

Creative Decision Making: A Handbook for Active Decision Makers

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1. BECOMING AN ACTIVE DECISION MAKER

Have you ever had to make a difficult decision? What did you do? Did you think carefully through your choices and then attack the decision with enthusiasm and confidence? Or did you react with diffidence and ask others what they would do? Did you actively try to invent new alternatives that might be better in some ways than the possibilities you immediately confronted? Or did you look only cursorily at the choices you had, assuming that the best among them would be good enough? Did you seize the day, thinking through your interests and making a choice that was truly consistent with what *you* wanted? Or did you acquiesce to some higher authority and do what *they* wanted?

Decisions can be very difficult, and many of us do take the easy way out at times. Sometimes we do what is expected of us by our parents, children, friends, colleagues at work, and supervisors. Occasionally we get into a habit (renting a video on Friday night) and let the habit dictate a choice, even though some other option might be better. Often we let some authority make the decision for us, such as blindly following religious “moral principles” or simply taking Nancy Reagan’s advice to “just say no.” Finally, and perhaps most incriminating, we often simply float along, letting circumstances take us from one situation to the next, rarely grabbing the opportunity to think deeply about what is important to us, what consequences we might face, and what better options we might be able to come up with.

This book is about decision making. It is a “how-to” book, meant to help the reader become an active and creative decision maker. Instead of letting things happen or blindly following someone else’s advice, we want you to be able to think through your options and improve your chances of satisfying your goals and concerns. Our objective is for you to learn the basics of decision making so that you will be able to gain clarity in understanding your choices and hence to make your decisions with confidence.

This is not to say that every action deserves extensive thought and analysis before taking action. If you had to think carefully before each footstep, before opening every door, or before speaking each word, you would be paralyzed. In fact, many of our day-to-day activities require us to make snap decisions. Driving an automobile is a perfect example; no time is available to analyze options in great detail. (Should I change lanes? Put on the brakes? Turn on the lights? Pull over and stop so the police car can — I hope — pass?)

Part of becoming a good decision maker is being able to identify those situations that deserve careful thought. The reason they deserve careful thought is because that thought might lead to any of a wide variety of alternatives, and those different alternatives can result in very different consequences right now, tomorrow, or even years into the future. Being an active and creative decision maker does not mean that you can predict the future or that you will never make mistakes. But it does imply a willingness to look at choices as opportunities rather than problems, to work through difficult decisions with care, and to strive for understanding and confidence in the choices you make.

1.1. Why do decisions matter? Why do we even bother to make decisions? The answer is that the different alternatives we face can lead to different consequences. Some of those consequences may be good, and some may be bad. And what is good or bad depends on our values.

“Values” is a vague term with many different meanings. We use it in a very specific way. For decision-making purposes, “values” refers to the many objectives that the decision maker wants to accomplish. What does the decision maker want to do? Improve his or her own quality of life? What about the quality of life of family members? Friends? What about staying healthy, making money, or taking long vacations in Hawaii? What about helping others?

We all have a number of objectives that we would like to work toward. Unfortunately, our objectives often conflict. For example, doing a great job on a task may require additional time or more money. How do we get the balance right? Or I might want to provide adequate living space for my children (implying I should buy a big house) and at the same time improve their chances of attending college (which implies that I

should save money now). To some extent these objectives conflict, and to make matters worse, the alternatives we face usually represent some kind of tradeoff among our conflicting values. Living in a big house with my family means I can save less for college, whereas saving a lot for college means I cannot afford as large a house.

In summary, decisions matter because we have values and the alternatives available to us typically represent tradeoffs with regard to those values. If the alternatives we faced never had any impact on what we want to accomplish, then there would be no sense in working hard to make a good choice; all the choices would have equivalent consequences. Because our choices can and do impact our lives in terms of what we want, we need to take care in making those choices.

1.2. Whose decision is it, anyway? Our discussion so far has assumed that you are the decision maker, and that you have full power to take action based on your own values and the available alternatives. In this case, you “own” the decision in the sense that you have the right to make the choice. You also have the responsibility to bear the consequences. For example, you might be the owner of a small business; as such, you would make many decisions and commitments regarding how your business is run.

Unfortunately, ownership of a decision often is not so clearly defined. For example, a teenager may be trying to decide whether to take an after-school job. Typically, he or she must obtain the agreement of parents, and hence the teen’s choices may be constrained by the parents’ desires. For example, consider a young woman who would like to have a job as a waitress in a particular restaurant. The restaurant’s location and the job’s late hours, though, may lead the parents to disallow this alternative out of concern for their daughter’s safety. Teachers, coaches, and others also may have a say in the decision.

Each individual in a shared-decision situation must think carefully about his or her personal values as well as understand the values of the other parties. Having to understand the values of others as well as one’s own makes shared decisions very difficult. It should be no surprise that the most complicated decisions can involve many “stakeholders,” groups that have an interest in the decision process or outcome. Public policy issues, such as governmental intervention in health care or environmental preservation, are notorious for affecting many different kinds of people. And, of course, different parties to a decision may have different views of the “facts.” (Teenager: That part of town is very safe! The crime rate in the area surrounding the restaurant is lower than most other parts of the city. Parents: But Joe Smith said he heard that a young girl was assaulted there just last week.) It is sobering to realize that we regularly ask adolescents to make just this sort of complex, multiparty decision; virtually every important decision a teenager makes must be reviewed by parents, teachers, or friends.

1.3. Decision analysis: A framework for making decisions. In the pages that follow we present a special approach to decision making that is based on the principles of decision analysis. In some ways, decision analysis is nothing to get excited about; it is just a collection of concepts and tools that help a decision maker employ his or her common sense in a structured and systematic way. In fact, in simple situations our common sense often serves as a satisfactory guide; it is in the difficult and complex decisions that we need help using our common sense, and this is where decision analysis comes in.

Although this book is a “how-to” book, it is not just a matter of us — the authors — telling you — the reader — about decision-making techniques that work well for us. Decision analysis has a solid theoretical grounding that lies at the heart of economics and statistical decision theory, with an appropriate academic history to go along with those foundations. In spite of this impressive (and perhaps intimidating) pedigree, decision analysis is no ivory-tower exercise. The basic principles of decision analysis have been applied in various forms for years by many different individuals and organizations. Our own practical experience with students, clients, and friends has convinced us that anyone, including even small children and politicians, can grasp and use the essential principles. Although many elaborate decision analyses use complicated computational techniques, anyone can use decision-analysis fundamentals to enhance his or her decision making in common, everyday situations.

1.4. Where do we go from here? Table 1.1 shows eight themes that will guide our discussion of decision-making principles through the remainder of the book. Each chapter includes many simple examples and exercises that (we hope) will make your reading fun and entertaining.

Table 1.1
Eight Themes of Decision Making

1. Establishing the Decision Context
2. Identifying Values
3. Understanding Uncertainty
4. Structuring Consequences
5. Using Information
6. Creating Alternatives
7. Making Tradeoffs
8. Neotiating

The first order of business for an active and creative decision maker is to understand the nature of the decision that must be made. As you can see, we have already opened the discussion about decision context with our focus above on decision ownership and active versus passive decision making. In the next section, we continue to examine decision context by looking at the elements of decision situations. Just as an atom can be broken down into protons, neutrons, and electrons, so a decision can be viewed in terms of certain elementary objects such as values, facts, alternatives, chances, and consequences. Chapter 2 presents this discussion and forms the basis of all that follows.

Chapters 3 and 4 introduce values and uncertainty, the topics of the next two themes. These two aspects are central elements of all decisions, and they reflect an important orientation of decision analysis. Looking at values involves careful introspection regarding what you want to accomplish. What are your objectives? The focus of such thought is inward, and a good decision is based on an utterly clear understanding of the decision maker's own interests as well as those held by other stakeholders. In contrast, uncertainty involves looking outward and trying to understand what the world holds in store for us. If I take a certain action, how will it work out for me? If I decide to purchase a used car, will it break down soon? What repairs will be necessary, how long will they take, and how much will they cost? At the time of purchase it is impossible to predict exactly what will happen, but consultation with a mechanic might help understand the contingencies, what could happen and how likely different scenarios might be. With this sort of understanding, I can give some thought to the consequences I would bear if, say, the car had to be in the shop for a week at a time or if the repair cost more than \$1000.

The fourth theme, structuring consequences, refers to the process of relating decisions and chance events to the consequences the decision maker must bear. In Chapter 2, the discussion of decision elements leads to the introduction of decision trees for structuring decision situations. Decision trees are graphical representations of decisions that systematically relate decisions, chance events, values, and outcomes. In creating a decision tree, the decision maker specifies the consequences of the various decision alternatives and possible chance outcomes; in each case, there is some particular impact on the decision maker that affects the extent to which his or her objectives are satisfied.

In Chapter 5, we present a pair of elaborate examples in which we use the principles and tools of decision analysis as presented in Chapters 1 - 4. These two examples show how the first four themes come together

to provide a coherent and comprehensive toolkit for thinking through difficult decisions. One of the examples involves a teenager's summer-job choice with a focus on values and tradeoffs. The second example has to do with purchasing a used automobile and demonstrates the central role uncertainty can play in a decision.

In the remaining four chapters, we discuss the last four themes from Table 1.1. In Chapter 6 the topic is quality of information and learning; both are important aspects of decision making. Chapter 7 takes us into the problem of creating new alternatives. It is not always necessary to pick one of the alternatives that present themselves; with a little thought and effort, one can often come up with new alternatives that dovetail better with your values. Chapter 8 examines some of the common tradeoffs that we have to make, such as short-term versus long-term payoffs, personal economic benefits versus health risks, or the problem of trading individual gain for social costs. Finally, we apply decision-analysis techniques to negotiation problems in Chapter 9, showing how a clear understanding of the relevant values and tradeoffs can open the door to improved decision opportunities for all parties in a negotiation.

Our goal is straightforward. We want you, the reader, to come away from this book with an understanding of the basics of decision making and with an improved ability to make sense out of the complex decisions that you face in your life. We do not promise to make your decision-making easy. In fact, to the extent that you face up to decisions that you used to ignore, you may have to work harder in those situations to be an active and creative decision maker. Still, with careful thought and a little practice, you can take control of the decisions in your life. Instead of feeling pulled along with an amorphous current of circumstances, you can feel the satisfaction of making your decisions with a full and clear understanding of what you want to accomplish and how your choice can help you achieve your goals. Instead of simply hoping that things will work out in your favor, knowledge of your own values and careful thought about your choices can help you get what you want out of each decision and ultimately out of your life. Instead of being blinded and paralyzed by the complexity of the decisions you face, you can seize the opportunity to seek out and make your decisions with clarity, understanding, and confidence.

2. ELEMENTS OF DECISIONS

We start our exploration of decision making in this chapter with basic questions. What is a decision? How can we decompose a decision into its elements? What is an insightful way to think about the pieces of a decision? Before we get to these decision elements, though, it is important to understand that each decision situation addresses specific issues and has its own boundaries. We call this the decision context.

2.1. The decision context. The starting point is to understand the overall nature of the decision that needs to be made and how it fits in with your life. Let's take a simple example. Suppose you are shopping for a new car. Naively, we might say that the context is simple; you need a new car and you are trying to figure out which one to buy. The context then defines the kinds of alternatives you would consider; available new cars.

Why do you need to purchase a car, though? Let's suppose you need to travel back and forth to your job and generally run errands around town. In this situation a good used car might serve your purpose. Thus, a better characterization of the decision context is "driving around town," and this context would reasonably lead you to consider available used cars as well as new cars.

We can take this discussion still further. Is the problem really how to "get around town" rather than "driving around town"? Perhaps you need to think about alternative modes of transportation that would serve your particular needs. If you live in a small town, infrequently drive out of town, and rarely need to carry more than yourself and a few incidental items, then you might consider a bicycle. Likewise, if you live in a large city like New York or Paris, you might be able to rely on public transportation, figuring that you can always rent a car for occasional trips out of the city. For some people, a combination of bicycle, bus pass, walking shoes, taxi rides, and an occasional rental car might be a perfectly suitable solution to the problem of providing around-town transportation. In this case, the decision context is how to get around town, and this context suggests that it is important to consider a broad array of transportation alternatives.

Establishing the decision context is a crucial step because it sets the boundaries for the thinking you will do about the decision. The context determines the set of alternatives that you will consider. This in turn implicitly defines which of your values you need to think about and exactly what sorts of contingencies you need to consider. If we define our decision contexts too narrowly — and many of us do, much of the time — then we may miss our best decision opportunities.

2.2. Creating your own decisions. The discussion so far has assumed that a decision "problem" has presented itself and that you are in the process of figuring out what to do about it. This is certainly the most common situation for most of us; we do not typically go out of our way to find problems to solve. In fact, most of us work hard to *avoid* problems.

In avoiding problems, though, we are passively allowing circumstances to dictate the decision problems we have to address. An active decision maker, on the other hand, does not wait for circumstances to present problems, but instead seeks out opportunities to make positive changes. In fact, searching for such opportunities usually leads to decision situations that are not "problems" so much as "opportunities." For example, instead of waiting for your boss to assign you a task, you might start to work on one of the jobs that you think the boss would like to have done. In looking for decision opportunities, we have to take initiative and look for ways to do things differently from how we have done them in the past.

What does this have to do with decision context? You can often give yourself an opportunity to make a positive change simply by defining a new decision context in a situation that you did not treat as a decision situation previously. What would you like to accomplish in this particular situation? What could you do? What options are available? By keeping questions like these at the forefront of your thinking, you will be able to find many occasions to make better and more satisfying choices in situations that did not appear to be decisions previously. (Moreover, decision opportunities that you create for yourself are usually much more fun to think about than "problems." And they often lead to additional positive opportunities.) This is

the first step to becoming an active and creative decision maker — vigorously seeking out decision situations that represent opportunities for positive change.

2.3. Decision elements. Having set the context of a decision, the next step is to identify the various elements of the decision situation, including decisions to make, uncertainties, and consequences. We begin with a decision that must be made.

Decisions and alternatives. Many decision contexts have as the central issue a decision that must be made right away. For example, high-school students might face situations in which they must decide which courses to sign up for, or where to apply for a summer job. Such a decision naturally involves at least two alternatives or choices. (If there were only one choice, then there would be no decision to make!) It is important to distinguish the decision itself — the opportunity to decide or the act of deciding — from the available alternatives. For example, a decision might be where to go on vacation, with a number of alternative destinations from which to choose.

In many situations a first decision leads eventually to another, which leads to another, and so on; the decision maker actually faces a sequence of decisions. For example, imagine a craftsperson who sells hand-made clothing at a local market. This individual might be considering whether to add a new type of clothing (vests, for example). If the decision is to go ahead, the next decision might be what sort of pattern to use. After this, there will be decisions about fabric, colors, sizes, and the initial number of vests to sew. Finally there will be questions about how to display the vests and what price to charge. It is easy to see that the context of the craftsperson's decision at the beginning (whether to add vests to the product line) implicitly includes a sequence of later decisions.

Uncertainty. Many important decisions have to be made without knowing exactly what will happen in the future or exactly what the ultimate outcome of today's decision will be. A classic example is investing in the stock market. An investor may be in a financial position to buy some stock, but how many shares and in which company? Some share prices will go up and some will go down; moreover, the market as a whole may move up or down, depending on economic forces. What is the investor to do? Common sense suggests that it might help to learn about possible companies (e.g., how well they have been doing lately relative to competitors) and on the economy as a whole.

We will use terms like “chance,” “uncertainty,” or “uncertain event” to refer to those upcoming situations for which we do not know what the eventual outcome will be. For example, one uncertain event might be tomorrow's weather, and the possible outcomes for this event include sunny skies, clouds, rain, or snow. Thus, we make a distinction between the *event* itself (the weather) and the possible *outcomes*.

In the case of the weather, the outcome must be one of several specific discrete possibilities. In other cases, like the stock market, the outcome is a value within some range. That is, next year's price of the stock bought today for \$50 per share may be anywhere between, say, \$0 and \$100. The outcome of the uncertain event that we call “next year's stock price” comes from a range of possible values and may fall anywhere within that range, whereas the outcome of the event “tomorrow's weather” is best thought of as falling into one of several categories.

Of course, it is perfectly possible that a decision context encompasses more than just a single uncertain event. Complicated decisions may involve many uncertain events. Moreover, some uncertain events may depend on others. For example, the price of the specific stock may be more likely to go up if the economy as a whole continues to grow.

How do uncertain events relate to a sequence of decisions within a decision context? For complicated decisions, uncertain events must be dovetailed with the time sequence of the decisions to be made; it is important to know at each decision point exactly which uncertainties have been resolved and which are still unknown. For example, in purchasing a car, the buyer might decide to make a minor commitment (a deposit to hold the car) without knowing much about the car's mechanical condition. Before making a final decision to purchase the car, the buyer might obtain a mechanic's assessment of the its condition. The

mechanic's assessment is unknown at the time the deposit is made but known at the time of the later and more critical purchase decision.

Values and consequences. After the last decision has been made and the last uncertain event has been resolved, the decision maker's fate is finally determined. We refer to what actually happens to the decision maker as the *consequence*. In the car-purchase situation, the consequence may be the combination of the car's quality, the purchase price and the cost of needed repairs. The consequence for an investor may be an increase in the value of a stock. In other cases the consequence may be a net figure that accounts for both expenses and income over a sequence of decisions. This might happen in the case of the craftsperson who decided to make and sell some vests; certain costs would have been incurred (cost of patterns and fabric, time spent sewing) before any income was received from selling the vests.

Consequences are naturally measured in terms of the decision maker's values. For example, the craftsperson may care about how much money is made in the venture, in which case looking at the incremental profit provided by the vests is very appropriate. How this person spends his or her time may also be important. If making and selling the vests requires time spent in some distasteful activity (e.g., driving to many different craft shows), then the craftsperson faces an important *tradeoff* between the objectives.

In the craftsperson's case, it may be relatively easy to make the tradeoff between time spent at shows and potential profit, because it is possible to think in terms of dollars earned per day on the road. In other situations, though, it will be difficult to determine exactly how the different objectives should be traded off. For example, how much of an increase in salary do you need in order to live in a city that has a substantially higher crime rate? How much in the way of health risks are we as a society willing to accept in order to have blemish-free fruits and vegetables?

Many decisions are complicated by tradeoffs. High-school students are asked to make many tough tradeoffs every day as part of relatively safe decision contexts (e.g., studying versus spending time with friends, buying a name brand of clothes versus saving money) and also as part of more problematic contexts involving career, drinking, sex, and drugs. A few moments spent contemplating the difficulty these tough tradeoffs pose for adults might increase our compassion for the eight- or eleventh-grader facing similar problems.

2.4. Values versus facts: a crucial distinction. The discussion of decision elements points up the important distinction between our values (what we want, what we are trying to accomplish, what gives us satisfaction) and facts (what we know about what might happen). We elaborate here on this distinction because it has an important impact on how to organize our thinking about decisions.

Values are important because they describe what we as decision makers want to accomplish. In many ways, understanding our values is a matter of *introspection*, thinking carefully about what is important to us. The focus of this kind of thinking clearly is inside our minds and hearts. What do we want? What do we hope to accomplish? What would please us?

Aside from knowledge about values, a decision maker must have a clear understanding of what he or she *knows* about the outside world. What might happen if you choose a particular alternative? What are the likely consequences? For example, in deciding which restaurant to go to for dinner, it is appropriate not only to understand how you would enjoy different kinds of food (a matter of understanding your values), but also to know what kinds of foods you can get at different restaurants (a matter of understanding the facts regarding these restaurants). In deciding on a timber policy for the Pacific Northwest, a decision maker would need to understand values (for example, the relative importance of jobs, economic growth, and protection of ecological diversity) as well as the facts (the impact each possible policy could have with respect to each value).

If an alternative leads to an uncertain event, then the decision maker should address that uncertainty explicitly. This means figuring out the potential outcomes, the chances of those outcomes, and the resulting

consequences (what those outcomes mean in terms of the decision maker's values). For example, in the timber-policy situation, one possible alternative might involve reducing the number of old-growth acres available for logging and at the same time creating a job-training program for displaced workers. The exact outcome, of course, is uncertain despite many studies by experts. Nevertheless, different scenarios can be envisioned; the job-training program might be very successful, resulting in a smooth transition and enhancement of the labor pool for fledgling industries in the region. On the other hand, it might fail, resulting in an increase in the number of impoverished families, broken homes, and child abuse.

When outcomes are uncertain, we use the term "facts" as shorthand to represent the decision maker's knowledge, imperfect though it may be, about his or her world. In this case, the focus is still "external" rather than "internal." Thinking about values requires the decision maker to adopt an internal focus: What does the decision maker want to accomplish? What are the sources of satisfaction in the decision context? When thinking about facts, the focus is external: What is known or believed about the world? What are the potential outcomes of uncertain events, and what are the chances associated with those outcomes occurring? Finally, what are the consequences; how do the different outcomes measure up in terms of our values?

2.5. Decision trees for organizing elements of decisions. With all this talk of decision elements, including decisions, values, alternatives, chance events, outcomes, and consequences, how can we keep it all straight? We need a way to organize these elements into a coherent structure. Decision trees provide an intuitive graphical tool for representing the elements of a decision.

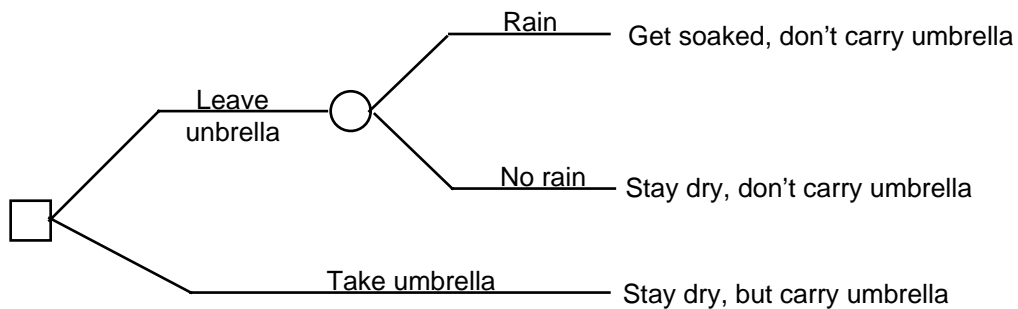


Figure 2.1. The Umbrella Problem.

Figure 2.1 is an example of a simple and basic decision tree that represents the prototypical decision of whether to carry an umbrella. The square on the left represents the decision, and the two branches emanating from the square indicate the two available alternatives: take the umbrella or leave it home. If the choice is to take the umbrella, then you will certainly stay dry, but you will have carried the umbrella around. On the other hand, if you leave the umbrella, then the uncertain event is the weather (represented by the circle), having outcomes of rain or no rain. If it does not rain, then the consequence you bear (what matters to you) is that you stay dry and you did not have to carry the umbrella. If it does rain, you get soaked, but you still did not have the burden of carrying the umbrella around. Thus, the obvious tradeoff that has to be made is whether the risk of getting soaked justifies the burden of carrying the umbrella around all day.

The decision tree above is quite simple, but it demonstrates many features of decision trees. In fact, with the building blocks of decisions to make, values, alternatives, chance events, outcomes, and consequences, virtually any decision situation can be represented with a decision tree. And the "rules" for creating decision trees are easy:

1. Squares represent decisions to be made, and circles represent uncertain events.
2. The branches emanating from a decision should cover all of the available alternatives.
3. The branches emanating from a chance event must represent the possible outcomes of the event. These branches should be such that one and only one of the possible outcomes will actually occur.

4. The descriptions of the consequences at the ends of the branches (on the right-hand side of the tree) should cover all aspects of your values that pertain in the specific decision context. For example, if carrying an umbrella causes you no inconvenience at all, then the description at the end of “Take umbrella” branch should be only “Stay dry.”

Decision trees are a flexible and intuitive tool for representing decisions. Furthermore, it is very easy to create decision trees for different decision situations. Here are some examples of decision trees for a few of the decision contexts that we have discussed:

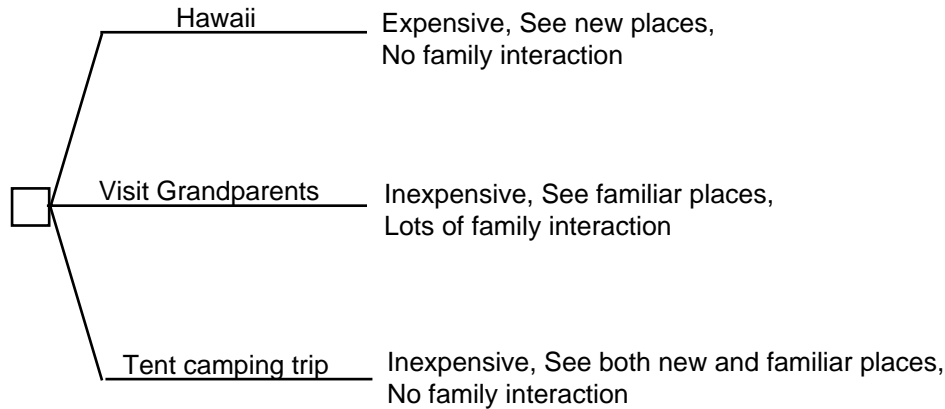


Figure 2.2. Vacation decision.

Figure 2.2 shows a vacation decision. In this decision context, three alternative vacations are being considered: going to Hawaii, visiting grandparents, and a tent-camping trip. At this level of analysis, no uncertainty is being considered. The family making the decision knows that Hawaii will be expensive compared to the other two, that the three options vary in terms of how much will be new to them, and that they can only accomplish a goal of interacting with family members by visiting the grandparents. Although this decision tree is simplistic, the very act of listing options (the three alternative vacations) and objectives (the three concerns) provides an explicit structure for decision making that can prove to be very helpful.

Of course, it would be possible to include consideration of uncertainty in thinking about vacation alternatives. Perhaps the most obvious uncertainty would be the weather as it relates to the camping trip. Under most circumstances, even an occasional rain shower, the camping vacation would be fine. However, if it were to rain for more than, say, one third of the days, no one would really have much fun. If such a possibility has much of a chance of happening, then it would be appropriate to include it in the decision tree model as in Figure 2.3. Notice that we have now included another consideration (weather), that we have defined the outcomes of this chance event (bad weather = rain for one-third or more of the days), and that we have added another value (fun) that matters to us in choosing among alternatives.

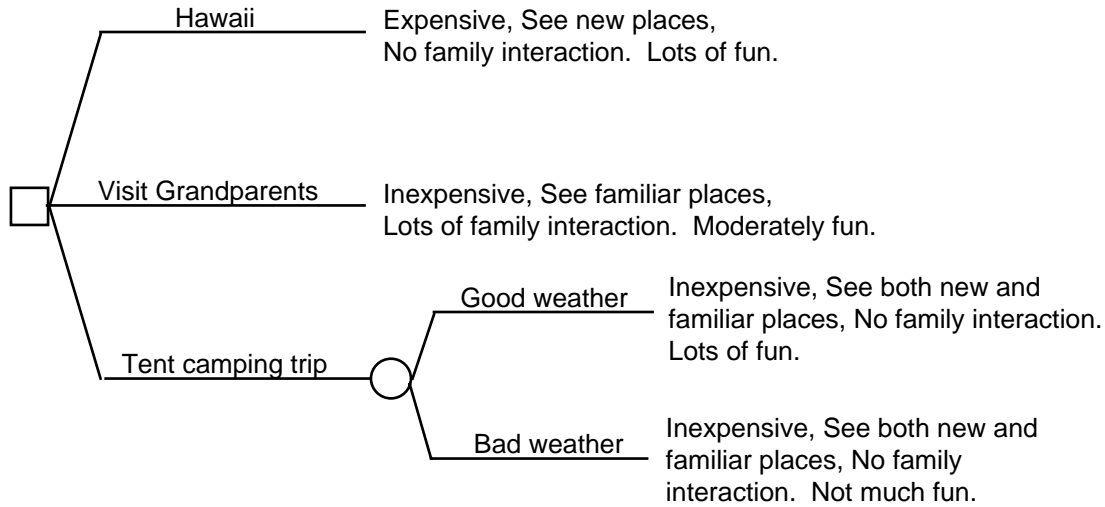


Figure 2.3. Vacation Decision with Uncertainty.

Another example is the car-purchase decision, which is shown in Figure 2.4. Here the choice is between a new car and a used car. The description of the consequences shows that the decision maker is primarily concerned about the tradeoff between expense on one hand and the lack of convenience associated with the repairs on a used car.

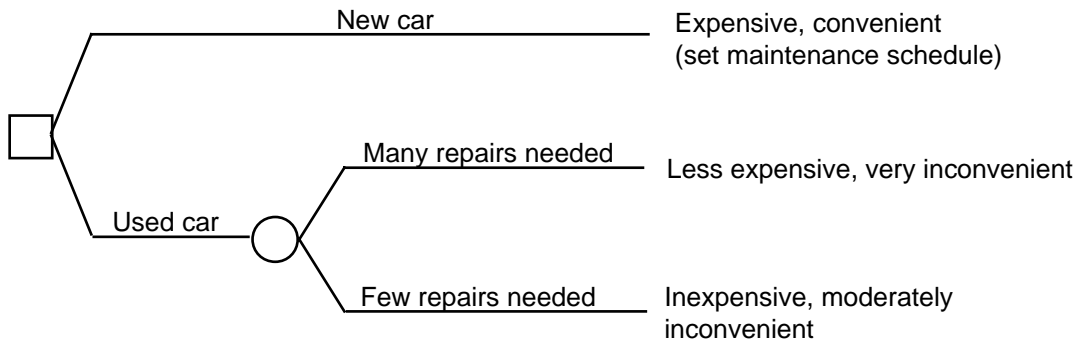


Figure 2.4. The Car Purchase Decision

Recall that we also discussed the possibility of expanding the decision context. That is, instead of looking just at different sorts of cars to purchase, the decision maker might want to consider the possibility of alternative transportation modes. In Figure 2.5 this decision is represented in a decision tree that compares purchasing and maintaining a car with the alternative strategy of using a bicycle, walking, taking the bus, and using taxis or renting cars as needed. In this expanded decision context, we still see the objectives of minimizing expense and maximizing convenience. In addition, though, it is now appropriate to consider the extent to which exercise is incorporated into one's transportation.

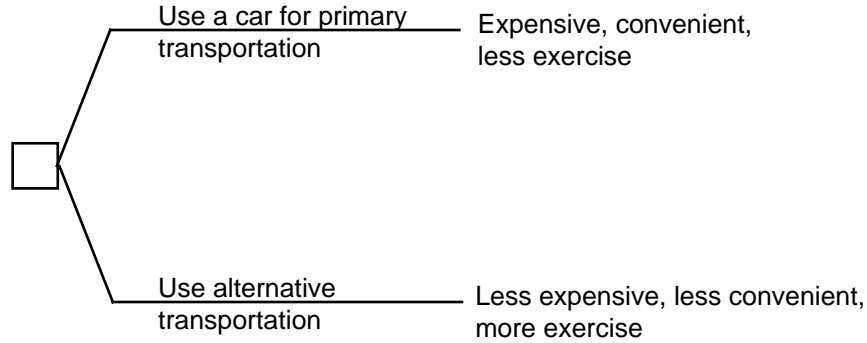


Figure 2.5. Alternative Transportation Decision

Finally, Figure 2.6 shows still another perspective on the car-purchase decision. In this case the issue is whether to obtain additional information about a car by taking it to a mechanic. There are a number of points to note about this decision tree. In the first place, three options are being considered: buying a used car without having an inspection, having the car inspected and then deciding, and keeping the old car. The sequential nature of the decision situation is apparent if you follow the “Get mechanical inspection” branch. After deciding to do this (committing to pay for the inspection), the next event is that the decision maker learns what the mechanic found. The decision to buy the car is not made until after the mechanic’s report is in. At that point, regardless of what is discovered, the decision maker still has the option of backing out of the purchase.

The description of the consequences at the branch ends indicates that the essential tradeoff for the first decision is whether the buyer knows enough about the car to make the purchase decision, which itself is a balance between the risks (expense and inconvenience) associated with the two cars. We will look at a similar decision in much more detail in Chapter 5.

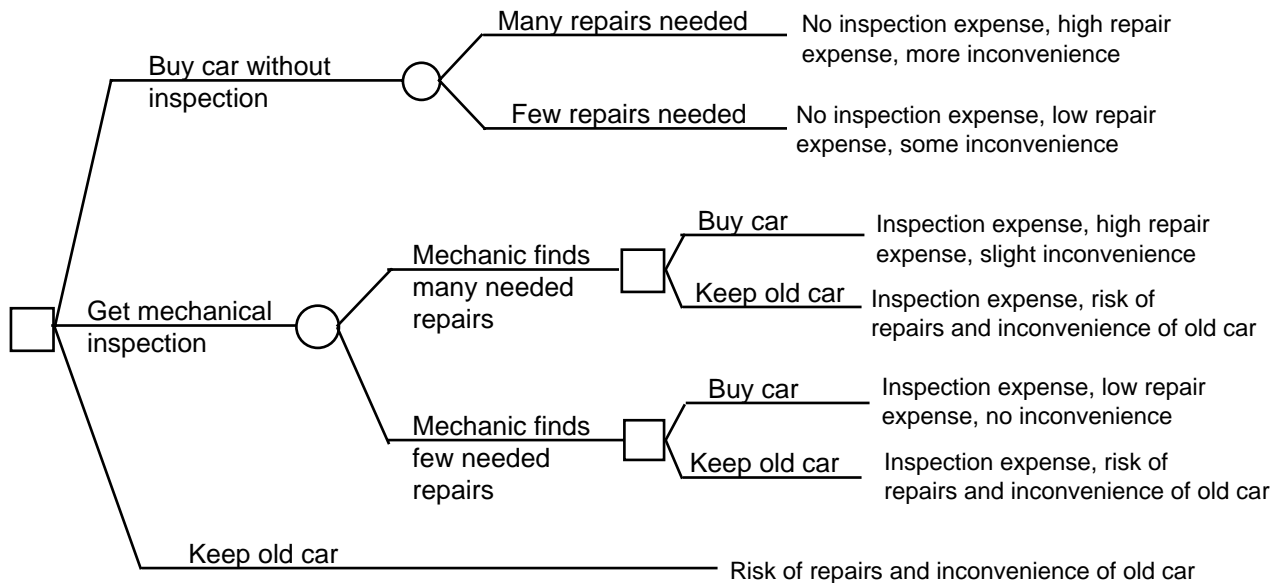


Figure 2.6. The Mechanical Inspection Decision

2.6. Types of decisions. Although each decision typically has its own special characteristics, we can talk about several broad categories of decisions. Using such a classification scheme can help when it comes to understanding and evaluating a particular decision situation.

a. *Riskless versus risky options.* This is a typical decision that we face often. Two options are available; one is a safe option, the outcome of which is known for sure, whereas the other option entails some risk. The umbrella problem discussed above exemplifies this type of decision; you're sure to stay dry if you take the umbrella, and you risk getting soaked if you don't. Keeping money in the bank versus investing in the stock market is another example. If you leave your money in a fixed-rate savings account, you know exactly what it will be worth next year, whereas the same is definitely not true if you invest in the stock market.

b. *Information-gathering decisions.* This type of problem centers on the information available for making a decision. The decision maker must first identify possible sources of information, then assess the quality and usefulness of the information, and finally decide whether to acquire the information. The decision in Figure 2.6 about having a mechanic inspect a car prior to purchase is an example of an information-gathering decision situation. In that situation, the buyer should realize that, regardless of how competent the mechanic appears to be, the inspection could fail to turn up important bits of information. In some cases the information may be more costly than it is worth. For example, if a car buyer knows the maintenance and repair history of the car (as he might if the seller were a friend), or if the mechanic's fee is expensive, it might make sense to forego the inspection altogether.

c. *Tradeoffs.* The most difficult decisions we have to face generally involve tradeoffs. We often want to accomplish many different but conflicting objectives at once. As a result, we have to weigh the importance of our objectives and the extent to which each alternative helps to accomplish these goals. Take the example of the teenager purchasing a car again. The buyer may want an inexpensive car, yet one that is sporty and has a high level of performance. It may be important the the car be reliable. The color may be important. What's more, additional objectives may be imposed by other parties to the decision; parents may want the teenager to drive a car that is safe, and hence may insist that the car *not* be sporty or high-performance.

Many of the issues that we face are difficult because of the tradeoffs involved. Better schools are a priority for many people, but we also want low property taxes. Spending time with one's children is a priority for many parents, but so is having free time available to spend by themselves or with friends. Public-policy decisions involve similar tradeoffs. In the Pacific Northwest, people debate the virtues of saving the remaining old-growth forests versus maintaining viable economic conditions for small mill towns in the mountains. The controversy stems from the existence of distinct and to some extent contradictory objectives.

d. *One-time versus repeated decisions.* In some cases it makes sense to think about a decision as a one-time problem, such as choosing a college. However, others are better viewed as decisions that are repeated many times. A perfect example is whether to wear a seat belt while driving. When looked at in the short term, it is fairly easy to justify not buckling up; the chance of an accident on any one trip is small, and wearing a seat belt is somewhat inconvenient and uncomfortable. However, viewed in the long run, it makes sense to develop a habit or policy of always buckling up. The chances of being in a serious accident sometime during one's lifetime are startlingly high — about 20% — and wearing a seatbelt dramatically reduces the risk of serious injury in an accident. An example of a repeated decision that many teenagers face is whether to use a condom during sex. Moreover, this decision problem is complicated by the difficulties of understanding the tradeoffs between the short- and long-run consequences, discussing the issues with one's partner, and not letting care and deliberation be overwhelmed by passion! (All the more reason for careful thought ahead of time.)

e. *Sequential decisions.* Often a series of decisions are clearly linked. In choosing a college, for example, a student first has to decide which colleges to write to for information, then which ones to apply to, and finally (assuming multiple acceptances), which one to go to. It is clear in this case that the decisions made at each point affect the options that are available later. On a societal level, decisions made regarding the regulations required of power-generation plants may have substantial impact on the development of new

power-generation technology and hence the specific power alternatives available in the future. One of the most difficult things for us is anticipating the effect of today's decisions on tomorrow's options.

f. *Individual versus group decisions.* In many cases an individual has the ability to make a decision alone. In others, the decision is shared by a group. For example, a committee may be responsible for making decisions regarding the senior prom (when, where, menu, band, price of tickets). On the other hand, an individual makes the decision of whom to invite or whether to accept an invitation. And once an invitation is accepted, the couple jointly decides (often a shared decision with the parents!) on some details of the date, such as what time they will meet, where they will go after the party, and when they will be home. In many cases, one of the most difficult issues is determining who has a legitimate claim to be involved in a decision.

2.7. Decision trees are for insight. It is important to realize that the purpose of using a decision tree is to get some insight and clarity regarding what may be a difficult decision situation. The point is not to "get an answer," but rather to gain understanding of the available alternatives. Only with such understanding can one clearly see which alternative is preferred and why. For example, in our first decision tree, the essence of the decision is whether carrying an umbrella is inconvenient enough to take the risk of getting soaked. How small does the chance of rain have to be in order for you to take the risk? Or how inconvenient does the umbrella have to be before you leave it at home? The purpose of the decision tree is to focus attention on questions such as these in order to help the decision maker understand the alternatives and make a defensible choice. For example, if there is no inconvenience in taking the umbrella, the answer is clear: take it along because you are guaranteed to have a consequence (stay dry) that is at least as good as either of the consequences if you don't take it!

3. VALUES

What are values? We have said that a decision maker's values are his or her goals and objectives, the fundamental issues that the individual cares about and wants to accomplish. This definition, though, is too general to be of much use. In this chapter we look at values in depth and develop tools for understanding those values. We devote special attention to the notion that people typically have multiple conflicting objectives. In particular, we will look carefully at the problem of identifying and structuring these multiple objectives and how to think systematically about tradeoffs among them.

3.1. Multiple dimensions, multiple perspectives, and conflict among values. The first thing to realize about our values is that they are multidimensional. We care not only about our own comfort and quality of life, but also that of our friends and family. We care about feeling good, being healthy, learning, socializing with other people, and perhaps helping other people in some way. Even when we make very simple decisions, such as what type of sandwich to buy, we may care about taste, nutrition, expense, and perhaps other concerns as well. (Can I eat the sandwich without making a mess? Will the onions give me bad breath?) A few moments of introspection will persuade you that your values are indeed multidimensional. Spend a few moments writing down your most basic values on the lines below. To help identify these basic values, think of things you enjoy doing, and ask yourself *why* you enjoy doing them. (As we will see later, the word "why" is a key to discovering and using our values in decision making.)

In addition to recognizing our values' multiple dimensions, we also can view many decision situations from multiple perspectives. For example, from an individual point of view a teenager might enjoy making music by playing the drums. However, a social perspective suggests that it is appropriate to limit playing to daylight hours! Similarly, an individual might find recycling terribly inconvenient, but from a broader perspective recycling programs make a lot of sense. Many regulations and social programs are in place specifically because individual decisions made on the basis of individual values would lead to detrimental effects for society as a whole.

Understanding the multiple dimensions of our values is only the first step. The second and more crucial one is identifying ways in which values conflict. For example, both being healthy and relaxing may be important to me. However, being healthy requires some attention to physical fitness, and one cannot be physically fit by relaxing all the time! Finding some balance between these objectives is important. Better yet, once these two values are understood, one can search for ways to address both relaxation and fitness at the same time (vigorous exercise followed by fifteen minutes in the spa comes to mind).

Conflicts between values lie at the heart of many of the most fundamental problems facing students today. For example, a student may want to do well academically in school but may also enjoy playing with friends and relaxing. In this context, each afternoon presents a difficult tradeoff in terms of how time will be spent. Or consider the single teenage mother who wants to prepare for a productive career and at the same time wants to be with her child as much as possible.. She knows that the time required to pursue an education and career represents time that could be spent raising and nurturing her child.

3.2. Structuring values in a hierarchy. When you think about your values, it becomes apparent right away that there are different categories. For example, at a very basic level you might have the objective of helping other people. This general objective can be broken down into others. You might want to distinguish, for example, between helping members of your immediate family, helping your neighbors, helping your more distant relatives, and helping strangers. This kind of division is useful because of decisions that we face; we are often asked to contribute time, energy, and money to various causes, and the

extent to which you devote these resources to one group of people means that you will have less to devote to the others. If you agree to serve on the local School Board, you will be helping your immediate neighbors and some strangers. Although you will also be helping your children a little, on balance the time you spend on the school board is like to detract from the time you can spend with your kids.

Values can be displayed in a *value tree*, a diagram that shows how general objectives are broken down into finer categories. A simple example is shown below in Figure 3.1. The hypothetical person who owns these values could be characterized as an “environmentalist” because of the large part of the value tree devoted to environmental concerns. Nevertheless, it is important to note that the value tree includes many other aspects that are not directly connected with environmental concerns. In fact, some of them conflict in some ways with environmental concerns. For example, the objective of learning about the world and its sub-objective of traveling necessarily require a fair amount of resource use and pollution, thereby conflicting with environmental protection; it is difficult to travel and not use fuel in some form or another!

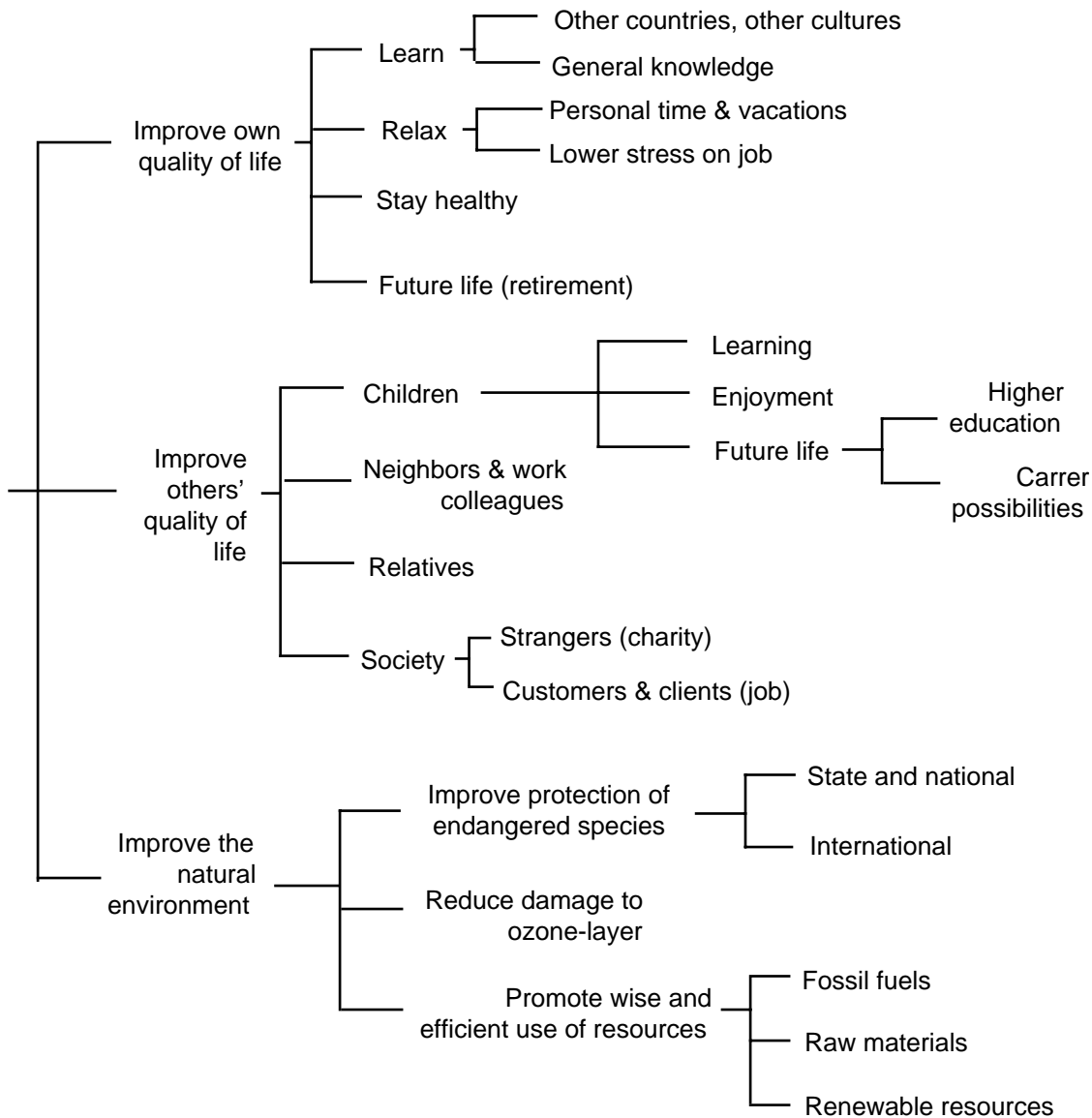


Figure 3.1. One Person's Value Tree

3.3. Fundamental and means objectives. So far we have been talking for the most part about values that represent *fundamental objectives*. These are objectives that describe what is directly important to us in a very basic sense. Examples typically include good health, learning, socializing with friends, relaxing with loved ones, and helping others. Identifying fundamental objectives is subtle but straightforward; if you think something is important to you, simply ask why it is important. Keep asking why until the answer is, "Because it just is important."

For example, suppose you wrote in your list above that playing in the community orchestra is important to you. Why is it important? Your answer might be that it is important because you visit with your friends, you enjoy making music, and you make a little money. Now ask yourself, why is it important to visit with your friends? You may answer that you simply enjoy interacting with them; socializing with your friends and loved ones may be a fundamental value for you. Similarly, making music may be important to you just because it makes you feel good. It's that simple.

On the other hand, why is making money important? Certainly no one can argue with the notion that money is important, but money alone is just a pile of green (and usually dirty) paper. So why is money important? One answer is that money is important to the extent that it lets you pursue your more fundamental objectives. We like to have more money because we can spend it on things that improve the quality of our lives and that of others we care about. (For example, I can purchase a better violin that will enable me to enjoy my music making even more!) Because money provides the means to achieve our fundamental objectives, we say that making money is a *means objective*.

For many people money is the most critical means objective, and often we lose track of other objectives in our quest for more money. However, other means objectives should not be ignored. One of the most important is time. In the example about the single mother, we made the point that time spent on education and career is time taken from being with her child. In fact, time (like money) is a resource that can be used to help us achieve our fundamental objectives. The abundance of self-help books and seminars on time management testifies to the fact that many people feel strapped for time (in the same way that many people feel strapped for money). The school day itself is divided into different class periods because as parents and teachers we felt the need to use time to address different educational needs of the students. The different educational needs follow from fundamental values (of teachers, parents, and society as well as students), and we try to use time efficiently as a means to accomplish these objectives.

Another example of a means objective is space. Though not critical for many activities, space can be viewed as a resource that is used to accomplish fundamental objectives. For example, an individual who enjoys being creative can use space in his or her home to set up a studio or shop. Someone for whom enjoyment of the outdoors is an important fundamental value may want to live near a park or work to establish a wilderness area. Schools themselves represent the allocation of space (land and buildings) for the purpose of pursuing fundamental objectives of our educational system. Within the school, space is used in different ways, and each different allocation of space addresses one or more fundamental objectives. Even the presence or absence of lockers represents an allocation of space to accomplish one or more objectives.

All of the objectives included in the value tree in the Figure 3.1 are fundamental objectives instead of means objectives. That is, they all represent values that are important to the individual for their own intrinsic reasons, not because they can be used (like time, money, or space can be) to further some other objectives. Figure 3.2 gives one example of a simplified objectives hierarchy that includes both means and ends (fundamental) objectives. The fundamental objective is to improve one's health as much as possible. To do that (following the top branches in the tree), this person has an objective of eating well, which in turn means "maintaining a balanced diet" and "avoiding junk food." Avoiding junk food is not fundamentally important in and of itself; in fact, the only reason many people limit their consumption of junk food is because they recognize the link between this means objective and their fundamental objective of being in good health.

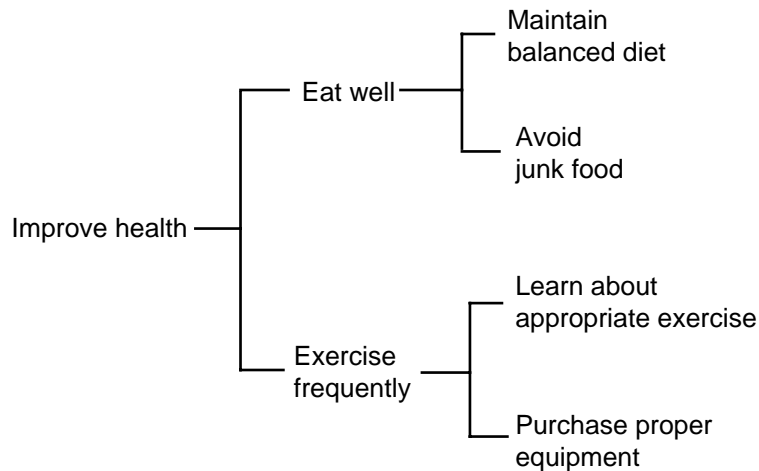


Figure 3.2. A Means-Ends Value Tree

3.4. Measuring differences in importance among objectives. Having established a hierarchy or tree that represents our value structure, the next step is to understand the relative importance of the different values. For example, you may feel that improving the quality of your children’s life is more important than improving the lives of strangers. This does not necessarily mean that you do nothing to help strangers, only that helping your children has a higher priority.

A key issue in assigning weights to values has to do with the extent to which your options differ on that value. For example, in considering which summer job to take, a teenager might indicate casually that the most important aspect of the jobs is the hourly wage. Suppose, though, that the wage is approximately the same for three different jobs. One of the jobs requires up to 20 regular hours during the week at minimum wage, another 15 hours on weekends at 10¢ above minimum wage, and the third up to 30 hours on afternoons and evenings at 20¢ above minimum wage. This teenager clearly needs to understand the tradeoffs between number of hours worked and when those hours occur; if being with friends on evenings and weekends is important, then the most attractive job may be the weekday job, even though it does not pay the most money. Clearly, in this decision the wage is not as important as other aspects of the jobs.

It is possible to assign numerical weights to the various values, but this process is complex and beyond the scope of this introduction. Doing so requires careful attention to how one measures each attribute in the value tree, followed by judgmental comparison of those attributes. The result is a full mathematical representation of one’s values. For some very complex situations, having such a detailed model can help us derive insight regarding the alternatives we face. However, for many everyday problems a good deal of insight can arise simply from the process of structuring our values and considering how those values apply to the available options. A more lengthy example in Chapter 5 will demonstrate one way that a decision maker can think systematically about tradeoffs by considering how much one attribute (say, time) is worth in terms of another (dollars).

3.5. Value trees and decision trees. In all of the decision-tree examples in Chapter 2, we explicitly included whatever values were appropriate in the decision tree by listing the necessary concerns in the consequences. Incorporating values into a decision tree really is no more complicated than this, although it can be done in a more organized way. Figure 3.3 shows how a decision tree and a value tree can be melded. The decision tree determines the endpoints for which consequences must be defined (Consequences A - F), and the value tree indicates the dimensions (Attributes 1 - 9) to use in describing the consequences. The result is a matrix in which each row describes a consequence. Moreover, that description is in terms of the decision maker’s values. For example, if one of the attributes is “expense,” then it will be necessary to figure out what the expense would be for each consequence. Exactly the things that matter to the decision

maker will be considered for each consequence. Issues that do not matter — those that are not included in the value tree — are ignored.

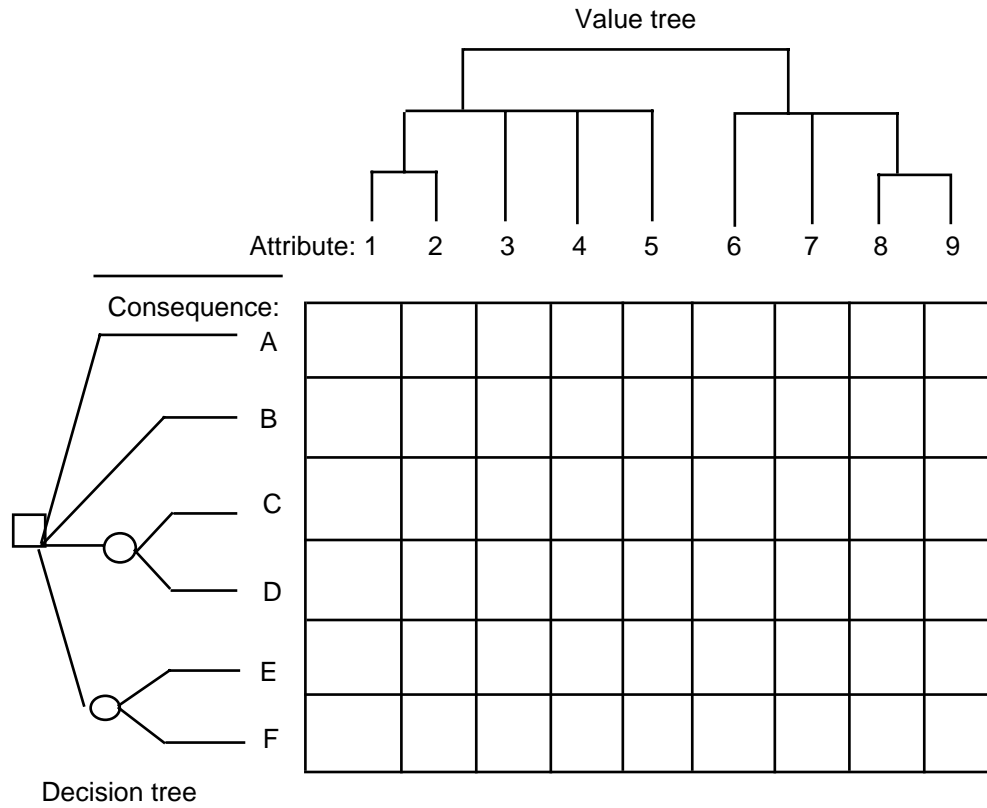


Figure 3.3. Combining Value and Decision Trees

The vacation decision tree in Figure 2.2 is a good example of this setup. Even though no value tree was created for this problem, it appears that the family is interested in four objectives, minimizing cost, seeing both new and familiar palces, enjoying some family interactions, and having fun. Hence, each of the three alternatives lead to consequences that are be described in terms of the four objectives. The complete structure, showing the contribution of both decision and value trees, is shown below in Figure 3.4.

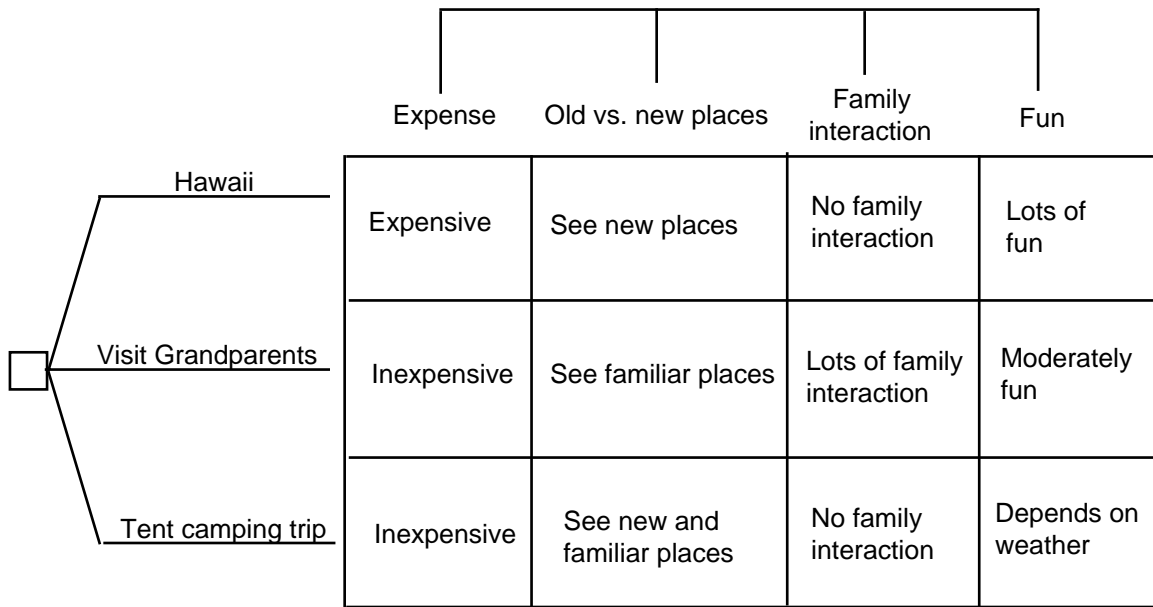


Figure 3.4. The Vacation Decision

4. KNOWLEDGE AND UNCERTAINTY

When we have an important decision to make, we naturally want to marshal all of the relevant and available information. In many cases this is straightforward; we use what we know, and if critical information is missing, we find it. Other situations, though, may be complicated by the fact that useful information is not readily available, which can occur for any of a number of reasons. For example, we may not have access to the information because it is confidential, or necessary scientific studies may not have been done. There are many occasions when we must make a decision even though we are *uncertain* — our information and knowledge are incomplete. In this chapter we discuss uncertainty in depth: what it is and why uncertainty matters, how to talk about uncertainty and deal with it in decision situations, and how uncertainty fits into a decision-tree representation.

4.1. Uncertainty as a state of knowledge. What does the future hold? Will my friends like the new CD that I want to buy? Will the California Condor eventually become extinct despite extensive prevention efforts? What will the job market be like ten years from now? These are questions that exemplify the uncertainties that each of us, as citizens and decision makers, must face every day.

If you *know* what will happen, then you have no uncertainty. If you *do not know* for sure, then you are uncertain. In fact, you may have different degrees of uncertainty on different issues. For example, you might be pretty sure that it will rain later today (especially if it is raining now), but you may be less sure of the weather next week, and still less sure about the weather a year from now. An economist forecasting next week's oil prices can probably give a fairly precise estimate. On the other hand, few people would expect a forecast for oil prices five years from now to be as accurate; it can only be a "best guess," and we would not be surprised if the error were large. The increased uncertainty reflects two considerations: less is known about events farther in the future, and lots of things can occur in the meantime.

Uncertainty is best viewed as a state of knowledge. How much we know determines how uncertain we are. In fact, most of us would be much more uncertain about oil prices than the economist, because we know less about the international oil economy. However, with some time and effort, we could learn about oil prices and reduce our uncertainty somewhat. In this sense, learning can be thought of as acquiring information to reduce uncertainty. In situations such as forecasting weather or oil prices, though, we can never know enough to eliminate uncertainty completely.

Uncertainty need not be about future events. A student can be uncertain about what the right answer is on a history exam, or a mechanic can be uncertain about why a car will not start. With time and effort, though, the uncertainty can be reduced or, in some cases, entirely resolved. For example, the student might eliminate his or her uncertainty by reviewing the reading material for a class. The mechanic might resolve the uncertainty by checking a car-repair manual and carefully analyzing the performance of the different systems in the car.

Because uncertainty reflects a state of knowledge, it makes sense for different people to have different levels of uncertainty in the same situation. Take the example of the history exam. Faced with a particular factual question, a student who has studied the appropriate material may know the answer right off, while another who has failed to read the assignment may be uncertain. A more complex situation is one in which two scientists may disagree on the impacts of a particular action. For example, two biologists might disagree on the potential impact of releasing genetically engineered organisms in an agricultural area. Both scientists may have read the same reports and have the same general level of understanding. Even so, when faced with an altogether new situation, it is not surprising that they may weigh the evidence differently and arrive at different conclusions.

4.2. Why does uncertainty matter? There are several reasons why it is important to think clearly about the uncertainty in any given decision situation. Perhaps the most important one is that most people do not like uncertainty and typically try to avoid it. However, the degree to which one likes or dislikes uncertainty varies from person to person. For example, some people always want to know for sure what will happen; they plan vacations with great care, they invest their money in certificates of deposit, and they do not take

many risks. At the other extreme are those who accept and sometimes even enjoy uncertainty. Such a person might play the stock market, make bets, or engage in risky activities such as skydiving or bungee-jumping. Most of us fall somewhere in the middle, being willing to take some risks but drawing the line at others.

In a decision situation we often would like to know how the risks compare from one alternative to the next. Suppose, for example, that we have the choice between two investment opportunities. One may yield a high return but is risky; there is a 50% chance of earning \$1000 in two years, but a 50% chance that you lose the investment. The other earns less, but is less risky; there is a 90% chance that you will earn \$500 in two years, and only a 10% chance of losing the investment altogether. For most people, the difference in the riskiness of these two options is an important concern, and it would be important to think hard about the tradeoff between risk and return.

Another reason why uncertainty is important relates to the possibility of gathering information. As noted above, uncertainty can be thought of as a state of knowledge; just how much do you know about the world around you? How sure are you about what will happen to you? To some extent it is possible to gather information to reduce this uncertainty, and an important element of good decision making is the ability to identify reliable sources of information that can reduce uncertainty.

The third reason why clear thinking about uncertainty is important relates to the fact that when we think casually about risky situations, we tend to make use of some simple *heuristics* or rules-of-thumb that can result in biased views of risk and uncertainty. One such heuristic is known as *availability* and refers to the ease with which similar events can be recalled. What is available in one's memory, though, can depend to a great extent on what one has recently seen. For example, if you were to judge the probability of being involved in a serious automobile accident, your probability would be higher if you had just witnessed such an accident, or if the evening news had just reported a series of serious accidents. Another example is *anchoring-and-adjusting*. For example, in estimating how long it will take to do a certain job (e.g., till the garden, paint the house, write a letter) we tend to think of a similar task from the past, use the time required for that task, and then adjust for differences between that task and the current one. The problem is that we usually adjust insufficiently. Clear thinking about uncertainty can help to overcome some of these built-in tendencies and biases.

4.3. Probability and decision trees. Recall from Section 2.5 that we can use decision trees to represent the elements of a decision situation. *Chance nodes*, indicated by circles, represent uncertain aspects of a decision. The umbrella problem is reproduced in Figure 4.1 as an example. In this situation, the uncertainty is whether it will rain or not. Of course, it may rain regardless of the decision taken, but this uncertainty only matters if the decision is to leave the umbrella; if the choice is to take the umbrella, the consequence is the same regardless of the weather. Also, note that the uncertainty is represented by a single chance node with two possible outcomes, Rain and No Rain. It might be possible to include different degrees and kinds of precipitation, such as snow, sleet, hail, and so on, or to measure the amount of precipitation that falls. In Figure 4.1, the uncertainty is stripped down to the bare essentials; whether it rains or not. Implicitly, what the decision maker cares about is whether it rains enough to cause an inconvenience.

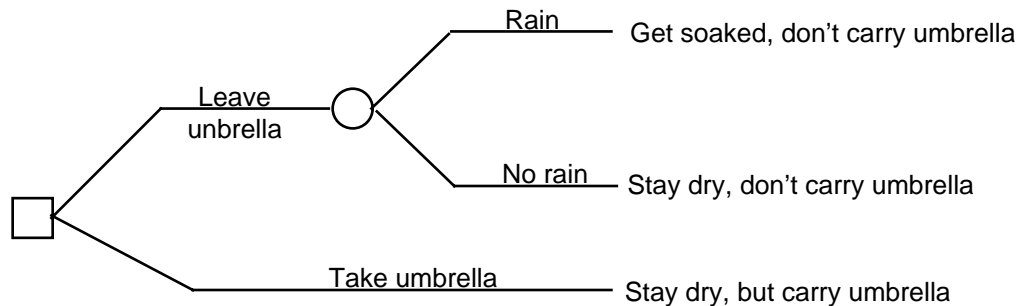


Figure 4.1. The Umbrella Problem.

The decision tree provides a useful vehicle for visually representing uncertainty. Now we need a way to measure that uncertainty. For example, is it quite likely to rain (as it might be in Portland, Oregon, in the winter), or would it be quite a surprise (Phoenix in June)? We need a language that we can use to represent different degrees of uncertainty. By far the best language for expressing degrees of uncertainty is probability. By using probability, we can make very precise statements about how likely or unlikely something is to occur. In fact, obtaining precision in expressing uncertainty is important; researchers have found that there is little consensus about the precise meanings of the verbal terms typically used to describe uncertainty (such as likely, unlikely, improbable, slight chance, etc.).

While we will not discuss probability in detail, some of the characteristics of probability have direct and useful interpretations for expressing uncertainty about different events. First is the notion that we can usually compare events in terms of which is more likely and which is less. For example, I think it is more likely that the US deficit will grow next year than that it will shrink. If I choose to buy a used car, it is more likely that I will have trouble with repairs than if I buy a new car. The California Condor is more likely to become extinct than the Northern Spotted Owl, even though it is possible that both may happen.

A second notion is that probabilities are positive and must add up to one, or to 100% in percentage terms. (Actually, these are technical requirements to make the mathematics convenient.) A probability of zero means you are sure the event will not occur, while a probability of one means you are sure it will occur. You can never be “more than sure” either way, so it makes no sense to use probabilities that are either less than zero or greater than one.

In fact, it is important to realize that we are rarely, if ever, perfectly sure, which suggests we should hardly ever invoke probabilities of zero or one. Are you sure that your students will know the answer to the test question? Are you sure that your parents will understand when you explain why you came home late? Are you sure that the movie starts at 7:15 and not 7:00? A good rule of thumb is never to use probabilities of zero or one. Instead, in these situations think about how surprised you would be if the result turned out to be the opposite of what you believe. For example, imagine having your name chosen at random from a group of twenty individuals. You would be pretty surprised, and the level of this surprise suggests a probability of $0.05 = 1/20$. Suppose there were 100 names in the hat. Your surprise would be even greater, and the appropriate probability would be $0.01 = 1/100$. By thinking in this way, you can lessen the tendency all of us have to think that we are more sure than we really are.

Finally, the notion of conditional probability is particularly powerful for helping understand the uncertainty that we face. The term “conditional” implies that this assessment of uncertainty is predicated on something; that something is often a particular state of knowledge. For example, suppose you were to say, “If Terry comes to the party, there is a 95% chance that Robin will be there, too. But if Terry is not there, there is only a 20% chance that Robin will be there.” If you know what Terry does, you can make a pretty strong statement (even though you aren’t absolutely sure) about what Robin will do. The condition could also be a particular choice that you might make, as in the following statement: “If I spend an hour on my math homework, I have a good chance (maybe 90%) of getting an A, but if I try to do it at the last moment before

class, the chance of getting an A is only 20%.” The chance of getting an A clearly depends on the choice that is made.

Finally, an important concept is that, in fact, all probabilities are conditional. Every probability statement that you make is conditional on the knowledge that you have at that particular point in time. As time passes and you learn new information, or as old information becomes outdated, your level of uncertainty will change, reflecting the current information you have.

These aspects of probability have important implications for how uncertainty is represented in a decision tree. First, consider the outcomes (branches) associated with a chance node. The branches should represent a set of outcomes that are defined so that one and only one outcome can occur. For example, it either rains or it does not rain. Second, there should be a probability associated with each branch, and the probabilities on the branches for any given chance node should add up to one. (If the probability for any branch is zero — which means the outcome cannot occur — then that branch can be deleted from the decision tree.) Third, the probabilities in a decision tree are all conditional probabilities. That is, the probabilities associated with a particular chance node are conditional on everything that has come before, or the path that has occurred to get to the chance node.

Figure 4.2 demonstrates these principles in the context of the earlier vacation example. The choice is whether to go to Hawaii or Alaska for a vacation. The weather can be good or bad (rain on more than half of the days, say) in either case. The probabilities differ, though, for the two destinations. This is the conditional nature of the uncertainty; the probabilities are conditional on the destination. Note that the branches cover an exhaustive set of outcomes (good or bad weather), and that the probabilities add up to one for each of the chance nodes. The specific numbers represent the decision maker’s degree of belief — presumably based on some reasonable information source like a weather forecaster — that the weather will actually turn out good or bad in either case.

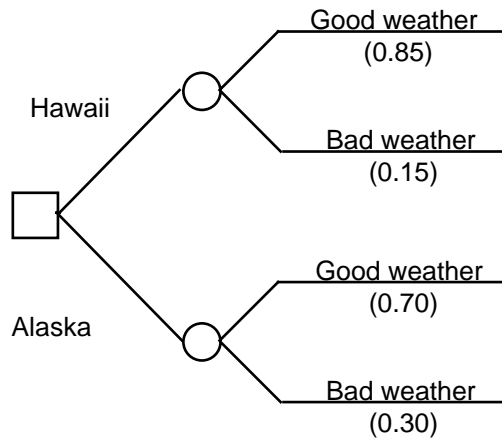


Figure 4.2. A Vacation Example.

4.4. Good decisions and bad outcomes. Even with the best available information and the clearest thinking about uncertainty, a decision maker still has no guarantees about the eventual outcome. Take a stock-market investor, for example. Even with sound investment advice and careful thought, the investor can experience bad luck; the market could crash, or individual companies in the investor’s portfolio could do poorly. The converse is also true; because of uncertainty, even stupid decisions can lead to great outcomes. Many people have made money in the stock market due to luck rather than insight. Of course, this is not a recommendation to make stupid choices; it is a mistake to rely on good luck to make up for bad decisions. Over the course of many decisions, better decision processes will lead to better outcomes. Whether you will be lucky or unlucky in any one decision, though, cannot be known in advance.

When decisions are made under uncertainty, even a great decision cannot ensure a great outcome. However, an active and creative decision maker can, to some extent, control his or her luck. By seeking out great decision opportunities, we put ourselves in situations where the possible outcomes are ones we would like, rather than passively waiting for decision situations that may present us with distasteful outcomes. If you actively seek out decision situations that you want to be involved with, and then make those decisions with care, you will probably not need to rely on luck!

4.5. Resolvable versus unresolvable uncertainty. In some cases uncertainty can be resolved by acquiring information. A simple example is an argument over a scientific fact. Reading a scientist's report or conducting an experiment can often resolve the uncertainty. In other cases, it may be possible in principle to determine the truth, but at the same time it may not be feasible to do so. For example, it would be possible to determine the number of words contained in all of the books in the Library of Congress but the time and expense would far outweigh the value of doing so. Computer scientists in particular are fond of dreaming up problems for which a solution procedure is theoretically possible but not implementable, because the necessary computer would have to be larger than the universe (or calculating the solution would take longer than the life of the universe).

In many situations, though, uncertainty may be reduced but never eliminated. The weather is a perfect example. Although we can be relatively sure of the weather at a given location over a short period of time, a precise prediction of next week's weather at any specific location is virtually impossible. No amount of research can reveal exactly what the weather will be. Likewise, changes in stock prices are unpredictable. In each case the uncertainty can be reduced by consulting a meteorologist or a financial analyst, but these experts can only give an opinion and advice; they are not clairvoyant!

4.6. Identifiable versus statistical risks. In our society we often have to make policy decisions that involve risk to the health or lives of individuals. However, these risks are typically not risks to any *specific* person but general risks to the population. For example, when we choose to set highway speed limits at 65 miles per hour rather than 55, we put more people at risk of suffering a serious injury or even a fatality in an accident. In exchange for the additional risk, we all enjoy a little more convenience by being able to get to our destinations a bit faster. Can these risks be quantified? They can be, and they are. In fact, the estimate is that a 10-mph increase in the speed limit results in approximately 10,000 additional deaths each year. This does not mean that your Aunt Nellie is going to die in an auto accident next year whereas she might not have if the speed limit had stayed at 55; when the speed limit is increased, no particular person or group of people is slated to bear the ultimate consequence. However, it does mean that Aunt Nellie, like everyone, bears a slightly higher risk when travelling on the freeways.

The notion of statistical risk is an important one to grasp in our modern society. Many risks impinge on our lives, and no realistic options are available to eliminate the risk entirely. At the same time, many of the risks are small; the risk of cancer due to too much sun, the risk of AIDS due to unprotected sex, the risk of being killed in an automobile accident when a seat belt is not used. Many of us tend to ignore these risks or act as if the risks do not apply to us. Teens are especially vulnerable. It is "uncool" to worry about the bad things that might happen; peer pressure often leads to enjoyment of the moment without regard to the risks being taken.

What happens to small risks as we repeatedly engage in an activity? They increase, often at a surprising rate. Suppose, for example, that we do some thing risky — climb to the top rung of a stepladder even though it rests on an uneven surface — because we figure that nine times out of ten we will be safe. If we climb the ladder ten times, though, the chance of an accident increases to about 65%, or almost two out of three! This same logic applies to actions such as wearing a seat belt when driving a car; although the added safety on any one trip is small, the reduction in risk over a lifetime is large.

5. STRUCTURING DECISIONS: TWO EXAMPLES

In this chapter we look at two fairly elaborate examples of decisions. The decisions themselves are not atypical; one involves the choice of what summer job to take, and the second concerns whether to buy a used car. These examples illustrate both the common-sense nature of our systematic decision-making approach and its generalizability. The same basic methods can be used in many different situations such as purchasing a home, choosing a subject for a class project, developing a campaign strategy for a political candidate, or even selecting a NASA space mission.

The two examples shown here demonstrate how decision trees are constructed and modified as the analysis proceeds. The decision trees take into account the values of the decision maker, the effects of uncertainty, and the consequences of the decision alternatives. The two examples show, in quite a bit of detail, how the principles we have developed can be used to help clarify one's thinking in difficult decision situations.

5.1. A summer job. Imagine a teenager deciding between two summertime alternatives. One is to take a job as an assistant (a "gofer") at a small business; the job would pay minimum wage (\$5.25 per hour), require 25-35 hours per week, and the hours would be primarily during the week, leaving the weekends free. The job would last for three months. A second alternative is to work as a member of a trail-maintenance crew for a conservation organization. This job would require 10 weeks of hard work, 40 hours per week at \$6.50 per hour, in the National Forest. The job would require extensive camping and backpacking. Members of the maintenance crew come from a large geographic area and spend the entire 10 weeks together, including weekends.

These two jobs are very different in many ways, and the choice may depend on things such as a preference for or against camping and backpacking or working outdoors instead of within a small business. In addition, the two jobs present very different uncertainties. With the in-town job, the teenager can be certain that weekends will be available and that it will be possible to spend time with close friends. Thus, the teenager can anticipate that his summer will involve a moderate level of spending time and having fun with existing friends. However, the total work hours and hence the amount of money earned is uncertain. The trail-maintenance job, on the other hand, presents no uncertainty in terms of the amount of money earned ($\$2600 = 6.50 \text{ per hour} \times 40 \text{ hours per week} \times 10 \text{ weeks}$). The main uncertainty for this choice, though, is the nature of one's work companions. What will the crew be like? Will new friendships develop? The nature of the crew and the leaders could make for 10 weeks of a wonderful time, 10 weeks of hell, or anything in between.

Values. The first step is to understand what makes this decision important. From the description, it appears that the teenager's values in this context are earning money and having fun with friends. These represent reasonable values, but the jobs offer very different possibilities for the amount of money earned and the quality of the summer in terms of fun with friends. Our main task in working through this decision will be to gain insight into the relationship between these two values in the context of the two job opportunities.

Decisions as choices among lotteries. Decisions can often be viewed as choices among uncertain events or lotteries. A generic decision tree for the summer-job decision (Figure 5.1) displays the two lotteries clearly and permits easy comparison of them in the mind of the decision maker. The crescents in the chance nodes in Figure 5.1 indicate that the consequences (amount of fun and amount of money) can vary, taking on any value along a continuum between "a lot" and "not much." For the trail-maintenance job, the amount of money is \$2600, regardless of the amount of fun. On the other hand, the in-town job leads to a moderate amount of fun, regardless of the amount of money. (More money could mean more fun, but earning more money means less time is available to spend with friends. Because of this offsetting effect, it seems reasonable to assume — at least for now — that the amount of fun is not in doubt for the in-town job.)

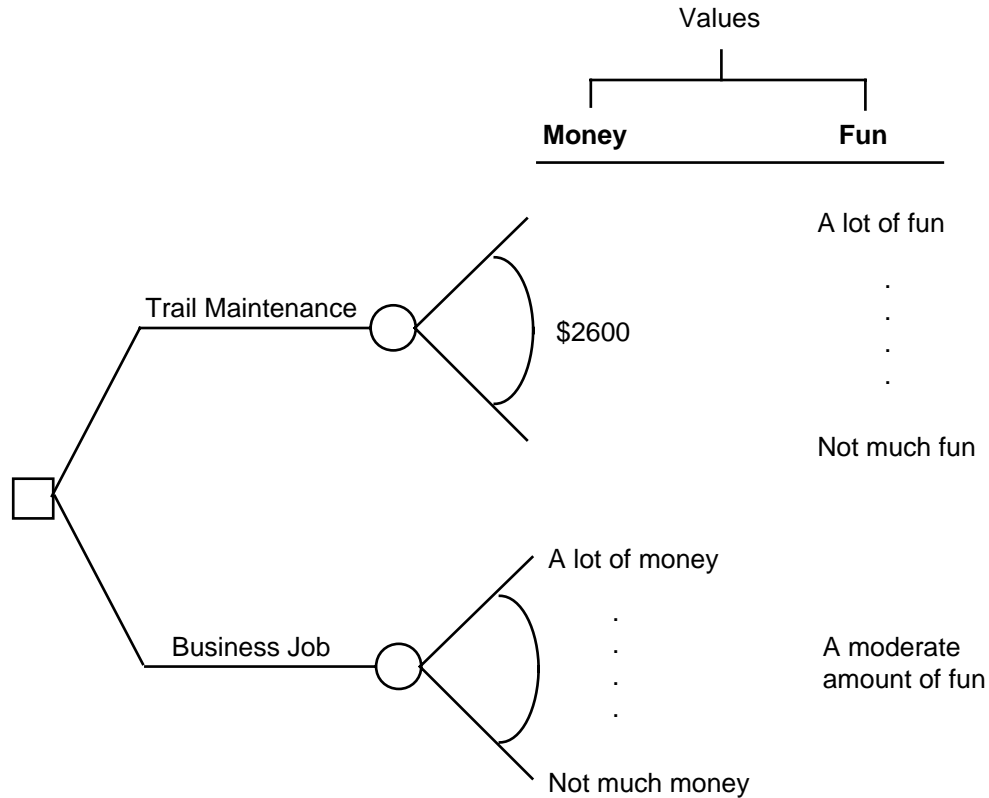


Figure 5.1. The summer-job decision.

Further analysis will require a more precise definition of the vague terms we have used such as “a lot of fun” or “not much money.” Even at this early stage, though, the decision tree visually emphasizes the major considerations affecting each job choice. For the trail-maintenance job, the key question is how much fun it will be, whereas for the in-town job the question is money.

Creating scales. The decision tree in Figure 5.1 reveals the essence of the decision problem. In order to make further progress, though, we need to be more specific. Just how much money might be made at the in-town job? How does the uncertainty about “fun” in the trail-maintenance job relate to the uncertainty about money in the in-town job?

Each alternative in Figure 5.1 requires a scale of some sort. For the in-town job, we have a natural measure: dollars. How much might be earned at this job? What are the possibilities? The obvious way to answer these questions is to speak with the proprietor of the business. There may be a budget limitation, essentially putting a cap on the amount that could be earned. And there may be a certain amount of work that must be done, thus setting a lower limit. In between, there may be a most likely value.

Suppose that the business owner and the teenager reach an agreement about the amount of work. They agree that the maximum amount of work would be 40 hours per week. If the minimum wage is \$5.25 per hour, then this outcome would amount to \$5.25 per hour x 40 hours per week x 13 weeks = \$2730 (before taxes). At the other extreme, the job would involve no less than 30 hours per week, for a total of \$2047.50. And the most likely outcome would be 34 hours per week, for a total of \$2320.50. With this information, we can now make the decision tree more precise for the in-town job:

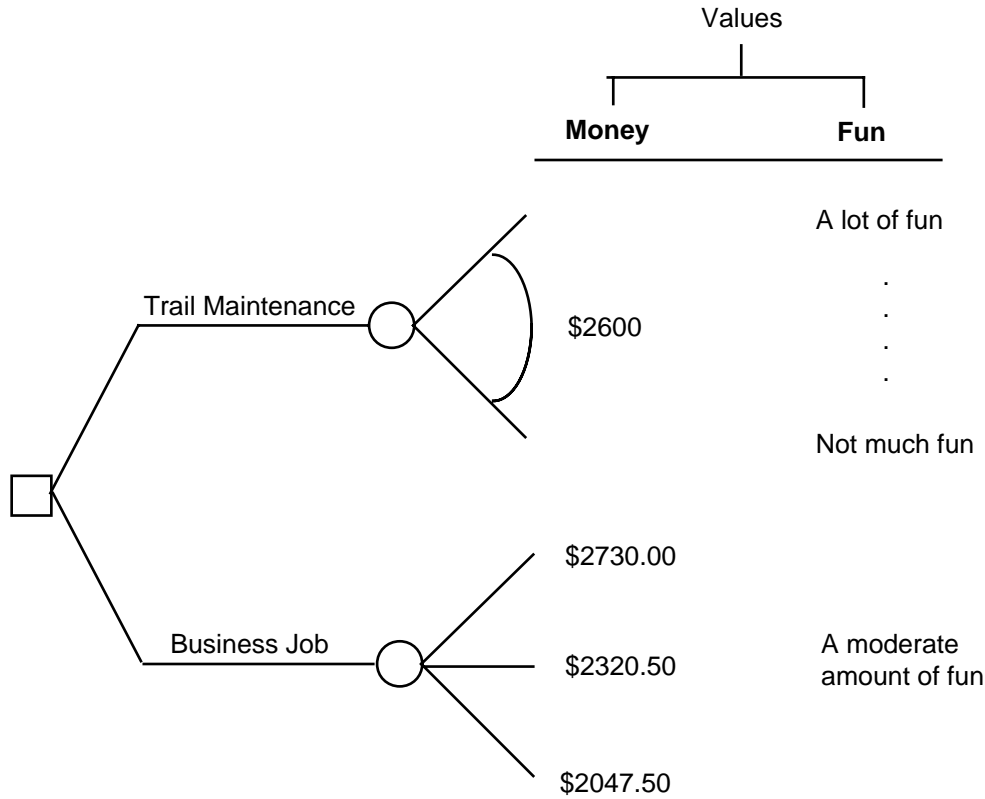


Figure 5.2. The summer-job decision with dollar values.

Of course, these three possible outcomes are not the only ones, but they give a reasonable way to think about the amount of money that might be earned.

Doing the same kind of thing for the trail-maintenance job is somewhat more challenging, because the definition of “fun” is not clear. In order to make sense of the situation, it will be necessary to define clearly what “a lot of fun” and “not much fun” mean, along with some intermediate possibilities. In other words, we need to create a “fun” scale that allows us to compare different amounts of fun, just like we created a dollar scale for the in-town job.

The way to start is to think of several possible scenarios, each of which represents a different level of “fun” in the context of the trail-maintenance job. One possibility is that the group is very congenial, everyone gets along, the work is interesting and satisfying, and at the end of summer the bonds of friendship are very strong. At the other extreme, the group may turn out to be people who do not get along, the work is boring, and at the end of the summer all participants leave with no intentions of staying in contact. And then there might be a number of in-between scenarios. The following table suggests some:

1. (Best) Congenial group, many strong friendships made, satisfying work, very enjoyable times.
2. A few of the participants form a congenial group and become friends. Work is interesting, and time off is spent with a few friends in enjoyable pursuits.
3. No special friends are made, but the project director provides good entertainment activities during leisure hours. The work is OK, and the compensation is viewed as fair for the work done and the overall experience.
4. The work is hard. Some participants cause tension by complaining about the low pay and poor conditions. On some weekends it is possible to get away with other participants, but no entertainment is provided by the director.

5. (Worst) The work is hard, and the working conditions poor. No friends, and time off is generally boring because outside activities are limited (for example, due to isolation).

Scenarios 1-5 above create the basis for a possible “fun” scale. Of course, there are many more possibilities, but this set (or one like it) can help provide a clear idea of what might happen. Creating a reasonable scale for possible outcomes can be both demanding and rewarding; doing so can (and should) take a lot of careful consideration and thought, and will result in a much clearer understanding of the risks faced.

With the “fun” scale constructed, we can now state more precisely the meaning of terms like “a lot of fun” or a moderate amount of fun. The description of the problem suggests that any of the five outcomes on the scale are possible with the trail-maintenance job. Figure 5.3 shows that this is the case by means of the five branches emanating from the upper chance node.

In order to make precise the meaning of “a moderate amount of fun” for the in-town job, the teenager must make a subjective judgment. Where on the scale does the in-town job fall in terms of fun? This judgment should be made with considerable care because it will serve as a key to the comparison of the two jobs. Naturally, two different teenagers might see the same situation differently because of differences in their circle of friends, the opportunities they have, or simply because of differences in their values. For the sake of this example, let us suppose that, after careful thought, the teenager concludes that the in-town job would be the equivalent of outcome #3 on the “fun” scale. This judgment is also included in the decision tree in Figure 5.3.

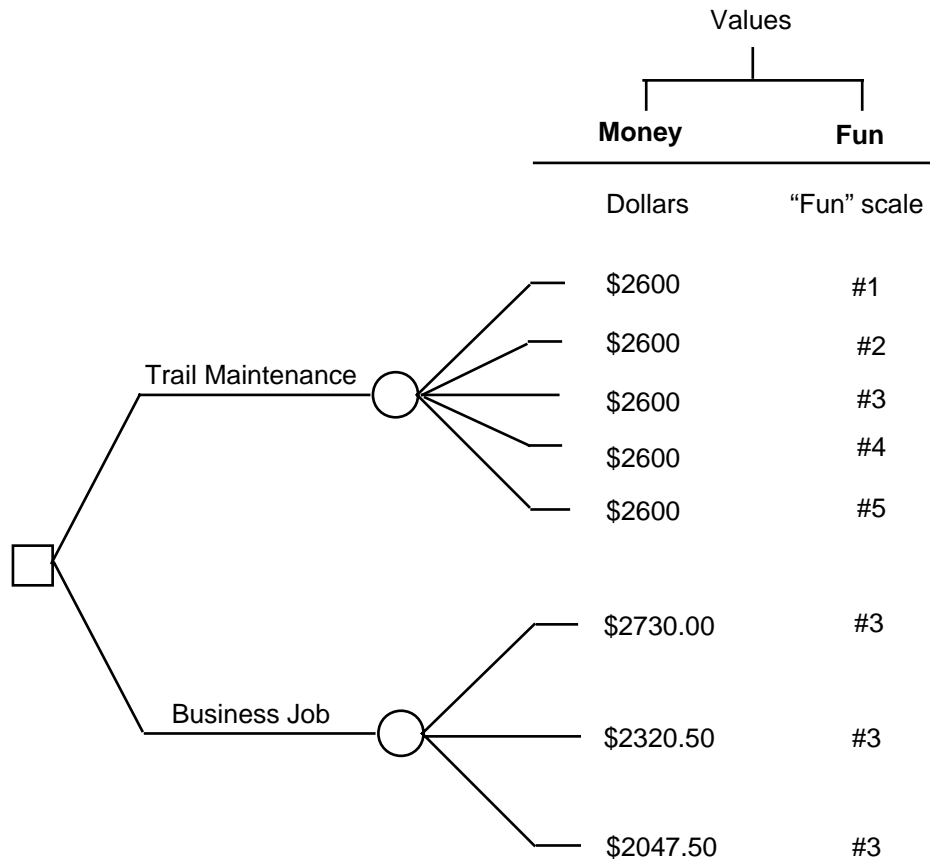


Figure 5.3. The summer-job decision with the “fun” scale incorporated.

Valuing outcomes. With the “fun” scale constructed, it is time to value the possible outcomes. Note that we still have the problem of comparing apples and oranges; the summer job in town pays an unknown quantity of dollars in total, whereas the trail-maintenance job involves uncertainty in terms of the quality of the experience. How can we make these two comparable?

One easy approach is called “pricing out,” or valuing one attribute in terms of another. In this case, it makes some sense to consider how much the possible “fun” outcomes would be worth in dollars. To do so, the first task is to identify a benchmark. Outcome #3 on our “fun” scale is a good candidate for such a benchmark for two reasons. First, it is viewed as a reasonable outcome; if outcome #3 occurs, then the teenager would view the monetary compensation as appropriate for the experience and work. The second reason is that the fun and experience associated with the in-town job is viewed as equivalent to outcome #3.

With the benchmark established, we turn to the assessment of how much changes from the benchmark are worth. This requires subjective judgments and careful thought. The teen should be asking questions like, “How much less money would I be willing to accept if I could go from the benchmark to outcome #2 (i.e., how much is the improvement in fun worth)? How about changing to outcome #1? How much more money would I have to be paid before I would think seriously about choosing outcome #4 over the benchmark? How about outcome #5?” The problem is to find just the amount of money that makes you indifferent between the outcomes being compared. These are difficult judgments. We make tradeoffs like this in our society all the time, though; harder jobs and jobs that are performed under worse conditions often pay more than “nicer” jobs requiring similar levels of training, experience, and skills.

Let’s consider comparison between outcomes #3 and #4. Suppose that after careful thought, the teenager concludes that the loss of fun associated with outcome #4 is equivalent to having the compensation reduced by \$250. (Alternatively, if the amount of fun on the trail maintenance were equivalent to outcome #4, the compensation would have to be $\$2850 = \$2600 + \$250$ in order for the teen to view the package as equivalent to outcome #3 with the salary of \$2600.) Likewise, suppose that dollar values are assessed for the others as indicated:

<u>Outcome</u>	<u>Change in Value (\$)</u>
1	+700
2	+300
3	0 (benchmark)
4	-250
5	-600

Now we can actually place dollar values on the different outcomes for the trail-maintenance job. To start, recall that the amount of pay for the trail-maintenance job is \$2600 dollars. Now increase or decrease that amount by an appropriate amount for each outcome:

<u>Outcome</u>	<u>Value (\$)</u>
1	$\$3400 = \$2600 + \$700$
2	$\$2900 = \$2600 + \$300$
3	\$2600 (benchmark)
4	$\$2350 = \$2600 - \$250$
5	$\$2000 = \$2600 - \$600$

Finally, we can include these dollar values in our decision tree as in Figure 5.4. Note that there is no adjustment to the salary figures for the in-town job, because the anticipated level of fun is the benchmark outcome #3.

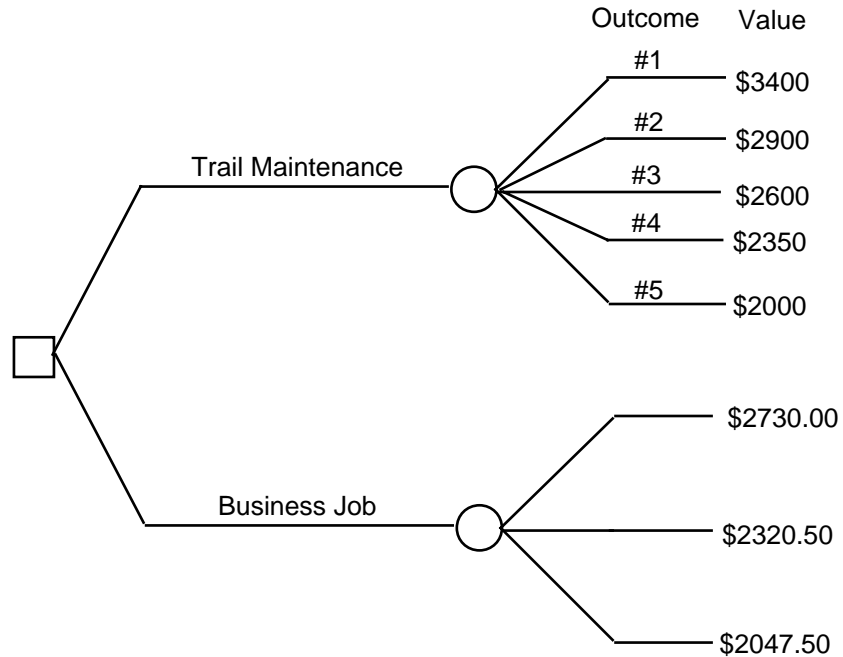


Figure 5.4. The summer-job decision with dollar values.

The decision tree in Figure 5.4 has a fair amount of detail, showing the alternatives, the possible outcomes, and comparable values (in dollars) for those outcomes. These dollar amounts include the essential tradeoff between fun and amount of earnings. At this point, it may be possible to make a decision with some confidence; the decision maker may be able to look at the two “gambles” and choose. An argument might be that for the in-town job two of the possible outcomes (\$2047.50 and \$2320.50) are virtually the same as the worst two outcomes for the trail-maintenance job (\$2000, \$2350), and that the best three outcomes for the trail maintenance job all compare favorably with the best outcome for the in-town job. On this basis, it might appear reasonable to choose the trail-maintenance job. If so, there is no need to go further; as soon as the decision can be made with understanding and confidence, there is no reason for further analysis.

Assessing Probabilities. Some people might be happy making a decision at this stage. But not everyone. In particular, what is missing from our decision tree is an idea of the likelihood of the different outcomes. For example, if the decision maker thinks that the two best outcomes for the trail-maintenance job are quite unlikely, and that the in-town job really has a good chance of being a full-time job, then the choice is not so clear. What is needed is further information, leading to the assessment of probabilities for each of the outcomes.

Figure 5.5 shows the decision tree with a reasonable set of probabilities attached to the outcomes. Of course, these are just hypothetical probabilities, and it would be important for the teen making the decision to search for good information about the possible outcomes. One avenue may be to talk with other people who have participated in the trail-maintenance program in previous years. Another possibility is to talk with employees of the in-town business to learn whether their current situation is consistent with the information they were given when hired. Gathering information such as this can take some work because it often requires searching out information from many different sources.

Although we do not go into depth here on formal techniques, assessing the probabilities for the in-town outcomes might start by reasoning as follows: The middle outcome is just as likely to happen as the other two combined. Thus, a probability of 0.5 goes on the \$2320.50 branch. As for the other two, the best outcome (\$2730) is a little more than twice the worst, thus leading to respective probabilities of 0.35 and

0.15. A similar reasoning process could result in probabilities for the trail-maintenance job. Note that the probabilities for each alternative have to add up to one. (If they do not, then reconsider the list of outcomes. Is it complete? Are some of the outcomes redundant?)

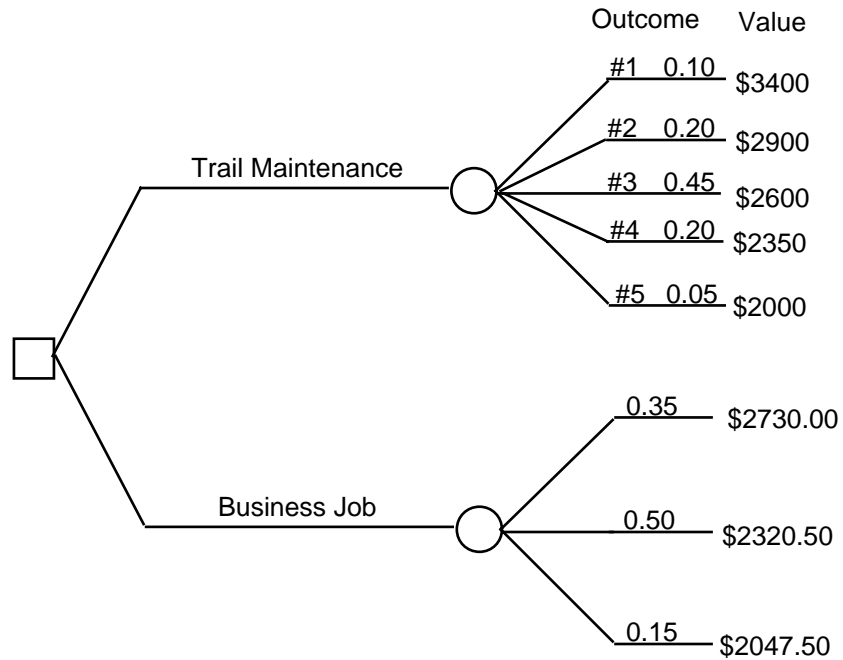


Figure 5.5. The summer-job decision with probabilities.

With probabilities plugged into the decision tree, our teenaged decision maker may be able to make a more meaningful comparison of the two risky options. For example, the middle outcome in each case is the most likely, carrying a probability of about one-half, and it is more highly valued for the trail-maintenance job. The in-town job has a 35% chance of earnings being \$2730, but the trail-maintenance job has the potential (probability 30%) for higher earnings (\$2900 or even \$3400). By comparing probabilities and outcomes in the two gambles, the teen may be able to see clearly which of the two gambles is the better risk. And as before, as soon as enough insight has been gained to make the decision, no more analysis is needed.

Calculating Expected Values. If the choice still is not clear, then further calculations may be necessary. A straightforward approach is to calculate the *expected value* of each risky option. The expected value is the probability-weighted average of the possible outcomes: take each value (in dollars), multiply by its probability, and sum across all outcomes. Here are the calculations for the two summer jobs:

Expected value (EV) for trail maintenance job:

$$\begin{aligned} \text{EV} &= 0.10 (\$3400) + 0.20 (\$2900) + 0.45 (\$2600) \\ &\quad + 0.20 (\$2350) + 0.05 (\$2000) \\ &= \$2660. \end{aligned}$$

Expected value (EV) for in-town job:

$$\begin{aligned} \text{EV} &= 0.35 (\$2730.00) + 0.50 (\$2320.50) + 0.15 (\$2047.50) \\ &= \$2422.88. \end{aligned}$$

The expected value is not what you *will* get if you choose a particular option. Instead, think of it as a representative value of what you *might* get. Another way to think about the expected value is that it represents the average you would get if you could go through the same decision many times, choosing the

same option each time. For this example, the trail-maintenance job has the higher expected value. On this basis, even though it entails slightly more risk, it might be reasonable to choose the trail-maintenance job.

There are many more possible ways to extend the analysis of this particular decision situation. Sensitivity analysis, thinking about one's attitude toward risk, searching for other important attributes, or even adding other job opportunities all might lead to better insights. These techniques are discussed in decision-analysis textbooks. However, this example provides sufficient detail to get across the idea that a good decision maker should be looking for insights in comparing the alternatives. Structuring the decision problem with a decision tree guides the analysis and the search for these insights. When enough insight has been developed to permit a clear and unambiguous choice, then the analysis should stop.

5.2. To buy or not to buy. In this second example, the question is whether to purchase a used car. Let's suppose that the car in question is a 1984 van, and that you (the decision maker) found the van listed in the classified section of the newspaper. The seller has agreed to sell it to you for \$5500. Now it is just a question of whether you should purchase the van or not.

A first step in structuring this decision with a decision tree is to create the simple tree shown in Figure 5.6. The decision is whether to purchase the van, and there are two alternatives, buy the van and do not buy it.

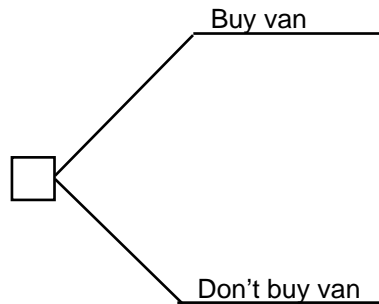


Figure 5.6. Starting the van-purchase decision tree.

Being a good consumer, you have learned a little about 1984 vans from this manufacturer. In particular, you learned from reading the consumer magazines at your public library that many of these 1984 vans had defective head gaskets. Such head gaskets *should* have been replaced long ago, but the current owner of the van does not know if the repair has been done. The issue is important because replacing the head gaskets is a major repair that would cost between \$500 and \$800.

In addition to the question about the head gaskets, you realize that, as with most used cars, this van will only last so long before it breaks down and cannot be economically repaired. The van currently has 110,000 miles. Will it last one more year? Five years?

Both uncertainties are important to you. First, you will have to spend extra money on repairs if the head gaskets need to be replaced. Your second concern is down time; making alternative transportation arrangements while your car is being repaired is a hassle that you would rather avoid. And the sooner the car breaks down beyond repair, the sooner you will have to go to the trouble of finding another vehicle and the less time you will have had to save money for that vehicle. There is no question, then, that these two sources of uncertainty need to be represented in our decision tree. Figure 5.7 shows an expanded tree with two additional chance nodes, one representing uncertainty about the gaskets and the second representing uncertainty about the car's life span. The crescent shapes in the nodes representing the van's life span indicate that the eventual breakdown could occur anytime between the day after the purchase and many years later.

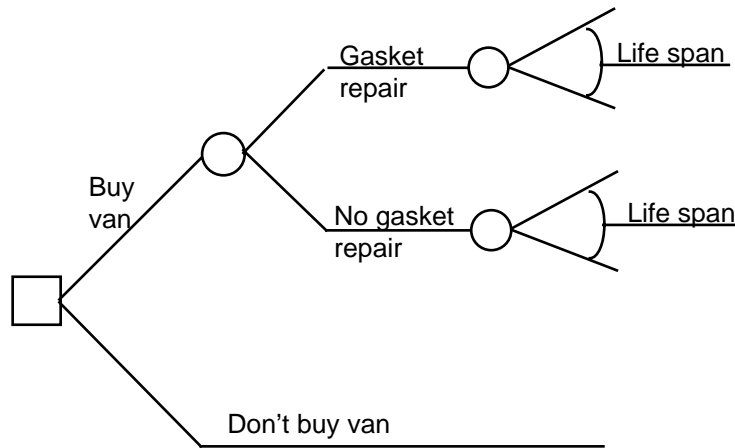


Figure 5.7. The van-purchase decision with two sources of uncertainty.

The next step in this example is to consider the possibility of getting information. A relatively inexpensive visit to a mechanic can tell you whether the gaskets need to be replaced. Moreover, you can postpone your final decision about buying the van until after you find out about the gaskets. This situation is a different from the alternatives we have considered above, and it is depicted in Figure 5.8. The incoming branch represents the alternative "Consult mechanic," the outcome of which is uncertain and may be either that the gaskets are OK or that they need to be replaced. The purchase decision appears after determining the state of the gaskets. Finally, only if the decision is to purchase the van will uncertainty about how long it will last come into play.

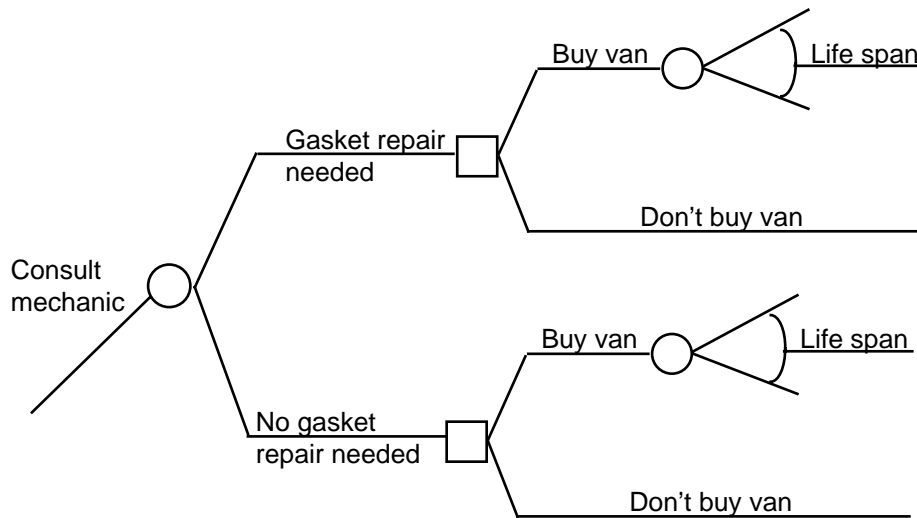


Figure 5.8. The consult-mechanic alternative.

The final step in constructing the whole decision tree is to realize that you really face three alternatives: You can buy the van now as is, you can not buy the van, or you can consult the mechanic and then decide. Figure 5.9 represents the decision with all three alternatives. This is a situation that potentially involves *sequential decisions*; if you decide to consult the mechanic, then you have a second decision to make after hearing from the mechanic.

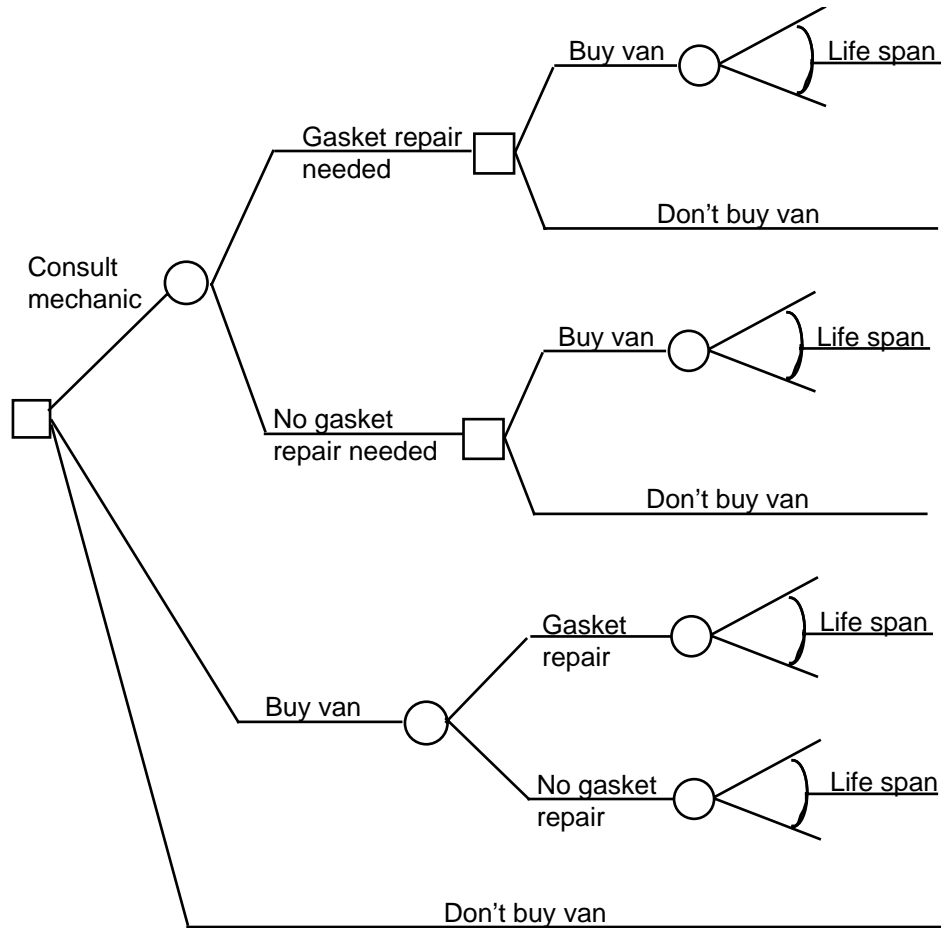


Figure 5.9. The fully expanded van-purchase decision.

Figure 5.9 is a fairly complex decision tree. The process of building it up should have persuaded you that constructing a decision tree requires only a little thought and common sense. But have we shown everything you need to make a decision? The answer is no. Information is missing regarding your values, the consequences you will face for each of your choices, and the possible outcomes regarding the van's life span and gaskets. In addition, we have not included probabilities for the chance events. How likely is it that the van needs new head gaskets? How likely is it that the van will last more than three years? More than five?

Even though the decision tree in Figure 5.9 is incomplete, we can already start to think about the alternatives. Consider the "consult mechanic" branch; should you do it? Conventional wisdom suggests you should, but throughout the book we have emphasized the need to look past conventional wisdom. Think about the information the mechanic might give you and what that implies for the action you would take. *If you would purchase the van regardless of what the mechanic says, then the mechanic's information has no value in the context of this decision.* The same holds true if you would not purchase the van regardless of the diagnosis. In other words, think carefully about the information you are considering and what it will do for your decision. There may be no sense in wasting time and money on a mechanical analysis of the car!

If you have not been able to eliminate the "Consult mechanic" alternative, then presumably the mechanic's information could lead you either to buy the van or not, depending on the report. What would happen next? The rest of the decision process looks a lot like the summer-job decision. That is, you would define your

values, specify consequences, put probabilities on the chance nodes, and think about tradeoffs. We will not go all the way through this decision in full detail, but here is the essence

1. Model "Life span" more specifically. For example, as an approximation you might figure that the car could last one, two, three, or five years.
2. Characterize the "Don't buy van" alternative. What exactly does this mean? Would you purchase a different car? Keep the one you have? Or would you do without a car altogether? Are there important uncertainties that you need to consider? We have spent a lot of time discussing the "Buy van" alternative, but the other one is important, too. A clear understanding of both alternatives is important if you are to make a good decision.
3. With life span and the "Don't buy" alternative spelled out, the next step would be to define consequences. Based on the description of the problem above, your major concerns are the amount of money that you spend on the car, the inconvenience and expense of the head-gasket repair, and the hassle of purchasing cars in general. Consequences would be defined in terms of these three values. Perhaps the best consequence would be the combination of owning and driving the van for a long time without having to repair the head gaskets.

At this point, it may be possible to make a decision. Can you compare the "gambles" that you face and see clearly that one is better than the other? Perhaps after careful thought it is clear that not buying the van is the thing to do. Or you may conclude that not buying the van is clearly dominated but that it would be silly to buy it without the mechanic's assessment; thus, off you go to the mechanic. However, if the decision is still not clear, then you would need to proceed with assessing either tradeoffs or probabilities. Here we look at probabilities, largely because this particular decision seems to be complicated mostly by the uncertainty surrounding the van's mechanical condition and its potential life span.

4. The next step would be to assess the probability that the car needs to have the head gaskets replaced. Under the circumstances, it might be a fairly low probability. What is your judgment? 0.1? More? Less? Is information available in the consumer magazine that can help you make a reasonable judgment?
5. Assess probabilities for life span. For example, you might assess a 0.1 chance that the van would last only one year, a probability of 0.5 that it lasts 2 years, 0.3 that it lasts three years, and the remaining 0.1 that it lasts for five years or more. You also might want to think about whether the probabilities depend on what the mechanic says about the head gaskets. If new head gaskets are needed, would that suggest that the car has been less well maintained and hence is more likely to break down sooner?

At any point in the probability assessment, you may be able to make a clear decision. For example, if the chance is small that the head gaskets need to be replaced, then you may decide to buy the van without the mechanic's assessment. Or if the probability is high that the head gaskets will need to be replaced *and* you assess a high probability that the van's life span will be short, then you may be able to decide not to buy the van at all. However, if you still cannot make a decision, you can continue by thinking carefully about tradeoffs.

6. Define scales for your attributes (e.g., money spent, inconvenience, and hassle). Since money is one of the attributes, it may be possible for you to "price out" the inconvenience of dealing with the head-gasket repair in the same way that we priced out the various levels of fun in the summer-job example. Perhaps you conclude that the hassle involved in getting the head gaskets replaced is worth \$25. In the decision tree, then, you would reduce the value of a consequence by \$25 if that consequence involved having the gaskets fixed. This would be in addition to the repair cost, which you would also have to pay.
7. Calculate expected values. If you have gotten all the way through the decision, having specified consequences, assessed probabilities, and defined tradeoffs, and you *still* cannot make a choice, you can always calculate the expected values of the alternatives. However, if you have gotten this far, you will probably find that the expected values are pretty close. (Of course! No wonder it's a difficult decision!) If

the expected values really are close, or if you really do feel nearly indifferent about the two alternatives, don't feel badly. The message from such an analysis is that the two alternatives are worth about the same to you; in terms of achieving your objectives, the two alternatives are more-or-less equivalent. Pick one, and enjoy!

We hope that the two examples we have gone through in this chapter give you a good feel for the kinds of analysis and thinking that can go into a decision. Obviously, not all decisions will merit this type of attention and analysis; as a general rule, those situations that include higher stakes or more novel circumstances deserve more careful thought. Furthermore, we do not expect that everyone will come away from this chapter fully confident in their ability to do the mathematical calculations.

Our basic hope is that you are now convinced of the importance of gaining a clear understanding of the issues, even for moderately consequential decisions. For most people thinking about spending days or weeks at a task or buying something for hundreds or thousands of dollars, it is well worth the time and effort required to structure the decision carefully by thinking through the relevant values and the possible consequences of the different alternatives. The hard work of coming up with probabilities, specifying tradeoff rates, or doing expected-value calculations is not always needed in order to obtain the clarity that lets you make a decision with confidence.

6. INFORMATION AND LEARNING

With all of the information from the previous five chapters, you might think that you are perfectly prepared to make any decision that comes along, right? Of course not. We have talked about principles for making decisions, once you know the things you need to know. But how do you find out this information? And what exactly do you need to know?

In this chapter we look at issues that concern the information you need in order to make good decisions. The kind of information you need falls into two different categories. Perhaps the most obvious is that you need information about the uncertainties you face. In fact, to the extent possible, you would like to learn enough to eliminate your uncertainty. Unfortunately, this is not always possible. Some good strategies exist, though, for thinking about information sources, deciding what information is worth obtaining, and using the information that you do have.

At a more fundamental level, you need information about your values. As we have argued throughout the previous five chapters, a clear understanding your own values forms the basis of good decision making. Although learning about your values is a lifelong task, we can make some recommendations about how to get the most out of your search to “know yourself.” A clear understanding of your values is crucial for identifying those aspects of decision opportunities that are important to you.

6.1. Learning About Your Values. What is important to you? How do you know what is important to you? It is too simplistic to assume that we all know ourselves so perfectly; indeed, our values change over time. Perhaps more to the point, in some ways the maturity of an individual refers to the extent to which that person has a clear understanding of his or her values. We grow, we make choices, we have experiences, and through all of this we come to know our likes and dislikes, our preferences, our values. Moreover, our values occasionally change over time. How can we learn about and keep track of what is important to us at a fundamental level?

Because we learn about our values through our life experiences, there must always be something of a random element to our self knowledge. We can, however, find ways to enhance our own self-knowledge. The method we propose relies heavily on developing your imagination and using it to contemplate choices and paths you have not taken. The obvious first source of information lies in the experiences you have had; surely the best indication of whether you will prefer a particular future consequence or not would be how you felt upon encountering a similar consequence in the past. But how about the new consequences you will experience in the future? Can you learn from someone who has had similar experiences? Can you learn from what that person can tell you, both about what happened as well as how he or she felt about it?

Suppose you are choosing between two different vacations. A wealth of information is available to help you imagine yourself engaged in an area or resort’s featured activities. Of course, this is the purpose of slick promotional advertising; the images that the brochures conjure up in your mind (scuba diving in crystal-clear water, skiing down sunny powder slopes, shopping in a bustling market in Europe) are supposed to compel you to spend your money on that particular option.

What is the best way to choose when a number of images in your mind seem compelling? Our advice is to sit quietly and reflect on one option at a time. Why does it appeal to you? If there is something about the image that you like, this suggests that there is an underlying value that is being served. If two very different vacation options appeal to you, there are probably at least two different implicit objectives that you have, any of which may be served by any given option. If you are drawn to a beach resort on one hand and a skiing vacation on the other, perhaps you value warmth and relaxation but at the same time exercise and an active social scene.

How can you sort through the many issues? Spend some time thinking about one particular option. Reflect as deeply as you can, carefully imagining yourself in various aspects of the experience. When you have a well developed scenario in your mind, start delving into your value structure. Ask yourself why this scenario appeals to you. What is important to you? Perhaps scuba diving is important because you enjoy

the opportunity to see new and unusual sights. Continue asking why until you get down to fundamental values, just as we discussed back in Chapter 3. For example, seeing new and unusual sights may be important to you because you enjoy learning about different parts of the world.

Once you have examined that scenario, try changing it slightly in a way that makes it less appealing. This may be difficult, especially in the vacation case, because none of the advertising material will offer suggestions about how the vacation could turn out badly. However, with a little thought, you can probably come up with a few not-so-great versions of your scenario. For example, in the scuba-diving example, imagine cloudy and windy weather. You might be cold, and the waves might make boat rides to the dive sight somewhat uncomfortable. In the skiing example, it is easy enough to imagine bitter cold, heavy snow conditions, or even rain. If you can imagine the scenario clearly, you can ask yourself why you are disappointed. As before, continue to delve into your values by asking why you do not like the scenario and why the uncovered values are important.

The vacation example is perfect for the imagination process described above. Based on the promotional literature, we can easily put ourselves into the vacation scene and reflect on how it feels to us in our imagination. But not all choice situations have options that are so easily imagined. What about choosing an automobile or a job? Both may involve commitments over several years, and it can be difficult or impossible to imagine all of the different dimensions of using a car or being on a job, in spite of all of the information that you can obtain before choosing. What can you do? In many cases you can talk with someone who has owned a similar car. Perhaps you can find someone who has worked for the same company or who has pursued the same kind of career. With a little encouragement, and under appropriate circumstances, your acquaintance can tell you in detail about his or her experience. In this situation, your friend is playing the same role as the promotional vacation literature; he or she is helping you to imagine yourself as the car owner or working for the company.

At this point, the process is the same as before. Put yourself in your friend's shoes. How do you feel about the dealings with the automobile salesperson or the service manager? Can you imagine having the positive or negative feelings? What do you think about the experience your friend has had with his or her boss? Again, you can delve into your value structure by asking why you like or dislike some aspect of the scenario, and whether you would react the same way that your friend did. It is possible to learn from others' experiences. Many of us enjoy putting ourselves in another person's shoes. We vicariously enjoy our friend's adventures through their stories and photos, and we empathize with them when they encounter difficulty and frustration in their jobs or their personal lives. It is a small step to reflect a bit more deeply in order to learn about our own values.

6.2. Learning About Facts. Learning about and understanding your values is crucial for making good decisions. In any given decision situation, though, it is also important to marshal the information you have about the uncertainties that you face. In the vacation example, you may need to know about the weather in Tahiti. What do you know? How can you find out more?

We rely on a variety of sources for the information we use in making decisions. Often we use information from various day-to-day media: television, radio, newspapers, computer networks, and so on. Often we search out information from books or magazines, or we ask friends. Occasionally we engage an expert. When you are ill, a visit to a doctor often is an attempt to gain information about both the cause of the illness and what is needed to get well. Travel agents can provide information about the myriad of uncertainties in an upcoming trip. Or a knowledgeable mechanic may be able to explain why a specific car is a good or bad risk.

The idea of using information from a variety of sources is certainly not new to you. We have three points to make, though, in this section. All three are important and deserve to become part of your decision-making tool kit.

6.2.1. Value of Information. The first point is that, apart from other considerations, information is only useful if it can make you change your mind and choose a different course of action. Consider the car-

purchase decision. Imagine being in a situation where, prior to purchasing a car, you are debating whether to take it to a mechanic for a his or her assessment. Will the assessment really help you make up your mind? What sort of thing could the mechanic say that would lead you to call off the deal? What diagnosis would make you positive that the purchase is a good deal? If you are convinced that there is nothing you could learn that would make you change your mind, then there is no reason to spend the money and the time for the assessment. On the other hand, if there are some possibilities that could lead you one way or the other (that wobbly steering could turn out to require an expensive repair, or the strange rattle could be just a minor annoyance) then the assessment may be worthwhile (as long as it is not too costly).

To decide whether information is worth pursuing, you need to know something about what kind of information you might get. In the car example, you need to know what kinds of diagnoses the mechanic might make. For a mechanical neophyte, this may be limited to statements such as, "This car will need repairs totalling at least \$850 very soon." A knowledgeable decision maker, though, may be able to understand detailed diagnoses about specific mechanical systems. And, of course, such a decision maker will be able to make good judgments about what kinds of problems may or may not show up. It should be no surprise, therefore, that the more knowledgeable consumer has less need for the expert information; the neophyte, even though less able to determine exactly what kind of information may come from the diagnosis, is the one who is likely to derive the most benefit from good and through expert information.

6.2.2. Identifying Information Sources. Our second point regarding information use is the importance of identifying information sources. It is important to get information from as many different sources as possible. More to the point, though, you want information from as many different *kinds* of sources as possible. Different experts have different opinions and ways of looking at the world. Your brother-in-law can tell you first-hand about his experience with his year-old car, and *Consumer Reports* can give you an completely different overview based on surveys of many owners. On one hand, you will get deep and detailed information from your brother-in-law, and on the other hand you will get less detailed information based on many more individuals from the magazine.

A myriad of information sources exist in our world today, and the number is growing. One of the most difficult chores we will have as time goes by is keeping up with all of the information sources that we can access. Imagine the plight of a member of congress who must constantly tap into news media, political consultants, and scientists. At the same time, experts from special interests groups push information that presents their causes in the most favorable light. This growing forest of information leads to our third point: the importance of carefully considering the quality of available information.

6.2.3. Quality of Information. In the car example, information from both your brother-in-law and *Consumer Reports* is useful. At the same time, the quality of the information from these sources must be considered. First consider your brother-in-law. He will have dealt with a small sample of cars (one), but he can give you detailed information on his experiences. His report also will be influenced strongly by both his values (he will not talk much about things not important to him) and the specific problems or advantages that he found. The *Consumer Reports* article is based on a much larger sample. Still, *Consumer Reports* will be concerned with issues that the writer and editor think are important, and these may not be the same issues that are critical to you.

Understanding quality of information is important for navigating through the vast array of information available to us. To make good decisions, we need to ask whether an information source is giving us information that is accurate, up-to-date, and based on solid evidence. Or is the information speculative or no longer current? How much and what kind of evidence forms the basis of someone's claim?

To see the problem in an abstract example, imagine that three people are offering to flip a coin, and each one says that the chance of getting heads is one-half. The first person bases his claim of one-half on the grounds that he flipped the coin ten times, and five times it came up heads. The second person, though, flipped the coin ten thousand times, and it came up heads five thousand times. The third person never flipped the coin but instead made a careful physical examination of it and found no evidence that it is

unbalanced. Which of these three people has the strongest case that the chances of getting heads is one-half?

The coin-flipping example may seem abstract, but we encounter similar situations every day. Based on their studies, two scientists may make contrary claims. Which one has the strongest case? Often claims are passed off as “scientific,” but the information is based on poor research methods and inconclusive results. As active decision makers, one of the problems we face is evaluating the quality of the information we obtain in order to make the best use of everything we know. The “best use” of our information may include ignoring poor information in favor of better information, or at least giving a greater weight to the information that we think to be based on stronger evidence.

7. CREATING ALTERNATIVES

7.1. Creativity, Decision Making, and Values. When we talk about good decision making, we typically refer to the process of thinking through the issues you face, including both values and facts. If you do a good job of understanding and structuring your values, and then if you do a good job of marshalling the information you have to evaluate your alternatives, you have been true to our paradigm; you have made a good decision. What you would really like, of course, is not so much a good decision, but a good outcome and consequence! Unfortunately, the consequences you can obtain are constrained by the alternatives you have. Sometimes the choices you have generally lead to undesirable consequences. This is when decision making is difficult and frustrating, when you have to choose “the lesser of two evils.”

What can be done? The simple answer is to find better alternatives. While this sounds flippant, many creativity-enhancing techniques exist that can help to discover new alternatives and improve existing ones. Many other authors have written on this topic, and we will review a few of the more important techniques. In particular, though, we want to show you how a thorough understanding of your values can form the basis of your creative search.

We start from the premise that finding good options — choices that can lead to consequences you would like — is much easier if you know what you like. After carefully structuring your values and thinking about relative importance of different objectives, you can begin to think about how to accomplish those objectives. Most of the techniques we present here are common sense. At the end of the chapter we will talk about some of the “standard” creativity techniques and how they can be enhanced by using your values, and we also discuss briefly the important problem of screening a large number of alternatives that may have been generated with these techniques.

7.2. Value-Based Creativity Techniques. We begin with two techniques for creating new alternatives based on your values. First, consider all of your different objectives. Include both means objectives and fundamental objectives in this list. Go through the list, and for each objective try to come up with at least one alternative that will do the best job possible in accomplishing that particular goal. In doing this, you should try to ignore all of the other objectives. If in choosing a vacation you have objectives of 1) relaxing in the sun but also 2) visiting Aunt Martha in Minnesota, you have to think about ways to relax in the sun without worrying about Aunt Martha! Of course, Aunt Martha gets her turn; on the next objective, you have to think about ways to visit with her without thinking about relaxing in the sun.

Once you have worked through your list of objectives one at a time, go through looking at the objectives two at a time. Can you come up with alternatives that do a good job of serving two objectives? This step starts you thinking about the tradeoffs you may have to make, but it may also help you think about ways to modify your one-dimensional alternatives in ways that improve their performance on another objective.

After working through your objectives two-at-a-time, you are ready to look at all of the alternatives you have created. They should be interesting, and each one of them will have some shortcomings in terms of objectives not considered. Now, though, try to find ways to modify the alternatives to address as many of your objectives as possible. Do you want to relax in the sun *and* visit Aunt Martha? Perhaps you can buy a ticket for Aunt Martha to fly to San Diego or Hawaii and join you on your vacation. Or perhaps you can visit her in Minnesota during the summer and make a special effort to find ways to play tennis or enjoy the outdoors while you are there. Or perhaps you need to look beyond your objective of relaxing in the sun; are you really looking for things to do outside during the winter to relieve your “cabin fever” in March? Perhaps you can visit Aunt Martha in Minnesota for a few days and then spend some time at a cross-country ski resort.

One of the problems we often have is that we look at our list of objectives and see clearly that they conflict. This puts us in a mind-set that is not conducive to creativity; instead we tend to constrain our thinking to search for alternatives that serve only one or maybe two objectives that appear to conflict. Suppose you are a teenager looking for a summer job. You would like to have fun with your friends, earn a lot of money, see new places, and relax. The standard set of alternatives (a job in a retail store, working for a construction

company, or even no job at all) all pale when it comes to accomplishing all of these objectives at once. Moreover, you might be tempted to think that relaxing is inconsistent with making a lot of money.

Here is a way to use your values to find new alternatives. Begin by imagining the best possible consequence. In the case of the summer job, you would be able to spend a lot of time with your friends, earn plenty of money, relax, and travel. Imagine that outcome, and think about ways that such an outcome might happen. Perhaps you can persuade a friend of yours to apply with you to work at a tourist resort. You and your friend may be able to help a family move across the country by driving their car, helping to load and unload their belongings, and running errands at the beginning and end of the trip. You may be able to combine two jobs, working both at the same time or perhaps working at one for a while and then changing to another. You can see the strategy; try explicitly to relax the constraint that only one or a few objectives can be satisfied.

The above two techniques are examples of how you can use your values to generate new alternatives. You can also use your values to improve alternatives. Suppose you have looked carefully at a few alternatives. Before committing to one, you can think about how it fares in terms of accomplishing your objectives. Are there ways to modify it to improve its performance on some objectives? You may also be able to combine two decisions into one package to gain flexibility in the available alternatives. For example, you may be able to combine two trips, one business-related and one to visit friends, into a single trip that is not much longer and not much more expensive. Perhaps an alternative can be improved if a constraint can be relaxed. In considering different colleges, a high-school student might feel constrained to apply only to state-supported schools because of expensive tuition. However, perhaps this constraint can be relaxed by considering possibilities like financial aid, student loans, and work-study programs at private institutions. Doing so permits the student to investigate a much broader range of alternatives.

7.3. Values and Standard Creativity Techniques. One of the best known creativity techniques is “brainstorming.” Brainstorming works best when done with a small group of people who follow four simple rules:

- No evaluation of any kind is permitted.
- All participants should try to think of the wildest ideas possible.
- The group should try to come up with as many different ideas as possible.
- Participants should try to build on each other’s ideas as much as possible.

Many people have used brainstorming successfully to generate a lot of good ideas quickly. We can enhance this technique even more, though, by incorporating values into the system. First, how about having a brainstorming session to come up with the values themselves? After listing many candidate values, the group can clean up the list, separating means and fundamental objectives, and create a value tree. Once the value tree is created, each objective can be the basis of a mini-brainstorming session. How many ways, for example, could you take a vacation and satisfy your objective of relaxing in the sun?

Another favorite creativity technique is the notion of using an idea checklist. Idea checklists often ask how an existing alternative can be modified — made smaller, larger, broader, different color, rearranged, and so forth. A well articulated list of values forms the perfect list, though, for transforming alternatives. Suppose your decision context is deciding what courses to take in school. If you have a list of objectives that you want to accomplish, such as learning something useful for getting a job, taking a course with a friend, or taking a prerequisite for a particular advanced course, organizing these objectives into a list and then asking how an alternative can meet these objectives is a useful way to create and improve the alternatives you have.

Many other creativity-enhancing techniques exist. We have only discussed two of them here and shown how they can be used in conjunction with knowledge about your values. Using your values with other techniques is mostly a matter of common sense; let your knowledge of what is important to you guide your search for new alternatives, regardless of the specific technique you use.

7.4. Screening Alternatives. Having created a large number of alternatives with your newly developed creative ability, how can you make sense of them? In this section we look at two ways to separate the wheat

from the chaff. The first requires the notion of dominance. One alternative dominates another if it performs at least as well in terms of all of your objectives, and is definitely better on at least one. In other words, if you were thinking about choosing a dominated alternative, you could instead pick another one that dominates the first, and you would be better off. We often use dominance implicitly when we shop. Are two stores selling the same item for different prices? As long as there are no other implicit costs (such as driving much farther to one of the stores or getting poorer service), then you purchase the item from the store that has the best price. You get exactly the same product, plus you have money left over.

Dominance is an easy principle to apply, especially if you have only a few objectives that you are trying to satisfy. First, you have to evaluate each of your alternatives very carefully in terms of all of your objectives. Then, a careful pairwise comparison of the alternatives will reveal which ones are dominated and can be dropped from consideration. This is not terribly difficult. Start with an alternative (call it A), and compare it with other alternatives one at a time. If at any point another alternative dominates it, discard alternative A and start over with the next alternative. Go through the comparisons systematically until you have dealt with each alternative, concluding that it is either dominated or not. You are left with a set that is not dominated.

A word of caution, though; do not throw away your notes about the alternatives you have screened out. It is entirely possible that, as you work farther through your decision, you will rethink your objectives. If your value tree changes much, you may want to revisit some alternatives that you eliminated previously.

Another possibility for screening alternatives is to set up some criteria or hurdles that each alternative must achieve. These criteria should be tied to your objectives. For example, you might have a budget constraint for the car you are choosing. If you are considering different names for a child, you might exclude any name that is longer than three syllables. Again, though, you will want to keep your notes about any alternative that you exclude on the basis of these criteria or constraints; you may find later that the constraints can be relaxed to make more alternatives possible. Another possibility is that you reconsider the objectives that were the basis of the criteria; some of the previously excluded alternatives could be perfectly acceptable in terms of your reformulated criteria.

7.5. Creativity and Decision Making. We often fall into the trap of thinking that decision making is essentially an analytical process. Faced with a decision situation, the task is to think through the options you have and carefully choose the one that does the best job of meeting your objectives. This view, though, is incomplete and denies the creative nature of decision making. An active decision maker will search for decision opportunities and try to create them whenever possible. In the process of working through these decision opportunities, an active decision maker will constantly search for new and better alternatives. This approach to decision making is highly creative; in fact, it is this creative aspect of decision making that makes decision making fun and leads to better lives for everyone involved.

Learning to embrace the creative aspect of decision making is also the most difficult part of decision making because it requires real changes in the way most of us behave in our lives. Everyone can learn the basics of how to think about values, uncertainty, and alternatives. Adopting an active and creative approach to decision making, though, requires a new approach to life and a new mindset. A creative and active decision maker must believe that decision opportunities and good alternatives exist, and that the decision maker's job is to discover them! Such an approach comes only with practice, diligence, and introspection; the good news is that the learning process is both fun and rewarding.

8. MAKING VALUE TRADEOFFS

Tradeoffs are a key to good decision making. In fact, most of the time when people talk about decisions they're referring to tradeoffs: decisions imply choices, and the reason why choices are tough is because they imply tradeoffs. In this sense, a tradeoff means that if we do, or have, one thing we cannot do (or have) something else. This is such a basic lesson that most of us take it for granted: we've all had the experience of hearing parents instruct their young children in the necessity of choosing between two desirable objects, and we can all recount times in our own lives when we have been faced with difficult choices between competing alternatives.

The problem is that few people have received any help in learning about methods for making tradeoffs. It is as if either there are no such techniques, which isn't true, or we all have learned them through some automatic process, which also isn't true. So we are left with homilies--look before you leap, think through things carefully, weigh the pros and cons--without really knowing what these terms mean (i.e., what is careful thinking?; how can pluses and minuses be weighed?) or how appropriate decision methods can be learned so as to assist us in making tough tradeoffs successfully.

As a result, decisions become something negative: we talk about "decisions we *have* to make" or about decisions being "problems," as if the decision were something terrible that we just want to get over and done with. Yet would we really prefer *not* to have a choice and instead to just have one thing we could do, or have, or buy? For many people, the surprising answer is yes. Why? Because the act of making tradeoffs--identifying the pros and cons of the various alternatives and then integrating across them to select a preferred option--produces only anxiety and worry: What if I make the wrong choice? What if I decide tomorrow that I should have done something different today? What if I omit something important?

In this chapter we provide an introduction to a general approach for making tradeoffs and to some specific tools and techniques. The approach we suggest builds on the earlier discussions in this book, such as defining values and consequences, facing uncertainty, and making use of information. Its purpose is, first, to help you--the decision maker--address the choices and tough tradeoffs that inevitably will come your way and, secondly, to encourage you to look on tradeoffs in a more friendly way: less as an enemy that some evil outside force has sent to you and more as an opportunity for using what you know of your values to select options that fit well with who you are.

8.1. Why tradeoffs are necessary. Why do we need to make tradeoffs at all? The simple answer is: because choices are a basic part of living. Many of the tradeoffs that we face in our lives are not even noticed because they are addressed successfully out of habit: Which foot should touch the ground first when we get out of bed? Which sock should we put on first? Which glass should we choose for our orange juice? Habit serves us well in such cases, because the differences in outcomes are not significant (one glass is much like any other) and because the tradeoffs among alternatives are negligible ("let's see: if I put on this sock first I will need to reach an extra 2.5 inches, which is a minus, but I'll be able to balance on my right foot, which is a plus, although ..."). Someone who considered all the tradeoffs all the time would be frozen into inaction, unable to do anything because they were overloaded with information about all the tradeoffs facing them.

In other cases, however, tradeoffs suddenly loom large. Because we haven't gained experience in dealing with the easy tradeoffs, we may find ourselves quite unprepared to face the more difficult ones. Take the case of buying a house. It's a consequential decision, for many reasons: different houses have different amenities; there are clear financial implications of the investment; it affects our choice of neighbors and friends; it influences commuting time to work and, thus, both our leisure time and health risks; and so forth. Typically, buyers look at many houses and end up, after some searching, facing a choice among several different alternatives. As long as the different houses are not identical, then the choice among them requires that tradeoffs be faced: House A is desirable because it's inexpensive, but it has a small kitchen and the roof may need replacing next year; House B is desirable because it has a big yard with an apple tree, but it's a long way from schools for the kids.

Buying a house is not the same as selecting socks, because we have no models to build on (for most of us, we're not "in the habit" of buying houses!) and because we're likely to care far more about the consequences of our decision. So what do we do? We can ask for help from the real-estate agent but they may not be a good judge of what we want and, besides, they may have agendas of their own (e.g., their commissions usually are related to the selling price of a house). We can go with our gut instincts, but that may provide little solace if we don't know what our intuition is telling us to do.

The case of buying a house is similar to other consequential choices we make--choosing a friend or spouse, taking a vacation, buying a stereo or an automobile--in that tradeoffs need to be faced: they are necessary elements of the decision. To the extent that friends and vacations and houses are normal parts of life, so too are the tradeoffs that accompany these decisions .

8.2. Why tradeoffs are hard. What is it that makes a tradeoff like these hard? There are at least four elements that underlie many of the tradeoffs that we need to make and that account for much of the anguish and difficulty we face in making tradeoffs well.

The first element is that *each of these alternatives has many dimensions*. A house is not just a collection of rooms; it is also a neighborhood, a part of town, and a greater or lesser distance from shops. A successful decision needs to account for, or integrate across, all these different dimensions. In practical terms, this means that you need to be able to come up with a logic that allows you to explain (to yourself as well as to others) why some dimensions of a decision are more important to you than others. Thus, a successful tradeoff process allows you to justify your action by referring to the different dimensions of the decision and by acknowledging how you were able to make a comparison across them. In the house decision, for example, you might hear someone say something like "We bought this house because it had a big kitchen and great views, even though the bedrooms were small" which implies that, for this particular decision context, the dimensions of "good views" and "big kitchen" together counted for more than the dimension of "bedroom size."

The second reason why tradeoffs are hard is that *we think about their dimensions in different terms*. The investment part of a house-purchase decision is thought of in dollar terms; the access side is measured in terms of distance (e.g., miles) travelled; views may be measured in terms of beauty or prestige. As a result, making a tradeoff by integrating across the different dimensions of a decision means that we somehow need to balance beauty against dollars, or time against prestige. Although tools exist for helping us, comparing the dimensions of a choice can be a very difficult task and--as we will address later in this chapter--requires us to think carefully about how we define the key elements of decisions that we face.

The third element is that *there are several alternatives*; in the example above, there is more than one house that we could buy. Alternatives make for choices, and choices make for tradeoffs. What if there are not alternatives: Is this good news? In general, no; you may recall earlier sections of this book that stressed the importance of using knowledge about your values to actively create alternatives. Or recall classroom discussions about the problems of communist nations during the 1970s and 1980s; a key criticism was always the lack of choices in stores for consumers and the absence of career options for young adults. In many ways, despite the headaches that may result, choices are embraced as a sign of a successful society or person: we like big stores because they ensure purchase choices, we go to college to ensure that we have career choices, and so forth.

The final, fourth element is that *we usually have access to less than complete information* about the alternatives. Our values tell us what we want information about but we may not be able to get high-quality information about all the things that matter (e.g., the roof will need fixing, but in two years or five?). To the extent we don't know all that we want to, we are forced to make tradeoffs in the presence of uncertainty. Sometimes we can gain access to additional information right away, by asking someone or by involving experts in the process; several examples were presented in Chapter 4. Other times we just need to wait and see, in which case we may end up feeling that we made a bad decision because things didn't work out as well as we expected (the great used car, set to go another 50,000 miles, blew its engine after 2 weeks; the so-so roof, probably good for another 5 years, starting leaking during the first heavy rain). But decisions

are made at one point in time, and so long as we have faced the uncertainty explicitly we need to realize that we can't control future outcomes (there is a good reason why hindsight, rather than foresight, is golden!).

8.3. Types of tradeoffs. There are many different types of tradeoffs: one could almost say that there are as many tradeoffs as there are decision situations, because the way in which we think about something changes as does the context for making tradeoffs. Consider an apartment that we're thinking about buying. We might value owning the apartment because it gives us a secure place to live (which we may compare to renting an apartment, or purchasing a house). Perhaps we value owning the apartment as an investment (and so we may compare its expected increase in value over time to that of a stock option, or buying artwork). Or we might value the apartment because its address conveys an image of prestige (in which case we might compare it to buying an expensive car, or spending money on jewelry). The point is that the apartment is not just one thing to us: the reason(s) why it is important varies as the situation changes.

Nevertheless, it is helpful to look across some of the different, common types of tradeoffs that we make in order to begin to feel more comfortable in working with the four key elements that make for successful tradeoffs: identifying the dimensions, defining them clearly, creating alternatives, and dealing with uncertainty.

Individual vs. group perspectives provide a common type of tradeoff. The individual perspective is quite straightforward, although knowing what we want is not always easy. One reason for this is that most of us also wear many other hats, besides the one that defines us as an individual, to signify those aspects of ourselves that belong to work, family, peer groups, or various organizations. Thus, what I want for myself may be different than what I want as a father or daughter; what I like the best may be different from what I think my friends or colleagues might prefer. This means that my values reflect tradeoffs between my different roles, and as the situation changes so might the importance given to these various roles.

Personal vs. societal perspectives also affect how we wish to make tradeoffs and to define alternatives. A societal perspective brings in notions such as altruism and caring for future generations that are very important to many people in the context of certain choices. This difference in perspectives may arise when a person makes a purchase decision between two products, one of which is cheaper (and thus preferred for economic reasons) and another whose use is better for the environment. From a strictly personal perspective, the cheaper item is preferred; from a societal perspective, the same person realizes his or her responsibility to consider the ecological implications of the choice. The importance of societal concerns is thus one of the factors that conditions value structures and suggests that, for many people, answers to the basic question "What is important to you" will go beyond purely hedonistic concerns.

Intuitive vs. rational perspectives is another common type of tradeoff. For some people more than others, the intuitive side of judgments is crucial: individuals have feelings or beliefs about tradeoffs and decisions that are very significant but difficult for them to put into a logical framework of analysis. Sometimes these intuitions can usefully be traced to prior events or information and, though this process, further defined in a way that links the rational and intuitive experiences. At other times, or for other people, it may not make sense to attempt this linkage. In such cases, the bottom line may be to help the person understand that their intuitions either complement, or contradict, a more rational analysis, which may then help them to accept the eventual outcome of their decision.

Time also affects how we make tradeoffs: a short-term view may suggest one action whereas a long-term view brings in other concerns and suggests that an alternative may be preferred. For example, a short-term perspective could emphasize pleasure and suggest that a second dessert is a great idea; a longer-term perspective may emphasize health considerations and serve to remind me that one piece of banana-cream pie is enough. Social decision-makers face this type of tradeoff all the time, and politicians frequently are judged on the basis of whether promises made at the time of election, when the short-term consideration of attracting voters is paramount, are realized as part of the longer-term, post-election reality.

8.4. Methods for addressing tradeoffs. Making tradeoffs is a central problem in multiple-objective decision making: How can we trade off increased value on one concern for lower value on another concern? Thankfully, there are many tools to help us make such tradeoffs in everyday decisions. We'll first discuss two methods for distinguishing between dimensions on the basis of their importance. At the end of the section, we'll briefly discuss some practical concerns.

Method 1: Swing weights. In the simplest case, we may have only a small set of concerns that matter to us and a straightforward choice. An example is selecting a meal in a cafeteria line, where the operative concerns might be price and taste and the choices may be a sandwich or the lunch special: the sandwich is \$1.25 cheaper but the lunch special will taste better. The relevant tradeoff is therefore between money and pleasure: Is it worth paying extra money to get the lunch special? Assume that you have enough money for either alternative in your pocket and that you are not in a position to suggest new alternatives (e.g., using the lunch special to make a different type of sandwich). Let's also leave out uncertainty, by assuming that you know this cafeteria and the food well. Your task is therefore to decide on the relative importance of the two concerns, taste and price.

Suppose you care a great deal about taste and very little about the additional expenditure. In more formal terms, you could think about having 100 importance points to give to the two concerns. Your particular values may translate into an "importance weight" of 90 (or 90% of your importance points) on taste and a matching weight of 10 (or 10% of the points) on cost. If your subjective evaluation of the expected difference in taste is large and the price difference isn't too large, you probably will select the lunch special. Note that this last issue – how large is the taste or price difference – brings into play the concept of a range or scale for each of the concerns, which we'll return to below.

All of us make tradeoffs like this all the time, and we obviously need not conduct formal analyses of all such choices. But the key questions needed for a robust approach to addressing tradeoffs are still here: deciding on the value dimensions, clarifying their definitions, coming up with appropriate measures, and determining which dimensions are most important.

Suppose we look at these same elements in the more significant context of buying a new car. You've thought about your values and decided that there are three relevant concerns: minimizing the financial implications (you don't want to spend too much money), minimizing anxiety (you don't want to be always worrying about the car), and minimizing damage to the environment. How well any car achieves these objectives can be measured by looking at the car's price, expected life span, and fuel economy. These are the three measures we'll use.

For the cars from which you will choose, there is a worst conceivable outcome on each of these characteristics and a best conceivable outcome. Let's take price as an example. Price is measured in dollars. Based on your reading and visits to several dealers, you know that you will have to spend at least \$12,000 to get the kind of car that you are looking for, but you have a firm upper limit of \$18,000. (Of course, other cars might cost less than \$12,000 or more than \$18,000, but you've already determined they are not relevant to your particular choice.) Therefore, for the dimension Price, the worst and best outcomes are:

	Price	
\$18,000		\$12,000
worst outcome		best outcome

Next, let's take Expected Life Span, measured in years. Suppose in our example that the worst conceivable outcome is buying a car that is expected to last only six years and the best outcome is buying a car expected to last ten years:

	Expected Life Span	
6 years		10 years
worst outcome		best outcome

The third dimension of the choice is Fuel Economy, measured in miles per gallon. Suppose that the worst conceivable outcome, given the relevant set of cars under consideration, is 20 highway miles per gallon (mpg) and the best conceivable outcome is 32 highway mpg:

	Fuel Economy	
20 mpg		32 mpg
worst outcome		best outcome

We now have definitions and ranges, measured from worst to best, for each of the three characteristics of a new car that matter most to us. Other characteristics, such as color or warranty length, may also be important considerations in the choice of a car. However, we're assuming that on all these other dimensions the differences between the cars from which you are choosing are so small as to be unimportant. This does not mean that these other characteristics don't matter to you, but only that—in the context of this choice—they are unlikely to vary sufficiently that you will have to make explicit tradeoffs about them.

We're now ready to think about the importance of each dimension. There are several different ways to treat this problem; here we'll be using a method, formally known as "swing weighting," that mirrors a common-sense approach to setting priorities. Imagine a hypothetical car that is the worst it can be on all three of the dimensions. In other words, its price is \$18,000, its expected life span is 6 years, and its fuel economy is 20 mpg. Now suppose that you get an opportunity to change one (and only one) of these dimensions from worst to best. This means that you can change only one of the following:

- Price, from \$18,000 (worst) to \$12,000 (best)
- Expected Life Span, from 6 years (worst) to 10 years (best)
- Fuel Economy, from 20 mpg (worst) to 32 mpg (best).

Which one would you want to change? Suppose you say Price. That means that you value a \$6,000 drop in price (a change from \$18,000 to \$12,000) more than you do either an increase of four years of expected life span or an increase of 12 mpg in fuel economy. This dimension—the one that you most want to change from worst to best—is the one you weight most highly in the context of this problem. Assign it a score of 100 value points.

Now, which dimension do you value second? Let's say it's Expected Life Span. Ask yourself: How much less do I value the four-year change in life span compared to the \$6,000 drop in price? Suppose that you value it one-half as much. Then you would assign it only 50 points, or half the weight you gave the most important dimension.

This leaves only one characteristic, Fuel Economy. Because you ranked this dimension below Expected Life Span, you know you should give it the smallest number of points. For example, if you value it two-thirds as much as Expected Life Span, then give it 33 points. Note that this also means you're saying that Fuel Economy, with its 33 points, is only one-third as important to you for this decision as Price.

Believe it or not, you have done everything you need to do in order to evaluate any set of cars. Here's how it works: Saying that the range for Price is twice as important as the full range for Expected Life Span is equivalent to saying that one-half of the price range (\$3000) is worth the same as the full range of life span (4 years) which means that one year is worth $\$3000 \div 4 = \750 . Similarly, one-third of the price range ($\$6000 \div 3 = \2000) is worth the same as the full range of fuel economy (12 mpg), which means that 1 mpg is worth $\$2000 \div 12 = \166.67 .

How can you use this information? Suppose you have two cars to choose from:

- Car A:** Price \$15,000, Expected Life 8 years, Fuel Economy 26 mpg
Car B: Price \$16,000, Expected Life 9 years, Fuel Economy 29 mpg

Car B costs \$1000 more, but do the extra benefits – an extra year of life span and another 3 mpg – offset the extra money you would pay? Let's see: The additional year of life span is worth \$750. The 3 mpg are

worth $\$166.67 \times 3 = \500 . Adding them together, we get a total increase in value of \$1250. So the answer is that it is definitely worthwhile to pay the extra \$1000 for Car B, because you are getting additional benefits that you value more than \$1000.

You can perform these comparisons for any set of cars. Just go through them, comparing two at a time, until you have found the one that comes out on top! (What would you do if you found two or more that tie for first place?)

Method 2: Pricing out. Another way to make the tradeoffs across these three dimensions is to directly assess the value on one dimension in terms of another. This method is commonly known as “pricing out,” because one dimension is “priced” in the units of another. Typically we use money for specifying the price.

The good news is that there is no need to “price out” the dimension Price. This dimension is already valued in dollars, so no conversion is needed. But we will have to price out Expected Life Span and Fuel Economy in order to make meaningful comparisons between cars.

Let’s start by pricing out a year of Expected Life Span. Your task is to find an increase in price that you feel just offsets a gain of one year of Expected Life Span. For example, you might start by saying that an extra year is worth at least \$500, but not as much as \$900. Can you narrow the range? Would you pay \$600 for an extra year? Yes? OK, what about \$800? No? So the value of a year is less than \$800. After some back-and-forth, suppose you finally settle on \$750. You can see that you are making a direct assessment of this value, whereas we derived it above using the swing-weight approach.

Now do the same thing for Fuel Economy. Consider an increase of six mpg; what is that worth to you? After some give-and-take and hard thinking, suppose you conclude that gaining 6 mpg in Fuel Economy is worth \$1000. Thus, we have again that one mpg is worth $\$1000 \div 6 = \166.67 . As before we can compare any two cars, and the procedure is just the same as we described above with Cars A and B.

Swing weights and pricing out are both straightforward tools for assessing tradeoffs. In addition, you can use these the two methods together to check yourself. For example, you might spend some time one day pricing out the important measures in a decision you have to make. A day or two later, assess swing weights and use those weights to calculate the relative prices. Do you get the same answers that you got from pricing out? If so (or even if they are pretty close), that’s great. If not, consider revisiting one or both methods. Think hard about the point values you assigned in the swing-weighting procedure, or the prices you assessed when pricing out. With some time and reflection, you ought to be able to reconcile your answers so that they give the same relative values, and doing so should give you confidence that your answers really do reflect your personal tradeoffs.

Many common examples are substantially more complex than selecting a car, because the choices involve more dimensions or because some of the dimensions are more difficult to define. However, the approach to thinking about tradeoffs is much the same whether you are sitting in the sports store wondering which skis to buy, or sitting in the White House wondering which space program to approve. In both cases, the clearer you can be about the dimensions of your choice, their relative importance, and their measures (including ranges), the better job you can do making decisions that satisfy your basic objectives.

8.5. Risk and return. There is one other issue that often comes up in the context of making tradeoffs. This is the issue of risk attitudes and how differences in people’s feelings about risk affects their willingness to make a variety of tradeoffs.

Individuals who are sensitive to risk, in the sense of avoiding risks when they can, are said to be risk-averse. In contrast, risk seekers tend to exhibit exactly the opposite behavior, such as freely entering into gambles where their expected earnings over time are less than their payments. (This is the secret of any lottery; state lotteries are usually set up so that you win back on average only about half of what you pay.) Risk-neutral individuals tend to make choices as if risk doesn’t matter. In their choices, they appear to ignore any risks associated with the alternatives they face.

Extremely risk-averse individuals tend to be frightened by risk and therefore exhibit cautious behaviors when making tradeoffs. For example, a risk-averse individual would be willing to forgo the possibility of making a large financial return in favor of a safer, albeit far less lucrative, investment. The same psychological state would carry over to other types of tradeoffs, for example in personal relationships or in assessing probabilistic consequences of actions (remember the initial decision-tree example of whether to carry an umbrella in case it rains? You can guess at what the extremely risk-averse person would do!). Risk-seeking persons, on the other hand, might find that the uncertainty inherent in a risky decision would be a source of excitement or exhilaration.

The usual recommendation is that social decision makers, when facing tradeoffs among competing alternatives, should always act as if they were risk-neutral (although in their personal lives they may be risk-averse or risk-seeking). This is because only risk neutrality will ensure that money is used as efficiently as possible and that with respect to other important considerations, such as health care or environmental protection, the savings (e.g., of lives or of species) per dollar spent will be maximized. Large corporations, when making tradeoffs among options that involve amounts that are small relative to their total assets, typically also adopt a risk-neutral position.

9. NEGOTIATIONS

Negotiations are often thought of as an occasion for compromise, following the rule that both parties need to give up something in order to reach an agreement. We disagree. Negotiations do not always have to involve compromise, sacrifice, or the frustration that accompanies giving up something you really want. Instead, negotiations are an occasion to engage in joint decision making and shared problem solving. A negotiation setting can provide an opportunity to realize more of what you want and (if we're speaking about a two-party negotiation) for the other party to also get more of what they want.

The key to discovering a mutually-acceptable agreement is to create an alternative that satisfies shared values and exploits the differences in other values. Consider an everyday meal-time negotiation between two young brothers, David and Henry. Both like bread, although David prefers the softer inside part and Henry prefers the crust. If David can give Henry his crusts and, in return, receive the inside parts of Henry's bread, both win (and the parents' goal, that both children eat their food, also is met). The basic concept is transparent. If options can be found that provide David with more of something that is very valuable to him at a low cost to Henry (because Henry is giving up something that, for him, is of limited value), and if Henry can in turn be compensated with more of something that he considers to be valuable (but that David considers to be relatively unimportant), then the basis is set for a mutually-agreeable trade that leaves both parties better off and satisfied that they "got the best of the deal."

Although it may seem like a long way from the kitchen table and a loaf of bread to the world of international negotiations on issues of climate change or debt management, the keys to negotiation success are similar. It helps to think about negotiations broadly as efforts to reach agreement between two or more parties who share some interests but not others. This definition makes the concept of negotiations compatible with interactions ranging from the locker room, car pool, or cafeteria to the executive boardroom or multinational agency. As illustrated by the example of the two young brothers, negotiations are not an abstract concept but a practical and familiar activity: each of us engages in negotiations--with more or less success--all the time.

We follow the lead of Roger Fisher, William Ury, and Bruce Patton, authors of the best-selling book *Getting to Yes* (2nd Edition, Penguin 1991), in identifying three insights as particularly significant to negotiator success:

1. *Separate the issues from the participants* by paying attention to underlying values or concerns rather than to personalities.
2. *Generate a wide range of options* by using your values to enhance creativity and avoid placing unnecessary limits on the domain of possible alternatives.
3. *Develop objective criteria* for evaluating alternatives by setting agreed-upon principles that can form the basis for identifying options that benefit all participants..

9.1. Identifying values in negotiations. We engage in a negotiation because there is something we want. This may be something we want for ourselves — a shirt, a bicycle, a house — or it may be something we want for others — playground equipment for a school, medicine for a developing country. Our values tell us what we want; if we don't care about something, then getting more of it provides no benefit.

In many ways, the typical concept of negotiations is one of adversaries fighting over a fixed amount of something. Imagine hungry people, each wanting the biggest slice of a pie. In such a case, there must be a winner and a loser because one party's gains inevitably result in less for the other. A starting point for a successful negotiation is to enlarge the set of issues so that there is something for each side to win and so that gains by one side do not necessarily imply losses to the other — in other words, enlarging the "pie" that the parties share. This shift in perceptions is not always possible, as demonstrated by the territorial wars that still are being waged with unfortunate frequency. Yet even here, the two sides rarely want only one thing: land may be the ostensible reason for the disagreement, but other values such as political power, control over resources, international goodwill, or honoring past commitments often are also important. In such cases, the hope for an agreement rests on creating solutions that provide both sides with more of those things that matter to them; for example, one side may get more land but the other side may gain control over

strategic resources or increased political power. The key is to look to the underlying values of participants and find solutions that speak to these concerns.

How easy is this search for underlying values? Remember the discussions of Chapter 3; getting in touch with our underlying values can be quite difficult, and gaining a sense of the underlying values of other parties in a negotiation is usually even harder. However, several basic tools of decision making provide useful guides. And, at its root, the search to understand fundamental values as part of a negotiations process provides an interesting opportunity to get to know ourselves, and perhaps also others, a little better.

Take the case of an employer and her potential new employee, engaged in a negotiation about the salary that the employee will have if he decides to accept a job offer from the company. Ostensibly, the conversation is about money. So long as all talk stays rooted on money the situation is that of the fixed pie shown in Figure 9.1: gains by the employee (who cares about his after-tax income) can only come at the expense of the employer (who cares about the company's profits). But what else is at stake? Are there opportunities for enlarging the pie by understanding the mutual interests of the negotiating parties?

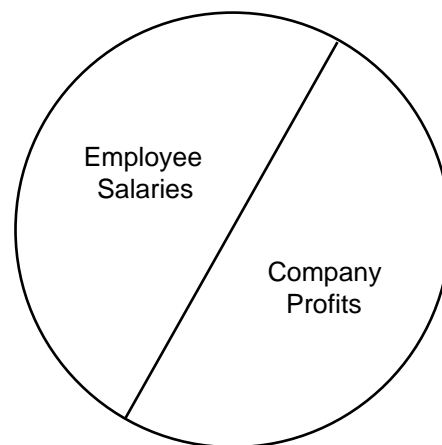


Figure 9.1. The fixed-pie contract negotiation

In the usual case, the answer (fortunately) is yes. The typical employee does care about salary but he also cares about the hours that he works, the view from his office, and how long his vacations will be. Other concerns, such as opportunities for advancement and whether a convenient parking space is available, might also be important. From the employer's standpoint, salary expenses matter but so does the employee's morale, the fairness of his salary relative to other workers, and how different offers affect the probability that he will join the company. Bringing in these other interests serves to enlarge the pie, as shown in Figure 9.2, while laying the groundwork for a successful negotiation.



Figure 9.2. The expanded-pie contract negotiation

In this case, for example, the employer may be willing to be flexible about schedules or to provide an extra week's vacation but she considers the salary to be fixed. The interviewee, on the other hand, might agree to soften his salary demands in return for a larger office or, perhaps, additional vacation times. Note that these issues are not necessarily, or even usually, the fundamental interests of the negotiating parties. The larger office, for example, may be important to the potential employee because he values prestige and believes that the clearest sign of success is to enter the company with a downtown view. Prestige, in turn, may be a means to self-esteem, which is a fundamental objective for this person. Or fairness on the part of the employer may be important because, if equity is violated, she expects the company will be sued by a disgruntled worker or by the union. Thus, fairness is a means to achieve compliance with the law, which in turn may be important because court battles are expensive and can eat away at company profits.

One of the most important aspects of such value clarification activities is to develop a clear sense of the nature of the problem. All too often in negotiations people struggle to develop solutions to what turns out to be the wrong problem. For example, we struggle to find ways to afford a trip to Hawaii when what we really want is 10 days free of stress. Or we may solve the short-term symptom but neglect the real long-term problem which, after all, is the cause of the symptoms. Asking the question "Why" can often help to shift attention from the mythical to the real problem. But problem definition is not an easy task. No less an intellect than Einstein has argued this same point, stating that "The formulation of a problem is often more essential than its solution... To raise new questions, new possibilities... requires creative imagination."

9.2. Searching for alternatives. A healthy dose of imagination also is essential to the search for negotiation alternatives. But imagination, however creative, needs to build on something. In successful negotiations a clear understanding of the relevant values of the involved parties drives the search for alternatives. Values tell us the underlying concerns and interests that need to be addressed; the best alternative is then the one that most fully responds to these interests.

The search for alternatives requires three distinct tasks:

1. Creating alternatives
2. Choosing among them, and
3. Improving the selected alternative.

Creating the alternatives is a natural starting point. In fact, many negotiations are doomed from the start because the alternatives fail to address important objectives of a key party in the dispute. It makes little sense to participate in a negotiation if the values that I hold most dear are nowhere reflected in the range of possible outcomes.

In many cases we do not even consider creating alternatives as a part of the negotiation process. Instead we accept the alternatives handed down to us by convention, habit, or the dictates of a superior. For example, a father argues with his adolescent son because the boy refuses to continue taking piano lessons. But the piano lessons themselves may not be so important: the father may instead care deeply about his son learning to play an instrument (which includes guitar as well as piano), to appreciate music (which includes listening as well as playing), or to develop a sense of discipline (which aikido or baseball may provide as well as music lessons). Recognizing these alternatives may change the nature of their negotiations. Similarly, a city may consider building a new highway as a way to solve its growing downtown traffic problems. Improving the bus system or building a light-rail transit network, though, may be feasible alternatives.

Often a key to coming up with creative alternatives is to encourage all sides in a negotiation to brainstorm without fear of commitment or being held to what is said. Instead, discussions should be set up as "what if" sessions, allowing an imaginative search for ideas. Surprisingly often, an idea that was at first considered to be outlandish or impossible due to presumed constraints of time, resources, or money turns out to be the kingpin of an eventual solution. The key step is to provide an environment in which creativity and ideas can flourish, without judgment or fear that what is said now may undermine the realization of interests in the future.

Expanding the pie, in the ways shown in Figure 2, often requires thinking outside the bounds of our typical patterns. In a sense, such creative thinking is at the heart of the negotiations process because it is usually the old patterns and ways of communicating that created the problem in the first place. But creativity may not come easily, if only because the basic way in which a problem is defined or framed can be so fundamental that it is almost invisible. For example, the manager who frames interviews with job candidates in terms of salary alone may feel fully justified in doing so because this is the way she was hired; it worked for her, so it should also work for others. All of us are subject to similar blind spots reflecting mental biases such as the manager's anchoring, which (unfortunately) encourages him to overlook important differences between a former decision setting and the one at hand. Another familiar mental bias has been termed "availability" by the psychologists Daniel Kahneman and Amos Tversky, who provide many examples of the ways in which our framing of current decision problems is affected by vivid (i.e., readily available) memories of previous solutions. Like other such mental rules of thumb, availability sometimes assists us in our judgments but at other times it can lead us to neglect more creative and helpful, but less easily available, negotiation strategies.

Choosing among alternatives requires the further step of evaluating options in terms of the relevant values. Chapter 5 provided one example (the summer-job decision) of the detailed calculations that can accompany a choice among alternatives, including a decision tree that provided illustrative assessments of the probability of different outcomes and calculations of the expected value associated with each (risky) option. The option with the highest EV, as in the example, is then preferred.

Although decision trees can prove to be a very useful tool for assisting choices among alternatives, important insights can arise simply from understanding the negotiation context. For example, there are always alternatives to reaching an agreement. Some of these will be nearly as good as the best possible outcome of the negotiation and some will be far worse. If the best of the alternatives — the Best Alternative to a Negotiated Agreement (BATNA) — is nearly as good as the hoped-for outcome of the negotiation, then reaching an agreement may not be terrifically important because you have a strong BATNA to fall back on.

The no-action alternative should also be remembered. Negotiations often involve a choice of actions and are framed as requiring the selection of either A or B. In many situations, however, the no-action alternative is to keep on with what is being done now; in other words, to choose neither A nor B but to stick with C. Sometimes C will be OK, sometimes intolerable; either way, your subjective evaluation of C provides a useful baseline against which the value of A, B, or any other alternative should be assessed.

At other times, it may be possible to realize both A and B. For example, if A involves mining an area and B involves preserving it, then the decision might be framed in terms of a choice between mining and preservation. However, if mining can be carefully controlled (e.g., take place only in one part of the region, or perhaps take place underground), and if preservation is expensive (thereby requiring a steady source of funding), then mining and preservation might best be combined into a single option.

As emphasized in Chapter 8, not all values are equally significant to the negotiator and, in selecting alternatives, it is helpful to choose options that are responsive to the most important values. This realization provides the basis of a useful strategy in negotiations, that of identifying some interests that are of very low concern so that, when it comes time for the final stages of a negotiation, you will have some things that can be traded away without substantial loss.

Finally, disagreements among parties in a negotiation are more often about differences in the weights given to specific objectives than they are about the identity of the objectives themselves. For example, in a dispute about the possible siting of an off-shore oil platform, we may not expect environmentalists and oil-company representatives to agree. But it is a mistake to think that their values are entirely incompatible. For example, even the most ardent environmentalist cares about jobs, and hardened oil-company employees still care about the marine environment. The difference, though, probably lies in their perspectives; the company may place more weight on economic concerns, whereas the environmentalists might emphasize the preservation of nature.

Improving alternatives is an important step in successful negotiations, because even after making a good choice there are usually many ways to improve an option. A natural place to start is by including useful aspects of some of the otherwise inferior alternatives. For example a design team may unanimously agree that a particular type of clothing is the best to include in next year's lineup. Yet specific features of some of the options that were not selected--an unusual color, or a novel choice of materials--may be included as ways to make the first choice even better. Or an option may be improved by incorporating the lessons of new learning over time; the nylon raincoat that was top-of-the-line in 1970 was replaced by the Gortex version in 1980, and that in turn will become outdated as the next miracle fabric is invented.

Finally, can the selected alternative be made even better? Particularly at the end of a long and difficult negotiation, there is a natural tendency to accept any option that is satisfactory for all parties. Yet even here — after one month of salary bargaining with the school board, or after one hour of arguing with your kids about chores — it is worthwhile to ask: Is this option really what I want? Does it help me achieve my objectives as much as possible? Can this option be improved in any way?

9.3. Criteria for negotiations. A successful negotiation is often thought to be one that ends in a mutually agreeable solution. Of course, consensus is great when you can get it. But consensus is not always possible, and it is important to realize that a negotiation can be successful even if it does not make all parties perfectly happy.

At a minimum, a negotiation can reveal new insights about differences among the parties. These insights can serve as the basis for discussions among the negotiating groups and foster an appreciation of their different points of view. Over time, closer collaboration among the groups may result from this understanding.

In those cases where consensus is reached, it can easily be oversold. In the rush to agree, parties in a negotiation may overlook concerns that in fact are quite important, with the result that constituents greet the

announcement with frustration or anger rather than joy. Unfortunately for such situations, it is usually much more difficult to step backwards and repair a broken agreement than it is to move forward toward a stronger agreement.

Negotiations occur in many different settings, and criteria for success may vary across those settings. The simplest negotiation is that of two people voluntarily attempting to agree on a single issue; this is the opening example of David and Henry arguing over a slice of bread. A somewhat more complicated situation occurs when two parties try to work out several issues at once. Still more complex negotiations might involve several groups attempting to reach an agreement on several issues; international negotiations at the United Nations, for example, frequently are of this type.

A related issue concerns the degree of control that rests in the hands of a third party involved in working things out. In simpler negotiation settings the two parties usually talk directly with each other. In more complex cases, or when there is a difficult or acrimonious history (e.g., divorce cases, Israel and Palestine), it may help to obtain professional assistance. This can range from a formal setting, such as that provided by a court, to help from an arbitrator (whose opinions can bind the disputing parties), mediator (who typically listens to both sides and then provides advice), or facilitator (who provides assistance in establishing and monitoring communication among the parties). These options are displayed in Figure 9.3.

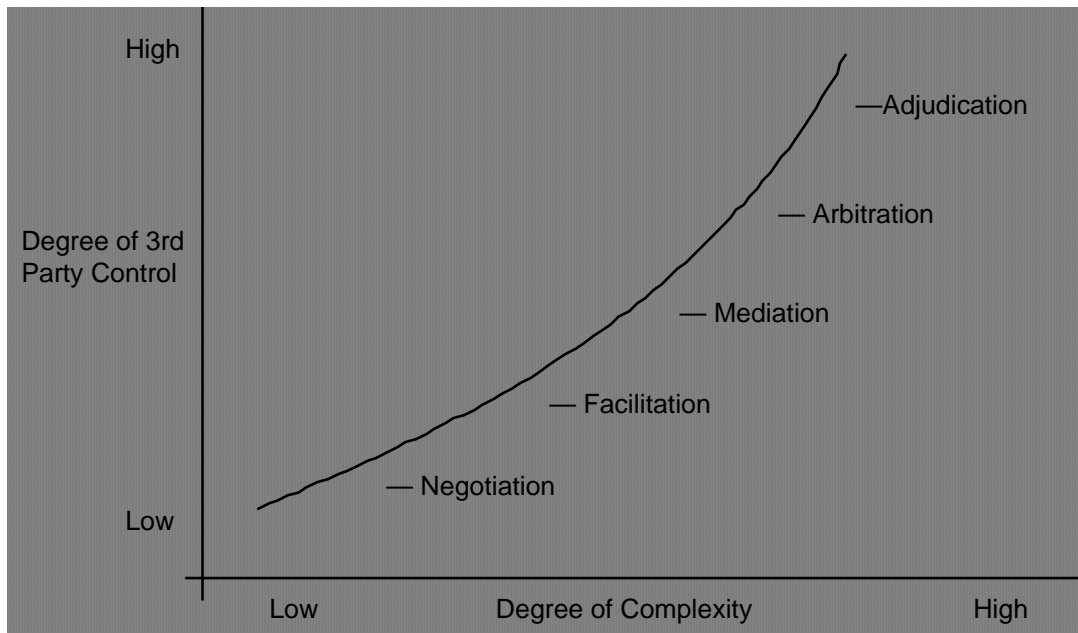


Figure 9.3. Alternative negotiation settings

Another important criterion for many negotiations is fairness, described in terms of both the procedures that are followed and the negotiated outcome. Were all interested parties given an opportunity to participate? Were their values used to help create the chosen alternative? Does that alternative find an appropriate balance among all of the parties?

Negotiations that are viewed by all stakeholders as fair are more likely to achieve two other criteria, efficiency and stability. Other things equal, it is certainly better to reach an agreement quickly and at a lower cost (less time, less money). And it is important to consider how a negotiated agreement's stability: Will the agreement endure? Are commitments appropriate and realistic? Can the assigned timetable be met?

Finally, it is helpful to build in some allowance for learning over time. As our interests change, or as we learn more about our values, a negotiated settlement once appeared terrific may begin to seem less than perfect. The world may have changed, so that key portions of the agreement have become less appropriate than at the time of the negotiation. In such cases, it may help to be able to renegotiate an agreement so as to keep it responsive to all involved parties' current values.