實驗經濟學一：行為賽局論

Experimental Economics I: Behavioral Game Theory

第六講：議價談判

Lecture 6 : Bargaining

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本課程指定教材: Colin E. Camerer, *Behavioral Game Theory: Experiments in Strategic Interaction*. New York: Russell Sage Foundation; New Jersey: Princeton UP, 2003.

Bargaining 議價談判

- Bargaining (就是「討價還價」！)
  - Process by which economic agents agree on the terms of a deal (個體間討論條件、達成交易的過程)
- Common even in competitive markets
  - The pit market in NYSE/market experiments
    (即使在完全競爭市場也很常見，例如紐約股市的交易坑市場)
  - Edgeworth Box (原本是用來研究談判！) was created to show range of possible bargaining outcomes
- Have you ever bargained with someone?
  - 你有跟別人談判過嗎？

Bargaining 議價談判

- Nash (1950, 1951):
  - (Cooperative) Nash Bargaining Solution (奈許談判解)
  - (Non-cooperative) Nash Equilibrium (奈許均衡)
- Nash could have won two Nobels…
- Nash Program: Is NBS the NE/SPE of a particular game? (奈許問： NBS 是否為某賽局的 NE/SPE?)
  - Yes: Binmore, Rubinstein and Wolinsky (1986)
- References (參考章節):
  - BGT, Ch. 4, HEE, Ch. 4, *MGS,* Ch. 23

2 Bargaining Experiments 兩種談判實驗

- Cooperative NBS vs. Non-cooperative NE
  - 對應合作賽局 NBS 和非合作賽局 NE ，也有兩種談判實驗：

1. Unstructured Bargaining Experiments
   - Free form procedure determined by players
   - Closer to naturally occurring bargaining
   - 自由談判實驗：雙方自行決定談判形式過程，較接近實務上談判
2. Structured Bargaining Experiments
   - Procedure specified by experimenter
   - Game theory makes specific predictions
   - 制式談判實驗：形式過程由實驗者決定，賽局論能做出明確預測

Negotiation Research 協商談判研究

3. Negotiation Research in applied psychology

- See review of Bazerman et al. (2000)

- **Bazerman, Magliozzi and Neale (1985)**
  - Negotiate over several issues (ex: price/quantity)
  - Free form communication with fixed deadline
  - Private point schedule (dep. on each issue)
  - 應用心理學研究：雙方各自知道自己的報酬計分方式，在一定時限自由溝通討論，最後須在價格數量等多層面 (連續或類別) 上達成協議

- **Results:** Deals not Pareto-efficient
  - Affected by systematic heuristics and other cognitive variables (unrelated to game)
  - 結果：達成的協議不都有效率且受到無關的經驗法則與認知因素影響

Negotiation Research 協商談判研究

- Why not much overlap? (為何沒有交集？)
  - Game theory assumes too much rationality
  - Solvable games are too simplified
  - Hard to apply to Negotiation games
  - 賽局論假設完全理性，解得出來賽局又太簡單，很難用在協商研究
- Like 2 traditions of experimental economics
  - Game experiments are too simplified
  - Hard to apply to market experiments
  - 正如賽局論實驗太過簡單，很難用賽局論來預測市場實驗的結果
- But the research questions are the same!
  - 但是兩者的研究問題是一樣的！

Unstructured Bargaining 自由談判

- Test: Nash Bargaining Solution (NBS)
  - The point maximizing the product of utility gains (beyond the disagreement point)
  - 奈許談判解 (NBS): 與談判破裂相較讓雙方效用增加量的乘積最大的解
- Only point satisfying 4 axioms:
  1. Pareto Optimality (效率性、不受額外無關選項影響)
  2. Symmetry (對稱、不受效用平移伸縮影響)
  3. Independence of Irrelevant Alternatives (IIA)
  4. Independence from affine utility transformation

Nash Bargaining Solution (NBS)

$$S^* = \arg \max_{(x_1,x_2)\in S} (x_1 - d_1)(x_2 - d_2)$$

$$= \arg \max_{(x_1,x_2)\in S} [u_1(x_1) - u_1(d_1)][u_2(x_2) - u_2(d_2)]$$

Satisfies:

1. Pareto Optimality (效率性): $\forall x \in S^*, \nexists y \in S, y > x$
   $\Leftrightarrow y_i \geq x_i \forall i, y_j > x_j$
2. Symmetry (對稱):
   $$d_1 = d_2, (x_1, x_2) \in S^* \Rightarrow (x_2, x_1) \in S^*$$
3. IIA (Independence of Irrelevant Alternatives; 不受額外無關選項影響)
   S^* solves (T, d) if S^* solves (S, d) and $S \subset T$
4. IAT (Independence from affine utility transformation, 不受效用平移伸縮影響): $u_1(x) = Ax + B, u_2(x) = Cx + D$

Unstructured Bargaining 自由談判

- Roth and Malouf (Psych Rev 1979)
- Player bargain over 100 lottery tickets
  - Risk neutral if can reduce compound lottery
  - 雙方談判如何分配 100 張彩券 (每張 = 1% 機率贏得獎金) 。用彩券可讓人風險中立地決策 (假設人們會把複合機率簡化成單一機率)
- 1 ticket = 1% chance winning a big prize
- Equal ($1) vs. Unequal Prize ($1.25/$3.75)
- Full vs. Partial (know own prize) Info.
- NBS: 50-50 split (NBS 預測： 50-50 對分)
  - 2x2 實驗設計 : 獎金相同 / 不同，資訊透明 / 不透明

Unstructured Bargaining 自由談判

Inform-ation	Money Prizes	# of Tickets for Player 2							% of Dis-agreement
		20	25	30	35	40	45	50	
Full Info.	1/1	0	0	1	0	1	0	20	0%
	1.25/3.75	1	6	3	2	2	1	4	14%
Part. Info.	1/1	0	0	0	0	0	1	14	6%
	1.25/3.75	0	0	0	0	0	3	13	0%

Unstructured Bargaining 自由談判

- Results: Agreements cluster at 50-50
  - Rare Disagreement (很少未達成協議，大部分 50-50 對分)
  - 14% Disagree when both know inequality
  - Divide tickets or $$$ payoffs equally
  - Sensitive to $$$ payoffs
  - Violate IAT (indep. of affine transformation)
  - 雙方清楚知道獎金不平等時，有 14% 未達成協議 (彩券 vs. 金錢平分)
  - 結果受金錢多寡影響，違反「不受效用平移伸縮影響」公設
- "Rawlsian" Bargaining Solution explains this
  - Followup: Roth & Murnighan (ECMA 1982)

"Rawlsian" Bargaining Solution

$$S^* = \arg \max_{(x_1,x_2)\in S} (x_1 - d_1)(x_2 - d_2)$$

$$= \arg \max_{(x_1,x_2)\in S} [u_1(x_1) - u_1(d_1)][u_2(x_2) - u_2(d_2)]$$

Satisfies:

1. Pareto Optimality (效率性): $\forall x \in S^*, \nexists y \in S, y > x$
2. Symmetry ($d_1 = d_2, (x_1, x_2) \in S^* \Rightarrow (x_2, x_1) \in S^*$
3. IIA (S^* solves (T, d) if S^* solves (S, d) and $S \subset T$)
4. Independence of utility transformation preserving

preference order & which player has larger gain

$$x_1 - d_1 \geq x_2 - d_2 \Leftrightarrow u_i(x_1 - d_1) \geq u_i(x_2 - d_2)$$

$$x_i \geq y_i \Leftrightarrow u_i(x_i) \geq u_i(y_i)$$

Unstructured Bargaining 自由談判

- Review earlier studies to find: (回顧先前實驗發現)
  - Murnighan, Roth & Schoumaker (JRU 1988)
- Pairs settle @ final minutes (of 9-12 min)
  - Convey private info (Stubbornness/Delay Cost)
  - 最後幾分鐘才達成協議 (用以表示自己很堅持 / 可以負擔延遲成本 ?)
- Follow-up: Roth & Schoumaker (AER 1983)
  - First play against computer that gives you a lot
- Expect & get this from later human players
  - Strong Reputation (如果有人先跟軟弱的電腦談判、被訓練覺得自己該拿比較多，接下來面對真人態度也會較強硬、並且真的拿比較多)

Unstructured Bargaining 自由談判

- Mehta, Starmer and Sugden (bk chp. 1992)
- Nash Demand Game (奈許需求實驗): 2 Players
  - Each state demand (兩人分別列出自己的需求金額)
  - Get their demand If sum <= £10, 0 otherwise.
  - 如果總和 <= 10 英鎊就會得到所求，不然都得 0
- Focal point: Players split 4 Aces + 4 deuces
  - Before bargain, players were told: "4 aces worth £10 together, so to earn $$ you have to pool your aces and agree on how to divide the £10."
    (兩人抽八張牌，其中四張 A 、四張 2)

Can BGT Explain This? 行為賽局論解釋？

- Roth (1985) explains as Coordination Game
- Two sides simultaneously propose to split tickets either 50-50 or *h*-(100-*h*)
  - 可用協調賽局解釋：雙方同時提議分配為 50-50 或 *h*-(100 – *h*)
- MSE: $p_1 = \frac{h-50}{150-h}$ $p_2 = \frac{h-50}{h+50}$

$$= \frac{(h-50)^2}{(150-h)(50+h)}$$

- Disagreement rates

Can BGT Explain This? 行為賽局論解釋？

- Roth (bk chp 1985)
- Disagreement rates $= \dfrac{(h-50)^2}{(150-h)(50+h)}$ 
- Predicted to be 0% ☒ 7% ☒ 10%
  - For $h = 50, 75, 80$ in pervious experiments
- Data: 7% ☒ 18% ☒ 25% (Direction is right!)
- Murnighan et al. (JRU 1988)
  - $h = 60, 70, 80, 90$ predict 1%, 4%, 10%, 19%
- Actual data not as good: Constant across h

Can BGT Explain This? 行為賽局論解釋？

- Cause of Disagreement: Self-Serving Bias
  - "What is better for me" = "Fair"
  - 自利偏誤 (對我自己有利的才叫公平): 加進上述協調賽局可解釋實驗結果
- Add this to the above coordination game
  - Can explain higher disagreement rate in data
- Same in Kagel, Kim and Moser (GEB 1996):
  - Ultimatum over 100 tickets (P/R value differently)
  - 用最後通牒談判分配 100 張 (對兩人價值不同的) 彩券
- P private value higher/lower ☒Propose 45%/30%
  - 對方不知道價值時提議者會在己方價值高 (低) 時提議 55-45(70-30)
  - Knowing P value higher, R rejects 40%, wants >50%
  - 回應者知道對方價值較高時會要求比 50-50 更好，使拒絕機率上升到 40%

Babcock et al.(AER 1995,Law&Social Inquiry 1997)

  - Self-serving bias Exp: Loewenstein et al. (JLegalStud 93')
- Read 27-page actual legal case 讀 27 頁卷宗 / 談判和解
  - Motorcyclist sues driver: $100,000 injury damage
- Bargain for 30 min. to settle it for ?? dollars
  - $5000 legal fees for every 5-min delay
  - Retired judge imposes award if no agreement
- First Guess what judge would award
  - US$1 (or 1 Grade Point) for every $10,000
  - 30 分鐘談判和解 (訴訟金額 $100,000)，每延遲 5 分鐘須付 $5000 律師費
  - 事先預測和解不成法官會如何判 (實驗中 $10,000 = 一美金或 1 GPA)

Gap of E(judgment) Predicts Disagreement

- Baseline: 70% cases settled at period 3-4 (out of 6)
- E(judgment) differ by $20,000 (20% of $100,000)
  - 控制組結果 : 70% 的組在第 3-4 回合達成和解 (總共 6 回合)
  - 雙方預期判決結果的落差在 $20,000 左右 (訴訟金額的 20%)

Experimental Condition		Settlement Stat.			E(judgment) Gap	
	N	%	periods	(s.e.)	mean	(s.e.)
Control (Babcock 95)	47	72	3.75	(0.28)	$18,555	(3,787)
Control (Babcock 97)	26	65	4.08	(0.46	$21,783	(3,956)

More Pairs Settled (and More Rapidly) if...

- Don't know role @ reading: 94% (in 2.51 pds)
  - Or, before bargaining, 1st tell about bias &
- List Weakness of own case: 96% (in 2.39 pds)

Experimental Condition		Settlement Stat.			E(judgment) Gap	
	N	%	periods	(s.e.)	mean	(s.e.)
Control (Babcock 95)	47	72	3.75	(0.28)	$18,555	(3,787)
Didn't know roles	47	94	2.51	(0.21)	-$6,275	(4,179)
Control (Babcock 97)	26	65	4.08	(0.46)	$21,783	(3,956)
1st List weakness	23	96	2.39	(0.34)	$4,676	(6,091)

p<0.01

p=0.01

p=0.02

Summary for Unstructured Bargaining

- Focal points affect bargaining outcome
- Chip value affect bargaining outcome
  - Violate IAT Axiom of NBS
- BGT Explanation: Bargainers try to coordinate under multiple focal points
- Self-serving bias predict costly delay/settle
  - "Outcome favoring me is more likely/fair"
  - Caused by knowing my role when reading case

Structured Bargaining 制式談判

- Finite Alternating-Offer Game (有限回交互提案)
- Binmore, Shaked & Sutton (1985): 2 period
- 1 offers a division of 100p to 2
- If 2 rejects, makes counteroffer dividing 25p
  - 成員甲提議如何分配 100p ，成員乙回應。若拒絕則由他提議分配 25p
- SPE: Offer 25-75 (子賽局完全均衡：成員甲提議 25-75)
- Experimental Results: mode at 50-50, some 25-75 and others in between
  - 實驗結果：提議分配的眾數在 50-50 ，有些在 25-75 ，其他在兩者之間

Structured Bargaining 制式談判

- Neelin, Sonnenschein and Spiegel (1988)
  - Economics undergrads yield different results
- Are they taught backward induction? Also,
  - 經濟系大學部學生實驗結果不同，因為學過倒推法？還是實驗說明？
- Binmore – “YOU WOULD BE DOING US A FAVOR IF YOU SIMPLY SET OUT TO MAXIMIZE YOUR WINNINGS.”
- Neelin – “You would be discussing the theory this experiment is designed to test in class.”

Structured Bargaining 制式談判

- Social Preference or Limited Strategic Thinking? (是因為人們有社會偏好，還是理性思考有限制？)
- Johnson, Camerer, Sen & Rymon (2002), “Detecting Failures of Backward Induction: Monitoring Information Search in Sequential Bargaining,” *Journal of Economic Theory,*104 (1), 16-47.
- Some do not even look at the last stage payoffs in 3-stage bargaining games!
  - 三回合談判，有人「不看」最後一回合

Structured Bargaining 制式談判

- Random Termination vs. Discounting
- Zwick, Rapoport and Howard (ToD 1992)
- Divide $30 with random termination
- Continuation probabilities 0.90, 0.67, 0.17
- SPE: 14.21, 12, 4.29
  - Accepted final offers: 14.97, 14.76, 13.92
- Close to discounting results (50-50 & SPE)
  - 14.90, 14.64, 13.57

Structured Bargaining 制式談判

- Fixed Delay Cost in Bargaining
  - Lost wages, profits, etc.
- SPE: Strong side (lower delay cost) gets all
- Rapoport, Weg and Felsenthal (ToD 1990)
  - Divide 30 shekels (pseudo-infinite horizon)
  - Fixed Cost: 0.10 vs. 2.50 or 0.20 vs. 3.00
- Strong support for SPE: In the 1st round,
  - Strong P offer 4.4-7.9, weak R accept 60-80%
  - Weak P offer low, strong R accept 30%, but later quickly settle in 2nd (35%) or 3rd-4th (22%)

Outside Option and Threat Points

- Binmore, Shaked and Sutton (QJE 1989)
  - Two players bargain over £7, discount $\delta = 0.9$
  - Player 2 has outside option of £0, £2, or £4
- Split-the-difference (NBS): 47%, 64%, 76%
  - Divide surplus beyond the threat points
- Deal-me-out (SPE): 47%, 47%, 57%(=4/7) $< \frac{\delta}{1-\delta}$
  - Options matter only if is credible; ignore if
- BGT, Figure 4.4: Deal-me-out wins
  - £0, £2: spike around 50% / £4: cluster @ 57%

Incomplete Information

- Add Asymmetric Information to bargaining
- More realistic, but
  - Hard to bargain for a bigger share AND convey information at the same time
- Might need to turn down an offer to signal patience or a better outside option

Seller Make Offer to Informed Buyer

- Rapoport, Erve, and Zwick (MS 1995)
- Seller: Own item (worthless to herself)
- Buyer: Private reservation price is unif. [0,1]
- Seller makes an offer each period
- Common discount factor δ

Seller Make Offer to Informed Buyer

- Unique Sequential Equilibrium:
- Seller Offer:

$$p_0 = \gamma \cdot \frac{1-\delta}{1-\gamma\cdot\delta}, \quad \gamma = \frac{1-\sqrt{1-\delta}}{\delta}$$

- Subsequently:

$$p_t = p_0 \cdot \gamma^t$$

- Buyer Accepts if

$$p_t \leq v \cdot \frac{1-\delta}{1-\gamma\cdot\delta}$$

Seller Make Offer to Informed Buyer

- Complicate Strategy: Depend on δ
  - Price discriminate high/low-value buyers
  - Price declines slow enough so high-value buyers will not want to wait
- Can subjects get these in experiments?
  - Different δ : H (0.90), M (0.67), L (0.33)
  - Opening p_0 : H (0.24), M (0.36), L (0.45)
  - Discount γ : H (0.76), M (0.68), L (0.55)

Seller Make Offer to Informed Buyer

- Please See Amnon Rapoport et. al , An Experimental Study of Buyer-Seller Negotiation with One-Sided Incomplete Information and Time Discounting” *Management Science,* Vol. 41, No. 3 (Mar., 1995), pp. 384.

Seller Make Offer to Informed Buyer

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  - Different δ: H (0.90), M (0.67), L (0.33)
  - Opening p_0: H (0.24), M (0.36), L (0.45)
  - Discount γ: H (0.76), M (0.68), L (0.55)
- Buyers accept the 1st or 2nd offer below v
  - Accept offers too soon
- Sellers ask for higher prices (than equil.)
  - But discount γ: H (0.81), M (0.68), L (0.55)

Strikes and 1-Sided Information

- Forsythe, Kennan and Sopher (AER 1991)
- Only Informed bargainer I sees pie size
  - Either large (π_g) or small (π_b)
- Free-form bargaining
- Uninformed U can strike to shrink pie by γ
- Can we predict what happens?

Strikes and 1-Sided Information

- Myerson (1979): Revelation Principle
  - I announces true state
  - U strikes to shrink pie by γ_g or γ_b
  - I gives U (based on true state) x_g or x_b
- IC requires:

$$(\gamma_g - \gamma_b)\pi_b \leq x_g - x_b \leq (\gamma_g - \gamma_b)\pi_g$$

Strikes and 1-Sided Information

- Interim Incentive Efficiency requires:

$$\gamma_g = 1, x_g - x_b = (1 - \gamma_b)\pi_g$$

- Strike ($\gamma_b < 1$) if and only if $p\pi_g > \pi_b$

- Deriving this is complicated…
- Could ANY subject get close to this?

Strikes and 1-Sided Information

- Random Dictator (RD) Axiom:
  - Agree fair mix between each being dictator to propose mechanism
- Then:

$$\gamma_g = 1, x_g = \frac{\pi_g}{2}, \gamma_b = \frac{1}{2}, x_b = 0 \text{ if } p\pi_g > \pi_b$$

$$\gamma_g = 1, x_g = \frac{\pi_b}{2}, \gamma_b = 1, x_b = \frac{\pi_b}{2} \text{ if } p\pi_g < \pi_b$$

Strikes and 1-Sided Information

- This is a win-win experiment:
  - Success if theory predictions are close
  - If not, will point to which assumption fails
- Forsythe et al. (AER 1991):
  - 10 minute sessions; written messages
- Is Myerson (1979) confirmed?
  - Surprisingly yes, though not perfect…

Strike Condition Off

$$p\pi_g < \pi_b$$

Game	p	State	π	π_U	π_l	total	%Strike
III	0.5	b	2.80	1.47	1.18	2.66	5.2
		g	4.20	1.52	2.41	3.93	6.5
		aver.	3.50	1.50	1.80	3.29	6.0
		pred.		1.40	2.10	3.50	0.0
IV	0.25	b	2.40	1.08	1.04	2.12	11.8
		g	6.80	1.58	5.03	6.61	2.9
		aver.	3.50	1.21	2.04	3.24	7.4
		pred.		1.20	2.30	3.50	0.0

Strike Condition On

$$p\pi_g > \pi_b$$

Game	p	State	π	π_U	π_l	total	%Strike
I	0.5	b	1.00	0.31	0.30	0.61	39.0
		g	6.00	1.78	3.70	5.48	8.7
		aver.	3.50	1.05	2.00	3.05	13.0
		pred.		1.50	1.75	3.25	7.1
II	0.75	b	2.30	1.06	0.84	1.90	17.2
		g	3.90	1.53	2.07	3.59	7.9
		aver.	3.50	1.41	1.76	3.18	9.3
		pred.		1.46	1.75	3.21	8.3

Sealed-Bid in Bilateral Bargaining

- Both buyers and sellers have private information
- Sealed-Bid Mechanism
  - Both write down a price
  - Trade at the average if $p_b > p_s$
  - Call Market: Many buyers vs. many sellers
- Two-Person Sealed-Bid Mechanism
  - One form of bilateral bargaining

Sealed-Bid in Bilateral Bargaining

- Two-Person Sealed-Bid Mechanism
- Buyer V ~ unif.[0,100]; Seller C ~ unif.[0,100]
- Piecewise-linear equilibrium: (not unique)
  - Chatterjee and Samuelson (1983)
  - Max. ex ante gains (Myerson & Satterthwaite 83)

$$p_b = \begin{cases} V & \text{if } V < 25 \\ \frac{25}{3} + \frac{2}{3}V & \text{if } V \geq 25 \end{cases}$$

$$p_s = \begin{cases} 25 + \frac{2}{3}C & \text{if } C < 75 \\ C & \text{if } C \geq 75 \end{cases}$$

Sealed-Bid in Bilateral Bargaining

- Radner and Schotter (JET 1989): 8 sessions
- 1, 2, 8: Baseline as above
- 3: Trade at price $(v + c + 50) / 3$ if $v > c + 25$
  - Should bid their values $v = V$, $c = C$
- 4: Price = v, (Buyers should bid $v = V/2$)
- 5,6: Alternative distribution for more learning
  - Distribution w/ more trade (for learning): m=0.438
- 7: Face-to-face bargaining

Estimated Buyer Bid Function Slope

Session	Below cutoff β	Below cutoff β_hat	T-stat	Above cutoff β	Above cutoff β_hat	T-stat
1	1	1.00	(0.01)	0.67	0.85*	(4.14)
2	1	0.91	(-0.52)	0.67	1.06	(1.28)
8	1	0.91	(-0.14)	0.67	0.80*	(2.32)
3	1	0.92	(-0.08)	1	0.73*	(-2.64)
4	0.5	0.55	(0.66)	0.5	0.58*	(2.32)
5	1	0.80*	(-4.17)	0.438	0.50	(1.12)
6(-20)	1	0.85	(-1.40)	0.438	0.40	(-0.56)
6(21-)	1	1.11	(0.70)	0.438	0.32	(-1.55)

Estimated Seller Bid Function Slope

Session	Below cutoff β	Below cutoff β_hat	T-stat	Above cutoff β	Above cutoff β_hat	T-stat
1	0.67	0.58	(-1.38)	1	0.97	(-0.32)
2	0.67	0.74	(1.28)	1	1.07	(0.14)
8	0.67	0.75	(1.65)	1	1.07	(0.17)
3	1	1.06	(1.04)	1	0.67	(-0.58)
5	0.438	0.48	(0.87)	1	1.00	(0.60)
6(-20)	0.438	0.57*	(2.16)	1	0.97	(-0.79)
6(21-)	0.438	0.52	(1.20)	1	0.95	(-0.69)

Sealed-Bid in Bilateral Bargaining

- Face-to-face yields efficiency 110%
  - Some truthfully reveal; others do not
- Radner and Schotter (1989, p.210):
  - The success of the face-to-face mechanism, if replicated, might lead to a halt in the search for better ways to structure bargaining in situations of incomplete information.
  - It would create, however, a need for a theory of such structured bargaining in order to enable us to understand why the mechanism is so successful.

Sealed-Bid in Bilateral Bargaining

- Follow-up Studies:
- Schotter, Snyder and Zheng (GEB 2000)
  - Add agents
- Rapoport and Fuller (1995)
  - Strategy method; asymmetric value dist.
- Daniel, Seale and Rapoport (1998)
  - Asymmetric value distribution (20 vs. 200)
- Rapoport, Daniel and Seale (1998)
  - Flip buyer-seller asymmetry; fixed pairing

Communication vs. Sealed-Bid

- Valley et al. (GEB 2002): Communication
- Buyer/Seller Values/Costs ~uniform[0, $50]
  - Bargain by stating bids; 7 periods; no rematch
  - Half had no feedback
- No communication: Sealed-bid in 2 minutes
- Written communication: Exchange messages for 13 minutes before final bid
- Face-to-face: Pre-game communication

Communication vs. Sealed-Bid

Please see “figure A”

in Kathleen Valley, Leigh Thompson, Robert Gibbons, Max H. Bazerman,”How Communication Imporves Efficiency in Bargaining Games,” *Games and Economic Behavior,* Vol.38,Issue.1 (2002), pp.138.

Communication vs. Sealed-Bid

Please see “figure B”

in Kathleen Valley, Leigh Thompson, Robert Gibbons, Max H. Bazerman,”How Communication Imporves Efficiency in Bargaining Games,” *Games and Economic Behavior,* Vol.38,Issue.1 (2002), pp.138.

Communication vs. Sealed-Bid

Please see “figure C”

in Kathleen Valley, Leigh Thompson, Robert Gibbons, Max H. Bazerman,”How Communication Imporves Efficiency in Bargaining Games,” *Games and Economic Behavior,* Vol.38,Issue.1 (2002), pp.138.

Communication vs. Sealed-Bid

- Empirical bid function slope = 0.7 (~0.67)
- Why are there “gains of communication”?
- Slope of buyer bids against seller bids=0.6
- Buyers bid higher when seller bids higher
  - Mutual bidding of values (common in students)
  - Mutual revelation of values (com. in students)
  - Coordinating on a price (40% written; 70% face)

Communication vs. Sealed-Bid

- Coordinating on a price
  - Happens 40% in written, 70% in face-to-face
- Not truth-telling (only 1/3)
  - TT not coordinated (4% written, 8% face)
- Feel each other out; give enough surplus
  - Modal – equal split of surplus
- Variance of surplus doubles (by mismatch)

Conclusion

- Unstructured Bargaining
  - Focal divisions; competing focal points
  - Self-serving bias (erased by veil of ignorance or stating weakness of own case)
- Structured Bargaining
  - Deviate toward equal splits
  - Social preference models could explain this
  - But Johnson et al. (JET 2002) suggest limited look-ahead as reason for such deviations

Conclusion

- Outside options affect bargaining divisions only if threats are credible
  - Lower fixed cost player gets everything
- Information Asymmetry: One-Sided
  - Revelation Principle + Random Dictator: Good
  - Bazaar mechanism:
  - Offers decline as theory predicts, but start too high and respond to δ wrongly
  - Buyers accept too early

Conclusion

- Bilateral Bargaining: Two-Sided
  - Sealed-bid mechanism: between truthful revelation and piecewise-linear equilibrium
- Players over-reveal values in face-to-face
  - Too honest, but “more efficient”
- Communication ☒ agree on a single price
- Why theory does better in sealed-bid than alternative-offer bargaining?
  - Is sealed-bid cognitively more transparent?

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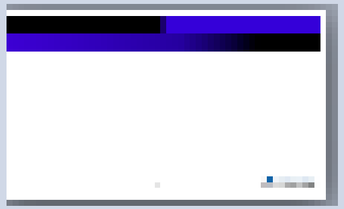
1-57			國立臺灣大學 經濟學系 王道一 教授
5	Negotiate over several issues (ex: price/quantity)`Free form …systematic heuristics and other cognitive variables (unrelated to game) $S^* = \arg\max_{(x_1,x_2)\in S}(x_1-d_1)(x_2-d_2)$ $= \arg\max_{(x_1,x_2)\in S}[u_1(x_1)-u_1(d_1)][u_2(x_2)-u_2(d_2)]$ Satisfies: 1. Pareto Optimality (效率性): $\forall x\in S^*, \nexists y\in S, y>x \Leftrightarrow y_i\geq x_i \forall i, y_j>x_j$ 2. Symmetry (對稱): $d_1=d_2, (x_1,x_2)\in S^* \Rightarrow (x_2,x_1)\in S^*$ 3. IIA (Independence of Irrelevant Alternatives; 不受額外無關選項影響) S^* solves (T,d) if S^* solves (S,d) and $S\subset T$ 4. IAT (Independence from affine utility transformation, 不受效用平移伸縮影響): $u_1(x)=Ax+B, u_2(x)=Cx+D$		Max H. Bazerman, Thmoas Magliozzi, and “Margaret A. Neale, ” “Integrative Bargaining in Competitive Market,” *Organizational Behavior and Human Decision Processes*, Vol.35, (1985), pp.294-313. 依據著作權法第 46 、 52 、 65 條合理使用
8			John Nash, “Two-Person Cooperative Games,” Econometrica, Vol.21, No.1, (Jan., 1953), pp136-137. 依據著作權法第 46 、 52 、 65 條合理使用
9	Player bargain over 100 lottery tickets …1 ticket = 1% chance winning a big prize Equal ($1) vs. Unequal Prize ($1.25/$3.75) Full vs. Partial (know own prize) Info. NBS: 50-50 split		Alvin Roth and Michael W.K.Malouf, “Game-Theoretical Models and the Role of Information in Bargaining,” *Psychological Review,*Vol. 86, No.6, pp586. 依據著作權法第 46 、 52 、 65 條合理使用

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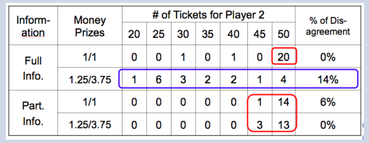
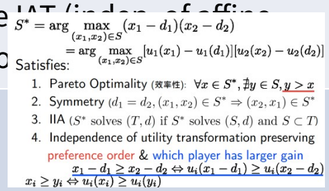
10			Alvin Roth and Michael W.K.Malouf, “Game-Theoretical Models and the Role of Information in Bargaining,” *Psychological Review,*Vol. 86, No.6, pp590. 依據著作權法第 46 、 52 、 65 條合理使用
11	Rare Disagreement 14% Disagree when both know inequality Divide tickets or $$$ payoffs equally Sensitive to $$$ payoffs Violate IAT (independence of affine transfo 		Alvin Roth and Michael W.K.Malouf, “Game-Theoretical Models and the Role of Information in Bargaining,” *Psychological Review,*Vol. 86, No.6, pp589-591. 依據著作權法第 46 、 52 、 65 條合理使用
12		 	Alvin Roth and J. Keith Murnighan, “the Role of Information in Bargaining : An Experimental Study,” *Econometrica*, Vol.50, No.5, (Sep.,1982), pp1128-1131 依據著作權法第 46 、 52 、 65 條合理使用
13	Convey private info (Stubbornness/Delay Cost)?		J. Keith Murnighan,Alvin Roth and Francoise Schoumaker, “Risk Aversion in Bargaining : An Experimental Study,” *Journal of Risk and Uncertainty*, Vol.1,(1988), pp104-124. 依據著作權法第 46 、 52 、 65 條合理使用

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13	First play against computer that gives you a lot Expect & get this from later human players Strong Reputation		Alvin Roth and Francoise Schoumaker, “Expectations and Reputations in Bargaining : An Experimental Study,” American Economic Review,Vol;73,No3, (1983), pp362-372. 依據著作權法第 46 、 52 、 65 條合理使用
14	Nash Demand Game (奈許需求實驗): 2 PlayersEach state demand … have to pool your aces and agree on how to divide the £10.” $x_1 = \frac{120 - y}{y - 20}$ $x_2 = \frac{y + 20}{y - 20}$ $= \frac{(120 - y)(20 + y)}{(y - 20)^2}$		Judith Mehta ,Chris Starmer, and Robert Sugden, “The Nature of Salience: An Experimental Investigation of Pure Coordination Game,” American Economic Review, Vol.84, No3(Jun., 1994), pp658-683. 依據著作權法第 46 、 52 、 65 條合理使用
15-16			Alvin Roth, ”Toward a Focal Point Theory of Bargaining,” *Game Theoretical Models of Bargaining*, ed. by Alvin Roth, Cambridge Up, 1985. 依據著作權法第 46 、 52 、 65 條合理使用
16	Actual data not as good: Constant across *h*		J. Keith Murnighan,Alvin Roth and Francoise Schoumaker, “Risk Aversion in Bargaining : An Experimental Study,” *Journal of Risk and Uncertainty*, Vol.1,(1988), pp105-121. 依據著作權法第 46 、 52 、 65 條合理使用

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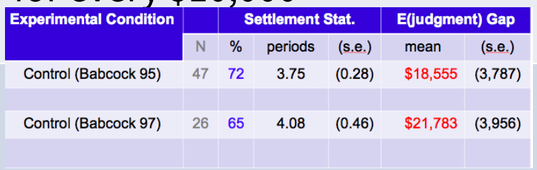
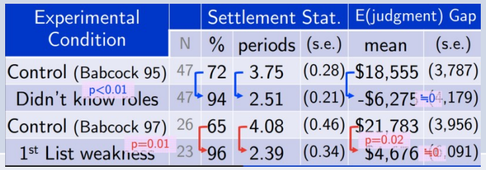
17	ultimatum over 100 tickets (P/R value differently) private value higher/lower ☒Propose 45%/30%		John H. Kagel, Cheung Kim, and Donald Moser, “Fairness in Ultimatum Games with Asymmetric Information and Asymmetric Payoffs,” Games and Economic Behavior, Vol.13, No.1,(1996), pp.100-110. 依據著作權法第 46 、 52 、 65 條合理使用
18	Read 27-page actual legal case …… First Guess what judge would award US$1 (or 1 Grade Point) for every $10,000 		Linda Babcock, George Loewenstein, and Samuel Issacharoff, “Biased Judgements of Fairness in Bargaining,” *American Economic Review*Vol.85, No.5, (1995), pp.1338-1339. 依據著作權法第 46 、 52 、 65 條合理使用
19			Linda Babcock, George Loewenstein, and Samuel Issacharoff, “Biased Judgements of Fairness in Bargaining,” *American Economic Review*, Vol.85, No.5,(1995), pp.1340-1341. ---. “Explaining Bargaining Impasse: the Role of Self-Serving Biases,” *Journal of Economic Perspectives*, Vol.11, No.1, pp.114. 依據著作權法第 46 、 52 、 65 條合理使用
20			Linda Babcock, George Loewenstein, and Samuel Issacharoff, “Biased Judgements of Fairness in Bargaining,” *American Economic Review*, Vol.85, No.5,(1995), pp.1340-1341.

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22	1 offers a division of 100p to 2 If 2 rejects, makes counteroffer dividing 25p……Experimental Results: mode at 50-50, some 25-75 and others in between		K.Binmore, A. Shaked, and J. Sutton, “Testing Noncooperative Bargaining Theory,” *American Economic Review*, Vol75, No.5, (Dec.,1985), pp.1178-1180. 依據著作權法第 46 、 52 、 65 條合理使用
23	“YOU WOULD BE DOING US A FAVOR IF YOU SIMPLY SET OUT TO MAXIMIZE YOUR WINNINGS.” “You would be discussing the theory this experiment is designed to test in class		Colin E. Camerer, *Behavioral Game Theory: Experiments in Strategic Interaction.* New York: Russell Sage Foundation; New Jersey: Princeton UP, 2003. pp.164. 依據著作權法第 46 、 52 、 65 條合理使用
25	Divide $30 with random termination…… Close to discounting results (50-50 & SPE)14.90, 14.64, 13.57	 	Rami Zwick, Amnon Rapoport and John C. Howard,”Two-Person Sequential Bargaining Behavior with Exogenous Breakdown,” *Theory and Decision*, Vol.32,No.5, (1992), pp.241-268. 依據著作權法第 46 、 52 、 65 條合理使用
26	Divide 30 shekels …… Weak P offer low, strong R accept 30%, but later quickly		Amnon Rapoport, Eythan Weg and Dan S. Felsenthal, “Effect of Fixed Costs in Two-Person Sequential Bargaining,” ” *Theory and Decision,* Vol.28, No.1, pp.47-71.

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27	Two players bargain over £7, discount Player 2 has outside option of £0, £2, or £4Split-the-difference (NBS): 47… Deal-me-out wins £0, £2: spike around 50% / £4: cluster @ 57%		Ken Binmore, Avner Shaked and John Sutton, “An Outside Option Experiment,” The Quarterly Journal of Economics, Vol.104, No.4, (Nov., 1989,) pp.753-770. 依據著作權法第 46 、 52 、 65 條合理使用
29	Seller: Own item (worthless to herself) Buyer: Private reservation price is unif.[0,1] Seller makes an offer each period Common discount factor δ $p_0 = \frac{1-\delta}{1-\gamma\cdot\delta}$ $p_t = p_0 \cdot \gamma^t$		Amnon Rapoport, Ido Erev and Rami Zwick,” An Experimental Study of Buyer-Seller Negotiation with One-Sided Incomplete Information and Time Discounting” *Management Science,* Vol. 41, No. 3 (Mar., 1995), pp. 377-394 依據著作權法第 46 、 52 、 65 條合理使用
30	$p_t \leq v \cdot \frac{1-\delta}{1-\gamma\cdot\delta}$		Amnon Rapoport, Ido Erev and Rami Zwick,” An Experimental Study of Buyer-Seller Negotiation with One-Sided Incomplete Information and Time Discounting” *Management Science,* Vol. 41, No. 3 (Mar., 1995), pp. 380. 依據著作權法第 46 、 52 、 65 條合理使用
	Complicate Strategy: Depend on δ……Opening p_0: H (0.24), M (0.36),		Amnon Rapoport, Ido Erev and Rami Zwick,” An Experimental Study of Buyer-Seller Negotiation with One-

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33	Different δ: H (0.90), M (0.67), L (0.33)Opening p_0: H (0.24), M (0.36), L (0.45)…Sellers ask for higher prices (than equil.)But discount γ: H (0.81), M (0.68), L (0.55)		Amnon Rapoport, Ido Erev and Rami Zwick," An Experimental Study of Buyer-Seller Negotiation with One-Sided Incomplete Information and Time Discounting" *Management Science,* Vol. 41, No. 3 (Mar., 1995), pp. 384. 依據著作權法第 46 、 52 、 65 條合理使用
34	Only Informed bargainer I sees pie size Either large (π_g) or small (π_b) Free-form bargaining Uninformed U can strike to shrink pie by γ $(\gamma_g - \gamma_b)\pi_b \leq x_g - x_b \leq (\gamma_g - \gamma_b)\pi_g$ $x_U = 1, x_I = \pi - (1-\gamma)\pi$ $\gamma\pi < \pi$ $x_U = 1, x_I = \frac{\delta}{\pi}, y_U = \frac{\delta}{1}, y_I = 0$ if $\gamma\pi < \pi$ $x_U = 1, x_I = \frac{\delta}{\gamma\pi}, y_U = 1, y_I = \frac{\delta}{\pi}$ if $\gamma\pi > \pi$		Robert Forsythe, John Kennan and Barry Sopher, "An Experimental Analysis of Strikes in Bargaining Games with One-Sided Private Information," American Economic Review Vol. 81, No. 1 (Mar., 1991), pp. 255. 依據著作權法第 46 、 52 、 65 條合理使用
35-37			Robert Forsythe, John Kennan and Barry Sopher, "An Experimental Analysis of Strikes in Bargaining Games with One-Sided Private Information," American Economic Review Vol. 81, No. 1 (Mar., 1991), pp. 256. 依據著作權法第 46 、 52 、 65 條合理使用
			Robert Forsythe, John Kennan and Barry Sopher, "An Experimental Analysis of Strikes in Bargaining Games with

Game	p	State	π	π_U	π_I	total	%Strike
III	0.5	b	2.80	1.47	1.18	2.66	5.2
		g	4.20	1.52	2.41	3.93	6.5
		aver.	3.50	1.50	1.80	3.29	6.0
		pred.		1.40	2.10	3.50	0.0
IV	0.25	b	2.40	1.08	1.04	2.12	11.8
		g	6.80	1.58	5.03	6.61	2.9
		aver.	3.50	1.21	2.04	3.24	7.4
		pred.		1.20	2.30	3.50	0.0

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40	<table><tr><th>Game</th><th>p</th><th>State</th><th>π</th><th>π_U</th><th>π_I</th><th>total</th><th>%Strike</th></tr><tr><td rowspan="4">I</td><td rowspan="4">0.5</td><td>b</td><td>1.00</td><td>0.31</td><td>0.30</td><td>0.61</td><td>39.0</td></tr><tr><td>g</td><td>6.00</td><td>1.78</td><td>3.70</td><td>5.48</td><td>8.7</td></tr><tr><td>aver.</td><td rowspan="2">3.50</td><td>1.05</td><td>2.00</td><td>3.05</td><td>13.0</td></tr><tr><td>pred.</td><td>1.50</td><td>1.75</td><td>3.25</td><td>7.1</td></tr><tr><td rowspan="4">II</td><td rowspan="4">0.75</td><td>b</td><td>2.30</td><td>1.06</td><td>0.84</td><td>1.90</td><td>17.2</td></tr><tr><td>g</td><td>3.90</td><td>1.53</td><td>2.07</td><td>3.59</td><td>7.9</td></tr><tr><td>aver.</td><td rowspan="2">3.50</td><td>1.41</td><td>1.76</td><td>3.18</td><td>9.3</td></tr><tr><td>pred.</td><td>1.46</td><td>1.75</td><td>3.21</td><td>8.3</td></tr></table> $\text{bp} = \begin{cases} \frac{3}{52} + \frac{3}{5}\Lambda & \text{if } \Lambda \geq 52 \\ \Lambda & \text{if } \Lambda < 52 \end{cases}$		Robert Forsythe, John Kennan and Barry Sopher, “An Experimental Analysis of Strikes in Bargaining Games with One-Sided Private Information,” American Economic Review Vol. 81, No. 1 (Mar., 1991), pp. 263. 依據著作權法第 46 、 52 、 65 條合理使用
42	$\text{bs} = \begin{cases} \text{C} & \text{if } \text{C} \geq 25 \\ 52 + \frac{3}{5}\text{C} & \text{if } \text{C} < 25 \end{cases}$		Roy Radner and Andrew Schotter, “The Sealed-Bid Mechanism: An Experimental Study,” *Journal of Economic Theory,*Vol.48, (1989), pp.181. 依據著作權法第 46 、 52 、 65 條合理使用
43	1, 2, 8: Baseline as above 3: Trade at price (v+ c+ 50) / 3 if v>c+25 …5,6: Alternative distribution for more learning Distribution w/ more trade (for learning): m=0.438 7: Fa <table><tr><th></th><th>Session</th><th>β</th><th>β_hat</th><th>T-stat</th><th>β</th><th>β_hat</th><th>T-stat</th></tr><tr><td>1</td><td>1</td><td>1.00</td><td>(0.01)</td><td>0.67</td><td>0.85*</td><td>(4.14)</td></tr><tr><td>2</td><td>1</td><td>0.91</td><td>(-0.52)</td><td>0.67</td><td>1.06</td><td>(1.28)</td></tr><tr><td>8</td><td>1</td><td>0.91</td><td>(-0.14)</td><td>0.67</td><td>0.80*</td><td>(2.32)</td></tr><tr><td>3</td><td>1</td><td>0.92</td><td>(-0.08)</td><td>1</td><td>0.73*</td><td>(-2.64)</td></tr><tr><td>4</td><td>0.5</td><td>0.55</td><td>(0.66)</td><td>0.5</td><td>0.58*</td><td>(2.32)</td></tr><tr><td>5</td><td>1</td><td>0.80*</td><td>(-4.17)</td><td>0.438</td><td>0.50</td><td>(1.12)</td></tr><tr><td>6(-20)</td><td>1</td><td>0.85</td><td>(-1.40)</td><td>0.438</td><td>0.40</td><td>(-0.56)</td></tr><tr><td>6(21-)</td><td>1</td><td>1.11</td><td>(0.70)</td><td>0.438</td><td>0.32</td><td>(-1.55)</td></tr></table>	 	Roy Radner and Andrew Schotter, “The Sealed-Bid Mechanism: An Experimental Study,” *Journal of Economic Theory,*Vol.48, (1989), pp.183-186 依據著作權法第 46 、 52 、 65 條合理使用
44			Roy Radner and Andrew Schotter, “The Sealed-Bid Mechanism: An Experimental Study,” *Journal of Economic*

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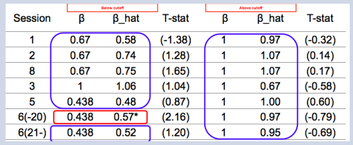
45			Roy Radner and Andrew Schotter, “The Sealed-Bid Mechanism: An Experimental Study,” *Journal of Economic Theory,*Vol.48, (1989), pp.193. 依據著作權法第 46 、 52 、 65 條合理使用
46	The success of the face-to-face mechanism, if replicated, might lead to a halt in the search for better ways …however, a need for a theory of such structured bargaining in order to enable us to understand why the mechanism is so successful.		Roy Radner and Andrew Schotter, “The Sealed-Bid Mechanism: An Experimental Study,” *Journal of Economic Theory,*Vol.48, (1989), pp.210 依據著作權法第 46 、 52 、 65 條合理使用
48	Buyer/Seller Values/Costs ~ uniform[0, $50] Bargain by stating bids; 7 periods; no rematch Half had no feedback No communication: Sealed-bid in 2 minutes Written communication: Exchange messages for 13 minutes before final bid Face-to-face: Pre-game communication	 	Kathleen Valley, Leigh Thompson, Robert Gibbons, Max H. Bazerman,”How Communication Imporves Efficiency in Bargaining Games,” *Games and Economic Behavior,* Vol.38,Issue.1, (2002), pp.128-129. 依據著作權法第 46 、 52 、 65 條合理使用
54	suggest limited look-ahead as reason for such deviations		Johnson, et al, “Detecting Failures of Backward Induction: Monitoring Information Search in Sequential Bargaining, ” Journal of Economic Theory, Vol.104, (2002), pp.16-47

Session	Below cutoff β	Below cutoff β_hat	T-stat	Above cutoff β	Above cutoff β_hat	T-stat
1	0.67	0.58	(-1.38)	1	0.97	(-0.32)
2	0.67	0.74	(1.28)	1	1.07	(0.14)
8	0.67	0.75	(1.65)	1	1.07	(0.17)
3	1	1.06	(1.04)	1	0.67	(-0.58)
5	0.438	0.48	(0.87)	1	1.00	(0.60)
6(-20)	0.438	0.57*	(2.16)	1	0.97	(-0.79)
6(21-)	0.438	0.52	(1.20)	1	0.95	(-0.69)