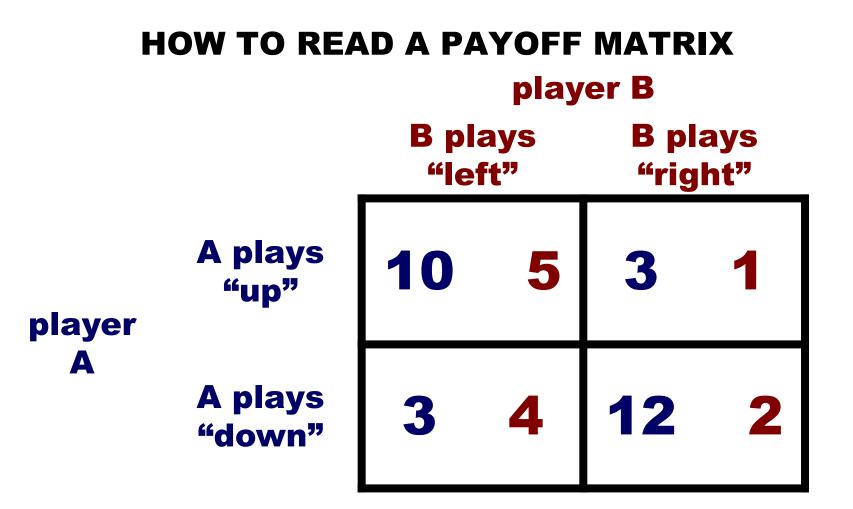
Chapter 10: Games and Strategic Behavior

Monday, July 19

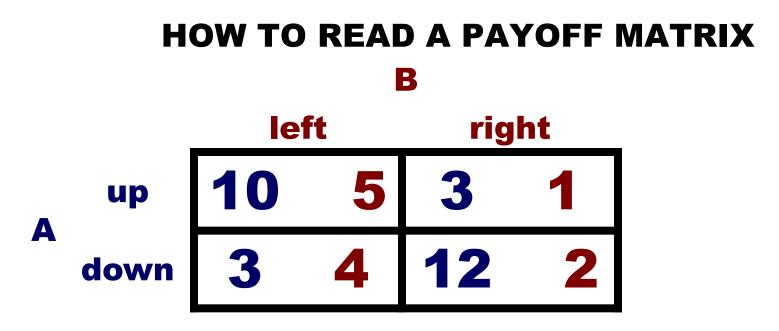
WHAT IS A 'GAME'?

- *basic elements of a game*:
- the players,
- the strategies available to each player,
- and the payoffs each player receives for each possible combination of strategies

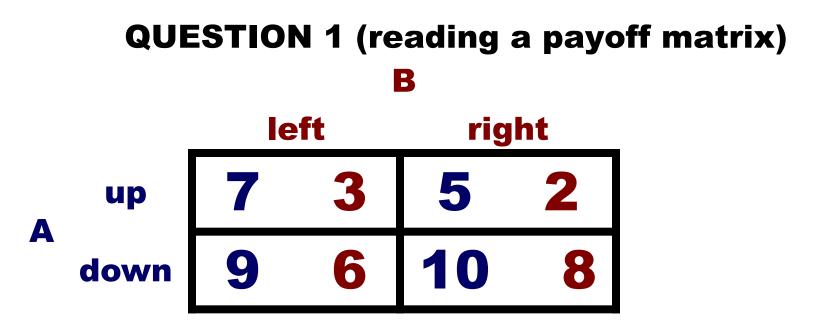


If A plays up, and B plays left, then A gets 10, and B gets 5.

By convention, the payoff for player on the left (in this case, A) is listed first in each cell.

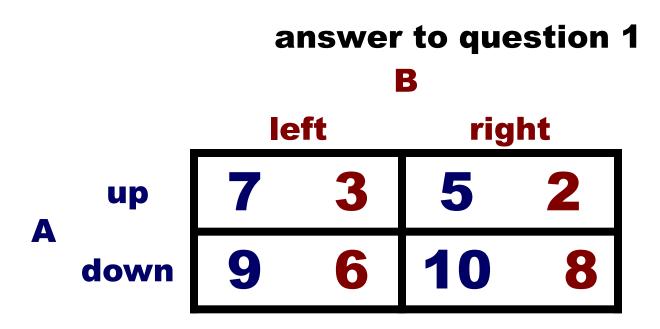


- If A plays up, and B plays left, then A gets 10, and B gets 5.
- If A plays up, and B plays right, then A gets 3, and B gets 1.
- If A plays down, and B plays left, then A gets 3, and B gets 4.
- If A plays down, and B plays right, then A gets 12, and B gets 2.

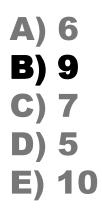


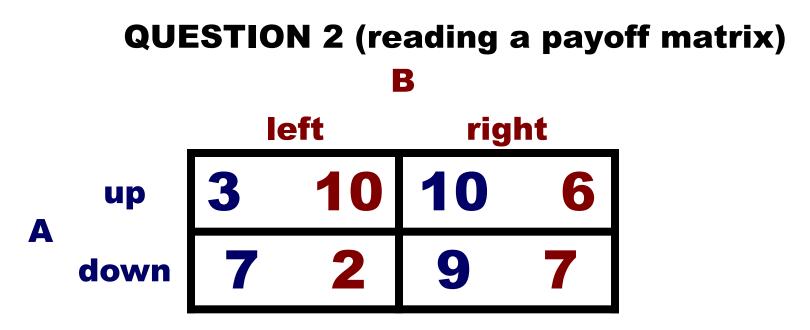
If A plays down, and B plays left, then what is A's payoff?

- **A)** 6
- **B**) 9
- **C**) 7
- D) 5
- E) 10



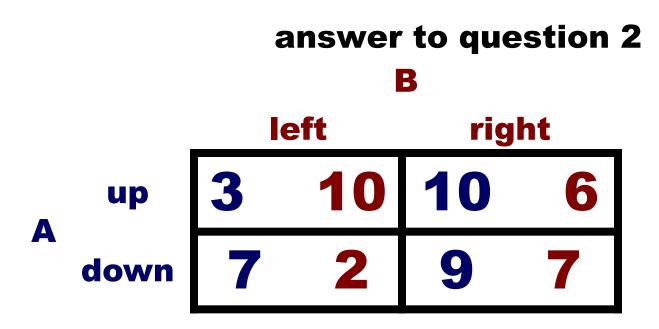
If A plays down, and B plays left, then what is A's payoff?





If A plays up, and B plays right, then what is B's payoff?

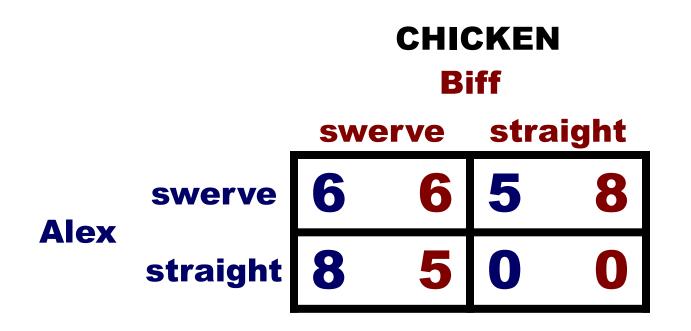
- A) 10
- **B) 2**
- Ć) 7
- D) 6 E) 3



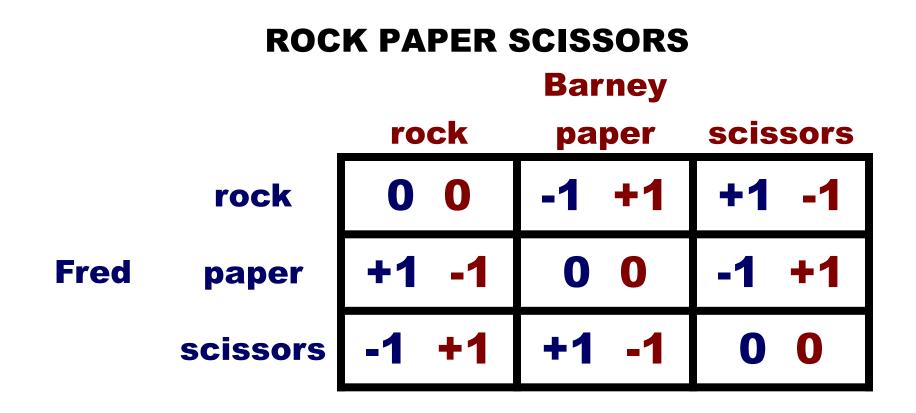
If A plays up, and B plays right, then what is B's payoff?

- A) 10 B) 2
- C) 7D) 6

E) 3

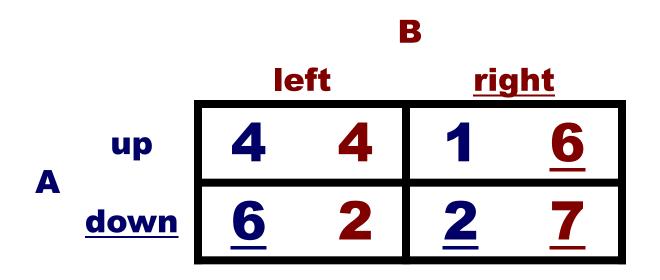


Alex and Biff drive towards each other. At the last second, they must each simultaneously decide whether to swerve, or to continue driving straight towards the other guy. The worst outcome for both players is if they both go straight. The best outcome for either player is if he's the only one who goes straight.



Fred and Barney are playing rock-paper-scissors for money. If Fred plays paper, and Barney plays rock, then paper covers rock, so Barney has to give \$1 to Fred.

DOMINANT STRATEGIES

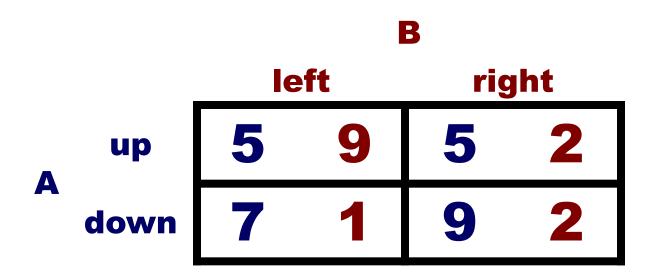


No matter what B does, A is better off if he plays down.

No matter what A does, B is better off if he plays right.

Hence, "down, right" is a *dominant strategy equilibrium*.

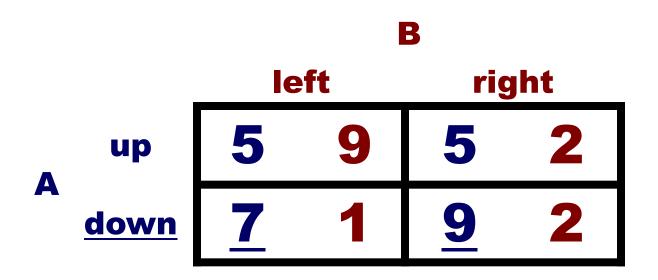
QUESTION 3 (dominant strategies)



Does A have a dominant strategy?

- A) Yes, his dominant strategy is to play up
- B) Yes, his dominant strategy is to play down
- **C)** No, he doesn't have a dominant strategy

answer to question 3



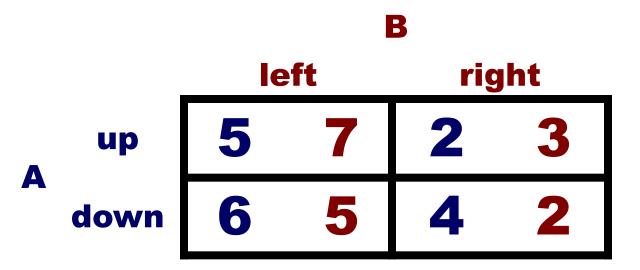
Does A have a dominant strategy?

A) Yes, his dominant strategy is to play up

B) Yes, his dominant strategy is to play down

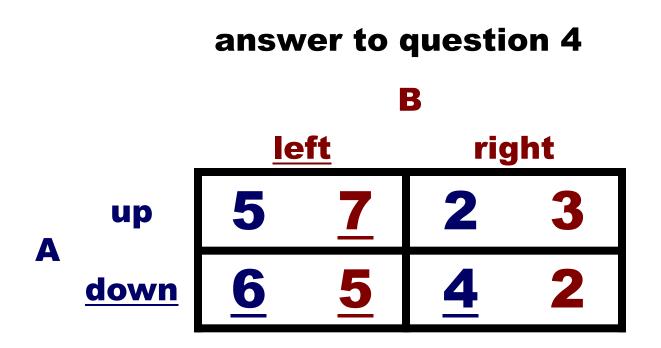
C) No, he doesn't have a dominant strategy

QUESTION 4 (dominant strategies)



Is there a dominant strategy equilibrium, i.e. a combination of strategies where both players are playing a dominant strategy?

- A) Yes, it's up, left
- B) Yes, it's up, right
- C) Yes, it's down, left
- D) Yes, it's down, right
- E) No



Is there a dominant strategy equilibrium, i.e. a combination of strategies where both players are playing a dominant strategy?

A) Yes, it's up, left
B) Yes, it's up, right
C) Yes, it's down, left
D) Yes, it's down, right
E) No

PRISONER'S DILEMMA

Jim and Mike are partners in crime. They've just committed a major crime, and the police are onto them, but they can't prove it was them. However, the police do have conclusive evidence that Jim and Mike have committed a smaller crime, and they plan to use this as leverage.

The police put Jim and Mike in separate interrogation rooms so that they can't talk to each other, and they give each of them the same ultimatum...



If neither criminal confesses, then the police can only convict them for the lesser crime, so that they each serve 1 year in prison.

If both confess, then they will be convicted of the major crime, and each serve 10 years in prison.

However, if only one criminal confesses, then the police will let him go free, and give the other criminal the maximum sentence of 20 years.



Is there a dominant strategy equilibrium?

- A) Yes, it's where they both confess.
- **B)** Yes, it's where they both deny.
- C) Yes, it's either outcome where only one confesses.
- D) No, there is no dominant strategy equilibrium.



Is there a dominant strategy equilibrium?

A) Yes, it's where they both confess.

B) Yes, it's where they both deny.

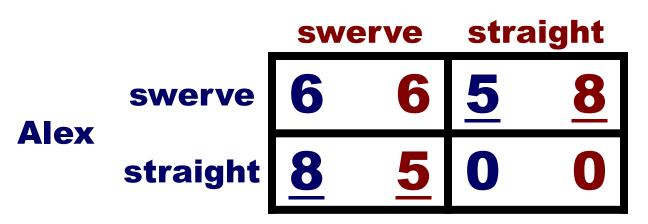
C) Yes, it's either outcome where only one confesses.

D) No, there is no dominant strategy equilibrium.

NASH EQUILIBRIUM

In a dominant strategy equilibrium, then each player has a strategy that is best no matter what the other player is doing. However, this is not always the case.

Biff

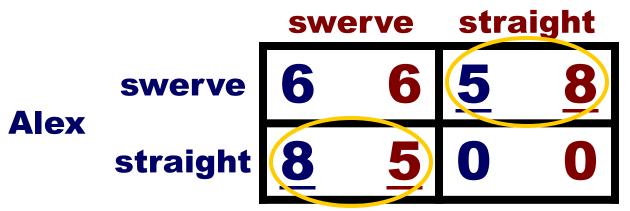


If Biff swerves, then Alex's best strategy is to go straight, but if Biff goes straight, then Alex's best strategy is to swerve.

NASH EQUILIBRIUM: CHICKEN

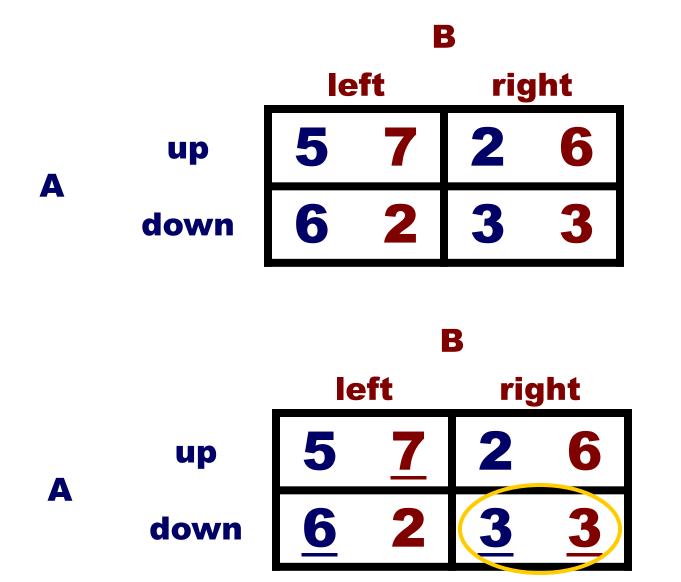
Nash equilibrium: any combination of strategies in which each player's strategy is his or her best choice, given the other players' choices

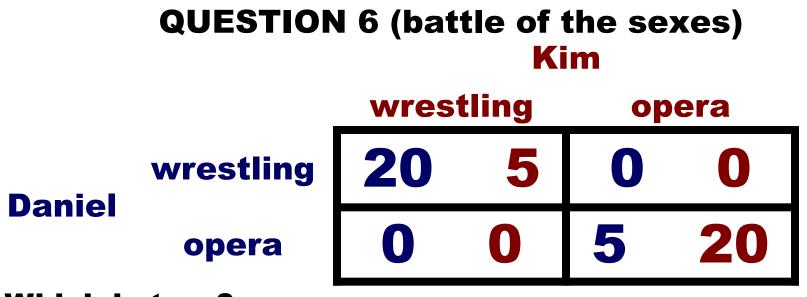
Biff



- In this example, there are two Nash equilibria, one where Alex is the chicken, and one where Biff is the chicken.
- Note that if a combination of strategies is a dominant strategy equilibrium, then it's necessarily also a Nash equilibrium.

NASH EQUILIBRIUM: GENERIC EXAMPLE





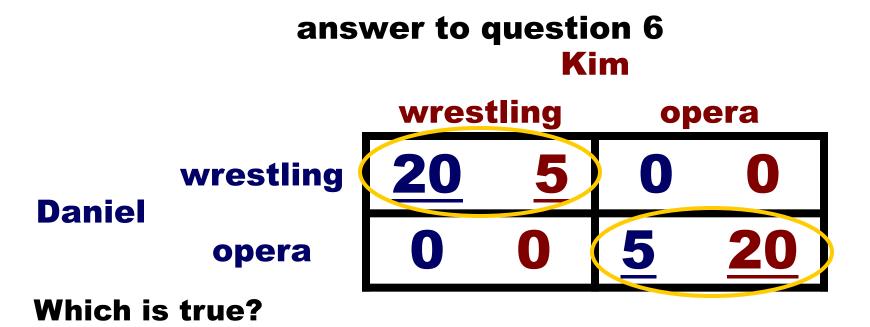
Which is true?

A) There is no Nash equilibrium

B) The only Nash equilibrium is when they both go to the wrestling match

C) They only Nash equilibrium is when Daniel goes to the wrestling match, and Kim goes to the opera

D) There are 2 Nash equilibria: one in which they both go to the wrestling match, and one in which they both go to the opera

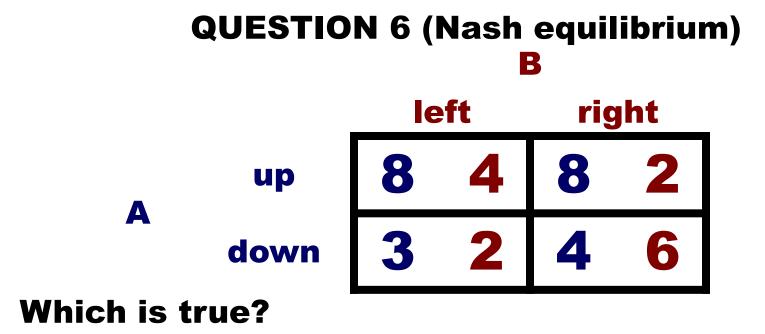


A) There is no Nash equilibrium

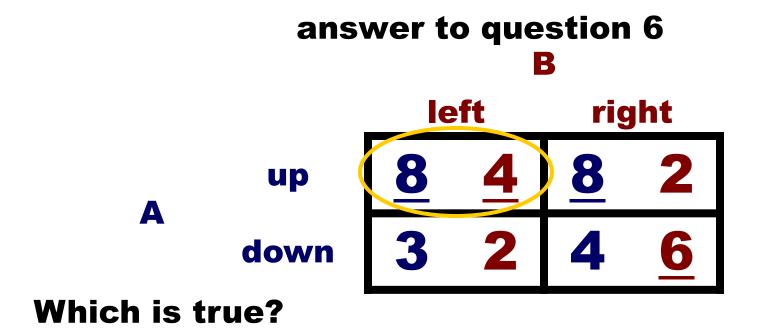
B) The only Nash equilibrium is when they both go to the wrestling match

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D) There are 2 Nash equilibria: one in which they both go to the wrestling match, and one in which they both go to the opera



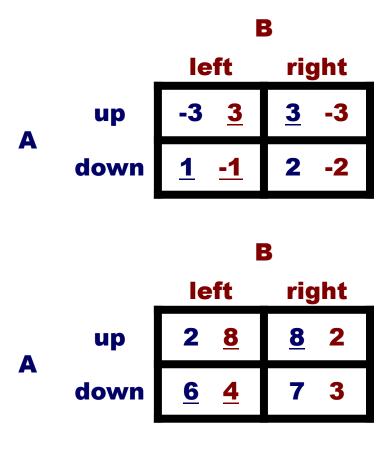
- A) up, left is the only Nash equilibrium
- B) up, right is the only Nash equilibrium
- C) down, right is the only Nash equilibrium
- D) up, left and up, right are both Nash equilibria
- E) up, left and down, right are both Nash equilibria



A) up, left is the only Nash equilibrium

- B) up, right is the only Nash equilibrium
- C) down, right is the only Nash equilibrium
- D) up, left and up, right are both Nash equilibria
- E) up, left and down, right are both Nash equilibria

ZERO-SUM GAMES

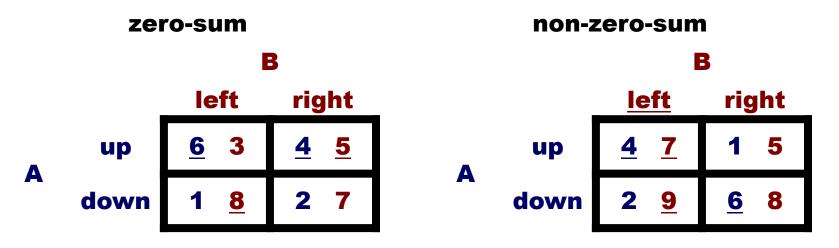


Both of these games are zerosum games.

Mathematically, this means that the sum of the players' payoffs are the same in every possible outcome. (In the first game, payoffs always sum to zero; in the second, payoffs always sum to 10.)

Intuitively, this means that there are no potential gains from cooperation; zero-sum games are 'strictly competitive'.

ZERO-SUM VS. NON-ZERO-SUM

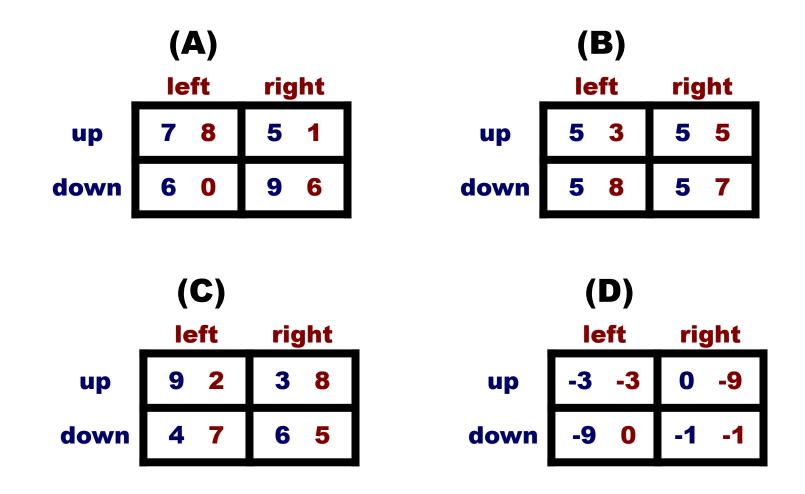


In the game on the left, the sum of the players' payoffs is 9, no matter what. It is a zero-sum game.

In the game on the right, the sum of the players' payoffs is variable. It is a non-zero-sum game.

QUESTION 7 (zero sum games)

Which of the following payoff matrices represents a zero-sum (or constant-sum) game?



answer to question 7

Below are the sums of the players' payoffs for each outcome. Only in answer choice C to they always sum up to the same number. Thus, any gain by one player must come at the expense of a precisely equal loss by the other player.

