

ECON 5103

Nash Equilibrium--the concept

Nash Equilibrium: Each and every player is doing the best that she can, given what the other players are doing.

Remember this:

In a non-cooperative game, a player has no control over the strategies (actions) of any other player.

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The Serenity Prayer



God grant me the serenity
to accept the things I cannot change;
courage to change the things I can;
and wisdom to know the difference.

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An outcome (situation) is a Nash equilibrium if it is impossible for any player to make herself better off, given what the other players are doing.

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Two player game.

Players: Ken and Barbie

Answer these two questions to determine if a situation is a Nash equilibrium

1. Can Ken make himself better off by changing his strategy (assuming that Barbie does not change her strategy)?
2. Can Barbie make herself better off by changing her strategy (assuming that Ken does not change his strategy)?

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1. Can Ken make himself better off by changing his strategy (assuming that Barbie does not change her strategy)?

2. Can Barbie make herself better off by changing her strategy (assuming that Ken does not change his strategy)?

If the answer to both questions is "NO," then the outcome IS a Nash equilibrium. In all other cases, the outcome is NOT a Nash equilibrium.

Example 1: Ken and Barbie own gas stations across the street from each other. Currently, Ken is charging a low price and has lots of customers and he is very profitable. Barbie is charging a very high price and has few customers and is not profitable.

Is the above situation a Nash equilibrium?

Here's a **bad** answer:

No because Barbie is losing money.

Here's a **bad** answer:

Yes because Barbie and Ken are risk averse.

Here's a **bad** answer:

No because Barbie can meet with Ken and get him to raise his prices.

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1. Can Ken make himself better off by changing his strategy (assuming that Barbie does not change her strategy)? **No he is already very profitable**

2. Can Barbie make herself better off by changing her strategy (assuming that Ken does not change his strategy)? **Yes she can lower her price to a level at or near Ken's prices, gain customers and maybe become profitable.**

If the answer to both questions is "NO," then the outcome IS a Nash equilibrium. In all other cases, the outcome is NOT a Nash equilibrium. **Conclusion: the initial situation was NOT a Nash equilibrium.**

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Example 2: Ken and Barbie are playing chess. Barbie is a much better player than Ken. Ken is playing as well as he can (and so is Barbie), but Ken is losing badly.

Is the above situation a Nash equilibrium?

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Here's are some **bad** answers:

No because Ken is losing.

No because the game isn't fair.

No because Barbie should be nicer to Ken.

No because Ken is risk loving and Barbie is risk neutral.

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1. Can Ken make himself better off by changing his strategy (assuming that Barbie does not change her strategy)? **No, he is already doing as well as he can.**

2. Can Barbie make herself better off by changing her strategy (assuming that Ken does not change his strategy)? **No she is playing as well as she can.**

If the answer to both questions is "NO," then the outcome IS a Nash equilibrium. In all other cases, the outcome is NOT a Nash equilibrium.

Conclusion: the initial situation is a Nash equilibrium.

Example 3: Ken and Barbie sell automobiles in an economy that is in a bad recession. Both Ken and Barbie are following the best strategies to try and make a profit, but due to the poor economy they are both losing money.

Is the above situation a Nash equilibrium?

Here's are some **bad** answers:

No because they're both losing money.

No because they can't make any money when there's a recession.

No because Ken is risk loving and Barbie is risk neutral.

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1. Can Ken make himself better off by changing his strategy (assuming that Barbie does not change her strategy)? **No, he is already doing the best he can so if he changes his strategy his losses would be even larger.**

2. Can Barbie make herself better off by changing her strategy (assuming that Ken does not change his strategy)? **No, she is already doing the best she can so if she changes his strategy her losses would be even larger.**

If the answer to both questions is "NO," then the outcome IS a Nash equilibrium. In all other cases, the outcome is NOT a Nash equilibrium. **Conclusion: the initial situation is a Nash equilibrium.**

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