then on an average day the casino can be very confident of retaining 2 percent of every dollar bet. The more money bet, the more dollars that 2 percent represents. Unless more than 100 percent of the money bet is returned to the bettors as winnings, we can be sure that over the long run the bettors go home losers, not winners, and not “breaking even.” An individual person winning a specific bet is, considered in itself, a random coincidence. The totality of all those coincidences can be aggregated into a large and highly predictable profit margin for the casino. The best generalization to infer is that, in the end, the casino will very likely separate the chronic gambler from more and more of his or her money.

“Fables should be taught as fables, myths as myths, and miracles as poetic fantasies. To teach superstitions as truths is a most terrible thing. The child mind accepts and believes them, and only through great pain and perhaps tragedy can he be in after years relieved of them.”

Hypatia of Alexandria, (370–415), Mathematician and Philosopher.12

CORRELATIONS As in the smoking and heart attack example, when the same coincidence is observed over and over again, that is, when people see a pattern, they begin to suspect that the events may be related by something more than pure random chance. Even before knowing that one event may be the cause of another, we can determine whether the two are correlated.

Correlations, calculated using statistical analyses, describe the degree to which two different sets of events are aligned. For example, scores on critical thinking skills tests are positively correlated with student success on state licensure exams in a number of health sciences professions.13 We might wish to speculate about the possible causal relationships of critical thinking skill to academic or professional success. But simply having the correlation in hand can be valuable to those professional programs that have more applicants than can be accepted. The admissions committees can use an applicant’s critical thinking skills test score in the way that it uses GPAs or letters of reference, namely as another valuable data point to consider when making its decision to admit or not to admit an applicant.14

When a research project reports that a statistically significant correlation has been found between events of kind #1 (scores on a critical thinking skills test) and events of kind #2 (scores on a state’s professional licensure examination), that means that the relationship between the two kinds of events is viewed as not likely to be happenstance or chance. Of course, there could be an error in this estimate, but typically the largest threshold for this error is a slim 5 percent. We can be 95 percent confident that the two events are really correlated. Even greater confidence that the events reported did not happen by mere chance can be found in many fields of research in which statistical significance is reported with 99 percent confidence, at 1 percent, or even less (0.001) chance of error. Even so, we remain in the realm of probabilistic reasoning because the warranted inference, which is logically very strong, holds open the possibility that the findings reported may have happened by mere chance. The odds are very definitely against that possibility, however. If the 0.001 confidence level is reached, then the odds that the conclusion is mistaken are 1 in 1,000.

Using statistical correlations as their basis for confidence in their products, manufacturers of over the counter medical test kits do a thriving business. Drug stores like Walgreens sell home tests kits for pregnancy, paternity, colon disease, illegal drugs, blood alcohol levels, and ovulation. These products are used by millions of people. And although these products can be highly reliable, most advertising themselves as 99 percent accurate, that still leaves a 1 percent chance for mistakes. At 1 percent, that comes to 10,000 errors out of 1,000,000 tests. Although the possibilities are remote, a test might be a false positive, meaning that that the
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**Test** indicates that someone is a biological parent, is pregnant, is using illegal drugs, is drunk, or has ovulated when those results are not true. Or a test might come back false negative, meaning that the test failed to indicate that the person was in fact a biological parent, pregnant, etc. Rare as false positives and false negatives are, they illustrate the difference between “highly confident but possibly mistaken” warranted inferences and the certainty, which characterizes valid inferences. Depending on one’s appetite for risk, with 1 chance in 100 of the test results being wrong, a person might be wise to double check before basing a major life decision on a single test’s outcome.

Well-researched correlations can be powerful tools. Consider this possibility. Suppose that writing assignments, which employ grammatically complex constructions, use expected words and expressions, include sentences with greater average word counts, and include fewer spelling mistakes are statistically significantly correlated with higher grades. And suppose that assignments that are missing one or more of those features are statistically correlated with lower grades. Based on this, we can design computer programs that assign grades by parsing grammar and counting words. The computer does not need to understand the meaning of the essay nor does it have to evaluate the quality of arguments used. The grades assigned by computers can then be checked.

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**THINKING CRITICALLY**

The Devil Is in the Details!

Ever wonder what the return on investment is for graduates from your university with your major? On its public website PayScale.com lists the annual return on investment by major for hundreds of institutions. (Navigate to the College ROI Report and select “Best ROI’s by Major” from the dropdown menu.) With data from 113 institutions, the top annual ROI for Humanities and English majors is 10.1 percent and the lowest was −3.9 percent. Looking at 840 institutions, for Business majors the top ROI was 12.3 percent down to −3.8 percent per year. Wha! Does this mean that a humanities major, like Philosophy, is financially comparable to a major in Business?

**What’s It Worth? The Economic Value of College Majors**, a study by the Center on Education in the Workforce at Georgetown University, looked at full-time full-year workers who had completed bachelor’s degrees in different fields. That report paints a very different picture. In the Georgetown report, the median salary for Business majors as a group is $60,000. The median annual salary for Humanities and English majors was $47,000. That’s 21 percent lower. You can find the Georgetown report on the web by Googling its name.

Why such huge differences? Which one is closer to the truth? Assuming both sources have provided accurate information based on the data available to them, how can we make sense out of the huge differences between what each says about the median salary by major? Hint: “The devil is in the details.” Check out the sample sizes and the sources of the information each report uses. This will help you evaluate which is the more credible source.

The Georgetown report showed earnings by major and gender and by race. How do we explain the differences by gender as reflected in this chart from the Georgetown Center for Education & Workforce. http://cew.georgetown.edu/whatsitworth/. Reprinted by permission.

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**EARNINGS BY GENDER**

*Full-time, full-year workers with a terminal Bachelor’s Degree.*

**Source:** From What’s It Worth? The Economic Value of College Majors, by the Georgetown Center for Education & Workforce. http://cew.georgetown.edu/whatsitworth/. Reprinted by permission.
Today writing samples, like those on college admissions tests, can be graded by computer. Sophisticated computer grading programs can generate the same grades as well-qualified humans 99.9 percent of the time, but the computer does its processing without comprehending the meaning of what is written and without applying the four tests of the quality of arguments presented.

against the grades that human evaluators assign to those same essays. Refinements can then be made in the computer program’s grading algorithms to achieve ever closer approximation to the results human beings would have produced. When the computer program is refined to the extent that it assigns the same grades as well-qualified human beings to 99.9 percent of the essays, then essay grading can be automated. To assign you the grade your professor would have assigned, the computer never needs to understand what you wrote. This is not science fiction. Automated grading is used by the Educational Testing Service.16

CAUSES Documenting that a causal relationship exists between events requires more than demonstrating a strong correlation. The intellectual challenge of designing research, which is capable of revealing the causal mechanisms at work in nature is important and interesting work. Perhaps this is why many strong critical thinkers find careers in scientific and technical fields attractive. Causal explanations are desirable because they enable us to explain, predict, and control parts of the natural world. Powerful investigatory methods are used by scientists to achieve causal explanations.

It is not always possible to move all the way from coincidence to correlation to causal explanation in every field of inquiry. For example, predicting the behavior of the stock market remains a hazardous and uncertain adventure. Because we do not really know how all the
factors that influence the market interact, we are not able to predict with high levels of confidence what the market will do on any given day. Some financial analysts turn out to be right, while others are wrong. Often, it seems as though the analysts announce why the market reacted as it did on a given day only after the day’s trading is completed. Then, we hear that the market responded to changes in the jobless rate, the prime interest rate, consumer confidence level, or something else. But those same analysts are not able to use those same factors to predict accurately what the market will do in the future. If their explanations of the past behavior of the market were correct, one would expect that they would be able to make reliable predictions about the market’s future behavior. That we are not able to make good predictions about the future leads us to suspect that we do not yet know, beyond the level of coincidences and correlations, what causal factors, individually or in combination with other causal factors, are relevant to explaining the behavior of the stock market. One can only wonder how relevant the factors those prognosticators identify as causes really are.

“The seeker after truth is not one who studies the writings of the ancients and, following his natural disposition, puts his trust in them, but rather the one who suspects his faith in them and questions what he gathers from them, the one who submits to argument and demonstration.”

Ibn al-Haytham, (965–1040), Astronomer and Mathematician.17

2 Fallacies Masquerading as Warranted Arguments

Just as some fallacies are presented as valid arguments, others are presented as warranted arguments. They draw their power to deceive and persuade from how closely they resemble the genuine article. Detailed analysis often helps us avoid being misled by the following fallacies.

ERRONEOUS GENERALIZATION Generalizations, even those based on solid evidence and vivid experiences, can be deceptively fallacious, too. At times, we make hasty and erroneous generalizations by relying on far too little information or by exaggerating the importance of one or two particular experiences. The result is a claim that goes beyond what the data can support. Erroneous generalizations tend to spring from and to reinforce preconceptions. Consider these examples:

- The paper showed a picture of the CEO in chains doing the perp walk as he was being led off to jail. Another middle-aged white guy with a $400 haircut! Same as Bernard Madoff, the guy who swindled $170 million out of rich people with his Ponzi scheme. All those corporate thieves are overpaid white guys.
- Many medical professionals recommend a healthy diet and regular exercise. More is always better, right? So the way to be super healthy is to go on a crash diet and exercise as much as possible! Yes?
- Seventy-one percent of the students enrolled in my educational methods course are women. So, women really like my courses.

In each of these cases, even if the premises were true, the conclusion goes unjustifiably beyond what those premises could support. If a person were interested in investigating independently the truth of the claims expressed as conclusions of these generalizations, is there a systematic and effective way to search for the evidence, which might confirm or disconfirm those claims?

PLAYING WITH NUMBERS Arguments, which use raw numbers when percentages would present a more fair-minded description, or use percentages when the raw numbers would present the more fair-minded description, can be evaluated as fallacies of Playing with Numbers. Arguments that cite statistics or numbers but do not provide sufficient information to make a good judgment about the significance of those numerical data are species of the Playing with Numbers Fallacy as well. For example:

- Six hundred people are affected by the decision you made prohibiting pythons as pets in this apartment complex. I want you to know that 80 percent of the people surveyed said that they wanted you to reconsider your decision. Exactly how many people, you ask? Well, I personally talked to my four roommates and three agreed with me, which makes 4 out of 5, including myself, and that’s 80 percent.
- The average salary for postal workers is 5.6 percent higher than the average salary for the employees of the Transportation Safety Administration. This establishes that postal workers are overpaid.
- The National Highway Traffic Safety Administration reports that there were 30,800 motor vehicle fatalities in 2012. Of those 4,957 were motorcyclist fatalities. This means that driving or riding in a car or a truck is six times more dangerous than riding a motorcycle.
Review these examples and add premises or restate the conclusion, or do both to transform each into a warranted argument that gives reasonable justification for believing that the claim—as you may have restated it—is now very probably true. For the third example about traffic fatalities visit the National Highway Traffic Safety Administration website nhtsa.gov to get the relevant details. For example note the ratio of motorcycles to other vehicles, or the ratio of total miles per year driven by the different types of vehicles.

FALSE DILEMMA A real dilemma is a situation in which all our choices are bad, like a person trapped on a window ledge of one of the upper floors of a burning building. But, at times we may think we are facing a terrible dilemma when we are not. Often the world offers more options than we may perceive at first. At times, the consequences of one or another of our options may not be nearly as dreadful as we initially imagine them to be. As the following examples indicate, upon closer analysis at times what appears to be a real dilemma turns out to be a false dilemma.

- The kidnappers have taken eight people hostage and are holding them at a farmhouse just outside town. If the SWAT team assaults the farmhouse, the hostages could be killed. But if we give into the kidnappers’ demands for ransom and safe passage out of the country, we’ll only be encouraging more kidnappings of innocent people. What can we do?
- If I go to the job interview laid-back and unprepared, I’ll blow it. But if I prepare for the interview I could overdo it and be so nervous that I’ll blow it anyway. I’m a mess. There’s no way to get ready for this interview.

As these examples show, another good name for this fallacy is “The Either/Or Fallacy” because the situations often appear to be limited to one option or another, but on further examination, additional options emerge. This is true of the first example. Assaulting the farmhouse and giving in are not the only possible options. Negotiating for the release of some or all of the hostages is an option. Waiting until those inside the farmhouse run out of food or water is another option. Blasting the farmhouse with mega decibels of sound and shooting tear gas in through the windows might force the occupants out. In other words, a little creativity can often reveal a way out of a false dilemma.

THE GAMBLER’S FALLACY Random events, by definition, are not patterned, correlated, or causally connected. But, at times, we make arguments that wrongly assume that what happens by chance is somehow connected with things we can control. We can use “Gambler’s Fallacy” as an umbrella term to remind ourselves that random events are, in fact, random and that drawing inferences based on the assumption that they are patterned, correlated, or causally connected is a mistake. Here are some examples of fallacious inferences that attribute more to mere chance coincidences than strong reasoning would warrant.

- If we’re going to Vegas, I’ll bring my blue socks to wear in the casino. You know, the pair with the word “Winner” embroidered on the side. They’re my lucky socks. Although I’ve lost money plenty of times wearing them, I’ve never won at slots without those blue socks. So, I won’t win a dime from the slots if I don’t wear those socks!
- Whenever I leave the apartment, I rub the tummy of the little statue of bronze Buddha we have on the table near the door. It makes me happy to do that because I know that it brings me good karma.
- I just flipped a coin twice and it came up heads both times. So, the next two times I flip it, the coin will come up tails because the chances are 50-50.
- Miguel Cabrera is batting for the Detroit Tigers. Cabrera’s batting average this year is .333. This is his third trip to the plate this game. He grounded into a double play his first trip and struck out his second time. So, he’s going to get a hit this time.

FALSE CAUSE This fallacy is one of the most common obstacles to good thinking. The False Cause fallacy is to assume that two events are causally related just because one happens right after the other. This mistake is jumping to the conclusion that the first event must have caused the second event.
• Look, I put the CD into the player and the windshield wipers wouldn’t turn on. It has to be that the problem with the wipers is somehow connected to the CD player.

• It’s hard to know exactly what made her so angry. She seemed fine when we were talking earlier about what a jerk her former boyfriend was. Then you came in and boom! She exploded. I think it’s your fault. Called “Post hoc, propter hoc” (“After this, because of this”), confusing temporal proximity with causality is one of several mistakes grouped together under the heading False Cause Fallacies. Another mistake is to confuse a correlation with a cause.

• Our information shows that in times of economic growth, the hemlines on women’s skirts go from below the knee to above the knee. And in times of a bear market when the economy slows down, the hemlines that are considered stylish go down below the knee, at times to mid-calf or even ankle height. I know how we can cure the current recession! All we need to do to pull out of the current recession is to make the fashion designers raise hemlines.

Other mistakes often grouped under the broad heading of False Cause Fallacies result from confusing symptoms, outcomes, or intentions with causes. Here are examples:

• The pressure was intense that day. I had to get from the university to my job, a drive that normally took 25 minutes. But the professor kept us late and then my car wouldn’t start. You know there had to be a traffic jam on the freeway that day. And I needed to get to work because I had to make this major presentation. My head was aching and my heart was beating so fast. I felt all sweaty and it was getting harder and harder to breathe. I think that it was all because I couldn’t get any air. That’s where the pressure was coming from. No air.
Three years ago we instituted a policy of Zero Tolerance for binge drinking in campus-controlled housing units. Simultaneously, we instituted a non-punitive program of substance abuse counseling. Today we have been honored by the state legislature because the reported incidents of binge drinking have dropped 32 percent compared to numbers from three years ago. The counseling program is why. That program has greatly reduced the number of incidents of binge drinking in campus-controlled housing.

We wanted it more than they did! And that’s why we won.

SLIPPERY SLOPE  Everyone knows that simply beginning something is no assurance that it will be completed. For a variety of reasons, too many good students never finish their degree programs. Not everyone who takes a drink becomes an alcoholic. Not everyone who buys a gun becomes a killer. The Slippery Slope Fallacy makes the false assumption that events are linked together so that the first step in the process necessarily results in some significant, usually bad, result way down the road somewhere. The image conjured by this fallacy is of walking along the edge of a muddy wet ridge. One step over that edge and we slide on our butts all the way to the bottom. Another image associated with this fallacy is the “camel’s nose under the tent” image. Once the camel gets its nose under the tent, there is no way to prevent the whole, huge clumsy animal from entering one’s well-ordered abode. There is wisdom in avoiding situations that can lead us down the path to major problems. But the fallacy fails to remember that even when we are headed toward trouble we have the power to turn ourselves around.

If you ever smoke a joint, then you are on the path to perdition. One puff and there is no stopping the inevitable fall. Next it will be snorting coke, then shooting up heroin, leading to addiction with track marks in your arms and hepatitis or worse from contaminated needles.

I warn you, you had better come to every training session. We start lessons Monday. If you miss the first day, then you’ll be behind and you will never catch up.

A person can make a mistake and recover from it. And some of the initial stages that are alleged to be dreadful turn out not to be problems at all. And the middle ground is often the best place to make one’s stand. To quote Terence of ancient Rome, “Moderation in all things.”
Warranted Inferences

Summing up this chapter,

the evaluation of probabilistic reasoning occurs each day of our lives. We evaluate inferences as warranted or unwarranted when talking with friends, working on projects, enduring television commercials, or reasoning through a decision. In this chapter we first worked to strengthen our critical thinking skill of evaluation by considering the impact of new information on extended examples of probabilistic reasoning. It is natural for our minds to think in terms of the progression from coincidence, to perceived pattern, to demonstrated correlation, and then to causal explanation. Although, often it is a mistake to jump to conclusions that events are connected when, in fact they are not. That is why we then worked on the evaluation of arguments that offer to generalize from a limited number of experiences and samplings of data to reach justified claims about the characteristics of larger populations. To protect ourselves from being easily deceived, we reviewed the collection of common fallacies that masquerade as warranted arguments.

Key Concept

**warranted** describes an inference or argument such that the truth of the premises justifies or strongly supports confidently accepting the conclusion as very probably true, but not necessarily true.

Applications

Reflective Log

*To Kill a Mockingbird:* Gregory Peck plays the defense attorney, Atticus Finch, in the classic film *To Kill a Mockingbird.* The story is about a young man accused of rape. Toward the end of the trial there is a courtroom scene where Atticus Finch gives his summation to the jury. He must be careful not to alienate the members of the jury, whom he regards as potentially biased against the defendant because of his race. Atticus first argues that the prosecution has not proved that a crime was actually committed. He then argues that the accused, Tom Robinson, could not physically have done the things that the prosecution claims. Atticus, believing that he must do more than make claims and logical arguments establishing reasonable doubt, then addresses a key question. Why would the young woman accuser, a White woman, have lied about being raped by the accused Tom Robinson, a Black man? Atticus says he has pity for the victim and then he argues that by accusing Tom Robinson, she was attempting to rid herself of her own guilt. The defense then attempts to challenge the prejudicial assumption: In the language of those days, “Negros cannot be trusted.” Locate the film and listen carefully to the claims and arguments made by Atticus Finch in his speech to the jury. Transcribe them and then analyze and map the arguments. Explain your analysis and your evaluation. Would you have made the summation differently? If so, how?

Individual Exercises

Evaluate the worthiness and explain: Assume that all the premises that are asserted in the arguments below are true. Apply the remaining three tests to evaluate each argument to determine which are worthy of acceptance. Begin with the Test of Logical Strength. Remember, if the argument fails a test you do not have to apply any further tests because, at that point, the argument has been found to be unworthy of acceptance. In each case, give a detailed
explanation to support your evaluation. State in your own words why each argument is worthy or unworthy of acceptance. Hint: Be prepared to add implicit but unspoken premises and assumptions. Keep in mind all the things we learned about fallacies and about logical strength from this chapter and the previous two.

1. Anthony was at risk of dying from the severe fall that he took when he was climbing. Many who had the same near-fatal experience become averse to climbing afterward. So, Anthony will surely become averse to climbing after his fall.

2. Susan is John’s younger sister. Linda is John’s elder sister. So, Linda is Susan’s elder sister.

3. I want to buy a boat and you want to buy a car. If we buy a car we can’t use it for fishing or to go tubing. But if we buy a boat we can’t use it in the city or anywhere else but at the lake. Either way we’re stuck.

4. Blood samples taken from the crime scene were type AB. The accused person’s blood is type AB. Therefore, the accused was at the scene of the crime.

5. Either we’ll study together tonight for tomorrow’s exam, or we will both blow it off. I’m too tired to study tonight. So, we’re going to blow it off.

6. Whenever I play the lottery, the number I put in is my birthday. If that’s not my lucky number, then I don’t have one.

7. Randolph knows that John Glenn was a senator. John Glenn was an astronaut. Therefore Randolph knows that John Glenn was an astronaut.

8. Every member of the House of Representatives is under the age of 90. Therefore, the House of Representatives is an organ of government that was created less than 90 years ago.

9. Seventy-three percent of the people surveyed said that they wanted universal health care coverage. Fifty-four percent said that they were worried about the cost of the program or the quality of the care that would be provided. Therefore, the American people are opposed to the President’s health care reform legislation.

10. The Mayor has been in office for three months, and our city’s economic recession has not gone away. The Mayor needs to take full responsibility for the sorry state of the city’s economy.

11. My dear old Uncle Joe has a statue of the Red Faced Warrior on his kitchen table. It faces the side door, and he says that it keeps bad people from coming into his house. He also has a picture of St. Christopher taped to the dashboard of his old Buick and a rosary draped over the rearview mirror. More protection he claims. On the other hand, he never locks his house, and he needs to get his eyes checked!

12. But if we don’t study together, then I’m not going to get through the course. And if I don’t get through the course, then I’m going to ruin my GPA and lose my financial aid. So if we don’t study together tonight, then I’m going to lose my financial aid.

13. We’ve lost six games in a row; our luck has to change today.

14. We didn’t know what to do to improve sales. So, we all started wearing bow ties and navy blue sweaters to work. And look, three weeks later sales are way up. I’m sure it’s our new office dress code.

15. It is March tenth and already this year six people have ordered new glasses with plastic frames. Last year only four people had ordered plastic frames by this date. That’s an increase of 50 percent. We had better stock up. It’s going to be a busy year.

16. Everyone loves ice cream. Children love ice cream. So, everyone’s a child.

17. Water is our most precious resource. So, a towel on the rack means “I’ll use it again” and a towel on the floor means, “Please replace.”

18. The archeological theory that the Clovis people of North America were related to the Solutrean culture of Ice Age France and Spain was based on the similarities in the stone tools used. But new DNA evidence suggests that theory is mistaken. The DNA evidence indicates that the ancestors of the Clovis people came from Siberia in Asia. Since present day Native Americans are descended from the Clovis people, their ancestors were Asian.

19. The suspect has a history of drug abuse. He has no alibi for the time of the murder. The suspect owns a collection of ceremonial knives and the murder weapon was a ceremonial knife. The suspect may have no motive as far as we know right now, but remember that his father was a serial killer. We found fibers at the crime scene, which are consistent with the brand of blue jeans the suspect wears. An eye witness places the suspect at the Fairfield Mall just one hour before the murder. So the suspect must be guilty.

20. Everyone believes that pornography harms people by modeling sexually aggressive behavior in men. But the evidence from recent studies suggests that pornography can have that effect only on men who are already prone to aggressive behavior. Therefore pornography is probably not the problem. Male aggressiveness is the problem.
21. Biologists observed that male crickets on Kauai and Oahu no longer sing. This is due to mutations in their wings, different on the two islands, but both with the same result. Over 20 generations crickets with these wing mutations survived and procreated while the male crickets without the wing mutation all but disappeared. Why? the biologists asked. The answer was that the singing male crickets attracted a species of fly that sprayed baby maggots onto the singing cricket’s back. The maggots burrowed into the cricket to feed. Thus killing the cricket. Biologists see this as more evidence that evolution is a natural process that continues to this very day.21

What’s the truth about colon cleansing? On most issues we can find seemingly credible sources presenting substantially different information. We become confused about what to believe. And if we are unable or unwilling to evaluate the arguments and reasons being presented, we might find ourselves wasting our money or backing the candidate who does not have our interests at heart. But a strong critical thinker sees it as a challenge when two apparently credible sources present highly divergent information: Which is closer to the truth? If selecting an academic major based on faulty information about potential future earnings is not bad enough, making personal health care decisions based on faulty information and weak arguments only adds to one’s problems. A service increasingly offered by spas and clinics that seems to be growing in popularity is colon cleansing or colonic hydrotherapy. Lots of colon cleansing products are marketed with celebrity endorsements. The arguments and reasons in support of colon cleansing include enhancing personal well-being, weight loss, and flushing bodily toxins. But there are reasons why colon cleansing is not recommended—for example, that the process itself can cause internal injuries and that its alleged benefits cannot be demonstrated.

You be the judge. Research the reasons given for and against the practice and evaluate them. Figure out which side in this issue is closer to the truth. Search “Colon Cleansing” for spa ads and claims about its advantages. For the other side see, for example, “The Dangers of Colon Cleansing,” published in the Journal of Family Practice. This is not a 50/50 issue. As compared to those urging caution, those promoting a non-essential service, activity, or product have the greater burden. For they must prove that we ought to do what we need not do.22

**SHARED RESPONSE**

**More Than Just a Couple of Cases**

To evaluate the logical strength of probabilistic generalizations, we need to do more than find one or two counterexamples. We must, instead, examine whether the sampling of cases reported in the premises is adequate to support the probabilistic inferences that are drawn. This means asking four questions and finding satisfactory answers to each of them.

- Was the correct group sampled?
- Were the data obtained in an effective way?
- Were enough cases considered?
- Was the sample representatively structured?

In an earlier shared response exercise, you evaluated the argument that pseudo mature young teens are more likely to experience a variety of problems as young adults. There we asked if one counter example invalidated the probabilistic generalization. Re-evaluate the generalization in light of these four questions. Comment respectfully on other peoples’ shared responses.

**Group Exercises**

Create your own examples of fallacies: Write two fallacious arguments exemplifying each of these six errors

- The Erroneous Generalization Fallacy
- The Playing with Numbers Fallacy
- The False Dilemma Fallacy
- The Gambler’s Fallacy
- The False Cause Fallacy
- The Slippery Slope Fallacy

**Bedbugs and cold days in August:** Evaluate the bedbug example and the San Francisco in August weather example. In each case ask:

- Was the correct group sampled?
- Were the data obtained in an effective way?
- Were enough cases considered?
- Was the sample representatively structured?

When the premises do not provide enough information for a satisfactory answer, explain what information one would have to find, as we did when we noted what would be needed for the sample of 435 to be considered representative of the population of people over the age of 60.

**How should the United States conduct the 2020 census?**

There are two ways to conduct a census. Contact everyone
and gather the data being sought, or generalize from well-structured representative samples. This group project invites you to evaluate the methodology used by the U.S. government for conducting the 2010 Census. You are invited to make recommendations for improving that methodology. If you come up with some good suggestions, offer them to your Congressional representatives and the U.S. Census Bureau. Begin your investigation at the U.S. government’s census website census.gov. Navigate to the methodology page.

To fully evaluate the methodology and make reasonable recommendations, your group will want to consider first and foremost the logical strength of the two alternatives (count absolutely everyone possible vs. make estimates based on samples.) When considering the sampling alternative, keep in mind the importance of sample size and representative structure. For both alternatives, keep in mind the question of the method of gathering data. For example, going door to door will ensure that homeless Americans are systematically excluded.

Other considerations that may weigh on your ultimate recommendations: You should consider the cost (money and time) of the two alternatives, the political consequences of each, and the social value associated with enlisting volunteers in an effort of national scope.

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**Bonus Exercise**

**The debate over the “Public Option”**

At the end of the July 24, 2009, episode of HBO’s *Real Time with Bill Maher*, Maher argues in support of the “public option” to be included in the health care reform legislation, which at that time was being fiercely debated.

The “public option,” a provision not included in the final Obamacare (Affordable Care Act) law, would have given tens of millions of uninsured and underinsured Americans the option of purchasing health care insurance at an affordable price. Either the government would provide the program through a not-for-profit agency, or the legislation would permit the establishing of co-ops. Maher’s barbed statements included these: “If conservatives get to call universal health care ‘socialized medicine,’ I get to call private, for-profit healthcare ‘soulless, vampire bastards making money off human pain.’” “I would love to have some journalist ask a Republican who talks about socialized medicine: If it’s so awful, how come it’s what we have for our veterans?”

Locate and watch Bill Maher’s commentary in episode 161 of *Real Time with Bill Maher*. In as fair-minded and nonincendiary a way as possible, present his arguments in support of the “public option.” Map his reasons using the techniques presented in the chapter, “Analyze Arguments and Diagram Decisions.” Then evaluate his arguments using the four-test process presented in the chapter, “Evaluate Arguments: Four Basic Tests.”

During the summer of 2009 many conservative political commentators spoke out against the “public option.” Research the web for videos and written editorials by political conservatives like Bill O’Reilly, Dennis Miller, and Sean Hannity. With the same concern not to be caught up in the rhetoric, but instead to dig for their reasons and evidence, analyze and map their main arguments in opposition to the “public option.” Once you have those arguments analyzed, apply all four of the tests for evaluating arguments. As with the arguments offered by Maher, here too arguments may fail because one or more of their premises are untrue, because the argument is illogical, because the reason is irrelevant, or because the argument is circular. To assist with these tests you might search for commentaries on the arguments, since many media outlets published editorials during those days to refute the arguments of the other side. One example focusing on Sean Hannity that we quickly found five years later was posted by the Media Matters Organization. Google “mediamatters.org/research/200910080006.”
Endnotes

1. Indiana State University is located in Terre Haute, Indiana. The statistics cited in this opening story are approximations of the 2013–14 data published on the US News and World Report’s Education Web site: Visit the web pages for their respective undergraduate admissions offices for more precise and up to date information on tuition and fees.

2. Researchers in the field of Informal Logic would categorize some, but not all, of the examples in this chapter as “Inductive.” Other examples they recommend categorizing as “Abductive” or “Conductive.” A helpful summary of the Informal Logic categorization is provided by Leo Groarke, “Informal Logic,” The Stanford Encyclopedia of Philosophy (Spring 2013 Edition), Edward N. Zalta (ed.). There is no question but that elaborating definitional schema expedites communication within a given disciplinary language community. Although, too often, that very goal is frustrated when speaking across the fence with the members of a neighboring disciplinary language community where those same words are used with different meanings. As valuable as technical definitions are for other purposes, they can be impediments when teaching for thinking. Like so many of our colleagues who teach critical thinking in open-admissions general education courses, we have found that the less we rely on the technical vocabulary of any one discipline or professional field the more successful our students are in applying their critical thinking skills and in developing the positive habits of mind.

3. The story as told here is derived from CSI episode 212, “You’ve Got Male” (episode #12, season 2), which first aired on December 20, 2001. The story as it is told in the CSI episode includes yet another twist that is not revealed as it is recounted in our chapter. Hint: “murder or accident” is a false dilemma if there are other possibilities. In the original script we learn that the wife did not purchase the life insurance policy, even though her credit card original script we learn that the wife did not purchase false dilemma if there are other possibilities. In the episode includes yet another twist that is not revealed as it is recounted in our chapter. Hint: “murder or accident” is a false dilemma if there are other possibilities. In the original script we learn that the wife did not purchase the life insurance policy, even though her credit card


12. Little Journeys to the Homes of Great Teachers by Elbert Hubbard (New York: Roycrafters), 1908.

13. Karen B. Williams, Colleen Schmidt, Terri S. I. Tilliss, Kris Wilkins, and Douglas R. Glasnapp, “Predictive Validity of Critical Thinking Skills and Disposition for the National Board dental hygiene examination: A Preliminary Investigation,” Journal of Dental Education 70(5) (2006): 536–544; Kenneth L. McCall, Eric J. MacLaughlin, David S. Fike, and Beatrice Ruiz, “Preadmission Predictors of PharmD Graduates’ Performance on the NAPLEX,” American Journal of Pharmacy Education 15; 71(1) (2007): 5; The CCTST total score is a prepharmacy predictor of successful licensure as a pharmacist (NAPLEX test). Age, advanced science education courses, and previous BS or MS degree were not significantly correlated with NAPLEX; J. Giddens and G. W. Gloeckner, “The Relationship of Critical Thinking to Performance on the NCLEX-RN,” Journal of Nursing Education 44(2)(2005): 85–89. CCTST total scores were higher in participants who passed the NCLEX-RN.

14. The power of a correlation to predict results depends on how strong the correlation is. Typically a correlation is reported as a decimal value between 0 and 1. For example, “the correlation of X and Y is 0.31.” Researchers use this number to calculate how much the change in X can predict changes in Y, and vice versa. That calculation is simple. Called the “variance,” it is correlation squared. If college success (measured as GPA)
is correlated at 0.40 with critical thinking skill, then we could infer that 16 percent of the variation seen in college GPA is predictable based on differences in critical thinking skills.


Credits

Credits are listed in order of appearance.

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