

# The Lone-Chooser Method

Lecture 16  
Section 3.4

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1 The Lone-Chooser Method

2 Example – 3 Players

3 Example – 4 Players

4 Assignment

- 1 The Lone-Chooser Method
- 2 Example – 3 Players
- 3 Example – 4 Players
- 4 Assignment

# The Lone-Chooser Method

## Definition (The Lone-Chooser Method)

In the **lone-chooser method**,

- One player is designated to be the **chooser**.
- The other players are the **dividers**. They divide the assets among themselves (details to follow).
- Then each of the dividers divides his share into equal **subshares**.
- The chooser then chooses one subshare from each of the dividers.
- The dividers keep the subshares that are left.

# The Lone-Chooser Method

- This is normally done in a **recursive** manner.
- For example, if there are 4 players  $A$ ,  $B$ ,  $C$ , and  $D$ .

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- For example, if there are 4 players  $A$ ,  $B$ ,  $C$ , and  $D$ .
  - $A$  starts off with all the assets.
  - Then  $A$  divides them into 2 equal shares.  $B$  chooses one of them.

# The Lone-Chooser Method

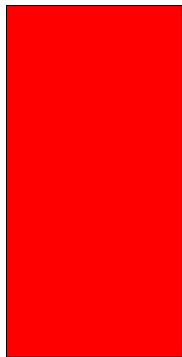
- This is normally done in a **recursive** manner.
- For example, if there are 4 players  $A$ ,  $B$ ,  $C$ , and  $D$ .
  - $A$  starts off with all the assets.
  - Then  $A$  divides them into 2 equal shares.  $B$  chooses one of them.
  - Then  $A$  and  $B$  each divide their shares into 3 equal subshares. Player  $C$  chooses one subshare from each.



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- For example, if there are 4 players  $A$ ,  $B$ ,  $C$ , and  $D$ .
  - $A$  starts off with all the assets.
  - Then  $A$  divides them into 2 equal shares.  $B$  chooses one of them.
  - Then  $A$  and  $B$  each divide their shares into 3 equal subshares. Player  $C$  chooses one subshare from each.
  - Then  $A$ ,  $B$ , and  $C$  each divide their shares into 4 equal subshares. Player  $D$  chooses one subshare from each.

# The Lone-Chooser Method



A

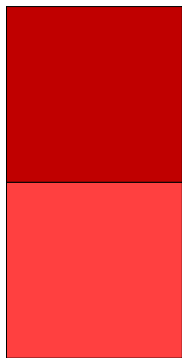
B

C

D

A starts with all the assets

# The Lone-Chooser Method



A

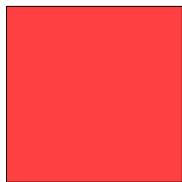
B

C

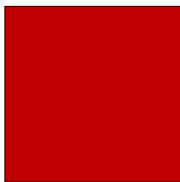
D

A divides them into 2 equal shares

# The Lone-Chooser Method



A



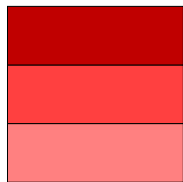
B

C

D

*B* chooses one of the shares

# The Lone-Chooser Method



A



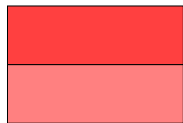
B

C

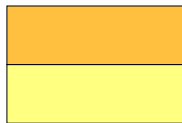
D

A and B divide their assets into 3 equal subshares

# The Lone-Chooser Method



A



B

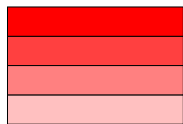


C

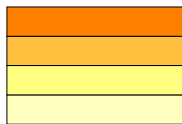
D

C chooses one subshare from each

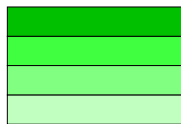
# The Lone-Chooser Method



A



B

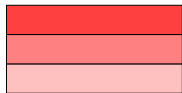


C

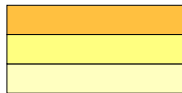
D

A, B, and C divide their assets into 4 equal subshares

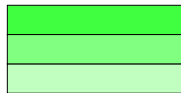
# The Lone-Chooser Method



A



B



C



D

*D* chooses one subshare from each



# Outline

- 1 The Lone-Chooser Method
- 2 Example – 3 Players**
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# Example

## Example (The Lone-Chooser Method – 3 Players)

- Andy, Bob, and Chuck are dividing 4 pies: apple, cherry, lemon, and pecan.
- The value systems of the players are as follows.

	Apple	Cherry	Lemon	Pecan
Andy	12	6	10	8
Bob	7	2	8	4
Chuck	6	4	2	6

- Chuck is the lone-chooser.
- But in the meantime, Andy and Bob divide the assets between the two of them, with Andy the divider and Bob the lone chooser.

# Example

## Example (The Lone-Chooser Method – 3 Players)

	Apple	Cherry	Lemon	Pecan
Andy	12	6	10	8
Bob	7	2	8	4
Chuck	6	4	2	6

- How should Andy divide **all** the assets into **two** equal shares?

# Example

## Example (The Lone-Chooser Method – 3 Players)

	Apple	Cherry	Lemon	Pecan
Andy	12	6	10	8
Bob	7	2	8	4
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- How should Andy divide **all** the assets into **two** equal shares?  $S_1$ :  $A + C$  (\$18.00);  $S_2$ :  $L + P$  (\$18.00)

# Example

## Example (The Lone-Chooser Method – 3 Players)

	Apple	Cherry	Lemon	Pecan
Andy	12	6	10	8
Bob	7	2	8	4
Chuck	6	4	2	6

- How should Andy divide **all** the assets into **two** equal shares?  $S_1$ :  $A + C$  (\$18.00);  $S_2$ :  $L + P$  (\$18.00)
- Which share should Bob choose?

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- Which share should Bob choose?  $S_2$

# Example

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	Apple	Cherry	Lemon	Pecan
Andy	12	6	10	8
Bob	7	2	8	4
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- How should Andy divide **all** the assets into **two** equal shares?  $S_1$ :  $A + C$  (\$18.00);  $S_2$ :  $L + P$  (\$18.00)
- Which share should Bob choose?  $S_2$
- Division so far: Andy has  $A + C$ ; Bob has  $L + P$ .

# Example

## Example (The Lone-Chooser Method – 3 Players)

- Now Andy and Bob each divide **their shares** each into **3** equal subshares.
- Andy's share, Apple and Cherry, to be divided 3 ways and Chuck chooses:

	Apple	Cherry
Andy	12	6
Chuck	6	4



# Example

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- What are Andy's 3 subshares?

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- Now Andy and Bob each divide **their shares** each into **3** equal subshares.
- Andy's share, Apple and Cherry, to be divided 3 ways and Chuck chooses:

	Apple	Cherry
Andy	12	6
Chuck	6	4

- What are Andy's 3 subshares?  $S_1: \frac{1}{2}A$  (\$6.00);  $S_2: \frac{1}{2}A$  (\$6.00);  $S_3: C$  (\$6.00)

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- Now Andy and Bob each divide **their shares** each into **3** equal subshares.
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- What are Andy's 3 subshares?  $S_1: \frac{1}{2}A$  (\$6.00);  $S_2: \frac{1}{2}A$  (\$6.00);  $S_3: C$  (\$6.00)
- Which one does Chuck choose?

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- Now Andy and Bob each divide **their shares** each into **3** equal subshares.
- Andy's share, Apple and Cherry, to be divided 3 ways and Chuck chooses:

	Apple	Cherry
Andy	12	6
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- What are Andy's 3 subshares?  $S_1: \frac{1}{2}A$  (\$6.00);  $S_2: \frac{1}{2}A$  (\$6.00);  $S_3: C$  (\$6.00)
- Which one does Chuck choose?  $S_3$

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- Now Andy and Bob each divide **their shares** each into **3** equal subshares.
- Andy's share, Apple and Cherry, to be divided 3 ways and Chuck chooses:

	Apple	Cherry
Andy	12	6
Chuck	6	4

- What are Andy's 3 subshares?  $S_1: \frac{1}{2}A$  (\$6.00);  $S_2: \frac{1}{2}A$  (\$6.00);  $S_3: C$  (\$6.00)
- Which one does Chuck choose?  $S_3$
- Now Andy has Apple and Chuck has Cherry.

# Example

## Example (The Lone-Chooser Method – 3 Players)

- Bob's share, Lemon and Pecan, to be divided 3 ways and Chuck chooses:

	Lemon	Pecan
Bob	8	4
Chuck	2	6

# Example

## Example (The Lone-Chooser Method – 3 Players)

- Bob's share, Lemon and Pecan, to be divided 3 ways and Chuck chooses:

	Lemon	Pecan
Bob	8	4
Chuck	2	6

- What are Bob's 3 subshares?

# Example

## Example (The Lone-Chooser Method – 3 Players)

- Bob's share, Lemon and Pecan, to be divided 3 ways and Chuck chooses:

	Lemon	Pecan
Bob	8	4
Chuck	2	6

- What are Bob's 3 subshares?  $S_1: \frac{1}{2}L$  (\$4.00);  $S_2: \frac{1}{2}L$  (\$4.00);  $S_3: P$  (\$4.00)



# Example

## Example (The Lone-Chooser Method – 3 Players)

- Bob's share, Lemon and Pecan, to be divided 3 ways and Chuck chooses:

	Lemon	Pecan
Bob	8	4
Chuck	2	6

- What are Bob's 3 subshares?  $S_1: \frac{1}{2}L$  (\$4.00);  $S_2: \frac{1}{2}L$  (\$4.00);  $S_3: P$  (\$4.00)
- Which one does Chuck choose?

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## Example (The Lone-Chooser Method – 3 Players)

- Bob's share, Lemon and Pecan, to be divided 3 ways and Chuck chooses:

	Lemon	Pecan
Bob	8	4
Chuck	2	6

- What are Bob's 3 subshares?  $S_1: \frac{1}{2}L$  (\$4.00);  $S_2: \frac{1}{2}L$  (\$4.00);  $S_3: P$  (\$4.00)
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- Bob's share, Lemon and Pecan, to be divided 3 ways and Chuck chooses:

	Lemon	Pecan
Bob	8	4
Chuck	2	6

- What are Bob's 3 subshares?  $S_1: \frac{1}{2}L$  (\$4.00);  $S_2: \frac{1}{2}L$  (\$4.00);  $S_3: P$  (\$4.00)
- Which one does Chuck choose?  $S_3$
- Final division: Andy gets Apple (\$6.00), Bob gets Lemon (\$8.00), Chuck gets Cherry and Pecan (\$10.00).

# Example

## Example (The Lone-Chooser Method – 3 Players)

- What if Chuck were the first divider, Bob the first lone chooser, and then Chuck and Bob the subdividers and Andy the second lone chooser?

# Example

## Example (The Lone-Chooser Method – 3 Players)

- What if Chuck were the first divider, Bob the first lone chooser, and then Chuck and Bob the subdividers and Andy the second lone chooser?
- What if Bob were the first divider, Andy the first lone chooser, and then Bob and Andy the subdividers and Chuck the second lone chooser?

# Example

## Example (The Lone-Chooser Method – 3 Players)

- What if Chuck were the first divider, Bob the first lone chooser, and then Chuck and Bob the subdividers and Andy the second lone chooser?
- What if Bob were the first divider, Andy the first lone chooser, and then Bob and Andy the subdividers and Chuck the second lone chooser?
- In general, which role would you prefer to be in: first divider, first lone chooser, or second lone chooser?

# Outline

- 1 The Lone-Chooser Method
- 2 Example – 3 Players
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- 4 Assignment

# Example

## Example (The Lone-Chooser Method – 4 Players)

- Andy, Bob, Chuck, and Dave are dividing 3 pies.
- Their value systems are as follows.

	Apple	Cherry	Lemon
Andy	12	6	6
Bob	4	8	4
Chuck	6	8	6
Dave	9	8	3

- First, Andy divides into equal halves and Bob chooses.
- Second, Andy and Bob divide into equal thirds and Chuck chooses.
- Finally, Andy, Bob, and Chuck divide into equal fourths and Dave chooses.



# Example

## Example (The Lone-Chooser Method – 4 Players)

	Apple	Cherry	Lemon
Andy	12	6	6
Bob	4	8	4
Chuck	6	8	6
Dave	9	8	3

- How does Andy divide the assets into two equal shares?

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Apple	Cherry	Lemon
Andy	12	6	6
Bob	4	8	4
Chuck	6	8	6
Dave	9	8	3

- How does Andy divide the assets into two equal shares?  $S_1: A$ ;  
 $S_2: C + L$

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Apple	Cherry	Lemon
Andy	12	6	6
Bob	4	8	4
Chuck	6	8	6
Dave	9	8	3

- How does Andy divide the assets into two equal shares?  $S_1: A$ ;  
 $S_2: C + L$
- Which share does Bob choose?

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Apple	Cherry	Lemon
Andy	12	6	6
Bob	4	8	4
Chuck	6	8	6
Dave	9	8	3

- How does Andy divide the assets into two equal shares?  $S_1: A$ ;  
 $S_2: C + L$
- Which share does Bob choose?  $S_2$

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Apple	Cherry	Lemon
Andy	12	6	6
Bob	4	8	4
Chuck	6	8	6
Dave	9	8	3

- How does Andy divide the assets into two equal shares?  $S_1: A$ ;  
 $S_2: C + L$
- Which share does Bob choose?  $S_2$
- Now Andy has Apple and Bob has Cherry and Lemon.

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Apple
Andy	12
Chuck	6

- Andy has only the Apple pie and now Chuck is the chooser.

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Apple
Andy	12
Chuck	6

- Andy has only the Apple pie and now Chuck is the chooser.
- How does Andy divide his asset into three equal subshares?

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Apple
Andy	12
Chuck	6

- Andy has only the Apple pie and now Chuck is the chooser.
- How does Andy divide his asset into three equal subshares?  $S_1$ :  $\frac{1}{3}A$ ;  $S_2$ :  $\frac{1}{3}A$ ;  $S_3$ :  $\frac{1}{3}A$



# Example

## Example (The Lone-Chooser Method – 4 Players)

	Apple
Andy	12
Chuck	6

- Andy has only the Apple pie and now Chuck is the chooser.
- How does Andy divide his asset into three equal subshares?  $S_1$ :  $\frac{1}{3}A$ ;  $S_2$ :  $\frac{1}{3}A$ ;  $S_3$ :  $\frac{1}{3}A$
- Which subshare does Chuck choose?

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Apple
Andy	12
Chuck	6

- Andy has only the Apple pie and now Chuck is the chooser.
- How does Andy divide his asset into three equal subshares?  $S_1$ :  $\frac{1}{3}A$ ;  $S_2$ :  $\frac{1}{3}A$ ;  $S_3$ :  $\frac{1}{3}A$
- Which subshare does Chuck choose?  $S_3$  (Or any other. They are identical.)

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Apple
Andy	12
Chuck	6

- Andy has only the Apple pie and now Chuck is the chooer.
- How does Andy divide his asset into three equal subshares?  $S_1$ :  $\frac{1}{3}A$ ;  $S_2$ :  $\frac{1}{3}A$ ;  $S_3$ :  $\frac{1}{3}A$
- Which subshare does Chuck choose?  $S_3$  (Or any other. They are identical.)
- Now Andy has  $\frac{2}{3}$  Apple and Chuck has  $\frac{1}{3}$  Apple.

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Cherry	Lemon
Bob	8	4
Chuck	8	6

- So far, Bob has the Cherry and Lemon pies and Chuck is the chooser.

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Cherry	Lemon
Bob	8	4
Chuck	8	6

- So far, Bob has the Cherry and Lemon pies and Chuck is the chooser.
- How does Bob divide his assets into three equal subshares?

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Cherry	Lemon
Bob	8	4
Chuck	8	6

- So far, Bob has the Cherry and Lemon pies and Chuck is the chooser.
- How does Bob divide his assets into three equal subshares?

$$S_1: \frac{1}{2}C; S_2: \frac{1}{2}C; S_3: L$$

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Cherry	Lemon
Bob	8	4
Chuck	8	6

- So far, Bob has the Cherry and Lemon pies and Chuck is the chooser.
- How does Bob divide his assets into three equal subshares?  
 $S_1: \frac{1}{2}C; S_2: \frac{1}{2}C; S_3: L$
- Which subshare does Chuck choose?

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Cherry	Lemon
Bob	8	4
Chuck	8	6

- So far, Bob has the Cherry and Lemon pies and Chuck is the chooser.
- How does Bob divide his assets into three equal subshares?  
 $S_1: \frac{1}{2}C; S_2: \frac{1}{2}C; S_3: L$
- Which subshare does Chuck choose?  $S_3$



# Example

## Example (The Lone-Chooser Method – 4 Players)

	Cherry	Lemon
Bob	8	4
Chuck	8	6

- So far, Bob has the Cherry and Lemon pies and Chuck is the chooser.
- How does Bob divide his assets into three equal subshares?  
 $S_1: \frac{1}{2}C; S_2: \frac{1}{2}C; S_3: L$
- Which subshare does Chuck choose?  $S_3$
- Now Andy has  $\frac{2}{3}$  Apple, Bob has Cherry (both halves), and Chuck has  $\frac{1}{3}$  Apple and the Lemon.

# Example

## Example (The Lone-Chooser Method – 4 Players)

	$\frac{2}{3}$ Apple
Andy	8
Dave	6

- Andy has only the  $\frac{2}{3}$  of the Apple pie.

# Example

## Example (The Lone-Chooser Method – 4 Players)

	$\frac{2}{3}$ Apple
Andy	8
Dave	6

- Andy has only the  $\frac{2}{3}$  of the Apple pie.
- How does Andy divide his asset into four equal subshares?

# Example

## Example (The Lone-Chooser Method – 4 Players)

	$\frac{2}{3}$ Apple
Andy	8
Dave	6

- Andy has only the  $\frac{2}{3}$  of the Apple pie.
- How does Andy divide his asset into four equal subshares?

$$S_1: \frac{1}{6}A; S_2: \frac{1}{6}A; S_3: \frac{1}{6}A; S_4: \frac{1}{6}A$$

# Example

## Example (The Lone-Chooser Method – 4 Players)

	$\frac{2}{3}$ Apple
Andy	8
Dave	6

- Andy has only the  $\frac{2}{3}$  of the Apple pie.
- How does Andy divide his asset into four equal subshares?  
 $S_1: \frac{1}{6}A; S_2: \frac{1}{6}A; S_3: \frac{1}{6}A; S_4: \frac{1}{6}A$
- Which subshare does Dave choose?

# Example

## Example (The Lone-Chooser Method – 4 Players)

	$\frac{2}{3}$ Apple
Andy	8
Dave	6

- Andy has only the  $\frac{2}{3}$  of the Apple pie.
- How does Andy divide his asset into four equal subshares?  
 $S_1: \frac{1}{6}A; S_2: \frac{1}{6}A; S_3: \frac{1}{6}A; S_4: \frac{1}{6}A$
- Which subshare does Dave choose?  $S_4$  (Or any other. They are identical.)

# Example

## Example (The Lone-Chooser Method – 4 Players)

	$\frac{2}{3}$ Apple
Andy	8
Dave	6

- Andy has only the  $\frac{2}{3}$  of the Apple pie.
- How does Andy divide his asset into four equal subshares?  
 $S_1: \frac{1}{6}A; S_2: \frac{1}{6}A; S_3: \frac{1}{6}A; S_4: \frac{1}{6}A$
- Which subshare does Dave choose?  $S_4$  (Or any other. They are identical.)
- Now Andy has  $\frac{1}{2}$  Apple and Dave has  $\frac{1}{6}$  Apple.

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Cherry
Bob	8
Dave	8

- Now Bob has only the Cherry pie.



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	Cherry
Bob	8
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- Now Bob has only the Cherry pie.
- How does Bob divide his asset into four equal subshares?

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	Cherry
Bob	8
Dave	8

- Now Bob has only the Cherry pie.
- How does Bob divide his asset into four equal subshares?  $S_1: \frac{1}{4}C$ ;  
 $S_2: \frac{1}{4}C$ ;  $S_3: \frac{1}{4}C$ ;  $S_4: \frac{1}{4}C$

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## Example (The Lone-Chooser Method – 4 Players)

	Cherry
Bob	8
Dave	8

- Now Bob has only the Cherry pie.
- How does Bob divide his asset into four equal subshares?  $S_1: \frac{1}{4}C$ ;  
 $S_2: \frac{1}{4}C$ ;  $S_3: \frac{1}{4}C$ ;  $S_4: \frac{1}{4}C$
- Which subshare does Chuck choose?

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## Example (The Lone-Chooser Method – 4 Players)

	Cherry
Bob	8
Dave	8

- Now Bob has only the Cherry pie.
- How does Bob divide his asset into four equal subshares?  $S_1: \frac{1}{4}C$ ;  $S_2: \frac{1}{4}C$ ;  $S_3: \frac{1}{4}C$ ;  $S_4: \frac{1}{4}C$
- Which subshare does Chuck choose?  $S_4$  (Or any other. They are identical.)

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Cherry
Bob	8
Dave	8

- Now Bob has only the Cherry pie.
- How does Bob divide his asset into four equal subshares?  $S_1: \frac{1}{4}C$ ;  $S_2: \frac{1}{4}C$ ;  $S_3: \frac{1}{4}C$ ;  $S_4: \frac{1}{4}C$
- Which subshare does Chuck choose?  $S_4$  (Or any other. They are identical.)
- Now Bob has  $\frac{3}{4}$  Cherry and Dave has  $\frac{1}{4}$  Cherry.

# Example

## Example (The Lone-Chooser Method – 4 Players)

	$\frac{1}{3}$ Apple	Lemon
Chuck	2	6
Dave	3	3

- Chuck has  $\frac{1}{3}$  Apple pie and the Lemon pie.

# Example

## Example (The Lone-Chooser Method – 4 Players)

	$\frac{1}{3}$ Apple	Lemon
Chuck	2	6
Dave	3	3

- Chuck has  $\frac{1}{3}$  Apple pie and the Lemon pie.
- How does Chuck divide his assets into four equal subshares?

# Example

## Example (The Lone-Chooser Method – 4 Players)

	$\frac{1}{3}$ Apple	Lemon
Chuck	2	6
Dave	3	3

- Chuck has  $\frac{1}{3}$  Apple pie and the Lemon pie.
- How does Chuck divide his assets into four equal subshares?  $S_1: \frac{1}{3}A; S_2: \frac{1}{3}L; S_3: \frac{1}{3}L; S_4: \frac{1}{3}L$



# Example

## Example (The Lone-Chooser Method – 4 Players)

	$\frac{1}{3}$ Apple	Lemon
Chuck	2	6
Dave	3	3

- Chuck has  $\frac{1}{3}$  Apple pie and the Lemon pie.
- How does Chuck divide his assets into four equal subshares?  $S_1: \frac{1}{3}A; S_2: \frac{1}{3}L; S_3: \frac{1}{3}L; S_4: \frac{1}{3}L$
- Which subshare does Dave choose?

# Example

## Example (The Lone-Chooser Method – 4 Players)

	$\frac{1}{3}$ Apple	Lemon
Chuck	2	6
Dave	3	3

- Chuck has  $\frac{1}{3}$  Apple pie and the Lemon pie.
- How does Chuck divide his assets into four equal subshares?  $S_1: \frac{1}{3}A; S_2: \frac{1}{3}L; S_3: \frac{1}{3}L; S_4: \frac{1}{3}L$
- Which subshare does Dave choose?  $S_1$

# Example

## Example (The Lone-Chooser Method – 4 Players)

	$\frac{1}{3}$ Apple	Lemon
Chuck	2	6
Dave	3	3

- Chuck has  $\frac{1}{3}$  Apple pie and the Lemon pie.
- How does Chuck divide his assets into four equal subshares?  $S_1: \frac{1}{3}A; S_2: \frac{1}{3}L; S_3: \frac{1}{3}L; S_4: \frac{1}{3}L$
- Which subshare does Dave choose?  $S_1$
- Now Chuck has Lemon and Dave has  $\frac{1}{3}$  Apple.

# Example

## Example (The Lone-Chooser Method – 4 Players)

	Apple	Cherry	Lemon	Fair Share	Actual Share
Andy	12	6	6	6.00	6.00
Bob	4	8	4	4.00	6.00
Chuck	6	8	6	4.50	6.00
Dave	9	8	3	5.00	6.50

- The final division:

- Andy gets  $\frac{1}{2}$  of the Apple pie.
- Bob gets  $\frac{3}{4}$  of the Cherry pie.
- Chuck gets the Lemon pie.
- Dave gets  $\frac{1}{2}$  of the Apple pie and  $\frac{1}{4}$  of the Cherry pie.

# Outline

- 1 The Lone-Chooser Method
- 2 Example – 3 Players
- 3 Example – 4 Players
- 4 Assignment**

# Assignment

## Assignment

- Chapter 3: Exercises 41, 42.
- Handout exercises.