

THE
WIN-WIN
SOLUTION

Guaranteeing Fair Shares to Everybody

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PREFACE

Since the publication of Roger Fisher and William Ury's highly influential book *Getting to Yes: Negotiating Agreement Without Giving In* (1981), it has been widely recognized that there is a middle ground—perhaps “high ground” would be better—between winning and losing in negotiations. Unlike *Getting to Yes*, however, which has helped disputants put some structure on their negotiation problem, our goal is to take such a well-structured problem and help the parties obtain a fair settlement. Thus, in a labor-management dispute, you certainly want to communicate clearly, to consider your opponent's interests as well as your own, and to persevere in taxing situations. But ultimately, you want to know on which issues you will win, on which you will lose, and on which you will have to compromise. By the same token, if you're facing a divorce, the question you want answered is, Who gets what?

This book presents new and superior procedures for helping the parties get to yes—if not nirvana—and most are not difficult to use. They take much of the worry out of being an inept bargainer by providing an ironclad guarantee of fairness. One of these step-by-step procedures even guarantees that the disputants will do as well as possible in realizing all the “win-win” potential that is available. Of course, sometimes there is no possibility of such mutual gain. If you are haggling with a car dealer, or your attorney is arguing the merits of an out-of-court settlement of your lawsuit, then any monetary gain for you is a loss for your opponent, and vice versa. The reader seeking clever advice on buying a car or settling a lawsuit can readily find it, but not here.

Our concern in this book is with disputes—from divorce to business to international—in which *everybody* can win. For such disputes, we will describe and illustrate step-by-step procedures that

help the disputants resolve their differences, capture the mutual gain, and reach a fair settlement. But what does it mean to be "fair"? Isn't fairness—whatever it is—naive and out of fashion in this highly competitive world? Why shouldn't everyone go all out to win? Instead of compromising, isn't it better to be a tough negotiator and try to face down adversaries? Our answer is that "winning," at least in the all-out sense of beating an opponent, may not be in the cards. In fact, it is naive to think that the alternatives of being either a winner or a loser are the only ones. Typically, the real alternatives are that everybody can win (when negotiations succeed) or everybody can lose (when negotiations fail).

Our interest in fair division stems from a mathematical problem having its roots in the 1940s. Roughly speaking, the problem was whether the well-known two-person procedure of "I cut (a cake), you choose (a piece)," or divide-and-choose, can be extended to several people so as to ensure that everybody gets a piece that he or she considers to be at least as large as the pieces that other people receive. We solved this problem by finding such a procedure in 1992. This research, and related research on several other fair-division problems, are described in our book *Fair Division: From Cake-Cutting to Dispute Resolution* (1996), which was written for a theoretically oriented audience.

The present book takes a more practical view. We limit our discussion to a trio of procedures that can be easily implemented:

- Strict and balanced alternation (both based on taking turns);
- Divide-and-choose, and an extension called trimming; and
- Adjusted winner.

Strict alternation (first you choose an item, then I do, then you do, and so on) is as old as the hills, but what we do to make it fairer is new. This variant, called *balanced alternation*, is presented here for the first time and is especially applicable to disputes in which there are many items to be distributed, as one often finds in divorces and estate divisions. *Divide-and-choose* is well known and certainly not without its charms. While it goes back to the Hebrew Bible, it is seldom used today. The *trimming procedure* extends the idea underlying divide-and-choose to

more than two parties. It was used, at least informally, to divide Germany and Berlin into four zones after World War II.

The last procedure, *adjusted winner*, is the centerpiece of the book and, we believe, has the greatest potential. But its use requires that the disputants think long and hard about how they value different items, and even what constitute "items." The product of these efforts is worth the cost: a settlement that has stronger claims to fairness than that provided by any of the other procedures in this book.

We keep the discussion relatively nontechnical throughout. Items set apart in the text, which provide elaborations of certain ideas, can be skipped on first reading. The sources and references at the end of the book provide details for the reader who wants to look further into the literature. Finally, a glossary gives definitions of important concepts, especially those that come up again and again in different contexts.

Besides our goals of describing different fair-division procedures and indicating in what situations they work best, we have a third, more ambitious goal: to help people settle their differences amicably. Toward this end, we offer numerous examples that illustrate how the various procedures may be applied to all kinds of conflicts, some hypothetical and some real. We believe the new procedures, especially, can help parties reduce the frustration, anger, and occasional violence that often accompany escalating demands and endless haggling. In the end, these procedures should enable parties to bring *their own* closure to a dispute, rather than have a settlement arbitrarily imposed on them or suffer from a continuing impasse.

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brings us back to the lack of efficiency of divide-and-choose. Indeed, this is divide-and-choose's great failing and, consequently, it cannot be generally recommended.

On the other hand, there are certainly situations, such as in the case of land division (in the Bible and in the allocation of oil tracts), in which divide-and-choose seems eminently reasonable. For one thing, it ensures envy-freeness, which seems especially important to preserve in personal disputes. For another, it can be symmetricized, using the moving-finger procedure, to give equitability if there are a sufficient number of items to shift back and forth between the two lists.

The trimming procedure has its roots in divide-and-choose, particularly in having parties create piles of equal highest value so as to ensure that each party can get a most-valued pile. There are, nevertheless, practical problems in creating a sufficient number of ties to make everyone happy. Also, it is not always possible literally to trim items, such as a house, in dividing up physical property, though sharing and rotation sometimes ease this kind of problem. Thus, while the underlying idea of trimming is one worth keeping in mind, rarely can the procedure itself be effectively implemented without alterations. This is the price one pays for extending divide-and-choose to three or more parties.

For two parties, however, there is a procedure that ensures efficiency, as well as envy-freeness and equitability. It is, as we will see, also relatively easy to apply.

Chapter 5 ADJUSTED WINNER

Let us recapitulate. The two alternating procedures, strict (Chapter 2) and balanced (Chapter 3), are simple to use, especially after the query step, which reduces the items that need to be divided to just those that are contested. Strict alternation, however, may give an enormous advantage to the first chooser. While balanced alternation mitigates this advantage, it has two drawbacks:

- One party may prefer the items that the other receives, creating envy;
- Even if this is not the case, both parties may not benefit to the same degree, making the resulting allocation inequitable.

If there are only two parties, and they are sincere or use the bottom-up strategy, both alternating procedures are efficient in terms of item-by-item comparisons (and balanced alternation is envy-free as well using the item-by-item criterion).

Divide-and-choose (Chapter 4), which requires that two parties be able to compare whole collections of items, is the most demanding of the procedures considered so far. For two parties, it ensures envy-freeness, but it is not efficient if the divider possesses no information about the preferences of the chooser. If the divider does possess such information, he or she can manipulate the selection of the chooser so that the resulting allocation is efficient but inequitable. On the other hand, if the chooser possesses information about the divider's preferences and decides to be spiteful, the resulting allocation will be inefficient. We also saw that it is possible to extend the rationale of divide-and-choose to more than two parties—via trimming to create ties—but this may complicate it considerably.

Can we satisfy all three of our criteria—envy-freeness, efficiency, and equitability—at once? The answer is yes, at least for two parties. In this chapter we introduce a procedure called

adjusted winner (AW) which accomplishes exactly that. We then apply this procedure to a variety of fair-division conflicts in the remainder of the book.

IDEA OF ADJUSTED WINNER

Under AW, the parties to a dispute must make more difficult choices than under balanced alternation in the sense that they must attach numerical values to each item. But the procedure produces divisions with more pervasive claims to fairness than either balanced alternation or divide-and-choose.

Like both divide-and-choose and balanced alternation, AW starts with the designation of goods or issues in a dispute. The parties then indicate how much they value obtaining the different goods, or "getting their way" on the different issues, by distributing 100 points across them. This information, which may or may not be made public, becomes the basis for making a fair division of the goods and issues later.

Point-allocation schemes have been proposed for other purposes. In the mid-1980s, political scientists Russell Leng and William Epstein proposed one scheme, and political scientist Stephen Salter another scheme, to facilitate balanced superpower arms reductions, which were bogged down at the time. Under the Leng-Epstein proposal, each superpower would distribute, for example, 1,000 points over its *adversary's* weapons; the adversary would then have to destroy weapons that would reduce these points by a specific percentage, such as 10%. Under the Salter proposal, each superpower would distribute points over its *own* weapons; the adversary would then indicate which weapons it wanted destroyed whose value was equal to the specified percentage.

In the case of goods, requiring that the parties assign points to them raises the question of whether the parties will be truthful in announcing their valuations. Likewise in the case of issues, indicating how important one considers each issue by point assignments raises the question of whether honesty is consistent with good bargaining tactics.

We encountered strategic questions of this sort earlier. In Chapter 4, for example, we saw how a party's knowledge of its adversary's preferences could be used to its advantage in divide-and-choose. Likewise for both strict alternation and balanced alternation in Chapters 2 and 3, we saw how a party might exploit knowledge of an adversary's preference ranking to improve on the sincere outcome.

In the case of the alternating procedures, however, we also saw that a bad outcome for three parties could occur if they were sophisticated. In effect, their strategizing could lead everyone into a three-person Prisoners' Dilemma.

The issue of being truthful is a general one, transcending any particular bargaining or fair-division procedure. As one theorist put it,

Preferences are usually private information, and we cannot expect people to honestly reveal them unless it is in their interest to do so. The challenge, therefore, is to design procedures that *induce* the claimants to reveal enough information about their preferences so that an equitable and efficient solution can be implemented.

We will see that AW offers, in practice if not in theory, the players such an incentive. First, however, we turn to a description of how this procedure works.

DESCRIPTION

Let's begin by illustrating AW with a specific example. Suppose that Ann and Ben are getting divorced and must divide up the following items:

1. *Retirement account.* A six-figure retirement account has been built up from Ben's employment over several years. This is valuable to both spouses, but it is more so to Ann because Ben will have more opportunity than Ann to reestablish such a fund before reaching retirement.
2. *Home.* This is a nice but not particularly extravagant house. Because Ben must remain close to his business, it is worth more to him than to Ann.

3. *Summer cottage.* This is a year-round house that is considerably less valuable than their home. But Ann realizes that she could live there quite comfortably.
4. *Investments.* These are largely mutual funds that are of considerably less value than the retirement account.
5. *Other.* This residual category includes two cars and a reasonably expensive sailboat that sleeps four, which Ben prizes.

Based on their preferences for each item, let's assume that Ann and Ben distribute their 100 points across these five items as follows:

<i>Item</i>	<i>Ann</i>	<i>Ben</i>
Retirement Account	<u>50</u>	40
Home	20	<u>30</u>
Summer Cottage	<u>15</u>	10
Investments	10	10
Other	<u>5</u>	<u>10</u>
<i>Total</i>	<u>100</u>	<u>100</u>

Point Assignments by Ann and Ben

AW works by assigning, initially, the item to the person who puts more points on it (that person's points are underscored). Thus, Ben gets the home, because he placed 30 points on it compared to Ann's 20. Likewise, Ben also gets the items in the "other" category, whereas Ann gets the retirement account and the summer cottage. Leaving aside the tied item (investments), Ann has a total of 65 (50 + 15) of her points, and Ben a total of 40 (30 + 10) of his points, which completes the "winner" phase of adjusted winner.

Because Ben trails Ann in points (40 compared to 65) in this phase, initially we award the investments on which they tie to Ben, which brings him up to 50 points (40 + 10). This starts the "adjusted" phase of AW. The goal is to achieve an equitable allocation by transferring items, or fractions thereof, from Ann to Ben until their point totals are equal.

What is important here is the order in which items are transferred. This order is determined by looking at certain fractions, corresponding to the items that Ann, the initial winner, has and

may have to give up. In particular, for each item Ann won initially, we look at the fraction given by the ratio of Ann's points to Ben's for that item:

$$\frac{\text{Number of points Ann (initial winner) assigned to the item}}{\text{Number of points Ben (initial loser) assigned to the item}}$$

In our example, Ann won two items, the retirement account and the summer cottage. For the retirement account, the fraction is $\frac{50}{40} = 1.25$, and for the summer cottage the fraction is $\frac{15}{10} = 1.50$.

We start by transferring items from Ann to Ben, beginning with the item with the smallest fraction. (Henceforth we will refer to this item as the *smallest-ratio* item.) This is the retirement account, with a fraction equal to 1.25. We work up to items with larger and larger fractions (there is only one larger fraction in our example) until the point totals are equalized.

Notice, however, that if we transferred the entire retirement account from Ann to Ben, Ben would wind up with 90 (50 + 40) of his points, whereas Ann would plunge to 15 (65 - 50) of her points. Plainly, transferring this entire item carries us way too far, pushing Ben into a big lead.

We conclude, therefore, that the parties will have to share or split this item. Now our task is to find exactly what fraction of this item each party will get so that their point totals come out to be equal.

Finding this fraction can be approximated by trial and error. For example, because Ben is 15 points behind Ann after the award of the investments (65 points for Ann, 50 points for Ben), we might give him 8 more points, hoping that it would reduce Ann's points by about the same number.

Now because Ben placed 40 points on the retirement account, awarding him 8 points translates into giving him one-fifth ($\frac{8}{40}$) of the account. If Ben in fact is given one-fifth of this account, he would have a new total of 58 points (50 + 8).

But how does Ann come out now? She valued the retirement account at 50 points, so giving up one-fifth of it means reducing her point total by 10 points. Thus, Ann would receive 55 (65 - 10) of her points. Because Ben is now ahead of Ann with 58 of

his points to 55 of hers, we have transferred a bit too much from Ann to Ben.

A little algebra helps us find the exact amount of the retirement account that we need to transfer from Ann to Ben in order to equalize their point totals. Let x denote the fraction of the account that Ben will get. After the transfer, Ben's point total will be $50 + 40x$, and Ann's point total will be $65 - 50x$. Because we want these point totals to be equal, we want to choose x so that it satisfies

$$50 + 40x = 65 - 50x.$$

Solving for x , we find

$$\begin{aligned} 90x &= 15 \\ x &= \frac{15}{90} = \frac{1}{6}. \end{aligned}$$

Thus, Ben should get one-sixth of the retirement account and Ann should get five-sixths.

Recall that Ben got the home (30 of his points), the other items (10 of his points), and the tied item, investments (10 points for both parties), totaling 50 of his points. Ann got the retirement account (50 of her points) and the summer cottage (15 of her points), totaling 65 of her points. With the 1:5 split of the retirement account, Ben's point total becomes

$$50 + 40(\frac{1}{6}) \approx 50 + 6.67 = 56.67,$$

and Ann's point total becomes

$$65 - 50(\frac{1}{6}) \approx 65 - 8.33 = 56.67.$$

That is, both people get exactly the same number of points, based on *their own* valuations of the different items. Subjectively speaking, then, each person does as well as the other, assuming their point valuations are honest reflections of their desires for the different items.

With the foregoing example in mind, let's see how AW works in general. Each party independently allocates a total of 100 points to the items, thereby indicating the worth of each to himself or herself, by putting one or more points on each item.

If the parties then submit their point assignments to a referee or mediator, he or she assigns the items in the following manner (the computation can be done by a computer, but this is hardly necessary):

1. Party 1 temporarily wins the items on which it puts more points, and party 2 wins those on which it puts more points.
2. Tied items on which the parties put the same number of points are awarded, one-by-one in any order, to the party with the fewer points at the time at which the item is awarded.
3. If the total number of points that each party wins is the same, then they are done.
4. Assume party 1 wins more points than party 2. Then party 1 will give back items (or parts of items) to party 2 in a certain order until both parties have exactly the same number of points. This transfer is called the *equitability adjustment*.
5. The giveback starts with the item having the smallest ratio of party 1's points to party 2's points, then goes to the item with the next-smallest ratio, and so on.

This calculation can be modified to reflect different entitlements—for example, if the divorce settlement states that Ann is entitled to three-fifths and Ben is entitled to two-fifths. The calculation for this example is given in "Unequal Entitlements," below.

Let's return to the case wherein Brad and Dick were dividing backhoes and boats in Maine. Both brothers were equally entitled to the ten different items that they received from their mother. Let's assume the percentages they associated with each item, given on p. 57 in Chapter 4, are the point allocations they would actually make. Using AW, Brad would initially get the piano, computer, tools, and the two mopeds, giving him a total of 74 of his points, and Dick would get the boat, motor, tractor, and truck, giving him a total of 63 of his points.

Giving Dick, in addition, the rifle, which is the one item on which Brad and Dick put the same number of points (4 points), still leaves Dick behind Brad, 67 to 74 points. Because the smallest-ratio item on which Brad beats Dick is one of the mopeds,

for which the fraction is $1\frac{1}{4} \approx 1.21$, we start with the transfer of it from Brad to Dick.

UNEQUAL ENTITLEMENTS

Assume that Ann is entitled to three-fifths and Ben is entitled to two-fifths of their divorce settlement, giving a ratio of $3/2 = 1.5$ for their respective shares. Because Ann is ahead initially by more than this ratio ($65/40 = 13/8 = 1.625$, based on her winning 65 points and Ben's winning 40 points on the nontied items), we must award some points on the tied item, investments (10 points each), to Ben. Obviously, we cannot give him all 10 points, because the resulting ratio, $65/50 = 13/10 = 1.3$, would give Ann less than her entitlement ratio of 1.5 and Ben too much.

Let x denote the fraction of the investments that Ben will get. After giving this fraction to Ben, his point total will be $40 + 10x$, and Ann's point total will be $65 + 10(1 - x)$ when we give her the complementary fraction, $(1 - x)$, of the 10 points. Because we want these point totals to be in the ratio $3/2$, we set the ratio of their point totals equal to $3/2$:

$$\frac{65 + 10(1 - x)}{40 + 10x} = \frac{3}{2}$$

$$2[65 + 10(1 - x)] = 3(40 + 10x).$$

The latter equation ensures that Ann will end up with more of her points (in brackets) than Ben will of his points (in parentheses), and in exactly the intended ratio. Solving for x , we find

$$\begin{aligned} 50x &= 30 \\ x &= 30/50 = 3/5. \end{aligned}$$

Thus, Ben gets three-fifths of the investments, and Ann gets two-fifths, giving Ben 6 points and Ann 4 points. Thereby Ann will receive 69 (65 + 4) of her points, and Ben will receive 46 (40 + 6) of his points, which gives them total allocations in the ratio of 69/46, or $3/2$.

This allocation is equitable in an extended sense: Ann and Ben each receive 15% more than their 60% and 40% entitlements. It is also envy-free in an extended sense: Although Ben receives less than half of all his points (46), he would not envy the two-thirds of Ann's share, which represents $(2/3)(54) = 36$ of his points, with which it is proper to compare his share of 46 (because he is entitled to only two-thirds of what Ann is).

Let x denote the fraction of this moped that Dick will get. After the transfer, Dick's point total will be $67 + 14x$, and Brad's point

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total will be $74 - 17x$. Setting Dick's points equal to Brad's yields

$$67 + 14x = 74 - 17x.$$

Solving for x , we find

$$\begin{aligned} 31x &= 7 \\ x &= 7/31 \approx .226. \end{aligned}$$

Thus, Dick is entitled to about 23% of one of the mopeds, and Brad 77%, which would be their shares if they sell it. Alternatively, either brother could buy out the other, paying the appropriate percentage of its sales price to the other.

However Brad and Dick decide to dispose of one of the mopeds, each will receive slightly more than 70 of his points:

$$67 + (14)(.226) = 74 - (17)(.226) \approx 70.16.$$

This number is considerably more than the approximately 57 points that Ann and Ben received from dividing up the five items in their divorce settlement.

This difference is readily explained: The valuations of the items by each person in the estate example with Brad and Dick are far more divergent than the valuations of the items in the divorce example with Ann and Ben. This makes possible more of a win-win outcome in the estate case.

ASSESSMENT

AW does well on all the criteria.

ENVY-FREENESS

It is not obvious that AW satisfies this property, but in fact it does always hold: Each party receives at least 50 of its own points and, hence, one party will not envy the other party because it will not desire to have what that other party received. Remarkably, this is true even if one party has advance information on the point assignments of the other party and exploits this information optimally. While such exploitation can hurt the

exploited party, as we will illustrate in the next section, it can never force the exploited party below the 50-point mark.

EFFICIENCY

Efficiency is the hallmark of AW—there is no other assignment of items that can give both parties more points. Satisfying this property is not easy to achieve, especially in the context of point-allocation procedures. Because no other allocation can give Ann more of her points without simultaneously giving Ben fewer of his, and vice versa, AW ensures that there are no win-win opportunities being missed in the final allocation.

Decision analysts Ralph Keeney and Howard Raiffa, in the absence of a procedure for ensuring an efficient settlement, propose that the parties to a dispute first work out an “acceptable” settlement, though they leave vague what this means. They suggest that a third party (“contract embellisher”) might then make adjustments in the original settlement that moves it toward efficiency—again without saying exactly how—in what Raiffa calls a “post-settlement settlement.”

By contrast, AW guarantees efficiency *on its own*, assuming that the parties are honest in their assignments of points to items. In theory, the parties can benefit by misrepresenting their preferences, as we will see. Because such misrepresentation can undermine AW’s attractive properties, we might worry that it will not be “safe” to buy into this procedure.

In practice, it turns out, AW is essentially nonmanipulable unless one party has advance information about the other party’s *exact* point assignments. Assuming that this is not the case, a mediator can play an important but unorthodox role, especially when what is being determined is not who gets what goods, as in a divorce, but rather who prevails on what issues in a dispute (more on this in Chapters 6, 7, and 8). Thus, instead of trying to coax the parties into a compromise, which may be very difficult, the mediator can help them (1) identify the issues in a dispute, (2) agree on what winning and losing on each means, and (3) assign points to each issue based on its relative importance to the parties.

While mediators, unlike arbitrators, cannot dictate a settlement, with AW they can be more than just neutral third parties, advising the disputants on how best to reconcile their differences. Their newfound contribution stems from the fact that AW provides them with an important tool to induce the disputants to make *their own* decisions about what they most value. Thereby it encourages the disputants to reveal their interests—not just their bargaining positions—and accept responsibility for the consequences of their choices, which, after all, they effectively make by assigning points to the items in the dispute.

EQUITABILITY

This property is guaranteed by the equitability adjustment (illustrated earlier) and, hence, is built into AW by design. It says that if Ann receives 67 of her points, then Ben necessarily will receive 67 of his points. Assuming that the parties are honest in their point assignments, both will know this and, consequently, think that they came out exactly the same. By getting two-thirds of what they wanted in such a case, they both should feel equally satisfied.

Equitability is the least studied of our three properties and, undoubtedly, the hardest to assess because of its subjective nature. Nonetheless, AW satisfies this property, as well as the properties of efficiency and envy-freeness, and is the only one of our procedures that does so.

STRATEGY

Under AW, points are assigned by the parties independently, which is easy to ensure by having the parties submit their assignments separately and at the same time. But how do we know whether each party’s assignment mirrors its true valuation of the items being divided?

There certainly are situations, such as one finds in divorce proceedings, in which each person will have more than an inkling of the preferences of the other person. Indeed, the intimate

knowledge that a divorcing couple will have of each other's cares and concerns will frequently enable each to make rather accurate estimates of the points that the other spouse is likely to assign to the items in a divorce.

Thus, as with earlier procedures, we are led to ask whether the parties under AW can capitalize on their knowledge of each other's preferences. It turns out that if this knowledge is possessed by only one side—a relatively unlikely scenario—then the knowledgeable side can, in fact, capitalize on its informational advantage. However, if knowledge is roughly symmetric, then attempts by both sides to be strategic can lead to disaster, even without their being spiteful.

To illustrate the potential vulnerability of AW to manipulation, let's start with a simple example. Suppose there are just two paintings, a Matisse and a Picasso, and Ann thinks the Matisse is three times as valuable as the Picasso, whereas Ben sees them in just the opposite way. Thus, if Ann and Ben are sincere, their point assignments will be as follows:

<i>Item</i>	<i>Ann</i>	<i>Ben</i>
Matisse	75	25
Picasso	25	75

Because of the symmetry in this example, the initial assignments, in which Ann gets the Matisse and Ben gets the Picasso, require no equitability adjustment: Both parties end up with 75 points, or three-fourths of the total value in their eyes.

But now suppose that Ann knows Ben's preferences, but Ben does not know Ann's. In addition, suppose that, in the absence of better information, Ben will be sincere by announcing 25 points for the Matisse and 75 points for the Picasso, and Ann knows this. Can Ann benefit from being insincere?

The answer is yes. Ann should pretend that she likes the Matisse only slightly more than Ben likes the Matisse (he put 25 points on this item). This way, Ann will get all of the Matisse initially, as she did before, but it will appear that she is getting only a little more than one-fourth of the total value in her opinion, whereas Ben is getting three-fourths in his opinion (since he put

75 points on the Picasso). Consequently, a big equitability adjustment will be required to transfer much of the value of the Picasso from Ben to Ann.

To be more precise, let's work from the numbers in this example to see the extent to which Ann can manipulate AW to her advantage. Knowing that Ben will place 25 points on the Matisse, Ann should place 26 points on this item and her remaining 74 points on the Picasso. Hence, the announced point totals, assuming Ben is sincere and Ann is not, will be as follows:

<i>Item</i>	<i>Ann</i>	<i>Ben</i>
Matisse	26	25
Picasso	74	75

Initially, Ann will get the Matisse, receiving 26 of her announced (and insincere) points, and Ben will get the Picasso, receiving 75 of his announced (and sincere) points. But now, since Ben appears to have almost three times as many points as Ann does (75 to 26), there must be a large transfer from Ben to Ann.

The exact amount can be determined by letting x be the fraction of the *apparent* value of the Picasso that Ann will get. After the transfer, Ann's point total will be $26 + 74x$, and Ben's point total will be $75 - 75x$. Because we want these point totals to be equal, we want to choose x so that it satisfies the following equation:

$$26 + 74x = 75 - 75x.$$

Solving for x , we find

$$\begin{aligned} 149x &= 49, \\ x &= \frac{49}{149} \approx .33. \end{aligned}$$

This gives Ben, in particular,

$$75 - 75(.33) \approx 75 - 25 = 50$$

of his points. In fact, it will appear that Ann, also, is getting the same low number of points, which is not surprising because their announced point allocations are practically identical.

In terms of Ann's *true* preferences, however, the situation is very different. She is getting 75 points from winning all of the

Matisse; in addition, she is getting 33% of the Picasso that she values at 25 points, which might mean that Ben would have to pay Ann one-third of the assessed value of the Picasso to keep it entirely for himself. Altogether, then, Ann is getting

$$75 + (.33)(25) \approx 75 + 8.33 = 83.33$$

of her points, or about five-sixths of the total value in her eyes rather than the three-fourths she would get if she were honest. Of course, Ben could exploit Ann in the same manner if it were he, rather than Ann, who had one-sided information and capitalized on his knowledge of her preferences.

But what if *both* players know each other's preferences? Will the same kind of strategizing work? For example, what if Ann and Ben both assume that the other will be sincere? Each might then be motivated to try to take advantage of this situation, as Ann did earlier, by being strategic. Their announced point allocations would then be as follows:

Item	Ann	Ben
Matisse	26	74
Picasso	74	26

Now Ann will get the Picasso and Ben will get the Matisse; there will be no equitability adjustment, since it appears that each person gets 74 of his or her points. But because Ann really thinks that the Picasso represents only 25% of the total value, and Ben really thinks the same of the Matisse, each in fact will receive only 25 points! Patently, this is a disastrous outcome: Not only is it massively inefficient, but it also leaves each person extremely envious of the other.

A lesson that Ann and Ben might take from this example is that they should not be too aggressive in misrepresenting their true preferences. Otherwise, they might succeed only in hurting themselves as well as the other party, as we have just seen.

On the other hand, some shading of their bids for their favorite items may not be harmful. For example, if both Ann and Ben decide to back down on their truthful point assignments of 75 points to their favorite items to, for example, 65 points, then the

result will be the same as if they were sincere: Ann will get the Matisse for 75 of her true points, and Ben will get the Picasso for 75 of his true points. Neither gains from this deception. However, if they back down from 75 sufficiently to make it appear that Ann favors the Picasso and Ben favors the Matisse, then we are back to the disastrous situation we had before, when each person gets only 25 of his or her own points.

Manifestly, insincerity carries with it risk, in part because successful manipulation requires not only having a good idea of your opponent's preferences—and his or her sincere point assignments—but also having some idea of what his or her *announced* point allocations will be. Without knowing the likely announced allocations, each party may end up being “too clever by half”—that is, hurting itself by being overly clever.

Unquestionably, it is safer to be naive or sincere, or almost so. Sincerity provides an absolute guarantee of obtaining at least 50% of the total value in one's own eyes, and possibly much more, as we will see in later examples. This makes sincerity a *guarantee strategy* under AW: No matter what strategy an opponent chooses, sincerity guarantees an envy-free portion to the sincere party.

EXTENSIONS TO THREE OR MORE PARTIES

Our analysis of AW so far has been quite abstract. Although Chapters 6, 7, and 8 are devoted to applications of AW, it is worth noting here that decisions about how to divide things, from cake to countries, not only are ubiquitous but also often involve more than two parties.

As a case in point, consider the aftermath of World War I, when President Woodrow Wilson proclaimed in 1918 his famous Fourteen Points. Point 5 read: “Free, open-minded, and absolutely impartial adjustment of all colonial claims”—certainly a noble ideal. It was not without reason that Wilson was called an idealist.

The reality, however, was ominously different. Harold Nicolson, a well-known British diplomat of the time, wrote to his wife, Vita Sackville-West, in 1919: “Darling, it is appalling, those three ignorant and irresponsible men cutting Asia Minor to bits as if they

were dividing a cake." The three men Nicolson was referring to were Wilson, Lloyd George, and Georges Clemenceau, the heads of state of the United States, Great Britain, and France, the three most significant players in the immediate postwar settlement.

The Balkans were subject to another parceling out of land some 75 years later that also involved several parties. Interestingly, this struggle was less among the great powers for control of the region and more among local parties that sought additional territory. Their conflicts were especially gruesome in the former Yugoslavia.

Roiled by long-standing ethnic and religious divisions in the early 1990s, Bosnian Muslims, Croats, and Serbs fought a bitter battle for land, and the ridding of opposition groups under their control, sometimes resorting to genocidal policies euphemistically called "ethnic cleansing." While outside parties, first under the auspices of the United Nations and later under NATO, intervened to stabilize the situation, their success in stopping the fighting occurred only in November 1995, when a peace treaty was finally signed after 250,000 people were killed and 3 million people became refugees in four years of fighting.

At root, this conflict involved at least three major local parties and various outside parties. Insofar as this conflict and others like it, such as that between Israelis and Arabs, cannot be reduced to two-person situations, we are led to ask whether AW can be extended to situations involving several parties.

When there are more than two parties, there is no procedure that will simultaneously satisfy envy-freeness, efficiency, and equitability (see "Impossibility of Satisfying Three Properties," below). However, it turns out that it is always possible to find an allocation that satisfies two of the three properties: A procedure that gives both efficiency and envy-freeness has been obtained by Dutch mathematicians J. H. Reijnierse and J. A. M. Potters; procedures (called "linear programs") that give both efficiency and equitability have been obtained by the American mathematician Stephen J. Willson; and an equal division of each item to the parties gives both equitability and envy-freeness.

IMPOSSIBILITY OF SATISFYING THREE PROPERTIES

This example was given by two Dutch mathematicians, J. H. Reijnierse and J. A. M. Potters. Call the three parties Ann, Ben, and Carol, and assume they allocate the following numbers of points to items X, Y, and Z:

Items	Ann	Ben	Carol
X	40	30	30
Y	50	40	30
Z	10	30	40

The only efficient and equitable allocation turns out to be to give X to Ann, Y to Ben, and Z to Carol. Obviously, this 40-40-40 allocation is equitable; it can also be shown to be efficient.

But it is not envy-free, because Ann will envy Ben for getting Y, which Ann considers to be worth 50 points. If we gave Y to Ann and X to Ben while still giving Z to Carol, this allocation would be efficient, but it would be neither equitable (because each player would get a different number of his or her points) nor envy-free (because Ben would envy Ann).

Of course, this three-person hypothetical example does not preclude the possibility that all three properties can be satisfied in a particular situation; it says only that it is not always possible to guarantee their satisfaction when there are more than two parties. The fact that one cannot guarantee the satisfaction of efficiency, envy-freeness, and equitability, however, means that a hard choice might have to be made among them in situations with more than two parties.

It is not clear *a priori* which pair of properties constitutes the most desirable set, and hence what would be the easiest property to give up if one had to sacrifice one property. To the degree that the three major parties in the Yugoslavian conflict considered themselves equal players, equitability might be the one most worth preserving, so let this be the starting point.

Given an equitable division of the land, envy-freeness might be more important to the parties than efficiency, because envy-freeness would undercut any charges that another party got a "better deal." Thus, the 40-40-40 allocation in "Impossibility of Satisfying Three Properties," which is not envy-free, might be worse than an envy-free and equitable allocation that is inefficient.

Rather than delving further into these issues, Chapters 6, 7, and 8 focus on two-person conflicts, to which AW is immediately applicable. This is not to say that extensions of AW should not be considered if there are three or more significant parties. But if a sacrifice is called for, it is by no means obvious which of the three properties that AW satisfies should be jettisoned.

Another difficulty is that all the extensions of AW to more than two parties have very much a "black-box" flavor. Unlike AW, which is basically a giveback procedure that is easy to understand and requires only simple algebra to solve, the extensions of AW use advanced mathematical methods that are intuitively opaque.

RECOMMENDATIONS

AW satisfies the three desiderata of efficiency, envy-freeness, and equitability, provided the parties are truthful in their announced valuations of the items in a dispute. AW is also straightforward to describe, though its application to real-world disputes will require considerable skill and substantive knowledge (more on this in Chapters 6, 7, and 8). On the negative side, AW's winner-take-all feature makes it potentially vulnerable to strategic misrepresentation, should one party have information about, or be able accurately to predict, the announced point assignments of the other.

If the items being divided are not tangible property but more intangible issues, then before AW is applied, the parties should decide what each would obtain if it came out the winner on an issue. Only on the one issue on which an equitability adjustment must be made will a finer breakdown actually be necessary.

Because this breakdown will be known only after AW is applied, the division on this issue must await the application of AW. This is a situation in which a mediator could play a valuable role. He or she could tell the parties the split on this issue but not which party is the relative winner. Each party, not knowing whether it got the larger or the smaller percentage, would then be motivated to reach a fair-minded agreement. For example, if the issue were what to call a new business product, and the split

was three-fourths to one-fourth, then the two disputants (for example, the manufacturing and the marketing departments) might agree that whoever gets the one-fourth share will choose the advertising firm, but the other department will select the name of the product.

One might also use divide-and-choose to implement such an agreement, especially if there are physical items to divide. Assume, as in the preceding example, that one side is entitled to a one-fourth share and the other side to a three-fourths share. If divide-and-choose is first applied to get a 50-50 division, and then to each of the two halves, a 75-25 division can be effected.

We saw how misrepresentation by both parties can backfire if each party tries to exploit its knowledge of the preferences of the other party. Honesty in announcing one's point allocations, therefore, is generally a sound policy to follow—not just for ethical reasons but for strategic ones as well.

In a bitter divorce, nevertheless, it is entirely conceivable that a husband and wife would be so resentful of each other that their highest priority would be to spite the other person, even if this means losing many of the goods they most desire. While on first blush this calculation seems irrational, it is not if the spiteful person attributes sufficiently high value to "getting even."

That is, by hurting himself or herself in order to punish the other party, the punisher may in fact derive a net benefit. On the other hand, it seems virtually impossible (absent spies) to anticipate an opponent's point assignments exactly and, consequently, to pursue this strategy optimally. Also, the fact that both parties can get themselves into big trouble trying to outguess each other should halt the most egregious attempts at manipulation.

Beyond the sphere of divorce, some of the most severe conflicts in the world today are essentially two-person conflicts, such as those between Hindus and Muslims in India and Hutus and Tutsis in Rwanda—not to mention the persistent, if now diminished, struggles between the Catholics and Protestants in Northern Ireland and blacks and whites in South Africa.

Other conflicts, such as that in former Yugoslavia (briefly discussed in the preceding section), have more than two parties. At an international level, the Israeli-Arab conflict also involves several

different countries, as well as factions within some of the countries (including Israel), which makes it decidedly a multiparty dispute.

As we saw in the preceding section, if there are more than two parties, no procedure guarantees the three properties of envy-freeness, efficiency, and equitability. By contrast, AW guarantees these properties in the two-party case if both parties are truthful. This is encouraging, despite AW's theoretical, but probably not practical, vulnerability to manipulation. Hence, AW will generally be the best procedure to use in two-party disputes in which the parties care differently about different issues. These differences, in fact, facilitate trade-offs that enable each party to win on its favorite issues.

In the next three chapters, we turn to a variety of two-person conflicts to illustrate the applicability of AW. In analyzing these conflicts and their possible resolution, the practical problems of implementing AW will be discussed.

Chapter 6

ADJUSTED WINNER: Application to Camp David

In this chapter, we apply AW to the 30-year Egyptian-Israeli dispute, which was settled by the Camp David accords of 1978. These accords were formalized by a peace treaty in 1979 that terminated one of the most enduring conflicts since World War II.

The Camp David application serves as a springboard for discussing several practical aspects of using AW, including different methods for assigning points to issues by the disputants. Some observations about the fairness of the Camp David agreement, both actual and that achieved by AW, are offered. In Chapters 7 and 8, we turn to AW's application to other disputes, one of which, like Camp David, is an international one and to whose future settlement AW might be able to contribute.

ISSUES AT CAMP DAVID

On September 17, 1978, after 18 months of negotiation and a 13-day summit meeting, President Anwar Sadat of Egypt and Prime Minister Menachem Begin of Israel signed the Camp David accords. Their final bargaining was not easy. By the third day of their summit meeting, the animosity between the two leaders had grown so great that they refused to meet with each other face-to-face, so the remaining ten days of negotiations had to be conducted through intermediaries.

Six months later, the accords provided the framework for the peace treaty that the two nations signed on March 26, 1979. This epochal agreement shattered the view of many observers that the Arab-Israeli conflict was probably irreconcilable.

A number of factors make the Camp David negotiations an excellent case for examining the potential usefulness of AW. First, there were several issues over which the Egyptians and

Israelis clashed. These issues can be considered as if they were goods to be divided fairly under AW, except to obtain a good translates into getting one's way, or winning, on an issue.

Second, most of the issues were to some degree divisible, rendering the equitability-adjustment mechanism of AW applicable to the issue that must be divided. Third, there is now considerable documentation on the positions of the two sides on each issue, based on detailed accounts of the negotiations at Camp David by several of the participants. The empirical evidence enables us to make reasonable point assignments to each issue, based on the expressed concerns of each side.

The Camp David accords need to be seen in the context of the wrenching conflict that existed between the Arab countries and Israel from the time of the latter's creation in 1948. The Arab states, including Egypt, did not recognize Israel's right to exist and continually sought to annihilate it. However, Israel was victorious in the 1948-49 war, the 1956 Sinai conflict, and the six-day war of 1967. As a result of the 1967 war, Israel conquered and laid claim to substantial portions of territory of its Arab neighbors, including the Sinai Peninsula, the West Bank, the Gaza Strip, and the Golan Heights.

In 1973, Egypt and Syria attempted to recapture the Sinai Peninsula and the Golan Heights, respectively, in the Yom Kippur War but were repelled by Israel. Henry Kissinger's shuttle diplomacy in 1973-74 helped bring about two disengagement agreements between the warring sides but no permanent resolution of their conflict.

When Jimmy Carter took office in January 1977, he deemed the amelioration, if not the resolution, of the Middle East conflict one of his top priorities. This conflict had contributed to major increases in the world price of oil; the fallout of these increases had been inflation and slowed economic growth.

From Carter's perspective, stable oil prices required an end to the turmoil in the Middle East. Furthermore, Carter believed that the prevailing disengagement was unstable; some sort of permanent settlement was necessary to prevent still another Arab-Israeli war and the potential involvement of the United States.

Thus, after assuming the presidency, Carter almost immediately began to use his office to press for peace in the Middle East.

The original U.S. plan was to involve all the major parties, including the Palestine Liberation Organization (PLO), in the negotiations. But as talks proceeded, it became clear that the most likely resolution to be reached would be between Egypt and Israel. Indeed, Sadat at one point sent the U.S. president a letter urging that "nothing be done to prevent Israel and Egypt from negotiating directly."

By the summer of 1978, it seemed to Carter that a summit meeting was necessary to bridge the remaining gap between Egypt and Israel. He invited Sadat and Begin to meet with him at Camp David.

When the Egyptian and Israeli leaders convened at Camp David, there were several major issues on which the two sides sharply disagreed. These issues can be grouped into six categories. Much of the dispute centered on different territorial claims regarding the Sinai Peninsula, the West Bank, the Gaza Strip, and Jerusalem. Each side's most pressing concerns regarding each issue were as follows:

1. *The Sinai Peninsula.* This large tract of land was conquered by Israel during the six-day war in 1967 and remained under its control after the Yom Kippur War. In many ways it was the most important issue dividing the two sides in the negotiations. For Israel, the Sinai provided a military buffer that offered considerable warning in case of a possible Egyptian attack. Israel had set up military bases in the peninsula, including three modern airbases of which it was very protective.

Israel had also captured oil fields in the Sinai that were of significant economic value. Furthermore, Israel had established civilian settlements in the Sinai that it was loath to give up. At one point at Camp David, Begin told a member of the American negotiating team, "My right eye will fall out, my right hand will fall off before I ever agree to the dismantling of a single Jewish settlement."

For Egypt, the Sinai was of such great importance that no agreement could be achieved that did not include Egyptian

control over this territory. Almost all observers of the negotiations concur that, among all his goals, Sadat "gave primacy to a full withdrawal of Israel's forces from the Sinai." He let the United States know at the earliest stages of the negotiations that while he would allow some modifications of the pre-1967 borders, the Sinai must be returned *in toto*.

Roughly midway through the 18 months of negotiation leading up to Camp David, Sadat began focusing almost exclusively on the Sinai in his discussions with both the Israelis and the Americans. From a material perspective, both its military significance and its oil fields made the return of the Sinai imperative for the Egyptians. But perhaps more importantly, the Sinai was highly valued by Egypt for symbolic reasons. For Egypt, "the return of the whole of Sinai was a matter of honor and prestige, especially since Sinai had been the scene of Egypt's 1967 humiliation."

2. *Diplomatic recognition of Israel.* Since its creation in 1948, Israel had not been recognized as a legitimate and sovereign nation by its Arab neighbors. In fact, almost all Arab countries remained officially at war with Israel and, at least for propaganda purposes, called for its liquidation. For Israel, diplomatic recognition by Egypt, its most powerful neighbor, was an overriding goal.

But Israel wanted more than just formal recognition. Israeli leaders desired normal peaceful relations with Egypt, including the exchange of ambassadors and open borders. Such a breakthrough would help liberate Israel from its pariah status in the region.

Egypt balked at normalizing relations with Israel, in part because other Arab nations would vehemently oppose such measures. Sadat also believed that normal diplomatic relations would take a generation to develop because they would require such profound psychological adjustments.

In the actual negotiations, Sadat asserted that questions of diplomatic relations, such as the exchange of ambassadors and open borders, involved Egyptian sovereignty and therefore

could not be discussed. Recognition of Israel became so contentious that it presented one of the major obstacles to the signing of both the Camp David accords in 1978 and the formal peace treaty in 1979.

3. *The West Bank and the Gaza Strip.* For most Israelis, the West Bank and the Gaza Strip were geographically and historically integral to their nation—at least more so than was the Sinai. Indeed, the Israeli negotiating team held retention of these areas to be one of its central goals. Begin, in particular, considered these territories to be part of Eretz Israel, or the land of Israel, and not occupied foreign land. As one observer put it, "Begin was as adamant in refusing to relinquish Judea and Samaria [the West Bank] as Sadat was in refusing to give up any of Sinai." By contrast, if Begin were to give up the Sinai, he was intent on getting some recognition of Israel's right to the West Bank and the Gaza Strip in return.

For Egypt, these two territories had little economic or geostrategic worth; Sadat did not focus much on them as the negotiations proceeded. However, Egypt did face pressure from other Arab countries not to abandon the Palestinian populations in these territories. Sadat told his aides that he would not leave Camp David without some commitment from the Israelis to withdraw from the West Bank and Gaza Strip. In fact, once he arrived at Camp David, Sadat informed Carter, "I will not sign a Sinai agreement before an agreement is also reached on the West Bank."

4. *Formal linkage of accords and Palestinian autonomy.* One of the major issues of the negotiations was the extent to which an Egyptian-Israeli agreement should be tied to formal, substantive progress on the issue of Palestinian autonomy. Begin held that there should be no linkage. While Egypt and Israel might agree to some framework for the resolution of the Palestinian question, Begin claimed that this must be a separate matter, not part of a treaty between the two states.

Sadat seemed to be of two minds on this issue. On the one hand, he pushed for Israeli recognition of the Palestinians'

right to self-determination as part of the treaty, holding that a bilateral agreement could not be signed before an agreement on general principles concerning a Palestinian state was reached. On the other hand, he pointed out that a truly substantive agreement on this issue could not be negotiated by the Egyptians alone. However, he opposed possible deferral of this issue to an Arab delegation, which he knew could sabotage an agreement.

5. *Israeli recognition of Palestinian rights.* From the Israeli perspective, recognizing the rights of the Palestinian people was difficult because of competing sovereignty claims between the Israelis and Palestinians. When President Carter declared at a meeting with Sadat in Aswân, Egypt, that any solution to the conflict "must recognize the legitimate rights of the Palestinian people," the Israelis reacted negatively. But because this recognition was not attached to any substantive changes (see issue 4, above), it was not viewed as excessively harmful to Israeli interests. In fact, Israeli foreign minister Moshe Dayan at one point sent a letter to the American negotiating team indicating that Israel would be willing to grant equal rights to Arabs in the West Bank.

From the Egyptian perspective, some form of Israeli recognition of the rights of Palestinians was deemed necessary. Even if the formulation was vague and largely symbolic, Sadat felt strongly that he needed at least a fig leaf with which to cover himself in the eyes of the other Arab countries. Rhetorically, such a declaration would allow Egypt to claim that it had forced Israel finally to recognize the rights of the Palestinian population, an accomplishment that no other Arab state had been able to achieve. Furthermore, this formulation was appealing to Sadat because it would not require the participation of other Arab states.

6. *Jerusalem.* Control of Jerusalem had been a delicate issue since 1948. The United Nations demanded in 1949 that the city be internationalized because of competing religious and political claims. Until the Israelis captured and unified the city in 1967, it had been split between an eastern and a western section.

For Israel, Jerusalem was the capital of their nation and could not be relinquished. At Camp David, Dayan told the Americans that it would take more than a United Nations resolution to take the city away from Israel: "They would also need to rewrite the Bible, and nullify three thousand years of our faith, our hopes, our yearnings and our prayers."

As was the case with other territorial claims, Egypt faced pressure from other Arab nations to force Israeli concessions on this issue. An Egyptian representative impressed on the Israelis that a constructive plan for Jerusalem would "lessen Arab anxiety and draw the sting from Arab hostility." However, Egypt did not push strenuously on this issue and, in fact, seemed willing to leave it for the future.

How might AW have been used to resolve these issues as fairly as possible? Assuming Egypt and Israel have 100 points to allocate across the six issues, let's suppose they make the following point allocations:

<i>Issue</i>	<i>Israel</i>	<i>Egypt</i>
Sinai	35	55
Diplomatic recognition	10	5
West Bank/Gaza Strip	20	10
Linkage	10	5
Palestinian rights	5	20
Jerusalem	20	5
<i>Total</i>	<u>100</u>	<u>100</u>

Hypothetical Israeli and Egyptian Point Assignments

These hypothetical allocations, to be sure, are somewhat speculative; it is impossible to know exactly how Israeli and Egyptian delegates would have distributed their points had they used AW. However, it should be noted that while different point allocations would produce different issue resolutions, this would not alter any of the properties that AW guarantees—envy-freeness, efficiency, and equitability.

The hypothetical allocation of points is based on the preceding analysis of each side's interests in the six issues. Briefly, it

reflects Egypt's overwhelming interest in the Sinai, Sadat's insistence on at least a vague statement of Israeli recognition of Palestinian rights to protect him from the wrath of other Arab nations, the Israelis' more limited interests in the Sinai, and Begin's strong views on Eretz Israel—that is, retaining the West Bank and Gaza Strip and control over Jerusalem. Notice that each side has a four-tier ranking of the issues: most important (55 points for Egypt, 35 for Israel), second-most important (20 points), third-most important (10 points), and least important (5 points).

This hypothetical allocation represents a truthful, rather than a strategic, point distribution for each side. Although in theory it is possible to benefit from deliberately misrepresenting one's valuation of the issues, as we saw in Chapter 5, in practice this would be difficult. Indeed, parties may succeed only in hurting themselves, as we showed in Chapter 5 and will revisit in the present case.

Initially under AW, Egypt and Israel each win on the issues on which they allocated more points than the other side (the under-scored numbers). Thus, Egypt would be awarded issues 1 and 5, for a total of 75 of its points; Israel would be awarded issues 2, 3, 4, and 6, for a total of 60 of its points.

Since Egypt has more points than Israel, some issue or issues must be transferred, in whole or in part, from Egypt to Israel in order to achieve equitability. Because the Sinai issue (issue 1) is the smallest-ratio issue ($\frac{55}{35} \approx 1.57$ is a smaller fraction than $\frac{20}{10} = 2.0$, the fraction for the Palestinian-rights issue), the former must be divided, with some of Egypt's 55 points on issue 1 transferred to Israel, which allocates 35 points to this issue, to create equitability.

Let x denote the fraction of this issue that Israel will obtain. Setting Israel's points equal to Egypt's yields

$$60 + 35x = 75 - 55x.$$

Solving for x , we find that

$$\begin{aligned} 90x &= 15 \\ x &= \frac{15}{90} = \frac{1}{6}. \end{aligned}$$

As a result, Israel is given one-sixth of issue 1, plus all of issues

2, 3, 4, and 6, for a total of 65.8 of its points. Egypt wins the remaining five-sixths of issue 1, along with all of issue 5, for the same total of 65.8 of its points. This final distribution is envy-free, equitable, and efficient.

It should be noted that AW, using the hypothetical point allocations, produces an outcome that mirrors quite closely the actual agreement reached by Egypt and Israel. From Israel's perspective, it essentially won on issue 2, because Egypt granted it diplomatic recognition, including the exchange of ambassadors. Israel also got its way on issue 3, when Egypt "openly acknowledged Israel's right to claim in the future its sovereign rights over the West Bank and Gaza." Additionally, Israel won on issue 4, because there was no formal linkage between the Camp David accords—or the peace treaty later—and the question of a Palestinian state or the idea of Palestinian self-determination. And, finally, Jerusalem was not part of the eventual agreement, which can be seen as Israel's prevailing on issue 6.

Egypt prevailed on issue 5: Israel did agree to the Aswân formulation of recognizing the "legitimate rights" of Palestinians. That leaves issue 1, on which Egypt won five-sixths (83%), according to our hypothetical division.

As we saw in Chapter 5, AW requires that one good or issue be divisible in order for the equitability-adjustment mechanism to work. In fact, the Sinai issue was multifaceted and thus lent itself to division. Besides the possible territorial divisions, there were also questions about Israeli military bases and airfields, as well as Israeli civilian settlements and the positioning of Egyptian military forces.

Egypt won on most of these issues. All the Sinai was turned over, and Israel evacuated its airfields, military bases, and civilian settlements, some forcibly. However, Egypt did agree to demilitarize the Sinai, and to the stationing of U.S. forces to monitor the agreement, which represented a concession to Israel's security concerns. Viewing this concession as representing roughly one-sixth (17%) of the total issue seems to be a plausible interpretation of the outcome.

One problem that arises for this hypothetical case relates to the

"separability" of issues. An issue is *separable* if a party's value of winning on that issue is independent of its winning on other issues. If issues are separable, then their points can be added, as assumed under AW: Winning on a set of two or more issues gives a value for the set equal to the sum of the points of the individual issues that the set comprises. In applying AW, a key question is whether issues can be treated independently of each other.

In the case of Camp David, it can be argued that the recognition of Palestinian rights was not independent of territorial issues. For Sadat, in particular, recognition may have been more important *because* of his failure to win Israeli concessions on the West Bank, the Gaza Strip, and Jerusalem.

Although finding reasonably separable issues—whose points can be summed—is never an easy task, skillful negotiators can mitigate this problem. This happened in negotiations over the Panama Canal treaty, which was signed and ratified by the United States and Panama in 1977, when the two sides reached a consensus on ten different issues that split them. An analysis of the point allocations made to these issues showed that lumping them together would have reduced the point totals of each side, indicating that under AW two sides can do best by carving out as many separable issues as possible.

At Camp David, it is likely that the two sides would have come up with a different set of issues than those considered here. This might have facilitated the application of AW if there had been a dozen rather than a half-dozen issues. Nevertheless, our list works tolerably well, at least to illustrate the potential of AW, with both sides obtaining nearly two-thirds of the total value in their eyes.

PRACTICAL CONSIDERATIONS

Let's examine the Camp David case more closely to anticipate several difficulties, when applying AW, that can arise in trying to (1) minimize AW's vulnerability to manipulation and spite, (2) make appropriate point assignments, (3) render issues separable, (4) optimize timing, and (5) define issues.

MINIMIZING ADJUSTED WINNER'S VULNERABILITY TO MANIPULATION AND SPITE

A potential problem with AW is its manipulability, which was illustrated with a hypothetical example in Chapter 5. One side may try to manipulate its point distribution in an attempt to increase its "winnings." Assume, for example, that Israel, anticipating that Egypt would put an overwhelmingly number of points on the Sinai—enabling Egypt almost certainly to "win" on this issue—reduced its points on the Sinai from 35 to 20. (We will see the effects of the opposite strategy—increasing its allocation—shortly.) Also anticipating that Egypt would not put too many points on Palestinian rights, suppose that Israel increased its own points on this issue from 5 to 20 (corresponding to the amount it took away from the Sinai issue), hoping, possibly, to win on Palestinian rights.

Under this scenario, Israel initially is awarded issues 2, 3, 4, and 6, for a total of 60 of its points, the same as before. However, Egypt wins only issue 1, for a total of 55 of its points, because now there is a 20-20 tie on Palestinian rights.

Because Egypt trails in points (55 to 60) at the start, it is awarded the tied issue of Palestinian rights. However, because these 20 points would now put it ahead of Israel (75 to 60 points), there must be an equitability adjustment on this issue. By giving Egypt 12.5 points (62.5%) and Israel 7.5 points (37.5%) on this issue, each side would seem to end up with a total of 67.5 points, slightly more than the 65.8 points each side formerly received.

But this improvement for Israel is illusory, because it is based on Israel's *announced* rather than true preferences. In fact, this maneuver backfires in two ways. First, insofar as Israel's earlier hypothetical point allocation reflects its true preferences, it actually ends up with fewer points. Instead of obtaining 37.5% of 20 points on Palestinian rights (its manipulative allocation), it actually obtains 37.5% of 5 points (its true value), or 1.875 points in addition to its initial 60 points, giving it a total of 61.875 points. This number is less, not more, than the 65.8 points it obtains by being honest in its announced allocation, whereas Egypt ends up with more (67.5 points).

The second way in which Israel's manipulative strategy backfires in this scenario is perhaps more costly. When both parties announce their true preferences, Israel is awarded part of the Sinai issue according to the equitability-adjustment mechanism. However, in the manipulative scenario, because Israel reduced the number of points it put on Sinai, Egypt wins this issue outright and need not make any concessions to Israel. In such a case, it could be assumed that Egypt would not have to demilitarize the Sinai, or allow the stationing of U.S. forces to monitor the agreement.

Although AW is manipulable in theory, as we saw in Chapter 5, in practice it is probably not manipulable unless a party has precise information about how the other side will distribute its points. Only then can the manipulator optimally allocate its points to exploit its knowledge. Short of having this information, however, a manipulative strategy like that just described is dangerous. The manipulator may succeed only in hurting itself and helping the other side, the opposite of what it intended to do.

In fact, Israel would do better to increase the number of points it puts on the Sinai—say, from 35 points to 45 points—while putting 10 points rather than 20 points on Jerusalem. Now, after the equitability adjustment, Israel would win one-fourth rather than one-sixth of the Sinai issue. The problem with this maneuver is that if Egypt at the same time came down, for example, from 55 points to 40 points on the Sinai—thinking the latter figure was sufficient to ensure that it would win on this issue—Israel would win instead. Egypt would lose, which is exactly the opposite of what both parties want. Once again (see the manipulative calculation on p. 82), this is a case of being too clever for one's own good.

A party to a dispute might try to manipulate its point distribution in an attempt to deny the other side a good or issue—the spite strategy. Imagine, for example, that Egypt wanted to deny Israel diplomatic recognition, even though Egypt itself did not value this issue highly, by increasing the points it allocates to the diplomatic-recognition issue.

A strategy designed to deny something to an adversary is potentially costly for the same reason that a manipulative strate-

gy designed to increase one's point total is: The additional points allocated to an issue out of spite have to come from another issue. Thereby the spiteful party runs the risk of losing on other issues. In this case, Egypt might risk losing part or all of the Sinai in order to deny diplomatic recognition to Israel.

To convince a party that manipulation is hazardous when information is incomplete, one might have it go through the exercise of allocating insincere points for itself and then test (via AW) the outcome of such an assignment against various point assignments that its opponent might make. This exercise, in the absence of having complete information about the other side's point distribution, should convince a party that honest allocations are generally a sound strategy. We already know from Chapter 5 that honest allocations always guarantee a party at least 50 of its points—even if the other party has advance information on its allocation and follows an optimal manipulative strategy—making the outcome envy-free but not equitable.

MAKING APPROPRIATE POINT ASSIGNMENTS

While honesty usually pays, it will not always be a simple matter to come up with point assignments that mirror one's valuations of the different issues. One way to facilitate this task is to have the parties begin by ranking the issues, from most to least important, in terms of their desire to get their way on each.

After the issues have been ranked, the parties face the problem of turning a ranking into point assignments that reflect their *intensities* of preferences for the different issues. In *The Art and Science of Negotiation* (1982), decision analyst Howard Raiffa discusses this problem in considerable detail, essentially concluding that a party must carefully weigh how much it would be willing to give up on one issue to obtain more on another. Thus, for the Israelis in our example, the West Bank/Gaza Strip and Jerusalem issues are worth twice as much (20 points each) as the diplomatic recognition and linkage issues (10 points each), which in turn are each worth twice as much as Palestinian rights (5 points).

To come up with such point assignments, one option for a party would be to begin by rating the importance of winning on its highest-ranked issue, compared with its next-highest-ranked

issue, by specifying a ratio. Continuing down the list, comparing the second-highest-ranked issue with the third-highest-ranked issue, and so on, a party would indicate, in relative terms, an "importance ratio" between adjacent issues.

For example, if there were three issues, and the importance ratios were 2:1 on the first issue relative to the second, and 3:2 on the second issue relative to the third, these would translate into a 6:3:2 proportion over the three issues. Rounding to the nearest integer, the point assignments would be 55, 27, and 18, respectively, on the three issues. A more systematic method for eliciting weightings, pioneered by mathematician Thomas L. Saaty and his associates and called "analytic hierarchy processing," could also be used.

Another option for a party is to begin by assigning points intuitively to items. These assignments could be "tested" by asking whether various 50-point packages represent half the total value. To the extent that they do not, the initial point assignments for items would need to be modified. This process would continue until a party is satisfied that no further adjustments in its allocations of points to each item are necessary.

RENDERING ISSUES SEPARABLE

There is also the problem of making the issues in a dispute as separable as possible in order to render the addition of points on different issues meaningful. If winning on, say, issue 1 affects the value of winning on issue 2, then the points a party receives on issue 2 cannot simply be added to the points it receives on other issues—this depends on what happens on issue 1. In this sense, the West Bank/Gaza Strip issue was probably best treated as a single issue—even though the West Bank and the Gaza Strip are two geographically separate territories—because it would have been difficult to make decisions on one independently of the other.

By contrast, in some future possible agreement, it is reasonable to suppose that the withdrawal of a few hundred Israeli settlers from the Gaza Strip will more easily be accomplished than the withdrawal of thousands, or even tens of thousands, of Israeli settlers from the West Bank. Although the 1993 Oslo and the 1998

Wye River accords between Israel and the PLO intricately linked the withdrawal of Israeli administrative and security personnel from the West Bank and from the Gaza Strip, the withdrawal of settlers is an entirely different story. In a future agreement, it would probably behoove negotiators to treat the withdrawal of settlers from the Gaza Strip and from the West Bank as separate issues, especially because Gaza has no biblical significance for the Israelis whereas the West Bank (also known as Judea and Samaria) does.

OPTIMIZING TIMING

When is it most advantageous for disputants to use AW? According to former secretary of state Henry Kissinger, "Stalemate is the most propitious condition for settlement." Former president Jimmy Carter echoed this sentiment, saying that "parties must know they cannot win on the battlefield." Carter added that

politicians have to see a significant difference between the costs of continuing with the status quo and the benefits of sitting down with the other side. A modest difference is not enough.

According to this view, it might be best to let the disputants try, on their own, to reach an agreement without AW. If they fail after repeated attempts, they may well become so frustrated and weary as to take seriously the adoption of a formal procedure like AW to break the impasse.

Of course, leaving the final shape of an agreement to any formal procedure is somewhat of a gamble, because one cannot predict the outcome with certainty. It becomes an acceptable risk to the degree that the disputants see AW as a procedure

- From which they can benefit equally, which equitability ensures;
- That provides a guarantee of getting at least 50 points (which is the same guarantee as provided by divide-and-choose), implying that it is envy-free;
- That is efficient, so the disputants can rest assured that there is no agreement, equitable or otherwise, that can benefit both more.

If one side thinks that it can frighten the other side into submission by threats, or that it can wear down the other side through endless haggling, then the equitability and efficiency of AW, compelling as they are, will not be properties that get it adopted. Indeed, it may take months or even years of impasse, as was the case in the negotiations leading up to Camp David, before the two sides are willing to contemplate certain compromises. Only then, perhaps with the help of a mediator, might they be willing to hammer out an agreement.

The attraction of AW is that it allows the parties to reach closure immediately, at least once they agree on what the issues are and what winning and losing mean on each one. These, of course, are no small matters, but it is probably easier to reach agreement on them—and then let AW find a settlement—than it is to strike a complex overall agreement without AW.

DEFINING ISSUES

Identifying the key issues, and rendering them as separable as possible, is likely to be time-consuming, requiring protracted negotiations before the players can implement AW. But if the costs of delay are substantial, and the issues are quite narrowly defined, then the two sides should be able to reach agreement on these issues more quickly than if they try to reach a consensus without AW.

The determination of what is entailed by winning and losing on each issue would have to be worked out beforehand. As with the definition of the issues, this determination will require good-faith negotiations, possibly aided by a mediator. Also, some way of monitoring and enforcing the agreements reached on each issue—whoever wins or loses—would have to be built into the agreement once it is implemented.

After AW is applied, the two sides will also have to decide what winning and losing in relative terms mean on the one issue on which there is an equitability adjustment. In the case of Camp David, it was suggested earlier that the demilitarization of the Sinai, and the stationing of U.S. forces to monitor the agreement, were tantamount to Israel's winning one-sixth on this issue.

Negotiations on what partially winning and partially losing mean on the equitability-adjustment issue can await the application of AW, as we saw in Chapter 5. Once the equitability adjustment is known, and on what issue, the parties can be told this information (for example, a 5:1 split on the Sinai issue is required), but not which party is the relative (five-sixths) winner and which the relative (one-sixth) loser.

At this point they would be told to negotiate two agreements, one in which Israel is the five-sixths winner and one in which Egypt is the five-sixths winner. This negotiation will be facilitated by the fact that either party could be the one-sixth loser. Thus, if one side asks for the moon—figuratively speaking—if it should be the winner, so can the other side. This will chasten both sides to be fair-minded, lest the loser, which could be either side, ends up doing very badly. Thereby both sides will be motivated to reach agreement on what being the five-sixths winner means, whichever side this turns out to be.

None of the aforementioned practical considerations presents insuperable barriers to the use of AW. In order for the procedure to work best, the two sides would have to be educated as to the risks of trying to manipulate AW to their advantage or out of spite, including the likelihood that such manipulative strategies could backfire. They would also have to be advised on how best to define issues to make them as separable as possible, thereby ensuring that the addition of points across different issues, once AW is applied, is sensible. Finally, they would have to reach agreements about what winning and losing on each issue mean.

AW does not so much eliminate negotiations as require that they be structured in a certain way, which might help the disputants avoid minutiae that otherwise might entangle them and sink an agreement. Once this structuring is accomplished, AW finds a settlement that is envy-free, equitable, and efficient without further haggling.

This method of achieving closure is likely to save the two sides valuable time. Additionally, it should produce a better agreement than one reached after rancorous negotiations, which often leave

both sides with a bitter taste that impedes future negotiations. Not only does AW diminish this problem, but also it offers a quick way of renegotiating agreements should priorities change due to a change, for example, in government leaders or possibly fortuitous circumstances.

FAIRNESS OF THE CAMP DAVID AGREEMENT

Was the Camp David agreement fair? We believe it was, because it mostly coincided with what AW would have produced. And an AW resolution—one that is envy-free, equitable, and efficient—is our standard of fairness.

Many Egyptians were disappointed with the results of the Camp David talks. A former foreign minister of Egypt, Ismail Fahmy, wrote,

The treaty gives all the advantages to Israel while Egypt pays the price. As a result, peace cannot last unless the treaty undergoes radical revision.

In his book *Camp David: Peacemaking and Politics* (1986), political scientist William B. Quandt also claimed that Israel did better in the negotiations. However, our reconstruction of the negotiations using AW suggests that the settlement was probably as fair as it could be. If Fahmy were correct in his belief that an unfair peace could not last, then the last two decades of peaceful relations (albeit a “cold” peace) between Israel and Egypt is testimony to the contrary.

Reinforcing this view is the fact that the negotiators, while undoubtedly desiring to “win,” realized that this was not feasible because they were not in a total-conflict situation, wherein what one side wins the other side necessarily loses. Abetted by Jimmy Carter, they were driven to seek a settlement that, because it benefited both sides more or less equally, could be considered fair.

If it is surprising that a fair agreement was reached in the Middle East, it is probably more surprising that *any* agreement was concluded. In political disputes in general, and in international disputes in particular, players often expend much time and

energy on procedural matters before substantive questions are even addressed. The Egyptian-Israeli negotiations were no exception: The two sides fought vigorously over procedural issues at several points in the negotiations.

Disputants have a strong incentive to do this because procedures can be manipulated so as to bring about better or worse outcomes. By guaranteeing a resolution that is fair according to several important criteria, by comparison, AW affords disputants the opportunity to focus on substantive issues—while largely protecting them from procedural manipulation.

Another problem that plagues international disputes is the concern that one side will come out looking worse than the other, which sometimes pushes the more anxious side to abandon talks altogether rather than settle for a one-sided resolution—and then attempt to explain it back home. At Camp David, Sadat at one point expressed such a fear and packed his bags on the eleventh day with the intent of returning to Egypt. Only a strong personal appeal from Jimmy Carter, coupled with pointed threats, kept Sadat from breaking off the negotiations.

By guaranteeing an outcome with very appealing properties, AW can reduce the fears of the disputants and help keep negotiations on track. In all likelihood, it would have worked well in the Egyptian-Israeli conflict—producing a less crisis-driven atmosphere than was the case at Camp David, and possibly speeding up a settlement by two or three years—even if the outcome would not have differed much from that which actually was achieved.

This is not to say that fair-division procedures like AW are without shortcomings. For one thing, formal procedures do not have the flexibility of informal approaches, though “flexibility” can be a double-edged sword that, in finding shortcuts, produces arbitrary results. While the synergy of issues poses difficulties for rendering them separable, their adroit packaging can attenuate this problem.

The benefits of a straightforward procedure that guarantees important properties of fairness should not be underestimated. Fairness, or the lack thereof, has long been a battle cry of people

who feel either disadvantaged or exploited. To the extent that AW can help relieve their distress by resolving conflicts, it offers bright promise for the future. Chapters 7 and 8 explore probable outcomes that AW would give in recent disputes, most of a very different character from the sovereignty, security, and territorial issues of Camp David.