

Choose the best answer. You cannot do that without reading all of the answers.

Part A: Fair shares

- Alex and Bart are playing a fair division game. Who can tell if Alex got his fair share?
 - Only Alex's parents, who always know best.
 - An impartial judge
 - Only Alex, or mind-readers who have access to Alex's utility function
 - No one, not even Alex.
 - All of the players in a fair division game.
- If three players each pay \$12 for their part of a cake, how much is each player's fair share?
 - Each paid \$12, so each needs to feel they got at least \$12 worth of cake.
 - Only the players themselves can know the dollar amount of a fair share.
 - The total amount paid was \$36, so each player needs to get \$36 worth of cake.
 - Each player paid \$12 and there are three players, so each player needs to feel they got at least \$4 worth of cake.
 - $\$12/4 = \3

Alex and Bart are dividing some cookies. Alex thinks a cookie's worth is determined by how many chocolate chips it has, and Bart thinks a cookie's worth is determined by how big it is.

- The first cookie they divide is kind of lumpy. It breaks into two pieces: one is about a quarter of the cookie but has 9 chocolate chips in it, while the other piece is more like three quarters of the cookie with only 3 chocolate chips in it. If Alex gets the three quarter piece and Bart gets the chocolatey piece then:
 - The division is equitable since Alex got 3 out of 12 chips (25%) and Bart got 1 quarter (25%), but not fair since both expected half (50%) of the cookie according to their own value system.
 - The division is fair since both Alex and Bart got 25% of the cookie, according to their own value systems.
 - The division is unfair since one piece had more chips than the other.
 - The division is unfair since one piece was bigger than the other.
 - The division is unfair since the cookie was lumpy.
- The second cookie they divide is more normal. It breaks into two pieces: one is about half the cookie with 6 chips in it, and the other is about half the cookie with 6 chips in it. If Alex gets the first piece and Bart gets the second piece, then
 - The division is equitable since Alex got 6 out of 12 chips (50%) and Bart got half the cookie (50%), but not fair since the two pieces were basically the same.
 - The division is fair since both Alex and Bart got 50% of the cookie, according to their own value systems.
 - The division is unfair since Bart got a lot of chocolate chips, but only wanted the big cookie.
 - The division is unfair since Alex got a lot of cookie, but only wanted the chocolate chips.
 - The division is unfair since the cookie was normal.
- The third cookie they divide is lumpy. It breaks into two pieces: one is about a quarter of the cookie but has 9 chocolate chips in it, while the other piece is more like three quarters of the cookie with only 3 chocolate chips in it. If Alex gets the chocolatey piece and Bart gets the three quarter piece then:
 - The division is equitable since Alex got 9 out of 12 chips (75%) and Bart got three quarters (75%), but not fair since both got more than 50% of the cookie according to their own value systems.
 - The division is fair since both Alex and Bart got at least 50% of the cookie, according to their own value systems.
 - The division is unfair since $75\% + 75\%$ is more than 100% and somebody (that is, you and me) are paying for that extra 50% they stole.
 - The division is unfair because they each got what they wanted.
 - The division is unfair because the cookie was lumpy.

Part B: You cut, I choose

1. The basic rules of I cut you choose are:
 - A. Randomly select a divider. The divider divides the loot into three pieces and declares he shall be happy with any two of the three pieces. The chooser chooses one of the pieces and declares he shall be happy with that piece. The chooser receives his chosen piece, and the divider keeps the rest.
 - B. An impartial judge splits the loot in half, and each player chooses their half.
 - C. One pirate takes out a cutlass, and the other pirate chooses whether to give up the loot or get cutlashed.
 - D. Randomly select a chooser. The chooser chooses which part of the loot is his, and the divider gets the rest.
 - E. Randomly select a divider. The divider divides the loot into two pieces and declares that he shall be happy with either piece. The chooser chooses a piece and declares that he shall be happy with that piece. The chooser receives his chosen piece, and the divider receives the other piece.

2. The winning strategy for the divider in I cut, you choose is to:
 - A. divide it into a good piece and a bad piece.
 - B. divide it so that the other player says that both pieces are equal.
 - C. divide it so that an impartial observer thinks he has cut it in half.
 - D. divide it so that his parents say both pieces are equal.
 - E. divide it so that both pieces are equal in his own opinion.

3. The winning strategy for the chooser in I cut, you choose is to:
 - A. choose the smallest piece.
 - B. choose the piece the other person likes best.
 - C. choose the piece that they themselves like best.
 - D. choose the worst piece according to their own value system.
 - E. choose the piece that an impartial observer thinks is best.

4. Amy and Bob are trying to share two slices of cake, each of a different flavor (Chocolate and Strawberry) Amy likes chocolate twice as much as strawberry, but doesn't know Bob's opinion. How should she divide the cake to guarantee she gets gets a fair share?
 - A. There is no way to be sure she can get her fair share.
 - B. One portion is half of the chocolate slice, and one portion is the rest.
 - C. One portion is three quarters of the chocolate slice, and one portion is the rest.
 - D. One portion is the chocolate slice, one portion the strawberry slice.
 - E. Cake is cake; it doesn't matter how she divides it.

5. Cher and Dale are trying to share about three gallons of pennies. Cher thinks each penny is worth about \$0.01. Dave divides the pennies into two piles. How should Cher choose which pile to pick to guarantee she gets her fair share?
 - A. She should choose the pile that looks bigger to her
 - B. She should choose whichever pile Dale looks at when she says, "Oh now THAT is a good pile"
 - C. She should phone a friend and ask them which pile they think is better
 - D. She should choose the pile that has the shiniest pennies
 - E. She should choose the pile that has the dirtiest pennies

Part C: Lone Divider

- The basic rules for Lone Divider are
 - Randomly select the divider. The divider divides the players into two teams, which then have a shoot-out. The survivors after 60 seconds play again, until only the lone divider remains standing.
 - Randomly select the divider. The divider stands by the loot while the others choose whether he deserves to get the loot. If so, he gets it all. If not, he is shot, and the remaining players play again. The game usually ends when there is only one player left, hence "Lone Divider".
 - Randomly select the divider. The divider divides the loot into one pile per player and declares he thinks each of the piles is a fair share for him. The choosers secretly commit to which piles they consider to be a fair share. All the choosers reveal their commitments. Try to assign piles to players that think those piles are fair. Some piles may be contested, but there is always at least one pile uncontested for the divider. Give the uncontested piles to players that want them (one pile per player), then start the game over with the remaining players and the remaining loot.
 - Randomly select the divider. The divider divides the loot into one pile per player, and then each player goes in order and chooses which pile to take.
 - An impartial judge is chosen to be the lone divider. The players then choose their favorite piece and walk away before the shooting starts.
- The winning strategy for the divider in the Lone Divider is
 - To divide it into one bad piece, and a whole bunch of good pieces.
 - To divide it into one good piece, and a whole bunch of bad pieces.
 - To divide it into pieces that the other players will like.
 - To divide it into pieces that an impartial judge likes.
 - To divide it into pieces that he himself likes equally.
- The winning strategy for the chooser in the Lone Divider is
 - Pick the piece the other chooser seems to like best.
 - Pick the piece the divider seems to like best.
 - Pick all the pieces that seem like fair shares in their own opinion.
 - Pick the piece they themselves like best.
 - Pick all the pieces that the divider seems to like.
- In a game of Lone Divider with three players, the divider (Mario) divided the loot into three pieces worth \$4, \$5, and \$6 in his own opinion. What is a worst case scenario for Mario?
 - The worst case scenario is that Mario gets the \$6 piece.
 - The choosers agree to take the \$4 and \$5 pieces, leaving Mario the \$6 piece, which is unfair.
 - The choosers agree to take the \$4 and \$6 pieces, leaving Mario the \$5 piece, which is unfair.
 - The choosers agree to take the \$5 and \$6 pieces, leaving Mario the \$4 piece, which is unfair.
 - The choosers fight over the \$6 piece, leaving Mario the \$5 piece, which is unfair.
- In a game of Lone Divider with three players, a chooser (Franky) is deciding between pieces that are worth \$2, \$6, and \$7 in his own opinion. He decides to choose the \$7 piece. What is a worst case scenario for Franky?
 - The other chooser also wants only the \$7 piece, forcing a tie-breaker. The \$6 piece goes to the divider, leaving only $\$2+\$7=\$9$ left to divide. In the next round, Franky is the divider, and so could only guarantee \$4.50 in the next round, less than the \$5 he expected for a fair share.
 - The divider cries because Franky took the good piece.
 - The other chooser wants the \$6 piece because they think it is worth \$12. They'll smile smugly while Franky gets his lousy \$7 piece, and even the divider will laugh a little when he realizes Franky took the \$7 piece like a sucker.
 - The worst case scenario is that Franky keeps his \$7 and cries all the way to the bank. The other two guys can split the \$8 like a bunch of dopes.
 - The worst case scenario is that Franky has to divide his \$7 evenly with the three players, resulting in less than his fair share of \$15.

Part D: Lone Chooser

1. The basic rules of Lone Chooser are:
 - A. Randomly select a chooser. They choose who gets what.
 - B. Randomly select a chooser. They choose their own piece, and the remaining players play again with the remaining loot.
 - C. Randomly select a chooser. They choose part of the loot as their own, then the other players decide whether to shoot them. If so, the remaining players play again with all the loot. If not, then the chooser gets their loot, and the remaining players play again with the remaining loot.
 - D. Randomly select a chooser. The remaining players play with all the loot (using I cut-You choose if there are only two players left). Once they are done, they divide their loot into one pile per player. The chooser chooses one pile per other player. The chooser gets the piles he chose, and the other players keep their other piles.
 - E. Randomly select a chooser. Everyone else divides the entire loot in half, and the chooser chooses which half he wants.

2. The winning strategy for the chooser in Lone Chooser is:
 - A. Take as many pieces as you can, and rearrange the remaining ones fairly amongst the players.
 - B. Choose the best piece from each other player.
 - C. Choose good pieces from some players, bad pieces from others.
 - D. There is no winning strategy, the other players can force you to lose.
 - E. It does not matter which pieces you choose, you always get a fair share.

3. The winning strategy for the dividers in Lone Chooser is:
 - A. Divide the goods into parts the chooser says are equal.
 - B. Divide the goods into parts that look equal in their own opinion.
 - C. Divide the goods into parts an impartial observer says are equal.
 - D. There is no winning strategy, the new player is always going to take some of your fair share.
 - E. It does not matter how you divide the pieces, you always get a fair share.

4. Lone Chooser is good to use if:
 - A. A new part-owner shows up, and you need to re-divide a previously fair division.
 - B. The loot to be divided can be divided continuously (like cake; unlike a car or a jet ski).
 - C. There are more than two players.
 - D. There are not just a ton of players, or at least you have a lot of time.
 - E. All of the above

5. Amy, Bob, Cid, and Deb each chipped in \$9 for a cake. While Deb went to wash her hands, Amy, Bob, and Cid used Lone Chooser to divide the cake into three pieces. Amy felt she got $33\frac{1}{3}\%$ of the cake. Bob felt he got 36% of the cake, and Cid felt he got 40% of the cake. When Deb gets back, Amy, Bob, and Cid each divide their piece into 4 pieces. Which most accurately describes the outcome if Cid plays the winning strategy:
 - A. Cid gets 40% of the cake, since Deb cannot defeat his winning strategy
 - B. Cid gets 25% of the cake, since his fair share is $100\%/4 = 25\%$ and he played the winning strategy
 - C. Cid gets 30% of the cake, which is a fair share, since he expects at least 25% of the cake.
 - D. Cid gets 15% of the cake, since Deb takes her fair share from him and $40\% - 25\% = 15\%$.
 - E. Cid gets $31\frac{2}{3}\%$ of the cake, since Deb takes $\frac{1}{3}$ of her fair share from him ($40\% - \frac{1}{3}(25\%) = 31\frac{2}{3}\%$)

Part E: Last diminisher

1. The basic rules of Last Diminisher are:
 - A. Put the loot into one giant pile. Each player either passes or diminishes the pile by returning some of the pile to the group. The last person to diminish the pile walks away with it, and the remaining players play again with the remaining loot.
 - B. Give each player their fair share. Each player can diminish their pile. The last diminisher is given all of the loot the other players gave up.
 - C. One player divides the loot into several piles, and then the other players take their favorite pile.
 - D. Each player submits a bid. The player with the highest bid gets the loot, and the other players split the bid.
 - E. Divide the loot into equal pieces. Each player shrinks a pile until everyone agrees they are equal. Give each player the last pile they diminished.
2. The winning strategy for Last Diminisher is:
 - A. Always shrink the pile, but just a little bit. If everyone else passes, then you get it!
 - B. Always pass. The last piece is the best piece anyways.
 - C. There is no set strategy. Sometimes you get lucky, and sometimes you don't. Somebody has to lose.
 - D. Pass unless the piece is too big to be a fair share for you. If it is too big, shrink it to exactly the right size.
 - E. Pass unless the piece is just right. Never shrink.
3. Maria is the third player of five in a game of Last Diminisher. The pile is worth about 40% of the loot. Maria should:
 - A. Shrink the pile to 35%. If everyone else passes, then she gets a big piece. Otherwise, she'll just get to play again next round.
 - B. Pass. While this is a big piece, the last piece will be even bigger.
 - C. do whatever she feels like. Maybe she wins, maybe she loses, but her choices have no real effect on the outcome.
 - D. Shrink it to 20% so that if she gets it, it is fair, but if she loses it, she doesn't lose too much.
 - E. Pass. The piece is too big for her, so she should pass it to someone who thinks it is the right size.
4. Francois is the last player of five in the last diminisher. The pile is worth about 10% of the loot in his opinion. What should Francois do?
 - A. Shrink the pile to 5%. He'll definitely get at least 5% of the loot.
 - B. Pass. Even the last player should wait for the last piece.
 - C. Francois should do what Francois does. Pass, Shrink; none of it matters. He is the last player, and the last player always wins in last diminisher.
 - D. Pass. It is too small, so he does not want this piece. 90% of the loot will be left next round amongst 4 players, so he'll actually end up with at least 22% of the loot instead of just 20%.
 - E. Take it. As last player he does not have to worry about how big the peice is; he should always take it.
5. Henry is the last player of four in the last diminisher. The pile is worth about 40% of the loot in his opinion. What should Henry do?
 - A. Increase the pile to 50%. The last player doesn't have to worry about anyone taking his super-large piece.
 - B. Pass. Even the last player should wait for the last piece.
 - C. Henry should phone a friend. Even if the friend gives bad advice, Henry went last, so he'll still end up winning no matter what choices he makes.
 - D. Take it. Even though he could shrink it to 25% and still get his fair share, as last player he can take a piece that is too big.
 - E. Pass. 40% is too big, but whoever last shrunk it must have thought it was just right.

Part F: Sealed Bids

1. The basic rules of Sealed Bids are:
 - A. Everyone secretly bids on the items in the loot. They declare these bids represent the value of the items in their own value system. The bids are revealed. Each high bidder receives the item, but pays full price of the item back to the loot. Now the loot has been replaced by money. Each player receives (in money) their fair share of what they bid, and then the remaining cash is given to Sweeney.
 - B. Everyone secretly bids on the items in the loot. They declare these bids represent the value of the items in their own value system. The bids are revealed. Each high bidder receives the item, but pays full price of the item back to the loot. Now the loot has been replaced by money. Each player receives (in money) their fair share of what they bid, and then the remaining cash is split equally.
 - C. Everyone secretly bids on the items in the loot. They declare these bids represent the value of the items in their own value system. The bids are revealed. Each high bidder receives the item, but pays each player their fair share of their own bid.
 - D. Everyone secretly bids on the items in the loot. They declare these bids represent the value of the items in their own value system. The bids are revealed. Each high bidder receives the item, but pays each player their fair share of the winner's bid.
 - E. Everyone secretly bids on the items in the loot. They declare these bids represent the value of the items in their own value system. The bids are revealed. Each high bidder receives the item, but pays each player the entire amount of the winning bid.
2. The winning strategy in Sealed Bids is:
 - A. Bid exactly what you think each item is worth. No more lest you end up buying it, no less lest you end up selling it.
 - B. Bid exactly what an impartial judge thinks each item is worth. No more lest you look like a sucker, and no less lest you look like you don't appreciate art.
 - C. Bid high on some items, and low on others. At the end of the auction, you're guaranteed your fair share.
 - D. Ask each player what they are going to bid, and then bid one dollar more than what they say.
 - E. Ask each player what they are going to bid, and then bid one dollar less than what they say.
3. Why does the high bidder get the item?
 - A. If the low bidder gets the item, and has to pay everyone else their fair share, then the low bidder will pay so much they won't get their fair share.
 - B. If an average or higher bidder gets the item, then there is enough to pay everyone their fair share, but not as much money as if the high bidder had paid.
 - C. To maximize happiness, it is generally important to give each item to the person who wants it most. Sealed bids takes care of the other people by having the winners pay for the items.
 - D. The high bidder wants the item more than they want the second highest bidder's money, so if we give the item to the high bidder and the money to the other bidders, everyone is happy.
 - E. All of the above.
4. In a game of sealed bids with two players (Harley and Quinn) and one item (Cheesecake, each player owns half) the bids are as follows: Harley bids \$36 for the cheesecake, and Quinn bids \$24 for the cheesecake. Which of the following is how Sealed Bids works out?
 - A. Quinn pays Harley \$36; Quinn gets the cheesecake.
 - B. Harley pays Quinn \$24; Harley gets the cheesecake.
 - C. Harley pays Quinn \$18; Harley gets the cheesecake.
 - D. Harley pays Quinn \$15; Harley gets the cheesecake.
 - E. Harley pays Quinn \$12; Harley gets the cheesecake.

5. In a game of sealed bids with two players (Tom and Wyatt) and two items (Key Lime and Cherry, each player owns half) the bids are as follows:

	Tom	Wyatt
Key Lime	20	5
Cherry	12	7

Which of the following is how Sealed Bids works out?

- A. Tom Pays Wyatt \$15; Tom gets both pieces.
- B. Tom pays Wyatt \$12; Tom gets both pieces.
- C. Tom pays Wyatt \$11; Tom gets both pieces.
- D. Tom pays Wyatt \$6; Tom gets both pieces.
- E. Tom gets the Key Lime, and Wyatt gets the Cherry.

Part G: Bonus

1. Four prospective roommates are trying to split up the house that rents for \$800 per month. They are also trying to decide whether to get internet and fancy tv, which are \$50 a month each. There are four bedrooms. The roommates think each room is worth a certain amount per month:

	Alex	Bart	Carl	Dirk
Master bedroom	300	275	200	250
Loft bedroom	150	250	275	225
Regular bedroom	200	100	200	200
Guest bedroom	150	175	125	125

Each of the roommates wants internet and fancy tv, but not all of them think it is even worth \$10 (the evenly split bill) a month. The following table shows what each person would be willing to pay a month for each service.

	Alex	Bart	Carl	Dirk
Internet	5	10	30	20
Cable	20	5	5	10

Who gets which room?

Master _____, Loft _____, Regular _____, Guest _____

Which services should they pay for? Internet _____, TV _____

How much should each person pay (rent plus bills)?

Alex _____, Bart _____, Carl _____, Dirk _____

Very clearly explain why everyone is happy and the bills still get paid: