**CHAPTER 1**

**Behavioral Foundations**

1. This question presents a simple choice task designed to help identify stochastic dominance. Typically, people compare the two risks by comparing how they perform by color, and eliminating from consideration colors that produce common outcomes. Proceeding this way leads to the elimination of yellow, red and white, and what remains are blue and green. A comparison of Urn A and Urn B on blue and green reveals that Urn B features a higher payoff if either a blue or green ball is drawn. Therefore Urn B is the dominant choice.

2. This is a judgmental question that focuses on how to differentiate between base rate information, singular information, and combine the two. Although it can be formulated as a Bayesian problem, most people will not do so. The base rate information is the proportion of engineers relative to lawyers, in this case 70/30. The singular information is the description of Jack, which people judge differently, although more people view the description of Jack as being more like an engineer than a lawyer. This is because many politicians have legal backgrounds, and engineers are educated to use analytical models to design and build things, which relate to mathematical puzzles and carpentry. Those who regard the singular information as completely uninformative will rely completely on the base rate and answer 70 percent. Others will answer differently, reflecting their subjective assessments and the weight they place on the description of Jack. Those whose answers lie above 75 percent virtually ignore the base rate information and rely heavily on the singular information contained in the description of Jack.

3. This question pertains to loss aversion. A loss averse individual will reject the opportunity, regardless of the stakes. A minority of people will reject the opportunity for the $450 stake opportunity, but accept the $225 stake opportunity. This question can be used to prompt a discussion about how people’s answers depend on stake size.

4.This question provides a second pass at the overconfidence trivia test. At issue is how quickly people can learn to widen their confidence intervals. Students should be asked to compare their hit rates for this question with their hit rates when answering Question 2 of the behavioral questionnaire discussed in Chapter 1 (Additional Resources). For a typical class, the histogram of responses to this question is similar to the histogram associated with the overconfidence trivia quiz discussed in Chapter 1, suggesting that most people do not find it easy to adjust their confidence intervals, and that doing so requires time and effort.

5. At one level, this is a Bayesian question. Most people are not good at applying Bayes rule, and by asking for a confidence interval the question focuses on how confident people are that they can use their intuition to come up with a sensible answer.

The correct answer to part a is 45 percent, which corresponds to the base rate.

The correct answer to part b, obtained by applying Bayes rule, is approximately 96 percent. The associated computation is presented below.



As for part c, in a typical class, hit rates are very low, and most people are surprised that the correct answer is above 90 percent.

A good way to discuss this problem is to explain why 45 percent is the correct answer to part a, as it reflects randomly drawing one of a hundred bags, of which 45 satisfy the criterion. Someone who had no additional information about the bag would only be able to count on base rate information. However, part b provides additional information. Some people will regard the additional information as useless, and will answer part b with the same answer they gave for part a. Those who regard the information as helpful will answer part b differently from part a.

The point of this question is not to teach Bayes rule, but to teach the intuition underlying Bayes rule. Doing so involves asking people to begin with their answers to part a, and asking them to think about what “scaling number” they would multiply by their part a answer to reflect the new information. If the new information favors the bag consisting predominantly black chips, the scaling number should exceed 1. If the new information favors the bag consisting predominantly red chips, the scaling number should be less than 1. If the new information favors neither, the scaling number should be equal to 1.

6. This question pertains to whether people rely on representativeness to make predictions. For the actual population of students, the mean graduating GPAs respectively corresponding to 2.2, 3.0, and 3.8 were 2.7, 2.9, and 3.3. Most people underpredict GPA for the 2.2 and overpredict GPA for the 3.8. In discussing this question, a good question to ask is whether people viewed the student with a high school GPA of 2.2 as representative of someone low in ability and the student with a high school GPA of 3.8 as representative of someone high in ability? If so, placing too much weight on the stereotype leads people to underestimate observed variables that impact scholastic performance, both in high school and in in college. Other factors can include a variety of personal issues such as health and family dynamics.

An important question to ask is whether any use was made of the means and standard deviations provided in the question. Most ignore this information. However, a good thing to do is to compute the z-scores for both the high school GPA scores and predicted college GPA scores. The z-scores for the predictions should be less than the z-scores for the inputs. Typically, this is the case. However, the z-scores for the predictions tend to be more than 1.5 times higher than the actual values, thereby providing an indication of the strength of representativeness-based bias.

7. This question pertains to anchoring-and-adjustment. People get anchored on the number on the ping pong ball, even though they have no reason to believe that it is relevant to the market price of wine.

8. The answer to part a should be contrasted with the answer to question2. People who answer part a and this question the same way completely ignore base rate information. The class histogram for answers to part a is typically much wider than the histogram of responses to question 2.

Answers to parts b and c are information that would be needed to use Bayes rule in order to arrive at a numerical judgment for question 2 and for part a.

In a typical class, most people do not ask themselves these questions. Most people do not think in Bayesian terms, even intuitively.

9. This question pertains to framing. Most people who answer this question do so by eliminating common outcomes, as was described in the answer to Question 1, would eliminate white. That leaves them considering the perceived advantage of choosing Urn B -- a higher probability of winning $45 if red comes up and a lower probability of losing $15 if yellow comes up -- and the perceived advantage of choosing Urn A – winning $30 instead of losing $10 if green comes up. Those who regard the perceived advantage of choosing A as important will be inclined to choose Urn A over Urn B.

The framing aspect of this problem is that it is quantitatively equivalent to the choice in Question 1, where Urn B is definitely the better choice. The frame in this problem is opaque. To see that the decision task in this question is equivalent to the decision task in Question 1, in Urn A of Question 1, combine the probabilities of the two events associated with losing $15. Likewise for Urn B of Question 1, combine the probabilities of the two events associated with winning $45. These combinations will produce the same probabilities and amounts that are depicted in this question.

10. Question 5 features the drawing of 12 chips with replacement from the selected bag of chips. Here *x* is 8, *n* is 12, and the probability *p* is 0.7 for the bag containing predominantly black chips and *p* is 0.3 for the bag containing predominantly red chips.

The binomial probability distribution applies to options, and those who have studied options should recognize the binomial option model.

**Minicase**

**Case Analysis Questions**

1. One way to analyze this question is to go through the list of ten major phenomena described in the chapter and look for evidence consistent with each one. Below are examples for phenomena that appear to be germane.

*Excessive optimism:* In respect to completing the project on time, the Grupo Unidos por el Canal consortium did not make the August 2014 deadline, as the first container ship passed through the new locks in June 2016. The minicase documents a series of problems in this regard.

According to the *Times* article, in 2009 Panama’s vice president told the American ambassador that when the winning bidder’s bid is a billion dollars below the next competitor then something is seriously wrong. This issue pertains to the source of excessive optimism, and judging whether something that sounds good is too good to be true. Desirability, or wishful thinking, is one of the main reasons why people are excessively optimistic. Receiving a very low bid, and hoping that the bid not entail any sacrifice in quality, lies at the heart of this issue. For this reason, some people use a rule whereby the invite at least three bids and reject the lowest. Failing to test whether a low price entails low quality reflects confirmation bias, mentioned below, as well as excessive optimism.

*Overconfidence:* Consider two issues. First, although the project’s approach to fixing problems was characterized as trial-and-error, the ACP described itself as “confident” about the concrete lasting for a century. This remains to be seen. Second, the canal dimensions leave very little margin for error for tug boats to move alongside the ships, especially on windy days. This issue pertains directly to the width of confidence intervals.

*Confirmation bias:* The ACP appears to have given low weight to the fact that the consortium’s budget for concrete was 71 percent smaller than that of the next lowest bidder, which appears related to its plan to use inferior aggregate instead of imported aggregate. In this regard Bechtel, one of the most experienced engineering and construction firms in the world, did plan to import aggregate. As the minicase mentions, during the testing phase in 2015, cracks emerged in the concrete lining the lock walls, and water rushed through the cracks, requiring the insertion of additional steel reinforcing bars.

*Representativeness:* If the Belgian locks were portrayed as prototypical, then it is possible that the ACP relied on representativeness when judging the suitability of tugboats, which perhaps combined with confirmation bias induced insufficient attention to differences between the locks in Belgium and those in Panama.

2. It does provide for at least the appearance of a conflict of interest. A possible example involves the canal administrator might have concerns pertaining to the tugboats, but not pursuing the ACP’s interests, or that of Panama, because of a concern that doing so would harm his son.

3.If the low bid reflected the use of low quality material, then the same concerns might apply to the gates in the new locks. Given the problems that occurred at Sault Ste. Marie, and the potential threat to U.S. commerce, the absence of discussion about this issue for the Panama Canal raises the possibility of availability bias: out of sight, out of mind.