

Appendix 1

Instructions for Experiment (Groups of 4 Partners)

Introduction

You are about to participate in a project about economic decision-making. You will be asked to make decisions about the investment of resources between two activities, which will be referred to as Markets 1 and 2. The amount of money you will earn in today's session will depend on your investment in Market 1 and the sum of your and others' investments in Market 2. Your earnings will be paid to you privately, in cash, at the end of the session. The money for this project is provided by several funding agencies.

The Environment

During this session you and 11 other people will have to make decisions to invest resources in two markets. You will participate in 18 decision rounds, called *periods*. The first three periods will be for practice. The last 15 periods will determine your earnings at the end of the session.

At the start of the first round the 12 participants in the session will be divided into 3 groups of 4 people. The distribution of people to groups is random and none of the participants will know who is in his or her group. After the three practice periods are over, we will scramble the membership of all the groups, so that everyone is playing in a new group. Each group of 4 participants remains together throughout the next 15 paid periods. . Your earnings will depend upon the investment decisions that you make, the investment decisions that the members of your group make, and the investment decisions that the members of the other groups make. Your earnings in each round will be reported to you in Laboratory Dollars (L\$). These will be converted to Canadian Dollars (C\$) at the end of the session using the relationship $0.005 \times L\$ = C\$$.

The Markets

At the beginning of each period you and each of the other participants will be given 28 tokens to invest. These tokens may be distributed in any way you wish between the two markets. Each period you will decide how many tokens to invest in Market 2. Whatever you do not invest in Market 2 will be automatically invested in Market 1.

Each token you invest in Market 1 yields a fixed return of L\$3.25. This return per token is independent of the amount you invest or others invest in Market 1. Your return from Market 2 depends on the total investment in this market by all participants in the session.

Although you keep all of your return from Market 1, you and the rest of your group will pool your returns from Market 2 and share them equally. Thus your *payoff* from Market 1 equals your return from Market 1 and your *payoff* from Market 2 equals your share of your groups' returns from Market 2. Your total payoff for the period is the sum of your payoffs in the two markets.

Numerical Example

In today's session there will be three groups of four participants. Each participant will have an endowment of 28 tokens to distribute between investments in Market 1 and Market 2.

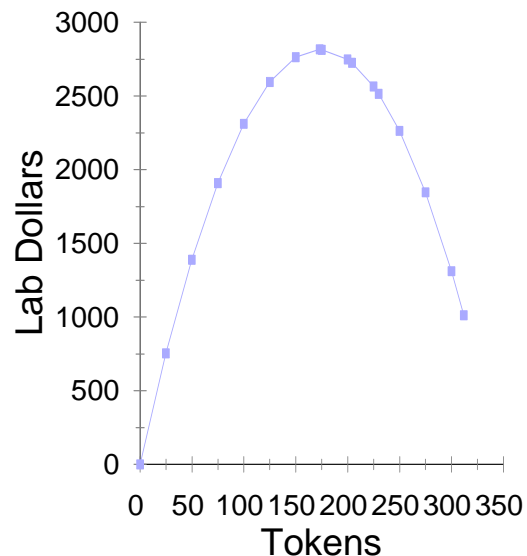
Suppose you invest 11 tokens in Market 2. Assume that each of the other members of your group invests 19 tokens. Assume that each of the other participants (not in your group) invests 17 tokens in Market 2. Here is how your payoffs in Market 1 and Market 2 are calculated:

1. You invest 11 tokens in Market 2, leaving 17 tokens to be invested in Market 1.
2. The total investment in Market 2 by the other members of your group is $3 \times 19 = 57$ tokens.
3. The total investment in Market 2 by the participants not in your group is $8 \times 17 = 136$ tokens.
4. The total investment in Market 2 by all participants is $11 + 57 + 136 = 204$ tokens.
5. The Market 2 Total Return Table shows the total and average return per token for a number of values of total investment in Market 2. If 204 tokens are invested in Market 2 the total return will be L\$2728.50. The average return per token is L\$13.37.

Market 2 Total Return Table

Tokens	Total Return	Average Return per Token
0	0	0
25	753.91	30.156
50	1390.63	27.813
75	1910.16	25.469
100	2312.50	23.125
125	2597.66	20.781
150	2765.63	18.438
175	2816.41	16.094
200	2750.00	13.75
204	2728.5	13.375
225	2566.41	11.406
250	2265.63	9.063
275	1847.66	6.719
300	1312.5	4.375
325	660.16	2.031
336	336	1

Market 2 Total Return



6. Your return from the 11 tokens you invested in Market 2 is $L\$13.375 \times 11 = L\147.125 . The total return from the 19 tokens invested by each of the other members of your group is $L\$13.375 \times 19 = L\254.125 . Therefore the total return to your group is $L\$909.50$. Since you share this return equally, your total *payoff* from Market 2 is $L\$909.50/4 = L\227.375 .
7. The constant return in Market 1 is $L\$3.25$ per token. Therefore the return from the 17 tokens you invested in Market 1 is $3.25 \times 17 = L\$55.25$.
8. Your total *payoff* from both markets combined is $L\$55.25 + L\$227.38 = L\$282.63$.
9. Each of your group partners total payoff, on the other hand, is $L\$227.38 + 9 \times L\$3.25 = L\$256.63$.

To simplify these calculations, the computer will show you an abbreviated Payoff Table for Market 2 and a Payoff Wizard which will calculate the exact payoff for any combination of your investment, the average investment by others that are in your group, and the average investment by others that are not in your group. The abbreviated Payoff Table will be similar to the Payoff Table for Market 2 shown below.

Payoff Table for Market 2: Your Payoff Only When There are 3 Groups with 4 Members in Each Group							
Average Investment of Tokens in Market 2 by Members of Your Group		0	6	11	17	22	28
Average Investment of Tokens in Market 2 by All Participants Other Than Those in Your Group	0	0	181.5	312.13	444.13	533.5	616
	6	0	154.5	262.63	367.63	434.5	490
	11	0	132	221.38	303.88	352	385
	17	0	105	171.88	227.38	253	259
	22	0	82.5	130.63	163.63	170.5	154
	28	0	55.5	81.13	87.13	71.5	28

The payoff based upon the numbers given in the previous section can be easily calculated from this Payoff Table. Since your group invested $11 + 57 = 68$ tokens, the average investment by people in your group is $68/4 = 17$ tokens. Locate the column headed "17". Since the other groups invested 17 on average, locate the row labelled "17". The number at the intersection of these rows and columns (227.38) is your share of your group's return from Market 2. Adding $L\$55.25$ (your payoff from Market 1) to this gives your total payoff of $L\$282.63$.

Practice Periods

To let you learn more about the environment we are going to run **three practice periods**. The results from these periods will **not** contribute to your final earnings. If you have any questions during these three periods, please raise your hand and we will answer them.

After the three periods are over, we will scramble members of the groups and begin the 15 periods which contribute to your earnings.

(Monitor starts the session)

Please examine your computer screens. In the upper right hand frame you will find a Payoff Table like the one in your instructions. Locate the cell showing your Market Two payoff if you invest 11 tokens, the others in your group invest 19 tokens and the people not in your group invest 17 tokens each. To find the cell you must calculate the average investment made by all of the members of your group (11 by you and 19 by each of the other three is 68 tokens; divided by 4 equals 17 tokens). Under these hypothetical conditions, your payoff from Market Two would be L\$227.38.

Please click on this cell. Now look at the Wizard at the upper left hand side of the screen. Note that the numbers from the Payoff Table have been entered into the Wizard. Your investment is identified as 17 tokens, the average investment of the others in your group is identified as 17 tokens, and the average investment of others not in your group is identified as 17 tokens. Note the displayed payoff from Market 2 is L\$ 227.38 and your displayed Total Payoff is L\$263.13.

Now use the spin-edit box to change your investment to 11 tokens and the average investment by others in your group to 19 tokens. Note that your payoff from Market 2 has not changed, but your Total Payoff has increased to L\$282.63. This total payoff is identical to the payoff you calculated in the previous example, in which your group average investment was 17, but you invested 11 tokens, while each of the others in your group invested 19 tokens.

You can calculate the payoff for any other combinations of investments by altering the numbers in the spin edit box. For example, suppose the others in your group lower their average investment in Market 2 to 11 tokens. Please change the value in the spin-edit box for the others in your group to 11. Notice that your payoff in Market 2 falls to L\$171.88 and your total payoff falls to L\$227.13.

Now try changing your assumed investment in Market 2. Suppose you lower your investment in Market 2 from 11 to 6. Note that your total payoff rises to L\$228.41. Suppose that the average investment in Market 2 by all participants other than those in your group falls to 14. Note that your total payoff rises to L\$250.35. Now change your investment in Market 2 to 15 tokens. Notice that your total payoff now rises to L\$252.25.

You make your decision by filling in the form at the lower left of your screen. Notice that the spin-edit box on this form shows the last value you entered into the Wizard. You can accept this value or change it any way you please. After you have entered your desired investment decision, push the **Press Here When Done** button.

We are now ready to start the practice sessions. Please make your decisions and submit them.

(after results are shown)

The computer screens are now showing the results of the period. When you are finished examining them, please press **Done**

(after screens change)

You are now ready to start the second practice period. Notice the results from last period are shown on the history page on the right hand side of your screen. Please make your decisions and submit them as before.

(after results are shown)

The results of the second practice period are now being shown. Please examine them and then proceed to the third practice period.

(after third period begins)

This is the third and final practice period. Please make your decisions and submit them as before. When the results of the third session appear, do not press the **Done** until you have read the remaining instructions.

(after the results appear)

Paid Periods

We are now about to begin the paid portion of the session. At the beginning of the next period we will scramble the membership of all the groups so that your group will consist of a completely new set of four people. You will remain grouped with this new set of participants for the next 15 periods.

If you have any questions, please ask them now.

Please examine the results of the third practice period and press **Done**. When everyone has done this, the first paid period will begin automatically. Please continue to follow the computer prompts until the end of the session.

Appendix 2

Figure A2.1 Participant's Screen

For an explanation of how this screen is used during the decision round of a laboratory session, please refer to the Instructions in Appendix 1. This screen corresponds to the treatment with groups of 4 participants who are partnered throughout the fifteen decision rounds of the session.

Subject 1 Period 1
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Instructions

It is period 1. Each participant can invest from 0 to 28 tokens in Market 2.

OF MEMBERS IN EACH GROUP: 4 (including you)

OF GROUPS: 3 (including yours)

Payoff Wizard

If your market 2 investment was:

and your 3 group members each invested:

and the 8 others not in your group each invested:

Then your total payoff would be:

Market 1: Market 2:

Total payoff from both markets:

Market 2 Decision

Please enter the number of tokens you want to invest in Market 2:

*Whatever is left of your 28 tokens will be invested in Market 1.

Press here when done

History
Payoff Table

Values in table = Your payoff from Market 2 only

Average Investment per Person in Market 2 from Your Group

	0	6	11	17	22	28
0	0.00	181.50	312.13	444.13	533.50	616.00
6	0.00	154.50	262.63	367.63	434.50	490.00
11	0.00	132.00	221.38	303.88	352.00	385.00
17	0.00	105.00	171.88	227.38	253.00	259.00
22	0.00	82.50	130.63	163.63	170.50	154.00
28	0.00	55.50	81.13	87.13	71.50	28.00

Subject: 1 Period: 1 Cumulative Payoff: \$0.00 lab dollars

Appendix 3

Table A3.1 OLS Regression Results: Dependent Variable is the Mean per Period System Effort over Periods 1 to 15

Independent Variable	Coefficient	Robust Standard Error	p-Value
Constant (Group Size One)	282.2	2.075	0.000
Group Size 4	-131.8	5.614	0.000
Group Size 6	-181.8	2.675	0.000
Random Allocation	11.8	12.965	0.384
Group Size 4 and Random	-18.4	15.519	0.263
Observations = 15	$R^2 = 0.977$	Root MSE = 12.128	F(4, 10) = 1168 p = 0.000

Table A3.2 Cochrane-Orcutt AR(1) Regression Results: Dependent Variable is the per Period System Effort of the 3 Sessions of the One-Person Group Treatment

Independent Variable	Coefficient	Robust Standard Error	p-Value
First Session Fixed Effect	267.5	20.349	0.000
Second Session Fixed Effect	258.5	15.722	0.000
Third Session Fixed Effect	236.9	7.908	0.000
Asymptotic Effort	289.0	2.764	0.000
Observations = 42	$R^2 = 0.998$	Root MSE = 17.790	F(4, 10) = 5782 p = 0.000

Table A3.3 Cochrane-Orcutt AR(1) Regression Results: Dependent Variable is the per Period System Effort of the 3 Sessions of the Four-Person Fixed Assignment Treatment

Independent Variable	Coefficient	Robust Standard Error	p-Value
First Session Fixed Effect	215.6	26.799	0.000
Second Session Fixed Effect	206.5	15.334	0.000
Third Session Fixed Effect	160.3	25.581	0.000
Asymptotic Effort	141.4	4.704	0.000
Observations = 42	$R^2 = 0.987$	Root MSE = 18.350	F(4, 10) = 1422 p = 0.000

Table A3.4 Cochrane-Orcutt AR(1) Regression Results: Dependent Variable is the per Period System Effort of the 3 Sessions of the Four-Person Random Assignment Treatment

Independent Variable	Coefficient	Robust Standard Error	p-Value
First Session Fixed Effect	199.4	14.548	0.000
Second Session Fixed Effect	127.9	24.939	0.000
Third Session Fixed Effect	133.3	25.749	0.000
Asymptotic Effort	142.6	4.703	0.000
Observations = 42	$R^2 = 0.985$	Root MSE = 18.444	F(4, 10) = 817 p = 0.000

Table A3.5 Cochrane-Orcutt AR(1) Regression Results: Dependent Variable is the per Period System Effort of the 3 Sessions of the Six-Person Fixed Assignment Treatment

Independent Variable	Coefficient	Robust Standard Error	p-Value
First Session Fixed Effect	132.4	25.733	0.000
Second Session Fixed Effect	167.9	20.718	0.000
Third Session Fixed Effect	122.2	28.578	0.000
Asymptotic Effort	91.5	4.578	0.000
Observations = 42	$R^2 = 0.967$	Root MSE = 17.947	F(4, 10) = 323 p = 0.000

Table A3.6 Cochrane-Orcutt AR(1) Regression Results: Dependent Variable is the per Period System Effort of the 3 Sessions of the Six-Person Random Assignment Treatment

Independent Variable	Coefficient	Robust Standard Error	p-Value
First Session Fixed Effect	577.4	116.248	0.000
Second Session Fixed Effect	325.0	136.642	0.023
Third Session Fixed Effect	224.2	130.973	0.095
Asymptotic Effort	73.5	17.065	0.000
Observations = 42	$R^2 = 0.912$	Root MSE = 20.391	F(4, 10) = 111 p = 0.000

Table A3.7 OLS Regression Results: Dependent Variable is the Mean per Person Cumulative Payoff

Independent Variable	Coefficient	Robust Standard Error	p-Value
Constant (Group Size One)	1843.6	48.000	0.000
Group Size 4	1492.7	49.250	0.000
Group Size 6	1208.4	54.125	0.000
Random Allocation	73.1	94.565	0.458
Group Size 4 and Random	-87.8	97.017	0.387
Observations = 15	$R^2 = 0.985$	Root MSE = 83.844	$F(4, 10) = 249$ $p = 0.000$

Table A3.8 OLS Regression Results: Dependent Variable is the Mean Coefficient of Variation of per Person Cumulative Payoff

Independent Variable	Coefficient	Robust Standard Error	p-Value
Constant (Group Size One)	6.19	1.296	0.001
Group Size 4	1.44	1.298	0.292
Group Size 6	0.48	1.723	0.785
Random Allocation	-3.01	1.165	0.027
Group Size 4 and Random	0.57	1.356	0.684
Observations = 15	$R^2 = 0.566$	Root MSE = 1.453	$F(4, 10) = 56.32$ $p = 0.000$

Appendix 4

Table A4.1 Mean Coefficients of Variation for Individual Payoffs in each Session per Period by Group Size and Group Allocation (standard deviations of the coefficients of variation are in parentheses, and the number of observations in each cell are also provided)

Period	Group Size 4		Group Size 6		Period	Group Size 4		Group Size 6	
	Partners	Strangers	Partners	Strangers		Partners	Strangers	Partners	Strangers
1	11.12	26.50	8.79	9.73	Total	12.34	18.09	13.98	13.29
	(3.50)	(18.33)	(2.57)	(2.95)		(4.47)	(8.43)	(6.76)	(5.82)
	3	3	3	3		45	45	45	45
2	8.71	12.19	11.15	17.09					
	(5.10)	(7.42)	(2.29)	(14.53)					
	3	3	3	3					
3	13.28	15.07	11.85	12.03					
	(7.40)	(2.15)	(3.77)	(2.56)					
	3	3	3	3					
4	14.70	16.36	10.69	14.64					
	(5.08)	(1.34)	(3.41)	(2.04)					
	3	3	3	3					
5	10.23	18.17	15.68	11.14					
	(4.05)	(7.66)	(6.20)	(3.88)					
	3	3	3	3					
6	10.27	14.04	12.53	15.54					
	(2.34)	(3.88)	(0.62)	(7.98)					
	3	3	3	3					
7	9.73	20.77	10.07	12.54					
	(3.16)	(5.63)	(1.07)	(4.47)					
	3	3	3	3					
8	13.18	25.19	8.80	12.83					
	(1.51)	(9.30)	(4.81)	(7.14)					
	3	3	3	3					
9	15.92	17.52	17.78	16.29					
	(2.65)	(2.92)	(7.14)	(6.41)					
	3	3	3	3					
10	10.56	15.74	18.91	16.54					
	(4.48)	(6.48)	(14.75)	(6.00)					
	3	3	3	3					
11	12.37	12.23	16.93	8.86					
	(7.31)	(0.26)	(9.70)	(3.72)					
	3	3	3	3					
12	13.21	20.40	10.87	10.12					
	(5.40)	(6.75)	(5.70)	(5.30)					
	3	3	3	3					
13	11.06	18.29	13.74	19.29					
	(2.87)	(11.03)	(1.69)	(3.59)					
	3	3	3	3					
14	11.57	22.19	21.47	12.67					
	(2.59)	(13.44)	(5.43)	(3.97)					
	3	3	3	3					
15	19.25	16.72	20.43	10.02					
	(2.56)	(13.87)	(9.90)	(3.42)					
	3	3	3	3					

Appendix 5

Numerical Example Demonstrating How a More Equitable Distribution of Income for Partners than Strangers can become a More Equitable Distribution of Wealth for Strangers than Partners

Definitions: Income is the Payoff received by a session participant in a decision-round. Wealth is the sum of all Payoffs received by a session participant across all decision-rounds.

Assumption 1: There are two three-person groups appropriating from a common pool resource.

Assumption 2: Each group realizes an average member payoff of 13.

Assumption 3: The Coefficient of Variation of income to all participants in a session is smaller for Partners than for Strangers.

Assumption 4: The incomes for participants in the Partners treatment are more stable over time than the incomes for participants in the Strangers treatment.

Assumption 5: There will be five decision rounds.

Assumption 6: The distribution of income across members of each group in any decision round is consistent with a Nash equilibrium.

Assumption 7: Partners never change their appropriations and so never change their incomes.

Assumption 8: Strangers always change their appropriations and so always change their incomes.

The example presented in Table A5.1 satisfies the assumptions listed above. In every period the coefficient of variation of income to Partners (9.93) is less than the coefficient of variation of income to Strangers (22.21). This indicates that income is more equitably distributed for Partners. However, the coefficient of variation of wealth for Partners (9.93) is greater than the coefficient of variation of wealth for Strangers (5.69). This indicates that wealth is more equitably distributed for Strangers.

Table A5.1 Payoffs and Descriptive Statistics by Participant and Treatment to Illustrate the Effect of Aggregation on the Distribution of Wealth

Subject #	Period 1	Period 2	Period 3	Period 4	Period 5	Totals
Partners 1	11	11	11	11	11	55
Partners 2	13	13	13	13	13	65
Partners 3	15	15	15	15	15	75
Partners 4	12	12	12	12	12	60
Partners 5	13	13	13	13	13	65
Partners 6	14	14	14	14	14	70
Mean	13	13	13	13	13	65
Std	1.29	1.29	1.29	1.29	1.29	6.45
CoV	9.93	9.93	9.93	9.93	9.93	9.93
Strangers 1	10	9	17	9	17	62
Strangers 2	13	13	16	13	16	71
Strangers 3	16	13	9	13	9	60
Strangers 4	9	16	13	16	13	67
Strangers 5	13	17	10	17	10	67
Strangers 6	17	10	13	10	13	63
Mean	13	13	13	13	13	65
Std	2.89	2.89	2.89	2.89	2.89	3.70
CoV	22.21	22.21	22.21	22.21	22.21	5.69

Note: Numbers in bold font indicate members of group 1 in the Partners and Strangers treatments. Std is the standard deviation of a distribution of payoffs. CoV is the coefficient of variation of a distribution of payoffs ($[\text{Std}/\text{Mean}] \times 100$).