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Committee Voting Under Alternative Procedures and Preferences: An Experimental Analysis

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Abstract. This paper reports on four series of experiments in a five-person committee voting under majority rule. Each of two voting procedures was paired with each of two types of preference sets. The types were characterized as high or low intensity. Every set of preferences had a Condorcet point and that point was the best alternative for one (and only one) voter. When the high intensity preferences were used, committees operating under either voting procedure selected the Condorcet point more than 90% of the time; when low intensity payoffs were used, the success rate was less than 51%. A theory is suggested which predicts which preference sets should successfully induce selection of the Condorcet point and which should not; in the latter case, the same theory predicts that the choice will be confined to a certain collection of the other points. Our observations are consistent with this theory.

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1. Motivation

Economists model cartels as quantity-restricting organizations but invariably ignore the voting processes by which cartels select quotas. It is widely appreciated that differences among cartel members in costs and/or capacity create sharp conflicts of interest. But how these conflicts affect what quota members ultimately vote to adopt has not been investigated.

Recently, Cave and Salant (1987) presented a simple model of quantity-restricting organizations which choose quotas by majority-rule voting.[1] Their model was intended to explain the performance of U.S. industries governed by federal marketing orders. Such orders permit the establishment of volume-restricting cartels in fruit and vegetable industries. Marketing boards are exempt from antitrust laws; indeed, the federal government *enforces* their quotas and punishes violators.

Under law, every cartel selects by majority rule a fraction which then constitutes the maximum portion of each firm's stocks which it may sell on the regulated market.[2] The voters in each cartel are industry participants who serve for terms of fixed length. Cartel meetings are open to the public. The Department of Agriculture, which monitors cartel meetings, forbids sidepayments. Cave and Salant analyzed the case where the heterogeneity

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[1] Their model is not only applicable to cartels but also to international commodity organizations, marketing boards, and prorationing boards governing common properties.

[2] Whether the remaining stock can be sold on other markets, stored, or whether it must be destroyed depends on the particular order.

among firms in the industry was limited to their stocks (or, equivalently, to their capacity); the same methodology is currently being used to investigate the behavior of cartels with heterogeneity in costs as well.

Cave and Salant employed a two-step methodology. They first asked how the industry would behave for any quota the cartel might adopt.[3] Having derived equilibrium profits of each firm as a function of the scalar quota, they then used these "induced preferences" as payoffs in a prior voting game.

Cave and Salant showed that even in the case of linear demand, the induced preferences need not be single-peaked. Nonetheless, they proved under weak assumptions that these preferences always have a Condorcet point.[4] They then asserted that the committee would select the Condorcet quota under majority rule.[5]

There is wide diversity in the types of voting procedures and quotas used by different cartels. For example, the International Coffee Organization, unlike U.S. marketing boards, uses weighted majority-rule voting to determine quotas and bases its quotas not on available stocks or capacity but on exports in the recent past. As a result, the voter preferences induced by various quota choices would differ and—even if they did not—the difference in the voting procedure would alter the collective choice of the voters.

Before analyzing the political-economic equilibrium of other real-world cartels, it seemed wise to determine if people—at least in an experimentally-induced economy—have the foresight and sophistication to behave the way the theory predicts.[6]

We report here on the first phase of this experimental investigation. We began simply. Fiorina and Plott (1978) had designed an experiment in which a committee of five indi-

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[3] Although in Cave and Salant's model it is assumed that such quotas are perfectly enforced, in other contexts it may be more realistic to include penalties for cheating or trigger strategies explicitly in the "economic" part of the model from which voter preferences are derived. If, however, insight rather than realism is the principal goal, an analysis in which the enforcement issue is ignored and the collective choice problem is highlighted may be preferable; in addition, such an analysis complements the previous literature, which focused attention exclusively on the enforcement problem.

[4] Since this proposition may be of particular interest to participants in the Carnegie Conference, it is reviewed in Appendix 1.

[5] In retrospect, Cave and Salant (1987) paid inadequate attention to the voting game. The absence of a Condorcet point does not imply nonexistence of an equilibrium point and its presence does not insure that the Condorcet outcome will occur in equilibrium. Both observations will be illustrated below.

[6] There is ample basis for skepticism given that perfect equilibrium play is not always observed when people play tic-tac-toe or chess.

viduals selected a point in a two-dimensional issue-space by majority-rule voting. Plott (1979) had modified the instructions to allow the same committee to make a *sequence* of decisions. In both cases, preferences were symmetric and single-peaked.

We wished to examine how a committee would vote under the Fiorina-Plott procedures if the issue space was one-dimensional and preferences were the multi-peaked, asymmetric kind generated in the cartel model.[7] Had we found in our preliminary experiments that the Condorcet point was selected with high probability, we would have gone on to see how subjects would vote if they were not explicitly told the economic consequences of their voting but could profit by anticipating how alternative quotas would affect their cash winnings in a subsequent market game.

Unfortunately, we found in our preliminary experiments that committees often failed to select the Condorcet point when operating under the Fiorina-Plott instructions; indeed they sometimes *voted down* the Condorcet point when it had been proposed.

Although Fiorina and Plott (1978) reported observing such phenomena, they interpreted them more charitably. Even though in the most favorable series of their experiments ("high payoff, full communication") the Condorcet point was selected *only once in ten trials,* they nonetheless argued that many of the other committee choices were "close" to the Condorcet point in terms of the difference in the Cartesian coordinates of the two points (hereafter referred to as "Cartesian distance").

Our first reaction to the failure of committees to choose the Condorcet point was to reject the theory. But what theory? To our knowledge, no one has determined the sequential equilibrium of the game induced by the Fiorina-Plott instructions. No one knows if the Condorcet point is even in the set of equilibrium outcomes—let alone its unique element. The Fiorina-Plott game involves not only incomplete information about rivals' payoffs but also uncertainty as to which committee member will make the next proposal as well as the prospect of unending play. Unable to solve this complex game, we designed an alternative voting game which we could solve. This alternative game always has a unique subgame perfect equilibrium outcome even when the Condorcet point does

[7] Our instructions are included in Appendix 2. Except for a minor change regarding the termination of discussion, these are essentially Fiorina-Plott procedures.

not exist. But in cases where a Condorcet point exists and it is the best alternative of one of the voters, it will be the unique outcome of this voting game in any subgame perfect equilibrium. The alternative voting game gave us a theory to reject if a committee operating under this alternative procedure still failed to select the Condorcet point.

Our second reaction to the failure of our committees to select the Condorcet point in the preliminary experiments was to question the adequacy of the preferences we were attempting to induce. Were they "high payoff" relative to Fiorina and Plott's? Were the outcomes we observed 'close' to the Condorcet point even if they did not exactly coincide with it?

While both ideas seemed extremely useful in practice—if not in theory[8] —we found the term "high payoff" vague and the notion of Cartesian distance unhelpful. Presumably, preferences are "high payoff" if there are "strong forces of attraction" to the Condorcet point. Presumably, if a non-Condorcet point is chosen *despite* the fact that the forces of attraction to the Condorcet point are strong, then we would want to characterize the choice as a serious blunder and to refer to such an outcome as "far" from the Condorcet point. We developed a measure of distance and payoff intensity which has these characteristics and seems to us plausible; we discuss it in Section 2.

We used this measure of preference intensity to classify preference sets into two groups: high intensity on the one hand and low intensity on the other. We then ran four series of experiments. In each, we paired one of the two voting procedures with one of the two types of preferences. We describe the two voting procedures in Section 3 and the committee choices in each series of experiments in Section 4. We found that both procedures hit the Condorcet point with high probability when the preferences were "high intensity" by our definition. When the preferences were "low intensity" both procedures frequently failed to elicit the Condorcet point. Section 5 summarizes our conclusions and plans for future work.

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[8] In theory, the outcome of the alternative voting procedure should always be the Condorcet point regardless of the payoff intensity; as for the Fiorina-Plott procedure, it is unknown whether the set of subgame perfect equilibrium outcomes change if the payoff intensity changes while the Condorcet point remains fixed.

2. "Distance" from the Condorcet Point

A measure of distance from the Condorcet point has potential practical—if not theoretical—value for two reasons: it can be used (1) to distinguish among points which a committee might select and (2) to evaluate the "strength of attraction" of the Condorcet point in a given set of preferences.

If the committee chooses some alternative other than the Condorcet point, we wish to label it "near" the Condorcet point if it was chosen when the forces pushing toward the Condorcet point should have been weak and "far" when the forces pushing toward the Condorcet point should have been strong. If for a given set of preferences *every* point is "far" from the Condorcet point in the foregoing sense, then the particular set of preferences should strongly attract committees toward the Condorcet point. We refer to such preferences as "high intensity."

Fiorina and Plott make a similar distinction but do not define it in a way we could apply to our sets of preferences. Hence we have no way of knowing if our preliminary sessions were "high payoff" in their sense of the term. What aspect of the payoffs matters—the winnings in the session or the winnings at the Condorcet point *relative* to other points? Whose winnings—all individuals or selected individuals? If selected individuals, which ones?

A number which can be assigned to *any* preference set *ex ante* and which can be used to predict the likelihood that the Condorcet point is chosen seems invaluable. We propose a plausible distance measure below and suggest that it be used—merely as a starting point in investigations by others—to classify preference sets *ex ante*.

•Cartesian Distance

Plott (1979) classifies distance in terms of the difference in coordinates between the Condorcet point and the point selected in the experiment. Thus, if (56,67) is the Condorcet point and (60,75) is selected, then the "distance from equilibrium" is labelled (4,8). This measure is obviously of little use if the alternatives voted on are not numbers. But even when numbers happen to be assigned to the alternatives, these are mere labels; relabelling the alternatives should not affect the voting behavior of committee members under any conceivable theory based on self-interest. Any reasonable distance measure should be invariant to such relabelling. Since relabelling of alternatives directly alters the distance measure used by Fiorina and Plott, it seems to us inappropriate.

• An Alternative Measure of Distance

Any measure based on the *payoffs* associated with the underlying alternatives will be invariant to such relabellings. There are many such measures—*each* with its own defects. One might, for example, use as the distance measure the aggregate loss to the committee in moving from the Condorcet point to each alternative—but this measure would be nonpositive at some points (*e.g.* at the alternative maximizing joint profit). Alternatively, since some members of the committee (at least a bare majority) are worse off at any distinct point than at the Condorcet point, one could use the largest or the smallest of their losses as the measure of distance. We found neither of these measures appealing and sought some alternative.

In a five-person committee, at least three people lose money (relative to their payoff at the Condorcet point) whenever the Condorcet point is rejected. If all voted for the more profitable choice (the usual assumption), the Condorcet point would *always* win. Evidently, people are willing to incur small losses for unspecified reasons (computation costs, guilt, desire to be thought of as unselfish, etc.). However, it seems plausible to us that no subject would willingly incur a loss if it were sufficiently large. Suppose there is some threshold, t, such that *no one* would willingly incur a larger loss. If we insured that at *every* alternative to the Condorcet point there are at least three people who would lose at least t (the identity of the losers would change as the point changed), then a committee of five such individuals would *always* select the Condorcet point. On the other hand, if there existed a restricted set of points the committee could choose where the loss to at least three of the committee members was smaller than t, then such committees could not be counted on to select the Condorcet point. But we would then expect that the alternative the committee did select would be contained in this restricted set. That is, if the preference set also contained alternatives where at least three people (a majority) sustained losses of at least t by not selecting the Condorcet point, we would expect that no such alternative would be selected.

To implement this approach, we defined the distance between the Condorcet point and any other point as the third largest loss incurred by a committee member. We then associated the intensity i with a set of preferences where i is the distance to the closest alternative to the Condorcet point.

Clearly, if the population has some common threshold t and $i \geq t$, then the committee will always choose the Condorcet point since selecting any other alternative instead would impose a loss of at least t (indeed, of at least i) on a majority of the committee and such losses would—by hypothesis—not be acceptable. We classify such sets of preferences (where $i \geq t$) as "high intensity." All other preferences are referred to as "low intensity."

The usual proposition that for *any* set of preferences the Condorcet point will be chosen can be viewed as a special case where $t = 0$. In that case, since *every* nondegenerate preference set has $i > 0$, every preference set would be "high intensity" ($i \geq t$) and the theory would predict that the Condorcet point would always be chosen.

If $t > 0$, however, then there will exist preference sets which are low intensity. The theory in that case implies that no point more than t units from the Condorcet point will be chosen.

We based our estimate of t on observations from our experiments.

Our definition of payoff intensity is motivated by the foregoing theory. But the theory is admittedly inelegant and *ad hoc*. Moreover, the theory (unlike subgame perfection) makes no prediction whatsoever if the preference set has no Condorcet point.

On the other hand, perfect equilibrium theory suggests that payoff intensity should not matter—at least when the alternative voting procedure is used.[9] Our experimental results indicate that payoff intensity—as we have defined it—*does matter*. This suggests that at least some modification of that theory should be entertained. We return to this point in Section 5.

We conclude this section by applying our measure of payoff intensity to Fiorina and Plott's preference sets. Since they permitted only integer choices in their experiments, they have a finite set of alternatives—albeit a very large set. We could, therefore, locate the alternative closest to the Condorcet point. Instead, we merely note that *each* of the nine other points chosen instead of the Condorcet point in what they term their ten

[9] What such theory suggests in the case of Fiorina-Plott's instructions remains to be clarified.

"high payoff" sessions was within \$.001 of the Condorcet point by our distance measure—three orders of magnitude below our estimated threshold. Hence, the closest point would certainly be smaller than this threshold and we would characterize these preferences as "low intensity." Moreover, although the committee failed to choose the Condorcet point in 90% of these cases, the point the committee did select was always "close" by our measure.

3. The Two Voting Procedures

In this section, we describe the Fiorina-Plott voting procedure and highlight aspects of it which might cause an outcome other than the Condorcet point to be chosen. We then describe the alternative procedure which we developed. The alternative procedure has the advantage of simplicity. A game of complete information with a short horizon and no chance moves, it can easily be solved by backward induction.

The Fiorina-Plott Game

- The Rules

The Fiorina-Plott procedure can be summarized as follows. The process begins with an initial motion on the floor. Any committee member can then propose that this motion either be adopted on the one hand or replaced on the other. After a discussion period, a vote is taken. If the proposal is to replace the existing motion with an alternative then the winner becomes the motion on the floor. If a proposal to adopt loses, that motion remains on the floor and is subject to further proposals. If the proposal is to adopt and it wins the session ends.

Committee members raise their hands when they wish to make a proposal. When the experimenter is unable to tell which of several hands has been raised first (which we found happens frequently) he arbitrarily selects one of those raising his hand to make the next proposal.

Each committee member is given a table indicating his own payoff information. No one is given information about the payoffs of others—and everyone knows this. Discussion periods afford members the opportunity to convey messages about their payoffs. They are not permitted to threaten, offer sidepayments, or characterize the cardinal aspects of their payoff tables. While committee members have the opportunity to convey messages about their ordinal rankings, their colleagues have no independent way to verify the accuracy of these messages.

Payoff charts were denominated in tokens and players were publicly informed at the outset the common rate of exchange of tokens for dollars. At the end of the experiment subjects were paid dollars in exchange for the tokens they had won. The number of tokens players earned for a given configuration of preferences varied from experiment to experiment as did the dollar/token ratio. Thus the dollar payments varied as well.[10] In our preliminary experiments, we asked the committee to decide among 100 alternatives. To assist them, we provided each subject with a graphical representation of his private preferences, in addition to payoff schedules; in all of the experiments reported here, we limited the choice to 10 alternatives and dropped the graphical aid.

Although reducing the number of alternatives did not significantly affect the committee's propensity to select the Condorcet point, the character of the discussion sessions changed radically. Instead of confining themselves to occasional remarks about the alternatives on the floor, members used the discussion periods intensively to make statements about their ordinal preferences. Despite frequent discussion, we observed *not a single instance* where a subject asserted that his payoff from one alternative would be higher than his payoff from another alternative when in fact the reverse was true. Moreover, only once did a subject indicate after a session had concluded that he momentarily considered that other people might be misrepresenting their preferences. Even given the high proportion of mid-westerners among our subjects, we find this apparent truthfulness striking.

Each five-person committee met for approximately an hour and made approximately five separate, sequential decisions. Players were primarily undergraduate economics students at the University of Michigan.

- Some Theoretical Aspects of the Fiorina-Plott Game

[10] Fiorina and Plott maintained a one-to-one exchange rate between the numbers in the payoff tables and the dollar amount a subject was paid. They discovered that the committee was more likely to select the Condorcet point in "high payoff" sessions. Their design did not permit distinction between large payments in dollars on the one hand and large payments in tokens on the other. By changing the exchange rate, we were in principle able to distinguish the two effects in these experiments. However, there was not enough variation of the exchange rate in our experiments to reach firm conclusions. While we found no statistical evidence of "token illusion," further experiments are needed to confirm this.

Since subjects using the Fiorina-Plott instructions are given no information about the preferences of the other members of the committee, recent results on voting games under incomplete information may be relevant. Ordeshook and Palfrey (1986) have shown for a different majority-rule voting game under incomplete information that in sequential equilibrium "a Condorcet winner need not be chosen even if nearly everyone on the committee most prefers it."

However, even if we follow much of the experimental literature in hypothesizing that subjects behave under incomplete information the way theory predicts they will behave under complete information, we do not know what *that* theory predicts.

It was our experience that the experimenter is frequently confronted simultaneously with several raised hands and must determine arbitrarily which of these committee members will make the next proposal. In effect, even if the game had complete information the experimenter's decision in such cases introduces a random element into the game.

The complete information game might, therefore, be described as follows. There is an initial motion on the floor. Nature selects according to some stationary probability distribution which of the five committee members will make a proposal. That player then proposes one of the set of alternatives. If he proposes the motion already on the floor, it is interpreted as a motion to adopt; if he proposes some other motion, the interpretation is a proposal to replace. After he makes his proposal, a simultaneous vote occurs and a transition occurs to a new motion on the floor at the next stage. Once again, Nature makes an independent random choice of proposer...and so on. Discussion moves are ignored since they would be irrelevant if subjects had complete information.

Some branches of this game tree would never terminate; along such branches players receive a zero payoff from the experimenter. Branches terminate if and only if a member whom Nature selects proposes adoption and it passes; in that event, players receive from the experimenter the payoff associated with the proposal adopted by the committee.

We have not yet solved this game.[11] However, it has two aspects which deserve mention: variability of duration and uncertainty.

[11] Blume and Salant are currently attempting to characterize the subgame perfect equilibrium outcomes of the complete-information version of the Fiorina-Plott game. Since we are newcomers to this area, references to related work would be appreciated.

• • Variable Duration

The Fiorina-Plott instructions do not to control for subjects who are motivated to adopt an inferior choice early so that they can return to their job or studies (or, as subjects suggested in our Springtime sessions, to sun themselves on the quad). If they are sufficiently impatient, rational players might well adopt some point other than the Condorcet point rather than take the time necessary first to determine the location of that point and then to get called on to make a proposal.

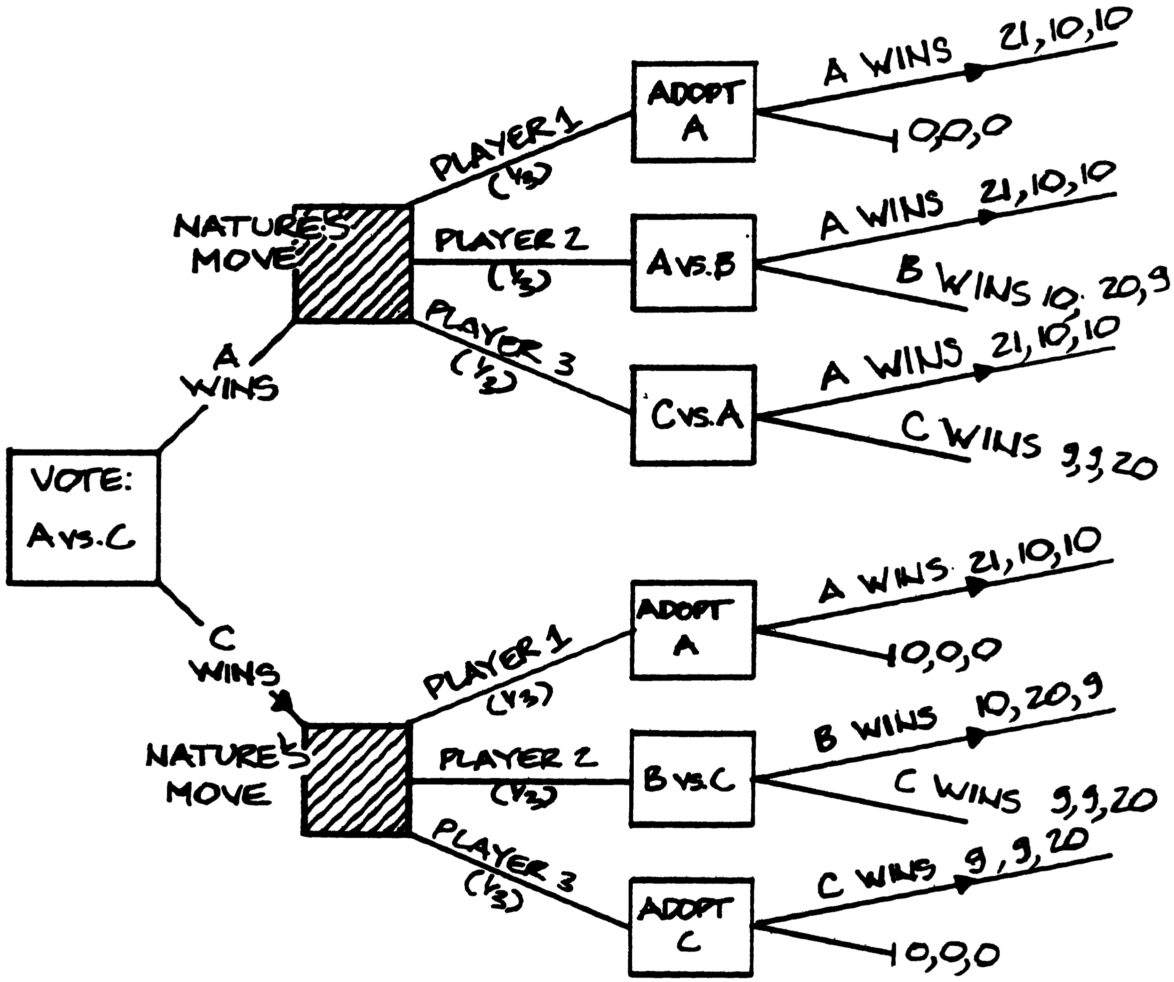
In addition, by conducting a sequence of sessions in a time-period which subjects must have surmised was limited, we created a situation where subjects may have feared that prolongation of one session would jeopardize the total number of sessions which could be run. Even in the absence of discounting, this might have altered incentives.

Formally, the original instructions and our adaptation of them to a sequence of decisions create a game where the payoffs to the subjects from playing down a particular branch might differ from the dollar amounts received from the experimenter.

• • Uncertainty

Impatience of this kind could explain why subjects with complete information might adopt a proposal prematurely—before the Condorcet point was proposed. But it cannot explain why the Condorcet point would ever be *rejected* once it was proposed. However, this sometimes happens. We observed the phenomenon in our preliminary experiments and Fiorina-Plott (1978,p.588) report an earlier sighting. One possible explanation of the phenomenon involves the randomness introduced in the experimenter's choice of proposer.

An example will focus the discussion. Consider the game in Figure 1. In this game, the Condorcet point (A) is paired against a given alternative at the penultimate stage. If the Condorcet point is voted down, the alternative will be the motion on the floor; if it is voted up, it remains the motion on the floor. In either case, Nature will choose who will make the final proposal. The final proposal is then voted on and the game ends. If the final proposal is to replace the existing motion with some alternative, the winner in the vote is the final committee choice and players receive the associated payoffs. If the final proposal is to adopt the existing motion and that proposal wins, players receive the



THE CONDORCET POINT (A) IS VOTED DOWN AT PENULTIMATE STAGE & WINS ONLY IF PLAYER 1 HAPPENS TO BE CHOSEN TO MAKE FINAL PROPOSAL.

FIG. 1

payoffs associated with that alternative; if the proposal to adopt is voted down in the final stage, players receive zero. [12]

If the Condorcet point wins in the first vote then the Condorcet point will be the final motion on the floor and—no matter who selects the final proposal—it will win in the final vote since it can beat any alternative which is proposed. Hence, at the penultimate stage, everyone will foresee that if the Condorcet point is chosen then the committee will ultimately select it.

Suppose, however, that the *alternative* to the Condorcet point wins in the penultimate stage. If one knew who would make the final proposal then one could work out what the final committee choice would be. Suppose the final choice varies depending on who gets called on to make the last proposal. Then even though the Condorcet point would win one majority's approval when paired against one alternative and another majority's approval when paired against the other alternative, nonetheless for the probabilities and payoffs in the Figure *it would lose when paired against a lottery of the three outcomes.* Thus, the committee would always vote down the Condorcet point at the penultimate stage. Which proposal the committee would ultimately adopt depends on the experimenter's choice of proposer.[13]

The Alternative Voting Procedure

The alternative voting procedure was designed to eliminate *each* of the problems and ambiguities we felt existed in the Fiorina-Plott procedure. Preferences were common knowledge: each member of the committee was given a copy of the same five tables indicating the payoffs to each voter from alternative committee decisions. Impatience was controlled for: subjects were told how long the session would last and were advised that—should they finish early—they would be required to participate in uncompensated sessions

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[12] Some payoff must be attached to this outcome; by assigning zero to it, we insure that it will never occur in equilibrium.

[13] In the Figure, there is a one-third probability that player 1 will be selected and hence a one-third chance that the Condorcet point will be the final choice of the committee. The chance that the Condorcet point will be the final selection can be reduced to zero by reducing to zero the odds that player 1 will make the final proposal.

to fill out the balance of the fixed time period. Uncertainty about the identity of subsequent proposers was also eliminated: proposals were made in a specified order as described below.

In each session, the committee member at one end of the table made the first proposal, the committee member next to him made the next proposal and so forth. At most, five proposals were entertained. If it was the turn of one of the first four subjects to make a proposal, some motion was on the floor and he could propose either that it be adopted or replaced. A vote then took place. If a proposal to replace had been made, the vote determined whether the previous motion or the proposed replacement was the motion bequeathed to the next proposer. If a proposal to adopt had been made and it was voted down, then the existing motion remained on the floor at the turn of the next proposer. If a proposal to adopt was victorious, the session ended and subjects received the payoffs associated with that committee choice. Failure to make some proposal when it was a committee member's turn resulted in forfeiture of his turn and a zero payoff to that individual for the session.

If it was the fifth subject's turn to make a proposal, the game concluded as follows. If he proposed some replacement of the existing motion, then the vote determined which of these alternatives was the final committee choice. If he proposed adoption of the existing motion and it was accepted, then the motion was deemed the final committee choice. If he proposed adoption and the proposal was defeated, every committee member received a zero payoff for the session.[14]

The subgame perfect equilibrium outcome associated with this procedure can be calculated by backwards induction. Given strict preferences, the *outcome* is unique. This uniqueness of the equilibrium outcome in any session in turn implies that there should be no intertemporal interactions among sessions.[15]

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[14] As was intended, the prospect of zero payoffs always deterred subjects from forfeiting their turn to propose and from voting down any proposal by the fifth person to adopt a motion.

[15] This follows from the standard "unravelling" argument. For any history in the previous sessions, the unique outcome will be chosen in the final session. Hence, no player in the penultimate session has any incentive to depart from his equilibrium strategy for that session in order to influence play in the final session...In practice, players had access to the payoff charts for every session and it was pointed out that there were no ties in any session in the payoff charts of any given player (preferences were strict). When

Uniqueness follows from a recursive argument. In the last stage, the proposer enters with some motion on the floor and can propose adoption or replacement by one of the nine alternatives. Since he knows each person's strict preferences, he can foresee—given each alternative proposal—the final outcome the committee would vote for; he would therefore select the proposal which would result in the committee selecting the final outcome he most prefers. His most preferred final outcome is unique since his preferences are strict. Every committee member will foresee what the final outcome will be for each motion on the floor at the last stage.

In the penultimate stage, the fourth proposer enters with some motion on the floor and can propose adoption or replacement by one of the nine alternatives. For any proposal he makes, committee members can foresee which pair of final outcomes they are really choosing between. Since the fourth proposer knows the strict preferences of the committee members over final outcomes, he can predict what final outcome would result from each proposal. The fourth proposer would then make the proposal which leads to the final outcome he most prefers. Since his preferences are strict, his most preferred final outcome will be unique...As long as preferences are strict, the final outcome is a unique function of the identity of the proposer and the motion on the floor. Since the initial proposer and the initial motion on the floor are pre-specified in the rules, the final outcome in any subgame perfect equilibrium is unique.[16]

The procedure has a unique equilibrium outcome even if no Condorcet point exists. However, if—as in our experiments—a Condorcet point exists which is the ideal point of one of the voters, then it will always be the unique equilibrium outcome. The proof is a variant of the proof of Farquharson's theorem about sophisticated voting.[17] First it can be verified that a Condorcet point would win at each subsequent stage of voting if it were ever proposed and would therefore be the final outcome if it were ever proposed.

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asked, we suggested that subjects would probably make more money if they focussed on the chart for the current session and disregarded future charts but that the decision was theirs. We were unable to detect empirically any interdependence between the choices of a given committee in different sessions.

[16] There will be many subgame perfect equilibria but all will have the same outcome. The multiplicity of equilibria arises because (1) if a voter is non-pivotal, he can change his vote without affecting the outcome and (2) the same final outcome might result from several alternative proposals of a given player.

[17] See Theorem 6.5 in Ordeshook (1986), p.271.

Next, note that if the person whose ideal point is the Condorcet point gets a turn to make a proposal he will insure that the Condorcet point is the final choice of the committee. Finally, observe that the committee will not adopt as final a different proposal before this person's turn because a majority of the committee prefers the Condorcet outcome to any alternative.

4. Results

We conducted forty-five sessions in total: twenty-four using the Fiorina-Plott procedure and twenty-one using the alternative procedure. In each session, one of twenty-one sets of preferences was used.[18] The preferences were developed by modifying preferences generated from the cartel model presented in Cave and Salant (1987). The cartel model produces preferences for any quota between 0 and 100% inclusive. As Appendix 1 shows the ideal point of one of the voters is always a Condorcet point. We computed the profits of five firms under ten alternative quotas (including the Condorcet quota), and relabelled them from 1 to 10. To generate a broad range of "distances", we monotonically transformed each individual's preferences. Selection, relabelling, and monotonic transformation all preserve the Condorcet point in the preference sets. Copies of the payoff charts are included in Appendix 4.

We estimated the threshold value t by assuming that observations of outcomes were drawn from two populations (high and low intensity) and that the intensity classification determined the probability of hitting the Condorcet point. For each threshold t dividing the two populations and each pair of "hit" probabilities, we computed the probability of drawing the observed sample of Condorcet hits. We then estimated the three parameters by maximum likelihood. The liklihood function is:

$$[P_h^{k_h}(1-P_h)^{(N_h-k_h)}][P_l^{k_l}(1-P_l)^{(N_l-k_l)}]$$

where P_i is the probability of Condorcet selection, k_i is the number of Condorcet selections, and N_i is the number of observations, for $i = h, l$, the high and low intensity populations

[18] Given our estimates of the threshold, ten of these preference sets are "high intensity."

respectively.[19] As discussed below, this estimation procedure put no weight on the implication of the theory that even when low intensity preferences were used the distance of the outcome from the Condorcet point should be within the threshold.

This procedure generated a threshold of \$1.20. [20] This estimate is consistent with our expectation from a glance at the raw data. Table 1 displays the intensity measure of each session in dollars and its success or failure—as well as the actual preference set used in the session, the committee type, and the point ultimately chosen by the committee. [21]

Employing the \$1.20 threshold value generated the results shown in the left-hand panel of Table 2. Under both voting procedures, the committees chose the Condorcet point greater than 90% of the time in the "high intensity" sessions, but less than 51% of the time in the "low intensity" sessions. The hypothesis that the parameters underlying the two intensity populations are nonetheless equal can be rejected at the .005 significance level. These results tend to confirm our hypothesis that the distance measure we employ is useful in determining which preferences are more likely to generate the Condorcet outcome.

Given the threshold value determined by the likelihood maximization procedure, our prediction that if committees did fail to select the Condorcet point the distance to the alternative actually selected would be below the threshold, is not borne out by the data. Alternatives other than the Condorcet point which were selected fell under the \$1.20 threshold only 6 out of 13 times, for a success rate of 46 %.

However, if the dollar threshold is raised to the next highest level (\$1.50), (thereby reclassifying the lone \$1.20 intensity session as low intensity), the value of the likelihood function falls to the second highest level[22] while the percentage of misses which are below

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[19] The maximum liklihood estimator of P_i is equal to k_i/N_i—which depends implicitly on the threshold. Once these two probability estimators were substituted back into the likelihood function, maximization with respect to t was done numerically.

[20] In fact, any t value between \$1.04 and \$1.20 is consistent with the maximum likelihood estimate, as can be seen from Table 1. We simply chose the upper bound of this interval.

[21] Only dollar distances are reported here. If instead distances were calculated in tokens, our maximum likelihood estimate of the threshold would be 7.90 tokens but the other results would be similar to those shown in Table 2 for dollar intensities. In our preliminary experiments we observed that the committees tended to do better when the token values were high, *even when dollar intensities were reduced*. However, in the actual experiments the correlation between token and dollar distances across sessions was too high to distinguish such "token illusion" if any occurs.

[22] A t value anywhere in the interval from \$1.20 to \$2.43, including \$1.50, generated the second highest likelihood value.

Table 1.

Preference Set and Experiment Type*		Point Chosen	Condorcet Point Chosen? (If not, distance to the alternative choice is shown)	Intensity of Preference Set
x	op	3	y	$3.56
k	op	2	y	$3.24
j	fp	7	y	$3.24
j	fp	3	n ($3.30)	$3.24
h	op	4	y	$3.09
h	op	1	n ($4.22)	$3.09
f	op	7	y	$3.09
f	op	7	y	$3.09
f	op	7	y	$3.09
f	fp	7	y	$3.09
f	fp	7	y	$3.09
f	fp	7	y	$3.09
h	fp	4	y	$3.09
h	fp	4	y	$3.09
y	op	3	y	$2.81
z	op	3	y	$2.81
w	op	4	y	$2.43
w	op	4	y	$2.43
w	op	4	y	$2.43
u	op	7	y	$2.43
u	op	7	y	$2.43
u	op	7	y	$2.43
w	fp	4	y	$2.43
w	fp	4	y	$2.43
u	fp	7	y	$2.43
u	fp	7	y	$2.43
a´´	fp	5	y	$1.20**
v	op	1	n ($1.41)	$1.04
v	op	8	n ($1.41)	$1.04
g	op	10	n ($1.41)	$1.04
v	fp	1	n ($1.41)	$1.04
a´	fp	4	y	$0.75
dt´	fp	5	n ($0.50)	$0.40
t´	fp	3	n ($1.26)	$0.34
dt	op	4	y	$0.32
a´	fp	2	y	$0.30
dt	fp	4	y	$0.16
d´	fp	3	y	$0.13
t	fp	9	n ($0.13)	$0.13
d	op	5	n ($0.96)	$0.11
i´	fp	3	n ($0.84)	$0.09
i	op	3	n ($0.34)	$0.07
d	fp	2	n ($0.05)	$0.05
i	fp	7	y	$0.04
i´´	fp	6	y	$0.04

*See Appendix 4 for a listing of the preference sets, indicated by letter. "fp" denotes a Fiorina-Plott type session, and "op" denotes a session with "ordered proposers."

**Dollar threshold selected by likelihood maximization procedure.

Table 2.

Threshold	$1.20				$1.50			
Committee Type	Ordered Proposers		Fiorina and Plott		Ordered Proposers		Fiorina and Plott	
Intensity Level	High	Low	High	Low	High	Low	High	Low
# of sessions	15	6	12	12	15	6	11	13
# of times the Condorcet point was chosen	14	1	11	6	14	1	10	7
% of times the Condorcet point was chosen	93.33%	16.67%	91.67%	50.00%	93.33%	16.67%	90.91%	53.85%
% of times an alternative choice fell under the threshold	46.16%				84.62%			

this higher threshold increases significantly. As is illustrated in the right-hand panel of Table 2 for the $1.50 threshold, committees using these slightly reclassified "high intensity" preferences continue to choose the Condorcet point with significantly greater frequency than do the "low intensity" committees. However, the percentage of the misses we recorded that lie within *this* threshold distance of the Condorcet point increases from 46% to 85%. These results bear out our expectation that when alternatives other than the Condorcet point were selected, they tended to lie within The threshold distance.

We have pooled the observations from both voting procedures in calculating both the estimates of t and the underlying probabilities. Contrary to our expectations, the procedure with "ordered proposers" did not significantly increase the probability of hitting the Condorcet point. A likelihood ratio test allowed us to reject at the .01 significance level the hypothesis that the parameters underlying the two voting procedures differed.

5. Conclusion

In this paper, we developed a measure of preference intensity and showed experimentally that committees operating under either voting procedure are much more likely to select the Condorcet point when "high intensity" preferences are used. We regard our measure as very useful empirically but find it unsatisfying theoretically.

Our experimental results using "low intensity" preferences and the alternative voting procedure are inconsistent with the predictions of perfect equilibrium theory.[23] Nonetheless, they *might* be consistent with a minor modification of that theory which takes "threshold effects" into account. One hypothesis we plan to test soon using our data is that—at each stage of the game—players select the better alternative with probability p when confronted with two alternatives whose expected payoffs differ by less than t but *always* select the better alternative when the differences exceed t. This would generate the unique equilibrium outcome for $t = 0$ but could generate a probability distribution over outcomes otherwise.

[23] Like many theories in economics, this one predicts that a given outcome will *invariably* occur rather than predicting that various outcomes will occur with specified probabilities. Theories of the former type are easily rejected by the data. To generate predictions of the latter type, we prefer to include the "error term" in the theory rather than merely to append it to the prediction in an *ad hoc* manner. In this case, however, there is no measurement error, unobserved variables, etc. which might be the source of the uncertainty. Hence, there seems no choice but to weaken the usual assumption of "rationality."

When more time and resources are available, we also plan to run further experiments to determine if our quite dissimilar voting procedures yield any differences in behavior which are statistically significant.

Appendix 1: Existence of a Condorcet Point with Multi-Peaked Preferences

Although multi-peaked, the preferences in our experiment always have a Condorcet point (which is the ideal point of one of the voters). In this appendix, we review conditions sufficient for the existence of such a point.[24] Preferences satisfying these conditions were generated by simulation of the Cave-Salant cartel model; they were then transformed in ways which preserved the existence of the Condorcet point.[25]

Assume an odd number (N) of voters with preferences $\Pi_i(F)$ (for $i = 1, \dots, N$) over a single issue $F \in [0, 1]$. Assume the preferences have the following properties:

A1. For each i, $\Pi_i(F)$ is continuous and achieves a maximum at I_i.[26]

A2. For each i, there exists a distinct scalar F_i—designated a "cutoff"—such that $\Pi_i(F)$ decreases for $F \geq F_i$. Without loss of generality, order the cutoffs and designate as voter 1 (respectively, voter N) the player with the largest (respectively, the smallest) cutoff. Hence $F_1 > F_2 > \cdots > F_N$.

A3. If $\tilde{F} \leq F_i$ and $\tilde{G} \leq F_i$ for some i and $\Pi_i(\tilde{F}) > \Pi_i(\tilde{G})$, then for every $j \neq i$ such that $\tilde{F} \leq F_j$ and $\tilde{G} \leq F_j$, $\Pi_j(\tilde{F}) > \Pi_j(\tilde{G})$.

Claim: If preferences satisfy A1–A3, then the ideal point of the voter with the median cutoff is preferred by a majority of the committee to any other $F \in [0, 1]$.

A formal proof for *any* odd number of voters is contained in Cave-Salant (1987). Here, we illustrate the argument by confining ourselves to the case where $N = 5$. In this case, voter 3 has the median cutoff. The claim is, therefore, that I_3 is the Condorcet point. From A1 and A2, $I_3 \leq F_3$.

Case (a): If $I_3 \geq F_4$, then I_3 is preferred to any $F \geq F_3$ by voters 3, 4, and 5. This follows from A2. Moreover, I_3 is preferred to any $F < F_3$ by voters 1, 2, and 3. This follows from A3. Hence, if $I_3 \geq F_4$, then I_3 is a Condorcet point.

[24] For details, see Cave and Salant (1987).

[25] First, ten points in the domain (including the Condorcet point) were selected; then these points were relabelled; finally, each preference was subjected to an increasing monotonic transformation.

[26] We do not assume that the maximum is unique. Our assumption of continuity of each $\Pi_i(F)$ could be weakened to the requirement that any jumps be downward.

Case (b): If instead $F_5 \leq I_3 < F_4$, then as before I_3 is preferred to any $F < F_3$ by voters 1, 2, and 3. This follows from A3. Moreover, as before, using A2, voters 3 and 5 prefer I_3 to any $F \geq F_3$. To prove that voter 4 likewise prefers I_3, however, requires an additional step. From A3, we know that voter 4 prefers I_3 to F_4. We know that $\Pi_4(F)$ is continuous at F_4 and is decreasing for $F > F_4$. Hence voter 4 must prefer I_3 to F_4 and it would defeat any alternative in pairwise voting.

Case (c): If instead $I_3 < F_5$, once again it is clear that I_3 is preferred to any $F < F_3$ by voters 1, 2, and 3 and for the same reasons. That voters 4 and 5 will join 3 in preferring I_3 to any $F \geq F_3$ requires the same two–step argument used in the previous case.

To complete this appendix, we consider two ways to generate a set of preferences with the foregoing properties. The first way is an *ad hoc* constructive procedure; the second way shows that the induced preferences of a standard cartel model satisfy A1 through A4.

Geometric Construction

- Draw one continuous function of F (it may have multiple peaks).
- Monotonically transform it four times to obtain five separate preference functions.
- Pick five distinct cutoffs with $F_1 > F_2 > \cdots > F_5$ and assign one to each of the five preferences.
- Check that each preference function is decreasing for $F \geq F_i$; if any is not, replace that portion of the function with one that has the same value at F_i but is decreasing for $F > F_i$.

The ideal point of the voter with the third cutoff is the Condorcet point for this set of preferences.

Cartel Model

Cave and Salant (1987) considered the case of quota restrictions applicable to N firms with common constant marginal cost C and distinct capacity constraints $(q_1 < q_2 < \cdots < q_N)$. Under the quota, firm i is allowed to produce $y_i \leq q_i F$, where F is chosen by a committee of sellers. Assumptions are made to insure that each firm's optimization problem is concave and that a unique equilibrium exists in pure strategies for any F. Let $\Pi_i(F)$ be firm i's profit in the Nash equilibrium if the quota is F.

Cave and Salant show that $\{\Pi_i(F)\}$ satisfy A1 through A3 and therefore have a Condorcet point.

Consider the largest quota which binds on firm i. Since the firm with the smallest capacity (q_1) is allowed to sell the least ($q_1 F$), it will be constrained at a larger quota than the other firms. Moreover, the firm with the next smallest capacity will be the next to be constrained. It remains to verify that these points where the firms are constrained have the properties of the cutoffs $\{F_i\}$ in A2. Intuitively, since $q_1 < q_2 < \cdots < q_N$, $F_1 > F_2 > \cdots > F_N$. In addition, since relaxation of a quota which is already nonbinding on firm i can only hurt i by allowing other members of the cartel to expand and thereby drive down the price, $\Pi_i(F)$ decreases for $F \geq F_i$. Thus, A2 holds.

If a firm is constrained, its profits are simply the net price times its allowed sales. Hence, if firm i prefers quota $\tilde{F}$ to quota $\tilde{G}$, then $q_i\tilde{F}[P(\tilde{F}) - C] > q_i\tilde{G}[P(\tilde{G}) - C]$. Now consider firm j. Multiplying each side of the foregoing inequality by $\frac{q_j}{q_i}$ we obtain $q_j\tilde{F}[P(\tilde{F}) - C] > q_j\tilde{G}[P(\tilde{G}) - C]$. This implies that firm j will likewise prefer $\tilde{F}$ to $\tilde{G}$ provided it is constrained at both quotas. Thus, A3 holds.

Appendix 2: Instructions for Modified[27] Fiorina-Plott Procedure

[27] Except for occasional changes in wording, the main modification of the Fiorina-Plott instructions is a minor change in the rules regarding termination of discussion; in practice, our time limit on discussion was never invoked.

Instructions for
Committee Experiment

General. You are about to participate in a committee process experiment in which one of ten competing alternatives will be chosen by majority rule. The instructions are simple. If you follow them carefully and make good decisions, you might earn a considerable amount of money. You will be paid in cash at the end of the experiment.

Instructions to Committee Members. There will be six sessions this morning. In each session, you and your fellow committee members in this room will be asked to reach a collective decision by majority rule. In each session, your five- person committee--after considering a series of alternatives--will select one and only one alternative from a set of ten alternatives. Your compensation for that session will be dictated by the final choice of the committee as described in your private Payoff Table. For example, suppose your Payoff Table was the attached Sample Table and that the committee's final choice of alternative is the point (x) = (7). Your winnings in this session would be 6.75 tokens. At the end of the series of sessions, you will be paid in dollars one fourth of your cumulative winnings of tokens.

You should be aware that different individuals will receive <u>different</u> Payoff Tables. For the convenience of each committee member, private Payoff Tables have each been arranged so that the alternative yielding the most tokens is listed first, the one yielding the next most tokens is listed second...and the least profitable alternative is listed last (tenth).

You will not all have the same patterns of preferred choices and will have different payoffs as well. The committee choice which would result in the highest payoff to you may not result in the highest payoff to someone else. You should decide what choice you want the committee to make and do whatever you wish within the confines of the rules to get things to go your way.

The experimenters are not primarily concerned with whether or how you participate so long as you stay within the confines of the rules. You are free, if you wish, to discuss with your fellow committee members which proposals you like best. But under no circumstances may you mention anything quantitative about your compensation or show your Payoff Table to your fellow committee members. Nor may you mention anything about activities which might involve you and other committee members after the experiment, i.e., no deals to divide winnings afterward and no physical threats.

Parliamentary Rules. The process begins with an existing motion (1) on the floor. You are free to propose amendments to this motion. Suppose, for example, (1) is the motion on the floor and you want the group to consider the amendment (4). Simply raise your hand and, when you are recognized by the experimenter, say "I move to amend the motion to (4)." At that time any individual will have the opportunity-- when recognized by the experimenter-- to argue either in favor of the motion on the floor or its proposed amendment. No individual shall speak for more than five minutes on any particular proposal. Once anyone wishing to has had the opportunity to speak, the group votes on the amendment. If three or more individuals (a majority of the committee) favor the amendment, (4) is the new motion on the floor and is subject, itself, to amendments. If less than three individuals favor the proposed amendment, it fails and the motion (1) remains on the floor and is subject to further amendment. Thus, amendments simply change the motion on the floor. Your committee may pass as many amendments as it wishes.

Provided no amendment is under consideration, you are free to propose that the motion on the floor be adopted as the final choice of the committee. Simply raise your hand and, when recognized by the experimenter, say "I propose that we adopt the existing motion on the floor." At that time any individual will have the opportunity--when recognized by the experimenter--to argue in favor of or against this proposal. No individual shall speak for more than five minutes. Once each of you has had the opportunity to speak, the proposal to adopt the motion on the floor will be voted on. If three or more of you vote in favor of the proposal, the motion on the floor becomes the final choice of the committee and the session terminates. If your proposal is rejected, the amendment process resumes.

To sum up, the existing motion on the floor is (1). You are free to amend this motion as you wish. The session will not end until three or more of you consent to end debate and accept some motion. Your compensation will be determined by the motion on the floor finally adopted by the majority.

At the end of each session, you should circle the committee's final choice and your winnings for that session on your Payoff Table. A new Payoff Table will be issued to you at the beginning of the next session. At the end of the last session, your cumulative winnings of tokens will be computed. You will be paid in dollars one fourth of your cumulative winnings of tokens (dollars equal tokens divided by four). Hence the more tokens you win, the more dollars you win.

Are there any questions?

Appendix 3: Instructions for Alternative Procedure of "Ordered Proposers"

Instructions for
Committee Experiment

General. You are about to participate in a committee process experiment in which one of ten competing alternatives (designated "one," "two,"..., "ten") will be chosen by majority rule. The instructions are simple. If you follow them carefully and make good decisions, you might earn a considerable amount of money.

The experiment should take approximately one hour and a half. There is no advantage in rushing to finish sooner since in that event a supplementary session for which there is no compensation will be used to fill up the balance of the time. You will be paid in cash--but only at the end.

Instructions to Committee Members. There will be *three* sessions this morning. In each session, you and your fellow committee members in this room will be asked to reach a collective decision by majority rule.

In each session, you will take turns making proposals. After each proposal, the experimenter will ask your five-person committee to vote on the proposal. If a proposal to adopt some motion as final is made and passes by majority rule, the session ends. Otherwise, a different committee member will be asked to make a proposal. After at most five such proposals are voted on, the session must end. The motion adopted as final by the committee, or the motion remaining on the floor after the fifth person's turn to make a proposal, will be deemed the final choice of the committee.

Your compensation for the session will be dictated by this final choice of the committee as described in your Payoff Table. For example, suppose your Payoff Table was the attached Sample Table and that the committee's final choice of alternative is the point (x) = (7). Your winnings in this session would be 6.75 tokens. At the end of the series of sessions, you will be paid in dollars one third of your cumulative winnings of tokens.

In each session, you will receive a sheet of paper containing not only *your* own Payoff Table but also the Payoff Tables of *every* member of the committee. That is, in each session every one of you will learn not only his own Payoff Table but the Payoff Table of every other player. To distinguish your own Payoff Table, it is circled in red.

For your convenience, the alternatives in each table have been re-arranged so that--for each voter--the alternative with the highest payoff appears first, the alternative with the next highest payoff appears second, and so forth. There will never be any ties: in none of the three sessions will anyone get the identical payoff from two alternatives.

The Payoff Tables for a given session contain a lot of information. You will be given *five minutes* at the start of each session to study them. You should note how *your* table differs from that of the *other* committee members. *The committee choice which would result in the highest payoff to you may not result in the highest payoff to someone else.*

You should decide what alternative you want the committee to choose and--given how other committee members are likely to behave--what you should do to get things to go your way. The experimenters are not primarily concerned with how you participate so long as you stay within the confines of the rules.

Parliamentary Rules. The process begins with an existing motion on the floor. By convention, it will be the number "one" (1) in every session. The committee member on your extreme right will make the first proposal. After his proposal is voted on, the session either ends or continues. If it continues, it becomes the turn of the person *on his left* to make the next proposal...and so on.

Whenever a person makes a proposal, there will always be some existing motion on the floor. The person may make one of two proposals: 1) a "proposal to adopt" the existing motion as final or 2) a "proposal to replace" the existing motion with one of the nine alternatives. *If no proposal is made, the person forfeits his turn to propose and receives zero for the session no matter how he votes in the future*; if such forfeiture occurs, the existing motion remains on the floor and the next person will have a turn to make a proposal. Each proposer will be given *two minutes* to formulate his proposal. The experimenter will remind him or her when the two minutes have elapsed.

After each proposal, the entire committee deliberates **in silence** for *two minutes*. At the end of that period, the experimenter will call for a vote. A proposal wins if at least three people (a majority of your committee) vote for it.

1) If the proposal was "a proposal to adopt" the existing motion as final and it passes, then the session ends. If such a proposal fails, the motion on the floor remains on the floor and it is the next committee member's turn to make a proposal.

2) If instead the proposal was "a proposal to replace" the existing motion with one of the nine alternatives and it passes, then the proposed replacement becomes the new motion on the floor. If such a proposal fails, the prior motion on the floor remains on the floor and it is the next committee member's turn to make a proposal.

If no motion is adopted as final before the last committee member's turn to make a proposal, then the session must end as follows: The last committee member may make a "proposal to adopt" the existing motion on the floor. If a majority of the committee accepts this proposal, then this motion becomes the final committee choice and each participant receives the payoff associated with that choice in his Payoff Table.

If the "proposal to adopt" is voted down by a majority of the committee, then the session ends and each participant earns zero for the session.

If the last committee member instead makes a "proposal to replace" the existing motion with one of the nine alternatives, then the committee vote determines whether the existing motion or the proposed replacement is the final committee choice. Each participant then receives the payoff associated with that choice in his Payoff Table.

If the last committee member *fails to make any proposal* at the end of two minutes, he receives zero tokens for the session and the final committee decision is deemed to be the existing motion on the floor. Payoffs to the other four committee members are determined from their Payoff Tables.

To sum up, the session ends either when a "proposal to adopt" wins approval or after the fifth commitee member has his turn to make a proposal. The final choice of the committee is deemed to be either 1) the motion which wins in a proposal for adoption or 2) the alternative which wins in the final vote. Should a "proposal to adopt" fail on the fifth vote, the session ends and all participants earn zero for the session. Any individual who fails to make a proposal when it is his turn to do so earns zero tokens for the session. Otherwise, each participant wins in the session the number of tokens associated in his Payoff Table with the final decision of the committee.

At the end of each session, you should circle your winnings for that session on your Payoff Table. A new Payoff Table will be issued to you at the beginning of the next session. At the end of the hour and a half and after the third session has been completed, your cumulative winnings of tokens will be computed. You will be paid in cash one third of your cumulative winnings of tokens (thirty-three cents for every token earned in the experiment).

Are there any questions?

Test

To make sure that you understand the procedures, we would like you to answer the following questions in the spaces provided using the attached Sample Payoff Table. We will collect your answers, and will clarify any sources of confusion before the experiment commences. We want to make sure that each of you thoroughly understands the rules before we begin the experiment.

1. At _________ I would make the most possible money. The amount of tokens I would win is _________. The amount of dollars I would therefore receive is __________.

2. Suppose (8) is the motion on the floor and a "proposal to replace" it with the alternative (6) passes, then the new motion on the floor is _________ . Suppose the proposal fails. Then the motion on the floor is _________. If the "proposal to replace" was made by the middle person at your table, it would be the turn of (first name) to make the next proposal. If all five members had taken a turn making a proposal, then the game (continues, ends).

3. Suppose it is my turn to make a proposal. At the end of _____minutes, the experimenter will remind me that it is time to make my proposal. If I fail to make one then, I will earn _________tokens for the session no matter how I subsequently vote or what the commitee chooses as its final decision.

4. Suppose (8) is the motion on the floor and it is the turn of one of the first four proposers to make his proposal. If he proposes adoption as final and it passes, *your* winnings in tokens would be __________. Your winnings in dollars would be__________. If he proposes adoption as final and it fails, then the new motion on the floor is __________.

5. Suppose (8) is the motion on the floor and all five members have taken a turn making a proposal. If the final proposal is to adopt the existing motion and it *fails*, your winnings in tokens for this session would be ___________. Your compensation in dollars would therefore be ___________.

Appendix 4: Preference Sets

.: sesf

Condorcet Point = 7 Distance = 12.72 Tokens

VOTE	PLAYER1 TOKENS
7	23.60
8	10.64
9	10.56
10	10.48
3	10.40
6	5.84
5	5.68
4	5.04
2	4.72
1	0.00

VOTE	PLAYER2 TOKENS
10	24.80
9	22.14
8	20.43
7	18.72
6	5.90
3	5.80
5	2.95
4	1.05
2	0.77
1	0.10

VOTE	PLAYER3 TOKENS
3	37.60
4	31.60
2	28.00
1	25.90
5	19.60
6	13.60
7	12.94
8	0.22
9	0.16
10	0.04

VOTE	PLAYER4 TOKENS
10	24.90
9	22.24
8	20.53
7	18.82
6	6.00
3	5.90
5	3.05
4	1.15
2	0.86
1	0.20

VOTE	PLAYER5 TOKENS
3	37.64
4	31.64
2	28.04
1	25.94
5	19.64
6	13.64
7	12.98
8	0.26
9	0.20
10	0.08

sesd Condorcet point = 3 Distance = 2.63 Tokens

VOTE	PLAYER1 TOKENS
1	288.20
2	214.20
3	188.70
4	170.00
5	163.40
6	161.8
7	159.30
8	157.70
9	156.50
10	156.00

VOTE	PLAYER2 TOKENS
1	184.80
2	172.30
3	146.70
4	128.00
5	121.90
6	119.80
7	117.70
8	115.70
9	115.50
10	115.00

VOTE	PLAYER3 TOKENS
3	106.83
2	91.00
4	89.00
1	88.70
5	82.90
6	80.80
7	78.70
8	76.70
9	76.17
10	76.00

VOTE	PLAYER4 TOKENS
5	58.90
6	56.80
4	54.90
7	54.70
8	52.70
9	52.03
10	52.00
3	35.60
2	30.33
1	29.60

VOTE	PLAYER5 TOKENS
10	46.00
9	45.97
8	44.60
7	40.40
6	36.10
5	31.50
4	27.4
3	17.80
2	15.17
1	14.77

SESG Condorcet Point = 2 Distance = 4.15 Tokens

VOTE	PLAYER1 TOKENS
9	20.00
10	18.60
1	17.70
2	16.80
3	12.65
6	12.60
4	9.90
5	7.50
7	7.35
8	1.50

VOTE	PLAYER2 TOKENS
9	20.00
10	18.60
1	17.70
2	16.80
3	12.65
6	12.60
4	9.90
5	7.50
7	7.35
8	1.50

VOTE	PLAYER3 TOKENS
2	19.70
1	14.30
10	14.06
6	13.40
3	13.28
9	13.04
4	9.32
5	5.78
7	5.54
8	2.00

VOTE	PLAYER4 TOKENS
5	33.50
6	28.50
7	25.50
8	23.75
4	18.50
3	13.50
2	8.10
1	2.35
10	2.30
9	2.20

VOTE	PLAYER5 TOKENS
5	33.50
6	28.50
7	25.50
8	23.75
4	18.50
3	13.50
2	8.10
1	2.35
10	2.30
9	2.20

sesh   Condorcet Point = 4   Distance = 12.72 Tokens

PLAYER1

VOTE	TOKENS
1	24.80
2	22.14
3	20.43
4	18.72
5	5.90
8	5.80
6	2.95
7	1.05
9	0.77
10	0.10

PLAYER2

VOTE	TOKENS
8	37.78
7	31.78
9	28.18
10	26.08
6	19.78
5	13.78
4	13.12
3	0.40
2	0.34
1	0.22

PLAYER3

VOTE	TOKENS
4	23.60
3	10.64
2	10.56
1	10.48
8	10.40
5	5.84
6	5.68
7	5.04
9	4.72
10	0.00

PLAYER4

VOTE	TOKENS
8	37.60
7	31.60
9	28.00
10	25.90
6	19.60
5	13.60
4	12.94
3	0.22
2	0.16
1	0.04

PLAYER5

VOTE	TOKENS
1	24.90
2	22.24
3	20.53
4	18.82
5	6.00
8	5.90
6	3.05
7	1.15
9	0.86
10	0.20

sesi

Condorcet Point= 7   Distance= 1.80 Tokens

PLAYER1

VOTE	TOKENS
3	392.40
4	346.60
2	345.40
1	205.40
5	200.20
8	177.70
6	171.30
7	120.20
9	113.50
10	108.40

PLAYER2

VOTE	TOKENS
3	392.40
4	346.60
2	345.40
1	205.40
5	200.20
8	177.70
6	171.30
7	120.20
9	113.50
10	108.40

PLAYER3

VOTE	TOKENS
7	119.50
8	117.70
9	113.50
6	110.60
3	109.00
10	108.40
5	102.20
4	96.30
2	95.90
1	57.10

PLAYER4

VOTE	TOKENS
10	102.00
9	99.20
8	97.40
7	95.60
6	88.50
3	87.20
5	81.80
4	77.00
2	76.70
1	45.60

PLAYER5

VOTE	TOKENS
10	102.00
9	99.20
8	97.40
7	95.60
6	88.50
3	87.20
5	81.80
4	77.00
2	76.70
1	45.60

3

ses3

Condorcet. Point = 7

Distance = 12.46 Tokens

VOTE	PLAYER1 TOKENS
10	26.10
9	23.30
8	21.50
7	19.70
6	6.20
3	6.10
5	3.10
4	1.10
2	0.80
1	0.10

VOTE	PLAYER2 TOKENS
10	26.10
9	23.30
8	21.50
7	19.70
6	6.20
3	6.10
5	3.10
4	1.10
2	0.80
1	0.10

VOTE	PLAYER3 TOKENS
7	23.60
8	10.64
9	10.56
10	10.48
3	10.40
6	5.84
5	5.68
4	5.04
2	4.72
1	0.00

VOTE	PLAYER4 TOKENS
3	43.83
4	36.83
2	32.63
1	30.18
5	22.83
6	15.83
7	15.06
8	0.22
9	0.15
10	0.01

VOTE	PLAYER5 TOKENS
3	43.83
4	36.83
2	32.63
1	30.18
5	22.83
6	15.83
7	15.06
8	0.22
9	0.15
10	0.01

sesk Condorcet point = 2 Distance = 12.96 Tokens

VOTE	PLAYER TOKENS
10	26.14
9	23.34
1	21.54
2	19.74
3	6.24
6	6.14
4	3.14
5	1.14
7	0.84
8	0.14

VOTE	PLAYER TOKENS
10	26.07
9	23.27
1	21.47
2	19.67
3	6.17
6	6.07
4	3.07
5	1.07
7	0.77
8	0.07

	PLAYER3 TOKENS
2	23.63
1	10.67
10	10.59
9	10.51
6	10.43
3	5.87
4	5.71
5	5.07
7	4.75
8	0.03

VOTE	PLAYER4 TOKENS
6	44.11
5	37.11
7	32.91
8	30.46
4	23.11
3	16.11
2	15.34
1	0.50
10	0.43
9	0.29

VOTE	PLAYER5 TOKENS
6	43.99
5	36.99
7	32.79
8	30.34
4	22.99
3	15.99
2	15.22
1	0.38
10	0.31
9	0.17

seesw

Candidate Point= 4 Distance = 9.72 Tokens .

VOTE	PLAYER1 TOKENS
8	31.50
7	26.50
9	23.50
10	21.75
6	16.50
5	11.50
4	10.95
3	0.35
2	0.30
1	0.20

VOTE	PLAYER2 TOKENS
8	31.50
7	26.50
9	23.50
10	21.75
6	16.50
5	11.50
4	10.95
3	0.35
2	0.30
1	0.20

VOTE	PLAYER3 TOKEN
1	21.60
2	19.36
3	17.92
4	16.48
5	5.68
8	5.60
6	3.20
7	1.60
9	1.36
10	0.80

VOTE	PLAYER4 TOKEN
1	21.60
2	19.36
3	17.92
4	16.48
5	5.68
8	5.60
6	3.20
7	1.60
9	1.36
10	0.80

VOTE	PLAYER5 TOKENS
4	18.70
3	8.98
2	8.92
1	8.86
8	8.80
5	5.38
6	5.26
7	4.78
9	4.54
10	1.00

SESV Condorcet Point = 10 Distance = 4.15 Tokens

VOTE	PLAYER1 TOKENS
7	20.00
8	18.60
9	17.70
10	16.80
1	12.65
4	12.60
2	9.90
3	7.50
5	7.35
6	1.50

VOTE	PLAYER2 TOKENS
7	20.00
8	18.60
9	17.70
10	16.80
1	12.65
4	12.60
2	9.90
3	7.50
5	7.35
6	1.50

VOTE	PLAYER3 TOKENS
10	19.70
9	14.30
8	14.06
4	13.40
1	13.28
7	13.04
2	9.32
3	5.78
5	5.54
6	2.00

VOTE	PLAYER4 TOKENS
3	33.50
4	28.50
5	25.50
6	23.75
2	18.50
1	13.50
10	8.10
9	2.35
8	2.30
7	2.20

VOTE	PLAYER5 TOKENS
3	33.50
4	28.50
5	25.50
6	23.75
2	18.50
1	13.50
10	8.10
9	2.35
8	2.30
7	2.20

sesu Condorcet Point = 7 Distance = 9.72 Tokens

VOTE	PLAYER1 TOKENS
7	18.70
8	8.98
9	8.92
10	8.86
3	8.80
6	5.38
5	5.26
4	4.78
2	4.54
1	1.00

VOTE	PLAYER2 TOKENS
3	31.50
4	26.50
2	23.50
1	21.75
5	16.50
6	11.50
7	10.95
8	0.35
9	0.30
10	0.20

VOTE	PLAYER3 TOKENS
3	31.50
4	26.50
2	23.50
1	21.75
5	16.50
6	11.50
7	10.95
8	0.35
9	0.30
10	0.20

VOTE	PLAYER4 TOKEN
10	21.60
9	19.36
8	17.92
7	16.48
6	5.68
3	5.60
5	3.20
4	1.60
2	1.36
1	0.80

VOTE	PLAYER5 TOKEN
10	21.60
9	19.36
8	17.92
7	16.48
6	5.68
3	5.60
5	3.20
4	1.60
2	1.36
1	0.80

sesy

Condorcet point = 3 Distance = 8.42 Tokens

VOTE	PLAYER1 TOKENS	VOTE	PLAYER2 TOKENS	VOTE	PLAYER3 TOKENS
10	109.20	5	58.60	3	18.48
9	107.45	6	54.40	2	9.00
8	104.30	4	50.60	4	7.80
7	89.60	7	50.20	1	7.62
6	74.55	8	46.20	5	4.14
5	58.45	10	44.80	6	2.88
4	44.10	9	43.80	7	1.62
3	10.50	3	12.00	8	0.42
2	1.40	2	1.40	9	0.30
1	0.00	1	0.00	10	0.00

VOTE	PLAYER4 TOKENS	VOTE	PLAYER5 TOKENS
1	34.90	1	60.74
2	28.65	2	27.44
3	15.85	3	15.92
4	6.50	4	7.50
5	3.45	5	4.76
6	2.40	6	3.81
7	1.35	7	2.77
8	0.35	8	1.96
9	0.25	9	1.88
10	0.00	10	1.65

sesx Condorcet Point = 3 Distance = 9.48 Tokens

PLAYER1 VOTE	PLAYER1 TOKENS	PLAYER2 VOTE	PLAYER2 TOKENS	PLAYER3 VOTE	PLAYER3 TOKENS
10	109.20	5	58.60	3	20.08
9	107.45	6	54.40	2	10.60
8	104.30	4	50.60	4	9.40
7	89.60	7	50.20	1	9.22
6	74.55	8	46.20	5	5.74
5	58.45	10	44.80	6	4.48
4	44.10	9	43.80	7	3.22
3	10.50	3	12.00	8	2.02
2	1.40	2	1.40	9	1.90
1	0.00	1	0.00	10	1.60

PLAYER4 VOTE	PLAYER4 TOKENS	PLAYER5 VOTE	PLAYER5 TOKENS
1	42.88	1	78.98
2	35.38	2	34.58
3	20.02	3	19.22
4	8.80	4	8.00
5	5.14	5	4.34
6	3.88	6	3.08
7	2.62	7	1.70
8	1.42	8	0.62
9	1.30	9	0.50
10	1.00	10	0.20

sesdt

Condorcet Point = 4 Distance = 7.90 Tokens

VOTE	PLAYER1 TOKENS
10	138.00
9	137.90
8	136.00
7	123.80
6	97.20
5	72.00
4	53.40
3	45.50
1	44.30
2	42.00

VOTE	PLAYER2 TOKENS
6	175.40
7	163.00
8	157.00
9	156.10
10	156.00
5	144.00
4	106.80
3	91.00
1	88.70
2	84.00

VOTE	PLAYER3 TOKENS
4	320.50
5	288.00
3	273.00
1	266.10
2	252.10
6	247.00
7	235.00
8	229.00
9	228.50
10	228.00

VOTE	PLAYER4 TOKENS
1	288.20
2	248.80
3	214.20
4	188.70
5	177.70
6	163.40
7	159.30
8	157.00
9	156.50
10	156.00

VOTE	PLAYER5 TOKENS
1	184.80
2	175.00
3	172.20
4	146.70
5	135.00
6	121.40
7	117.30
8	115.70
9	115.50
10	115.00

sesa "

condorcet point = 5 distance = 60 tokens

vote	profit pos1
9	400
7	300
5	200
8	200
10	200
3	140
6	140
1	100
4	60
2	40

vote	profit pos2
7	450
5	300
8	300
6	210
9	210
3	210
10	150
1	150
4	90
2	60

vote	profit pos3
5	400
6	320
3	280
7	280
8	240
1	200
9	160
4	120
10	80
2	80

vote	profit pos4
3	350
4	300
5	250
1	250
6	200
7	175
8	150
9	100
2	100
10	50

vote	profit pos5
1	400
2	360
3	320
4	280
5	240
6	200
7	160
8	120
9	80
10	0

sest condorcet point = 8 distance=6.7 tokens

VOTE	PROFIT1	VOTE	PROFIT2	VOTE	PROFIT3
3	572.40	3	441.60	8	358.50
4	526.60	4	411.10	7	349.10
2	525.40	2	410.20	9	340.50
1	385.40	5	380.20	6	331.80
7	380.20	7	380.20	3	327.00
5	380.20	6	351.30	10	325.20
6	351.30	1	316.90	5	306.60
8	300.20	8	300.20	4	288.90
9	293.50	9	293.50	2	287.70
10	288.40	10	288.40	1	171.30

VOTE	PROFIT4	VOTE	PROFIT5
10	306.00	10	306.00
9	297.60	9	297.60
8	286.80	8	286.80
7	279.30	7	279.30
6	265.50	6	265.50
3	261.60	3	261.60
5	245.40	5	245.40
4	231.00	4	231.00
2	230.10	2	230.10
1	136.80	1	136.80

sesi'   condorcet point = 7   distance = .18 tokens

VOTE	PLAYER1 TOKENS
3	39.24
4	34.66
2	34.54
1	20.54
5	20.02
8	17.77
6	17.13
7	12.02
9	11.35
10	10.84

VOTE	PLAYER1 TOKENS
3	39.24
4	34.66
2	34.54
1	20.54
5	20.02
8	17.77
6	17.13
7	12.02
9	11.35
10	10.84

VOTE	PLAYER3 TOKENS
7	11.95
8	11.77
9	11.35
6	11.06
3	10.9
10	10.84
5	10.22
4	9.63
2	9.59
1	5.71

VOTE	PLAYER4 TOKENS
10	10.2
9	9.92
8	9.74
7	9.56
6	8.85
3	8.72
5	8.18
4	7.7
2	7.67
1	4.56

VOTE	PLAYER5 TOKENS
10	10.2
9	9.92
8	9.74
7	9.56
6	8.85
3	8.72
5	8.18
4	7.7
2	7.67
1	4.56

sesdt' condorcet point = 4 distance = .79 tokens

VOTE	PLAYER1 TOKENS	VOTE	PLAYER2 TOKENS	VOTE	PLAYER3 TOKENS
10	13.80	6	17.54	4	32.05
9	13.79	7	16.30	5	28.80
8	13.60	8	15.70	3	27.30
7	12.38	9	15.61	1	26.61
6	9.72	10	15.60	2	25.21
5	7.20	5	14.40	6	24.70
4	5.34	4	10.68	7	23.50
3	4.55	3	9.10	8	22.90
1	4.43	1	8.87	9	22.85
2	4.20	2	8.40	10	22.80

VOTE	PLAYER4 TOKENS	VOTE	PLAYER5 TOKENS
1	28.82	1	18.48
2	24.88	2	17.50
3	21.42	3	17.22
4	18.87	4	14.67
5	17.77	5	13.50
6	16.34	6	12.14
7	15.93	7	11.73
8	15.70	8	11.57
9	15.65	9	11.55
10	15.60	10	11.50

sesd condorcet point=3 distance=.26 tokens

VOTE	PLAYER1 TOKENS	VOTE	PLAYER2 TOKENS	VOTE	PLAYER3 TOKENS
1	28.82	1	18.48	3	10.68
2	21.42	2	17.23	2	9.10
3	18.87	3	14.67	4	8.90
4	17.00	4	12.80	1	8.87
5	16.34	5	12.19	5	8.29
6	16.18	6	11.98	6	8.08
7	15.93	7	11.77	7	7.87
8	15.77	8	11.57	8	7.67
9	15.65	9	11.55	9	7.62
10	15.60	10	11.50	10	7.60

VOTE	PLAYER4 TOKENS	VOTE	PLAYER5 TOKENS
5	5.89	10	4.60
6	5.68	9	4.60
4	5.49	8	4.46
7	5.47	7	4.04
8	5.27	6	3.61
9	5.20	5	3.15
10	5.20	4	2.74
3	3.56	3	1.78
2	3.03	2	1.52
1	2.96	1	1.48

sesi''   condorcet point = 6   distance = 2 tokens

vote	profit pos1
10	204
9	201
8	197
7	193
6	191
5	183
4	172
2	171
3	148
1	133

vote	profit pos2
10	204
9	201
8	197
7	193
6	191
5	183
4	172
2	171
3	148
1	133

vote	profit pos3
6	239
7	235
8	229
5	229
9	223
10	217
4	215
2	214
3	186
1	167

vote	profit pos4
2	385
3	334
1	300
4	274
5	233
6	180
7	177
8	172
9	167
10	108

vote	profit pos5
2	385
3	334
1	300
4	274
5	233
6	180
7	177
8	172
9	167
10	108

sesa condorcet point = 4 distance = ~~[illegible]~~ 15 tokens

vote	profit pos1
8	100
6	75
7	50
4	50
9	50
10	40
5	35
2	35
3	15
1	10

vote	profit pos2
6	112.5
7	75
4	75
5	52.5
8	52.5
2	52.5
10	40
9	37.5
3	22.5
1	15

vote	profit pos3
4	75
5	60
2	52.5
6	52.5
7	45
8	30
3	22.5
9	15
1	15
10	10

vote	profit pos4
2	70
3	60
4	50
5	40
6	35
7	30
8	20
1	20
9	10
10	5

vote	profit pos5
1	90
2	80
3	70
4	60
5	50
6	40
7	30
8	20
9	10
10	5

sesa' condorcet point = 4 distance = 1.5 tokens

vote	profit pos1
8	10.00
6	7.50
7	5.00
4	5.00
9	5.00
10	4.00
5	3.50
2	3.50
3	1.50
1	1.00

vote	profit pos2
6	11.25
7	7.50
4	7.50
5	5.25
8	5.25
2	5.25
10	4.00
9	3.75
3	2.25
1	1.50

vote	profit pos3
4	7.50
5	6.00
2	5.25
6	5.25
7	4.50
8	3.00
3	2.25
9	1.50
1	1.50
10	1.00

vote	profit pos4
2	7.00
3	6.00
4	5.00
5	4.00
6	3.50
7	3.00
8	2.00
1	2.00
9	1.00
10	0.50

vote	profit pos5
1	9.00
2	8.00
3	7.00
4	6.00
5	5.00
6	4.00
7	3.00
8	2.00
9	1.00
10	0.50

sest' condorcet point = 8 distance= .67 tokens

VOTE	PROFIT1
3	57.24
4	52.66
2	52.54
1	38.54
7	38.02
5	38.02
6	35.13
8	30.02
9	29.35
10	28.84

VOTE	PROFIT2
3	44.16
4	41.11
2	41.02
5	38.02
7	38.02
6	35.13
1	31.69
8	30.02
9	29.35
10	28.84

VOTE	PROFIT3
8	35.85
7	34.91
9	34.05
6	33.18
3	32.70
10	32.52
5	30.66
4	28.89
2	28.77
1	17.13

VOTE	PROFIT4
10	30.60
9	29.76
8	28.68
7	27.93
6	26.55
3	26.16
5	24.54
4	23.10
2	23.01
1	13.68

VOTE	PROFIT5
10	30.60
9	29.76
8	28.68
7	27.93
6	26.55
3	26.16
5	24.54
4	23.10
2	23.01
1	13.68

ex2.1, sesz

Condorcet Point = 8

Distance = 8,42 Tokens

PLAYER1

VOTE	TOKENS
1	109.20
2	107.45
3	104.30
4	89.60
5	74.55
6	58.45
7	44.10
8	10.50
9	1.40
10	0.00

PLAYER2

VOTE	TOKENS
6	58.60
5	54.40
7	50.60
4	50.20
3	46.20
1	44.80
2	43.80
8	12.00
9	1.40
10	0.00

PLAYER3

VOTE	TOKENS
8	18.48
9	9.00
7	7.80
10	7.62
6	4.14
5	2.88
4	1.62
3	0.42
2	0.30
1	0.00

PLAYER4

VOTE	TOKENS
10	34.90
9	28.65
8	15.85
7	6.50
6	3.45
5	2.40
4	1.35
3	0.35
2	0.25
1	0.00

PLAYER5

VOTE	TOKENS
10	60.74
9	27.44
8	15.92
7	7.50
6	4.76
5	3.81
4	2.77
3	1.96
2	1.80
1	1.65

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