DECISION ANALYSIS IN NEGOTIATION

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Imagine a United States President facing a decision on whether to attempt a military mission to rescue Americans trapped in a hostile country. In a meeting in the White House Situation Room, top military advisers describe a possible plan. The President asks about the chances of success for the mission. The advisers respond that there are six crucial stages of the plan, and all have to go smoothly in order for the mission to work. They state that the overall chances for the plan are good because each individual stage has an eighty percent chance of success. What should the President do?

A field known as "decision analysis" can help answer this type of question and many others in a wide range of situations.[1] When parties understand what their chances of success are for each of several possible choices, they can make better decisions on how to proceed. The tools of decision analysis are particularly useful for negotiators. People who are negotiating need to be able to evaluate what is likely to happen to them if they accept a deal and what will occur if they do not.[2]

In the rescue example above, it is easy to see how a President might be tempted to authorize the plan. If the chances of success at each stage of a mission are eighty percent, it may seem that the chances of success for the overall mission would be reasonably good. However, decision analysis shows that the mission is much more likely to fail than succeed. The statistical method used to calculate the overall likelihood of success in this situation requires multiplying the chances of success of each individual stage. Thus the

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1. Readers desiring additional information on the topics covered in this essay can consult JEFFREY M. SENGER, FEDERAL DISPUTE RESOLUTION: USING ADR WITH THE UNITED STATES GOVERNMENT 80, 113-15 (2004); Marjorie Corman Aaron, *The Value of Decision Analysis in Mediation Practice*, 11 NEGOT. J. 123 (1995); David P. Hoffer, *Decision Analysis as a Mediator's Tool*, 1 HARV. NEGOT. L. REV. 113 (1996); Marc B. Victor, *The Proper Use of Decision Analysis to Assist Litigation Strategy*, 40 BUS. LAW. 617 (1985).

2. *See* ROGER FISHER ET AL., GETTING TO YES: NEGOTIATING AGREEMENT WITHOUT GIVING IN (2d ed. 1991) (describing the importance of analyzing the best alternative to a negotiated agreement, known as "BATNA").

President should multiply 0.80 (the chance of succeeding in the first stage) by 0.80 (the chance of the second stage), then multiply this result by 0.80 for the third stage, and so on, all the way through the six stages of the mission. This total, 0.80 x 0.80 x 0.80 x 0.80 x 0.80 x 0.80, (or 0.80 to the sixth power), is 0.26. Thus, the overall chances of success for the mission are only approximately twenty-six percent, or slightly better than one in four.

I. EXAMPLES OF DECISION ANALYSIS

The mathematical processes used in risk analysis may be explained further with several examples. Imagine going to a local carnival and approaching a midway booth with a giant "Wheel of Chance." The wheel has many spaces on it, half colored blue and half yellow. The carnival operator tells you that if you spin and the wheel lands on a blue space, you will win $20.[3] If it lands on a yellow space, you win nothing. How much would you pay to play this game?

Many people can answer this question intuitively, without having to use a mathematical approach. However, following the math in this example can be helpful to understanding what happens in more complicated situations. Decision analysis principles state that the expected outcome of a situation like this is found by multiplying the probabilities of each possible outcome by the result of that outcome (called the payoff), and then summing these products. In the Wheel of Chance example, the probability of landing on blue is 0.50, and the payoff for landing on blue is $20. Multiplying these numbers yields $10. The probability of landing on yellow is 0.50, the payoff for this is $0, and multiplying these numbers yields $0. Adding these two results, $10 plus $0, gives the expected result of the game: $10.

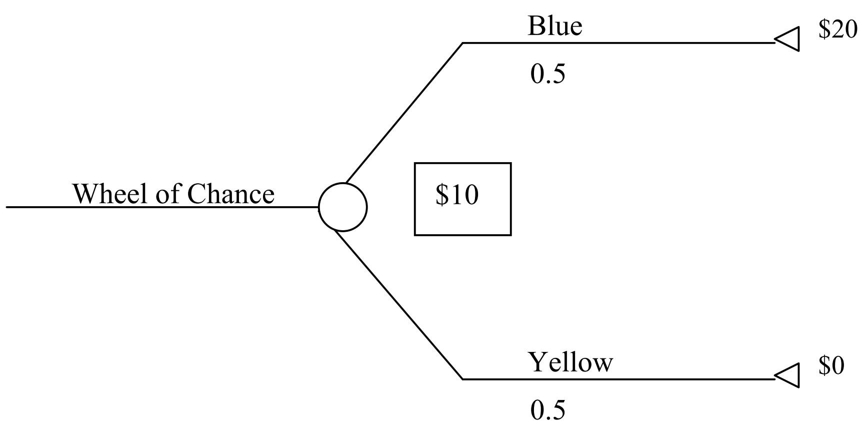
Figure 1 shows a graphical representation of this situation, which is a simple example of a "decision tree."[4] The trunk of the tree (entitled "Wheel of Chance") breaks off into two branches, representing the two possible outcomes of the game, blue or yellow. This juncture is marked with a circle (called a "chance node"), indicating that the results at this point cannot be controlled. The probabilities of each outcome (0.50) are written below each branch. Each branch ends in a triangle (called a "terminal node"), indicating that the game is over at that point, with payoffs of $20 for blue and $0 for yellow. A computer can be used to "roll back" the tree, which gives the expected value of the tree at the chance node. The box next to the chance

3. Assume for purposes of the example that the carnival operator has not rigged the wheel to give an unfair result.

4. Technically, this figure would be called a "chance tree" or an "event tree," as a decision tree would include another branch to indicate the option not to play the game at all.

node in Figure 1 shows the expected value of $10.

FIGURE 1



It is worth noting that $10 is not a possible outcome from playing a single game (which yields either $20 or $0). Instead, it is a mathematical construct providing a sense of what the game is worth, in a theoretical sense, to someone who plays it. One way of explaining this is that the expected value represents the average payoff for someone who played the game many times.

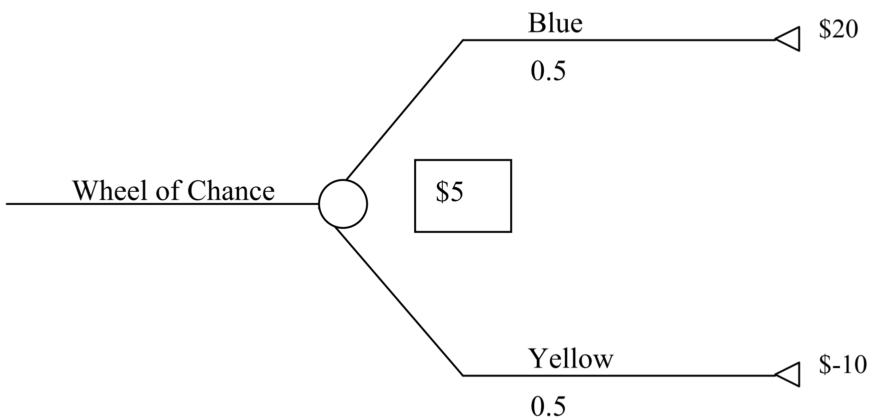
Different individuals will have different reactions to this information. People who do not enjoy playing games of chance may be willing to pay only $8 to play the Wheel of Chance (perhaps because they dislike risking money or because they would rather spend their time riding the roller coaster). On the other hand, carnival midways (not to mention Las Vegas casinos) exist because many people are willing to pay considerably more than $10 to play games such as this.[5]

For another example, imagine a slightly different Wheel of Chance. In this game, if the wheel lands on blue you will still win $20, but if it lands on yellow you must pay an additional $10. How much would you pay to play this game? The analytical approach is the same as in the first example: multiply the probabilities by the payoffs and add the results. The probability of landing on blue is 0.50, the payoff for landing on blue is $20, and multiplying these numbers yields $10. The probability of landing on yellow is 0.50, the payoff for this is -$10, and multiplying these numbers yields -$5. Adding these two results, $10 and -$5, gives the expected result of the game:

5. It is possible to use more advanced decision analysis tools to account for parties' risk preference. These tools can provide more specific information for parties who are inclined either in favor of or against taking risks.

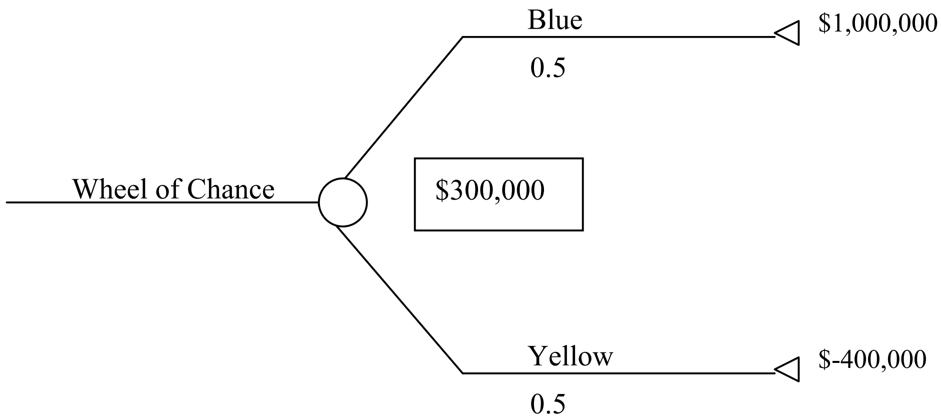
$5. This example is somewhat closer to the realities of litigation, where parties who fail to win lawsuits not only win nothing, but also must pay their attorneys. It is shown graphically in Figure 2.

FIGURE 2



Finally, imagine a high-stakes Wheel of Chance, where the carnival operator will give you $1 million if the wheel lands on blue, but you must pay $400,000 if it lands on yellow. What would you do in this situation? Mathematically, the probability of landing on blue is 0.50, the payoff for landing on blue is $1 million, and multiplying these yields $500,000. The probability of landing on yellow is 0.50, the payoff for this is -$400,000, and multiplying these numbers yields -$200,000. Adding these two results, $500,000 and -$200,000, gives the expected result of the game: $300,000. This is shown in Figure 3.

FIGURE 3



The high-stakes nature of this game introduces another factor into the analysis. Many people could not afford to take a chance of losing $400,000, even though the game as a whole has a highly favorable expected outcome. Similarly, some parties must settle a case in litigation, even when they expect to win, because they do not want to take the chance of losing. This provides another way for the rich to get richer—they can afford to take favorable risks that others must avoid.

II. DECISION ANALYSIS IN NON-LEGAL CONTEXTS

Decision analysis has wide application outside the legal arena, with interesting implications. In some cases, parties knowingly take significant risks because they determine these risks are necessary in order to achieve important goals. For example, planners know that building large public works projects involves substantial risks of bodily injury and even death for workers. With knowledge of the size and nature of the projects, it is even possible to make rough predictions of these events. More than ten people died when the subway system was constructed in Washington, D.C., a result that was reasonably foreseeable when the project began. Nonetheless, projects like this continue to be built because communities (and workers) decide to take risks.[6]

Decision analysis can yield unexpected results. One example is the decision of whether to shop at health food stores. It is possible that eating health food from these stores may result in a slightly longer expected lifespan

6. Some government positions include a specific salary component known as "danger pay" to compensate employees for additional risks they face on the job. *See, e.g.*, U.S. Department of State Standardized Regulations 650-57 (2001), *available at* http://www.state.gov/m/a/als/1767.

for consumers. On the other hand, because there are relatively fewer health food stores than conventional grocery stores, most people must drive a greater distance to get to one. Driving is a risky endeavor, with a significant risk of bodily injury or death. Some statisticians have speculated that the risks of driving may outweigh the benefits of health food (at least for those who do not live close to a health food store).

Environmental analysts look at these types of calculations as well. Communities have decided to send recycling trucks to pick up materials from homeowners in order to protect the environment. However, for rural areas where citizens are spread widely apart, some have theorized that the pollution created by the trucks, and the gas consumption required for them to make their rounds, may do more harm to the environment than the benefits realized from the newspapers and aluminum cans that are recovered.

Justice Stephen Breyer has written about the importance of analyzing risk carefully. He discussed a case over which he presided involving a ten-year effort to force cleanup of a toxic waste dump in New Hampshire:

> The site was mostly cleaned up. All but one of the private parties had settled. The remaining private party litigated the cost of cleaning up the last little bit, a cost of about $9.3 million to remove a small amount of . . . [pollutants] by incinerating the dirt. How much extra safety did this $9.3 million buy? The forty-thousand-page record of this ten-year effort indicated (and all the parties seemed to agree) that, without the extra expenditure, the waste dump was clean enough for children playing on the site to eat small amounts of dirt daily for 70 days each year without significant harm. Burning the soil would have made it clean enough for the children to eat small amounts daily for 245 days per year without significant harm. But there were no dirt-eating children playing in the area, for it was a swamp.[7]

Some may argue that $9.3 million is a small price to pay for protecting the environment, but Breyer responds to that argument as follows:

> The . . . reason that it matters whether the nation spends too much to buy a little extra safety is that the resources available to combat health risks are not limitless. . . . If we take the $9.3 million spent on the New Hampshire waste dump clean-up as an indicator of the general problem of high costs in trying for that "last 10 percent" ($9.3 million times 26,000 toxic waste dumps is $242 billion), we have an answer to

7. STEPHEN G. BREYER, BREAKING THE VICIOUS CIRCLE: TOWARD EFFECTIVE RISK REGULATION 11-12 (1993) (internal citations omitted).

> the question, "Does it matter if we spend too much over-insuring our safety?" The money is not, or will not be, there to spend, at least not if we want to address more serious environmental or social problems—the need for better prenatal care, vaccinations, and cancer diagnosis, let alone daycare, housing, and education.[8]

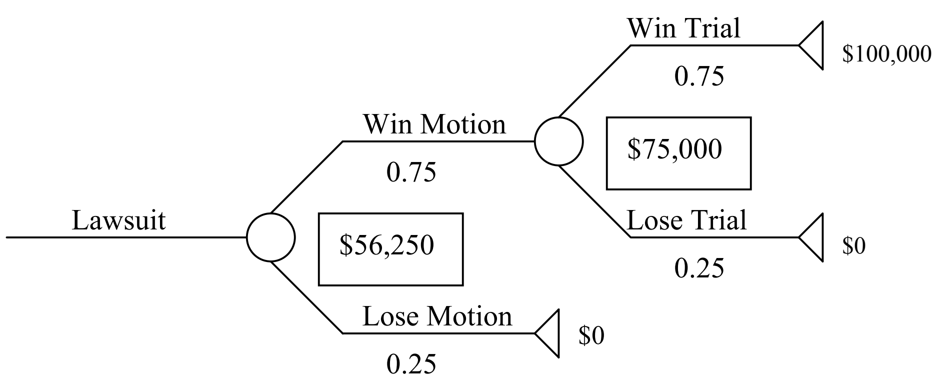
III. DECISION ANALYSIS IN LEGAL NEGOTIATION

Moving to the world of negotiation in litigation, imagine you are the plaintiff in a lawsuit where the defendant has filed a motion to dismiss the case. You believe you probably will win the motion, and you believe you probably will win the trial as well. The damage award from the trial would be $100,000. The defendant has offered to pay you $40,000 to settle the case. Should you accept the offer?

In order to answer this question, you need to provide a mathematical probability that represents the value of the word "probably." This requires making your best estimate of how likely you are to win the motion and the trial. Assume you decide your chances of winning in each instance are 75%. Would you accept the offer in these circumstances?

In this example, you must prevail in both the motion and the trial in order to win any money. Decision analysis under these circumstances involves multiplying the probability of winning the motion by the probability of winning the trial, 0.75 x 0.75, which is 0.5625. This result is then multiplied by the payoff that results ($100,000), which yields an expected value of $56,250. Under this scenario, the $40,000 offer is too low, and the plaintiff should continue with the lawsuit. This case is represented in Figure 4.

FIGURE 4



8. *Id*. at 18-19 (internal citations omitted).

It is worthwhile to examine the effect of attorney fees on this analysis. In the example above, the expected outcome of the case is $56,250. Thus, on average, the plaintiff can expect to receive $56,250 from litigation, and the defendant can expect to pay $56,250. However, assume that both sides would face attorney fees of $10,000 if they took the matter all the way through trial. In this case, the expected income from the lawsuit would be only $46,250 for the plaintiff ($56,250 reduced by $10,000 in fees), and the expected cost of the lawsuit would be $66,250 for the defendant ($56,250 in addition to $10,000 in fees).[9]

This difference in expected outcome creates opportunities for the parties to settle. Any settlement amount greater than $46,250 would represent an improvement for the plaintiff over litigation, and any settlement amount less than $66,250 is better for the defendant. The $20,000 range between these two numbers is a zone of potential agreement. In this case, it is in the economic best interest of both parties to settle somewhere in that range. Decision analysis can be a valuable tool in this regard to show both parties in a lawsuit how they benefit from reaching a settlement.

Decision analysis can be particularly powerful in complex cases. Consider the multiple stages of proof involved in a Title VII discrimination lawsuit. First, in order to survive a motion for summary judgment, the plaintiff must produce evidence sufficient to prevent the defendant from establishing that there is no genuine disputed issue of material fact.[10] At trial, the plaintiff then must establish a prima facie case indicating discrimination.[11] If that burden is met, the defendant must articulate a legitimate, non-discriminatory reason for its actions. In order to prevail, the plaintiff must then establish that this reason is pretextual.

In a hypothetical Title VII case, the plaintiff makes the following estimates: the chance of surviving the motion for summary judgment is 75%, the chance of establishing a prima facie case is 90%, and the chance of establishing that the defendant's explanation is pretextual is 67%. To analyze likely jury awards, the plaintiff estimates that there is a 10% chance that the jury will award $35,000, an 80% chance the jury will award $100,000, and a 10% chance that the jury will award $300,000.[12] This type of calculation is

9. Technically, a dismissal based on the motion would probably require lower fees than a trial, altering these numbers slightly, but the general point remains valid.

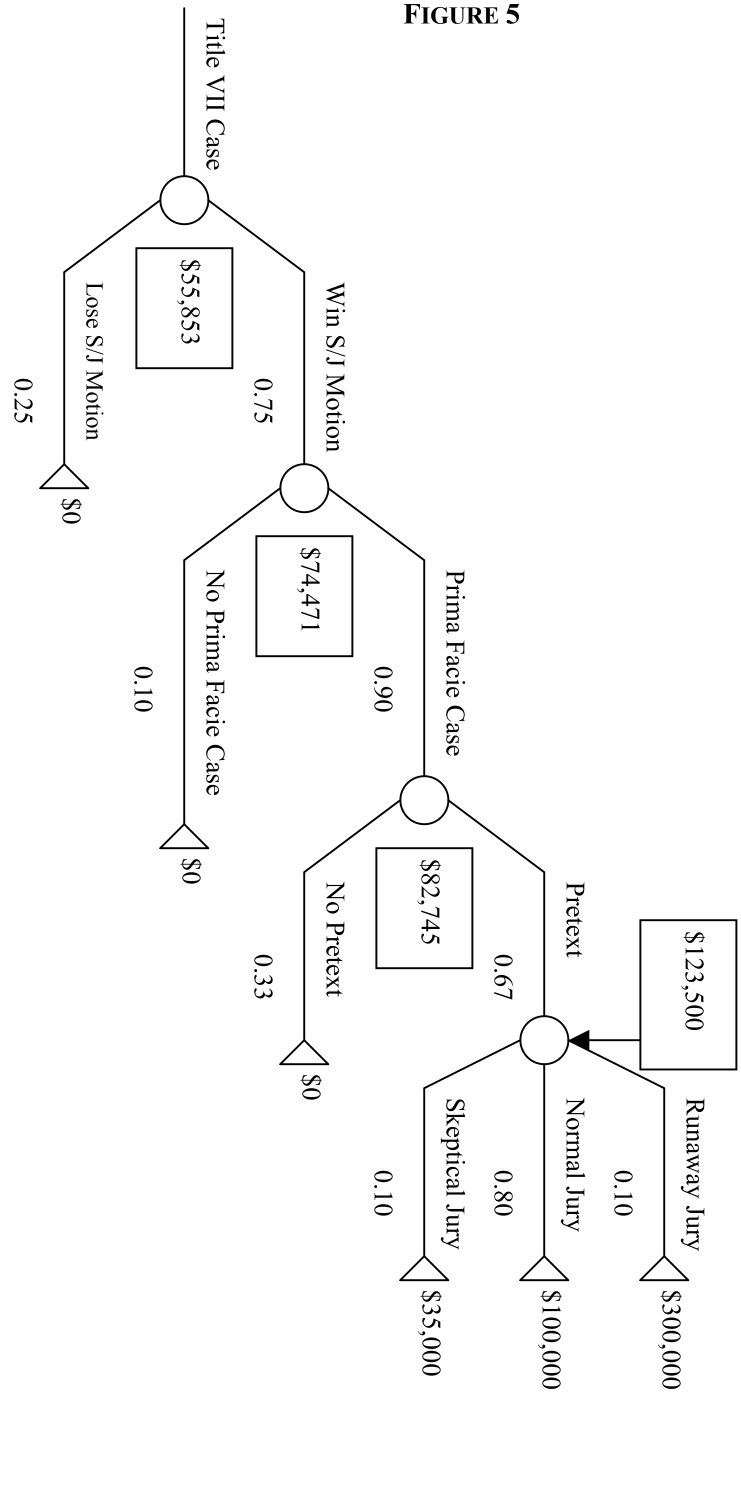
10. Celotex Corp. v. Catrett, 477 U.S. 317, 322-23 (1986).

11. McDonnell Douglas Corp. v. Green, 411 U.S. 792, 802 (1973).

12. Jury awards are often estimated with this type of approach, with normal juries being in the middle of the bell curve (and thus more likely) and with skeptical juries and runaway juries on either end (being less likely).

difficult to do by hand and almost impossible to do accurately by means of a hunch. A computer, however, can calculate the result in an instant, as shown in Figure 5.

FIGURE 5



Title VII Case
$55,853
Lose S/J Motion
0.25
$0
Win S/J Motion
0.75
$74,471
No Prima Facie Case
0.10
$0
Prima Facie Case
0.90
$82,745
No Pretext
0.33
$0
Pretext
0.67
$123,500
Skeptical Jury
0.10
$35,000
Normal Jury
0.80
$100,000
Runaway Jury
0.10
$300,000

This analysis shows that the expected value of the case at the beginning of litigation is $55,853. It also shows the value of the case as litigation proceeds. The second chance node (immediately after the summary judgment stage) has a value of $74,471, indicating that if the plaintiff wins the summary judgment motion, the case rises in worth by almost $20,000. At the final stage (when the jury is deliberating), the case is worth $123,500.

IV. ADVANTAGES AND DISADVANTAGES OF DECISION ANALYSIS

Decision analysis is not a perfect tool. The probabilities that parties place on the likelihood of various events are not magically accurate. The final result of an analysis is only as reliable as the data that parties use to create it, and the data are usually uncertain and subjective. Indeed, the figure that results from a decision analysis can appear artificially precise. Parties must recognize that it represents only an estimate based on the information available at the time.[13]

Nonetheless, decision anaylsis can be a valuable tool to enable parties to make more accurate predictions in negotiation. Assessing the future outcomes is uncertain and subjective no matter what method is used. Predictions based on hunches or intuition are no more accurate than those based on decision analysis, and they may be less so. The advantage of decision analysis is that it allows parties to combine several individual hunches in a rigorous, mathematical manner. As Professor Howard Raiffa wrote, "The spirit of decision analysis is divide and conquer: Decompose a complex problem into simpler problems, get one's thinking straight in these simpler problems, paste these analyses together with a logical glue, and come out with a program for action for the complex problem."[14]

Decision analysis can also help parties overcome the human tendency to be overconfident.[15] The example at the start of this essay shows how it is natural to underestimate the chances for failure in a situation. Looking at the results of a decision analysis can help bring parties back down to earth. As another example of this, the author of this essay is a college football fan who begins every season with great expectations for his team. One reason for

13. Parties can perform more complicated calculations, known as "sensitivity analyses," to examine the consequences that result when probability estimates are varied to account for different possible scenarios.

14. HOWARD RAIFFA, DECISION ANALYSIS: INTRODUCTORY LECTURES ON CHOICES UNDER UNCERTAINTY 271 (1968).

15. Robert N. Mnookin & Lee Ross, *Introduction* to BARRIERS TO CONFLICT RESOLUTION 17-18 (Kenneth J. Arrow et al. eds., 1995).

these expectations is that the probability is high that the team (the Nebraska Cornhuskers) will win each of its individual games. Statistics professor (and Nebraska fan) Brad Carlin examined this phenomenon by calculating the odds of the team winning each of its games. The calculations were done by examining the Sagarin computer rankings of each team, accounting for home field advantage (typically three or four points), creating an expected margin of victory, and determining the likelihood of winning based on all of these factors. The probabilities of victory seem quite high, as in the following example from a recent season:

Opponent	Likelihood of Victory
Arizona State	92%
Troy State	98%
Utah State	99%
Penn State	74%
Iowa State	83%
McNeese State	99%
Missouri	95%
Oklahoma State	89%
Texas A & M	70%
Texas	73%
Kansas	97%
Kansas State	57%
Colorado	83%

These numbers appear to represent overwhelming odds in favor of victory. Indeed, the team is favored to win every single game, many by more than 90%. However, decision analysis shows that that the likelihood of going undefeated for an entire season is very slim.[16] Using these numbers, the chance of an undefeated regular season is only 11%, or about one in nine. Considering the Big XII championship game and the national championship bowl contest, the odds of winning every game drop to only 3%.

Ultimately, negotiators should use decision analysis as a tool. It can be valuable for parties to use their intuition to make their best estimate of the overall value of a case before beginning any statistical analysis. Once the analysis is complete, parties can then compare their initial estimate with the result generated by the computer. When the results are comparable, parties

16. Fans may also remember that the team lost seven of these games that year (2002).

can have more confidence in their position. If they are significantly different, parties should figure out why. In this way, decision analysis can enable parties to examine their assumptions rigorously and determine the best possible strategy for their negotiations.