1. BARGAINING

1.1 Introduction

Bargaining situations involve two individuals trying to agree on terms of a trade.

- Terms can include price, quantity, attributes.
- Agreement of terms is necessary for trade.

Trading is not a zero-sum game.

There are *gains from trade* that will generally leave both parties better off than if they had foregone trade.

Gains result from risk-sharing (hedging).

Relevance for security markets

Security markets have many buyers and sellers, but ultimately, virtually all trade is bilateral.

Often the process leading up to a trade is bilateral.

Most trade involves one agent accepting terms proposed by another.

Structure of the bargaining protocol

Most situations are relatively unstructured negotiations.

Other settings are structured: who can move when, how many rounds of counter offers, etc.

Here are some examples:

- Liquidnet

  Electronic trading system for US stocks (about 12 million shares/day).

  Open to institutions (pension, mutual, hedge funds).

  An institution enters a list of stocks that it wishes to buy (and a list that it wishes to sell).

  E.g., "I want to buy 200,000 shares of Intel."

  The system holds these lists *anonymously* and scans for a match.

  Then the two institutions are put into a private chat room where they negotiate price, and possibly an increase in quantity ("workup")

GovPx (a U.S. treasury trading system) also has a workup facility.

- Cybersettle

  Internet-based system to facilitate negotiation between attorneys in civil law suits.

  Bargaining consists of making an offer to settle; up to three rounds of counter-offers.

Economic analysis

- Ultimatum games
- Sequential bargaining
- Fairness and information asymmetries
- "Formal" analysis
- Experimental results

1.2 Ultimatum game

Players are allocator "A" (sometimes called the "proposer") and recipient "R"

Stakes are $c.

A proposes a division: "$x to me; the remainder to recipient"

If R rejects the proposal, neither side gets anything.

"Rational" strategies in the ultimatum game

"Rational" recipient R accepts any proposal that gives him/her a positive payoff.

With stakes of $100, if A proposes: "$99 to me; $1 to you," R accepts.

The allocator who believes R is "rational" will offer $1.

Structure of the game gives more power to A.

The Bergstrom & Miller ultimatum game

The buyer B: A student at the end of the term wants to buy a bicycle (value=$100)

The seller S: A graduating student has a bike that will either be sold or junked.

Can B and S agree on a price?

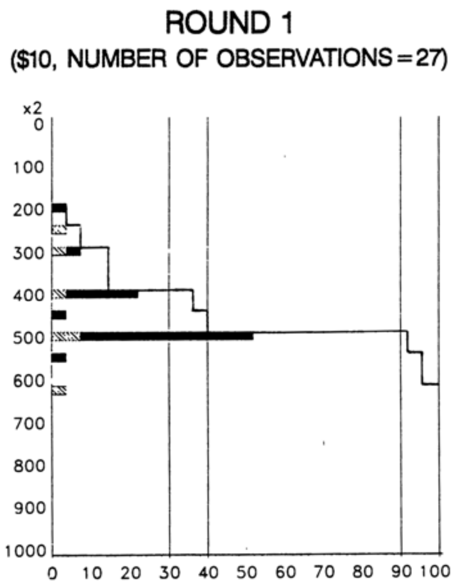
Example: B bids $40

If S accepts, she receives $40; B receives $100–$40
(the value of the bicycle to him less the cash payment).

If the S rejects, both get zero.

Typical outcomes [Roth et al. (1991)]

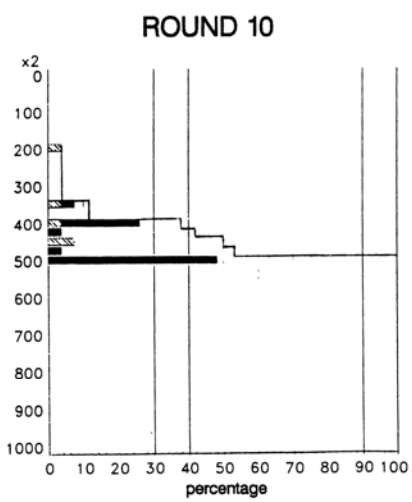
Setup: Ultimatum bargaining with ten rounds
(opportunity to gain experience)



Large number of even-split offers

Offers of all levels are sometimes rejected (!)

Overall rejection rate = 22%



Fewer lower offers

Even split most common

Overall rejection rate = 19%

Does fairness play a role?

Kahneman, Knetsch, and Thaler (1986), cited in Thaler (1988)

Modify game: allocations can't be rejected.
("Dictator game")

Allocator's choice: With stakes of $20, choose $10/$10 or $18/$2 split.

76% allocate 10/10

Do people value the opportunity to punish?

Follow-up experiment in KKT.

You (the subject) are being matched with two other individuals:

- "E": As an allocator in the first round, "E" proposed the EVEN split.
- "U": As an allocator in the first round, "U" proposed the UNFAIR/UNEVEN split.

You have two choices:

- $6 to yourself and $6 to "U"
- $5 to yourself and $5 to "E"

74% chose the 5/5 split (thereby paying $1 to punish a stranger).

Fairness and Information

Kagel, Kim, and Moser (1996)
(some findings cited in Camerer and Thaler (1995)).

Stakes are 100 "chips"

For each player, there are two possible exchange rates: 10¢ or 30¢.

Each player is told that the exchange rates are random, so each player believes that there are four possible combinations.

Player 1	10¢	10¢	30¢	30¢
Player 2	10¢	30¢	10¢	30¢

In actuality, there are only two exchange rate regimes:

- Player 1 ("Allocator") gets 30¢/chip; Player 2 ("Recipient") gets 10¢/chip.
- Player 1 ("Allocator") gets 10¢/chip; Player 2 ("Recipient") gets 30¢/chip.

There are three information regimes:

Is this deception fair? Necessary?

- Only player 1 knows both exchange rates
- Only player 2 knows both exchange rates

► Both players know both rates (symmetric information)

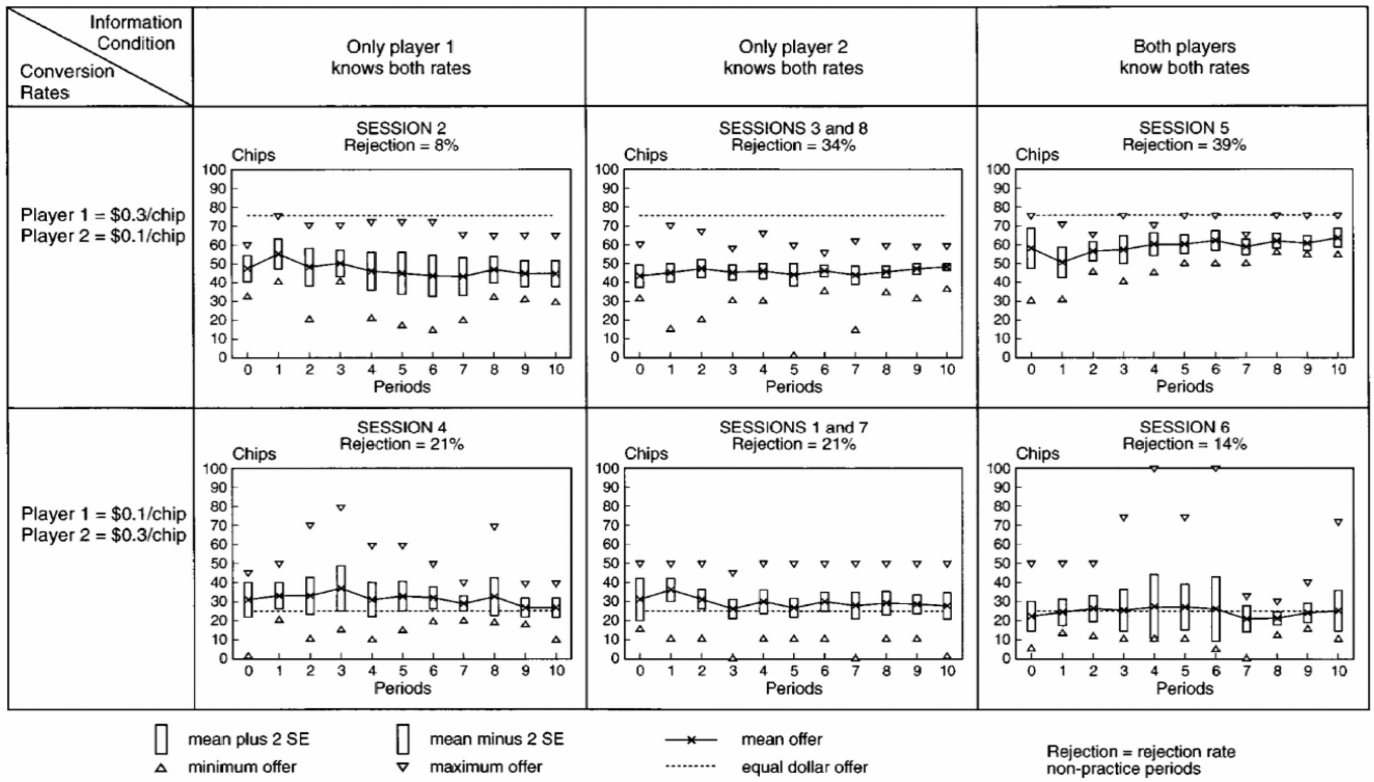


FIG. 1. Effects of information and conversion rates on offers and rejection rates.

"Fairness" here can be interpreted in two ways:

► "Fair chip" Equal division of chips (ignoring exchange rate differentials)

► "Fair $" Equal division of monetary payoffs.

> The player with the 30¢ exchange rate ends up with 25% of the chips.

Investigate "conflicting fairness norms" in the symmetric information sessions

Session 5: Highest rejection rate (39%). Mean offer is about 60/75 of fair.

Session 6: Rejection rate much lower (14%)

Asymmetric information

Player 1 knows; Player 2 doesn't.

Session 2: lowest rejection rate; Mean offer close to "Fair chip"

Session 4: Offers above fair $, below fair chip; moderately high rejection rate.

Player 1 doesn't know; Player 2 does.

Sessions 3 & 6: Player 1 offers similar to session 2.

Types of information

Common information: what everyone knows.

Differential information: different people have different information, but everyone has the same quality of information.

Asymmetric information: some people have better information.

It is difficult to generalize about information effects.

Usually more common information makes markets better: traders can make more informed decisions. But…

- Processing information is costly.
- "Better markets" does not mean that everyone is better off. (Would health insurance be available if it were common knowledge who would get sick with what?)
- More information makes financial assets more distinctive, and therefore less substitutable for other assets.

  Example: There are over one million issues of municipal bonds. Each issue is distinctive in terms of maturity, coupon, and special features. As a result, munies are costly to buy and sell.

Usually more acute information asymmetries lead to market failures.

- Would you buy a stock from someone who knows a lot more about than you do?
- But here, the highest rate of disagreement occurs with symmetric information.

1.3 Sequential bargaining

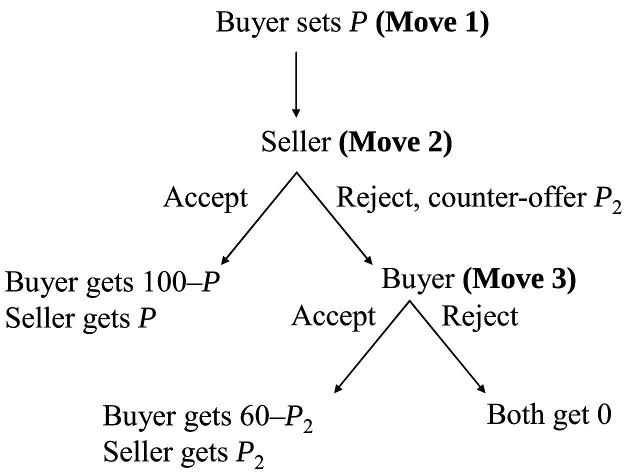
We often have to opportunity to reject a proposal and counter.

There is often a cost of reject/counter

Communications, delay, depreciation

Two-round game (Bergstrom and Miller)

Bicycle is worth \$100 on first round; \$60 on second.



Get “rational” solution by “backwards induction”.

At move 3, a rational buyer accepts any offer < 60.
(If the seller offers 59, and the buyer accepts, buyer gets 1; if the buyer rejects, gets 0)

At move 2, a seller thinks: I can always reject the buyer’s initial offer and counter with 59. The buyer will accept this offer and I’ll get 59.

At move 1, the buyer thinks: If the seller rejects my first offer, she’ll counter with 59, which I’d accept.
How can I ensure that the seller gets at least 59 by accepting my initial bid?
I’ll bid 60

Prediction: First player bids 60 and this is accepted.

What is there is some chance that buyer at move 3 will be insulted by a high demand price?

What actually happens?

Note that addition of a second round shifts the advantage to second mover.

A “subgame” covers play subsequent to any decision point after the first.

“Subgame perfect” outcomes are those which would arise if the game were played by fully rational players.

Assumes no mistakes and full rationality at all subsequent moves.

Sequential bargaining with an infinite number of rounds (Rubinstein (1982))

Value of $1 to player 1 received on round *t* is δ_1^t.

Similarly, for player 2, δ_2^t.

Note that discount factor need not be the same for each person.

Player 1 makes the first offer. She can project ahead what she and her opponent will do assuming that each is perfectly rational.

"Rubinstein Theorem": Player 1 proposes that she takes $S = \frac{1-\delta_2}{1-\delta_1\delta_2}$ for herself. Player 2 accepts this proposal.

δ_1	δ_2	Player 1 takes
0.999	0.999	0.5003
0.5	0.5	0.6667
0.99	0.1	0.9989

When $\delta_1 = \delta_2$, both slightly <1, rational solution is an event split.

When $\delta_1 \neq \delta_2$, advantage goes to the more patient player.

Think of δ as a present value discount factor.

$1 discounted back *t=2* periods at 10% per period has a present value of $1/(1.1)^2 = 0.909^2 = 0.826$.

Here $\delta = 0.909$

Sequential bargaining in Cybersettle

Defendant ("insurance company") submits to the system three bids to settle ("maximums")

Ex: 16, 20, 24 ($ Thousand)

These are not disclosed to the plaintiff.

Plaintiff submits three offers ("minimums").

Ex: 32, 26, 22

Round 1. Compare first bid and offer. Is there an overlap? [No: 16<32]

Round 2. No, 20<26.

Round 3. Yes, 22<24. Settlement amount is average of 22 and 24 = 23

Settlement capped at 120% of offer for that round. Example: if plaintiff's third round offer were 10, the case would settle for 12.

1.4 Social distance effects on bargaining

Anonymous vs. Face-to-Face Bargaining

In ultimatum games, disagreements (failures to reach agreement) are unusual with face-to-face bargaining, and more common with anonymous bargaining.

Radner and Schotter (1989) [discussed in Roth (1995), p. 295-296] report average gains from trade captured:

Face-to-face	99%
Anonymous	92%

RS also conclude: face-to-face does better than anonymous + exchange of typed messages

Does the *content* of communication matter?
[Roth (1995), p. 296-298]

Setup: ultimatum experiment with varying sorts of pre-trade communication.

Results:

		Disagreement Frequency
No communication		33%
Unrestricted face-to-face communication	For 2 minutes, buyer and seller can talk about anything, including the game	4%
Social communication only	2 minutes. Can talk about anything *except* game. Must learn each others' first name and year in school	6%

1.5 Deadlines

Bargaining (with repeated rounds) against a 9-minute clock (Roth, Murnighan, and Shoumaker (1988)).

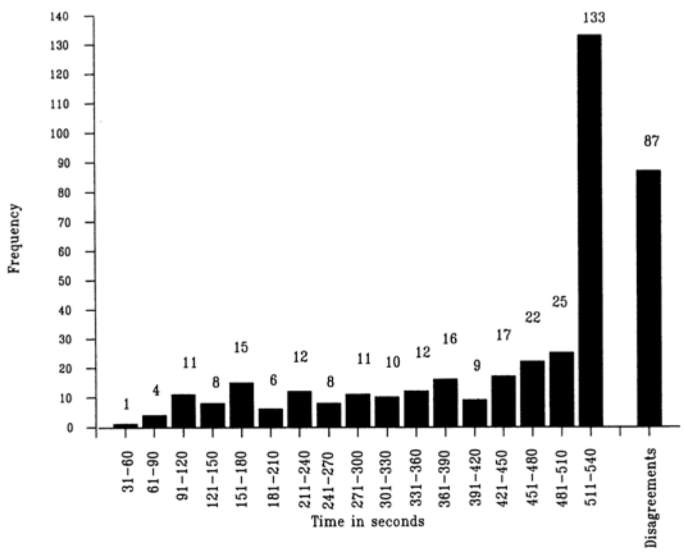


FIGURE 1A. THE FREQUENCY OF AGREEMENTS AND DISAGREEMENTS FROM THE NEW EXPERIMENT

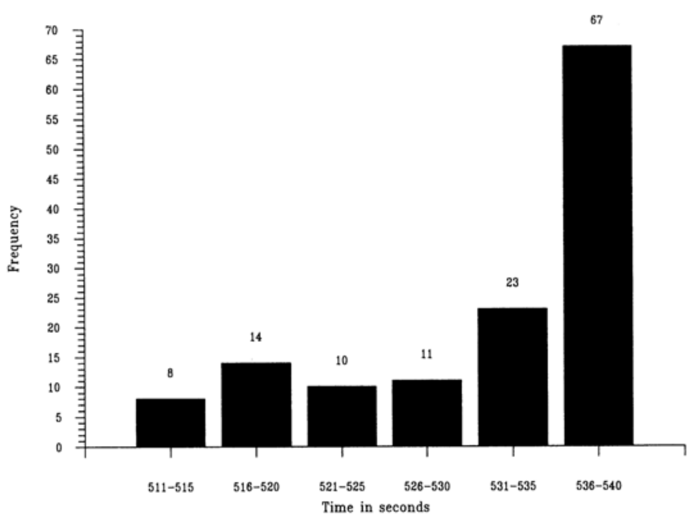
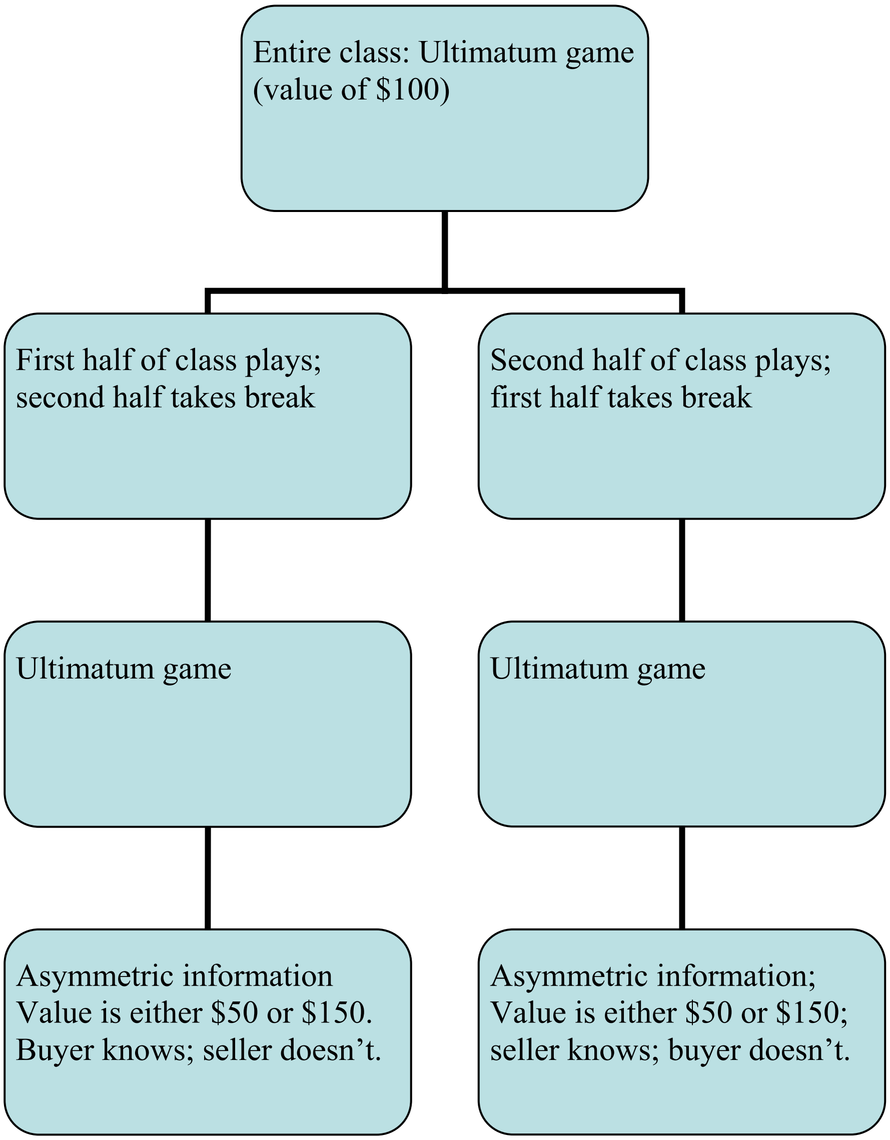


FIGURE 1B. THE FREQUENCY OF AGREEMENTS REACHED IN THE LAST 30 SECONDS OF BARGAINING IN THE NEW EXPERIMENT

1.6 Games

a. Overview



b. Ultimatum game form

Game 1 Type: Fixed **Buyer Name** [ ] **Bid** [ ] ← *Write your bid in both places.* → Match 99 Ultimatum, I & II	Game 1 Type: Fixed **Seller Name** [ ] **Bid** [ ] Circle one: Accept Reject Match 99 Ultimatum, I & II

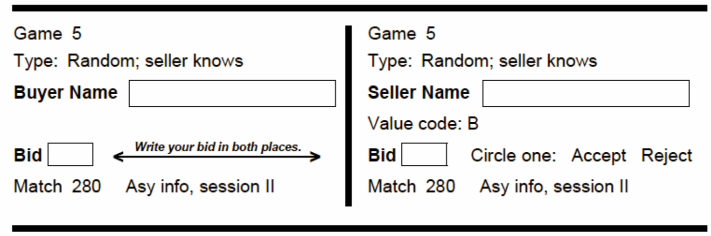
- Fill out buyer side of form. Fill in a bid. (If you bid $25 and your bid is accepted, you get $100– $25 = $75.)
- Copy your bid onto the right side of the sheet.
- Turn in your sheet.
- The sheets will be cut in the middle and shuffled.
- You will receive a random "seller" side.
- Accept or reject. If you accept, you receive the amount of the bid; if you reject, you get nothing.

c. Asymmetric information game form. (Random value: buyer knows, seller doesn't)

Game 3 Type: Random; buyer knows **Buyer Name** [ ] Value code: B **Bid** [ ] ← *Write your bid in both places.* → Match 190 Asy info, session I	Game 3 Type: Random; buyer knows **Seller Name** [ ] **Bid** [ ] Circle one: Accept Reject Match 190 Asy info, session I

- Your value code will be either A or B.
- After all the sheets have been passed out, I'll toss a coin. If heads: value code A means the cake/bicycle is worth $150; value code B, $50. If tails, the reverse.
- Proceed as above.

d. Asymmetric information game form.
(Random value: seller knows, buyer doesn't)



Game 5	Game 5
Type: Random; seller knows	Type: Random; seller knows
Buyer Name [ ]	**Seller Name** [ ]
	Value code: B
Bid [ ] ← *Write your bid in both places.* →	**Bid** [ ] Circle one: Accept Reject
Match 280 Asy info, session II	Match 280 Asy info, session II

Note: value code is on the *right* side of the sheet.

- Buyer makes a bid.
- Forms are collected, cut. Seller sides are shuffled and redistributed.
- After everyone has a seller form, I'll toss a coin. If heads: value code A means the cake/bicycle is worth \$150; value code B, \$50. If tails, the reverse.

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1.7 Bargaining problems

a. *Bergstrom and Miller Warm-up questions 14.1-14.9;*

Answers:

14.1 \$1 if accept; \$0 if reject $\Rightarrow$ accept
14.2 none
14.3 \$60, \$60 – counteroffer
14.4 \$60 – \$50 =\$10, \$0 $\Rightarrow$ accept
14.5 \$59 gives buyer a profit of \$1, which is better than nothing.
14.6 reject; \$1, \$59
14.7 \$60 won't be rejected
14.8 \$100 – P; \$60 – counter; 36 – second offer
14.9 \$60 – \$50 = \$10; \$36-\$1=\$35

b. *Bergstrom and Miller Exercises 14.1-14.4 (See attached table, next page/)*

c. *Suppose that in the setup of the Bergstrom and Miller exercises, we allow for an infinite number of rounds. What does the Rubinstein theorem predict my initial bid will be?*

Answer:

$\delta_1 = \delta_2 = 0.8 \Rightarrow$

Initial offer is $\dfrac{1-\delta_2}{1-\delta_1\delta_2} = \dfrac{1-0.8}{1-0.8^2} = 0.56$

I offer \$56

d. *In a Cybersettle negotiation, the defendant (the insurance company) enters offers to settle of (at most) 5, 25 and 30. The plaintiff's attorney offers to settle are (at least) 100, 50 and 10. Does the case settle, and if so, at what price?*

e. *In the Kagel, Kim and Moser game, the social surplus is the total monetary value of the chips of both players, converted at their respective exchange rates. Does their Figure 1 offer any evidence for or against the hypothesis that players try to maximize this social surplus?*

B & M Ch. 14 Exercise: Bargaining against a robot

Round	**1**	**2**	**3**	**4**	**5**
	I offer x				
	R accepts I get 100-x R gets x	R rejects, and offers y			
		I accept I get 80-y R gets y	I reject, and offer x		
			R accepts I get 64-x R gets x	R rejects, and demands y	
				I accept I get 51-y R gets y	I reject, and offer x. R accepts I get 41-x R gets x

Number of rounds in game					
1	I offer x=1; R accepts; I get 99.				
2	To give R 80, I offer x=80; R accepts; I get 20	R demands y=79; I accept:I get 1.			
3	To give R 17, I offer x=17; R accepts; I get 83.	To give me 64, R demands y=16; R gets 16	I offer x=1; R accepts; I get 63		
4	To give R 67, I offer x=34; R accepts	To give me 14, R demands y=66; I accept	To give R 51, I offer x=51; R accepts; I get 13	R demands y=50; I accept; I get 1.	
5	To give R 27, I offer x=63; R accepts. I get 63.	To give me 54, R demands y=26; I accept.	To give R 11, I offer x=11; R accepts; I get 53.	To give me 41, R demands y=10; I accept.	I offer x=1; R accepts; I get 40

3. References

Camerer, Colin, and Richard H. Thaler, 1995, Anomalies: ultimatums, dictators and manners, Journal of Economic Perspectives 9, 209-219.

Kagel, John H., Chung Kim, and Donald Moser, 1996, Fairness in ultimatum games with asymmetric information and asymmetric payoffs, Games and Economic Behavior 13, 100-110.

Kahneman, Daniel, Jack L. Knetsch, and Richard H. Thaler, 1986, Fairness as a constraint on profit seeking: entitlements in the market, *American Economic Review* 76, 728-741.

Radner, Roy, and Andrew Schotter, 1989, The sealed bid mechanism: an experimental study, *Journal of Economic Theory* 48, 179-220.

Roth, Alvin E., 1995, Bargaining experiments, in John H. Kagel and Alvin E. Roth, eds., *The Handbook of Experimental Economics*, (Princeton University Press, Princeton).

Roth, Alvin E., Keith E. Murnighan, and Francoise Shoumaker, 1988, The deadline effect in bargaining: some experimental evidence, American Economic Review 78, 806-823.

Roth, Alvin E., Vesna Prasnikar, Masahiro Okuno-Fujiwara, and Shmuel Zamir, 1991, Barganing and market behavior in Jerusalem, Ljubljana, Pittsburgh and Tokyo: an experimental study, American Economic Review 81 , 1068-1095.

Rubinstein, Ariel, 1982, Perfect equilibrium in a bargaining model, Econometrica 50, 97-110.

Thaler, Richard H., 1988 , Anomalies: the ultimatum game, Journal of Economic Perspectives 2, 195-206.

Misc.

3.1 GovPX

Screen-based trading system for US Treasury securities.

Dealers display bids and offers.

A bid is a proposal to buy: “$50 bid for 1,000 shares”

An offer (“ask”) is a proposal to sell: “2,000 shares offered at $51.”

Another dealer can:

Hit the bid (sell into the first dealer’s bid)

Lift the offer (buy at the offer).

When you put out a bid and/or offer, you are “making” a market.

When you hit/lift another’s bid/ask, you are “taking” [the terms proposed by the other]

Other dealers can hit the bids (or lift the offers)

Bids and offers are for a minimum quantity.

When one dealer takes another’s price, the two parties into a private chat room where they “work up” a quantity.

