KELLOGG SCHOOL OF MANAGEMENT

Game Theory and Strategic Decision-Making

DECS-452
Spring

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"O wad some Pow'r the giftie gie us
To see oursels as others see us!
It wad frae monie a blunder free us
And foolish notion:"

To a Louse, Robert Burns

Introduction

A decision-maker normally faces two types of uncertainty. He (or she) may be unsure about the state of "Nature" –future interest rates or weather conditions, the amount of extractable minerals on a tract of land, whether a particular development project will be successful. Additionally, he may be unsure about the strategic behavior of other decision-makers — their marketing policies, their bidding behavior, their response to a breakdown in negotiations. Indeed, many decision-making problems involve direct confrontation between parties with conflicting interests — court battles, labor/management negotiations, arms limitation talks. And, in addition, a decision-maker must sometimes design a framework within which others will compete — an auction format must be chosen for the letting of contracts, a dispute must be arbitrated, a voting agenda must be established, a regulatory mechanism must be designed.

This course will focus on the unique and varied aspects of decision-making in the face of strategic uncertainty, although the role (and value) of information concerning other uncertainties in the environment will receive substantial regard. Topics to be covered include negotiation and arbitration, collusion and competition, building and sustaining a reputation, joint cost allocation, market entry and product differentiation, and competitive bidding.

A principal question is how to act when one holds private information (about anything, ranging from the state of Nature to one's own preferences). It is necessary to look at ourselves through our competitors' eyes, in order to properly choose our own actions (cf. Burns, quoted above). This course will elaborate upon this issue by considering several recent cases in which firms have made costly and foolish errors by ignoring this maxim.

During the course, students will be asked to participate in several role-playing exercises, each of which will culminate in the choice of an action to be matched against the actions of their fellows. Several case analyses and problems will also be assigned. Course grades will be based primarily on the completion of group projects involving the analysis of a few minicases (with self-chosen groups of 1-3) during Week 5 and a larger number of minicases (with self-chosen groups of 1-5) during the last three weeks of the quarter, with an optional (take-home) final examination counting at the margin. Specifically, performance in the role-plays will *not* be counted towards grades. However, failure to participate will count against you.

Readings and notes will be distributed each week, typically *after* related material has been developed in class or through out-of-class "games." The course material will also be posted on http://www.kellogg.northwestern.edu/faculty/weber/decs-452. **There is only one major rule which applies (via the Honor Code) throughout the course: You may *not* refer to material distributed in prior offerings of the course, nor may you discuss specific material with anyone who has previously taken the course until *after* we have covered that material in class.**

KELLOGG SCHOOL OF MANAGEMENT

Strategic Decision-Making

DECS-452 Professor Bob Weber

Rough Course Outline

A. Introduction
B. Decision trees and the extensive form
C. Strategies
D. Equilibrium analysis
E. The Ware case
F. Walkenhorst Chemical
G. The Dragon/Quantum case
H. The repeated Prisoners' Dilemma
I. The commons problem (the multi-person Prisoners' Dilemma)
J. The Akerlof “lemons” model
K. The Salty Dog case: Distributive bargaining
L. Ice-cream in the desert: The value of organizational authority
M. Multi-issue negotiations (the Riverside/DEC case)
N. Auctions and competitive bidding
O. The War of Attrition
P. Miscellany: The economics of gift-giving, cartel stability, ...
Q. Ethics

As the course progresses, I will distribute a detailed (nine-or-ten page) course outline. However, most portions of the outline will not be given out until *after* the related issues have been discussed in class.

KELLOGG SCHOOL OF MANAGEMENT

Strategic Decision-Making

DECS-452 Professor Bob Weber
Week #1 Leverone 567

(a) Read the attached material.

(b) Carry out the instructions on the sheet attached to the end of this packet (which refers to Example 3), and bring the sheet to our next meeting. Day section: Also enter your bids and submit the form on the class webpage no later than 9PM Thursday: http://www.kellogg.northwestern.edu/faculty/weber/decs-452.

(c) Over the coming weekend, play the poker game described on the next page (Example 2(a)) with a friend (or enemy); use a normal deck, and call the red cards "high" and the black cards "low". (Note: All red cards are equal, as are all black cards.) Try playing one role (either dealer [Player I] or responder [Player II]) for a while (say, about 20 hands), then switch roles. Be prepared to discuss your "strategies" (in both the dealer and non-dealer roles), how they worked, and what you learned as you played.

Also, for review purposes, you might wish to try working through Example 1.

Examples

1. (Decision-making under environmental uncertainty) Connecticut Electronics, in its use of gold-plating in a semiconductor memory module, has had adhesion problems caused by irregularities in electric flow during the plating process. Based on historical data, they know that approximately 70% of the time the current is fairly uniform, in which case the batch of modules they produce (one thousand at a time) will consist of roughly 90% good modules and only 10% defectives. The other 30% of the time, when the current is somewhat irregular, only 60% of the modules are good and 40% are defective.

Unfortunately, there is no way the engineers at CE can determine the uniformity of the current flow. However, they have several alternative ways to handle each batch. One alternative is to send the batch directly to the assembly operation and hope for the best; their records show that when they do this they incur subsequent delay and adjustment costs of about \$1000 for each 90%-good batch, and of about \$4000 for each 60%-good batch. Another alternative is to replate the entire batch; this ensures that that batch will be sufficiently free from defects so that no delay or adjustment costs will occur, but the replating costs \$2000.

(a) What should the company do? What is the (expected) cost per batch if they follow this strategy?

Testing a module is an expensive proposition. (A 4096-bit unit has more than 16 million interconnections.) Nevertheless, CE is thinking of testing one unit from each batch. The test will definitely establish whether that (single) unit is good or not.

(b) How should the outcome of such a test influence the replating decision? What is the expected value of the information gained from the test? (That is, how much should CE be willing to pay, in order to conduct the test?

1. (continued)

A unit from a particular batch is tested, and proves to be good.

(c) What is the probability that a second unit from the same batch will also test out to be good?

(d) How much should CE be willing to pay to test a second unit, after the first test is positive (i.e., the first item tested is good)? (Note: It is not immediately obvious that the outcome of a second test would affect their decision; if it wouldn't, then they shouldn't be willing to pay anything.)

2. (Decision-making under environmental *and* strategic uncertainty) Each of two players is dealt a high or low card, with equal probability. Each player antes $1, then looks (privately) at his or her own card. Player I (the dealer) may either fold, or bet $1. If I bets, then II may fold, call (matching the bet), or raise $1 (putting two more dollars on the table). Finally, if II raises, I may either fold or call (matching the $1 raise). A player wins the pot if his opponent folds, or if a call occurs and he holds a higher card than his opponent. If they hold equal cards, a call results in the pot being split evenly.

(a) How would you play this game as Player I? As Player II? Which role would you rather play?

(b) How would your strategy be affected if Player I also had the right to pass initially (i.e., to force Player II to make the first move)?

3. (Competitive bidding, with private valuations) You are one of two connoisseurs involved in the sealed-bid auction of a bottle of rare wine. The wine being sold is worth $_ to you, that is, **you would be indifferent between losing the auction, and paying this amount for the bottle**. Having sized up your opponent, you think it could be worth anything between $0 and $100 to him. (He has probably sized you up similarly.) The two valuations are subjective — primarily matters of taste — and therefore it is reasonable to assume that they are independent, i.e., the value you assign to the wine should not affect your assessment of his valuation. (Whoever wins the auction will drink the wine.)

Consider two different sets of rules under which the auction could be held:

(a) The winning (high) bidder receives the bottle, and pays the amount of his own bid. What will you bid? What do you think is your chance of winning with this bid?

(b) The winning (high) bidder is required to pay only the amount of the lower, losing bid. Now, what will you bid? What do you think is your chance of winning with this bid?

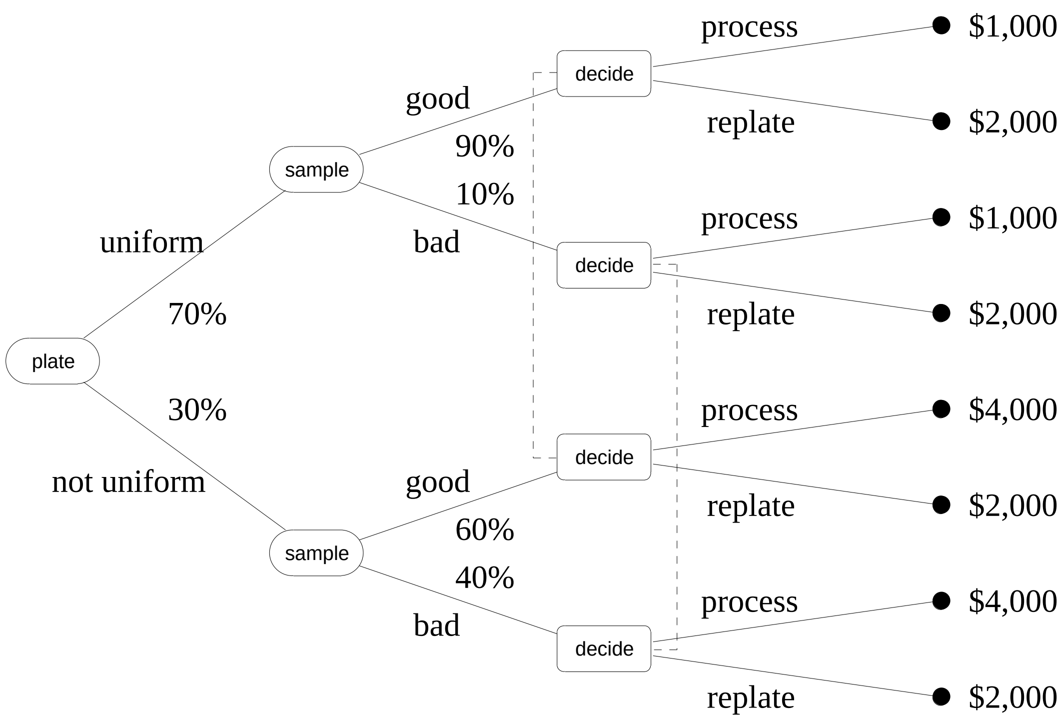
Simulation:

On the attached sheet, you will use your student ID number to determine the actual value of the bottle to you. You will have a pair of values, and will make two bids. (This is to avoid discriminating against those with low ID numbers.)

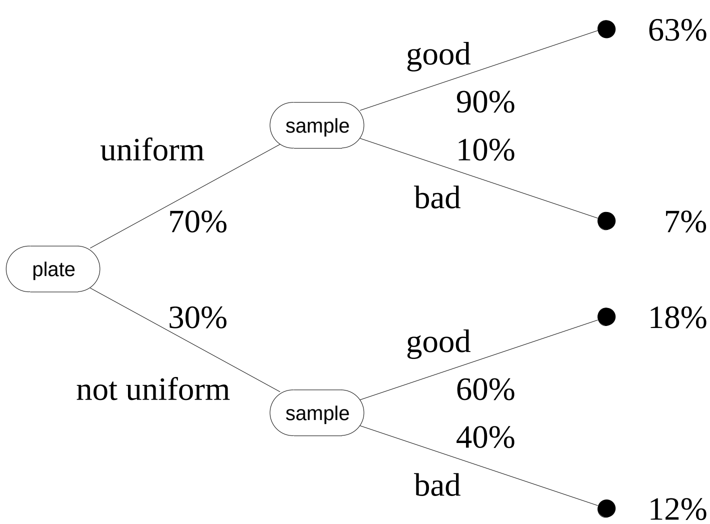
In class, I'll pick two of the sheets at random, flip a coin to select either the first or second values-and-bids (for auction (a)), sell the “wine” to the high bidder for the amount he or she bid, and immediately redeem it for his or her value (i.e., we'll simulate auction (a)).

Connecticut Electronics:

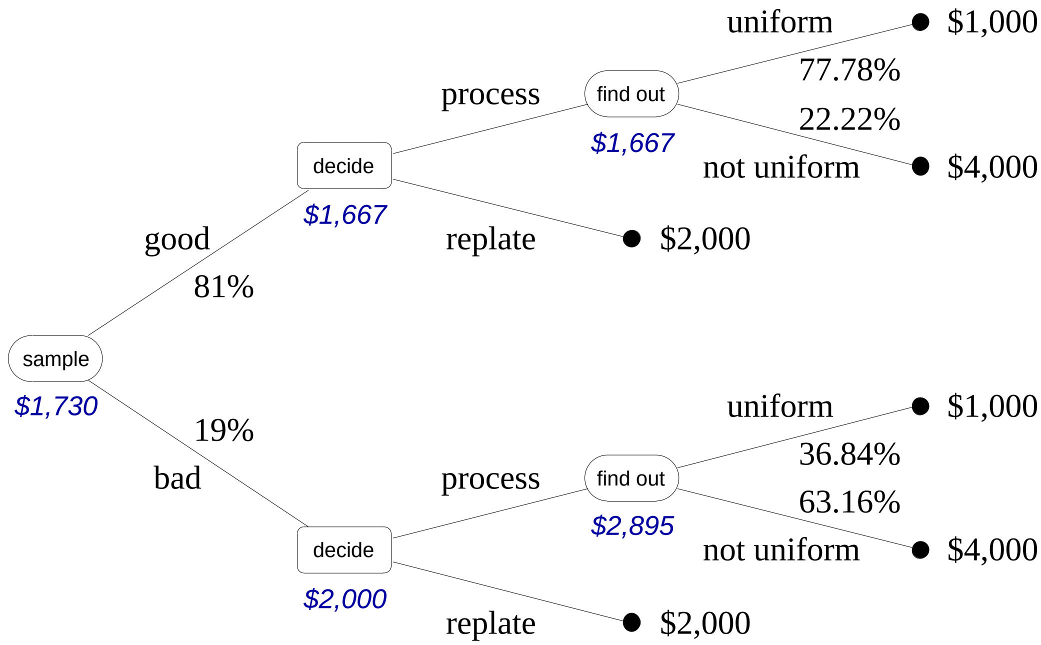
The temporal-order tree



The probability tree



The decision (informational-order) tree



Typically, the representation of a decision problem in temporal order requires the use of "information sets" which link decision nodes corresponding to the same "situation" (i.e., nodes at which precisely the same information is available at the time an action must be chosen). It is impossible to take systematically different actions at nodes in the same information set.

However, every single-person decision problem can be represented in informational order, by not listing any moves of "Nature" until they become observable. In this representation, each decision node is an information set by itself, and the problem can be analyzed by "pruning" the tree from the end.

The complication present in most strategic problems is that every representation has multi-node information sets. Hence, analysis of these problems requires a new type of reasoning.

Connecticut Electronics:

(a) Send the batch on to assembly, at an expected (rework) cost of $1900 per batch.

(b) If the tested item is good, send the batch on; if bad, replate the batch: The expected cost per batch is $1730, so it's worth $170 to do the test.

(c) 83.33%

(d) The information gained by testing a second unit, given that the first is "good", is worth $100. After the first unit tests OK, sending the batch on to assembly has an expected rework cost of $1666.67; if a second unit is tested, and the batch is replated if the second unit is "bad", the expected cost per batch (given that the first tested unit was good) is $1566.67.

Examples

	L		R	
T	1	-1	2	-2
B	3	-3	4	-4

A *dominant strategy* is a strategy that is optimal, no matter what strategy our competitor selects.

A *best response* to a competitor's choice of strategy is a strategy that maximizes our own expected payoff.

An *equilibrium point* of a (two-player) “game” is a pairing of strategies such that each is a best response to the other.

Incredibly important normative observation:

If two “players” are facing one another, and neither makes a mistake (that is, each correctly anticipates the other’s strategic choice, and responds optimally), then they will end up selecting strategies that together constitute an equilibrium point.

Still, ... pre-play signaling and positioning can affect the game itself;
we can try to lead others into making a mistake;
sometimes there are multiple equilibria

Incredibly important prescriptive observation:

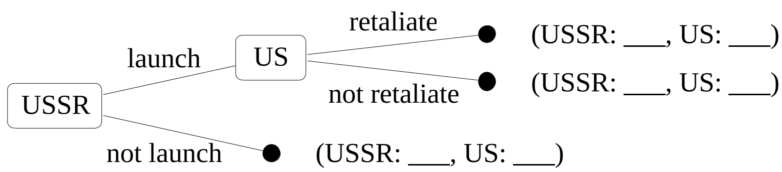
Generally, there’s much more to “playing a game” than just identifying an equilibrium point and playing your side of it.

	L		R	
T	4	-4	1	-1
B	3	-3	2	-2

The Strategic Value of Precommitment

We consider here the “game” of global thermonuclear war. Consider the situation facing U.S. military planners in the early 1950's. “We” had the bomb; “they” would have it soon. “We” were developing intercontinental ballistic missiles; “they” were doing the same. Wisely, the U.S. planners looked into the future, to see what this all might mean in a time of high international tension.

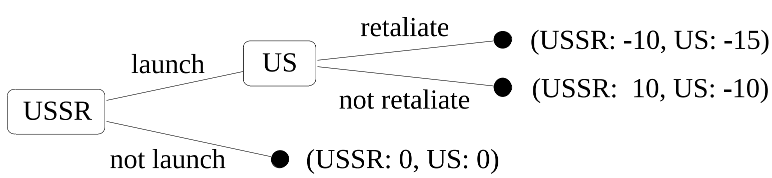
A working assumption was that the U.S. would not be the first to launch a strategic nuclear strike, but that retaliation to a first strike was a viable alternative. So the prospective situation looked something like this:



What would be the payoffs to each party from the various choices of actions? If the Soviets chose not to launch, then the crisis would be resolved conventionally: Let the payoffs to both sides be 0 (the non-nuclear status quo). If they launched, and the Americans chose not to retaliate, the result would be a victory for the U.S.S.R.: Represent this by a payoff of +10 to them, and -10 to the Americans. (The numbers need not be assigned dimensions: They simply represent a better-than-status-quo outcome to the U.S.S.R., and a worse-than-status-quo outcome to the U.S.)

What of the launch-and-retaliate outcome? Both countries would be devastated. Assign a (worse-than-status-quo) payoff of -10 to the Soviets. And the payoff to the Americans? This number has been the topic of heated debate for four decades. The early fears of radioactive fallout encircling the earth and destroying mankind were replaced in the seventies and eighties by the specter of “nuclear winter.” Consistently over time, there have been many who have believed that life itself would not survive a full-scale, two-sided exchange of nuclear weapons. Let us take a payoff of -15 for the Americans, to reflect this view. [There is no need here, or in the subsequent analysis, to compare the Soviet and American payoffs. We simply take the destruction of all life to be viewed by the U.S. as a worse outcome than the loss resulting from acceptance of an attack without retaliation. The rallying cry of nuclear disarmament advocates in the 50's and early 60's — “Better Red than dead!” — reflected the payoffs used here.]

Our representation of the situation in a time of world tension then becomes:



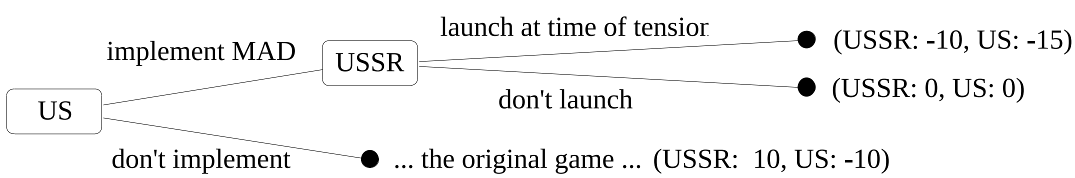
How might this situation be analyzed by the Soviets? With strategic wisdom, they would put themselves in the Americans' shoes, and predict the American response to a launch. The Americans would face an unattractive choice between payoffs of -10 and -15 (life isn't always fair), and their only rational response would be to take the -10, yielding a payoff of +10 to the U.S.S.R. Assuming the Americans to be rational, the Soviets could then return to their own choice problem, which presents them with an expected payoff of +10 if they launch, and 0 if they don't. Obviously, the better choice is to launch.

As one might imagine, this analysis frightened the American planners. But what could they do? One approach would be to ensure that the U.S. never again elected a rational leader. This seemed somewhat unattractive. Fortunately, they found another alternative. They built a "Doomsday Machine."

In the film **Dr. Strangelove**, an American SAC commander "goes a little funny in the head," and sends a wing of U.S. nuclear bombers to attack the Soviet Union. Unable to obtain the recall codes, the American president calls the Soviet premier, and offers to provide the information necessary to shoot down the planes. The Soviets reveal to the Americans the existence of their "Doomsday Machine," a gigantic bomb buried under their own country, large enough to destroy the world. The bomb is connected to a network of computers and seismographs. If a nuclear attack against the U.S.S.R. is detected, *or if an attempt is made to disconnect or reprogram the computers*, the bomb will automatically be detonated. The "Machine" was, of course, built as a deterrent. The mistake made by the Soviets (in the film) was in keeping its existence a secret.

Of course, the Americans didn't bury a bomb. Instead, they restructured the U.S. strategic nuclear command-and-control network, in order to make retaliation unavertable: They implemented the policy known (officially) as "MAD" — mutual assured destruction. The strategic triad (land-based ICBM's in hardened silos, strategic bombers carrying nuclear weapons, and, most importantly, submarines carrying nuclear missiles (SLBM's)) formed a decentralized retaliatory system, "programmed" to strike back under prespecified conditions. [The Polaris submarine project was the source of PERT techniques for project management: Those techniques were developed in order to make the third leg of the triad operational as quickly as possible.]

The Americans changed the order of moves in the game:



Putting themselves in the Russian's shoes, the Americans anticipated that once MAD was implemented (*and the implementation announced!*), the Russians would choose not to launch (and take a payoff of 0) rather than launch (and take a payoff of -10). Given this, the Americans were better off implementing MAD (and obtaining a payoff of 0) rather than not implementing (and eventually obtaining a payoff of -10).

Should this analysis seems simplistic, please note: Since MAD was implemented, nuclear weapons have not been fired in anger. [It might also be noted that the film came after the policy, and was inspired by it.]

The main lessons are:

1. the value of anticipating conflict before it actually arises.
2. the need to "put ourselves in our opponent's shoes" in order to properly analyze strategic problems.
3. the usefulness, at times, of binding precommitments.

With respect to the third lesson, note that having one's choice of actions restricted is *never* of positive value in a single-person decision problem. This is one important way in which strategic problems differ from those involving only one person.

Negotiation and Arbitration:
A Game-Theoretic Perspective

by

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1. **Introduction**

In the past few years, a number of texts have been written concerning the “art” of negotiation. The authors of these texts, with little exception, have relied on their personal experiences, and on historical precedent, to derive lists of maxims and “rules” for dealing with others in situations of conflict wherein mutual gain is available through cooperative action. While advice of this kind can be useful, few of the maxims have been given formal (i.e., non-experiential) justification, and there has been little discussion of the domain of applicability of the rules. A purpose of this paper is to provide a linkage between these popular treatises and recent game-theoretic research on bargaining and related issues.

On one level, the game-theoretic perspective involves formal quantitative models of negotiations, and much of the detailed analysis cannot directly be put into practice due to the difficulty in accurately estimating the preferences and beliefs of the involved parties. Fortunately, on another level one can gain much qualitative, applicable insight into real-world problems from an understanding of the principles involved in the formal analysis, and from a study of the various phenomena that arise in simple examples chosen to emphasize different components of more complex real problems. The organization of this paper was chosen to emphasize these principles and phenomena.

The focus of our approach is on interactions involving “rational” parties, who act as expected utility maximizers, who correctly perceive the structure of the “game” they are playing, and who deal with uncertainty according to the laws of probability. Experimentalists in the behavioral sciences have repeatedly shown that very few of their subjects perfectly satisfy these assumptions. Yet violations of the assumptions tend to be consistent in direction across individuals (cf. the Allais paradox, insensitivities to small probabilities, anchoring in the updating of beliefs, etc.). Hence, the study of fictitious rational parties provides both a norm against which actual behavior can be compared, and also a guide to participants in negotiations, as well as third-party interveners, about potential difficulties that can be anticipated, and at times avoided. Chapter 2 of this paper presents the concept of an “equilibrium” pairing of strategies in a game, together with a discussion of the reason for giving this concept a central focus in the remaining chapters. Chapter 4 develops a precise definition of “strategy” in settings where a party holds private information (about, for example, his own preferences).

Research into bargaining can be classified along two dimensions. One dimension distinguishes problems of “complete information,” in which both parties are fully informed concerning the possible outcomes and one another's preferences over those outcomes, from those of “incomplete information,” in which some aspects of the situation, typically the individual preferences, are not commonly known to the two parties. The latter case is the one usually faced in actual bargaining; the analysis of the former, simpler case serves to provide perspectives for generalization, and to delineate those issues in the latter which arise purely from the incompleteness of each party's information. One major difference is seen in the avoidability of conflict in the first case, and the inevitability of conflict (at times) in the second. Chapter 3 of this paper deals with negotiations in settings of complete information, and Chapter 4 extends the analysis to settings of incomplete information.

The other dimension distinguishes between studies of the actual mechanics of negotiation, wherein the parties exchange information through discussion of the issues and the making of offers and counter-offers, and the direct study and classification of agreements that could be reached through *some* set of mechanics. The central part of Chapter 4 deals with the characterization of the range of attainable agreements, while Chapter 5 examines several models that give specific regard to the role of time in the interaction between parties.

In discussing the models and issues which have arisen in research on bargaining, we will also present a perspective on the different roles played by third-party interveners in conflict situations. While we acknowledge that words such as "mediator" and "arbitrator" carry multiple connotations in common parlance, we will clarify the various roles by providing new, restrictive definitions for mediation, arbitration, regulation, and auditing. Discussion of these roles is interspersed throughout Chapters 3 and 4.

2. **Bargaining, viewed as a noncooperative game**

"Game theory" has traditionally divided its objects of study into "cooperative" and "noncooperative" games. The study of cooperative games begins with a specification of the possible agreements available to two or more parties in settings where their interests conflict, and focuses on the selection of an agreement (or set of agreements) with desired properties (e.g., equity, or stability).

In contrast, the study of noncooperative games focuses directly on the problem of individual strategic choice. The principal objects of investigation are the "equilibrium points" of a game: An **equilibrium point** is a collection of strategies, one for each player in the game, with the property that each player's specified strategy is optimal for him, given that the other players follow their specified strategies.

Why this focus on equilibria? A "game" can be loosely defined as a situation in which the final outcome for a participant depends not only on his own actions, but also on the actions of others. In order to appropriately choose his own action, the participant must formulate a belief about how the others will act: Presumably, he will then choose his own action as an optimal response to the anticipated actions of the others. If he believes the others to be rational, he must assume that they are going through the same process, that is, that they are formulating beliefs about *his* action, and choosing their own actions to respond optimally. One of two cases must hold: Either each party correctly formulates his beliefs, in which case the chosen actions form an equilibrium point of the game, or someone errs. Even in this latter case, the equilibria of the game provide standards to which the nature of the error can be compared.

This argument can be put more bluntly – If you are playing a game, and choose to employ a strategy which is *not* a component of some equilibrium point, then either (1) you are not acting optimally, given your expectations about your opponent's choice of strategy (i.e., *you* are acting foolishly), or (2) you are expecting your opponent either (a) to act non-optimally, given his expectations about your behavior, or (b) to form his expectations incorrectly (i.e., you are expecting *him* to act foolishly). Of course, people *do* act foolishly at times, and both psychological and decision-analytic research on negotiations has been directed towards an understanding of foolish actions and a development of prescriptive rules for the anticipation and exploitation of an opponent's foolishness. But only the game-theoretic perspective provides a view of the "rational" norm, in terms of which foolish actions can be defined, analyzed, and interpreted.

The adjective “noncooperative” is not to be confused with “competitive”: In a noncooperative game, mutual gain is frequently available through coordinated actions. A noncooperative game is simply a game in which the strategies of the players are given explicit regard, and in which binding agreements between the players are not permitted. (Later, we will introduce the notion of a “regulator,” an intervener who is given the power to exact penalties upon violators of an agreement. But even in the presence of a regulator, the parties retain full freedom of strategic choice: It is the existence of the penalties that enforces the agreement, by making violation of the agreement more costly than adherence to it.) The various actions available to the parties in the course of negotiations can be explicitly incorporated into the rules of a game; thus, the choice of what to say, and when to say it, becomes a strategic choice, and a negotiation problem, which has a cooperative flavor, can be studied as a noncooperative game.

We give three examples of noncooperative games and their equilibria: The first is trivial, and the latter two are well-known.

Example 1. Two acquaintances are discussing their plans for the evening. Each wishes to go to the opera. If they *both* attend, they will not only enjoy the opera itself, but also will enjoy one another's company.

Each has available two “strategies”: to go, or not to go. For each, “going” is a **dominant strategy**, preferred to the other strategy no matter what the other individual chooses to do. The only equilibrium pairing of strategies is (“go”, ”go”) (where, by convention, we label one of the two individuals “Player 1”, and write his strategy first); clearly, this is the choice of strategies we would expect to observe. Notice that there is no conflict of interest in this problem: There are no two different pairings of strategies, with one pair preferred by one party, and the other pair preferred by the other party.

Example 2 (The Prisoners' Dilemma). Two men have been arrested for a minor offense. However, the district attorney is certain (although he has no hard evidence) that they are also responsible for a much more serious crime. He separates the criminals, and offers each the same deal: If neither confesses to the more serious crime (such a confession would implicate both), he will ask for two-year sentences on the lesser offense. If both confess, he will request six-year sentences. But, if only one confesses, that one will go free, and the maximum penalty of the law (a ten-year sentence) will be requested for the other.

In this example, again, each has a dominant strategy: to confess. And again, the strategy pair (“confess”, “confess”) is the unique equilibrium point of the game. At this equilibrium point, both are worse off than at the outcome of the strategy pair (“don't confess”, “don't confess”). Yet, in the absence of any external, enforceable agreement, it must be expected that each will confess.

Example 3 (The Battle of the Sexes). A man (Rowan) and a woman (Columbia) must choose where to spend the weekend. Each can go either to the mountains or to the beach. Each derives pleasure from the other's company, and also from being at his or her more-favored location. However, the man favors the mountains, and the woman, the beach. The payoff matrix below indicates the utility payoffs to each, depending on the ultimate destination chosen by each.

		C	
		mountains	beach
R	mountains	$t_R + d_R, t_C$	d_R, d_C
	beach	0,0	$t_R, t_C + d_C$

(t represents the utility premium for "togetherness", d for "most-favored destination.") In order to focus on the most interesting case, we assume that the togetherness premium for each is greater than his or her destination premium.

In this example, there are three equilibrium points. (1) Both go to the mountains. (2) Both go to the beach. (3) R makes a random decision, going to the mountains with probability $1/2(1 + d_C/t_C)$; C goes to the mountains with probability $1/2(1 - d_R/t_R)$. This last, "mixed-strategy" equilibrium point is inferior for both parties to either of the first two equilibria. But the selection between the first two remains to be decided.

One possibility would be for the two to agree to a coin toss, to select a joint destination. But this merely confounds the problem: How should the coin be weighted? (Obviously, weightings other than 50:50 are possible.) Now, instead of bargaining over the choice of destination, they must choose from among an infinite number of possible weightings.

The Prisoners' Dilemma

	confess		don't	
confess	-6	-6	0	-10
don't	-10	0	-2	-2

... and Omerta

	confess		don't	
confess	-6	-6	-1000	-10
don't	-10	-1000	-2	-2

The generic "Battle of the Sexes"

	mountains		beach	
mountains	t_R+d_R	t_C	d_R	d_C
beach	0	0	t_R	t_C+d_C

Ships passing in the night: $t_R=t_C=1$, $d_R=d_C=2$

	mountains		beach	
mountains	3	1	2	2
beach	0	0	1	3

I will follow you ... : $t_R=1$, $t_C=2$, $d_R=2$, $d_C=1$

	mountains		beach	
mountains	3	2	2	1
beach	0	0	1	3

The real "Battle of the Sexes": $t_R=t_C=2$, $d_R=d_C=1$

	mountains		beach	
mountains	3	2	1	1
beach	0	0	2	3

Fatal Attraction: $t_R=-2$, $t_C=2$, $d_R=1$, $d_C=0$

	mountains		beach	
mountains	-1	2	1	0
beach	0	0	-1	2

DECS-452 Course Outline

A. Introduction

1. General comments
    a) The role of game theory in the M.B.A. curriculum
        1) The manager as competitor
        2) The manager as dispute resolver
    b) The relation between theory and practice
        1) Quantitative models (theory) illustrate qualitative concepts
        2) Qualitative concepts help identify important components of the strategic-choice process (practice)

2. **Dominance**
    a) Definition: One strategy dominates another if it does at least as well as the second against every possible opposing strategy. A strategy is dominant if it dominates all other strategies.
    b) Playing a dominant strategy (example). If we are rational, and we identify a dominant strategy for ourselves, we need do no further analysis.
    c) Anticipating an opponent's selection of a dominant strategy (example). If we believe our opponent to be sufficiently clever/rational to identify and follow a dominant strategy, then we should choose our own strategy to be an optimal response to the opponent's dominant strategy.

3. **Equilibrium points**: The prescriptions of a consistent theory of rational choice
    a) Definition: An equilibrium point of an n-person game is an n-tuple of strategies, one for each player, from which no player gains by deviating unilaterally. Alternatively: An equilibrium point specifies simultaneously for each player a strategy, together with his beliefs about how the others will act; for each, his specified action is optimal for him, given his specified beliefs, and furthermore the beliefs of each are correct.
    b) The Battle of the Sexes
        1) Multiplicity of equilibria
        2) The "focal point" effect: If the attention of all players can be brought to bear upon a specific equilibrium point, we should expect that equilibrium point to arise (even without direct communication among the players).
        3) Binding precommitments: Sometimes we can change the game, in order to avoid personally-disliked equilibrium outcomes.
    c) The Prisoners' Dilemma
        1) Potential inefficiency of equilibrium behavior
        2) Regulation (modification of the game): One way out of mutually-disadvantageous competition is to change the rules (or payoffs) of the game. ("Honor among thieves.")

From the *Oxford English Dictionary*:

omertà. dial. form of Ital. umiltà humility, with reference to the Mafia code which enjoins submission of the group to the leader as well as silence on all Mafia concerns. Refusal to give evidence by those concerned in the activities of the Mafia.

The Auction Experiment (for your notes)

Please fill out this form, and bring it to our next meeting. Day section: In addition, fill out the matching form on the class webpage (http://www.kellogg.northwestern.edu/faculty/weber/decs-452) no later than 9 PM Thursday night.

To begin, enter your name and student ID number below:

Name : __________________________

ID : __________________________

Next, write down the two-digit number formed by the last two digits of your student ID number:

Value #1 : $______

And now, subtract this number from 99, obtaining a second number between 0 and 99:

Value #2 : $______

First, we consider a standard sealed-bid auction, where the higher of the two submitted bids wins, and the winner pays the amount he or she bid.

Assuming the value of the bottle of wine (to you) to be Value #1:

What will you bid? ________ ($0-$100)

How likely do you think it is that your bid will win? ________ (0%-100%)

Assuming the value of the bottle of wine (to you) to be Value #2:

What will you bid? ________ ($0-$100)

How likely do you think it is that your bid will win? ________ (0%-100%)

Now, we consider an auction where the higher of the two submitted bids wins, but the winner only pays the amount of the (lower) losing bid.

Assuming the value of the bottle of wine (to you) to be Value #1:

What will you bid? ________ ($0-$100)

How likely do you think it is that your bid will win? ________ (0%-100%)

Assuming the value of the bottle of wine (to you) to be Value #2:

What will you bid? ________ ($0-$100)

How likely do you think it is that your bid will win? ________ (0%-100%)

The Auction Experiment (to turn in)

Please fill out this form, and bring it to our next meeting. Day section: In addition, fill out the matching form on the class webpage (http://www.kellogg.northwestern.edu/faculty/weber/decs-452) no later than 9 PM Thursday night.

To begin, enter your name and student ID number below:

Name : ___________________________

ID : ___________________________

Next, write down the two-digit number formed by the last two digits of your student ID number:

Value #1 : $______

And now, subtract this number from 99, obtaining a second number between 0 and 99:

Value #2 : $______

First, we consider a standard sealed-bid auction, where the higher of the two submitted bids wins, and the winner pays the amount he or she bid.

Assuming the value of the bottle of wine (to you) to be Value #1:

What will you bid? _________ ($0-$100)

How likely do you think it is that your bid will win? _________ (0%-100%)

Assuming the value of the bottle of wine (to you) to be Value #2:

What will you bid? _________ ($0-$100)

How likely do you think it is that your bid will win? _________ (0%-100%)

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